SSEN DISTRIBUTION RIIO-ED2

SCOTTISH ISLANDS STRATEGY

RIIO-ED2 Business Plan Annex 8.1

Scottish & Southern Electricity Networks

CONTENTS

EXECUTIVE SUMMARY

Our investment in the north of Scotland during RIIO-ED2 will be the foundation for our net zero future. Serving the needs of our customers located across 59 inhabited Scottish islands via an extensive subsea network and embedded generation stations is a responsibility unique amongst GB networks. During RIIO-ED2 our baseline investment requirements are forecast to be £329.2m[1]. The drivers for each and the justification of options adopted are clearly set out in accompanying Engineering Justification Papers[2].

We recognise that providing security of supply in remote locations requires higher marginal investment compared to large towns and cities on the mainland. However, this necessary higher investment also creates opportunities to secure wider net zero outcomes and leverage additional benefits for customers.

- Our remote island communities are also the **green energy hubs** which will enable the UK to meet its carbon targets. Our investment decisions today can help unlock that potential.
- Current diesel solutions that secure supply for today's customers are the largest source of controllable carbon emissions on our system. By challenging and then changing these network solutions we can **eliminate these emissions** for future generations.
- **Reliable electricity supply** will become increasingly more critical for remote communities as we move to alternative low carbon technologies. Our investment decisions today need to secure that future for our customers.

We recognise we cannot achieve these outcomes without working with other parties nor can we fully control the timeline to achieve these benefits. Our stakeholders are clear they want to see us pursue increased benefits and unlock the economic potential of remote communities. We have, therefore, amended our draft Business Plan to introduce an ambitious north of Scotland Whole System mechanism that we believe will be the largest in RIIO-ED2.

[1] Figures for remote generation in this annex are presented showing the impact of energy sales as appropriate

[2] All associated Engineering Justification Papers (EJPs) are listed in Appendix B to this Annex

Our baseline plan investment represents the activity necessary to secure the individual outcomes that meet our stakeholder needs, £329.2m.

Within this £329.2m we propose investments of £63.5m in subsea cables, including intervention via replacement or augmentation of 15 cables with the greatest needs case of proactive work to avoid faults. Further, three cables totalling £83.9m: Skye to Uist (x2) and Pentland Firth West to Orkney are also proposed for intervention or augmentation and are critical components of our proposed Whole System approach during RIIO-ED2. Finally, £37m is also proposed as ancillary costs for cables.

£42.5m of the £329.2m is proposed for maintaining and operating standby diesel generation for island communities at seven sites. Within this expenditure we will replace the engines at Battery Point on the Isle of Lewis to improve its environmental impact and uprate the capacity of Bowmore Power Station on Islay. We expect our whole system uncertainty proposal to have significant role in this area as we seek to identify best value, integrated solutions that will allow us to deliver a 1.5 degree carbon reduction pathway in line with our Science Based Target commitments (see our ***Sustainability Strategy (Annex 13.2)*** for further details).

The third area of specific regional factors investment is £99.8 for Shetland. This will cover ongoing maintenance of Lerwick Power Station which will ensure reliability of supplies until the new transmission link is constructed and the transmission and distribution networks are connected; plus the development of a new fault ride-through system to operate with this link; and thirdly the continued maintenance of Lerwick Power Station post link commissioning to ensure its operational life until 2035 as a standby generator.

We have maintained a simple uncertainty mechanism to respond to unforeseen subsea network failure and ensure that replacement is rapid and efficient[3].

The certainty of need for these investments is clear, well evidenced, and stakeholder supported, but we know needs will continue to evolve as unforeseen occurrences occur, such as subsea cable faults; and policy updates emerge from government bodies. For this reason, we are proposing uncertainty mechanisms to cover known unknowns. These mechanisms are summarised in this Annex and set out in detail in ***Uncertainty Mechanisms (Annex 17.1)***.

We have added our Hebrides and Orkney Whole System Uncertainty Mechanism (HOWS) to enable us to leverage baseline totex and achieve greater customer value.

This proposal recognises that a significant proportion of our baseline expenditure will be in close proximity to, and concurrent with, other potentially material energy investment decisions[4]. In our RIIO-ED1 Shetland whole system solution, we realised over £100m of customer value. We believe similar material value is possible during RIIO-ED2 for stakeholders if we can develop integrated whole system energy solutions in parallel with the needs of other vectors.

We have already initiated the discovery phase of this work and include early thinking within our Business Plan. We commissioned Mott MacDonald to assess whether there was justification for ongoing investment in Island networks to meet all our stakeholder's needs, starting with the Hebrides. This is a qualitative assessment of the drivers of investment and an opportunity to identify potential for solutions to interact with other energy and stakeholder activity. Mott MacDonald identified '*a clear need for ongoing material investment within the Hebrides/Western*

3 Hebrides & Orkney Whole Systems UM, Annex 17.1

4 These include the 2022 Contract for Difference allocation round 4, the ScotWind leasing process, inflight generation led transmission reinforcements, development of alternatives to existing LPG and LNG gas networks and the extensive ambition represented in local energy planning.

Isles distribution network within the RIIO-ED2 price control period'. In its report, it also concludes that '*the necessary steps and value of investment cannot be firmly defined at this stage, as significant decisions in the transmission network infrastructure […] will require differing investments at the distribution level'*. Looking to the next phase of this work Mott MacDonald note, '*The purpose of the quantitative stage is to determine potential savings in terms of diesel not burned by making investments in suitable interventions as part of a wider system solution over the RIIO-ED2 period*.'

The HOWS framework enables us to explore the potential that Mott MacDonald has concluded exists in our Island networks. In anticipation of the HOWS uncertainty mechanism being approved, we will use the remaining years of RIIO-ED1 to work with all stakeholders to evaluate potential whole system outcomes, align decision making with external timelines and be ready to submit amended allowances and output deliverables to Ofgem early in RIIO-ED2. Further detail on this framework can be found in Section 4 and ***(Uncertainty Mechanism (Annex 17.1)***.

Under the HOWS framework the following components of our baseline expenditure would be subject to adjustment as part of the uncertainty mechanism assessment by Ofgem.

Table 1.1: RIIO-ED2 baseline allowances subject to HOWS uncertainty mechanism

Totex activity area	Total baseline RIIO-ED2	Baseline subject to HOWS UM	*Notes*
Subsea cable replacement (CV7 & HVP)	£147.4m	£111.8m	*Geographic cluster of cable assets listed in UM Annex*
Subsea cable other (multiple BPDT)	£37m	£0	*Fault, inspections, R&M etc required under all future scenarios*
Remote Generation (CV15/C8)	£42.5m	£40.1m	*Component of Scottish Island investment most likely to flex under HOWS*
Shetland (multiple BPDT)	£99.8m	£0	*Whole System solution identified in RIIO-ED1*

On balance these investments represent a credible transition from RIIO-ED1 to RIIO-ED2. The need case for subsea cable intervention in RIIO-ED2 is asset data led; refined and iterated by overlaying the industry standard risk management methodology with bespoke risk modelling and cable specific cost benefit analysis. We are focused on cables where certainty of need to intervene is highest. We are optimising the benefits of investment by prioritising reduction of consumer impact and meeting the needs of local communities and stakeholders, including considering the impact on the environment and lost renewable energy to GB grid.

For standby generation our current proposals are consistent with core network requirements to maintain security of supply to island communities. This base investment will ensure the continued operability of these strategic sites and deliver improvements in network emissions. In RIIO-ED2 we recognise the need to achieve a step change in the sustainability of network standby solutions. To achieve this the whole system mechanism will be crucial. And in Shetland our investment requirements align with the needs case previously supported by Ofgem for standby arrangements post construction of the new transmission link.

Scottish island communities will additionally benefit from the rest of our investments proposed for our North of Scotland Licence area (SHEPD) and justification for these proposals is set out in the other chapters and annexes of our plan.

We identify these areas of our plan as specific regional factors because the investments required are unique to us. Our network of subsea cables and standby power stations serves our customers across 59 inhabited Scottish islands while we also support and encourage the potential for growth in green energy production.

This means these investments cannot be considered within the standard cost assessment model and cross-Distribution Network Operator (DNO) benchmarking process administered by Ofgem for our RIIO-ED2 plan. We have provided specific and tailored justifications for our investments which account for unique regional aspects of the Scottish island communities. Our Scottish Islands outputs are summarised below.

Table 1.2: RIIO-ED2 Scottish Island outputs

Output	Output type	RIIO-ED2 target	Cost in baseline plan	Consumer benefit
Subsea cables – targeted intervention	PCD[5]	Replacement or augmentation of 15 subsea cables with the greatest needs case	£63.5m	• Improved reliability and resilience in the longer term • Contribution to risk reduction on our network (see Maintain a resilient network, Chapter 7) • Increased capacity to enable renewable generation to connect • Condition driven replacement to avoid supply failure and improvement of network for capacity reasons • Enables a Whole System approach to these communities. Needs case development during RIIO-ED2.
Subsea cables – strategic upgrades	PCD	Three new cables between Skye and Uist, and Pentland Firth West to Orkney	£83.9m	
Distributed Embedded Generation	PCD	Maintaining and operating standby generation for island communities at our seven island power stations	£42.5m (including £9.5m for schemes within our Environmental Action Plan)	• Improved reliability of distributed generation reduces risk of loss of supply for customers • Increased efficiency results in lower emissions and running costs.
Shetland	LO	Continued running of Lerwick Power Station to 2025 and then successful transition to standby status	£99.8m	Extended operational life until 2035 as a standby generator to ensure continuity of supply for island customers

LO: licence obligation; PCD: price control deliverable; ODI: output delivery incentive (F: Financial, R: Reputational), CVP: Consumer Value Proposition, SSEN Aim: company goal

[5] The subsea cable PCD is only applicable to the investments that are related to the HOWS UM for whole system opportunity development. Please see ***Annex 17.1 on Uncertainty Mechanisms*** for full detail and explanation about our approach to protect customers from unnecessary expenditure.

ENHANCED ENGAGEMENT

Our Scottish Islands strategy has been informed by our Enhanced Engagement programme, full details of which are set out in Annex A 3.1. Our draft plan was underpinned by three phases of stakeholder and customer engagement (illustrated in the diagram above). The details of this engagement and insights are set out in Appendix A to this Annex and provide a clear line of sight between what stakeholders told us and our Scottish Islands strategy and outputs.

FINAL SCOTTISH ISLANDS STRATEGY TESTING AND ACCEPTANCE

We have refined our final Scottish Islands strategy and outputs based on Phase 4 of our Enhanced Engagement, which involved direct testing of the strategy, outputs and costs with 214 stakeholders through eight events. The table below sets out the clear line of sight of the changes between our draft and final Scottish Islands strategy and outputs based on this engagement.

ENGAGEMENT EVIDENCE TRIANGULATION AND CHANGES BETWEEN DRAFT AND FINAL PLAN

The table below summarises the clear line of sight between stakeholder and consumer insights and our Scottish Islands strategy and outputs. For our **draft Scottish Islands strategy** and outputs, based on phases 1 to 3 of our enhanced engagement program, we demonstrated how engagement insights had informed our outputs using these keys:

Findings converge to support proposals.

Findings generate new insights that lead to further refinement of proposal.

The proposed approach diverges from the findings.

To demonstrate the line of sight between the scope of **change between draft and final**, based on testing our draft proposals with stakeholders and consumers, we use these keys:

Strategy/Output	Phases 1-3 Enhanced Engagement	Phase 4 Outputs and Cost Testing	Acceptability
REFINED **Scottish Islands strategy**	**Stakeholders said** Lack of reliability has a high impact on both demand and generation customers **Our response** We will invest £63.5m in replacing subsea cables selected as having the greatest value for money for consumers. **Stakeholders said** We should prioritise subsea cable replacement based on the impact to communities, generators and environment of a cable failure. **Our response** We amended our asset strategy, taking a more proactive, impact-based approach to replacing cables that serve large populations of customers and generators. **Stakeholders said** Generation customers called for greater capacity as the level of renewable generation increases and the need to meet Net zero. **Our response** We will invest £83.9m in three major projects – Skye-Uist (times two) and Pentland Firth West – which will enable us to continue a whole system assessment in ED2, including assessing relative export capacity needs from these major island groups.	**Stakeholders said** Based on a deep dive session with stakeholders on the Scottish Island Strategy and costs, stakeholders supported its comprehensiveness noting that engagement was a step up from ED1 performance and also raised areas for further refinement: • Application of how the Uncertainty Mechanism would be applied suggesting cost/benefit and Net zero should be considerations • Enhanced ambition to facilitate more renewable generation from the Islands and whole system solutions **Our response** Our strategy includes the addition of a Whole Systems Uncertainty Mechanism (HOWS) in response. We believe this is an optimal approach to realise customer value by providing flexibility to develop integrated whole systems solutions as we work with stakeholders to identify and value opportunities.	79% for *A Safe, Resilient and Responsive Network* strategic outcome

Strategy/Output	Phases 1-3 Enhanced Engagement	Phase 4 Outputs and Cost Testing	Acceptability
REFINED **Shetland**	**Stakeholders said** Approximately a third of stakeholders at our Shetland Engagement Forum supported procuring, building and using a new standby solution until 2030s-40s at higher cost. **Our response** We discounted this minority view because it is a more expensive option, the existing equipment at Lerwick Power Station is proven, and it would delay an economic move to a lower-carbon solution. **Stakeholders said** Shetland Islands Council shared information on long-term energy plans for Shetland (Project Orion – primarily oil and gas decarbonisation) **Our response** This influenced our longer-term plans for possible low carbon backup options. We will maintain engagement with the project. **Stakeholders said** Maintaining a reliable supply is the top priority for Shetland stakeholders, so a robust standby solution is essential in the event of subsea cable outages **Our response** We will retain Lerwick Power Station as the main standby solution. As its diesel generator takes time to power up (c.30-60 minutes), supplementary solutions are required to prevent blackouts during this period. We will conduct a market process to procure these. Renewables will be used, where possible, to displace thermal generation, and the potential for flexibility services will also be explored.	**Stakeholders said** The Shetlands outcome evolved into a whole systems solution. How will the learnings be continued to apply to Shetlands and the wider Scottish Islands strategy for ED2, taking into consideration optionality, a smarter energy future and Net zero **Our response** This Whole System thinking has informed the creation of the HOWS mechanism. We have demonstrated the ability to identify, develop and deploy large scale whole system solutions and expect similar opportunity to be present in the Hebrides and Orkney zones during RIIO-ED2. We will further consult with stakeholders on the development of low carbon standby solutions with the objective that any solutions identified through our innovation program will be evaluated for deployment.	Not tested

1 INTRODUCTION

1.1 NETWORK BACKGROUND

Our North of Scotland licence area (SHEPD) covers 25% of the UK land mass but is the most sparsely populated Electricity Distribution region in Great Britain with roughly 14 customers per km^2 (National average – 133 per km^2). We serve 59 remote island communities who are supplied and interconnected through 110 submarine cables stretching 454km. To ensure security of supply for island communities, we currently own and operate seven Distributed Embedded Generation (DEGs) sites, relying on them to support the network if the cables supplying the islands are on an outage or have faulted.

In addition, we also operate and maintain power supplies to the island of Shetland, 170km north of mainland Scotland, inhabited by approximately 23,000 people. Shetland is currently 'electrically islanded' which means that there is no direct connection to the wider transmission grid. The island's electricity is supplied and managed by Lerwick power station, supplemented with a contract with Sullom Voe Power Station and supply from local wind farms. In 2025 the construction of, and connection to, a new transmission link provided by SSEN Transmission will enable us to transition away from full duty diesel generation to a standby role. We will adopt the station as a standby plant and continue our active role as Distribution System Operator.

1.2 CONTENT OF THIS ANNEX

In this Annex we outline our baseline RIIO-ED2 investment proposals for three specific and unique parts of our SHEPD licence area: (1) Subsea cables; (2) Distributed Embedded Generation: and (3) Shetland[6]. These are specific, measurable, and stakeholder supported investment proposals required in the RIIO-ED2 period. We consider these aspects of our plan separately as specific regional factors because the investments required are unique to us amongst our Distribution Network Owner (DNO) peers. This means they cannot be considered within the standard cost assessment and cross-DNO benchmarking process administered by Ofgem for our RIIO-ED2 plan. We have provided specific and tailored justifications for our investments which account for unique regional aspects of the Scottish island communities.

These investments represent c.22.4% of our SHEPD RIIO-ED2 investment proposals. Scottish island communities will additionally benefit from our total £1,466.7bn of investments proposed for SHEPD in RIIO-ED2. These wider investments include funding to facilitate growth in Low Carbon Technologies and meet sustainability ambitions to enable net zero; as well as investment to serve the needs of some of our Worst Served and most vulnerable customers; and to maintain overall asset health. Justification for these proposals is included throughout the other chapters and Annexes of our plan.

The nature of the three regional factors outlined above are not new for the RIIO-ED2 period; but our investments reflect evolving stakeholder needs, changing asset conditions and updated policy requirements. They ensure we can deliver on our RIIO-ED2 strategic outcomes of being a trusted and valued service to our customers and communities; a safe and resilient network; and a provider of a smart, flexible and sustainable energy system enabling the transition to net zero in Scotland.

[6] Whilst Worst Served Customers was considered a regional factor in RIIO-ED1 the funding approach has now been standardised across DNOs for RIIO-ED2 and interested readers should see our ***Reliability Strategy (Annex 7.2)*** for details. Readers interested in our approach to Load Managed Areas in SHEPD for RIIO-ED2 should consult the ***Load Related Plan build & Strategy (Annex 10.1)*** document

In this Annex we also summarise the justification for our Hebrides and Orkneys Whole System uncertainty mechanism (HOWS).

We see the potential to secure materially greater long-term value outcomes for our customers and wider stakeholders by leveraging our baseline allowances, and any additional investment secured under this mechanism, to deliver whole system solutions (which align to our ***Whole System*** principles as set out in ***Annex 12.1***). Our assessment confirms that decisions on the viability of potential solutions depend on timelines set by third parties. For that reason, inclusion of the whole system proposal as an uncertainty mechanism is the most appropriate recourse to ensure we can continue to pursue consumer value. This initial review also confirms that the size of the potential prize is worth this effort.

Section 6 summarises the drivers for such a mechanism, the justification for the solution proposed and some of the benefits which we would aim to secure through this for customers.

1.3 STRUCTURE OF THIS ANNEX

This annex has adopted a logical structure which walks the reader from identification of need through to recommended options, output benefits and associated costs.

- We begin with a brief outline of the context of our North of Scotland network.
- We then summarise what consumers will get from our baseline RIIO-ED2 proposals along with the actions we will take to deliver on these proposals.
- We then summarise the justification for the chosen investment proposals over alternatives.
- This is followed by a summary of the uncertainty mechanisms we propose, addressing the risk to customers as changes in the drivers of investment need result in uncontrollable network events, such as cable faults which cannot be resolved through repair and require full replacement.
- We then introduce our Hebrides and Orkney Whole System (HOWS) uncertainty mechanism which enables the process of identifying and funding the long-term whole system solutions for the Hebrides and Orkney islands.
- Finally, we conclude with summary remarks on how our proposals on balance achieve a credible transition from RIIO-ED1 to RIIO-ED2.

2 CONTEXT TO SCOTTISH ISLAND INVESTMENT

This section provides the necessary background to each of the three areas of network activity considered within the Scottish Islands scope. We highlight some of the unique characteristics of each area and explain the drivers for and challenges associated with current network operations.

2.1 SUBSEA CABLES

We operate 110 submarine cables totalling 454km serving 59 Scottish Island communities. These cables have provided vital connections with the mainland electricity system and interconnection between island groups since the 1950's. They also provide local renewable generation sources a critical route to national electricity markets. The cables operate in highly challenging environmental conditions and as such are prone to exceptional wear and tear not experienced by other distribution assets.

We have a comprehensive inspection programme that utilises dive and Remotely Operate Vehicle visual survey information to assess our asset condition. The information gathered combined with the known consequence of failure of the assets allows us to determine which cables need replacement and/or remedial repair. In RIIO-ED1 we have delivered a programme of proactive cable replacement focused on highest risk cables.

Unfortunately, unforeseen faults do occur from time-to-time due to a range of factors outside of our control. Even with a proactive asset management strategy and regular inspections faults are often unavoidable. When faults occur, we often make use of Distributed Embedded Generation, back feeds (*where available from other circuits*), and local and mobile generation to ensure we retain safe and secure supplies to consumers. The costs of managing subsea cable faults are significant due to weather restrictions, cable procurement costs (*a specialist asset with limited availability*) and limited availability of specialist vessels to support with cable laying. Unique to our northern licence area, these assets are in open water and exposed to a wide range of extreme tidal and seabed conditions. Very few are located in the relative calm of rivers, estuaries or lakes / lochs.

The funding of all works on subsea cables is approved by Ofgem through our price control submission or uncertainty mechanisms; and all work is consented through Marine Scotland to grant a specific Marine Licence to undertake works - whether that's installation, maintenance, repair or decommissioning. Having two regulatory bodies in this area of network activity requires careful planning to ensure we satisfy a much wider body of stakeholders while keeping within delivery timelines and cost limitations.

Our ongoing investment in subsea cables is part of a holistic Whole Systems approach which considers the need of consumers and generation customers on the islands. We work closely with our transmission company and local generators to ensure the most economic and efficient outcomes are reached today, with due consideration for future energy scenarios.

2.2 DISTRIBUTED EMBEDDED GENERATION

Our diesel-powered Distributed Embedded Generation (DEG) units were established in the 1950's before the use of subsea cables as the main source of electricity to some island communities. Over time DEG units have evolved to be used as an essential alternative supply to subsea cables when on outage and following faults, especially to island communities. DEG units ensure Engineering Recommendation P2 licence obligations on security of supply for these islands are complied with. The current fleet of DEG units for SHEPD are detailed in table 2.1, which also details information on the age of the asset.

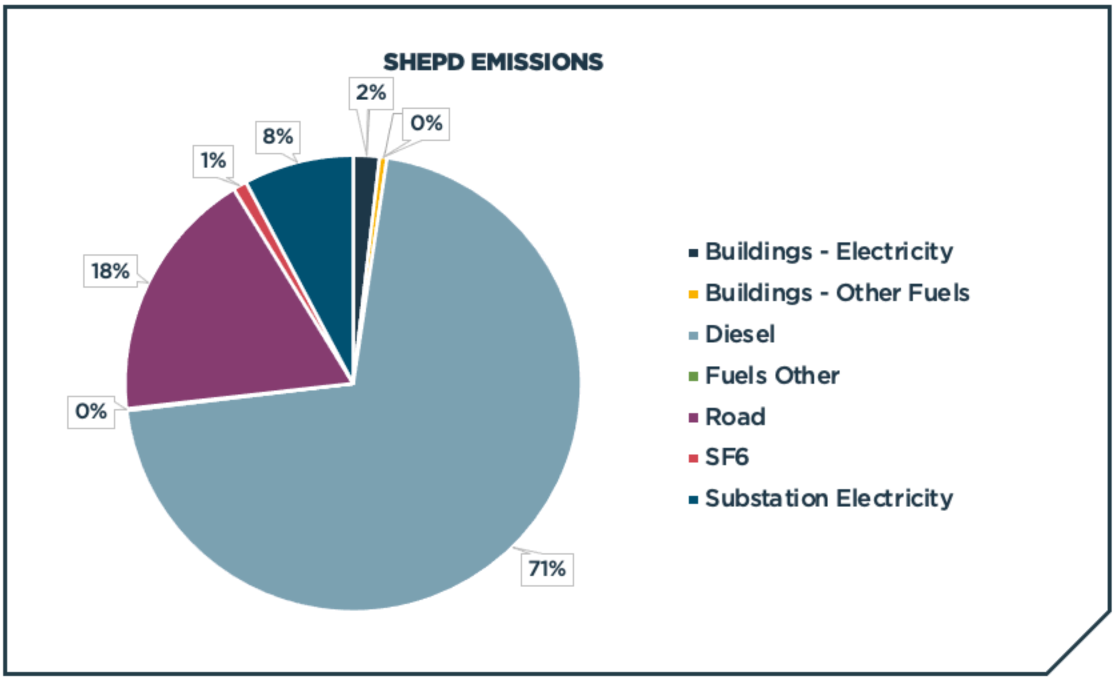
Table 2.1: Current fleet of Distributed Embedded Generation (DEG) power stations operated by SHEPD

Station	No of Engines	Oldest Asset Year of Installation	Export capacity
Battery Point, Stornoway	7	1954	22.8MW
Arnish, Stornoway	7	2006	11.2MW
Loch Carnan, South Uist	5	1972	11.8MW
Barra Power Station, Barra	3	1997	2.9MW
Tiree Power Station, Tiree	4	1973	2.7MW
Bowmore, Islay	4	1977	6.0MW
Kirkwall, Orkney	3	1975	16.3MW

During normal operation the DEG units provide standby cover for planned and unplanned events. Planned events typically last up to two weeks and are usually known well in advance with the DEG maintaining supplies to customers whilst project or maintenance work is undertaken. During unplanned subsea cable faults, the running duration can extend to over six months, depending on the nature of the solution required to manage the fault and the time of year. Rough winter seas, water depth, fault location, and poor weather can prolong the time taken to replace subsea cables.

DEG units are licenced for SHEPD’s operation under special licence conditions recognising the uniqueness of their role. Furthermore, six of the seven DEG units are regulated in accordance with the Medium Combustion Plant Directive for environmental emission control. At Battery Point, due to its size and age, the site is regulated more stringently through a Pollution Prevention Control licence. Strict environmental reporting on annual basis of identified conditions relating to engine emissions, interceptors, and cooling towers is required. Emission outputs are also captured in the European Union Energy Trading Scheme for qualifying units. We work closely with SEPA and other government agencies as they regulate these activities always seeking to keep the correct balance between the environmental and economic impact of our actions.

Figure 2.1: SHEPD Diesel generation emissions (excluding losses)



The graphic above shows that the emissions from our DEG are the largest controllable component of our carbon footprint (excluding losses). As such, developing long term solutions to eliminate reliance on diesel based DEG is crucial to remaining on the pathway to net zero through RIIO-ED2 (2028), RIIO-ED3 (2033) and to 2045. The role of our HOWS mechanism is essential here to leverage the potential from other system investment to facilitate this transition at best value for consumers. Further details on delivering our net zero pathway are set out in our ***Environmental Action Plan Annex 13.1***.

While the network configuration remains as is, investment is required in RIIO-ED2 to extend operational lives of existing DEG assets, replace aging assets, and procure fuel to ensure that we can continue to manage back up island supplies in the most cost efficient and sustainable way whilst ensuring continuity of security of supply. Our ambition is to move away from dependency on diesel as a back-up solution during RIIO-ED2 and eliminate current emissions by exploring long term, lasting and innovative solutions.

2.3 SHETLAND

As part of our licence we manage the supply of electricity to the population of Shetland. Shetland is not currently connected to mainland electricity network and must therefore locally generate its electricity supply. Its primary generation source is Lerwick Power Station, with additional capacity available through a Power Purchase Agreement with Sullom Voe Terminal. The costs of maintaining these supply sources fluctuates year-on-year, linked to third-party commercial drivers and market values for fuel prices outside our direct control. There is also a contribution to supply from island renewables, enabled by an Active Network Management scheme to ensure adherence to standards on electrical frequency and voltage levels. Much of the current Shetland configuration was enhanced under the DPCR5 / RIIO-ED1 NINEs innovation project (see our ***Innovation Annex 14.1*** for further details).

To reduce the impact on customer bills in the SHEPD licence area, the Department for Business, Energy & Industrial Strategy consulted on and then expanded the current Hydro Benefit Replacement Scheme to include the incremental costs of maintaining supply to Shetland.

This ensures that customers in our network area are not unduly impacted by the high cost of maintaining the network in the North of Scotland, and in particular, Shetland.

To secure Shetland's future energy needs, in RIIO-ED1 we developed a whole system solution which proposed a financial contribution towards a transmission link to Shetland. The financial contribution of £236m[7] towards the 600MW HVDC transmission link is based on the value of services the link would provide to the local distribution network. The contribution value is materially lower than the next viable alternative solution to secure energy security on Shetland (c. £400m) and therefore represented a material saving to all GB consumers. This contribution has been discussed, evidenced, and approved by Ofgem[8] with the final contribution value to be determined based on the final link cost. This Whole System thinking has informed the creation of the HOWS mechanism. We have demonstrated the ability to identify, develop and deploy large scale whole system solutions and expect similar opportunity to be present in the Hebrides and Orkney zones during RIIO-ED2.

The new transmission link will provide our customers with an enduring supply solution, substantially reducing Shetland's reliance on remote fossil fuel generation and associated emissions. In addition to supplying the distribution system, the new transmission link will enable the connection and export of a significant amount of renewable generation to the GB energy market.

The link itself will be connected to Shetland's electricity distribution system through the development of a new grid supply point. The distribution connection to the transmission link is expected to become operational in 2025.

In addition to the transmission link, we require to secure a standby solution that maintains security of supply under outages of the transmission link, in a similar application to those used in other Scottish islands via DEGs. Ongoing investment will be required to maintain an economic and efficient back-up and the ongoing maintenance of Shetland's distribution network.

[7] Final contribution will be based on the SSEN Transmission link investment and is yet to be determined.
[8] Decision on Scottish Hydro Electric Power Distribution's proposals to contribute towards proposed electricity transmission links to Shetland, Western Isles and Orkney

3 WHAT WILL CONSUMERS GET FROM OUR PROPOSALS?

Our baseline totex proposals for RIIO-ED2 are developed to ensure that when we meet core customer needs, we are efficient and timeous. This section explains what investment is proposed and the scale and scope of the stakeholder benefits expected from its delivery. We also note where the investment proposed is the baseline, do minimum option, and expected to be subject to variation through the HOWS uncertainty mechanism in early RIIO-ED2.

3.1 SUBSEA CABLES

In RIIO-ED2 we propose to spend £185m on subsea cable through our baseline plan. Our approach is reflective of taking a balanced approach to risk and impact of failures with proactive replacement of the poorest condition and highest risk of failure cables. Where certainty of need is lower today, but unforeseen events occur, we will adopt a fix on fail approach supported by our proposed reactive replacement uncertainty mechanisms. This does not negate our need for continued inspection programme and remedial repairs to prevent against faults.

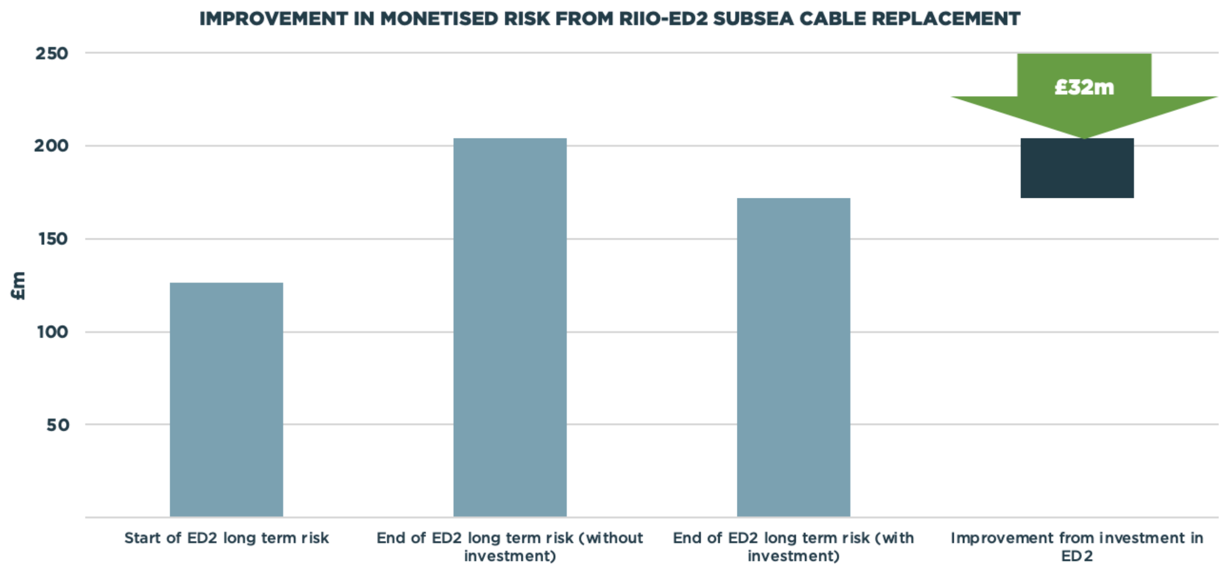
Our allowance proposals also cover the ongoing costs from RIIO-ED1 for routine inspections, cable repairs in the event of a fault (*where repairing is deemed more economic than replacing*), and strategic spares. The actions we will take are outlined in Section 4 of this Annex. We have reflected a continued innovation focus in RIIO-ED1 within our proposal by including more real time subsea cable condition monitoring in our plans, leveraging the benefits of the Network Innovation Allowance funding. This will help us to extend useable life of subsea cables using real time data and alerts to take proactive intervention before faults occur.

Our proposed investment programme in RIIO-ED2 is asset data led; refined and iterated by overlaying the industry standard risk management methodology with enhanced risk modelling and cable specific cost benefit analysis. We are proposing planned replacement of 15 cables where the certainty of need is highest driven by high probability and impact of failure in RIIO-ED2.

In addition to our asset replacement programme we are proposing a wider Strategic Planned upgrade programme for Pentland Firth West and Skye - South Uist to cover two longer length cables (>30km). Our work here will replace one of the cables linking mainland Britain to Orkney. We will also replace the existing cable between Skye and South Uist and in the process add an additional cable between Skye and North Uist. Our new HOWS uncertainty mechanism will create the framework through which we can explore whole system solutions in response to wider assessments of future demand, transmission network interactions, local community economic development as well as government auction and leasing rounds. We will explore how these, or modified, cable solutions can increase redundancy and provide load capacity to the islands; and provide more sustainable generation access.

Across our intervention proposals we have optimised the benefits of investment by prioritising reduction of consumer impact (*lower interruptions and minutes lost*) and are meeting the needs of local communities and stakeholders, including considering the impacts of constrained generation. In figure 3.1 we summarise these benefits showing how long-term Monetised Risk is reduced by £32m by the end of RIIO-ED2 through our subsea cable investments relative to a future without intervention.

Figure 3.1: Long-term Monetised Risk benefits of subsea cable replacement

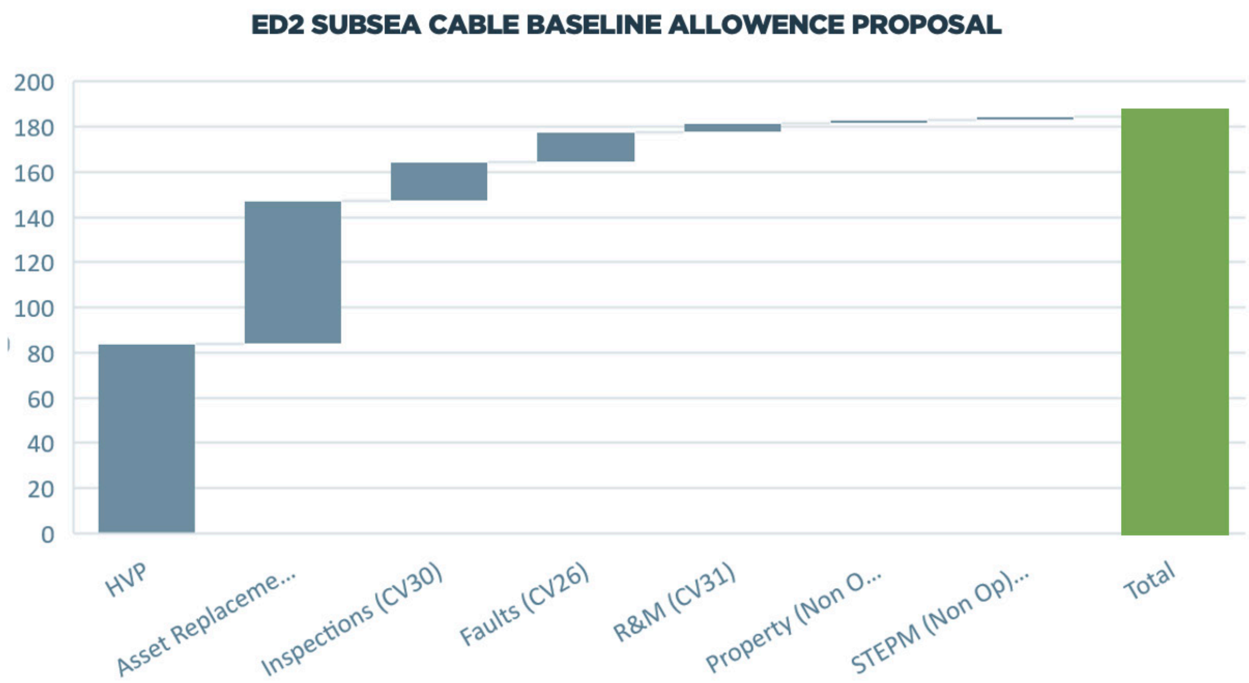


Further information on the cable specific drivers for investment and the outputs secured can be found in our Subsea cable EJP and accompanying CBAs.

3.1.1 BASELINE INVESTMENT IN RIIO-ED2

Our total allowance request of £185m for subsea cables in RIIO-ED2 includes expenditure divided across seven cost reporting categories in the Business Plan Data Tables (BPDTs). This spend is exclusive of our request for additional uncertainty mechanisms to manage unforeseen events, further detail set out in Section 5 of this Annex. Figure 3.2 summarises our breakdown of baseline expenditure across subsea cables.

Figure 3.2: Break down of proposed subsea cable expenditure in RIIO-ED2 for SHEPD



The largest expenditure category in our baseline allowance proposal relates to our proposed proactive replacement or augmentation of 18 subsea cables in the RIIO-ED2 period, including an additional cable from Skye to Uist. This investment is represented in our Business Plan Data Tables in the High Value Projects (HVP) and Asset Replacement (NARM Non-load) activities. Table 3.1 summarises the cables we intend to intervene on.

Within table 3.1, we have highlighted the refinement in projects from the draft business plan. Two replacement projects were removed (Yell-Feltar and River Oich) and two projects added (Jura-Islay and Coll-Tiree).

- River Oich – Fort Agustus: we have been able to identify a local solution which will negate the need for a high cost replacement
- Yell - Feltar: the latest condition data indicated the asset deterioration was not as advanced as initially thought.
- Jura - Islay: latest condition data indicates rapid deterioration due to marine conditions. Option proposed for HDD to avoid future marine driven deterioration (see EJP).
- Coll - Tiree: latest condition data indicates rapid deterioration due to marine conditions – shallow route with high currents. New, longer, route to avoid extreme marine impact (see EJP).

Table 3.1: Our proposed subsea cable replacements and augmentations in RIIO-ED2 for SHEPD

Cable	Voltage	Age (years) of existing cable	Length (km)	CBA outcome	Cost (£m)
Skye - Uist 1st Cable	EHV	31	35.50	Two cables - shorter route	[redacted]
Skye - Uist 2nd Cable	EHV	N/A	31.00	Two cables - shorter route	[redacted]
Pentland Firth West	EHV	23	35.80	Augment - similar sized cable	[redacted]
Eriskay - Barra 2nd cable	EHV	8	9.66	Augment - similar sized cable	[redacted]
Yell-Feltar	EHV	32	n/a	Adopt reactive replacement	n/a
Kintyre - Gigha	EHV	35	3.65	Replace - similar sized cable	[redacted]
South Uist - Eriskay	EHV	34	2.75	Replace - similar sized cable	[redacted]
Mull-Iona	EHV	33	1.95	Augment - similar sized cable	[redacted]
Laxay - Kershader 2nd cable	EHV	27	0.59	Replace - similar sized cable	[redacted]

Loch Long (Dornie)	EHV	41	0.36	Replace - Using land route	[redacted]
Mainland Orkney - Hoy South (3)	HV	23	4.91	Augment - similar sized cable	[redacted]
Mainland Orkney - Shapinsay	HV	28	2.90	Replace - larger cable	[redacted]
Hoy - Flotta	HV	44	2.27	Augment - similar sized cable	[redacted]
Loch A'Choire South	HV	35	4.00	Replace - similar sized cable	[redacted]
Loch A'Choire North	HV	35	4.00	Replace - similar sized cable	[redacted]
Mainland - Kerrera 2nd cable	HV	14	1.48	Replace - similar sized cable	[redacted]
Mainland - Kerrera	HV	28	1.00	Replace - similar sized cable	[redacted]
Jura – Islay	**EHV**	**10**	**1.98**	**Replace - HDD[9] route**	[redacted]
Coll – Tiree	**HV**	**8**	**8.20**	**Augment - similar sized cable**	[redacted]
River Oich - Fort Augustus	HV	33	n/a	Adopt reactive replacement	n/a
Total			**152.00 km**		**£147.4m**

In Section 4 of this annex we set our rationale for intervening on these cables. In order to support this and the continued upkeep of our other subsea cables our £185m allowance proposals includes £37m to cover combined costs associated with ongoing inspections, cable repairs in the event of a fault (*where repairing is deemed more economic than replacing*), and strategic spares storage. Table 3.2 summarises these costs.

Table 3.2: Summary of proposed ancillary costs related to subsea cables in our SHEPD RIIO-ED2 plan

CV table	Item	Cost (£m)
CV30	Inspections	17.0
C7	STEPM (SUBsense[10])	1.4
CV26	Faults (repair costs)	13.1
CV31	R&M (onshore remedial works)	4.3
C5	Property (cable storage)	1.4
Total		**37.1**

[9] Horizontal Directional Drill

[10] See section 4.1.8

3.2 DISTRIBUTED EMBEDDED GENERATION

In RIIO-ED2 we propose to spend a total of £42.5m on standby generation for island communities, across our seven DEGs sites. Without wider network reinforcement or smart system solutions it is essential we maintain these power plants to provide a vital service ensuring continuity of security of supply in the event of outages on subsea cables. We recognise that meeting our environmental targets, emissions reductions, relies on the solutions and investment emerging from the new HOWS mechanism and that our baseline investment is insufficient to achieve that. However, as a minimum, our baseline investments have been chosen to ensure that we will improve the efficiency and sustainability of operation by replacing the engines at Battery Point on the Isle of Lewis.

As part of our HOWS mechanism in early RIIO-ED2 our focus will be on identifying market-based solutions that can provide the necessary standby or network solutions which remove the need for such services. Many of the concurrent third-party investment has the potential to provide those solutions at, we believe, a lower marginal cost to customers.

That search for better ways to support our networks and not impact the environment continues ahead of RIIO-ED2. We have learned significantly from our experience in RIIO-ED1 when we utilised a Constrained Managed Zone (CMZ) contract during the Jura subsea cable fault (see our DSO Strategy annex 11.1 for further detail on CMZs). We contracted with Inver Hydro to help us meet 2MW of demand and enabling us to reduce the export requirements from the diesel plant at Bowmore. This proved to be a very cost-effective way of managing the network and reducing the carbon emissions. We will look to apply a similar strategy if third party technology readiness and procurement costs allow.

3.2.1 BASELINE INVESTMENT IN RIIO-ED2

Our total allowance proposal for DEG units is £42.5m, with the largest component £28.5m to cover the continued operation and maintenance of our seven DEG sites in RIIO-ED2, these are shown in table C8 of the BPDTs. We also propose a £7m mechanicals and civils work budget for these seven sites, these costs are shown in table CV15. Note that figures for remote generation in this annex are presented showing the impact of energy sales as appropriate.

We propose to spend [redacted] on replacing two engines at Battery Point with more efficient ones; these costs are shown in table CV15 of the BPDTs. In our Draft Business Plan we proposed introduction of a battery solution at Bowmore. Further study confirms that this will not avoid the capacity issues nor provide the necessary security of supply. We have removed that investment from the baseline, replaced it with [redacted] to procure reconditioned generation equipment which will provide additional capacity and avoid the cost of mobile generation during RIIO-ED2. The environmental opportunities will then be considered during the development windows of the HOWS submission (late RIIO-ED1 and early RIIO-ED2).

Figure 3.3: Breakdown of our proposed Distributed Embedded Generation allowances for SHEPD in RIIO-ED2

[redacted]

3.3 SHETLAND

In RIIO-ED2 we propose to invest £99.8m in the Shetland islands distribution network. This excludes the capital contribution toward the new transmission link which will be operational in 2025 and the pass-through fuel costs associated with running Lerwick Power Station.

The needs case and consumer benefits for the transmission link and the distribution contribution have already been made and accepted by Ofgem. The RIIO-ED1 Whole System solution delivers connection to the Great Britain energy market and in turn lower network bills than the next best alternative solution. Both Shetland and wider Great Britain will benefit from increased sustainability with a significant step-change reduction in emissions in moving to renewables. The link will offer potential for renewable exports from Shetland and renewable imports to and power from mainland GB to cover supplies when local generation is insufficient. It will facilitate a reduction in the running hours of Lerwick Power Station which will shift from 24/7 operation to standby and removal of our reliance on the fossil fuel-based generation from Sullom Voe Terminal.

From our RIIO-ED2 investments consumers will get a new fault ride through system and the continued maintenance of Lerwick Power Station to ensure its operational life until 2035, if required. Our ongoing maintenance of Lerwick Power Station will ensure reliability of supplies until the new transmission link is constructed. Post construction it will be available to provide back-up supplies for both short- and long-term outages, thereby continuing security of supply when Shetland must operate 'electrically islanded'.

The new fault ride through system will enable Shetland to retain an uninterrupted supply in the event of a transmission fault. It will provide energy and system inertia for up to an hour through energy storage and synchronous condenser giving sufficient time for Lerwick Power Station to warm-up to provide cover.

By continuing to run Lerwick Power Station as standby consumers will avoid the costly impacts of procuring and establishing a new solution that would replace a station which, with careful RIIO-ED1 investment, has over 10 years of operational life remaining in standby mode.

3.3.1 BASELINE INVESTMENT IN RIIO-ED2

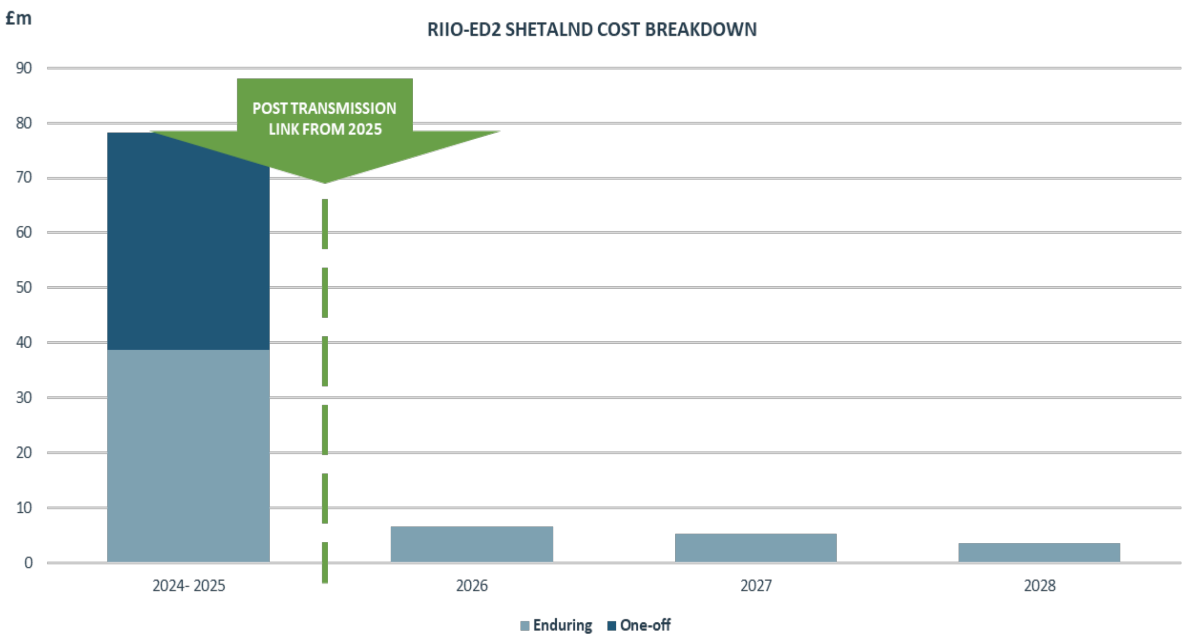
The total allowance proposal for Shetland is £99.8m, exclusive of pass through fuel costs and our contribution to the transmission link. This is composed of costs pre and post construction of the new transmission link and connection of the Shetland distribution and transmission networks. Pre-construction of the transmission link and distribution connection in 2025 we will spend £84.1m on capital and operating costs associated with Lerwick Power Station, the Power Purchase Agreement with a third party and running a local Active Network Management scheme which optimises the output from Shetland's renewable energy providers.

Included within the £84.1m are the one-off costs of establishing the standby solution for Shetland post construction of the transmission link. This green solution includes capital costs for a synchronous condenser to provide reactive power, inertia, and short circuit infeed. This will be supplemented by an energy storage system which will provide short term energy needs and manage the frequency for up to the first hour until the standby solution is started.

Post construction of the transmission link and connection of the transmission and distribution networks, our proposed allowance amounts to £15.7m for the last three years of RIIO-ED2. These costs cover the ongoing capital and operating costs of Lerwick Power Station, continued operation of the Active Network Management Scheme, and operation and maintenance costs associated with the standby solution. The enduring costs will decrease in the final years of RIIO-ED2 as Lerwick Power Station operation shifts from a 24/7 basis to 'as required' and there will be a lower need to procure standby from third parties and we have a projected low-level requirement for fault ride-through and blackout avoidance services from third parties.

Figure 3.4 summarises the breakdown of our baseline allowance proposal for Shetland, exclusive of fuel price pass through and contributions to the transmission link.

Figure 3.4: Breakdown of our baseline allowance proposal for Shetland in RIIO-ED2



The introduction of our connection to the GB system via the link, with the standby solution in place, will reduce the cost of maintaining supply security on Shetland from between £20-25m per year in RIIO-ED1 to around £15m going forward. This Whole System benefit will be shared across all GB customers through the Hydro Benefit Replacement Scheme.

3.4 DELIVERABILITY

Our ***Deliverability Strategy (Annex 16.1)*** describes our approach to evidencing the deliverability of our overall RIIO-ED2 plan as a package, and its individual components. Testing of our plan has prioritised assessment of efficiency and capacity, and this has ensured that we can demonstrate a credible plan to move from our RIIO-ED1 performance to our target RIIO-ED2 efficiency. We have also demonstrated that our in-house and contractor options can, or will through investment or managed change, provide the capacity and skills at the right time, in the right locations. This assessment has been part of the regular assessment of our engineering justification papers, and business plan data tables, which has continued through to our final plan submission. Our deliverability testing has identified major strategic opportunities which are relevant across our plan:

1. In RIIO-ED2 we will change the way capital expenditure is delivered, maximising synergies within the network to minimise disruptions for our customers. This is particularly relevant for a price control period where volumes of work are increasing across all work types.

2. The principle is to develop and deliver programmes of work, manage risk and complexity at programme level and to develop strategic relationships with our suppliers and partners to enable efficiency realisation.

3. The commercial strategy will explore the creation of work banks and identify key constraints. The load work will be the primary driver for a work bank, supplemented by non-load work at a given primary substation.

This approach will capitalise on synergies between the load and non-load work, whereby the associated downstream work from a primary substation will maximise outage utilisation, enabling the programme to touch the network in a controlled manner with the objective of touching the network-once.

4. Transparency with the supplier in terms of constraints, challenges, outage planning and engineering standards will capitalise on efficiencies, supported by a robust contracting strategy.

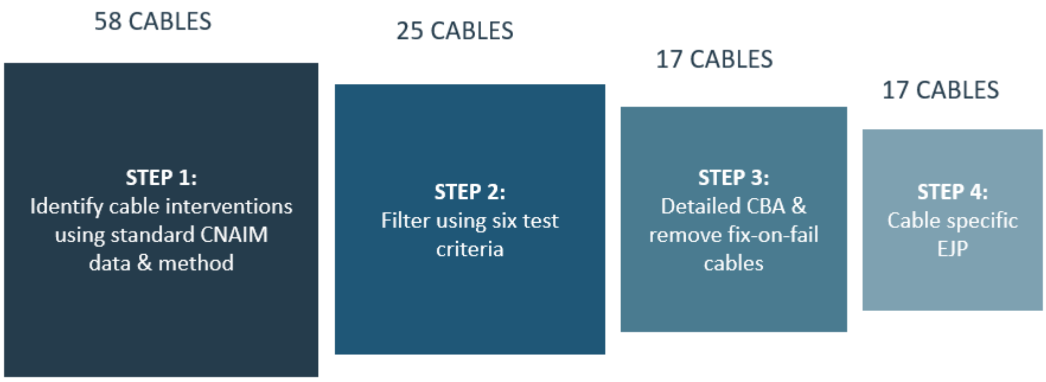
These are in addition to leveraging the opportunities afforded by pursuing the whole system opportunities in the Hebrides and Orkney.

4 WHY DID WE CHOOSE THESE INVESTMENTS OVER ALTERNATIVES?

4.1 SUBSEA CABLES

4.1.1 PRINCIPLES AND APPROACH

Figure 4.1: Process for determining subsea cable interventions for our SHEPD RIIO-ED2 plan



Subsea cables at distribution are largely unique to SHEPD (*although we do operate 18 in our Southern England licence area, SEPD*). The approach to identifying assets where intervention, such as cable replacement or augmentation, needs to be set against the unique role subsea cables play. We have adopted a four-step funnel approach to determining the interventions required on the network. This approach allows us to filter from an initial examination of the complete list of subsea cables we operate to a credible and deliverable list of interventions which are supported by robust analysis. This approach is detailed in figure 4.1. Each of the 4 Steps of the process are explained in the following sections. For Step 4 the reader should refer to our Engineering Justification Papers for a comprehensive justification of the specific interventions selected for each cable.

4.1.2 STEP 1: IDENTIFYING CANDIDATE CABLES FOR INTERVENTION

The first Step involved considering all our 110 subsea cables in SHEPD and from this we identify those which would be candidates for intervention in RIIO-ED2. This was done using the standard Common Network Asset Indices Methodology (CNAIM); using the latest asset condition data sets held for subsea cables from inspections and surveys to inform the long-term risk calculation for each cable expressed as the Monetised Risk. This Monetised Risk value accounts for the Probability of Failure multiplied by the financial impact associated with the Consequence of Failure, as shown below:

Monetised Risk per asset = Consequence of Failure * Probability of Failure

Standard variables and assumptions were included within this calculation consistent with the outputs of the Condition Based Risk Management (CBRM) system utilising the CNAIM v2.1 model, see *TG-NET-ENG-024* explaining our approach on Network Asset Risk Metrics (NARMs) for further details.

The Monetised Risk is then compared to the cost of a generic intervention, in this case an asset replacement and a Net Present Value (NPV) is constructed for each cable.

58 cables with a positive NPV (*Monetised Risk reduction is greater than the investment to achieve this reduction*) were flagged for further consideration from this process. This small increase from our draft Plan reflects the impact of the latest asset condition information.

4.1.3 STEP 2: DETERMINING THE INVESTMENT STRATEGY WITH SIX TESTS

Using the candidate cables for intervention we have applied six logical selection tests to determine the high-level intervention strategy for the cable. This strategy gives us a clear indication of the type of work required during the RIIO-ED2 period and allows us to tailor a set of intervention options which are assessed through specific Cost Benefit Analysis in Step 4, as discussed in Section 4.1.5 below. It also allows us to identify if any cables should be considered as fix-on-fail, thereby further filtering our list of 58 cables.

We do this filtering with six tests for two reasons:

(1) The calculation of Monetised Risk a defined in CNAIM needs to be **supplemented with additional factors important to determining the overall cost impact from not intervening**. This includes the cost of constrained generation and the associated cost (*including carbon*) of bringing on standby and mobile generation units. Consideration of future loading also needs to be supplemented in. Without these factors the impact of a faulty cable is not fully accounted for and there is a danger we prioritise the lower impact over higher impact cables at the expense of high costs to local communities. The six tests account for these local factors in each cable and allow for a weighted prioritisation to be determined.

(2) We apply the six tests so a deliverable set of interventions can be identified for the RIIO-ED2 period. Throughout our RIIO-ED2 subsea cable strategy we are seeking to balance the proactive intervention and reactive fix on fail by assessing the certainty of local need. In several cases whilst CNAIM may identify a positive NPV this doesn't equate to a strong certainty in need to act proactively to manage the cable. For shorter length cables or those with fewer customers supporting a fix-on-fail strategy is often sensible given the costs of standby generation are not prohibitively impactful if required.

There are six possible intervention strategies we could adopt on the candidate cables as set out in table 4.1. One of these strategies is determined for each of our 58 cables identified as NPV positive from CNAIM by applying the six tests.

Table 4.1: Possible subsea cable intervention strategies in RIIO-ED2 plan for SHEPD

Score	Investment strategy
0	Do nothing/Fix on failure
1	Planned replacement
2	Planned upgrade
3	Strategic addition
4	Strategic replacement or addition
5	Strategic upgrade

To determine which investment strategy to pursue for a candidate cable six tests are applied to the cable, each test awarding the cable a score corresponding to one of the numbers in table 4.1. A combined score is then formulated, and an investment strategy determined, further details below.

The six tests, the qualifying threshold and resultant investment strategy if the threshold criteria are met are outlined in table 4.2. In all cases for table 4.2, the default if the qualifying threshold is not reached is 'do nothing/ fix-on-fail'.

Table 4.2: Six tests applied to subsea cable population in SHEPD to help identify intervention strategies

#	Test	Qualifying threshold	Investment strategy if qualifying threshold met
1	Total impact cost [11] + Constrained generation cost / Intervention cost [12]	20%	Strategic replacement or addition
2	Total impact cost	£2m	Strategic replacement or addition
3	Carbon cost	£100k	Strategic replacement or addition
4	Service life	55 years	Planned replacement
5	Start of RIIO-ED2: Max cable load/ Cable rating	90%	Planned upgrade
6	End of RIIO-ED2: Max cable load [13] / Cable rating	90%	Planned upgrade

The qualifying threshold for test one is set at 20%. Based on engineering judgement and iterative testing we picked this value so that the balance of cables qualifying through this test for intervention is sensible and pragmatic. If the value is set too high, we risk not further assessing significant population of our cables. If too low, we risk significant time spent assessing healthy cables. The value though is one driving factor.

For test two the £2m qualifying threshold is equivalent to cost per fault including repair/replacement. For RIIO-ED2 if a cable, through our analysis, has an impact cost less than the average impact cost in RIIO-ED1 we will fix on fail unless there are other driving factors from the other test condition.

For test three the value is based on historically observed carbon costs incurred because of cable failure. The purpose of this test is to ensure cables with a low customer impact from failure, but a high carbon impact due to the nature of the standby solution are not ruled out from further analysis.

[11] Total impact cost is defined as CI/CML cost + cost of interim power supply (including carbon costs if applicable)

[12] Intervention costs are defined as the cost of a generic cable replacement

[13] End of RIIO-ED2 max cable loading are defined by the Consumer Transformation scenario from DFES 2020 which is used as our planning scenario across our RIIO-ED2 plan (see Chapter 9)

In test four the qualifying threshold based on the CNAIM expected life of the cable as 60 years, however we modified this to 55 years to highlight cable that have reached the end of their expected life during RIIO-ED2 and indicate planned replacement if they do not fall under any other criteria.

In tests five and six we set the qualifying threshold at 90% which corresponds to the point at which cable electrical deterioration begins to occur. We have observed from historical faults that cables subject to maximum loadings greater than 90% will typically deteriorate faster increasing the probability of failure.

Upon applying the six tests and awarding a score for each test a combined score is formulated for the candidate cable corresponding to a value in table 4.1. If the maximum score for tests one to four is ‘do nothing/ fix- on- fail’ then the investment strategy is dependent on whether tests five or six indicate a planned upgrade, based on the cable loading relative to the cable rating. If the maximum score of tests one to four is anything other than ‘do nothing / fix- on- fail’ then then maximum score corresponding to the value in table 4.1 is added with the maximum score for tests five and six (*also corresponding to a value in table 4.1)* to determine a combined maximum score, which is then divided by two to determine an overall score. This overall score is compared to the corresponding investment strategy in table 4.1 to determine the investment approach for the cable.

Applying the six tests the total of 58 cables arising from Step 1 was reduced to 25 cables. The 33 cables discounted are where the intervention strategy was deemed as ‘do nothing/ fix- on- fail’. This process did not in itself justify cable replacement investment, with the final decision being driven by cost benefit analysis and engineering justification.

4.1.4 STEP 3: DETAILED COST BENEFIT ANALYSIS

For each of the 25 cables a detailed Cost Benefit Analysis (CBA) was undertaken considering a range of options for intervention guided by the intervention strategy in Step 2 above. This process utilised the standard CBA modelling and assumptions set out by Ofgem for RIIO-ED2. A range of options were considered and factors such as local demand growth from the Consumer Transformation scenario were included in our assessments. Models of the CBAs we have undertaken have been provided to Ofgem as part of our Business Plan submission.

From this process a total of 17 cables progressed for a detailed Engineering Justification. 8 projects whilst identified as candidates for intervention in Step 2 were subsequently assigned ‘do nothing/ fix-on-fail’ strategies as the detailed CBAs failed to substantiate the need to intervene proactively.

4.1.5 STEP 4: PROJECT SPECIFIC CABLE ENGINEERING JUSTIFICATION

Accompanying this Annex are a series of Engineering Justification Papers (EJPs) which together with our CBAs form an Investment Decision Pack (IDP) for each of the proposed 17 subsea cable interventions in RIIO-ED2. Each of these documents follows a standard approach to clearly justify why the circuit design approach being proposed and associated costs are the most economic and efficient and what work would be required to deliver on these investments. The reader is urged to review these documents for a full explanation of the approach adopted for each cable.

4.1.6 COSTING OUR OPTIONS

Following publication of our draft Business Plan we have sought to make our costing and forecast process more transparent for stakeholders and in order that Ofgem can place a high level of confidence in the information and in its resulting cost assessment process. Our Final Business Plan includes details (Annex 15.3) on the source of the cost book information used to forecast totex for HV and EHV subsea cable replacements. We have summarised this below.

We have based our RIIO-ED2 forecast costs on the average outturn costs experienced during RIIO-ED1; this forms our cost book. By using actual project expenditure which has formed the basis for annual reporting we provide the transparency and trend information which Ofgem requires to develop Cost Assessment techniques. These projects represent a range of delivered lengths, in different marine environments and with a mixture of additional protection needs or none. This approach ensures that we have a representative basis for forecast costing.

Table 4.3: Project information used to form cost book and basis of RIIO-ED2 forecasting

	Project	HV / EHV	Length	£ (2021 prices)
	Rousay-Westray	33kV	10.5	[redacted]
	Mossbank-Yell, Yell-Unst 1&2	33kV	9.2	[redacted]
	Mainland-Jura	33kV	9.0	[redacted]
	Bute-Cumbrae	11kV	4.6	[redacted]
	Pentland Firth East	33kV	36.0	[redacted]
	Sanday Eday	33kV	4.3	[redacted]
	Eday - Westray	33kV	8.6	[redacted]
	Aultbea - Ullapool	33kV	2.0	[redacted]

Recognising that there is an inherent economy of scale present when delivering longer length projects, we have subdivided our cost base into three length categories: 0-3km, 3-20km and above 20km. We have then recognised the consistency and fixed nature of project set up costs and, using the historic cost breakdown, identified a fixed cost of [redacted] per replacement project regardless of the overall length. The result of this cost book exercise are the following base rates on which we have costed our RIIO-ED2 baseline activity.

Table 4.4: Forecast RIIO-ED2 subsea cable activity costs

	Component	Classification	£ (2021 prices)
	Fixed costs (all projects)	All	[redacted]
	Band 1 length projects	0-3km	[redacted]
	Band 2 length projects	3-20km	[redacted]
	Band 3 length projects	20km+	[redacted]

These costings have been used to form the individual project costs considered in the 4-stage assessment outlined above and then captured within each Engineering Justification Paper.

4.1.7 ENHANCING OUR WHOLE SYSTEMS APPROACH FROM DRAFT

In our Draft Business Plan we noted our ambition to examine the whole system potential represented by two of our three High Value Projects (Pentland Firth West cable between mainland Britain and Orkney and augmenting a second cable between Skye and North Uist).

Since our draft plan, after hearing stakeholder feedback and evaluating the wider potential represented by activity across the energy industry in these geographic locations, we have introduced a structured whole system proposal. The Hebrides and Orkney Whole System (HOWS) uncertainty mechanism is described further in section 6 of this annex and in our ***Uncertainty Mechanism Annex 17.1***.

This proposal will consider how we can improve the return for the two HVP schemes proposed. It will also capture our existing commitment to address the needs of the communities on Skye-Harris. It is important to note that we have not included baseline costs for Skye – Harris in our ED2 plan as, unlike Skye-Uist and Pentland Firth West, there is no remaining condition issue to address having replaced the aged cable during RIIO-ED1 following the fault. This now represents an opportunity to consider the wider needs of stakeholders and the drivers, such as load growth and resilience, under the HOWS mechanism.

4.1.8 ANCILLARY SUBSEA CABLE COSTS

In Sections 4.1.1-4.1.7, we have outlined our rationale and stakeholder support for investing in proactive replacement of subsea cables in RIIO-ED2 equating to £147m of investment. To support this and our overall continued maintenance of subsea cable spend we require £37m of ancillary cable allowances. These cover allowances for ongoing inspections; remedial work including post fault repairs; and storage of spare cable. Table 4.5 summarises these costs.

Table 4.5: Summary of proposed ancillary costs related to subsea cables in SHEPD RIIO-ED2 plan

CV table	Item	Cost (£m)
CV30	Inspections	17.0
C7	SUBsense[14]	1.4
CV26	Fault repair costs	13.1
CV31	Onshore remedial works	4.3
C5	Storage	1.4
Total		**37.1**

4.1.8.1 Inspections

For our inspections programme we are proposing an allowance of £17.0m, which is consistent with the RIIO-ED1 run rate.

This routine activity involves the physical visual inspection of the subsea cable and the shore end, which in turn informs our asset data sets and populates models such as CNAIM allowing future maintenance and remedial works to be planned, as well as longer term strategies to be developed for RIIO-ED3 and when undertaking Whole System development.

From this total allowance:

- £16.77m covers the cost of subsea inspection by means of diving and remotely operated vehicles. This is based on inspecting the full subsea length of all cables 110 currently operational cables (450km) at least once every four years, so 1.25 times in five years at a cost [redacted].
- £0.22m is allocated to shore end physical inspection by a qualified engineer at both ends of all 110 operational cables, at least twice per annum in the five years of RIIO-ED2 at a cost of [redacted].

In addition to our inspection programme we are proposing to spend £1.4m on installing SUBsense cable condition monitoring on [redacted] of our existing subsea cables during RIIO-ED2.

SUBsense is the project name for Distributed Acoustic Sensing (DAS) which is a technology that can be installed on submarine cables with an embedded fibre optic bundle. SUBsense is an internationally tested real time monitoring system that we have trialled as a Network Innovation Allowance (NIA) project in RIIO-ED1 (see our ***Innovation Annex 14.1***). SUBsense was identified as being a solution to assist with fault finding and extending the useable life of subsea cables.

[14] See section 4.1.8

The technology gives us information and alerts if we have excessive cable movement on the seabed which can lead to premature wear or environmental damage. SUBsense will also give us alerts should any third-party intervention such as anchor snags occur. The system will also provide us with an accurate fault location should a submarine cable fault occur.

To operate SUBsense an embedded fibre optic cable is required. It uses a single core from the fibre bundle which are typically present on all recently installed submarine cables. As a default we will install SUBsense technology on all proactive cable replacement and augmentation works in RIIO-ED2. Our allowance request covers the cost of additionally installing SUBsense on 10 existing cables previously installed within RIIO-ED2 which include a fibre bundle, so that we can increase the presence of real time monitoring across our cable portfolio.

The total allowance asks for additional SUBsense is £1.4m which breaks down to £[redacted] per unit. This further breaks down to £[redacted] for core monitoring equipment costs; £[redacted] for installation of specialist wireless telephony equipment for each cable; and £[redacted] for installation. We are asking for [redacted] units which is reflective of our assessment of existing cables suitable for installation[15]. By default, all new cables installed through our asset replacement and augmentation proposals will have SUBsense.

Consumers benefit if we can extend useable life of submarine cables using the data and alerts provided by SUBsense. Currently, most of our subsea cables condition is not monitored in real time and is assessed by routine inspection by divers and Remotely Operated Vehicles'.

These inspections assess the external condition of the cable, of which only the top surface is visible, and can only routinely notify events such as third-party intervention. Existing fault detection techniques can only be used post fault and have an accuracy of approx. 150m on a 15km cable.

SUBsense will allow a proactive approach to subsea cable maintenance. For example, if a cable movement alert is issued preventative measures can be taken such as additional rock dumping to secure the cable prior to it failing. SUBsense can allow us to plan for a potential short-term failure should an anchor snag occur; and arrange for an enhanced inspection of the cable for damage in that location.

4.1.8.2 Remedial works

In our proposals we have set out an allowance ask of £13.1m to take remedial maintenance action post fault on subsea cables. We also set out an ask for £4.3m to undertake repairs and maintenance at the shore end for our cables.

For subsea cable remedial works our allowance ask of £13.1m is calculated on a consistent basis with the RIIO-ED1 run rate for faults requiring repair. In RIIO-ED1 we have spent £27.3m to date (*excluding Skye-Harris*) on repairing or replacing subsea cable due to faults. This is equivalent to a 3.2 average fault rate per annum, with 1.8 of these faults requiring a complete cable replacement and 1.4 requiring cable repair. Applying a pro-rata for RIIO-ED2 would ordinarily set our allowance ask at £29.9m, however as outlined in Section 5 we are proposing an uncertainty mechanism to cover the cost of replacement activities, where necessary, so we have adjusted our allowance ask for RIIO-ED2 to cover repair work only[16].

[15] [redacted]

[16] Calculated as [redacted]

For remedial works at the shore end our allowance ask of £4.3m covers conducting ongoing repairs and maintenance of damaged and exposed shore ends through activities like adding and replacing split piping, putting up new Atons (*navigational signalling required for installations at the coast*) and reburying cable. These require routine remedial works given coastal exposure of many sites increasing general wear and tear. Consistent with our RIIO-ED1 run rate we are asking for allowance to cover remedial works at [redacted] sites per year ([redacted] *HV and* [redacted] *EHV*) for the five years of RIIO-ED2 at a cost of £[redacted] per site[17].

In addition, we have an allowance for preservation and maintenance of our strategic stock of spare subsea cables and associated ancillaries located in various storage sites. We have also made an allowance for our annual licence requirements which are mandatory as part of our marine and environmental project execution activities. These cost as consistent with our RIIO-ED1 expenditure and equate to £2.1m.

4.1.8.3 Property costs

We retain contracts with third parties for the storage of a limited volume of spare cable in case required. This does not cover all cable types and does not mean we do not need to go to the market from time to time to procure new cable post-fault if this is part of the technical solution required to meet individual circumstances. We are proposing an allowance of £1.4m to cover the ongoing cost of these contracts.

This includes £[redacted] for cable storage and the fabrication of new cable baskets; and £[redacted] for the cost of insurance payable through the contractor[18].

4.2 DISTRIBUTED EMBEDDED GENERATION

4.2.1 REPLACING THE ENGINES AT BATTERY POINT ON LEWIS

As part of our proposals to spend £42.5m on DEGs in RIIO-ED2 we will spend £[redacted] replacing four of the ten engines at Battery Point on Lewis in the Western Isles. We have prepared a detailed Engineering Justification Paper with Cost Benefit Analysis setting out our rationale for replacing the oldest engines, c. 2MW in size and installed between 1954 and 1957.

Our needs case to replace these engines is rooted in our obligation to maintain network security while the Western Isles remain connected by radial links or do not have access to alternative reliable low carbon energy sources. While this is our primary driver, we have also designed our baseline response to secure reductions in emissions across our operations and move towards delivering our net zero targets. Whilst Battery Point is a back-up supply in the Western Isles it has been used extensively in the past year following a fault on the subsea cable between Skye and Harris, which has required replacement. The CO_2 output in 2020 was 16,929 tonnes compared to just 3,400 tonnes in 2019. The site is also aging with the oldest generating units dating back to the 1950s.

Due to the relatively infrequent use of the site and good maintenance we have been able to maintain the units for much longer than other comparable units, however they are coming to the end of their working lives and spare parts are increasingly challenging to source and significantly increasing the cost of maintenance schedules.

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[17] Calculated as [redacted]

[18] Our ask of £[redacted] includes storage for [redacted].

Further, MAN Energy Solutions, the successor owner to Mirrlees who manufactured the Mirrlees KVSS engines which are installed at Battery Point, have informed us of their discontinuation of support for these engines.

In the related EJP, we have set out the options considered to replace the engines and shown the results from our supporting CBA. This includes a full set of assumptions and modelling approaches used. We plan to replace the oldest units with two newer more efficient diesel generating units costing £[redacted] each. We will adopt a similar delivery approach to our successful replacement of engines at Lerwick in Shetland in RIIO-ED1. These were installed using our staff with local labour under term contracts to do the work associated with the civil, mechanical, and electrical installation.

This investment will be included within our new whole system mechanism (HOWS). While we have identified the minimum solution which ensures security of supply on the Western Isles our ambition is to achieve much more, and importantly, identify and invest in the long term solution to removing diesel based carbon emissions from standby generation during RIIO-ED2. We have end of RIIO-ED2 and RIIO-ED3 (35% and 55% respectively) carbon emission targets which compel us to think long term, strategically and innovatively to deliver. Creating the opportunity of combining this with the concurrent whole system opportunities in the Outer Hebrides has driven our creation of the HOWS mechanism.

4.2.2 ADDING NEW CAPACITY AT BOWMORE ON ISLAY

In our Draft Business Plan we set out proposals to invest £[redacted] to update the capacity of Bowmore power station on Islay through investment in battery solutions and in support of our Environmental Action Plan. Further review and challenge have identified that this proposed solution will not meet the core network needs and does not represent value for money for our customers.

Currently, the station capacity (6MW) does not meet the winter maximum demand (7.6MW) for the network on the islands of Islay, Colonsay and Jura. To meet demand, mobile generation sets are rented annually. However, these are costly, logistically time consuming, and increase short term interruptions to supply due to synchronisation issues. In RIIO-ED1 a market-based solution of procuring capacity from the Inver Hydro plant was utilised, to supplement the capacity at Bowmore during a fault on the subsea cable on one occasion. This option has been beneficial however its future availability is dependent on where the network fault occurs on Jura and the output cannot always be guaranteed from the plant owners.

While we have eliminated the solution proposed at draft Plan, we must still identify an enduring solution to be implemented that will reduce costs, minimise emissions and provide the security of supply.

Our Final Business Plan proposes to procure and install a reconditioned engine to the station at Bowmore, therefore providing the full capacity required to meet winter demand. This solution allows us to secure the cost savings from avoided mobile generation hire and keep open the opportunity to identify better long-term solutions to reduce emissions through the HOWS mechanism.

4.3 SHETLAND

In this Section we summarise the rationale for the selection of our RIIO-ED2 investment proposals for Shetland pre and post construction of the transmission link and connection of the transmission and distribution networks.

This Section predominantly focuses on our proposed investment for standby arrangements post-construction of the transmission link and draws extensively on the information provided to Ofgem in December 2020 setting out proposals for 'Standby Arrangements in Shetland' post transmission link completion, as part of the 'Shetland New Energy Solution'.

The costs for the proposed investments set out in the 'Standby Arrangements in Shetland' are included in our RIIO-ED2 business plan and this Annex summaries key points to substantiate our allowance ask but does not seek to replicate the 'Standby Arrangements in Shetland' document.

Further, the case for us making a contribution to the transmission link has already been approved in July 2020[19]. This Annex does not re-justify that decision.

4.3.1 INVESTMENT PRE-TRANSMISSION LINK CONSTRUCTION

In addition to allowances for the link contribution and standby arrangements, allowances are also required to support the extended supply arrangements for the first years of RIIO-ED2 until the transmission link is made available, the transmission and distribution networks are connected, and the standby arrangements are in place. This will be achieved by: (1) operating and maintaining Lerwick Power Station at full capacity; (2) procuring additional capacity and standby from a third party; and (3) running our Automatic Network Management (ANM) Scheme with local renewable energy providers. Our costs for these are detailed in the BPDT. These costs represent a "rolling on" of the same level of costs for these services as RIIO-ED1, and consistent with those assessed by Ofgem in 2017-18 as part of the decision to extend the interim arrangements to 2025.[20]

Post construction of the transmission link we still propose to spend on two of these items: operating and maintaining Lerwick Power Station; and running our ANM Scheme with local renewable energy providers. However, our required allowance run rate to undertake these activities will decrease significantly due to the supply contribution from the transmission link.

4.3.2 SUMMARY OF INVESTMENT OPTIONS FOR FUTURE STANDBY

Investment options are required for standby arrangements in Shetland post construction of the transmission link. These ensure we can meet licence condition CRC2Q. As noted, our proposals for these have already been submitted to Ofgem in December 2020 as part of the 'Standby Arrangements in Shetland'. This set out a holistic approach to ensure we select investment options which are economic and efficient and represent best value for money for customers.

The investment options cover future blackout avoidance, fault ride through capability and enduring standby requirements when the transmission link is on outage. The options considered aim to achieve an optimal balance between maintenance, refurbishment, and replacement throughout RIIO-ED2 to minimise the cost of managing this asset category. As local flexibility markets develop, we will assess the option to utilise local flexibility providers as part of the standby arrangement and consider funding arrangements so

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[19] https://www.ofgem.gov.uk/publications-and-updates/update-decision-approve-shepds-propossed-methodology-contribute-shetland-transmission-project

[20] https://www.ofgem.gov.uk/publications-and-updates/decision-costs-extended-interim-energy-solution-shetland

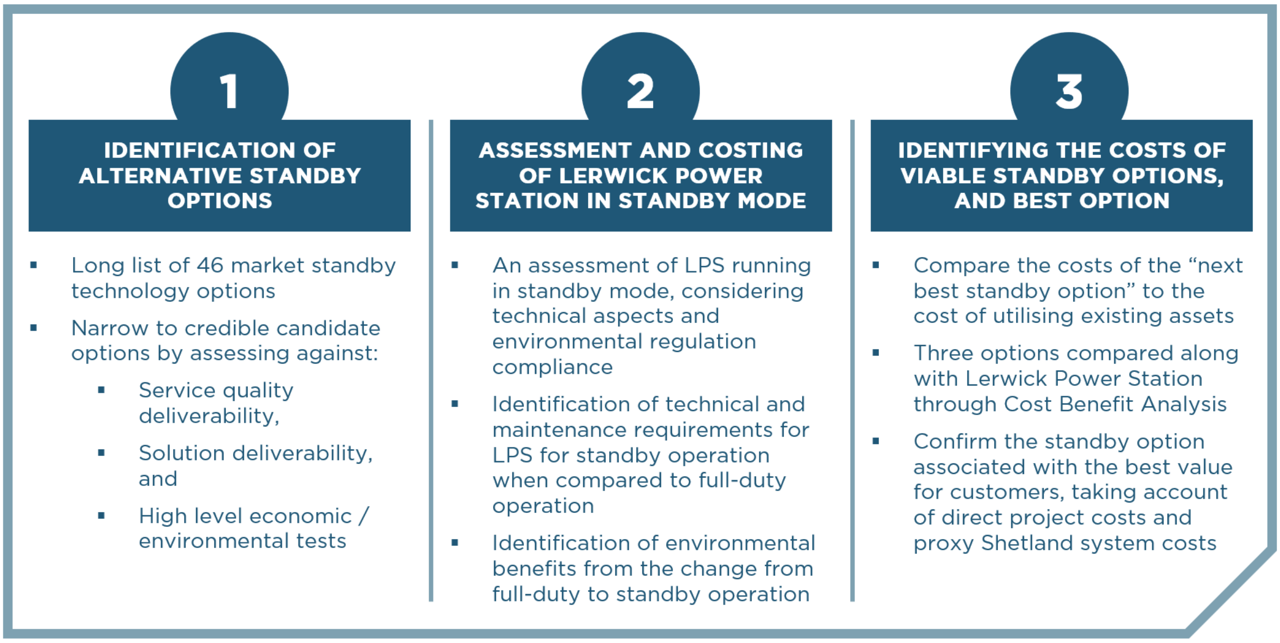
that consumers continue to experience the most economic, efficient and low carbon solutions (as detailed in our ***DSO Strategy Annex 11.1*** and our related Market Stimulation Consumer Value Proposition).

Our overarching aim is to maintain continuous supply to distribution customers without any blackout being experienced because of unplanned outages of the transmission link. Equipment is required to: i) enable the distribution system to 'ride through' a transmission fault, and ii) provide an instantaneous response of energy to meet demand that conventional generation technologies cannot, fulfilling this function while generation plant is started up ('blackout avoidance').

Fault ride-through functionality is expected to be deployed to manage any imbalances or interactions between the transmission and distribution systems immediately upon an outage occurring. The blackout avoidance equipment and services are also expected to enable us to maximise the use of distributed generation during outages, and assumptions have been made on the size and cost of this equipment for the purpose of the analysis. We intend to seek these solutions, services, and equipment from the market - these aspects are discussed in more detail in the following Sections.

Our approach to identify investment options followed a three-step approach as outlined in figure 4.2.

Figure 4.2: Our approach to identify enduring standby generation in Shetland



In Step 1 outlined above in figure 4.2 the technologies that qualified for final economic analysis were gas turbines, and reciprocating engines. While gas turbines meet all of the requirements, we typically observe that this cost more than reciprocating engines; and for low load factor applications, the low capital cost of high-speed units tends to be more economical against the slightly higher efficiency of the medium speed options.

In Step 2 we applied the same assessment criteria as applied to other standby options when assessing the continued viability of Lerwick Power Station. This confirmed the existing unit met high level economic and environmental requirements and so was suitable for inclusion in the detailed Cost Benefit Analysis.

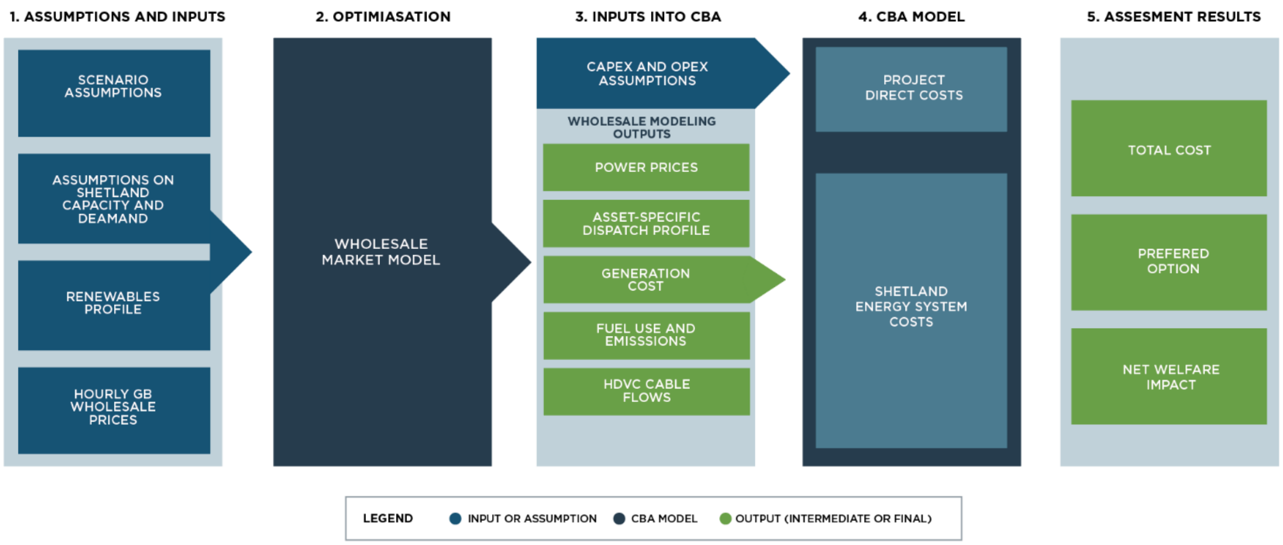
In Step 3 we compared the two qualifying alternative standby solutions to Lerwick Power Station. The details of these options are set out in table 4.6.

Table 4.6: Final alternative standby solutions for Shetland that we considered

Option	Primary back-up option	Ramp-up solution	Note
Lerwick power station ('LPS')	Adapting the Lerwick Power station for back-up operation until 2035	45-minute 61MW battery operating while the power station ramps up in a T-link outage	In 2035, an alternative solution would need to be commissioned (e.g. second link, hydrogen power station, or high-speed engine and a 10-minute battery2)
High-speed back-up ('HS')	Commissioning 70.2MW high-speed reciprocating engines for back-up operation from 2025	10-minute 61MW battery	Lerwick Power Station retires in 2026
Medium-speed back-up ('MS')	Commissioning 76.58MW medium-speed reciprocating engines for back-up operation from 2025	15-minute 61MW battery	Lerwick Power Station retires in 2026

Our selection approach to find the best option is based on a CBA with five key modelling stages, illustrated in figure 4.3. This enabled us to determine total solution costs for each standby option and to identify the preferred solution for Shetland in a similar way to tenders assessed in a competitive process.

Figure 4.3: CBA modelling approach for Shetland



4.3.2.1 Identifying the costs of viable standby options and the “next best” standby option

Working with consultancy partners we developed costs and other key assumptions for the modelling process. This included running a power market optimisation model, Plexos, which simulates the power market for Shetland, using updated (*from the Shetland New Energy Solution process*) and new modelling inputs. The model simulates how power is transported and dispatched to meet Shetland demand, taking account of forecast demand, link operation, outages, and standby operation.

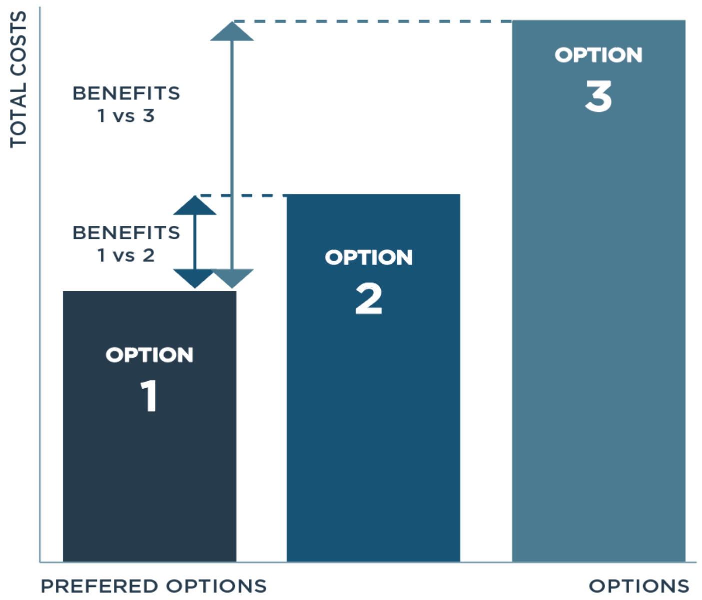
Subsequently we carried out a CBA taking the outputs from the Shetland power market model including the specific dispatch profile, fuel usage, carbon and other emissions profiles of each of the standby options and applied the CapEx and fixed and variable O&M assumptions for each standby option to assess the costs of each, including Lerwick Power Station. This analysis takes account of benefits to customers in terms of blackout avoidance and maximising use of distributed generation across all options.

4.3.2.2 Identifying the preferred standby option

Post identifying yearly costs profiles for the standby options, we aggregated them into Net Present Costs (NPC). This methodology ensures that differences in the costs and the timing of their accrual are evaluated on a consistent basis across all options and determines the total cost of each option to customers.

Based on the outcome of the NPC analysis, we confirmed the standby option associated with the best value for customers, taking account of direct project costs and proxy Shetland system costs. This step is illustrated in figure 4.4. We have also determined the benefit to customers by calculating the savings associated with selecting the best option over the more costly best alternative.

Figure 4.4: Illustration of the Net Present Cost methodology



We undertook sensitivity analysis around the central case to test the standby option costs under different assumptions and the extent to which the conclusions of the study hold under different potential future scenarios and wider energy market conditions. This is discussed in detail in our December 2020 submission.

We modelled 10- and 20-year cases: a 20-year evaluation period to match the estimated lifetime/ contract term for new build thermal back-up options from 2025 to 2044, and a 10-year period reflecting the expected lifespan of Lerwick Power Station until 2035. We pro-rated the CapEx to reflect the years of operation within the assessment timeframe, to ensure that options with different economic lives are compared on a like-for-like basis and options that have a longer economic life as well as a higher total cost are not unfairly disadvantaged; and annuitised at rates deemed to be appropriate for the different asset types given their ownership arrangements.

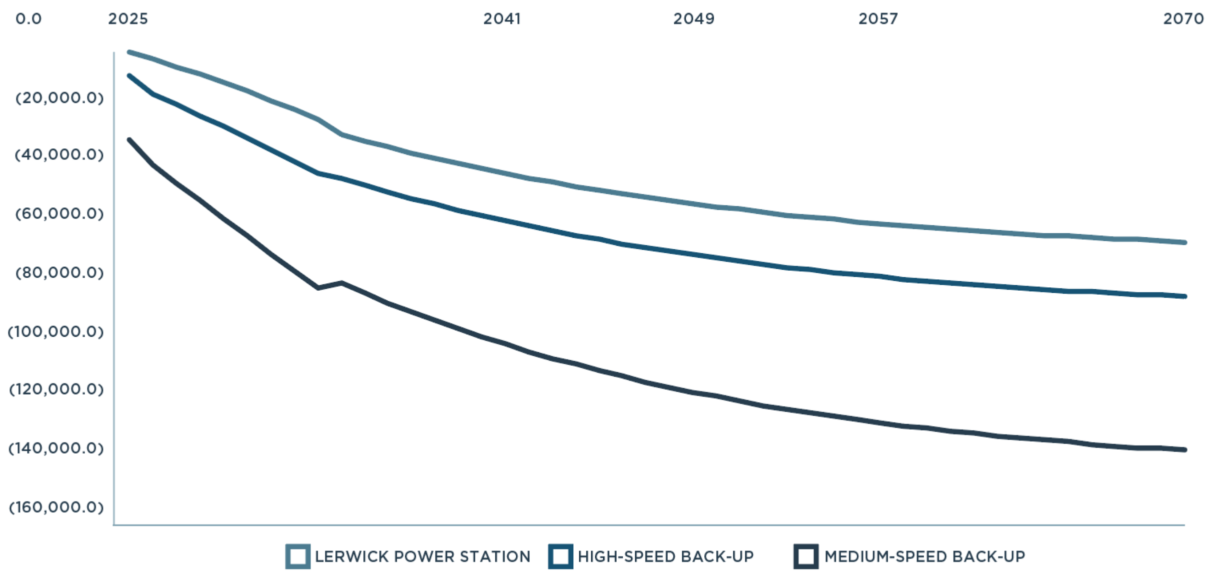
For our own assets, we used a discount rate based on RIIO-ED2 standard assumptions set out by Ofgem. For commercially owned and operated assets, we have used a discount rate reflecting a third-party commercial investment and have also run a sensitivity on this assumption. These assumptions are consistent with the approach taken in the Shetland New Energy Solution process, which identified that the contractual structure and risk profile for a third-party owner and operator was materially riskier than for the construction and operation of an asset by a regulated business, and the expectation that tendered pricing will include contingency and rates of return in excess of those which network licensees would apply in a regulated business project.

4.3.3 SELECTING THE MOST ECONOMIC AND EFFICIENT INVESTMENT

We analysed the three options set out in table 4.6 in the Cost Benefit Analysis process set out in figure 4.3. This process concluded that continuing to run Lerwick Power Station until 2035 was the preferred standby solution post commissioning of the transmission link. On an NPC basis running Lerwick Power Station was least costly to consumers considering the CapEx and OpEx outlay required in comparison to alternative standby solutions. Whilst all standby options considered have a significant carbon reduction benefit compared to providing Shetland’s energy needs without the transmission link, the three options have negligible carbon benefits relative to each other.

In figure 4.5 the NPC curves of the three options are presented illustrating the benefits of continuing to run Lerwick Power Station. These are set out in more detail along with a detailed consideration of costs and benefits in the Shetland Specific Engineering Justification Paper and the full assessment from 2020.

Figure 4.5: Net Present Cost curves for options considered for Shetland standby provision



4.3.4 DELIVERABILITY OF THE STANDBY SOLUTION

We intend to run a procurement process for blackout avoidance and fault ride through equipment aligned as closely as possible with the RIIO-ED2 business plan submission process in 2021. Our process must find the most efficient options to meet the specific needs in Shetland. We are running a standard two-stage procurement process through to 2022:

1. **Pre-Qualification** – an opportunity for market participants to express interest and an assessment of key capabilities of bidders to identify those qualified to invite to tender.

2. **Invitation to Tender** – submission of specific proposals to meet design criteria from qualified market participants. Assessed to enable shortlisting, identification of best options and negotiation with most preferred bidders.

Once tenders are submitted, these will be assessed against system stability and performance dynamics to ensure that the overall system is integrated and secure. Post system modelling, discussion with bidders will progress to optimise and finalise the solution(s) and associated costs.

The delivery of the preferred market solution will be run in accordance with SSE's Large Capital Projects process to ensure that the project is governed, developed, approved, and executed in a safe, consistent, and effective manner. This is done for all projects greater than £10m or assessed as uniquely complex.

The Large Capital Projects process includes a detailed governance process overseen by a company Director and specialist committee with five phases and formal gates between phases. The gates ensure transparency, scrutiny and appropriate approval of project development and the required deliverables. Clarity on project risks and issues, are also sought throughout to assist with decision making during this process.

5 WHAT IF THE FUTURE IS NOT AS PREDICTED?

5.1 SUBSEA CABLES

The condition profile of our subsea cables varies, and we therefore have an ongoing programme of cable inspection works which aims to proactively identify cable damage and assess the need for remedial works. Where appropriate, we conduct works to reduce the risk of future cable faults and power outages. This approach recognises that subsea cable faults can be highly detrimental to island communities, interrupting power supplies and requiring the use of remote backup generation. An effective proactive approach to cable inspection and remedial works reduces the occurrence of future faults and therefore the need for reactive cable repair or replacement.

Our RIIO-ED2 business plan therefore places emphasis on conducting proactive replacement works, recognising that this is more efficient and significantly less disruptive than relying on reactive replacement works to address cable damage.

We also recognise we are managing an asset population which was installed prior to the available innovative current technology which would afford us the ability to constantly monitoring cable condition. Furthermore, these assets are located on the seabed in some of the most challenging waters around the GB coast. It is therefore not possible to eliminate unexpected failures and the need for additional cable reactive works. There is significant uncertainty over the volume of this reactive work and therefore the costs which would be incurred during RIIO-ED2. Many of the waterways crossed by our subsea cables have volatile weather conditions, and they are also busy maritime routes, with extensive marine traffic. These factors are beyond our direct control and an important driver of the cost uncertainty we face.

When reactive work is required, the costs of this work can be substantial, with the potential for significant premiums compared to proactive replacement work. This reflects the need to secure the required equipment and personnel for reactive work at short notice (including hiring vessels). The RIIO-ED1 period has seen several cable faults occur on our network, requiring substantial reactive works. Whilst we have historic data on the costs of reactive replacement works, which gives us a view of average unit costs, there remains significant uncertainty over the volume, timing or location of cable faults (and therefore reactive replacement works) at RIIO-ED2.

Aside from the replacement or repair of active cables, a further key aspect of the cost uncertainty regarding subsea cables concerns future cable decommissioning requirements. Marine Scotland is responsible for the integrated management of Scotland’s seas, and our subsea cable management activities in the SHEPD licence area must comply with Marine Scotland requirements. In RIIO-ED2, there is potential for Marine Scotland to tighten requirements around the decommissioning of cables which are no longer in active use. As part of the decommissioning process, Marine Scotland may require more frequent inspections and increased removal of these cables from the seabed, which could have a significant cost impact.

In our ***Uncertainty Mechanisms Annex 17.1***, we set out proposals for uncertainty mechanisms with a full justification against minimum requirements. Given the cost uncertainties specified above, we are proposing three uncertainty mechanisms to provide flexible adjustment of cost allowances over RIIO-ED2. These mechanisms include:

- A volume driver to cover reactive replacement works required following cable faults.
- We are additionally proposing a closely related re-opener to cover additional efficient costs associated with providing remote power generation (and backup power supply) for communities following cable faults, where this is required.
- A re-opener to cover new cable decommissioning requirements initiated by Marine Scotland which could include cable inspections and partial or full cable removals.

Taken collectively, our proposed uncertainty mechanisms for reactive replacement together with the remote generation re-opener aim to ensure that cable damage is addressed promptly and efficiently.

Our proposed volume driver for reactive replacement recognises that cable faults cannot always be avoided and may occur for reasons beyond our control. Restoring subsea cable supplies quickly and cost-effectively is critical, as this minimises the negative impacts of disrupted power supplies and importantly reduces the need for backup remote generation. Currently when faults do occur, diesel generators are often required to bring the remote areas back online and local renewable generators are disconnected as the network is down. The timely replacement of subsea cables is therefore vital not only for customer service, but also in supporting the net zero transition and minimising disruption to renewable generators in our island communities (which in turn impacts their profitability). Our volume driver will strongly incentivise us to respond with agility and efficiency when cable faults occur. This will be further supported by our remote generation re-opener, which will provide the flexibility needed to secure remote backup generation quickly and cost-effectively, thereby reducing customer disruption.

Our proposed re-opener for decommissioning costs reflects the substantial uncertainty we face over future cable decommissioning requirements, bearing in mind that we have not conducted many inspections or removals of decommissioned cables to date.

The scope of any new requirements is unknown, creating significant uncertainty over their cost impact, especially because the changes could apply across selected high-risk cables or across our broader network. We consider that our re-opener provides the required protection should our decommissioning costs substantially increase (maintaining a clear financial distinction from our management of active cables), whilst recognising that these highly uncertain costs are not suitable for baseline funding.

These mechanisms to address uncertainty are focused on the response to subsea cable events. They are therefore separate from our whole system mechanism, HOWS, which enables the investment in proactive, integrated, multi-party solutions. We expect HOWS to address multiple, wider, customer needs including load growth, emissions reductions to meet SBT pathways (see ***Environmental Action Plan Annex 13.1***), existing condition programmes, new renewable generation export routes and reliance on standby stations plus benefits in local communities and other energy sectors.

5.2 DISTRIBUTED EMBEDDED GENERATION

Throughout this Annex we have discussed ongoing efforts to reduce the number of diesel generators across our network, to support the broader transition towards renewable generation and net zero. Our analysis has identified that the business has a good understanding of which generators may need replacement in RIIO-ED2, and the average costs involved, with an intended replacement trajectory. While this analysis identifies the investment to maintain security of supply, it always will default to traditional solutions (diesel) due to the atypically high costs of alternatives where there is only one driver to the cost benefit analysis – security of supply. Our HOWS mechanism allows multiple drivers of investment to be brought together and considered concurrently including emissions, security of supply, new renewable generation, demand load growth to name a few. We believe this approach has the capability of unlocking the investment dilemma and enabling a transition away from traditional diesel power stations. See **Section 6** for a summary of our proposals.

5.3 SHETLAND

Whilst we have undertaken significant work over the last few years to establish a clear Whole System solution to Shetland's energy needs, which will ensure it can contribute to delivering net zero in Great Britain. We will develop the necessary arrangements with Ofgem to put into effect its decision in relation to the distribution contribution to the transmission link costs. Provision for this will need to be made within the licence and relevant financial handbook and Price Control Financial Model.

The process to procure the backup solution and services to enable operation of the system on Shetland is ongoing. There therefore remains some uncertainty on future needs and requirements as this solution is put into place. To protect consumers and our business, we require flexibility in the price control framework to manage changes to cost allowances as specific element of the needs case firms up. In the ***Uncertainty Mechanisms (Annex 17.1)*** we set out detailed proposals for uncertainty mechanisms to help us manage changes to cost allowances.

6 CREATING VALUE FOR CUSTOMERS

In this annex we have demonstrated the need to invest significant sums to maintain security of supply and meet increased needs of customers across our Scotland Island networks. Within the same timeframe, other parties in the energy sector and wider are considering making strategic and material investment in infrastructure in the same geographic locations.

Our Hebrides and Orkney Whole System uncertainty mechanism recognises that these events in the wider energy industry and beyond represent opportunities for integrated solutions that meet the needs of a wider range of stakeholders and represent better overall present value. By integrating multiple solutions to individual needs, we believe a better value overall outcome is possible. We see multiple potential ways this could be realised in our island and remote communities during RIIO-ED2 and have already commenced the discovery phase in anticipation[21].

We want to use the flexibility afforded by the uncertainty mechanism framework to pursue multiple opportunities for Whole System solutions across our island communities in RIIO-ED2. Further detail of the proposed mechanism is contained in our ***Uncertainty Mechanisms Annex 17.1***. We have summarised the key components here.

6.1.1 OPPORTUNITY FROM UNCERTAINTY

Driving need for investment In the Hebrides and Orkney island areas of our network the scale, scope and timing of the drivers of investment across multiple sectors remains highly uncertain during the final years of RIIO-ED1. The following are examples of what we are witnessing as we approach RIIO-ED2.

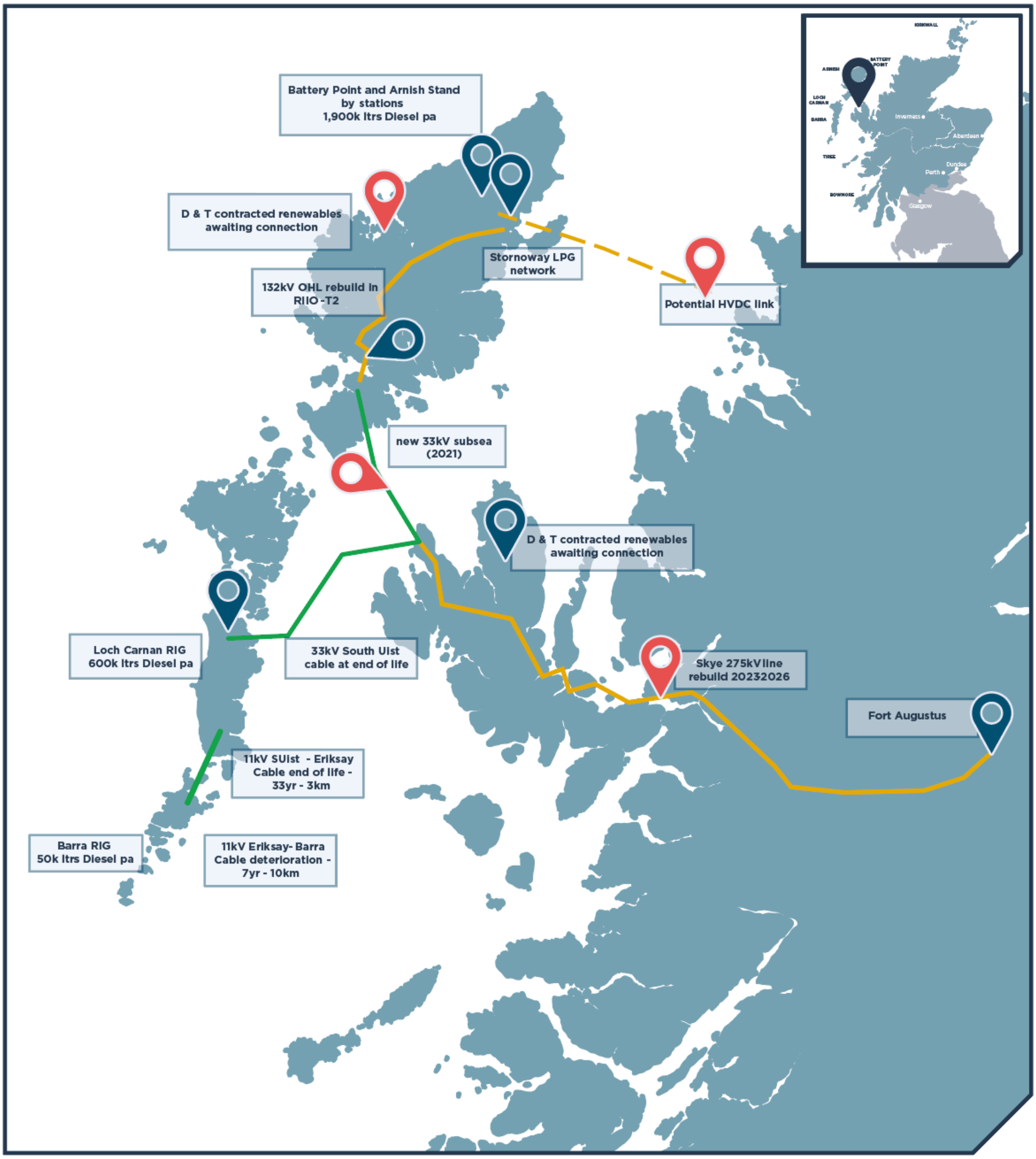
> **Development of renewable generation:** Developers are awaiting the outcome of the 2022 UK Government Contract for Difference auctions. Any new generation will require increased network capacity to export while smaller developers are seeking improved export security. Until we know the outcome of these auctions the need we are catering for remains uncertain.
>
> **Response to Access SCR:** Customer engagement confirms that the impact of Access SCR may not be immediate and will only become clear once additional policy reviews, such as TNUoS reforms are complete. We expect this to resolve in the coming 18 months which will likely alter the driving need for enabling investments. (See Annex 10.1 for further details).
>
> **Other energy sectors:** The future of LNG / LPG gas networks on the islands or west coast of Scotland are under review. The search for alternative sources of energy for heat and industrial loads is being pursued through innovation projects, for example the H100 / HyCORAL concept led by SGN, as well as reviews by individual local councils. The success of this work and the consequential impact on electricity networks will significantly influence local energy network needs in the region.
>
> **Securing alternatives to diesel:** Scotland has a target to reach to reach net zero emissions by 2045. Whilst this target is clear there remains uncertainty on the optimal solution for sustainable alternatives to the vital security of supply role our seven Distributed Embedded Generation (DEG) sites fulfil in the Hebrides and Orkney. The need to act as a DNO to provide the security of supply changes as other third-party factors change in the region.

[21] Hebrides Network: Qualitative Analysis for Future Investment and Review of CBA for Skye-Harris 33kV cable replacement November 2021

We must factor in potential roles for greater Distribution System Operation activity through active network management, alternative technologies such as batteries and hydrogen, and further subsea reinforcement.

We can see an example of how these factors interact by looking at the geographic distribution around the Outer Hebrides and Skye, figure 6.1 below

Figure 6.1: Example of whole system zone - multiple drivers of need / multiple parties



Each one of the above items is strong enough to create a need to review the whole system needs for the Hebrides and Orkney. When they occur simultaneously, as they likely will, they create an unprecedent need for industry to re-evaluate from a broader whole system perspective the optimal route to fulfilling consumer need. Issues that we currently experience in the Hebrides and Orkney will not abate or disappear until some form of step change is introduced. Incremental change will never be sufficient to address the barriers and investment by individual parties and in a whole system context would be sub-optimal to the needs of consumers.

Optimal investment response Once the combination of driving need is more certain it will be necessary to undertake a whole system review of investment solutions considering multiple energy vectors. This assessment must consider the holistic outcomes to the region and the UK including:

- Ensuring there is sufficient capacity to give routes to market for developers
- Maintaining security of supply, including for worst served customers
- Maximising long term socio-economic welfare for consumers and producers

To do this, key stakeholders including developers, local communities & government, the Electricity System Operator, and other parts of the utility sector such as transmission and gas must be involved, alongside us as DNO. There is a risk of material regret if we fully commit to one solution now without a more detailed whole system thinking in the next 18 months. We also recognise that we cannot delay action in perpetuity if we are to meet net zero targets, enable economic progress and prevent the negative impact from end-of-life assets failing. The next 18 months are crucial to removing the uncertainty of several moving parts and finding a solution which delivers on the outcome's consumers need for the region, but we need this to come with hard deadlines and clear target outcomes.

6.1.2 THE DESIGN OF THE PROPOSED MECHANISM

This mechanism facilitates the investment we may need to take as a stakeholder post a whole system review of the Hebrides and Orkney. The re-opener will allow for either upward or downward adjustment of baseline allowances and could be triggered multiple times upon completion of whole system assessments.

We propose use of the mechanism would be limited to the first two years of RIIO-ED2, unless otherwise directed by Ofgem. This will give time to complete the whole system reviews but will ensure investments are not held in perpetuity in the need case stage. We consider that it is our sole responsibility to apply for funding adjustments when required, ensuring that we provide the necessary justification.

How the UM will work with the baseline allowances

Our draft plan includes baseline ex-ante investments which are required to allow us to progress development in the region in the event a whole system review cannot be completed in the time available. The baseline therefore is our commitment to stakeholders that they will get genuine improvement in the event certainty cannot be found through a whole system assessment. The mechanism will be symmetrical, relevant allowances can be reduced as well as rise, and baseline funding will be subject to PCDs. This will ensure: (a) baseline funding can be removed and replaced with the most efficient whole system solution(s) where justified; and (b) if the uncertainty persists and the baseline works are not undertaken the PCD will claw back unused baseline allowances, thus protecting consumers in any outturn event. The elements of our Scottish Islands baseline allowances which are subject to the HOWS mechanism are summarised in table 6.1.

Table 6.1: RIIO-ED2 baseline allowances subject to HOWS uncertainty mechanism

Totex activity area	Total baseline RIIO-ED2	Baseline subject to HOWS UM	*notes*
Subsea cable replacement (CV7 & HVP)	£147.4m	£111.8m	*Geographic cluster of cable assets listed in UM Annex*
Subsea cable other (multiple BPDT)	£37.0m	£0	*Fault, inspections, R&M etc required under all future scenarios*
Remote Generation (CV15/C8)	£42.5m	£40.1m	*Component of Scottish Island investment most likely to flex under HOWS*
Shetland (multiple BPDT)	£99.8m	£0	*Whole System solution identified in RIIO-ED1*

Getting the right balance of risk between company and consumer

This mechanism appropriately shares risk between us and our consumers but also triggers the transfer of benefits back to consumers. Our stakeholders can have confidence that any need for additional distribution allowances following Ofgem's assessment of our whole system submission will be because we have succeeded in identifying an improved economical and efficient solution to their network needs. Consumers are also protected should a whole system solution not be found in the time available. By including an efficient level of baseline spend within our ex-ante plan consumers have a 'back-stop' that delivers benefits within the RIIO-ED2 period.

6.1.3 SCALE OF THE MECHANISM

Our estimate materiality range associated with this UM is -£151m to £275.6m. The lower end of this range is calculated on an assumption that a portion of our ex-ante baseline spend could be replaced by third party whole system solution. The upper end of this range is based on 'do minimum' lifetime costs of a distribution solution. We don't know what types of options could be assessed through a whole system assessment, so we have based our assessment on a 'do minimum' distribution solution which would implicitly have to be signed onto in the event that no whole system solution can be found in order to maintain security of supply and to reduce emissions as far as possible. Further detail on these assumptions is to be found in our ***Uncertainty Mechanism Annex 17.1***.

We have already initiated the discovery phase of this work and include early thinking within our Business Plan. We commissioned Mott MacDonald to assess whether there was justification for ongoing investment in Island networks to meet all our stakeholder's needs, starting with the Hebrides.

This is a qualitative assessment of the drivers of investment and an opportunity to identify potential for solutions to interact with other energy and stakeholder activity. Mott MacDonald identified '*a clear need for ongoing material investment within the Hebrides/Western Isles distribution network within the RIIO-ED2 price control period*'. In its report, it also concludes that '*the necessary steps and value of investment cannot be firmly defined at this stage, as significant decisions in the transmission network infrastructure […] will require differing investments at the distribution level'.*

Mott MacDonald have been able to identify a range of potential interventions which are able to deliver some of our Stakeholder needs.

The identified needs so far include projected demand growth, queued and proposed renewable generation and continued security of supply (recognising components of the current network configuration are at the end of their asset lives). We recognise wider needs of other stakeholders which would come into consideration as we develop the whole system solution under a HOWS mechanism. These include large renewable generation, local gas networks and other industrial energy users.

At the qualitative stage, Mott MacDonald produce a shortlist of five distribution interventions which we should consider evaluating further in preparation for and during RIIO-ED2. These include - three cable, one storage and one dispatchable thermal generation intervention. Mott MacDonald will consider the relative benefits of each through its quantitative assessment stage which will continue following submission of our Plan. Looking to the next phase of this work Mott MacDonald note, '*The purpose of the quantitative stage is to determine potential savings in terms of diesel not burned by making investments in suitable interventions as part of a wider system solution over the RIIO-ED2 period*.'

Through the HOWS mechanism, we will continue to identify and evaluate the wider, whole system, benefits that our distribution solutions can create for other parties and the benefits that other investment solutions could secure for our customers. This work will not be limited to the Outer Hebrides. Our HOWS proposal covers the other island groups which depend on diesel generation and contain a significant population of subsea cable assets; the Inner Hebrides and Orkney Islands.

This will then lead to submission of the whole system proposal to Ofgem in the respective HOWS reopener windows (early 2023 and 2024).

6.1.4 VALUE FOR MONEY FOR CONSUMERS

Our proposed re-opener creates the opportunity to secure significant value for money for consumers by facilitating a whole system assessment across multiple energy vectors thereby ensuring the most economic and efficient solution to a multitude of regional issues is developed. Its scope ensures we can bring a full range of conventional and innovative solutions into the whole system assessment, maximising the outcome choice for consumers and helping to discover what is really value maximising to socio-economic welfare through exploring the full range of technological options. The re-opener recognises that the there are several ongoing requirements which are unique to the Hebrides and Orkney regions which are not mutually exclusive and cannot be resolved in silos but only through a holistic approach.

The final size and range of benefits secured will depend on the multi-party engagement to develop a whole system solution. However, at this initial stage we would expect potential benefits to include some of the following.

- Material reductions in carbon and other associated emissions by eliminating the need or reliance on diesel standby stations
- Improved security of supply by removing assets at end of life and reducing dependence on them (subsea cables and standby generation)
- Meeting short- and longer-term demand growth (ED2 and ED3) driven by the transition to low carbon technologies as represented in the distribution future energy scenarios
- Enhanced resilience for current renewable generators and certainty for future
- Increased capacity for additional renewable generators
- Local economic development from increased renewable activity and construction of proposed solutions

- Reduction in cost to consumer relative to full life cost of alternative solutions

Our approach provides broader value to customers through social, economic, and environmental outcomes. Successful whole system solutions would ensure the most economic enduring solution, encourage socio-economic welfare growth, support renewable generators to stay connected to the mainland grid and reduce the need for diesel-powered island generation. Our proposals will also reduce the environmental footprint of our island communities and support the transition to net zero, ultimately benefiting consumers right across our licence areas.

7 A CREDIBLE TRANSITION FROM RIIO-ED1 TO RIIO-ED2

7.1 SUBSEA CABLES

In RIIO-ED1 we were allowed £36.9m for proactive replacement of subsea cables. There was no specific adjustment to named projects, km, or outputs post determination. Although our initial proposal was based on 34 cable replacement. In addition, £14.9m was allowed for cable repairs following faults. Costs of £31m were forecast for our full programme of work for inspection and maintenance in SHEPD, including subsea cables. A reopener uncertainty mechanism was included in 2019 for the protection and decommissioning of subsea cables given changes underway in relation to Marine Plan Scotland.

During RIIO-ED1 a request for additional allowances of £45.2m through the subsea cable protection re-opener was awarded. A request through the High Value Project re-opener to replace the faulted Pentland Firth East cable was initially rejected by Ofgem; however, a final decision on its funding is expected through RIIO-ED1 close-out based on updated evidence to justify our intervention strategy. Following the fault of the Skye-Harris cable in October 2020 we are continuing discussions with Ofgem on the most appropriate cost recovery mechanism of our cable replacement. Total fault expenditure in RIIO-ED1 is running higher than our allowance at £27.3m, excluding Skye- Harris, with faults averaging 3.2 per annum.

Our proposed investment programme in RIIO-ED2 is asset data led; refined and iterated by overlaying the industry standard risk management methodology with bespoke risk modelling and cable specific cost benefit analysis. We are proposing investment of £64m of planned replacement of 15 cables where the certainty of need is highest driven by high probability and impact of failure in RIIO-ED2. We are optimising the benefits of investment by prioritising reduction of consumer impact and meeting the needs of local communities and stakeholders, including considering the impacts of constrained generation. This investment programme is similar in size to RIIO-ED1 although the volume of assets differs on account of specific cost factors associated with each of the cables. Where certainty of need is lower, we will adopt a fix on fail approach supported by our proposed reactive replacement uncertainty mechanisms. This will not however negate our continued inspection programme and remedial repairs to prevent against faults.

In addition to our asset replacement programme we are proposing a wider strategic planned replacement programme for Pentland Firth West and Skye - South Uist of £84m to cover two longer length cables (>30km). Funded as High Value Projects. Through the RIIO-ED2 period we will continue to take a Whole System view to the development of these assets including wider assessments of future demand on the islands. These cables ultimately though will increase redundancy and load capacity to the islands; as well as providing greener alternative backup generation in events of faults.

Our proposed expenditure for asset replacement is supported by £37m of ancillary subsea cable costs covering inspections, remedial work, and property costs for strategic spares. Costs are set at a consistent run rates from RIIO-ED1, where applicable. For post fault remedial costs our proposed allowance of £13.1m is consistent with our observed RIIO-ED1 fault rate of 3.2 faults per annum, with 1.4 faults requiring repair. For RIIO-ED2 this only covers repair activity, with replacement works covered through an uncertainty mechanism. We are also embedding benefits of RIIO-ED1 NIA innovation by installing SUBsense live monitoring on each of our replaced cables and retrofitting onto [redacted] existing cables where the design of the cable allows.

7.2 DISTRIBUTED EMBEDDED GENERATION

In RIIO-ED1 we were allowed costs of £4.2m per annum to run our seven DEG sites, this included costs for fuel and operation and maintenance costs. Average total outturn costs in the last five years of RIIO-ED1 have however been higher at £8.2m per annum. Costs for the operating and maintaining components at these sites have risen markedly (>50%) since DPCR5 a reflection of running older aging plant which require more frequent maintenance and bespoke made parts, which cannot be easily sourced. Due to two significant subsea cable faults in ED1 the DEG plants have also operated for extended periods in some cases for over six months. The fuel cost component has fluctuated significantly in RIIO-ED1, which reflects prices trends on international markets over the last five years but have on average has been less than half the average in DPCR5. The net effect however is that the total cost of running these sites has increased in the last five years of ED2 compared to DPRC5; total running costs in DPRC5 amounted to £28m, and RIIO-ED1 £40.8m to date.

In RIIO-ED2 our total gross cost is £28.5m, based on a £5.7m per annum total average running cost. We see this as consistent with costs in the five years of DPCR5 and the first five years of RIIO-ED1. We foresee fuel costs being on average higher than RIIO-ED1 to run these sites based on latest market trends, though not as high as DPRC5; and the cost of operations and maintenance being slightly lower than RIIO-ED1, impacted by replacing engines at Battery Point; installing new capacity at Bowmore; and subsea cable replacement which will lower expected running times of the DEG units in RIIO-ED2.

The works at Battery Point are one-off activities driven by clear need cases and evidenced through CBAs undertaken as part of our justification of our proposed expenditure in RIIO-ED2.

7.3 SHETLAND

Over the last few years, we have worked closely with local stakeholders, customers, market participants government bodies and our transmission company to develop an enduring Whole System solution to meet the future energy needs of Shetland and to enable the island to support the transition to net zero through its extensive natural resource potential. Shetland's electricity costs and wider activities on Shetland associated with securing an enduring solution are currently funded through the Extended Interim Energy Solution, which was decided by Ofgem in 2018.[22] We have established and had approved[23] the needs case for a contribution to the transmission link. In December 2020 we submitted a proposal for an enduring solution for Shetland to Ofgem, post construction of the transmission link.

Our request for allowances in RIIO-ED2 is consistent with both our RIIO-ED1 extension costs previously approved by Ofgem and our enduring solution proposal in December 2020 and represents a logical extension of the governance process for establishing the long-term energy needs of Shetland. This solution contributes significantly in our advance towards net zero, taking into account the renewables and emissions benefits unlocked by the link, combined with the transitional standby arrangements which will maintain security of supply in the medium term as alternative net zero aligned options crystallise and mature.

[22] https://www.ofgem.gov.uk/system/files/docs/2018/06/decision_on_shetland_interim_solution_-_final_1.pdf
[23] https://www.ofgem.gov.uk/publications-and-updates/update-decision-approve-shepds-propossed-methodology-contribute-shetland-transmission-project

APPENDIX A: ENHANCED ENGAGEMENT

SCOTTISH ISLANDS – SUBSEA CABLES

- Overview: **We are making a step change in our investment levels in subsea cables to deliver greater reliability to our island customers**
- Total cost: **£147.4m (replacement only) plus £42.5m (island standby generation)**
- Contribution to annual customer bills: **£15.18 plus £4.48 (North only)**

RIIO-1 context

We are responsible for monitoring the efficiency and integrity of the 454km submarine electricity cable network which provides power supplies from the mainland to 59 Scottish islands as well as enabling export of renewables generation. During ED1 to date, we have inspected 355km of cables and are on track to have covered the entire subsea portfolio during the price control period. We adopted a proactive approach to replacing subsea cables, which will continue to the end of ED1. More subsea cable faults have occurred than anticipated.

ENGAGEMENT SYNTHESIS

Stakeholder engagement

Engagement details	Insights derived
Non-consumer stakeholders We tested our **Scottish Islands strategy, outputs and costs** with a broad range of non-consumer stakeholders to understand their views on the **acceptability and bill impacts** of our Draft Business Plan via an online consultation event and surveys	• Stakeholders supported the Scottish Island strategy recognising that SSEN had learnt from their experiences in ED1 and were bringing forward that knowledge and best practice into ED2. [E151] • Stakeholders felt that the balance was right on the uncertainty mechanism, and that it provided value for customers, and sought some refinement to ensure optionality was retained, and that the costs and benefits of additional capability for Scottish Islands' generation was taken into account as well as wider impacts on net zero. [E151] • Better engagement with communities, which would allow for supply chain, construction, and other parties to plan their assets, time and workforce around SSEN's projects which would reduce costs. [E151] • Opportunities to reduce the overall cost of sub-sea cable investment through innovation. [E151] • Local authority and community energy representatives urged sufficient capacity on the two subsea cables to Uist to facilitate viable wind turbines in Uist and Barra. [E151]

	• The failure rate of subsea cables in ED1 has meant generators cannot obtain insurance cover against this risk, and a prolonged outage could drive some organisations to insolvency. [E155] • Community energy segments also noted it is not tenable to be reliant on diesel generation for prolonged periods, adding further support for redundancy of two new cables to Uist. [E155]
National Government We engaged MPs and MSPs about our Draft Business Plan via bilateral meetings	• MP for the Western Isles was very supportive of our proposals, particularly the proactive approach to subsea investment and our strategy for the Scottish islands and could also consider the potential for tunnels connecting Islands. [E166] • Regarding the Island Broadband CVP, the MP for the Western Isles raised the potential to offer something similar for the mobile network using wooden poles in remote and rural locations [E166]
Local authorities/ community interest groups/ community energy schemes/ distributed generation customers/ supply chain We co-created our subsea strategy via open discussions at a workshop on our proposed approach for supporting remote islands	• Stakeholders supported substantial investment tempered with the view that customers in vulnerable situations did not face increased bills as a result by apportioning costs appropriately between domestic and commercial customers. [E095] • Stakeholders were pleased that communications around infrastructure planning have noticeably improved during ED1 and wanted this communication to continue or improve further. [E095] • Stakeholders in Orkney wanted us to disclose the data we hold on the community to ensure it is accurate and create transparency around decision making. [E095] • Stakeholders in Orkney noted that investment in subsea cables should be planned alongside investment in the local network to optimize benefits from local generation. [E095] • There were also concerns about our current approach being too focused on projects involving large numbers of customers. Stakeholders hoped that projects involving small number of customers would not be forgotten, so as to engender a sense of fairness. [E095] • It was also noted that stakeholders would rather find local suppliers for project work rather than a multi-national [E086]. • Stakeholders noted that we need to work in partnership with local projects or else they'll be forced into Hydrogen generation if the current distribution system cannot meet its needs [E086]. • Stakeholders were concerned with the increased cable failures and supported the new strategy of assessing both the risk and impact of failure [E086]. • There was considerable support for increased information and monitoring of the sub-sea cables as well as ensuring that they are future-proofed as not to limit future developments [E086].

Marine Scotland We engaged with Marine Scotland (MS) via a bilateral to modify how we best work with this key stakeholder on submarine cable installation	• While our current consultation is meant to start about 12-18 month in advance, the current pre-application consultation (PAC) process cannot take place any more than a year in advance of the project start date. [E070] • Chronological bundling of consents was preferred by MS over geographical bundling along with rationalizing the PAC process where possible. [E070] • MS requested that we continue to follow consultation process for site designation. [E070] • MS requested that we remain engaged with key stakeholders such as fisheries groups and maintain agreed quarterly communication schedule. [E070] • The stakeholder confirmed that CBA is suitable for starting the conversation but the approach could be reviewed. [E070] • MS advised that it did not take bill impact into consideration as its statutory responsibility is to protect the environment, human health, the sea and anything that Scottish Ministers deem necessary. [E070]
Infrastructure/engineers We collaborated with stakeholders at an open forum focused on improving network reliability and resilience	• We should place greater investment focus on overcoming curtailment-related issues caused by submarine cable faults to island with high LCT potential (e.g. scheme on Lewis and Harris). [E067]
Community Energy Scheme We engaged with Skye Climate Action at a bilateral on a number of topics	• Stakeholders were concerned about the imbalances in generation and demand between Skye and the mainland: it is unjust that there is cheap, renewably generated electricity being imported back at high prices [E136] • There is also a growing desire for developing local community energy infrastructure for resilience and sustainability, especially given the recent power cuts [E136]. • A key strategy was making demand more flexible to optimize the price arbitrage effect. Quantum storage heaters can have a big role to play [E136]. • The importance to local energy security of existing and new community energy enterprises used as means of generating income need to be acknowledged [E136]. • It would be useful to establish communication between SSEN and interested energy groups on Skye e.g. producers: [redacted] about putting in control systems, and with [redacted] (consumer implications) [E136]. • The Resilience as a Service (RaaS) battery is seen as a very exciting project and may be used for constraint management, but this will be up to the third-party battery controller. It was noted that it may be useful for customers to know when they are connected to the RaaS service as they may choose to hold off putting washing on

	until they are back on the grid, which would allow the battery to last longer [E136]. • Stakeholders were keen to ensure that the local residents would benefit from the project and reduced resilience costs [E136] • It was noted that while the RaaS project won't solve network constraints or the problem of exporting the vast amount of energy generated on Skye, it does help to make the best use of locally-generated renewable energy [E136]. • Stakeholders noted that this is a transition stage: by 2030 they would love to see much more local energy use and production, but steps need to be taken now. [E136].
Current and future employees We engaged colleagues via an anonymous survey on the outputs and costs in our Draft Business Plan	• The costs of proposed spending on subsea cables should be examined to ensure all options are considered. [E153]

Engagement statistics

Stakeholder segments engaged

CONSUMERS	Domestic customers	Customers in vulnerable situations	Transient customers	Next generation bill payers	SMEs	Major energy users	
CUSTOMERS	Distributed generation customers	Builders and developers	Community energy schemes	Landowners/ farmers			
POLICY MAKERS AND INFLUENCERS	Government	Research bodies, policy forums and think tanks	Media	Consumer groups	Regulators		
COMMUNITIES AND LOCAL DECISION MAKERS	Local authorities	Charities	Academic institutions	Housing associations			
	Vulnerable customer representatives	LEPs	Emergency response	Healthcare	Community interest bodies		
WIDER INDUSTRY AND VALUE CHAIN	DNOs	Transmission	GDNs	Water	Telecoms	IDNOs	
	ICPs	Consultants	Energy suppliers	EV charging	Other supply chain	Storage and renewable providers/ installers	Transport and highways agencies
PARTNERS AND ENABLERS	Current and future employees	Contractors	Service partners	Shareholders	Investors	Business advisers	Trade Unions

EVIDENCE ASSESSMENT

Engagement scoring key

The engagement score assigns a weight to each source accounting for the robustness of the engagement event and the relevance of the feedback to the topic.

Score	Description
1-1.66	Limited evidence of good event planning, methodology or data collection. Feedback provided is high level with tangential relevance to the topic.
1.67-2.33	Good evidence of engagement planning and discussion of data collection methods, but limited depth of feedback and range of opinions. Feedback not necessarily fully aligned to the topic and only provides a limited insight and thus moderately useful.
2.34-3	Well-conducted, trustworthy event with highly relevant feedback. Specific, clear and relevant information with clear link to the topic discussed and high value added.

Phase	Date	Event ID	Event name	Key stakeholder groups	Number of stakeholders engaged	Engagement score
Phase 4: Testing and Acceptance	Oct-21	E153	Employee Consultation Document Engagement on Draft Plan	Current and future employees	3	2.3
	Oct-21	E155	Stakeholder Consultation Document Engagement on Draft Plan	Community interest groups, storage and renewables suppliers, emergency response, healthcare and highways agencies	19	2.8
	Sep-21	E151	Consolidated Outputs and Costings Event	Contractors, Consultants, Local Authorities, National Government, Storage and Renewables suppliers, Supply Chain	106	3.0
	Aug-21	E166	Corporate Affairs General Bilateral	Government, Storage and renewables providers	25	2.5

Phase	Date	Event ID	Event name	Key stakeholder groups	Number of stakeholders engaged	Engagement score
Phase 3: Business Plan Refinement	Apr-21	E136	Sustainability Bilateral Skye Climate Action Group	Community Energy Schemes	10	2.5

Phase 2: Co-creation	Mar-21	E086	Powering Scotland's Isles bilaterals	Local authorities	7	2.5
	Feb-21	E095	Remote Island Communities workshop - Orkney	Local authorities, distributed generation customers, community energy schemes	18	3.0
	Jan-21	E070	Marine Scotland bilaterals	National government	2	2.5
	Dec-20	E067	Shetland Engagement Forum	Local authorities, distributed generation customers	23	2.0

MEASUREMENT OF SUCCESS

Output	Northern target	Southern target	Comparison to RIIO-1	Cost in baseline plan	Consumer benefits
Replacement or augmentation of 15 subsea cables with the greatest needs case	15 cables replaced	N/A	£88.2m	£63.5m	• Improved reliability and resilience in the longer term • Contribution to risk reduction on our network (see Maintain a resilient network, Chapter 7) • Increased capacity to enable renewable generation to connect • Condition driven replacement to avoid supply failure and improvement of network for capacity reasons • Enables a Whole System approach to these communities. Needs case development during RIIO-ED2.
Three new cables between Skye and Uist, and Pentland Firth West to Orkney	3 cables replaced	N/A	New for ED2	£83.9m	
Maintaining and operating standby generation for island communities at our seven island power stations	Standby generation available when required	N/A	£48.4m	£42.5m	• Improved reliability of distributed generation reduces risk of loss of supply for customers • Increased efficiency results in lower emissions and running costs.

SCOTTISH ISLANDS – SHETLAND

- Overview: **Provision of back up generation to support reliability of supply to Shetland during RIIO-ED2**
- Total cost: **£99.8m**
- Contribution to annual customer bills: **N/A** (**will be recovered from all GB customers from 2021 through Hydro Benefit Replacement Scheme[24]**))

RIIO-1 context

Demand in Shetland is currently met by Lerwick Power Station (50%) which will reach the end of full duty operations in 2025, Sullom Voe Terminal (30%), and from renewable energy from distributed generators. Ofgem has now approved a mainland cable connection for Shetland expected to supply the distribution system from 2025, which is expected to meet demand for 97% of the year and enable transition from the current high level of fossil-fuel generation (c.80%) to low carbon island renewables and mainland supply. While this connection is not within our remit, we will support it with a £236m contribution (subject to finalisation), and we remain responsible for backup generation (likely to be needed one to three times per year) when there is maintenance or a fault on this cable.

ENGAGEMENT SYNTHESIS

Stakeholder engagement

Engagement details	Insights derived
Non-consumer stakeholders We tested our **Scottish Islands strategy, outputs and costs** with a broad range of non-consumer stakeholders to understand their views on the **acceptability and bill impacts** of our Draft Business Plan via an online consultation event and surveys	• A consumer group stakeholder questioned why there was no mention of smaller producers that are already generating electricity on Shetland and feeding into the local network. [E151] • A vulnerable customer representative questioned the use of fault ride-through on the Shetland network as part of the investment, why it was utilised in that context and whether it would also be implemented elsewhere. [E151] • A national government representative thought that the Shetlands is a really good example of whole systems and the outcome for the Shetlands was pretty unique, perhaps driven by need rather than being whole systems from the outset. They thought it would be helpful to understand how that’s been taken and incorporated into what we are doing and what is meant by whole systems as part of that strategy. [E151]

[24] https://www.gov.uk/government/consultations/hydro-benefit-replacement-scheme-and-common-tariff-obligation

Business representatives We co-created our ED2 strategy for planning reliable electricity supply for consumers in the Shetland Islands by seeking their input on the Shetland standby reliability arrangements and transition to net zero at an online workshop	• Building trust and communicating honestly with stakeholders in Shetland when things go wrong is extremely important; issues in the past with the Viking energy project mean stakeholders are sensitive [E072].
Local Authority, distributed generation customers, community energy schemes, contractors, consultants We co-created a solution via a bilateral meeting with Shetland Islands Council and an Open Forum with multiple stakeholders focused on standby arrangements for Shetland and gather additional feedback on Shetland-specific elements of our Whole System Planning and Reliability strategy	• Stakeholders were unanimous that the future standby solution should maintain the current security of supply for the islands at a slightly higher cost rather than adopt a slightly lower cost solution which would result in short duration (around 1hr) occasional loss of supply [E067] • 89% of stakeholders at the event said we should prioritise the ability of renewable generation to provide power during outages, at a slightly higher cost, over constraining renewable generation from providing power during outages, at a slightly lower cost. [E067] • 69% of respondents said that we should continue to use existing generation until 2030s at lower cost, rather than procure, build and use new standby solution until 2030s-2040s at a higher cost and then seek net zero options [E067] • A local authority was glad to see that the resilience of the system following the loss of the connection to the mainland has been considered [E067] • Renewables – possibly including hydrogen – should be incorporated in the backup option [E067].

Engagement statistics

ED2 ENGAGEMENT EVENTS	INSIGHTS	STAKEHOLDERS ENGAGED
10	53	298

Stakeholder segments engaged

CONSUMERS	Domestic customers	Customers in vulnerable situations	Transient customers	Next generation bill payers	SMEs	Major energy users	
CUSTOMERS	Distributed generation customers	Builders and developers	Community energy schemes	Landowners/ farmers			
POLICY MAKERS AND INFLUENCERS	Government	Research bodies, policy forums and think tanks	Media	Consumer groups	Regulators		
COMMUNITIES AND LOCAL DECISION MAKERS	Local authorities	Charities	Academic institutions	Housing associations			
	Vulnerable customer representatives	LEPs	Emergency response	Healthcare	Community interest bodies		
WIDER INDUSTRY AND VALUE CHAIN	DNOs	Transmission	GDNs	Water	Telecoms	IDNOs	
	ICPs	Consultants	Energy suppliers	EV charging	Other supply chain	Storage and renewable providers/ installers	Transport and highways agencies
PARTNERS AND ENABLERS	Current and future employees	Contractors	Service partners	Shareholders	Investors	Business advisers	Trade Unions

EVIDENCE ASSESSMENT

Engagement scoring key

The engagement score assigns a weight to each source accounting for the robustness of the engagement event and the relevance of the feedback to the topic.

Score	Description
1-1.66	Limited evidence of good event planning, methodology or data collection. Feedback provided is high level with tangential relevance to the topic.
1.67-2.33	Good evidence of engagement planning and discussion of data collection methods, but limited depth of feedback and range of opinions. Feedback not necessarily fully aligned to the topic and only provides a limited insight and thus moderately useful.
2.34-3	Well conducted, trustworthy event with highly relevant feedback. Specific, clear and relevant information with clear link to the topic discussed and high value added.

Phase	Date	Event ID	Event name	Key stakeholder groups	Number of stakeholders engaged	Engagement score
Phase 4: Testing and Acceptance	Oct-21	E153	Employee Consultation Document Engagement on Draft Plan	Current and future employees	3	1.8
	Sep-21	E151	Consolidated Outputs and Costings Event	Contractors, Consultants, Local Authorities, National Government, Storage and Renewables suppliers, Supply Chain	106	2.5
	Aug-21	E174	Consumer and Vulnerability Employee Engagement	Current and future employees	17	1.5
	Jul-21	E149	Citizens' Jury	Domestic Customers	34	2.0
	Jul-21	E167	Sustainability Strategy consultation	Vulnerable customer representative, A storage and renewables representative and Community Interest Group	4	1.5

Phase 2: Co-creation	Mar-21	E086	Powering Scotland's Isles bilaterals	Local authorities	7	2.0
	Feb-21	E095	Remote Island Communities workshop - Orkney	Local authorities, distributed generation customers, community energy schemes	18	2.0
	Jan-21	E070	Marine Scotland bilaterals	National government	2	2.5
	Dec-20	E067	Shetland Engagement Forum	Local authorities, distributed generation customers	23	2.5
	Sep-20	E072	Annual Stakeholder Workshops - North	Local authorities, vulnerable customer representatives, housing associations	84	2.5

MEASUREMENT OF SUCCESS

Output	Northern target	Southern target	Comparison to RIIO-1	Cost in baseline plan	Consumer benefits
Continued running of Lerwick Power Station to 2025 and then successful transition to standby status	LPS remains operational	N/A	£114.3m* * Excludes passthrough costs	£99.8m	Extended operational life until 2035 as a standby generator to ensure continuity of supply for island customers

APPENDIX B: SCOTTISH ISLANDS – ENGINEERING JUSTIFICATION PAPERS

LIST OF EJPS ASSOCIATED WITH SCOTTISH ISLAND INVESTMENTS

EJP Reference	EJP	Primary Investment Driver
328/SHEPD/SUBSEA/SKY/S_UIST (north route)	Skye - South Uist Strategic Reinforcment	Reduced overall monetised risk
458/SHEPD/SUBSEASKY/S_UIST (south route)	Skye - South Uist Strategic Reinforcment	Reduced overall monetised risk
329/SHEPD/SUBSEA/PFW	Pentland Firth West (2) reinforcement	Strategic investment to reduce monetised risk
331/SHEPD/SUBSEA/HOY_FLOTTA	Hoy – Flotta Strategic Reinforcement	Strategic investment
335/SHEPD/SUBSEA/LOCH_LONG	Loch Long (Dornie) Strategic Reinforcement	Reduced overall monetised risk
338/SHEPD/SUBSEA/MULL_IONA	Mull – Iona Strategic Reinforcement	Reduced overall monetised risk
388/SHEPD/SUBSEA/ORKNEY_HOY	Mainland Orkney – Hoy South Strategic Reinforcement	Reduced overall monetised risk
394/SHEPD/SUBSEA/ORKNEY_SHAPINSAY	Mainland Orkney Shapinsay Strategic Investment	Reduced overall monetised risk
401/SHEPD/SUBSEA/ SUIST_ERISKAY	South Uist - Eriskay	
403/SHEPD/SUBSEA/MAINLAND_KERRERA2	Mainland – Kerrera 2 strategic replacement	Reduced risk
405/SHEPD/SUBSEA/LAXAY_KERSHADER2	Laxay – Kershader 2 Strategic Investment	Reduced overall monetised risk
441/SHEPD/SUBSEA/JURA-ISLAY	Jura-Islay	Reduced overall monetised risk
395/SHEPD/SUBSEA/COLL-TIREE	Coll Tiree	Reduced overall monetised risk
390/SHEPD/SUBSEA/Eriskay- Barra 2	Eriskay – Barra 2 Strategic Reinforcement	Reduced overall monetised risk
333/SHEPD/SUBSEA/Loch A'Choire South	Loch A'Choire South Strategic Investment	Reduced overall monetised risk
414/SHEPD/SUBSEA/Kintyre - Gigha	Kintyre – Gigha Strategic Reinforcement	Reduced overall monetised risk
404/SHEPD/SUBSEA/Mainland - Kerrera	Mainland – Kerrera 1 strategic replacement	Reduced risk
457/SHEPD/SUBSEA/Loch A'Choire north	Loch A'Choire North Strategic Investment	Reduced overall monetised risk
345/SHEPD/REGIONAL/BATTERYPOINT	Island Generation - Battery Point	North of Scotland Resilience
387/SHEPD/REGIONAL/SHETLAND	Shetland Standby Project	Shetland