Scottish & Southern Electricity Networks

TRANSMISSION

Sector Leading Efficiency

A Network for Net Zero

Draft RIIO-T2 Business Plan

Scottish Hydro Electric Transmission plc

Sector Leading Efficiency

Strategic Objective

Sector Leading Efficiency
Integrated approach to whole life development and operation, using risk-based engineering to deliver value.

Energy networks must be affordable to consumers, and be open about the trade offs between cost and investment for local and national benefits to achieve the transition to a low carbon economy.

Targets for RIIO-T2

We are developing a set of targets by which our stakeholders can judge our progress against our strategic objective and goals. These indicative targets currently proposed are set out below for the Certain View with reference to equivalent forecast outcomes during the RIIO-T1 period as a benchmark where available.

Clear Goals

Transport the renewable electricity that powers 10 million homes
Build electricity network flexibility and infrastructure that can accommodate 10GW renewable generation in the north of Scotland by 2026.

£100 million in efficiency savings from innovation
Through targeted new technology and ways of working, achieve £100 million customer benefits by 2026.

		RIIO-T1	RIIO-T2
Renewable Energy Installed renewable generation capacity directly or indirectly connected to the north of Scotland transmission network by the end of the period.	Total GW*	6.8GW	9.9GW
Shared Use Infrastructure Capacity Increase in shared use infrastructure capacity facilitating the connection of new renewable generation during the period.	Total MVA	4166MVA	1327MVA
Energy Transport Capability Increase in boundary transfer capability due to strategic network investment during the period.	MW (Boundary)	2717MW (B0,B1,B3)	1090MW (B4)
Innovation Benefits Innovation projects underway or completed, and estimated benefits during the period.	Number Benefits (£m, NPV)	41 projects / £29m benefit	61 projects / £100m benefit
Early Engagement Number of regional and community engagement events on north of Scotland future energy scenarios and strategic network development planning	Number of events per annum	N/A	5

*1.3GW non renewable also connected

Target for Network Asset Risk Metric (NARM) have still to be confirmed

What's in this section?

Some context... on customers' concerns about the cost of energy and why it is important that we strive for sector leading efficiency.

Some background... on what we mean by cost efficiency, how we can measure it and what we have learned over the past five years about how to improve our efficiency.

Being efficient... how our past and proposed expenditure is made up, and where in our draft Business Plan we explain how our activities and expenditure are efficient.

How we identify the need to spend... on a whole GB system basis, working with Electricity System Operator (ESO) and other Transmission Owners (TOs), through industry network planning using future energy scenarios.

How stakeholders are involved in the Strategic Optioneering Assessment to identify the preferred investment option... this being a comprehensive, multi-year process to identify a range of viable options to meet the network need and then narrow these down to a preferred option based on technical, environmental and cost factors along with the views of stakeholders.

The detail of our proposed capital investments for the RIIO-T2 Certain View... sets out in a series of regional maps and project descriptions.

How we deliver capital investment efficiently, while minimising the impact on local communities... by having a well understood scope for delivery, working effectively with the industry supply chain and using innovation to deliver measurable whole life project benefits.

Overview

The electricity transmission network is made up of high cost equipment. Individual specialist pieces of plant can cost many millions of pounds to buy and install. However, once in operation, the equipment will last for many years of service and benefit homes and businesses across GB.

Consumers are concerned about the cost of their energy bill. While electricity transmission makes up a small proportion of that bill (the north of Scotland transmission system is less than 1% of the total), consumers expect that we provide the service they need for as low a cost as possible.

Electricity transmission is unusual in that the activities necessary to run the network are bespoke and specialised. This makes it difficult to do year-on-year or network-by-network comparisons of expenditure to assess productivity and efficiency of operation. The international studies we participate in shows we benchmark close to the median for service and cost.

Our own analysis of (and lessons we have learned from) our historic performance is that the greatest savings can be achieved through:

1. **A strong justification of the need to spend**
2. **A thorough optioneering assessment to identify and define the best solution to meet that need**
3. **The targeted use of innovation – new technology and ways of working**
4. **An effective procurement approach that considers the whole network need, not just the individual project**

We have applied this approach to the development of our proposed capital investment programme for RIIO-T2. This section describes the process we have followed to identify a strong, evidence-based and justified need for £1.8 billion* investment in new and existing network assets. This includes significant investment to upgrade the existing transmission circuits between Aberdeen and Dundee, so as to relieve a system 'bottleneck' and reduce the cost of constrained energy.

The investment programme we describe is for a Certain View, that is for activities where we can show a justified need now. We anticipate further investment requirements will have a need during the RIIO-T2 period. We do not propose that these are agreed and funded upfront, but that uncertainty mechanisms are used to release funding only once the need is confirmed.

*Includes circa £200 million expenditure associated resilience (excluding asset replacement, see section 2)

Why Sector Leading Efficiency?

Concerns about the cost of energy

The cost of energy is of significant concern to consumers and wider stakeholders.

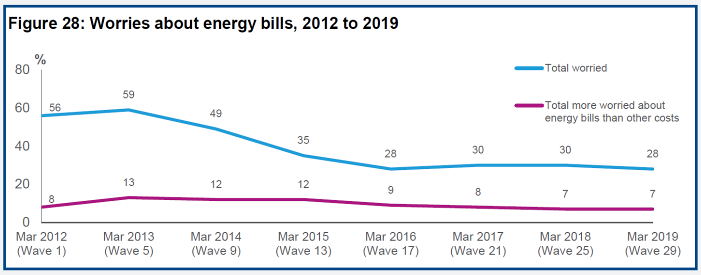
The Public Attitudes Tracker survey[1], run four times a year by the UK Government, consistently reports a significant proportion of respondents being worried about paying their energy bills **(Figure 4.1).** The same survey indicates that around three-quarters of people are concerned about steep rises in energy prices in the future.

This is consistent with the feedback we have heard. In March 2018 we asked workshop attendees to rank the most significant factors affecting electricity transmission in the future[2], cost to customers was ranked second behind security of supply.

"As a domestic customer, I would say that cost is the most important factor." – Attendee at our stakeholder event

Respondents to our February 2019 Emerging Thinking consultation[3] highlighted the cost of energy, with many advocating for the cost of the north of Scotland transmission network to be kept as low as possible. However this was tempered with support for the decarbonisation of energy and the need to maintain security of supply.

Figure 4.1 Worries about energy bills, 2012-2019



Source BEIS Public Attitudes Tracker, March 2019 (Wave 29)

Fuel poverty and vulnerability

Electricity transmission network costs make up £37 (3%) of the typical duel-fuel energy household bill of £1,117 each year[4]. Of this £37, the north of Scotland transmission network is around £4.50 (12%).

For some, this bill is hard to afford.

In Scotland[5], a household is in fuel poverty if: in order to maintain a satisfactory heating regime, it would be required to spend more than 10% of its income on all household fuel use. Extreme fuel poverty indicates that a household would have to spend more than 20% of its income to maintain a satisfactory heating regime.

In 2017[6], 24.9% of households in Scotland were estimated to be in fuel poverty, with 7.0% living in extreme fuel poverty. The highest rates of fuel poverty are in the north **(Figure 4.2):** Highland (52%) and the Islands (50-59%).

The impact of fuel poverty is felt across society. The Scottish House Condition Survey notes that:

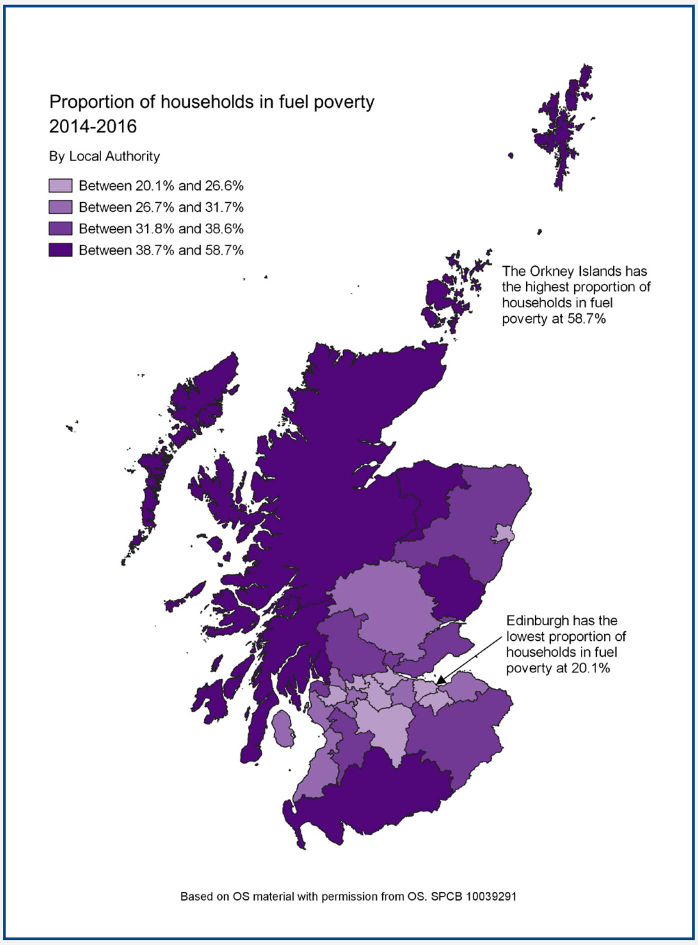
"Fuel poverty is affected by levels of household income, the price of fuel required for space and water heating, and the energy efficiency of housing. Fuel poverty under the current definition is distinct from poverty in that, while low income is an important driver, it is not a prerequisite... fuel poor households are found in all income bands."

Fuel poor households can also be vulnerable. Vulnerability issues are complex, and there are many ways in which consumers can be vulnerable. With our colleagues in the north of Scotland distribution network, Scottish Hydro Electric Power Distribution (SHEPD), and working with partner organisations, we believe we have an important role to support those who are in vulnerable situations or require additional advice or assistance.

You can read more about our approach and proposals to support communities, including the fuel poor and vulnerable consumers, in section 5.

[1]BEIS Public Attitudes Tracker, (BEIS, March 2019) available at: www.gov.uk/government/statistics/beis-public-attitudes-tracker-wave-29
[2]SSEN Transmission Stakeholder Workshop, (EQ, March 2018) available at: www.ssen-transmission.co.uk/media/2730/ssen-transmission-stakeholder-workshop-report.pdf
[3]Emerging Thinking, Your Plan, Our Future: RIIO-T2, (SSEN, February 2019) available at: www.ssen-transmission.co.uk/information-centre/industry-and-regulation/riio-t2/emerging-thinking-documentation
[4]Bills, prices and profits (Ofgem, May 2019) see: https://www.ofgem.gov.uk/publications-and-updates/infographic-bills-prices-and-profits
[5]In June 2018, the Scottish Government published a Bill that would introduce a new definition of fuel poverty that would target households in financial need.
[6]Scottish house condition survey: 2017 key findings, (Scottish Government, Dec 2018) available at: https://www.gov.scot/publications/scottish-house-condition-survey-2017-key-findings/

Figure 4.2 Proportion of households in fuel poverty 2014-2016



Source The Scottish Parliament background to the Fuel Poverty (Target, Definition and Strategy) (Scotland) Bill[7]

Responding to concerns about cost

Keeping costs down matters

While the north of Scotland transmission network element of the average household energy bill is relatively small (less than 1%), we understand that every part of the bill must be kept as low as possible. This was strongly expressed by stakeholders in response to our forecast household bill impacts for the RIIO-T2 period in our Emerging Thinking consultation.

The north of Scotland transmission network provides an essential public service: a safe and secure supply of electricity to homes and businesses. This includes the transportation of clean renewable energy, and being resilient to threats. There is a cost to providing this essential service and so our focus is on providing the service that our stakeholders want at an acceptable cost.

Being cost efficient

We define efficiency as the optimal use of resources (time, materials, people and money) to achieve a necessary outcome.

Broadly, in practice this means following a rigorous justification process before progressing a course of action:

- What is the desired outcome - is this supported by customers and stakeholders?
- What are the options to achieve that outcome?
- What are the relative costs and benefits of each option, including the timescale for achieving the outcome?

In some instances, where permitted by law and our licence, the conclusion of this process might be to do nothing. For example, stakeholders might express a desire for an outcome, but change their mind when faced with the associated costs or environmental consequences. As we described in section 3, we had examples of this when we presented stakeholders with options for investment during RIIO-T2.

We also believe there is an important role for third party providers and the competitive market in striving for cost efficiency. We do not have all of the answers about the options to achieve an outcome and do not always have the specialist expertise to deliver most cost-effectively. Through our Innovation Policy[8] and Capital Delivery Strategy[9] we seek to maximise the benefits to consumers through working with others.

Our experience of being cost efficient

The cost efficiency of electricity transmission can be challenging to assess due to the non-comparability of the networks and activities undertaken.

Academic studies

A major study of productivity in GB gas and electricity networks since 1990 undertaken by the University of Cambridge for Ofgem[10], showed productivity improvements for electricity transmission taking into account quality of service improvements. However, this study also highlighted the challenges of achieving and measuring productivity growth in industries with high capital investment and where wider benefits (such as decarbonisation and environmental improvements) are not taken into account.

The results and conclusions of the University of Cambridge study are consistent with a recent study by NERA that we commissioned to assess network productivity. We have two further studies underway on capital and operational efficiency.

[7]Fuel Poverty (Target, Definition and Strategy) (Scotland) Bill, (Greig Liddell, June 2018) available at: https://sp-bpr-en-prod-cdnep.azureedge.net/published/2018/9/3/Fuel-Poverty--Target--Definition-and-Strategy---Scotland--Bill/SB%2018-52.pdf
[8]https://www.ssen-transmission.co.uk/media/3390/111regulatory-framework_final-draft.pdf
[9]www.ssen-transmission.co.uk/riio-t2-plan/
[10]Productivity growth in electricity and gas networks since 1990, (Energy Policy Research Group, University of Cambridge, Dec 2018) available at: \https://www.ofgem.gov.uk/system/files/docs/2019/01/ofgem_productivity_report_dec_2018_1.pdf

Comparison with other transmission networks

The small number and big differences between the GB electricity transmission networks makes comparison of relative efficiency very difficult. Hence such benchmarking is explored using an international dataset of transmission operators.

We participate in a number of international benchmarking studies and use the findings to inform our business improvement activities. The most important of these studies are:

- The International Transmission Operations and Maintenance Study (ITOMS), which we are currently engaged in the fourth cycle of benchmarking. Our performance in previous ITOMS benchmarking has shown continual improvement and we now benchmark close to the median for both cost and service levels (see Figure 3.6 in section 3).
- The International Transmission Asset Management Study (ITAMS), which we participated in for the first time in 2018. ITAMS does not include cost benchmarking, but we have adopted best practice and learning from other network operators.
- The Council for European Energy Regulators (CEER) study to assess the relative cost efficiency of European electricity transmission operators. This study is underway having been delayed due to difficulties in achieving consistency in data inputs for the different networks.

Through participating in these types of study, we have established collaborative relationships with international transmission operators. We use these networks to share best practice in all of our activities. In the past year we have undertaken exchange visits with comparable networks in Finland and Australia.

Lessons learned

Our internal business procedures mandate lessons learned reviews following completion of all major projects and events. This includes capital investment, new IT systems, events resulting in network interruptions and implementation of new ways of working.

This can include the appointment of independent consultants or our internal assurance functions to undertake the lessons to learn review. We might also involve third parties, in particular the supply chain, in the review.

The learning from these ex-post reviews are shared widely and action plans put in place to address the findings. Given the significant scale of our capital investment, over £3 billion between 2010 and 2021, a focus of these reviews has been the cost-effectiveness of our approach to capital project development and delivery.

"Following the completion of our independent review, in general terms, we conclude that outturn costs on the project have been incurred on an efficient basis. SHE Transmission has demonstrated that effective and appropriate project governance has been applied throughout the project duration. Good cost controls have been in place to efficiently manage any changes deemed necessary. Cost variances relative to the original Asset Value Adjustment Event (AVAE) allowance are clearly understood and considered reasonable." – Independent audit of the Beauly Denny project

Three lessons from the RIIO-T1 period are central to our approach to achieving sector leading efficiency:

1. The criticality of comprehensive pre-construction works to achieve cost-effective project delivery. Our ex-post review of realised risk events during construction has resulted in an increased scope of pre-construction activities to remove or mitigate these type of events occurring.

2. Timely and targeted use of innovative technology and ways of working. Our decision to use the new Aluminium Core Composite Conductor (ACCC) allowed us to accelerate customers' connection works and realise benefits of £7.5 million within RIIO-T1.

3. Tailoring the procurement model to the overall programme of works. For RIIO-T1, the scale and remote location of the complete programme of capital investment meant securing appropriate and sufficient contracting resources was a significant risk and our procurement strategy was designed to manage this.

Many of the challenges we will face during the RIIO-T2 period are similar to those we have addressed over the past ten years. By building upon our experience, we are well placed to manage these challenges and so deliver cost-effective outcomes that keep down the household energy bill.

Efficient expenditure

Being efficient

There are four main categories for our controllable expenditure **(Figure 4.3):**

1 Our day-to-day operating costs
This includes the cost of inspection and maintenance, and the cost of responding to unexpected events (such as landslides, see page 65). We explain our approach to efficiently planning these activities in section 3.

2 Other operating costs
This includes IT, protection and control systems and running the control centre. We explain our approach to efficiently planning these activities in section 3.

3 Capital investment in existing assets
To maintain, refurbish or replace equipment on the network that is worn, damaged or at the end of life. We explained the risk-based approach to identifying the need for this type of investment in section 3. In this section we consider how we determine the most appropriate option for investment and set out our proposed investments during RIIO-T2.

4 Capital investment in new assets
For example, to grow the network to connect new renewable generators or to ensure the reliable performance of the network. In this section we explain how we identify the need and preferred option for this investment and set out our proposals for RIIO-T2.

For the eight years of the RIIO-T1 period, we forecast total controllable expenditure across all these categories of £3.3 billion or, on average, £410 million each year.

Figure 4.3 Controllable expenditure by category

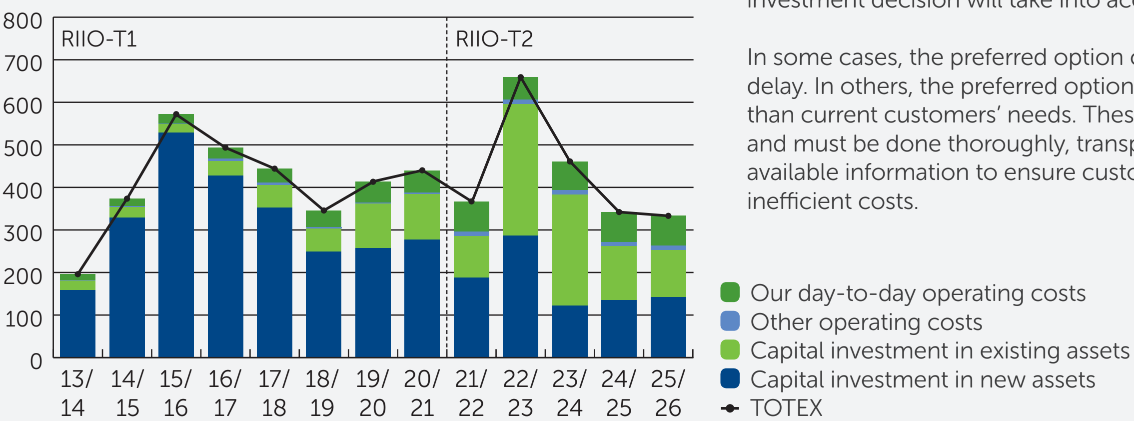
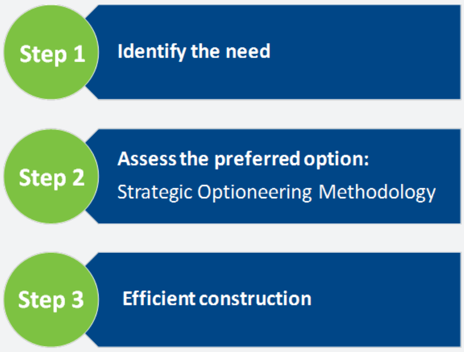


Figure 4.4 Overview of approach to capital investment



In our draft Business Plan, we present our 'Certain' scenario for RIIO-T2. This forecasts total controllable expenditure over the five years of £2.2 billion or, on average, £432 million each year. The majority of this expenditure is capital investment in existing or new assets, equating to £1.8 billion (82%). Given the quantum of the proposed investment, even small efficiency improvements can result in significant savings to the GB energy consumer.

This section of our draft Business Plan considers how we can be confident in the efficiency of our proposed capital investment programme due to the rigorous approach to identifying need, assessing the preferred option and efficiency in construction **(Figure 4.4).**

The most important thing we do, in the context of cost to customers, is decide there is a justified need for efficient expenditure. For this reason we invest significant time and analysis, including engagement with customers and stakeholders, in the pre-construction phase. We will spend up to 10% of the final investment cost in this phase.

This pre-construction assessment process can be complicated by the long life and high cost of transmission infrastructure. A decision to invest will impact our current customers and also future customers of whom we might not be aware. A balanced investment decision will take into account the needs of both.

In some cases, the preferred option can be to do nothing, or to delay. In others, the preferred option might be to build larger than current customers' needs. These decisions are a forecast and must be done thoroughly, transparently and with the best available information to ensure customers are not exposed to inefficient costs.

Identifying the need for investment

Scope

We explain here how we identify the need for capital investment in new assets to grow the network capacity or capability[11].

Drivers for investment

There are two principal drivers for investment:

1. Growth, or 'load related', drivers result from changes in connected generation and/or demand, including consequential changes in network operating characteristics.

2. Asset, or 'non-load related', drivers result from asset risk and other system needs such as resilience, black start and system access and system operability requirements (see section 3).

When we consider the need for capital investment in new assets (i.e. growth drivers), we also consider the local asset drivers. We can commonly realise significant savings by undertaking growth and asset driven capital investments at the same time.

The simplest case of a growth driver is the connection of a new generator through construction of the necessary transmission equipment. Similarly, growth in electricity demand may require the uprating of an existing, or installation of a new transformer to accommodate the increased power flow without unacceptable overloading. In the context of the wider transmission network, the aggregated effect of these changes will bring more significant capacity improvement requirements to the fore.

The role of the Electricity System Operator (ESO)
The new, legally separate ESO was established on 1 April 2019. The ESO is responsible for the real time balancing of supply and demand in electricity across GB. To do this, the ESO operates the electricity transmission network in real time including the procurement of balancing and system services. To prepare for future users' needs, the ESO works with the TOs on medium to long term network planning. The ESO also has specialist teams that provide a central connections and charging function for the GB transmission sector.

You can read more about the ESO here:
www.nationalgrideso.com/

nationalgridESO

A GB approach

When we consider the drivers and need for investment in the wider north of Scotland transmission network, it is essential to take a whole GB system approach.

The north of Scotland network does not operate in isolation. There are significant flows of power across the network boundary with the south of Scotland and shared operating characteristics. Efficient and co-ordinated network operation and development looks at the whole GB system (and, to an extent, the local distribution networks).

The GB transmission system has a common Security and Quality of Supply Standard (SQSS)[12] that stipulates the planning and operational criteria. All TOs and the ESO are obligated by licence to comply with the SQSS. We work with the other TOs and the ESO to apply the SQSS in the interests of all GB electricity network customers.

The SQSS sets out deterministic criteria for the outcomes that the GB transmission system must achieve. For example, it prescribes restoration times for interruptions in demand under specified system conditions. It is these criteria that large demands must be immediately restored that results in double (or triple) circuit security investments (i.e. construction of a back-up).

Power system studies reveal conditions which could lead to breaches of the SQSS criteria such as overloading of circuits, voltages outside planning limits or system instability. Breaches of the SQSS criteria could result in damage to assets or threaten system shutdown, leading to loss of supply.

The application of the SQSS through power system studies is forward looking. Thus we must make assumptions about the future use of the transmission network. For this, we use future energy scenarios.

Energy scenarios

ESO Future Energy Scenarios

Since 2011, the ESO has been preparing and publishing an annual suite of Future Energy Scenarios (FES) that outline credible pathways for the future of energy in GB for the next 30 years and beyond. The scenarios consider energy demand and supply on a whole system basis, incorporating gas and electricity across the transmission and distribution networks.

[11]The explanation of how we identify the need for capital investment in existing assets is in section 3
[12]Security and Quality of Supply Standards (National Grid ESO), available at: https://www.nationalgrideso.com/codes/security-and-quality-supply-standards

Future energy scenarios

The 2018 FES[13] set out four scenarios **(Figure 4.5):**

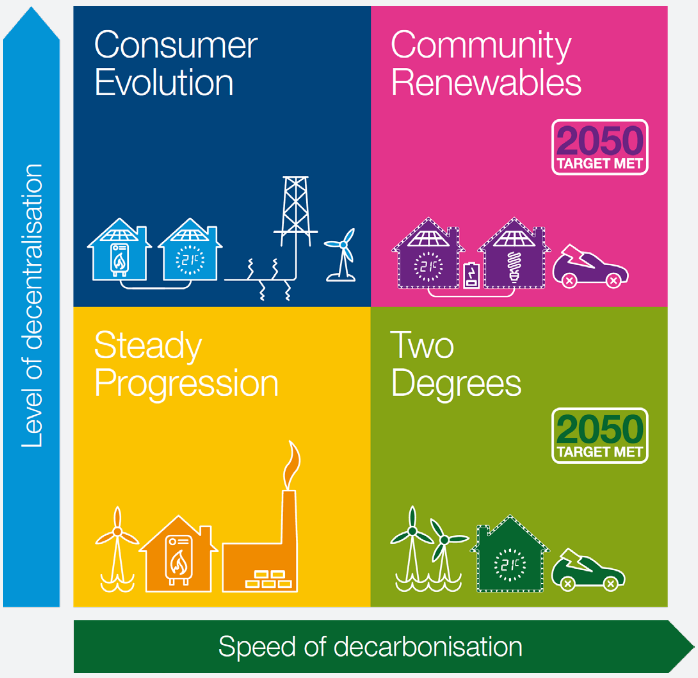
- Community Renewables under which the UK 2050 decarbonisation target is reached through decentralised energy sources;
- Two Degrees under which the decarbonisation target is met with large, centralised technologies;
- Steady Progression where current UK trends continue and the decarbonisation target is not met; and
- Consumer Evolution under which there is some decentralisation and some decarbonisation, but the targets are not met.

The FES takes a whole GB view of the future, with a focus on the UK's target to reduce greenhouse gas emissions by at least 80 per cent from 1990 levels by 2050.

North of Scotland Future Energy Scenarios

We work closely with the ESO in the development of the FES, and this has highlighted to us that there are significant differences in electricity use in the north of Scotland when compared to the GB average. For example, while commercial electricity consumption was declining at a GB level, it was increasing in the north of Scotland.

Figure 4.5 ESO Future Energy Scenarios 2018



Stakeholder-Led scenarios
Stakeholders were central to the development of the North of Scotland Future Energy Scenarios. Over 150 individuals and organisations were involved including through events, workshops, working papers, consultation and bilateral meetings.

"I have very much appreciated the opportunity to take part in the Future Energy Scenarios workshop."
– Argyll and Bute Council

In August 2018, following an 18-month Stakeholder-Led process, we published our North of Scotland Future Energy Scenarios (NoS FES)[14]. These scenarios complement the ESO FES, but consider in more detail the regional variations in potential energy supply and demand.

A key concern from stakeholders was to ensure that we prepare for the most and least ambitious decarbonisation outcomes recognising the important role of the north of Scotland in achieving UK targets. Hence we set out three scenarios:

- **Proactive Decarbonisation** where Scottish consumers are supportive of decarbonisation, increasing their use of renewables and engage in the benefits of decarbonisation and decentralisation at local levels;
- **Local Optimisation** where Scottish consumers and businesses are driven by cost reduction as well as decarbonisation, investing in decentralised, domestic microgeneration to reduce their spend on energy; and
- **Cost Limitation** where Scottish consumers are focused on cost reduction in energy bills. Decarbonisation is a secondary consideration, as a result there is low uptake in domestic microgeneration and little focus on decentralisation.

We are continuing to develop the NoS FES, and in particular work with SHEPD to expand these to a whole system basis encompassing transmission and distribution in the north of Scotland.

[13]The 2019 FES will be published on 11 July, and taken into account in our final RIIO-T2 Business Plan.
[14]North of Scotland Future Energy Scenarios (SSEN Transmission, August 2018), available at: www.ssen-transmission.co.uk/information-centre/industry-and-regulation/future-energy-scenarios/

Identifying the need for investment

Long term network planning

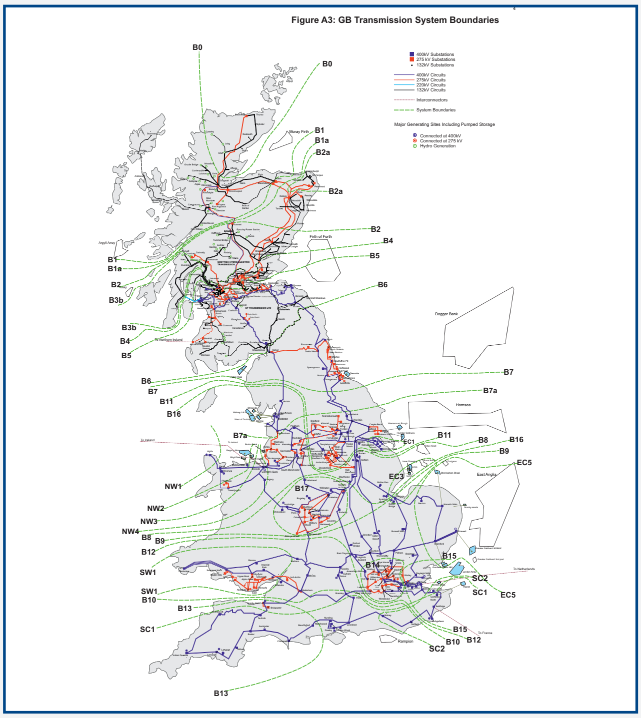
There is an existing framework for long term investment planning under the annual Electricity Ten Year Statement (ETYS)[15] and Network Options Assessment[16] (NOA) processes for GB:

- The ETYS presents the results of system modelling, using the SQSS and ESO Future Energy Scenarios, that describe future GB transmission system development requirements; and
- From the results of the ETYS, the TOs produce asset solutions to meet the required capability needs. These options, alongside system options are assessed through the NOA.

The outcome of the NOA is recommendations to the TOs to delay or continue identified capital investment options. In the January 2019 NOA report, we were given three "proceed" recommendations: for the Peterhead to Drax High Voltage Direct Current (HVDC link), the East Coast onshore 275kV upgrade, and the East Coast onshore 400kV incremental reinforcement. All three of these projects are in the Certain View material parts of our draft Business Plan.

Both the ETYS and NOA are whole GB system plans and, as such, consider the critical paths – known as boundaries **(Figure 4.6)** – for the bulk transport of power. The need for capital investment between boundaries is undertaken by the local TO.

Figure 4.6 GB transmission system boundaries



The need for investment during RIIO-T2

Our approach to defining the need for capital investment to accommodate network growth during RIIO-T2 builds upon the existing industry framework and long term network plans. There are three parts to this work **(Figure 4.7).**

Figure 4.7 Our approach to RIIO-T2 planning

WIDER	REGIONAL	OPERABILITY
Main interconnected transmission system and boundaries	Local Sole-Use and Shared-Use infrastructure, including connections	- Summer off peak - Voltage containment - Low fault levels - Harmonic background
Strategic investment, including NOA recommendations	Preferred option assessment, opportunity for flexibility	Opportunity need for reactive power control, TO filtering, protection scheme modification

Wider system

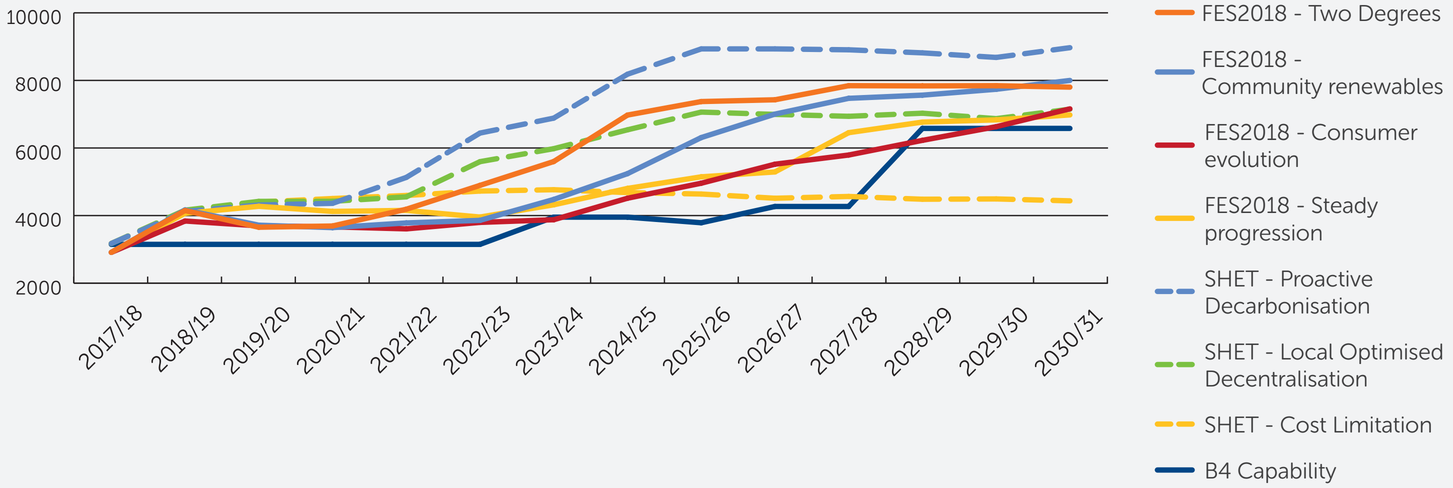
The growth of renewable generation in the north of Scotland, coupled to date with the relatively static gross demand, has seen an increase in the magnitude of north to south power transfer. This has driven significant network reinforcements over the past decade.

Both the North of Scotland FES and the ESO FES show a continuing need for boundary capacity increase during RIIO-T2 (with only the Cost Limitation scenario suggesting that modest further reinforcement may be required). **Figure 4.8** shows the expected required transfer of power across our southern boundary (B4).

It is based on this modelling that the NOA recommends we proceed with reinforcement options. The NOA also considers commercial solutions to reduce the costs due to network constraints. These solutions can allow the ESO to manage constraints pending the delivery of infrastructure reinforcement. We are continuing to work with the ESO[17] and customers on opportunities for such commercial solutions during RIIO-T2.

[15]Electricity Ten Year Statement, (National Grid ESO, November 2018) available at: www.nationalgrideso.com/insights/electricity-ten-year-statement-etys
[16]Network Options Assessment 2018/19, (National Grid ESO, January 2019) available at: www.nationalgrideso.com/insights/network-options-assessment-noa
[17]We propose that the ESO has the ability to direct investment under a new licence condition

Figure 4.8 Required power transfers at our southern boundary (B4)



Regional

Our regional approach maintains compliance with the SQSS between the critical system boundaries. In general, this is driven by the need to connect new generation. However our NoS FES also identifies potential SQSS issues arising from changes in the nature of demand, in particular the electrification of transport. We define two types of investment:

1. Sole-Use infrastructure, with a single user of the transmission equipment. Most commonly this is the local connection infrastructure to connect a generation customer to the nearest point on the existing network.

2. Shared-Use infrastructure, where there are multiple users (generators and demand) of the network assets. Shared-Use infrastructure is not critical path that crosses a system boundary.

The need for Sole-Use and Shared-Use infrastructure can be highly uncertain due to the uncertain nature of the drivers. For example, the certainty over which customer will connect and when. For this reason we set out in our draft Business Plan our Certain View only, based on consented customer projects with known investment pathways. Like the RIIO-T1 period, we propose that uncertainty mechanisms are put in place to facilitate the currently uncertain Sole-Use and Shared-Use infrastructure.

We will work with current and future customers to understand their needs and network requirements

Operability

The growth in renewable generation customers connected to the north of Scotland transmission network (including the use of flexible access arrangements) has created particular challenges for the Safe and Secure Operation of the Network:

- A drop in voltage performance. To address this, we invest in reactive compensation equipment;
- Conversely high voltage events in low wind conditions. Specialist equipment, e.g. STATCOMS, can provide dynamic voltage support at strategic network sites;
- Widening extent power quality issues such as flicker and harmonic distortion. We can use equipment (for example, filters) to remedy these disturbances; and
- Reduced fault currents, requiring re-setting of protection systems.

These operability issues are exacerbated by the closure of conventional thermal generating stations. The loss of these stations weaken the historic response to a Black Start situation, and we are working with the ESO to identify network solutions (e.g. synchronous condensers) that would provide whole system benefits.

Innovation, whole system and flexibility

Throughout our approach to long term system planning, we are active in pursuing new means to achieve better outcomes for customers and end consumers.

Given the unique characteristics of the north of Scotland energy system, we have long developed whole system options working with customers, SHEPD and more recently the ESO. As a consequence, over a quarter of our connected generation customers use active network management schemes.

We also target innovations that meet system planning needs. Considering, for example, the need to maximise line ratings we have developed real time line ratings, new tower types and new conductor technology.

Identifying the preferred investment option

Scope

From our risk-based approach to managing our assets (section 3) and GB-wide approach to system planning (above), we can identify a clear and justified need for capital investment during RIIO-T2 in four categories:

1. Strategic boundary capability reinforcement to accommodate increased north to south power flows, largely due to increasing installed renewable generation in the north of Scotland and interconnection to other jurisdictions. This is **Strategic Infrastructure.**

2. Regional investments to connect new renewable generation and accommodate changes in the use of energy due to electrification. This is **Sole-Use and Shared-Use Infrastructure.**

3. System driven investment to ensure the operability of the network with a more flexible generation and demand mix, and provide commercial alternatives to reinforcement. This is **System Infrastructure.**

4. Asset risk driven investments to replace assets in poor condition, performing below expectations or of undue risk to the environment or public, and maintain the integrity of the existing transmission system. This is **Non-load Related Infrastructure.**

These categories are not progressed in isolation from each other. Asset risk driven investment, work to address operability or network access issues, or black starting of the system may have overlaps with growth driven reinforcement requirements. These overlaps can influence the preferred option. These aspects are considered in an interactive approach that takes initially independent drivers and considers opportunities to accommodate these in a combined and coordinated solution.

We also seek to develop the network in a way that maximises existing route corridors and infrastructure where practicable. This supports our wider sustainability and environmental considerations (see section 5). Thus we will explore:

- Network management options;
- Reconfiguration (for example of busbar running arrangements or circuit connection points);
- Uprating of existing circuits (for example by reprofiling to operate at higher temperatures or reconductoring with higher capacity conductors); and
- New build infrastructure alongside or in place of existing network assets

To be efficient is essential that we identify the most cost effective option to meet this system need.

Strategic optioneering assessment

The purpose of strategic optioneering is to gather all of the necessary information to be able to make an informed and justified selection of the preferred option to meet a network outcome. This accounts for all synergies between scheme types and drivers across a geographical region and thus ensures the overall system delivered provides a holistic benefit.

Doing this thoroughly and effectively results in:

- A robust regional solution that takes account of multiple drivers;
- Comprehensive input to CBA for investment justification;
- Fully developed project solutions ready for delivery as part of a co-ordinated regional plan.

Therefore an investment can be delivered most cost-effectively and on time.

We have published with our draft Business Plan our Strategic Optioneering Methodology. This follows consultation on our transmission asset development process in late 2018. The key findings from that consultation was the need for us to be more transparent, to engage earlier in the project development lifecycle and to engage on the long term strategic development of the network (in addition to individual investments). We accept all of this feedback and have revised our methodology accordingly.

The building blocks of the strategic optioneering assessment are shown in **Figure 4.9**.

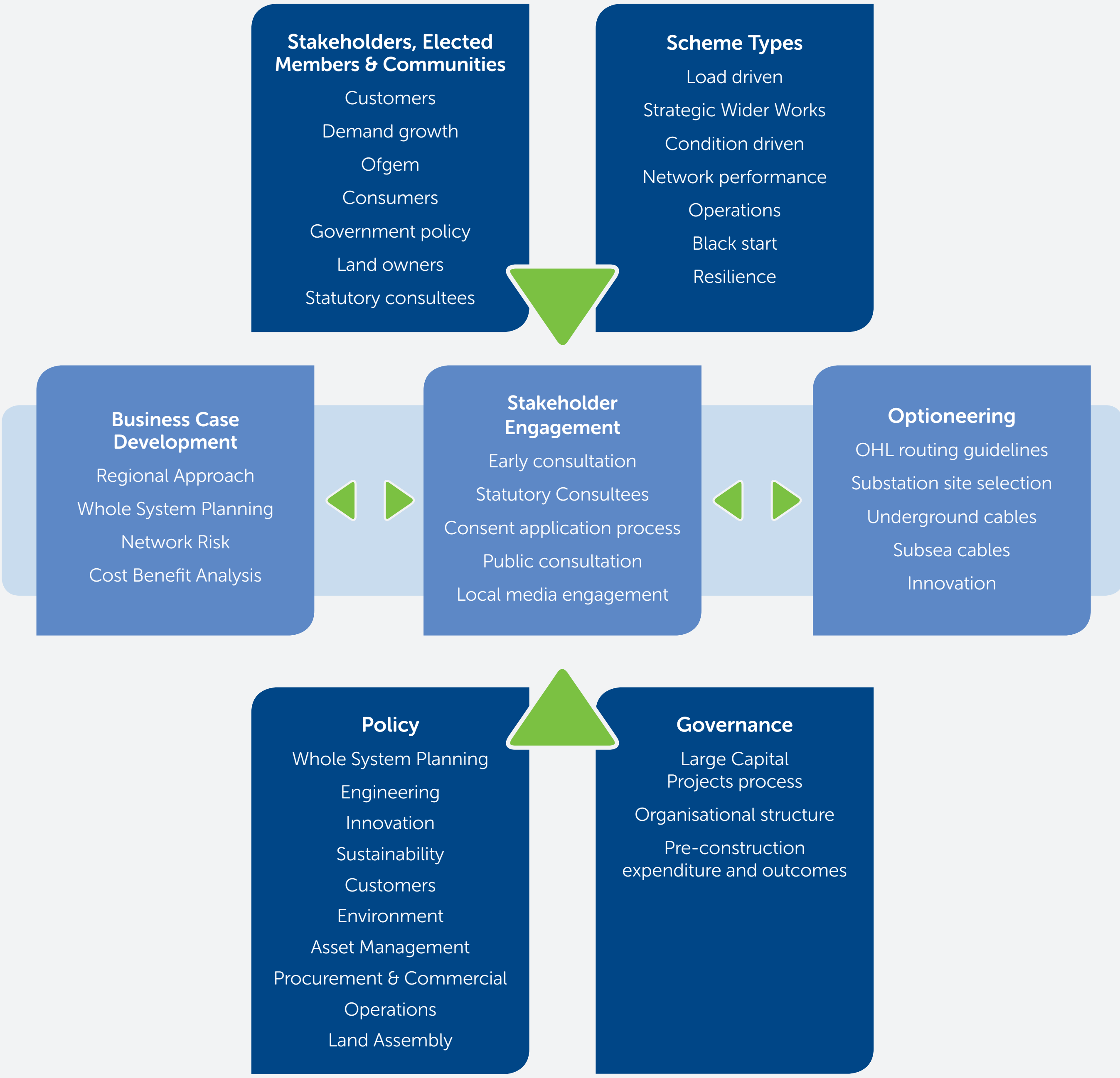
Regional approach

We undertake strategic optioneering by region, with a lead manager responsible for all network developments in that area. Each region has specific characteristics, both electrically and geographically. The multi-disciplinary regional team, using their knowledge and experience of that region, are tasked with developing an economic and co-ordinated whole system solution.

The regional team includes stakeholder and community liaison specialists. The active engagement of local stakeholders (communities, businesses and statutory authorities) occurs throughout the optioneering process and will strongly influence the outcomes (see case study on page 103).

Strategic optioneering assessment

Figure 4.9 Strategic Optioneering Methodology for transmission investment



Options development

For a clearly defined network need, and with a continual programme of stakeholder engagement, the initial stage of strategic optioneering assessment is the identification of viable options to meet that network need and society.

The definition of options uses a comprehensive body of internal policies, such as: health and safety specification; engineering and technical standard; environmental management and impact; asset management and network risk; and operational procedures. These policies are not static, but incorporate national and international standards, new legislation, learning and business practice, and our Strategic Themes.

Taking these policies together, the regional development team will establish a long list of viable options. At this point there might be an initial filter of, for example, high cost or high environmental impact options.

The next stage, which can take many years to complete, is the detailed options development. This starts with a holistic regional view of, for example, existing land use, water courses, ground conditions, and environmental designations. Defining potential locations requires close engagement with local land owners, statutory authorities, communities, businesses and other interest groups.

Through these investigations, a preferred route corridor and/or preferred sites will be identified. These preferences will be established through balancing:

- Technical factors, such as ease of connectivity to the existing network, access, ground conditions, proximity of watercourses, proximity to other infrastructure, topography, altitude and physical size of asset;
- Environmental factors, including avoiding international and regional designated sites, proximity to urban environments and major settlements, amenity of land use, areas prone to flooding, impact on biodiversity and noise;
- Cost, considering the whole life cost of options and the associated whole life benefits; and
- Impact on stakeholders, including but not limited to, local communities and businesses, visitors and interest groups, the customers that will benefit from the infrastructure, and the impact on consumers

Further detailed studies are then undertaken to refine the alignment of linear infrastructure (overhead lines or cable) and static sites (substations or switching stations). These studies are comprehensive: habitat surveys, landscape and visual assessments, peat probing and ground sampling, local water use. Again stakeholder engagement is essential throughout. For example, 3D visualisation of specific options can assist in understanding the potential impacts and aid refinement.

Option selection

It is only after this comprehensive, multi-year process that a final option is selected. We have a best practice gated-based governance process to ensure that all of the necessary steps are followed and evidence gathered before the final option can be selected.

Once the final option is selected, we will undertake further detailed environmental assessments in accordance with the relevant Environmental Impact Assessment (EIA) regulations where this is identified as a requirement. For projects that do not fall under these regulations, we undertake voluntary environmental appraisals to ensure all potential environmental impacts are assessed and appropriate mitigation measures put in place for the construction and operational phases of the development.

Cost Benefit Analysis

Cost Benefit Analysis (CBA) is a valuable modelling tool that we use to assist in strategic optioneering assessments.

The principle of CBA is to systematically consider the strengths (benefits) and weaknesses (costs) of alternatives to determine which of the options, if any, present the greatest net benefit. As far as possible, CBA is quantified; that is, a monetary value is ascribed to each of the strengths and weaknesses. Also the CBA will be conducted over the whole cost and the whole life of the options.

Traditionally in energy networks, CBA will compare capital costs and energy transported (measured by avoided constraints). This is increasingly recognised as a very narrow view of the role of energy networks given the wider socio-economic and environmental impacts of energy. As part of our Sustainability Strategy (page 134), we are committed to develop and implement a full variable CBA methodology.

We also use a variant of CBA in the assessment of system need and in the risk-based approach to determining the need for asset replacement.

The importance of the pre-construction period for the identification and development of the preferred investment option cannot be understated. This includes the involvement and participation of the impacted communities (Case study 1 below) and identification of environmental factors (Case study 2 below). Without comprehensive and rigorous pre-construction to identify and mitigate project risks, a suboptimal option might be chosen with consequential increases in cost, delays or undue socio-environmental impacts.

Case study 1

Lairg Loch Buidhe overhead line
In order to enable the connection of new renewable customers in Caithness, we have undertaken a five year consultation to understand and address the needs of local residents.

Initial options were discussed with the community in 2013-15 which highlighted complex concerns with visual amenity and landscape impacts, proximity to dwellings, and construction disruption. Following further discussions in 2016 and early 2017, we undertook further studies and put forward revised proposals in late 2017. At the request of community members who could not attend, we repeated this session and then held a final event three months later to address residual concerns.

An important part of this consultation was the use of our innovative 3D visualisation technology, which allows users an immersive experience of the proposed infrastructure.

As a result of this detailed consultation and engagement, we changed both our preferred substation location and the routing of the overhead line around Lairg.

Lairg Loch Buidhe is included in the Certain View on which our draft Business Plan is based. You can read more about the project and this engagement at **www.ssen-transmission.co.uk/projects/lairg-loch-buidhe/**

Case study 2

New transmission infrastructure to connect the Orkney Isles
In response to the need of renewable energy customers looking to connect, we have developed proposals for new transmission infrastructure to connect the Orkney Isles to mainland Scotland. Critical to the finalisation of the subsea cable route and substation location archaeological considerations were explored during the pre-construction subsea surveys and site-specific digs.

Scapa Flow has rich natural, cultural and archaeological interest. Wrecks in Scapa Flow are designated as Scheduled Monuments, and the Scottish Government is currently consulting on designating Scapa Flow a Historic Marine Protected Area. Detailed subsea surveys were essential to the determination of the cable route, to avoid and minimise the impact on that environment and archaeology.

Neolithic monuments on the Orkney mainland were proclaimed an UNESCO World Heritage Site in 1999. As part of pre-construction works for the main substation location near Finstown we have commissioned extensive archaeological investigations of the site, extending this programme in conjunction with Orkney Historic Scotland, in light of early discoveries. This has uncovered domestic structures, a burial cist and pottery.

Bronze Age Cist discovered at the proposed Finstown Substation Site, Orkney.
www.orca-archaeology.org

Proposed capital investment during RIIO-T2

Overview of proposed investment

The following pages set out, by region, the proposed capital investment projects during RIIO-T2 for the Certain View. This is: strategic investment, Sole-Use and Shared-Use infrastructure, non-load related infrastructure and system infrastructure. Some individual investments meet multiple network needs, e.g. for growth and asset replacement. These investments have been identified and defined using the process described in the preceding pages:

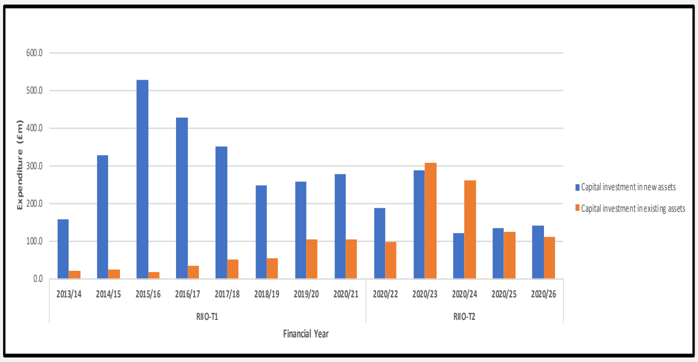
1. A clear, evidence-based and justified need; and
2. Comprehensive strategic optioneering assessment to determine the preferred option.

For some of the proposed investments, given the time gap between our draft Business Plan and the start of construction, the detailed options development is still ongoing. This includes engagement and statutory planning requirements. Our December Business Plan will be updated for this ongoing work.

Of particular note, we are currently undertaking an options review for the growth and asset driven need on the Fort Augustus to Skye overhead line. This has been based on stakeholder feedback and changing customers' requirements. Our final proposal for this project will be in the December Business Plan.

In our draft Business Plan, for the Certain View, we forecast capital investment in existing or new assets of £1.8 billion over the five years of RIIO-T2, or on average £356 million each year **(Figure 4.10)**. This compares with an equivalent average annual capital expenditure during RIIO-T1 of £375 million.

Figure 4.10 CAPEX for RIIO-T1 and RIIO-T2



Overview of proposed investment

Our rigorous approach to assessing the need for future development of the north of Scotland transmission network involves undertaking modelling many potential futures, each a future energy scenario. The scenarios we use are the ESO FES and our North of Scotland FES.

These scenarios are invaluable in our planning to, for example:

- Provide insight into the local drivers impacting future development and how these vary regionally;
- As a platform to consider other areas of the energy system (distribution, heat, transport) as we move towards a whole system planning approach; and
- To quantify the range of uncertainty and, hence, how this can be most effectively managed to avoid inefficient expenditure or outcomes.

However, we cannot present a Business Plan for each of these possible futures. Taking the four ESO FES and three NoS FES for connected generation alone, this envisages a range of outcomes by 2025/26 of between 8.6GW and 15.7GW **(Figure 4.11).** There is also a mismatch between scenarios based on hypothetical outcomes, and a Business Plan which must be based on evidence-based and justified need.

To resolve this, we consider our draft Business Plan with two parts:

1. The Certain View which incorporates all outputs and expenditure that have a known, well justified need, i.e. a 'bottom up' view of demonstrable network requirements. This includes asset driven investments, along with generation connections already 'in flight' and strategic investments with a strong NOA "proceed" signal. It also includes the associated operational expenditure.
2. An additional Uncertain element, from which we know something will be required but we can't be certain what at this time. A "known unknown". This incorporates future generation connections where we have a connection agreement with the customer, but the decision to proceed is not yet certain. It also uses the energy scenarios as a basis for medium to long term network planning and strategic optioneering.

Our draft Business Plan presents the Certain View only. We are confident in the case for delivering these outputs in the RIIO-T2 period. Thus this presents a certain view of the outcomes, expenditure forecast and cost to consumers. In December, we will propose this Certain View for Ofgem upfront funding approval.

For the Uncertain element, we do not believe it is appropriate to present a case for outputs and expenditure that, at this time, cannot be justified. Instead we propose that regulatory mechanisms are put in place to release funding for outputs only once that justification can be made. This approach avoids exposing customers and ourselves to unnecessary risk and cost.

The following pages set out the capital investments from the Certain View that we propose to take forward during RIIO-T2.

The ENA Core Scenario

As part of the RIIO-2 regulatory process, Ofgem and its RIIO-2 Challenge Group[18] asked the GB energy networks to work together to establish a common 'core' future energy scenario. This work has been co-ordinated through the Energy Networks Association (ENA).

The approach adopted to establishing this core scenario was to identify the key drivers of energy networks for the RIIO-2 period. Initially these drivers were to apply across all four types of energy network (gas and electricity, transmission and distribution), but given the resultant range this was subsequently refined to key drivers for each of the four sectors.

A summary of the identified drivers for electricity transmission are shown in the table below. This table indicates the degree to which the named driver is material across the whole of GB, highlighting the regional variability in network drivers. This regional variability is reflected in our North of Scotland Future Energy Scenarios.

Category	Key Drivers	Sub-elements	Majority view (based on Dec '18 work)	2017 position	FES 2030 Lower end	FES 2030 Upper end
Generation	Onshore wind (GW)	Transmission connected only	Medium - Broad consensus	6.1	9.3	12.4
Generation	Nuclear (GW)	Large nucler only	Low - broad consensus	9.2	1.2	9
Generation	Distribution Connected Generation (GW)	Solar, waste, biomass, hydro	Medium - Broad consensus	20.4	29.6	52.5
Generation	Other Gen (GW)	Hydro, CCGT, Marine, CCS, Coal	Low - wide range of views	31.73	23.02	41.1
Balancing	Interconnectors (GW)		Medium - Broad consensus	0	9.8	19.8
Balancing	Storage	Pumped Hydro, Distribution batteries, transmission batteries and other storage	Medium - Broad consensus	0	5.49	9.16
Demand	Low Carbon Vehicles (m)	PEVs, PHEVs, Number (m)	High - broad consensus	0.06	2.67	10.62
		Demand (GW)		0.1	2.6	8.1
Demand	Heat ('000 properties)	Number of heat pumps, properties served by district heating	Low - broad consensus	488	1050	5440
Demand	Underlying Peak demand (GW)	All demand, balancing and DG components	High - broad consensus	59.4	60.8	62.9

Figure 4.11a NGET Future Energy Scenarios

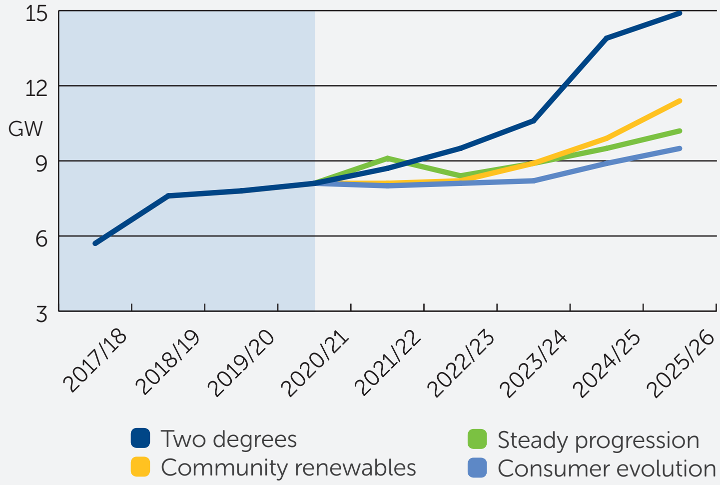


Figure 4.11b North of Scotland Future Energy Scenarios

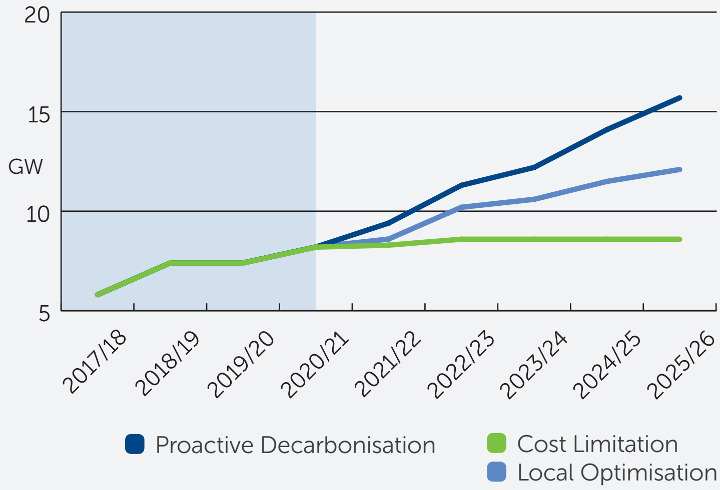
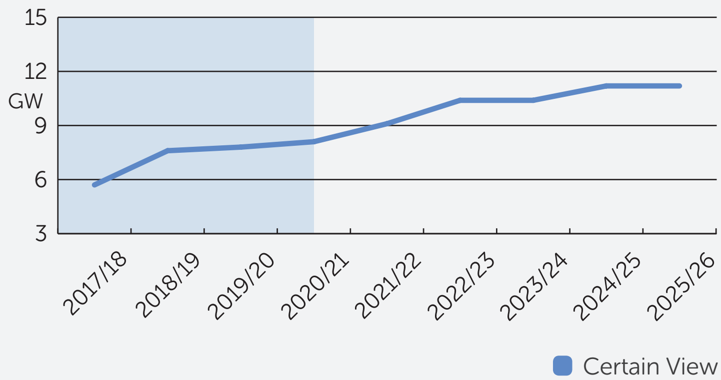


Figure 4.11c Certain View



[18]The RIIO-2 Challenge Group was established by Ofgem to provide independent scrutiny of networks' Business Plans. See Challenge Group Terms of Reference, (Ofgem, November 2018) available at: www.ofgem.gov.uk/publications-and-updates/riio-2-challenge-group-terms-reference

Certain View: Eastern

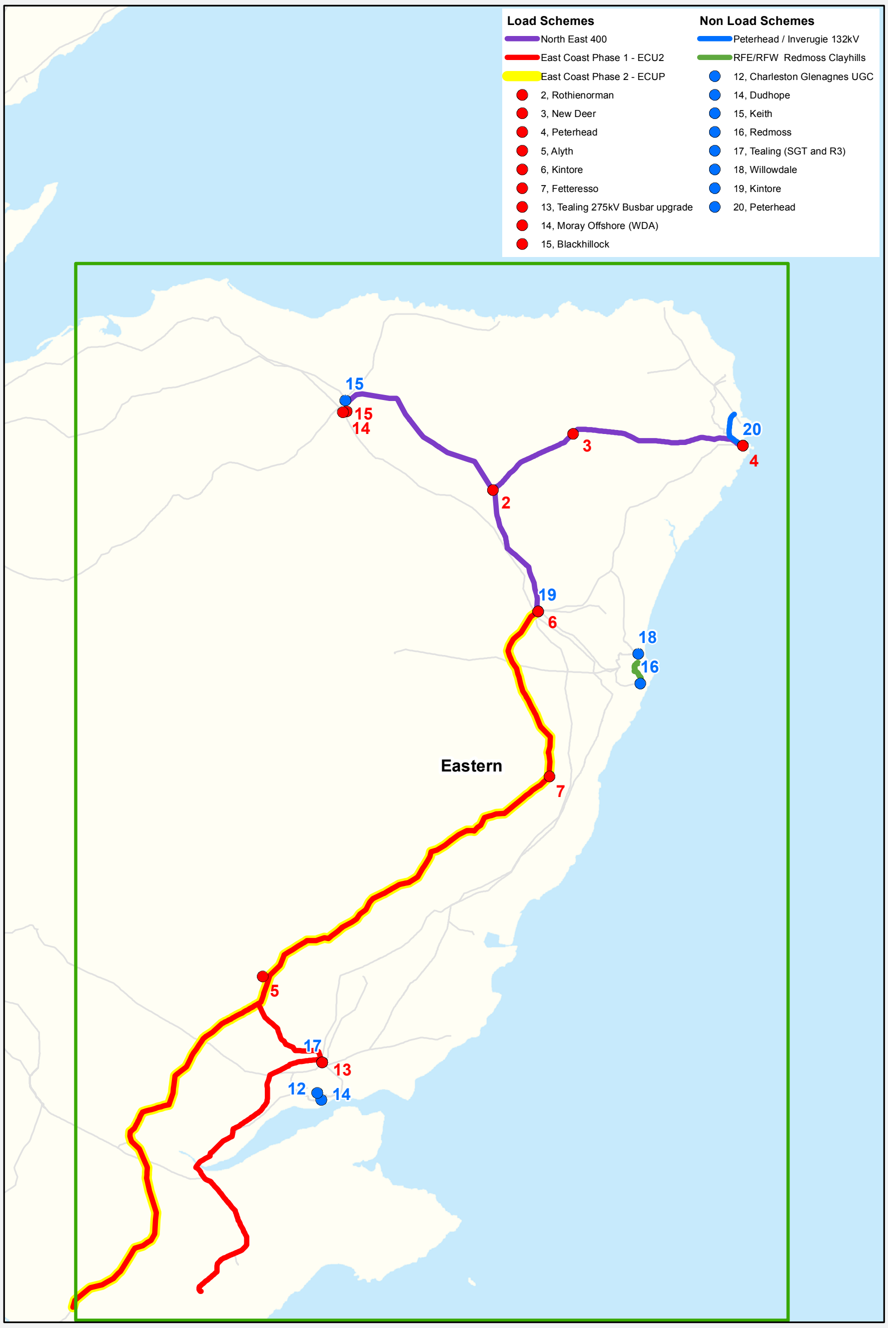


Figure 4.12 Eastern region Certain View schemes

Background

Significant amounts of offshore wind customers as well as the new interconnector to Norway (North Connect) are driving the portfolio of works in the region as well as asset condition considerations. The portfolio in this area demonstrated large volumes of renewables generation and therefore bulk power transfer requirements across the key transmission network boundaries. We also expect an increased demand for the connection of battery and photovoltaic customers during the RIIO-T2 period.

Certain View - costs and outputs

Anticipated RIIO-T2 Expenditure - £857m

Offshore Wind – 1875MW

Onshore Wind – N/A

Additional Shared Use Capacity - 720MVA

Boundary Uplift – 1090MW, Boundary B4

NARMS Output TBC

Your feedback

Regional roadshows will take place at various locations during August this year to invite feedback from our key stakeholders on our proposed plans and expenditure during the RIIO-T2 period.

12th August – Aberdeen
16th August – Perth

Certain View - Load Related Schemes					
Scheme Name	Asset Category	Scheme Description	Output	RIIO-T2 Cost	Scheme duration
Moray Offshore WDA	Sole Use	New 400KV Bays @ Blackhillock s/s	800MW	£6 million	2022-2023
Tealing 275kv Busbar	Shared Use	Connection for Firth of Forth Offshore w/f	1075MW	£19 million	2018-2023
North East 400			**720MVA**	**£165 million**	
Kintore substation extension	Shared Use	2 x 400/275kV transformers	inc above	inc above	2019-2024
New Deer 400kv Upgrade	Shared Use	Convert exisiting s/s to 400kV operation	inc above	inc above	2019-2024
Peterhead 400kv Busbar	Shared Use	New 400kV susbstation & transformers	inc above	inc above	2017-2024
Peterhead to Rothienorman 400kv Upgrade	Shared Use	Reinsulate & Conductor Replacement	inc above	inc above	2017-2024
Rothienorman 400kv Upgrade	Shared Use	New 400/275kV transformers (x4)	inc above	inc above	2019-2024
East Coast Phase 1 - ECU2:			**610MW, B4**	**£180 million**	
Alyth Substation	SWW	New 275kV switching station	inc above	inc above	2017-2024
Errochty Intertrip	SWW	Intertrip scheme	inc above	inc above	2019-2024
Kintore / Fetteresso / Alyth 275kV (224km DC tower line)	SWW	Reprofiling of existing OHL circuit	inc above	inc above	2020-2026
Tealing PSTs	SWW	Installation of new Phase Shifting Tx's	inc above	inc above	2019-2024
East Coast Phase 2 - ECUP:			**480MW, B4**	**£245 million**	
East Coast 400kv OHL Upgrade	SWW	OHL Reinforcement to operate @ 400kV	inc above	inc above	2022-2026
Kintore 400kv Busbar	SWW	Substation ext to operate @ 400kV	inc above	inc above	2022-2026
Alyth 400kv Upgrade	SWW	Substation ext to operate @ 400kV	inc above	inc above	2022-2026
Fetteresso 400kv Upgrade	SWW	Substation ext to operate @ 400kV	inc above	inc above	2022-2026
Blackhillock PSTs	SWW	Installation of new Phase Shifting Tx's	inc above	inc above	2022-2026
Total				**£615 million**	

Certain View - Non Load Related Schemes					
Scheme Name	Asset Category	Scheme Description	Output	RIIO-T2 Cost	Scheme duration
CGN/CGS (Charleston (Elmwood)/Glenagnes)	NLRE	Replacement of 3.6km 132kV UGC	NARM	inc below	2019-2023
Dudhope GSP	NLRE	Replacement of existing Tx's	NARM	inc below	2021-2026
Keith	NLRE	Replacement GIS switchgear	NARM	inc below	2021-2025
Kintore	NLRE	Replacement GIS switchgear & Tx's (x4)	NARM	inc below	2021-2025
Peterhead	NLRE	Replacement Tx's (x2)	NARM	inc below	2021-2025
Peterhead / Inverugie 132kV (8km DC tower line)	NLRE	Replacement tower fittings	NARM	inc below	2021-2024
Redmoss	NLRE	Replacement Tx's & Switchgear	NARM	inc below	2022 -2023
RFE/RFW (Redmoss/Clayhills)	NLRE	Replace existing 132kV UGC (4.8km)	NARM	inc below	2021-2024
Tealing (SGT and R3)	NLRE	Replace SGT3 & Reactor R3	NARM	inc below	2021-2026
Willowdale	NLRE	Replacement of GT(x2) & switchgear	NARM	inc below	2022-2026
Total				**£242 million**	

Case study - Eastern upgrades

Background

The need to reinforce the transmission network in the east and north-east of Scotland has been demonstrated through the Network Options Assessment (NOA) process. The latest NOA report (published in January this year) recommended investment in the east coast network by 2026 in a two-stage approach and in the HVDC link from Peterhead to England with the associated AC onshore works at both ends by 2029.

North East 400 reinforcement

The local connections driving the North East 400 reinforcement are the contracted connections - 900MW Moray East Offshore windfarm (2021), 800MW Moray West Offshore windfarm (2024), increase in Peterhead capacity to 1180MW (requires works to be delivered by 2021) and the 1400MW NorthConnect interconnector to Norway (2023). The scope of the North East 400 reinforcement includes the construction of New Deer and Rothienorman 400kV substations by 2021 and the Peterhead 400kV busbar by 2023 to support these local drivers. The North East 400 reinforcement will be delivered ahead of the NOA recommended dates to facilitate these customer connection dates.

East Coast phase 1 & 2 reinforcements

The NOA options for the east coast onshore reinforcement include (i) the Eastern 275kV Onshore Reinforcement (ECU2) in 2023, (ii) the Eastern 400kV Onshore Incremental Reinforcement (ECUP) in 2026, following ECU2 and (iii) the Eastern 400kV Onshore Reinforcement (ECU4) in 2025.

The NOA considered two paths for the east coast onshore upgrade to 400kV namely; (a) ECU2 followed by ECUP (i.e. East Coast phase 1&2 reinforcements) and (b) ECU4. The NOA CBA results indicated that the combination of ECU2 and ECUP outperforms ECU4 in all 2018 Future Energy Scenarios (FES) by £84m to £415m as shown in the table below. The lower benefit of £84m is based on the Consumer Evolution scenario which is an outlier for our area. The benefit of the phased approach is due to the capacity delivered by ECU2 earlier in 2023 which significantly reduces constraints on the SHE Transmission/SPT border (boundary B4).

2018 Future Energy Scenario

	Two degrees	Community Renewables	Consumer Evolution	Steady Progression
Benefit of (ECU2 + ECUP) vs ECU4	£278m	£415m	£84m	£199m

ECU2 delivers significant capacity on B4 in 2023 ahead of the alternative ECU4 which would deliver the same capacity as (ECU2 + ECUP) later in 2025. A further capacity increase on B4 will be realised by the Peterhead to Drax HVDC link (E4D3) in 2029. It is important to note that the NOA CBA also indicated that further reinforcement is required beyond the HVDC link and also that any advancement in these eastern reinforcements will reduce the overall costs to GB consumers (indicative benefit from ESO of c.£400m/annum for advancement of E4D3). The required boundary transfers show that transmission reinforcements are trailing the requirements in the majority of the scenarios including our own North of Scotland FES **(Figure 4.8).**

Condition assessment of the existing conductors between Blackhillock, Rothienorman and Peterhead have established that the conductors should be replaced between 2026 and 2031.

Considering the NOA recommendations, local drivers and asset condition, an opportunity assessment has identified an approximate capital cost saving of £56m through the removal of abortive works and reduction in construction outages by up to 70 weeks. This assessment concluded that the most coordinated, economic and efficient strategy for delivering the North East 400 reinforcement is to align delivery of the Peterhead 400kV busbar and the connection of NorthConnect in June 2023, and to concurrently reinsulate and reconductor the overhead lines between Blackhillock, Rothienorman and Peterhead.

Certain View: Caithness, Orkney and Shetland

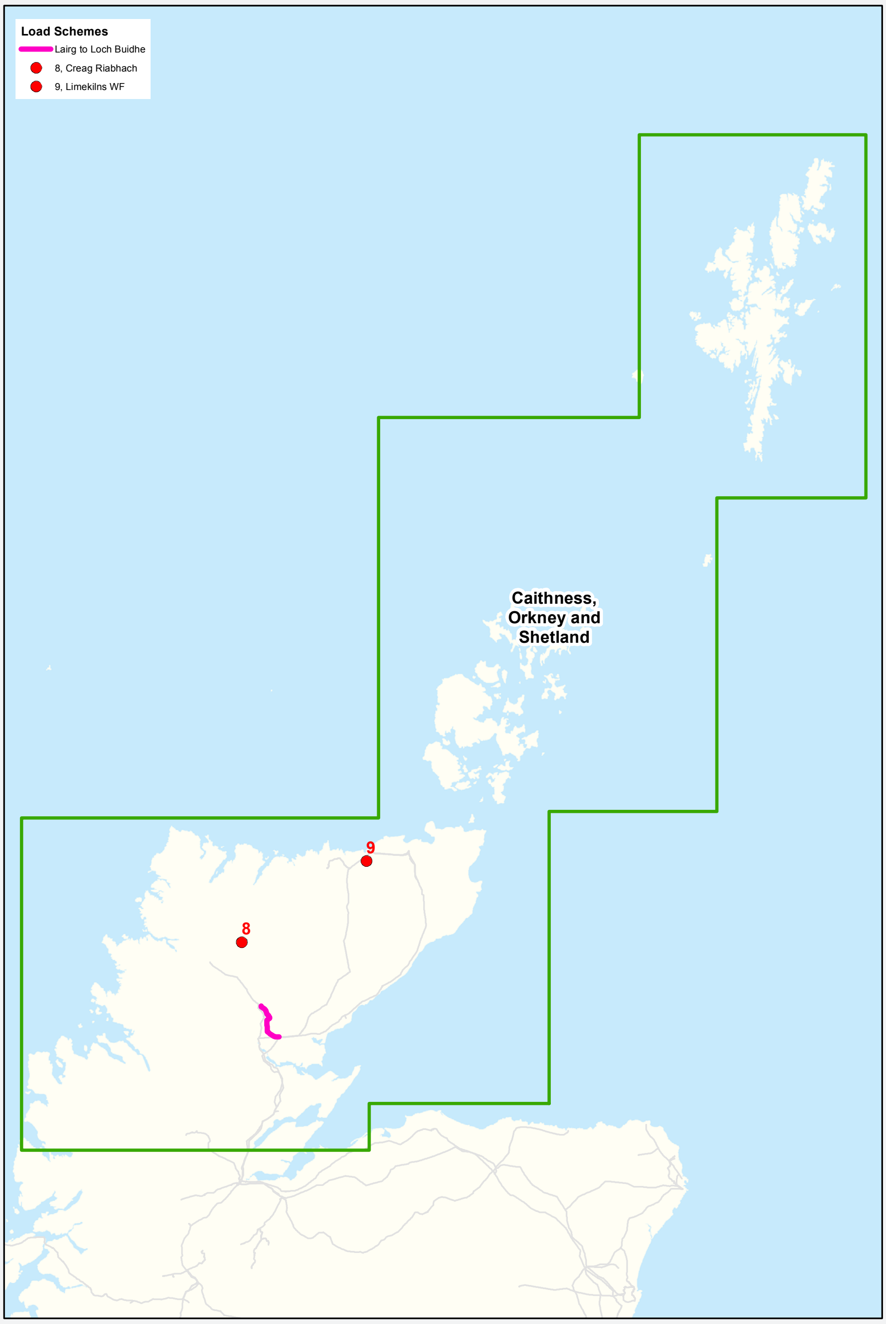


Figure 4.13 Caithness, Orkney and Shetland region Certain View schemes

Background

The existing assets in this region are in good health and there are no non-load driven pieces of work in the regional portfolio. The mainland works are driven by the continued demand for the connection of local customers, with a number of schemes currently under development and scheduled to connect in the early part of the RIIO-T2 period.

The Orkney and Shetland island subsea connection are subject to an ongoing approval process driven by customer connections. If approved, both schemes would result in connection of significant levels of generation (and associated infrastructure).

Certain View - costs and outputs

Anticipated RIIO-T2 Expenditure: £55m

Onshore Wind – 169.2MW

Additional Shared Use Capacity - 607MVA

NARMS Output TBC

Your feedback

Regional roadshows will take place at various locations during August this year to invite feedback from our key stakeholders on our proposed plans and expenditure during the RIIO-T2 period.

14th August - Inverness

Certain View - Load Related Schemes					
Scheme Name	Asset Category	Scheme Description	Output	RIIO-T2 Cost	Scheme duration
Creag Riabhach	TCA/Sole	22km OHL Connection	79.2MW	inc below	2018-2023
Limekilns	TCA/Sole	5km OHL Connection	90MW	inc below	2018-2022
Lairg - Loch Buidhe	Shared Use	16km 132kV OHL tower & new s/s	607MVA	inc below	2017-2023
Total				**£55 million**	

Island connections

We've not presented any of our island schemes within our Certain View for the following reasons:

- Although a Needs Case has been submitted for the Orkney, Western Isles and Shetland Links, there remains uncertainty over progression of these links;
- Recent generation connection requests from customers in Skye have resulted in a review of our overall development strategy taking account of both generation and asset drivers.

Our expectation is there is, subject to approvals, likely to be significant investment requirements for island schemes spanning both the RIIO-T1 and RIIO-T2 price control periods.

Orkney Islands	220kV Subsea Link from Dounreay to a newly created GSP at Finstown, plus associated 132kV island infrastructure and connection assets for each generator
Project Driver	Customer connections
Contracted Generation	300.8MW
Target Delivery Date	2024
Anticipated Costs (Strategic)	c£260m
Status	Approval process underway

Western Isles Islands	600MW HVDC Link from Beauly to Arnish Point in the Western Isles, plus associated 132kV island infrastructure and connection assets for each generator
Project Driver	Customer connections
Contracted Generation	330MW
Target Delivery Date	2024
Anticipated Costs (Strategic)	c£624m
Status	Approval process underway

Shetland Islands	600MW HVDC Subsea Link from Sinclairs Bay in Caithness to Kergord in Shetland, plus associated 132kV island infrastructure and connection assets for each generator
Project Driver	Customer connections and demand
Contracted Generation	649.3MW
Target Delivery Date	2024
Anticipated Costs (Strategic)	c£709m
Status	Approval process underway

Skye	New 132kV Overhead Line from Fort Augustus to Skye plus refurbishment of existing section of Overhead Line
Project Driver	Customer connection & asset condition
Contracted Generation	87MW
Target Delivery Date	2024
Anticipated Costs (Strategic)	TBC
Status	Recent generation developments and review of existing asset condition has led to an overall review of the development strategy for Skye

Case study - Lairg to Loch Buidhe reinforcement

Background

The proposed reinforcement of our network between Lairg and Loch Buidhe is being driven by growth of renewable generation in the area to the north and west of Shin. There are two generation schemes driving the network reinforcement:

- Sallachy Wind Farm (50MW)
- Creag Rhiabhach Wind Farm (79.2MW)

There is already 49.35MW of renewable generation connected at Lairg including the 38MW Achany wind farm and 16.6MW of hydro generation at Cassley which is connected to the overhead line circuit.

Consequently, the connected and contracted customer will significantly exceed the capability of the existing 132kV network in the area (89MVA summer pre fault rating) and reinforcement is therefore required on this network.

The relevant connected, contracted and scoping generation is shown in the table below:

Customer drivers for the Lairg Loch Buidhe

Customer	Connection point	Capacity (MW)	Connected (MW)	Contracted (MW)	Scoping (MW)
Achany	Lairg GSP	38	38		
Lairg - Smalls	Lairg GSP	11.3	11.3		
Sallachy Wind Farm	Cassley 132kV	50		50	
Cassley - Smalls	Cassley GSP	22.8	16.6	6.2	
Creag Riabhach Wind Farm Ltd	Lairg 132kV	79.2		79.2	
Dalchork (EON)	Lairg 132kV	>50			159
Braemore Wood Wind Farm	Lairg GSP	36.0			36
Strath Tirry Wind Farm (REG)	Lairg region	12.0			12
TOTALS (MW)			**66**	**135**	**207**

Options assessment and recommendation

The transmission reinforcement solution was assessed to reflect both the latest generation background within the Lairg region and updated project cost estimates.

Significant consultation has been undertaken with the local community and key stakeholders throughout the development of the scheme.

The Options Assessment considered four generation scenarios spanning a range from connected plus contracted and consented customers only, through to connected plus contracted plus all customers known to be in scoping. Several potential transmission reinforcements and their phasing to meet the power flow requirements arising from the generation scenarios were considered. These have ranged from reconductoring the existing Lairg - Shin circuit to building a high capacity new build 275kV double circuit that would, by default, be capable of uprating to 400kV.

Technical studies have been undertaken to assess each reinforcement options' ability to achieve National Electricity Transmission System Security and Quality of Supply Standard (NETS SQSS) compliance while accommodating the generation scenarios. Local network assessments have been undertaken considering the SQSS Generation Connection Criteria, while the Wider network assessments have been undertaken considering the SQSS Design of the Main Interconnected Transmission System (MITS), focussing on the impact on Boundary B0. The studies comprised load flow, contingency, voltage step and reactive compensation.

The cost estimates for the various reinforcement options have been used to carry out a high level economic assessment that consider the Net Present Value (NPV) of various development paths and also the Least Worst Regret option.

Based on the technical and economic results, the reinforcement option that has been recommended to be progressed is a 132kV new build. The new build consists of a new overhead 132kV tower line between Lairg and Loch Buidhe and construction of a new 132kV switching station at Dalchork. The results from the technical analysis have shown that this option meets compliance for three of the four generation scenarios, while the economic analysis showed that this option carries the Least Worst Regret. The cost of work required to upgrade this option to meet the full scoping generation scenario has been included within the economic analysis.

Construction of the works will commence in 2020 with anticipated completion date of April 2022, the main elements of the project are:

- New 132kV substation (Dalchork substation);
- New 132kV overhead line tower circuit between Lairg to Loch Buidhe fault rating of 348MVA per circuit;
- Modifications at the existing Loch Buidhe 275/132kV Substation to provide connection for the new overhead tower line; and
- Dismantling of the existing Lairg to Shin 132kV OHL Circuit.

Certain View: Argyll, Central and Western Isles

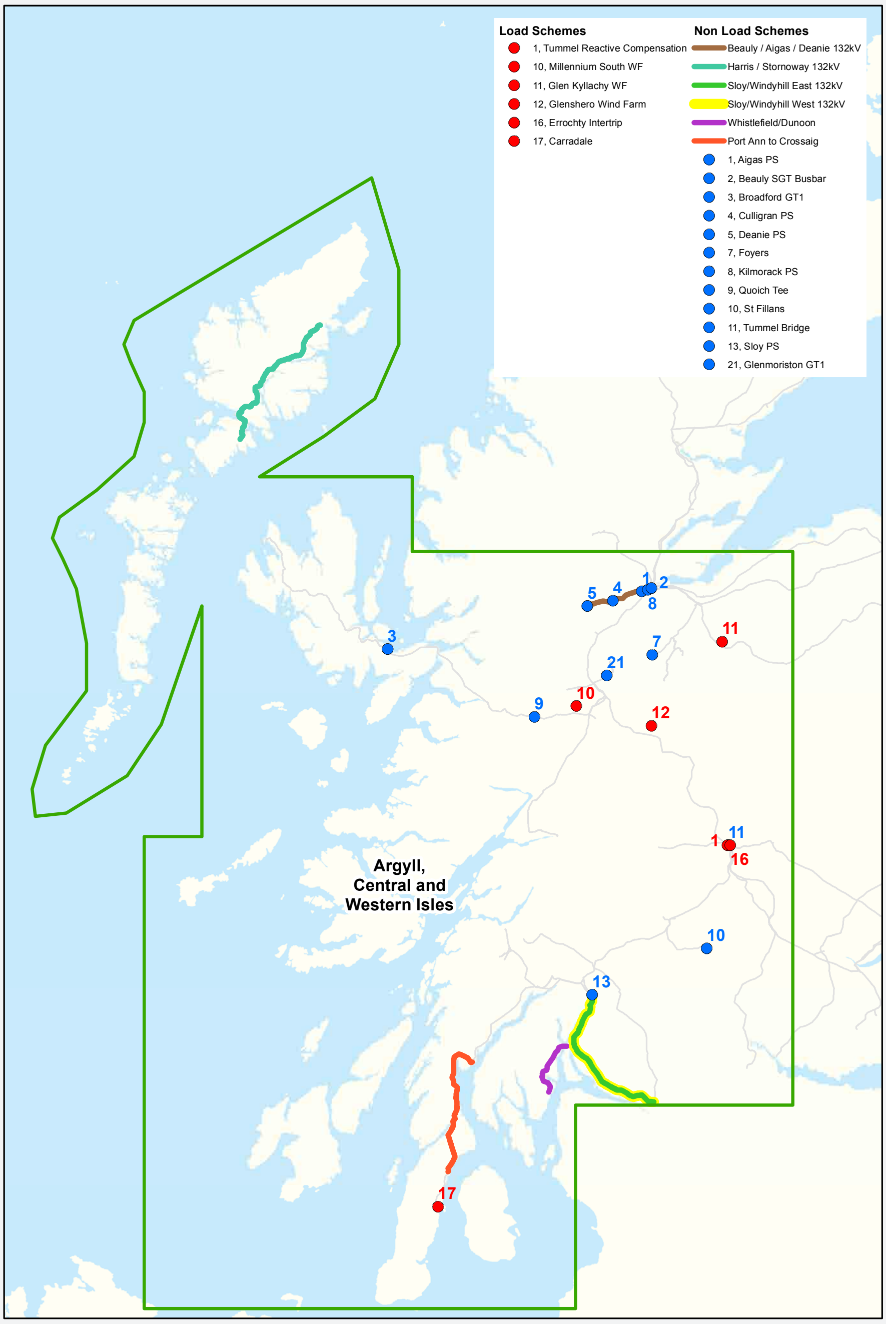


Figure 4.14 Argyll, Central and Western Isles region Certain View schemes

Background

The Argyll and Central region portfolio is driven by the asset condition of an ageing 132kV network and the continued demand for the connection of local renewable generation at both Transmission and Distribution level. There are also network performance issues to be addressed. This region covers a wide variety of challenging geography which means there are several large schemes with significant cost drivers. A holistic approach has been undertaken across this region, taking account of the multiple drivers, to ensure development of the most economic and efficient schemes. We have developed a robust strategy for the development of infrastructure in the Argyll region during RIIO-T1 and this continues into our RIIO-T2 plan. Recent generation connection requests in the Skye region has led to a review of the requirements taking into account these changes in conjunction with existing generation and asset condition drivers.

The Western Isles connection is subject to an ongoing approval process driven by renewable generation connections.

Certain View - costs and outputs

Anticipated RIIO-T2 Expenditure: £540m

Onshore Wind – 328.2MW

Additional Shared Use Capacity - TBC

Additional Reactive Capacity - +325/-75MVAr

NARMS Output TBC

Your feedback

Regional roadshows will take place at various locations during August this year to invite feedback from our key stakeholders on our proposed plans and expenditure during the RIIO-T2 period.

14th August – Inveraray
16th August – Perth
22nd August – Glasgow

Certain View - Load Related Schemes					
Scheme Name	Asset Category	Scheme Description	Output	RIIO-T2 Cost	Scheme duration
Millennium South	TCA/Sole	New terminal tower & Switchgear	25MW	inc below	2018-2022
Glen Kyllachy	TCA/Sole	3.0km OHL/UGC Connection	48.5MW	inc below	2018-2022
Glenshero	TCA/Sole	200m 132kV UGC from Glenshero EnergyPark S/s to Melgarve S/s	168MW	inc below	2018-2023
Carradale GSP Reinforcement	TCA/Sole	Transformer Upgrade (x4)	86.7MW	inc below	2018-2022
Tummel SVC	Shared Use	SVC Install at Tummel	+325/- 75 MVAr	inc below	2020-2024
Total				**£92 million**	

Certain View - Non Load Related Schemes					
Scheme Name	Asset Category	Scheme Description	Output	RIIO-T2 Cost	Scheme duration
Port Ann / Crossaig 132kV (49km DC tower line)	NLRE	Re-build of existing 132kV OHL	NARM	inc below	2021-2025
Sloy	NLRE	Replacement of 132kV GT's	NARM	inc below	2021-2024
Sloy / Windyhill East 132kV (15km DC tower line)	NLRE	Tower painting & earthwire replacement	NARM	inc below	2021-2023
Sloy / Windyhill West 132kV (15km DC tower line)	NLRE	Tower painting, replacement fittings & foundation repairs	NARM	inc below	2021-2023
Whistlefield / Dunoon 132kV (17km DC tower line)	NLRE	Re-build of existing 132kV OHL	NARM	inc below	2019-2024
Aigas PS	NLRE	Replacement of GT1 and associated plant	NARM	inc below	2022-2026
Beauly (SGTs) & Busbar	NLRE	GIS Substation Build & replace GT2/4/6	NARM	inc below	2020-2024
Beauly / Deanie 132kV (23km SC tower line)	NLRE	OHL full refurbishment	NARM	inc below	2020-2023
Broadford (Condition Driven GT1)	NLRE	Replacement of SGT1 & SGT2	NARM	inc below	2021-2026
Culligran PS	NLRE	Replacement of GT1 and associated plant	NARM	inc below	2022-2026
Deanie PS	NLRE	Replacement of GT1 and associated plant	NARM	inc below	2022-2026
Foyers	NLRE	Replacement of Gen Tx & swithgear	NARM	inc below	TBC
Glenmoriston GT1	NLRE	Replacement of GT1 and switchgear	NARM	inc below	TBC
Invergarry T 132kV (2.4km SC tower)	NLRE	Tower painting & Conductor replacement	NARM	inc below	2023-2025
Kilmorack PS	NLRE	Replacement of GT1 and associated plant	NARM	inc below	2022-2026
Quoich Tee	NLRE	Replacement disconnectors & Earth Switch	NARM	inc below	2022-2024
St Fillans	NLRE	Replacement of GT1 and associated plant	NARM	inc below	2019-2026
Tummel Bridge	NLRE	Replacement Tx's & Switchgear	NARM	inc below	2019-2026
Harris / Stornoway 132kV (58km Wood pole)	NLRE	Full rebuild with composite pole.	NARM	inc below	2018-2024
Total				**£448 million**	

Case study - Argyll reinforcement

Background

Development of the network in Argyll and Kintyre has been ongoing for some time and it follows on from the reinforcement to the network provided by the Crossaig to Hunterston sub - sea cable circuits commissioned in 2015. The connected and contracted generation customers background was continuing to grow at that time, driving a need for further network reinforcements, including this project to rebuild the overhead line between Inveraray and Crossaig.

An opportunity to combine several separate developments into a more coordinated, strategic development was explored during 2015 and 2016. This resulted in an options assessment considering a range of overall development paths for the region as well as addressing ongoing asset condition concerns. This work identified that the preferred development should ultimately be centred on developing a radial network from Scottish Power Transmission (SPT's) Dalmally substation via a new substation in north Argyll and running down the Kintyre peninsula to Crossaig.

A significant volume of additional customers contracted and forecast renewable generation developments were, at one stage, seeking connection in the Inveraray and Kintyre peninsula area. The contracted dates associated with many of these schemes were in 2020 and 2021 and made the load related reinforcement timescales consistent with the existing non-load related refurbishment commitments included as an output in the RIIO-T1 period. The withdrawal of subsidies for onshore windfarms from 1st April 2016 resulted in a significant reduction in the volume of generation seeking near term connection.

These changes in circumstance made it appropriate to review the continuing need and basis for the transmission construction works to upgrade the Inveraray to Crossaig double circuit based on asset condition, and the connection of contracted generation in Kintyre.

The requirement to undertake non load related refurbishment of the line was identified in the RIIO-T1 Business Plan. This included for re-conductoring the section between Inveraray and Port Ann. Subsequent to this the section of line between Port Ann and Crossaig suffered a tower failure due to an extreme weather event in 2013

The existing 132kV OHL circuit between Inveraray and, originally, Carradale was constructed over 55 years ago, and the towers and associated foundations have deteriorated considerably over time. In addition, the OHL circuit, constructed without an earth wire has a poor performance record and is subject to frequent, unplanned outages, possibly due in part to lightning strikes. The section of 132kV OHL between Carradale and Crossaig was rebuilt under the Kintyre – Hunterston project, to accommodate new generation customers in Carradale.

In addition, to the asset condition driver for refurbishment there are several contracted generation customers in the Argyll and Kintyre area that impinge on the power flow in the Inveraray – Crossaig circuits. The volume of connected and contracted customers south of Inveraray is beyond the current capacity of the existing overhead line; meaning any works need to take into account future customers levels.

A summary of the contracted generation in the region is shown in the table below. The table on the next page shows generation customers who in the last six months have submitted connection applications, or have discussed potential applications through pre-application meetings.

Contracted generation

Customer	Site name	MW	Generation type	D or T	TOCO connection date	Requested Distribution connection date	LT40	Customer consents Y/N
SPR	BAT III (Beinn an Tuirc)	50.0	Wind	D	01 April 2022		Y	Yes- 23/02/17
Good Energy Development	Willow	45.0	Wind	T	01 April 2023		Y	No
							95	**MW**

Details of scoping generation customer activity in the Kintyre and Argyll network area

Customer	GSP	Rating (MW)	Type	Status	Connection Date
Clachaig	Carradale	47	Wind	Offered	Apr 2022
Cour North	Crossaig	50	Wind	Competency Check	Competency Check
Airigh	West Tarbert	50-58	Wind	Pre-application	Pre-application
Kintarbert	North Tarbert	50	Wind	Pre-application	Pre-application

Options Assessment and Recommendation

A multi criteria options assessment covering capital cost, system performance, technical and environmental considerations has been completed looking at options for reinforcing the network in Argyll. It concluded that the option comprising development of a reinforced overhead line down the Kintyre peninsula and a new substation in Argyll connected to the existing Dalmally substation consistently ranked highest across all criteria weightings applied.

Consideration was also given to reconductoring the existing line in order to defer a larger reinforcement, however there is significant difficulties associated with this approach.

There was particular concern over the feasibility of this option on review of the necessary modifications. Levels of steelwork strengthening were considered unusually high and it is likely that replacement of the entire structures would be more suitable than developing a strengthening regime. Similarly, it was considered impractical to provide an earthwire peak on existing towers which would provide shielding to the top phase conductors. Also, due to the significant volume of steel replacement required, double circuit outages were considered necessary. Reconductoring was therefore discounted as a feasible option.

A detailed analysis has been completed to determine the optimal design of the replacement overhead line taking into account anticipated future generation levels in Kintyre. The conclusion from this analysis is that the replacement overhead line should be constructed with the capability of operating at 275kV in the future, therefore providing enough capacity to meet future generation customer requirements.

The upgrading of the line will be undertaken in stages:

Stage 1 (Existing RIIO-T1 Commitment – Completion Date 2021)
Replacement of the of the existing overhead line between Inveraray to Port Ann circuit with a new overhead line rated to operate at 275kV but operated initially at 132kV.

Output – Improved asset condition.

Stage 2 (RIIO-T2 – included within our Certain View)
Replacement of the existing overhead line between Port Ann to Crossaig circuit with a new overhead line rated to operate at 275kV but operated initially at 132kV.

Output – Improved asset condition and additional generation capacity for connecting renewable generation in the region.

Stage 3 (RIIO-T2 – uncertain)

New substation within Argyll (Creag Dubh) and new overhead line circuit to Dalmally, radial link operating at 275kV established to provide significant additional capacity for connecting renewable generation in Kintyre.

Capital Delivery Strategy

Capital Delivery Strategy

Having undertaken a rigorous and comprehensive approach to determining the need and identifying the preferred option, the final step is timely and cost effective delivery. The objective of our capital delivery is to ensure that we build the right thing, at the right time for the safe and co-ordinated operation of the GB transmission system, for the benefit of the GB consumer, economy and environment, and for the most beneficial whole life cost.

Effective procurement

We are subject to laws that require us to undertake competitive procurement for all of our capital investment and associated works. As our capital investment is around 80% of our total expenditure, achieving efficient outcomes from this competitive process is essential to the overall efficiency of our activities.

Our full time procurement and commercial team determine the optimum supply chain procurement solutions for our current and future capital delivery programme. The objective of this approach is to determine the most economic procurement strategy to delivering projects whilst ensuring we do not compromise project delivery or other requirements such as safety, environmental and land assembly. In developing the strategy, the team apply a variety of procurement tools including market analysis, stakeholder engagement and lessons learned.

On an individual project basis, the team will undertake: cost estimating, cost reporting and Cost Breakdown structure (CBS) analysis, supply chain engagement, procurement and tendering, contract and commercial management, and supply chain performance monitoring and management. Our supply chain includes all of the major international engineering and capital delivery companies, such as ABB, Siemens, Nexans, GE and Balfour Beatty.

A critical part of our procurement and commercial activity is the allocation of risk between delivery parties. Risk allocation is complex and subject to the peculiarities of each project – by the very nature of our network and its location – no two projects are the same. The result being our procurement processes can be complex with significant analysis undertaken on the differing contractual positions bidders take to determine a basis of lifetime cost of a project.

Bespoke procurement approaches

East coast

As shown on pages 106-109, we have a significant programme of works required on the east coast of Scotland during the RIIO-T2 period.

We have developed an holistic approach to the commercial and contracting strategy for the full programme of East Coast work. An overarching strategy identifies synergies in the nature of works, procurement activities/milestones, contract awards and construction dates. From this, supply chain engagement is also being considered holistically. Early engagement, including local Meet the Buyer events, are intended to identify potential challenged and risks to the delivery of the works in line with the proposed programmes.

The information gained from this will inform our detailed work allocation strategy, after integration with system constraints for example detailed outage programmes. Individual project requirements will also be taken into account. For example, Alyth substation requires Reactive Compensation which is not suited to be being procured under our substation frameworks. Preliminary market engagement for a standalone regulated tender has already commenced to engage the specialist knowledge required. However, to ensure the project delivers the best efficiency approach, the tender is likely to include the option to provide the substation and reactive compensation elements as a single lot each, as well the option to provide a full turnkey solution if best value can be demonstrated.

Shetland

While the links to the Scottish islands are not part of our Certain View (pages 110-111), these are important projects for the development of our Capital Delivery Strategy.

During RIIO-T1 we delivered, on time and under budget, the Caithness Moray HVDC link. Using the experience gained from the Caithness Moray investment, we have a strong and capable internal team for HVDC technology, high value project interface management and management of subsea risks.

This experience and capability has led to the development of a multi-contract strategy for the Shetland HVDC link. This applies our learning on the definition of works information and contractual terms and conditions. This approach, compared with the turnkey approach for Caithness Moray, brings greater responsibility for project and risk management in-house. We can apply our experience and capability to realise productivity improvements for customers.

[19]www.ssen-transmission.co.uk/riio-t2-plan/

Learning from RIIO-T1

We successfully delivered, on time and under budget, a significant programme of capital investment to grow the north of Scotland transmission network and so double the capacity of connected renewable generation. Key learnings from the success of that programme that we have also applied, and built upon, for the RIIO-T2 period are:

- Demand planning and strategy: to assess the ten-year ahead programme of work across the network and engage with the supply chain on deliverability. This was overseen by a Steering Group of senior management;
- Delivery risk management: considering the long term programme of work, potential challenges and constraints. Internal resources, capability and business processes, procedures and governance were key;
- Independent governance: a Large Capital Project gate process ensured efficiency as project progression was contingent on governance assurance and oversight at each gate. An independent assurance function focussed on programme, risk management and outturn cost; and
- Supply chain management: midway through the programme, we reviewed the contracting model and renegotiated terms with framework contractors to realise the efficiency gains.

The key challenge for the efficient delivery of the capital programme in the north of Scotland has been securing appropriate and sufficient contracting resource. The north of Scotland is remote and can be inhospitable, with limited local supply chain. To address this, and give confidence to our customers on timely delivery, our contracting strategy for key work categories (overhead lines, substations and underground cable) was based on five-year framework agreements. The competitive tender resulted in framework price schedules incorporated into the contracts.

The benefit of a multi-year, multi-project contracting strategy was to give confidence to the supply chain in a portfolio of work. The selected contractors were able to effectively manage and plan for projects, commit necessary resources and capabilities in the north of Scotland and thus reducing costs of supporting infrastructure and overheads, consider innovation in design and construction and take less adversarial risk to project risks (and associated costs) through long-term 'partnership' approach.

Cost analysis undertaken at the time of framework award demonstrated savings when compared with historical procurement approaches. A subsequent review of the contracting model confirmed these savings, and renegotiation further reduced rates. These opportunities could not have been delivered through discrete, one-off tenders. The final gate of the governance process requires a thorough lessons to learn exercise, with these lessons applied to subsequent capital investments.

Case study - Beauly Denny 400kV Overhead Line Project

The Beauly Denny 400kV Overhead line project was one of our flagship projects delivered during the RIIO-T1 period. The new overhead line was constructed to accommodate increased renewable generation in the North of Scotland, representing the first stage in transforming our network to enable transfer of large volumes of renewable energy on our network. The scope of works included construction of the new 200km double circuit overhead line, construction of five new substations and numerous ancillary works ranging from road infrastructure upgrades to undergrounding of existing 132kV overhead lines.

The project was constructed through four winter periods and had to overcome significant environmental and logistical issues with the final expenditure ~£700m.

The project was constructed through engagement with a number of supply chain partners to meet and overcome the significant challenges associated with constructing a linear project in some of the most challenging terrain in the UK. The project team had to manage a significant amount of technical, interface and constructability issues to ensure the project was delivered successfully. Through effective project, programme and risk management, the outturn costs were deemed by an independent consultant to have been incurred on an efficient basis.

Protecting customers from uncertainty

Uncertainty is an inevitable element of any forecast.

The RIIO-T2 price control settlement will fix the amount that we are allowed to charge, and the outcomes we must deliver for that money, between 1 April 2021 to 31 March 2026. One of the challenges in making this settlement is how to deal with uncertainty about what might be needed and when.

It is essential that customers are not asked to pay for things that are not needed or do not actually happen. Likewise that we are not exposed to the risk of being required to do things that were not envisaged in the fixed price control agreement. One consequence of such a risk is to increase our cost of capital (see section 6), so increasing the cost to customers.

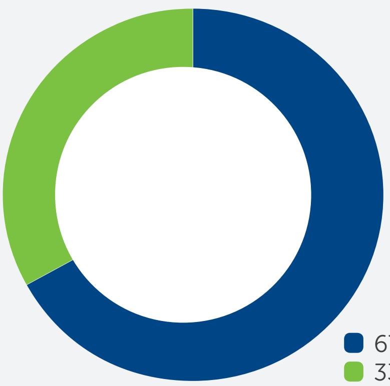
Our RIIO-T1 settlement demonstrates how this challenge can be successfully addressed – making an upfront agreement for costs and outputs that are certain and known, and then adjusting the settlement later when the need for additional outputs is confirmed. This approach uses a combination of upfront allowances and uncertainty mechanisms.

For RIIO-T1, our upfront allowances were for asset-driven investment where the need was known, for a prudent forecast of growth investment and for day-to-day operating costs. In addition, uncertainty mechanisms were agreed that were automatically triggered when additional customer needs were identified. The most significant of these were:

- The volume driver that released a pre-determined investment allowance per MW of new generation connecting (or per MVA of new infrastructure) and
- The Strategic Wider Works (SWW) re-opener mechanisms where Ofgem could review the case for additional strategic investment within the price control period.

Together this regulatory framework ensured protection for customers without compromising the network growth necessary for decarbonisation.

RIIO-T1 forecast



Citizens Advice RIIO-2 Principle 2

The value of any unspent funding for infrastructure projects is returned to consumers promptly and in full

We propose to adopt the same combination of upfront allowances and uncertainty mechanisms for RIIO-T2.

Certain View

The Certain View is our proposal for upfront costs and outputs for RIIO-T2. This comprises all investment and outcomes where there is a strong, evidence based need for the activity. Where the need is known, and can be demonstrated, there is no risk that customers are being asked to pay for an outcome that is not required or going to be undertaken.

Our Certain View forecast expenditure is £2.2 billion comprising growth, asset and resilience investment, IT and data investment, and day-to-day operating costs.

Uncertainty mechanisms

We have separately identified potential outcomes during RIIO-T2 where we do not have certainty, at this time, of the scope, timing or cost of the activity. Rather than seek upfront allowances, we propose to use uncertainty mechanisms. Examples of these outcomes are:

- Generation connections in excess of the 11.2 GW capacity for the Certain View. For our full contracted background, the total investment required would be around £850 million;
- The three Scottish islands links and associated on-island infrastructure (investment up to £1.5 billion) that are currently subject to detailed scrutiny of the need;
- For the evolving cyber and physical threats we face. These are fast moving and the actions required in the medium to long term are difficult to forecast accurately; and
- The requirements of the ESO for the safe operation of the GB transmission system, including for Black Start. For Black Start alone, potential expenditure could be in excess of £200 million.

There are different approaches to designing the right uncertainty mechanism. You can read more about our proposals for uncertainty mechanisms in our RIIO-T2 Regulatory Design paper[20].

[20]https://www.ssen-transmission.co.uk/media/3390/111regulatory-framework_final-draft.pdf

Effective delivery

Effective delivery

By the point at which a decision is made to proceed with an investment, most of the work to achieve an efficient outcome should have been completed **(Figure 4.12).** A thorough strategic options assessment and tailored procurement approach will mean that the project has the components in place for successful delivery.

However there are efficiency gains to be realised through good execution.

Under our capital delivery model, the key components for successful project delivery are:

Health and safety

For asset integrity and mitigation or control measures to the design, construction and operational safety risks. Hazards are understood and the appropriate detailed risk studies have been done resulting in an inherently safer and environmentally compliant design approach being adopted.

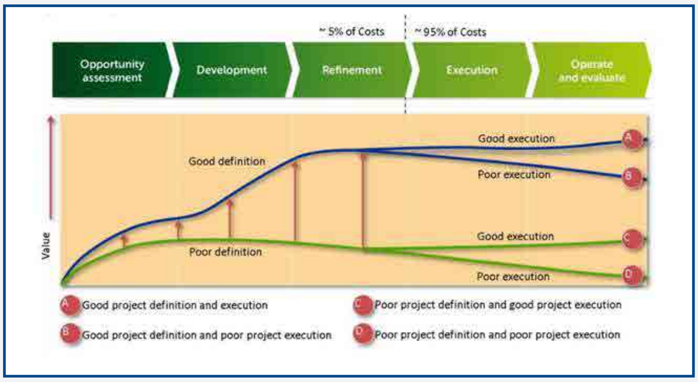
Environmental management

Documenting how environment related pre-commencement conditions have been, or shall be, satisfied, including any requirements for a Habitat Management Plan (HMP). Also setting out how environmental and sustainability objectives will be met, Construction Method Statements (CMS) and Environmental Statement requirements are in place.

Security

The key aspects of asset security. The operational, IT (including cyber-security) and physical security strategies shall be documented.

Figure 4.12 Impact on value of pre-construction definition



Project execution

With a clear project scope, delivery strategy, objectives and drivers. Project resources, including a Project Manager, are in place with Suitably Qualified and Experienced Personnel (SQEP) for Site Supervision and Quality intervention roles. The project schedule shall detail key activities and interfaces (integrated and logic-linked), which must be aligned to customer requirements. Change control processes, constructability and operability reviews, and project commissioning phase considerations are documented. Stakeholder engagement requirements, communications interfaces, community and public relations, legal, reporting and consent issues are clearly identified and subsequent actions defined. Transmission system outages are planned and booked.

Land and consent

Planning permissions and consents are secured and detailed responses to appropriate conditions are documented and discharged. All land titles are secured with an associated stakeholder engagement plan.

Commercial and procurement

Key contracts are developed and agreed, ready for signature following review and approval by Procurement and Commercial, Legal, and Insurance.

Design management

Project technical specifications are complete. Project design development and definition are finalised based on design. The process for design change control and review is documented and approved. The operational and system security strategies are finalised.

Project commissioning

An initial Commissioning Plan is prepared to ensure that risks and constraints to commissioning are identified, costed and accounted for. Any outages required are scheduled. Commissioning Panel responsibilities and resources are documented and Commissioning Panel meetings scheduled.

Project quality

A Risk Based Quality Interventions (RBQI) workshop has been undertaken and schedule of quality interventions has been developed and resourced for manufacturing, construction, installation and commissioning works.

Risk management

Documenting the management of risk during execution, including risk identification and development, the deployment of effective risk mitigations and risk management performance. A Quantified Risk Analysis (QRA) has been undertaken and a register of risks is in place, complete with planned responses and costed mitigation.

Summary

One of our four strategic themes is for Sector Leading Efficiency. This theme was developed following a review of our strategic objective, when stakeholders were clear that, while the decarbonisation of energy is important, we must also be concerned about the cost of our network to the household bill payer. We have set two principle goals:

- Transport the renewable energy that powers 10 million GB homes
- £100 million in efficiency savings from innovation

We have described in this section our draft proposals to achieve Sector Leading Efficiency:

The approach we take to establishing a **justified need for investment**. The best way to keep costs down for bill payers is not to do anything. However there can be significant inefficiency in doing the wrong thing at the wrong time. Working with the ESO, other networks and stakeholders, we undertake long term network planning for a range of possible outcomes (or scenarios). This complements our risk-based approach to determining the need for intervention on existing assets. Through this we can be confident that investment is needed and justified.

The importance of strategic optioneering assessment. Once a network need has been identified, there will be different viable options to meet that need. Our strategic optioneering assessment is a multi-year process to explore the technical, environmental and cost of the options and determine the preferred option for investment. Stakeholders are central to this process, both local communities and businesses directly impacted by the infrastructure and the wider GB household who will pay the bill.

How **we continue to learn from the success** of our capital delivery programme to date, and have applied this learning to ensure timely, cost-effective delivery during RIIO-T2. As over 90% of this expenditure is subject to competitive procurement, we emphasis the criticality of our procurement strategy and supply chain relationships.

We set out £1.8 billion of proposed capital investment for our RIIO-T2 Certain View.

Our ambition is to build on our track record for capital delivery, and demonstrate sector leading efficiency. This will be achieved by focus throughout the project development and delivery lifecycle. The proposals that we have set out here are intended to enable us to achieve that ambition during RIIO-T2.

Find out more...

North of Scotland Future Energy Scenarios
Network Options Assessment 2018/19
Consultation on Transmission Asset Development Process
Capital Delivery Strategy
Innovation Strategy

Tell us what you think

We invite your views on the proposals we have set out here. We welcome comment on any aspect of our proposals, and in particular on:

- The Certain View and our proposal that investments with uncertain need are not agreed upfront
- Whether the approach we take could be improved for greater benefits to GB bill payers

We are holding a number of events to seek views on our proposed capital investment programme during RIIO-T2 during the summer:

12 August	Aberdeen
14 August	Inverness
16 August	Perth
20 August	Oban
22 August	Glasgow