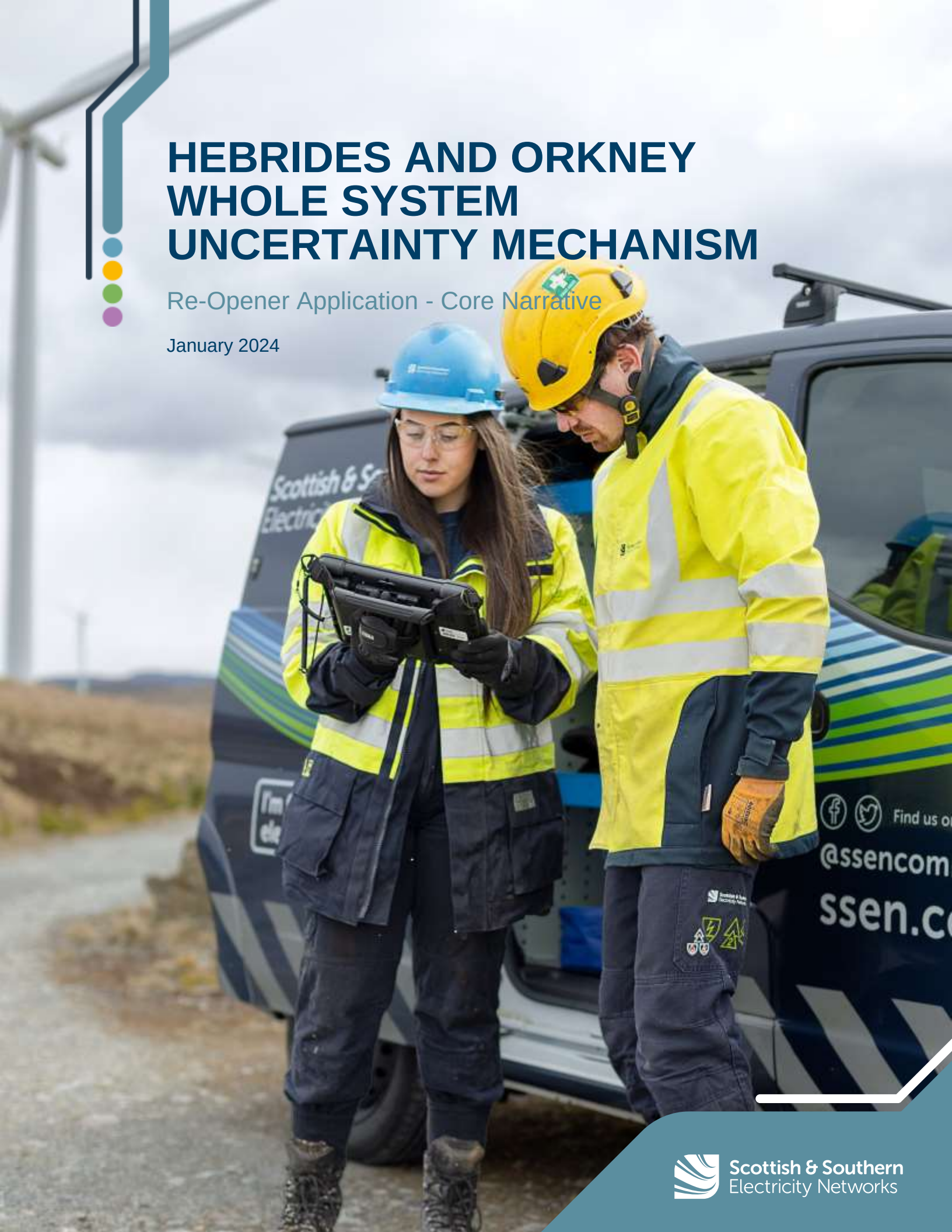
# HEBRIDES AND ORKNEY WHOLE SYSTEM UNCERTAINTY MECHANISM

## Re-Opener Application - Core Narrative

January 2024



Scottish & Southern Electricity Networks

# CONTENTS


ABOUT SSEN DISTRIBUTION ..... 5
EXECUTIVE SUMMARY ..... 6
MEETING OFGEM'S REQUIREMENTS ..... 13
Structure of this application ..... 13
Ofgem re-opener requirements ..... 14
Summary of bilateral engagement ..... 15
Planned HOWSUM submission phasing ..... 15
Related documents ..... 17
Application contact point ..... 17
1. ADJUSTMENT SUMMARY ..... 18
2. INTRODUCTION ..... 19
2.1. Background to investment ..... 19
2.2. Approach to island groups ..... 20
2.3. Primary and secondary investment drivers ..... 22
2.4. Timing of investment ..... 23
2.5. Expected outputs ..... 24
3. NEEDS CASE AND PREFERRED OPTION ..... 25
3.1. Alignment with business strategy and commitments ..... 25
3.2. Alignment with licence, statutory obligations and business plan for future price control periods ..... 25
3.3. Demonstration of needs case / problem statement ..... 26
3.4. Overarching methodology for identifying needs and options ..... 27
3.4.1. Overarching process overview ..... 28
3.4.2. Scottish islands methodology ..... 29
3.4.3. Whole System optioneering and considerations ..... 34
3.4.4. Technical and commercial assessment of options ..... 34
3.4.5. Rationale for phasing interventions ..... 34
3.4.6. Approach to documenting the needs case, option development and preferred option description for specific options ..... 35
3.5. Specific needs cases / problem statements ..... 35
3.5.1. Specific needs case - Outer Hebrides 2050 Whole System Proposals (Skye – Uist – Harris) ..... 36
3.5.2. Specific needs case - South Uist – Eriskay ..... 36
3.5.3. Specific needs case - Eriskay – Barra ..... 37
3.5.4. Specific needs case - Pentland Firth East 3 ..... 37
3.7. Consideration of options and methodology for selection of the preferred option ..... 38
3.7.1. Options considered - Outer Hebrides 2050 Whole System Proposals (Skye – Uist – Harris) ..... 38
3.7.2. Options considered - South Uist – Eriskay ..... 43

3.7.3. Options considered - Eriskay – Barra ... 45
3.7.4. Options considered - Pentland Firth East 3 ... 46
3.7.5. Methodology, criteria and process for technical optioneering ... 48
3.7.6. Sensitivity analysis ... 52
3.7.7. CBAs and EJPs ... 53
3.7.8. Additional expenditure ... 54
3.8. Detail on the preferred options ... 54
3.8.1. Preferred option - Outer Hebrides 2050 Whole System Proposals (Skye – Uist – Harris) ... 54
3.8.2. Preferred option - South Uist – Eriskay ... 63
3.8.3. Preferred option - Eriskay – Barra ... 65
3.8.4. Preferred option - Pentland Firth East 3 ... 67
3.8.5. Resources ... 69
3.8.7. Mitigation measures ... 70
3.8.8. Reporting mechanisms ... 70
3.8.9. Comparison with RIIO-ED2 Business Plan position ... 71
**4. STAKEHOLDER ENGAGEMENT AND WHOLE SYSTEM OPPORTUNITIES ... 72**
4.1. Stakeholder engagement ... 72
4.1.1. Our RIIO-ED2 stakeholder engagement strategy ... 72
4.1.2. Recent engagement ... 74
4.1.3. Stakeholder engagement feedback ... 75
4.2. Whole System opportunities ... 76
4.2.1. Interactions with Transmission works ... 77
4.2.2. Implications of Load Managed Areas ... 79
4.2.3. Relevance of community energy projects ... 79
4.2.4. Future whole system analyses as part of HOWSUM ... 79
4.2.5. HOWSUM Whole System methodology ... 80
4.2.6. Future work being assessed under HOWSUM mechanism ... 80
**5. COST INFORMATION ... 82**
5.1. Allowance adjustment ... 82
5.1.1. Demonstrating additionality ... 82
5.1.2. Cost efficiency ... 84
5.1.3. Assumptions and data sources ... 85
5.1.4. Key cost drivers ... 86
5.1.5. Areas of ongoing uncertainty ... 87
5.1.6. Risk register ... 88
**6. COST BENEFIT ANALYSIS AND ENGINEERING JUSTIFICATIONS ... 89**
6.1. Cost Benefit Analysis and Engineering Justification Papers ... 89
6.2. Summary of Engineering Justification Papers ... 89
6.3. Summary of Cost Benefit Analysis ... 89

6.3.1. Skye – Uist – Harris CBA ..... 90
6.3.2. South Uist – Eriskay CBA ..... 92
6.3.3. Eriskay – Barra CBA ..... 93
6.3.4. PFE3 CBA ..... 94
7. CONCLUSION ..... 96
APPENDIX 1 – DEFINITIONS AND ABBREVIATIONS ..... 98
APPENDIX 2 – HOWSUM DEVELOPMENT FUNDING ..... 100
EXTERNAL APPENDICES ..... 101
APPENDIX 3A – OUTER HEBRIDES 2050 WHOLE SYSTEM PROPOSALS EJP (SKYE – UIST – HARRIS) .....
APPENDIX 3B – OUTER HEBRIDES 2050 WHOLE SYSTEM PROPOSALS CBA (SKYE – UIST – HARRIS) ....
APPENDIX 4A – UIST – ERISKAY EJP .....
APPENDIX 4B – UIST – ERISKAY CBA .....
APPENDIX 5A – ERISKAY – BARRA EJP .....
APPENDIX 5B – ERISKAY – BARRA CBA .....
APPENDIX 6A – PENTLAND FIRTH EAST 3 EJP .....
APPENDIX 6B – PENTLAND FIRTH EAST 3 CBA LW .....
APPENDIX 6C – PENTLAND FIRTH EAST 3 CBA CT .....
APPENDIX 7 – JACOBS OPTIONEERING REPORT .....

# ABOUT SSEN DISTRIBUTION

### Who We Are

SSEN Distribution (SSEN) is responsible for the operation and maintenance of the electricity distribution networks north of the central belt of Scotland and across central southern England. Through our two licensed electricity distribution network areas, Scottish Hydro Electric Power Distribution (SHEPD) and Southern Electric Power Distribution (SEPD), we deliver power to over 3.9m homes and businesses, with over 106,000 substations and pole-mounted transformers and 130,000 km of overhead lines and underground cables across one third of the UK land mass.

We serve some of the most diverse and unique geographies across the UK, and keep customers and communities connected whilst developing the flexible electricity network vital to achieving net zero. Our network serves some of the UK's most remote communities and also some of the most densely populated. Our two networks cover the greatest land mass of any of the UK's DNOs, covering 72 local authority areas and 75,000km2 of extremely diverse terrain.

Our core purpose is to power communities to thrive today and create a net zero tomorrow. We have a responsibility to supply customers with safe and reliable power, allowing them to focus on the things that matter most, while we work hard to build a smarter, flexible, greener network that's fit for the future.

SSEN is part of SSE, a UK-listed company that operates across the energy sector and its activities and investments contribute around £9bn to the UK economy every year.

### Scottish Hydro Electric Power Distribution (SHEPD)

The electricity distribution network in the north of Scotland covers a quarter of the UK landmass, powering over 780,000 homes and businesses across 13 local authority areas and serves island communities across 59 inhabited islands and through 113 dedicated subsea cable installations. The licence area stretches northwards from Loch Lomond and Dundee up to Orkney and the Shetland Islands. It is a unique region, containing the farthest western and northern mainland points in Great Britain.

As our communities strive to meet their net zero ambitions, we're preparing our network to accommodate the uptake of low carbon technologies across the region and significant increase in local generation connections.

# EXECUTIVE SUMMARY

### Introduction

From a Great Britain perspective, our SHEPD network faces unique challenges as it transitions to net zero and our investment in the north of Scotland during RIIO-ED2 will be the foundation for our net zero future. We serve the needs of our customers located across 59 inhabited Scottish islands via an extensive subsea network and Distributed Embedded Generation (DEG) stations, which is a unique responsibility. Our island networks connect some of our most remote communities and large amounts of renewable generation critical to meeting net zero targets across the country.

The need to consider the future requirements of these communities formed an important component of our RIIO-ED2 business plan and was recognised by Ofgem through the introduction of dedicated mechanisms including the Hebrides and Orkney Whole System Uncertainty Mechanism (HOWSUM) re-opener, designed to deal with the region's set of unique circumstances. Through this process there was general recognition of the need to take whole system approaches in designing and delivering solutions for the Scottish islands.

The Hebridean and Orkney island groups share common drivers for change but form geographically and electrically separate areas with more interactions with the adjacent sections of the Scottish mainland than with each other. Recognising this, we are applying a similar methodology to the three island groups of:

1. Outer Hebrides;
2. Inner Hebrides (Mull – Coll – Tiree and Jura – Islay); and
3. the Orkneys;

but are progressing each area separately, subject to specific island group drivers. Such an approach allows us to tune the options developed to meet the need of specific communities and industries, whilst also allowing us to understand and leverage learning opportunities from our approaches.

Across all three island groups we have considered future system needs through to 2050. We are taking whole system views understanding the future energy needs and ensuring our proposals consider factors such as transmission developments, the use of flexibility and emerging technologies.

We understand the inherent uncertainties associated with such long-term projections of demand and generation requirements. We are therefore taking an approach of progressing least regrets elements with immediate drivers for change, whilst continuing to review and refine our longer-term needs. Such an approach allows us to proactively develop our network ahead of need whilst also ensuring we are making efficient decisions for the consumer through minimising the risk of early sub-optimal investment. We will also be ensuring that non-network options are considered as part of this development work including the use of flexibility services provisioned from third parties as applicable. This aligns with stakeholder feedback and interest in these developments.

This January 2024 application document focuses primarily on the future needs of the Outer Hebrides islands group, while also addressing the Pentland Firth East 3 project which is now complete, further, to being progressed in response to an unexpected fault in 2022. We will continue to develop our proposals for all three island groups in 2024 to provide a second regulatory application in the agreed January 2025 window. This will allow us to consider stakeholder insights from our 2023 islands focused engagement as well as take onboard learnings from our 2023 work programme to refine our approach.

### Drivers for change and factors considered

We have worked with stakeholders to identify a number of critical drivers for change. These have been considered in the development of our proposals with further context provided later in this application document.

- *Future demand and generation requirements for the islands:* We need to ensure our networks are appropriately sized to meet the requirements of parties who wish to connect to and use our assets. We have assessed future needs against our DFES forecasts through to 2050 and worked with Regen to gain further specific insights.
- *Subsea cable asset condition*: Another key driver for our works is to maintain and, as needed, replace our submarine cables. These cables exist in extreme environmental conditions and a cable that fails can take many months to locate and repair or in worst case scenarios completely replace.
- *Continued island resilience:* Resilience conditions for Scottish islands are unique given the geographies and potential lengthy system outages in the unlikely event of a subsea cable fault. We have developed a specific net zero policy for the treatment of these island groups recognising the impacts of decarbonisation on electrification of heat and transport.
- *Decarbonisation of our diesel generation fleet:* This is a significant source of carbon emissions for SHEPD when required to run for long periods of time. Emissions reached 2238.49t$CO_2$-e in 2022/23 across the fleet, and we must reduce these to meet our 1.5-degree Science Based Target (SBT).

### Overview of the Outer Hebrides whole system solution

The Outer Hebrides consists of around 70 islands located off the west coast of Scotland with around 26,000 inhabitants.

Electrically the islands are fed from a transmission network through Skye which connects to Lewis and Harris via a 33kV subsea cable link. This is shown by the blue line in the diagram below.

The Uist archipelago is fed from Ardmore Grid Supply Point (GSP) on Skye via a 33kV subsea cable to Loch Carnan. This is shown by a green line on Figure 1 below.

The diagram also shows the location of the main diesel generation stations used to provide back-up supplies in the event of loss of supply from the in-feeding network.


Figure 1: Map of Outer Hebrides and existing electricity infrastructure

The Outer Hebrides have been our first priority within HOWSUM due to the past performance of the Skye – Harris cable which failed in 2020 and required replacement. Given the similar relative age of the Skye – Uist 33kV cable and the environment where it is also installed, we see this as a priority for replacement, and this is strongly supported by local stakeholders.

Whilst this specific need has driven the urgency for our work, our proposals have considered the full range of drivers and provide a whole system strategy of the future requirements for the Outer Hebrides through to 2050. This strategy has considered:

- The timing of future system needs to ensure solutions are delivered ahead of need.
- The future-proofing solutions to ensure that they provide capacity for future requirements and also minimise any loss of future optionality, assessed on a whole system basis.
- The relative merits of timing of implementation of solutions, e.g. efficiency of an early delivery of multiple cable deliveries in parallel, but with loss of future benefits such as optionality for longer term developments.

We have determined that not all elements need to be delivered now reflecting the uncertainty in future demand and generation requirements. We are therefore taking a phased approach to delivering our strategy.

In this application we provide detail on works that need to be delivered before the end of RIIO-ED2 which are illustrated in Figure 2.


Figure 2: Map of Outer Hebrides development proposals to be undertaken for delivery in RIIO-ED2 (by 2028)

Our overall strategic plan out to 2050 is shown diagrammatically in Figure 3 below once all the key components of the delivered network strategy become operational. This has been developed through engagement with stakeholders with webinars and bilateral meetings held through the Autumn. An initial list of 30 options was developed that was refined through both technical feasibility and cost assessments.

This solution will meet the electricity needs of our current and future customers on the Outer Hebrides. Through creation of interconnected networks between islands we will provide the appropriate level of resilience and either remove or significantly reduce the future need to operate our diesel generators.

Our process and our proposed solution has been discussed with stakeholders through both webinars and bilateral meetings. Stakeholders are supportive of a process which starts by looking at the drivers for change. On the solution we have been told us that they value greater connectivity between island groups and the resilience it brings. Stakeholders are also supportive of our phased approach of focusing on urgent works early and retaining optionality in our future plans.


Figure 3: Map of Outer Hebrides strategic plan out to 2050

### Overview of Orkney whole system solution

The existing Orkney network is fed via two 33kV cables from the mainland. Our application contains funding for the emergency replacement of one of these cables, Pentland Firth East 3, which has now been completed. In 2024 we will consider the future requirements for the Orkney islands accounting for transmission developments including the proposed 220kV AC link to Finstown.

### January 2024 application overview

Our January 2024 application consists of four discrete elements:

#### *Outer Hebrides*

- Skye – South Uist 33kV cable replacement – **installation of new 33kV circuit between Dunvegan GSP and Loch Carnan 33kV switching station**. The replacement circuit will be of **larger capacity to meet future forecast needs**. It will consist of approximately 37.6km of subsea cable, 15km of overhead line and 1.5km of underground cable. This is expected to be delivered in 2027/28. We are also developing a mitigation solution to both potentially bring this date forwards and also manage either the unlikely event of a cable failure or potential consenting challenges.

- Eriskay – Barra 11kV cable augmentation– **installation of a second 10.7km Eriskay – Barra cable to support intervention on the existing cable**. It is not proposed to remove the existing cable until after failure. The installation of the new cable is programmed for mid-2027 though could move if more efficient to bundle with other works as part of a wider campaign of installations. **The cable will maintain resilience and has been sized to meet forecast needs to 2050**.
- South Uist – Eriskay 11kV cable replacement – **replacement of existing subsea cable with a land-based solution across the Eriskay Causeway** and associated decommissioning of existing 11kV submarine cable. This will be designed and consented through 2025/26 with installation in later 2026/27. **The solution will maintain resilience and has been sized to meet forecast needs to 2050**.

### *Orkney*

- Pentland Firth East 3 (PFE3) 33kV cable replacement – recovery of costs from completed cable replacement with **larger 500mm² 33kV cable from Thurso to Scorradale**, following failure of Pentland Firth East 2 cable in January 2021. **The cable is operational and will play a core role in the future whole system solution for the Orkney islands**.

Table 1 sets out a summary of our project recommendations and the summary of the requested allowance adjustment.

In this application, we are specifically requesting funding for Eriskay – Barra, South Uist – Eriskay and Pentland Firth East 3. These costs are discrete from the Skye – South Uist replacement and can be progressed at Ofgem's earliest convenience.

We are now in the process of tendering out the solution for the Skye – South Uist cable replacement, and as such this application represents the first stage of the re-opener process for this work and focuses on outlining the needs case for investment and the preferred solution. This will be followed by a second stage application, which will outline costs, in summer 2024. We propose to work closely with Ofgem and our stakeholders in the interim to ensure that the needs case and proposed solution is well-understood and tested. We hope that this approach will help expedite Ofgem's decision making process allowing us to move quickly with delivery.

| **Adjustment summary (£m, 2020/21)** | **2023/24** | **2024/25** | **2025/26** | **2026/27** | **2027/28** | **Total** |
|---|---|---|---|---|---|---|
| Skye – Uist | - | - | - | [redacted]* | [redacted]* | [redacted]* |
| South Uist – Eriskay | - | - | - | [redacted] | - | [redacted] |
| Eriskay – Barra | - | - | - | [redacted] | - | [redacted] |
| Pentland Firth East 3 | [redacted] | - | - | - | - | [redacted] |
| **Total adjustment (excl. Skye-Uist costs and development costs)** | [redacted] | **-** | **-** | [redacted] | **-** | **£46.28m** |

**Notes:**
* These are estimated costs provided prior to carrying our procurement process. SHEPD will submit its costs for the specific Skye – Uist element for assessment by the 31st July 2024.
All values are net of development costs already funded through RIIO-ED2 HOWSUM Development Funding.

Table 1: Project and allowance adjustment summary

### January 2025 application outline

We will continue to develop our proposals for the Hebridean and Orkney island groups and have already engaged with stakeholders from all island groups. There are more complexities to be considered in these groups where it has been necessary to take a more considered approach to understand the correct timing for known developments and ensure the most efficient deployment of the right long-term investment is proposed which is why we have phased certain aspects.

At this time, we anticipate our January 2025 application will be comprised of the following elements:

- Orkney whole system solution to 2050 building on the SSEN Transmission AC link proposals and how best to support the security and export needs following the completion of the Pentland Firth East No3 circuit included within this application.
- A 2050 whole system solution for the Inner Hebridean island groups of:
    - Mainland – Islay – Jura – Colonsay to address improved security of supply to Islay and Jura with options to remove the reliance on Bowmore DEG decarbonisation options, incorporating considerations of the Machair offshore wind and other renewable resources and technologies.
    - Mainland – Mull – Coll – Tiree by incorporating our planned investment in Coll – Tiree cable replacement with a wider whole system review to address options for removal of reliance on Tiree DEG through renewable, flexibility options or other energy storage.
- Updated plans for our 2050 whole system solution for the Outer Hebrides (North Uist – Harris and Skye – Harris) outlined in this proposal but with more specific detail.

This will allow us to consider stakeholder insights from 2023 islands focused engagement as well as take onboard learnings from our 2023 work programme to refine our approach.

# MEETING OFGEM'S REQUIREMENTS

## Structure of this application

Our application consists of:

- a core narrative document developed to address the requirements of Ofgem's Re-opener Guidance for all of the recommended solutions included in our application,
- Engineering Justification Papers and Cost Benefit Analyses for each of the recommended solutions, and
- appendices consisting of supporting consultant reports on the technical and cost benefit analysis.

The structure and outline content of this application is illustrated in Figure 4.

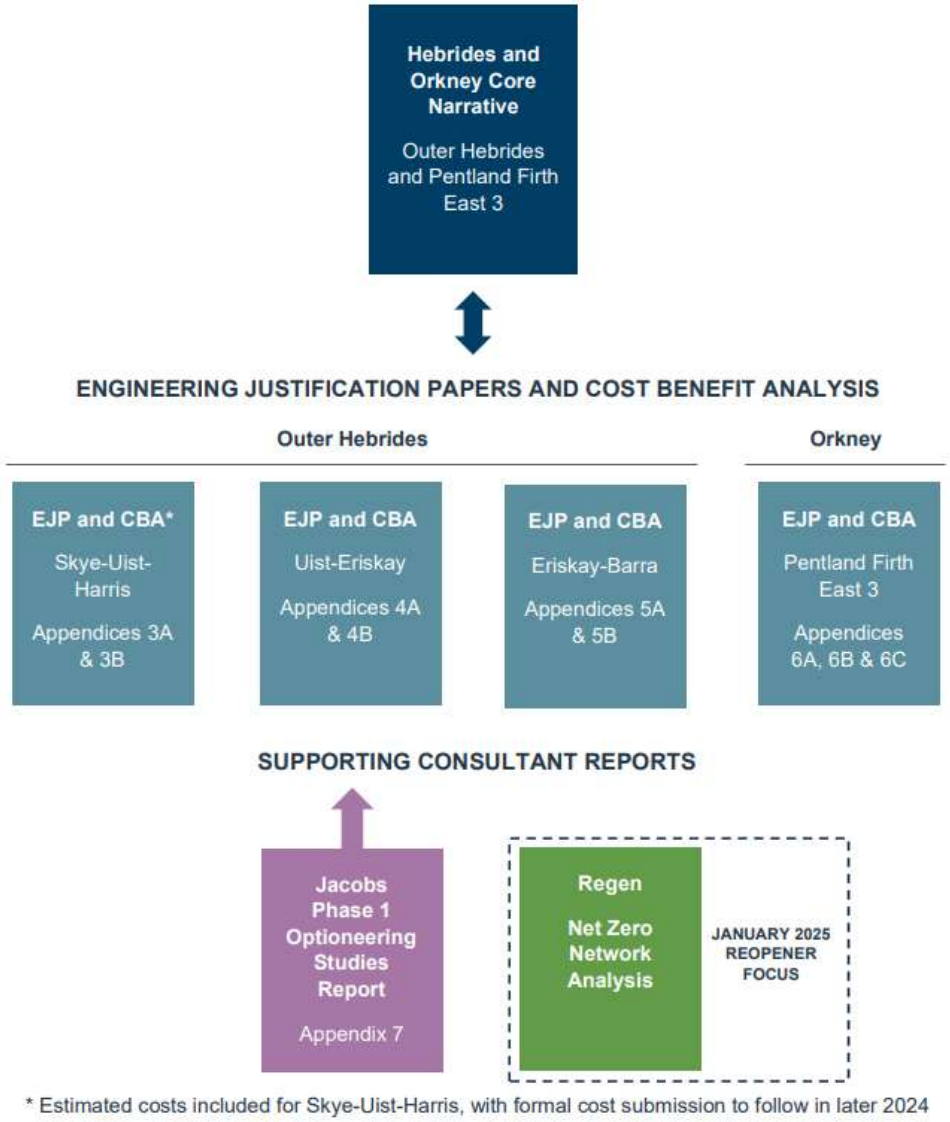



Figure 4: SHEPD January 2024 HOWSUM application structure

As noted below, agreed with Ofgem and explained further later in this document, estimated costs have been included for the Skye – Uist – Harris recommendation, with the formal cost submission to be made later in 2024 following procurement processes.

## Ofgem re-opener requirements

Table 2 sets out how we meet Ofgem's Re-Opener Licence requirements in this application.

| Ofgem Re-Opener Licence requirement | Requirement met? | How addressed |
|---|---|---|
| (a) the licensee has incurred or expects to incur costs as a result of changes to the scope or timing of work relating to twelve subsea cables:<br>i. Skye to Uist (North route);<br>ii. Skye to Uist (South route);<br>iii. Pentland Firth West;<br>iv. Pentland Firth East;<br>v. Mainland Orkney – Hoy South;<br>vi. Orkney (additional 66kV circuit)<br>vii. Eriskay – Barra 2;<br>viii. South Uist – Eriskay;<br>ix. Mull to Coll (double circuit);<br>x. Coll – Tiree (double circuit);<br>xi. Mainland – Jura (double circuit); and<br>xii. Jura – Islay (double circuit); or | ✓ | SHEPD has incurred or expects to incur costs for Pentland Firth East, Skye – Uist, Uist – Eriskay and Eriskay – Barra. |
| (b) the licensee has incurred costs associated with ensuring security of supply in the Scottish islands, and can demonstrate efficient whole systems considerations have been taken into account, including considering alternative activities to installing the cables listed; or | N/A | |
| (c) the licensee has incurred or expects to incur costs associated with the outcomes of additional whole system analysis in the Scottish Islands to contribute to net zero Carbon Targets and ensure long-term security of supply, including any alternative activities to installing the cables outlined in 3.2.105(a); and | ✓ | This application includes interventions which are associated with the outcomes of whole system analysis in the Scottish islands to contribute to net zero carbon targets and ensure long-term security of supply. |
| the change in those costs in paragraphs 3.2.105(a) or 3.2.105(b) exceeds the Materiality Threshold and are not otherwise funded by the special conditions. | ✓ | The costs incurred or expected to be incurred exceed the Materiality Threshold (£2.26m). |

Table 2: Mapping Ofgem's Re-Opener Licence requirements

Table 3 sets out where we meet Ofgem's Re-Opener Guidance requirements in this application.

| Ofgem Re-Opener Guidance requirement | Requirement met? | Where addressed |
|---|---|---|
| Needs Case and Preferred Option | ✓ | Section 3, EJPs and Jacobs Stage 1 report |
| Stakeholder Engagement and Whole System Opportunities | ✓ | Section 4 and EJPs |

| Ofgem Re-Opener Guidance requirement | Requirement met? | Where addressed |
|---|---|---|
| Cost Information | ✓ | Section 5, EJPs and CBAs |
| Cost Benefit Analysis and Engineering Justifications | ✓ | Section 6, EJPs, CBAs and Jacobs Stage 1 report |

Table 3: Mapping Ofgem's Re-Opener Guidance requirements

# Summary of bilateral engagement

We have held a number of meetings with Ofgem ahead of this re-opener application. Key areas of focus and outcomes to date are summarised in Table 4.

| Engagement (date) | Scope | Discussion and outcomes |
|---|---|---|
| 28 September 2023 | Introductory core meeting | SHEPD introductory recap on HOWSUM development, licence provision, geography, outline whole system approach, and proposed way forward. |
| 23 October 2023 | Engineering Hub introductory meeting | Discussion on technical considerations for HOWSUM interventions. |
| 26 October 2023 | Second core meeting: | SHEPD process update; stakeholder engagement update (webinar); whole system approach update; phased intervention approach; phased submission approach; Ofgem considering phased submission approach. |
| 23 November 2023 | Third core meeting: | SHEPD process update; agreement to focus on PFE3 and phased submission approach in next engagement. |
| 11 December 2023 | PFE3 focus meeting | SHEPD PFE3 summary paper; Ofgem queries on specific PFE3 aspects (see PFE EJP); Ofgem to provide feedback on PFE3 executive summary in advance of re-opener window. |
| 14 December 2023 | Fourth core meeting: | SHEPD process update; stakeholder engagement update (webinar); Ofgem confirms no objection to SHEPD phased submission approach. |
| 12 January 2024 | Fifth core meeting | SHEPD process update; update on Skye – Uist route options. |
| 25 January 2024 | Sixth core meeting | SHEPD update on application recommendations, summer 2024 cost submission, Island Resilience strategy, and next steps. |

Table 4: Recent bilateral engagement on HOWSUM

# Planned HOWSUM submission phasing

Table 5 summarises our approach to phasing interventions across the HOWSUM re-opener windows, interim decision timeframes, and looking forward to RIIO-ED3. This phased approach has been supported by stakeholders at our webinars and bilateral meetings. Note this does not capture our intended applications for Orkney or the Inner Hebrides, which we plan to make at the January 2025 re-opener window and also as part of our RIIO-ED3 application.

| | Decision sought at January 2024 re-opener | | Decision sought in later 2024 | | Decision sought at January 2025 re-opener | | Rationale |
|---|---|---|---|---|---|---|---|
| | Needs case, technical solution | Costs | Needs case, technical solution | Costs | Needs case, technical solution | Cost | |
| **Pentland Firth East 3** (Cable solution implemented) | ✓ | ✓ | | | | | Intervention required upon failure of PFE2; costs are outturn |
| **Uist-Eriskay solution** (Causeway solution recommended) | ✓ | ✓ | - | - | - | - | Intervention required within RIIO-ED2; justified on basis of least regret; not impacted by or enables wider options; costs estimated with reasonable certainty |
| **Eriskay-Barra solution** (Cable solution recommended) | ✓ | ✓ | - | - | - | - | |
| **Skye-Uist solution – Phase 1** (Cable solution proposed) | ✓ | - | - | ✓ | - | - | Intervention required earlier within ED2; justified on basis of least regret; not impacted by or enables wider options; costs uncertain until tender results later summer 2024 |
| **Skye-Uist-Harris solution – Phase 2** (Potential cable, flexibility, DEG solutions) | Outline information | - | - | - | ✓ | ✓ | Intervention required later in ED2; incorporates outstanding whole system analysis; costs not yet known |
| ***Outer Hebrides solutions – Phase 3*** *(potential cable, flexibility, DEG, wider solutions expected)* | Outline information | - | - | - | Outline information | - | *Intervention required in ED3* |

Table 5: HOWSUM windows submission plan

### Drivers for phased submission

The rationale for requesting a phased assessment for the Skye – Uist – Harris option specifically, whereby we have submitted the Needs Case / Preferred Option now and will submit the formal cost element later in 2024, is driven by the procurement programme for that solution.

This first part of the re-opener application, including Needs Cases and Preferred Options for all recommended interventions, and costs for all recommended interventions except Skye – Uist, will enable Ofgem to understand the drivers for the work, to assess that our technical solutions are least regrets activities and the most efficient solutions, and to assess costs for all projects for which cost submissions are included (all projects except Skye – Uist).

In parallel to this we will use the HOWSUM Development Funding allowed by Ofgem to progress desktop analysis, subsea surveying, and procurement activities for the Skye – Uist project, to generate accurate costs to complete the work. The subsea construction vessel market is oversubscribed, in part due to high oil prices and in part due to widespread offshore wind farm construction, which was acknowledged by Ofgem in its Final Determinations.[1] The existing supply chain with the capability to do this work is small. There have recently been unprecedented cost increases, driven by resource constraints increasing labour costs, the Ukraine conflict impacting on global supply chain, price increases and scarcity of materials, and a high oil price increasing day rates for installation vessels.

Given the anticipated scale of costs, and current market conditions, we have made the case to Ofgem that our cost submission for Skye – Uist specifically should be based on actual tendered costs rather than an estimated view, meaning we will present the refined costs for this element of the application later in summer 2024. Taking this approach allows us to progress work on the project as quickly as possible.

1 RIIO-ED2 Final Determinations SSEN Annex (Ofgem.gov.uk), Section 3.2.4 - November 2022

For the purpose of the Skye – Uist intervention in this application we have used recent costs for similar projects to develop an appropriate estimated view of costs to inform our CBA.

The primary driver for intervention on the Skye – Uist element is that the cable is at significant risk of failure in the near future. A cable of comparable characteristics between Skye – Harris failed in 2020. The secondary driver is future demand and generation needs. We consider its replacement relatively urgent, and it would not be prudent to delay associated delivery processes until after the assessment period associated with the January 2025 re-opener window.

We will therefore follow up with the Skye – Uist cost element of the application in later summer 2024 when we will have completed the first stage of our tender process. As noted, we will progress survey work on the recommended route in the meantime using HOWSUM Development Funding.

# Related documents

**Ofgem Draft Determinations[2] including SSEN Annex**

**Ofgem Final Determinations[3] including SSEN Annex**

**SSEN Business Plan[4] including Islands Annex**

**SHEPD Special Licence Conditions[5] specifically Special Condition 3.2, Part O**

# Application contact point

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2 RIIO-ED2 Draft Determinations | Ofgem

3 RIIO-ED2 Final Determinations | Ofgem

4 Home - SSEN Future

5 Decision on the proposed modifications to the RIIO-2 Electricity Distribution licences | Ofgem

# 1. ADJUSTMENT SUMMARY

Table 6 provides a high-level summary of the adjustment relevant to this re-opener application.

It was agreed as part of RIIO-ED2 Final Determinations that SHEPD would receive development funding for HOWSUM projects. The adjustment summary takes account of this funding by defining the development costs associated with each recommended solution and deducting the development costs from the funding request and associated allowance adjustment.

We highlight that while we have included our technical recommendation for the Skye – Uist project in this application, no funding request has been included for the project at this stage – as agreed with Ofgem, SHEPD will submit its costs for this specific element for assessment later in 2024. All other project costs are included for assessment at this January 2024 re-opener window.

| **Adjustment summary (£m, 2020/21)** | **2023/24** | **2024/25** | **2025/26** | **2026/27** | **2027/28** | **Total** |
|---|---|---|---|---|---|---|
| **Baseline RIIO-ED2 allowances:** | | | | | | |
| **HOWSUM development funding** | | | | | | £20.63m |
| **Adjustment request:** | | | | | | |
| **Skye – Uist** | - | - | - | [redacted] | [redacted] | [redacted] |
| – *Development costs* | [redacted] | [redacted] | [redacted] | - | - | [redacted] |
| **Uist – Eriskay** | - | - | - | [redacted] | - | [redacted] |
| – *Development costs* | - | - | [redacted] | - | - | [redacted] |
| **Eriskay – Barra** | - | - | - | [redacted] | - | [redacted] |
| – *Development costs* | - | - | [redacted] | - | - | [redacted] |
| **Pentland Firth East 3** | [redacted] | - | - | - | - | [redacted] |
| – *Development costs* | - | - | - | - | - | - |
| **Total adjustment (excl. development and Skye – Uist costs)** | [redacted] | **-** | **-** | [redacted] | **-** | **£46.28m** |
| – ***Total development costs*** | [redacted] | [redacted] | [redacted] | **-** | **-** | ***£13.2m*** |

**Notes:**
1. The HOWSUM Development Funding provision of £20.6m was provided to cover development funding for HOWSUM-eligible projects. See Section 5.1 for more information.
2. No formal funding request for the Skye – Uist project is included in this re-opener application, and all cost values are estimated. SHEPD will submit its costs for this specific element for assessment later in 2024.
3. Pentland Firth East 3 development costs are not covered by the HOWSUM Development Funding provision.

Table 6: Adjustment summary

# 2. INTRODUCTION

## 2.1. Background to investment

SHEPD submitted proposals to Ofgem for the North of Scotland region in its RIIO-ED2 Business Plan, including the HOWSUM, to provide for flexible adjustment of cost allowances for investment in subsea cables and whole system investment options that aim to increase resilience, and reduce our reliance on island diesel embedded generation over the 5-year price control and beyond.

We included a number of proposals for managing the Scottish islands in our RIIO-ED2 Business Plan, including:

- PCDs for subsea cable replacement, for strategic subsea cable upgrades, and embedded generation,
- A fix-on-fail volume driver for subsea cables,
- Re-openers for subsea cable decommissioning and use of remote generation during network outages.

In our final Business Plan, we included an early-stage form of the HOWSUM proposal. In April 2022, Ofgem proposed that the HOWSUM could be included in Draft Determinations if SHEPD could provide additional clarity on its proposed operation, including a re-calibration of investments where the needs cases were conditional on the outcome of whole system analysis for the islands. We carried out this work and at that point moved £70.44m for Scottish Island funding out of baseline, into the assumed scope of the HOWSUM.

At Draft Determinations Ofgem rejected all of the noted bespoke subsea cable and embedded generation mechanisms except HOWSUM, and confirmed that strategic subsea cable upgrades would be covered by HOWSUM.[6] In response to Draft Determinations, SHEPD also asked for PFE3, the replacement for PFE2, to be included in the scope of HOWSUM.

In its Final Determinations Ofgem confirmed its decision to include Pentland Firth East 3 (PFE3) and the Skye – Uist South cable in the scope of HOWSUM; and confirmed the provision of £20.6m development funding for HOWSUM pre-construction and whole system analysis.

Ofgem ultimately determined at Final Determinations stage to remove associated funding for all HOWSUM-related interventions from SHEPD's baseline allowances and provide the HOWSUM as the confirmed route for funding these costs.

Figure 5 summarises the treatment of HOWSUM-eligible projects and the historical development of the HOWSUM mechanism.

6 RIIO-ED2 Draft Determinations SSEN Annex (ofgem.gov.uk), Section 4 – June 2022

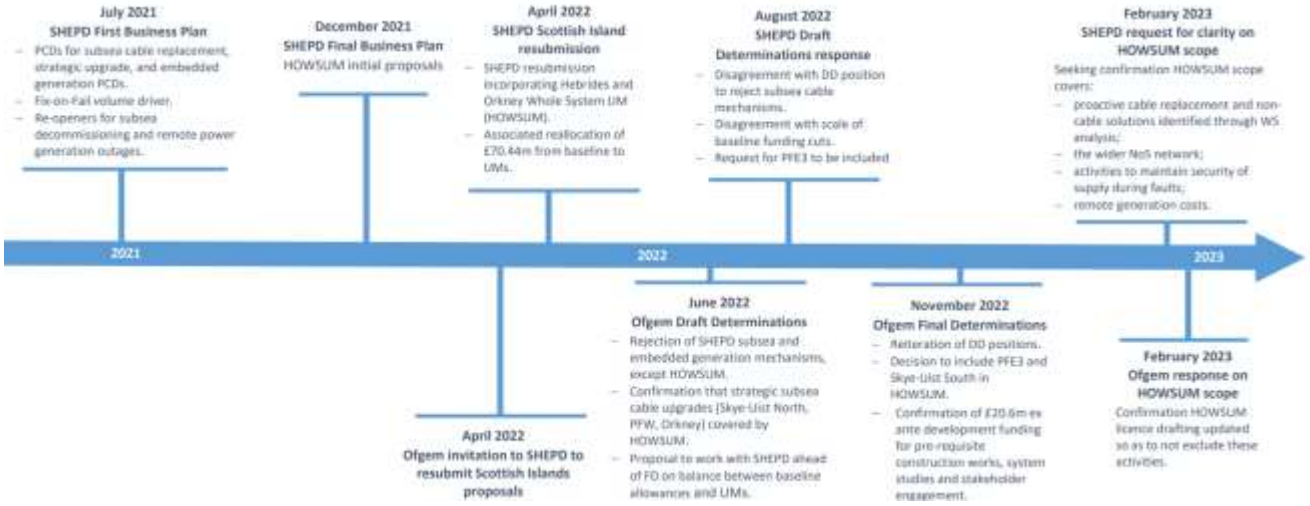


Figure 5: Ofgem and SHEPD engagement on HOWSUM mechanism

More information on the role of the HOWSUM Development Funding is included at Sections 1, 3.7.8 and 5.1.1.

## 2.2. Approach to island groups

The Hebrides and Orkney islands can be considered as three main island groups:

- the Outer Hebrides, in orange on Figure 6 below, comprising Lewis, Harris, North and South Uist, Eriskay and Barra;
- Orkney, which is in purple on the map, the main islands and stretches of water relevant for RIIO-ED2 purposes being the Mainland, Hoy, Shapinsay, and the Pentland Firth between Orkney and mainland UK, and
- the Inner Hebrides, in green, relevant islands for RIIO-ED2 being Coll, Tiree, Jura, Islay, Mull, Iona.

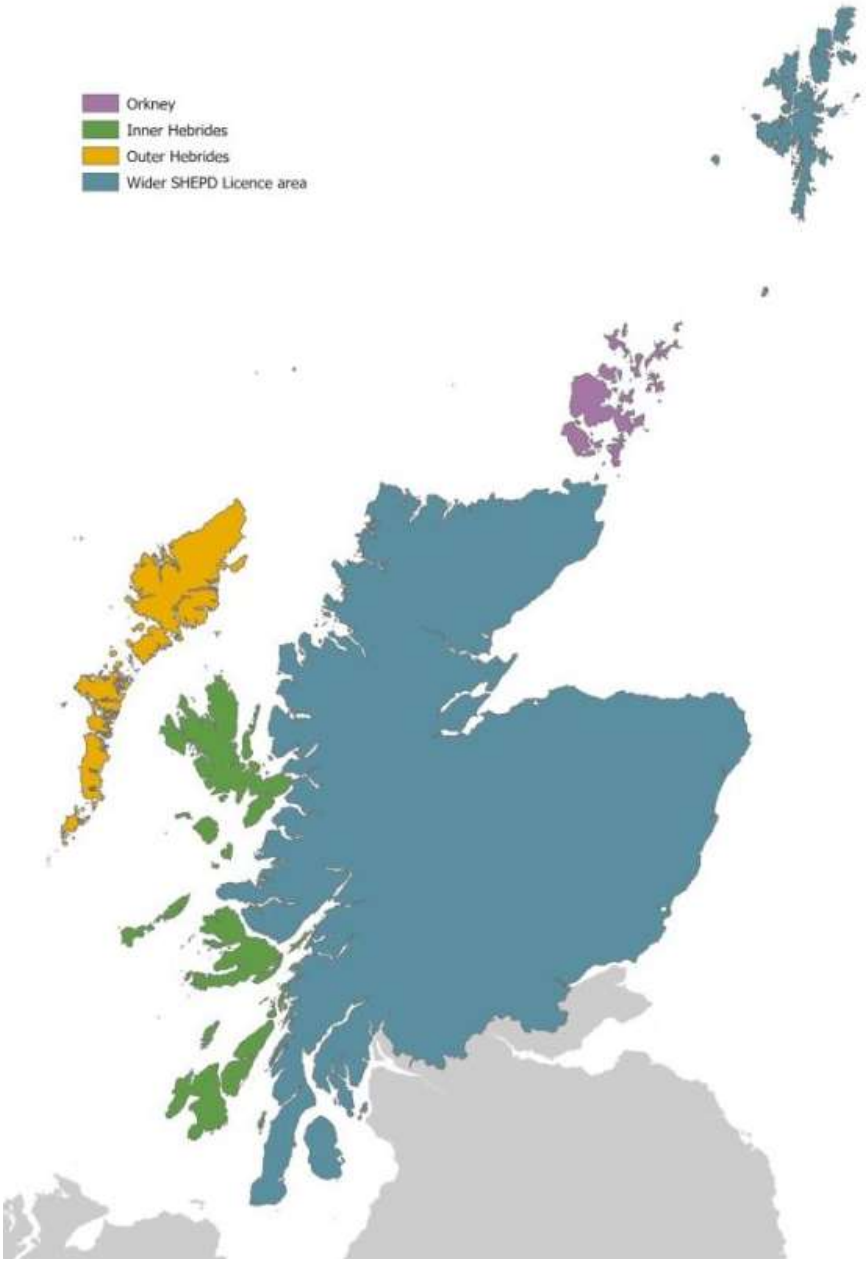


Figure 6: Scottish island group locations

The HOWSUM defines certain circuits across the Hebrides and Orkney as being eligible for funding, including the following associated with the Outer Hebrides:

- Skye – Uist (South)
- Skye – Uist (North)
- Eriskay – Barra 2
- South Uist – Eriskay

Our approach to interventions takes account of the geographically and electrically distinct nature of the island groups. Recognising this we are taking a similar approach to the island groups of but are progressing each area separately, subject to specific island group drivers. Such an approach allows us to understand and leverage learning opportunities from our approaches, whilst also allowing us to dial the options developed to meet the need of specific communities and industries.

Our whole system analysis and this application has been commissioned to identify the correct enduring solution for, firstly, the Outer Hebrides islands group, meeting our commitment to achieve net zero by 2045 and the drive to decarbonise the electricity network by 2035, in addition to the completed Pentland Firth East 3 solution.

We will bring forward analysis and recommendations for Orkney and the Inner Hebrides at the January 2025 HOWSUM re-opener window and in RIIO-ED3 as appropriate.

## 2.3. Primary and secondary investment drivers

### Outer Hebrides

This section covers the elements of a long-term strategy for the Outer Hebrides that requires to be progressed now, and for which we are seeking approval for funding at this time. The primary investment drivers for completing this work are on the basis of condition. All three cables targeted for intervention are aged subsea cables which are approaching the end of their asset life.

There are also a number of secondary drivers for our proposals. Whilst these are longer term drivers we have taken them into account both in the development of our longer-term strategy and also in the sizing of cables and other circuit elements within this application. These are:

1. **Future demand and generation requirements on the islands:** We have investigated future demand and generation backgrounds, ensuring cable sizing will allow the forecast import and export of power to the islands.
2. **Future resilience needs of the islands:** Currently our diesel generation fleet provides back-up supplies for the islands, which assist us in remaining compliant with both network planning standard P2/8[7] and the Distribution Code[8] on security of supply for these islands[9]. However these generators are aging, and are a significant source of carbon for our distribution business. Indeed, carbon emissions form a further driver for our proposals in this regard.

In addition to these drivers there are a number of other factors we have taken into account including the potential use of flexibility to defer traditional assessment, and the impact of SSEN Transmission's HVDC works.

### Pentland Firth East 3

The primary investment driver for PFE3 was the immediate need to manage security of supply, which arose when the PFE2 cable failed in February 2021. From that stage, the Orkney islands were reliant upon the single grid connection provided by PFW alongside support from Kirkwall Power Station (KPS) to meet security of supply requirements. KPS was required to peak lop in periods of high demand.

7 ENA EREC P2 Issue 8 (dcode.org.uk)

8 Specifically PO-PS-037 in Distribution Code Annex 1; Microsoft Word - Section 11 Notice - Schedule 2 - POPS037.doc (Ofgem.gov.uk)

9 For Lewis and Harris and also smaller parts of these networks, exemptions are in place.

## 2.4. Timing of investment

### Outer Hebrides

Funding is sought for the replacement of three cables connecting Uist, Eriskay and Barra to the mainland. The main driver for this work is asset health and network risk, and we are keen to progress works as soon as funding is secured. To mitigate any delays, we are proceeding with cable route surveys in parallel to this application which will enable us to provide tendered costs for the Skye – Uist solution to Ofgem in summer 2024. These works are least regrets activities recognising the drivers for the Skye – Uist intervention, the need for the Uist archipelago to remain connected to the main GB electricity system, and the drivers for and substantively discrete nature of the Uist – Eriskay and Eriskay – Barra interventions.

We have also included further proposed works in our long-term plan for the Outer Hebrides. Whilst there may be efficiencies through delivering these works alongside the works quoted above, we recognise this potential benefit is outweighed by the longer-term loss of optionality for the islands. Given the emerging nature of technologies such as hydrogen storage we maintain the option of keeping these elements under review. We continue to develop these proposals with a view to making associated recommendations in either the January 2025 HOWSUM application window and / or RIIO-ED3. In assessing the least regrets options and taking account of the long-term DFES and wider forecast network interactions, including the standby stations, renewables and other energy projects and transmission developments, we are ensuring that the options we assess and take forward are compatible with an economic whole system solution for the islands. Where there are demonstrable efficiencies, we will look to align these longer-term works. We will also look to utilise flexibility to help assist in the timing of works.

Our long-term plan has been developed consistently with our broader approach to strategic investment requirements. This process is described in more detail in Section 3, 'Needs Case and Preferred Option'. Further to our current analysis, our long-term strategy will be most optimally delivered through three main elements:

1. **Immediate requirements that need progressing in RIIO-ED2**
    a. **Near-term least regrets options:** These are least regrets options that resolve immediate drivers and risks, whilst delivering solutions that form part of the least regrets solutions for 2050, and do not preclude, but enable, the wider whole system solution. This includes our proposal to progress replacing the existing Skye – Uist subsea cable with a new larger capacity cable. This removes operational risk for our customers, whilst sizing the cable to meet future demands. This option is considered an integral piece of all feasible solutions offered and facilitates optionality at later stages.

    In this stage we also plan to progress replacing the existing Uist – Eriskay and Eriskay – Barra subsea cables.
2. **Longer term whole system requirements**
    a. **Capacity increase to Harris and Lewis:** There is a need to increase the capacity of the network to Lewis / Harris, i.e. augmenting the existing subsea cable or replacing it with a single larger cable at 132kV. Island storage will be assessed as an alternative along with flexibility to help defer works.
    b. **Long term resilience for the Outer Hebrides:** Additional distribution circuitry between Harris and Uist will help deliver longer term resilience to the island group taking advantage of the new transmission infeed from the HVDC link. This will reduce our reliance on the aged diesel generation fleet by 2035 whilst also allowing other third-party options including hydrogen storage[10] to further develop.

10 Green hydrogen future for Outer Hebrides with major clean energy investment — Making Hydrogen Happen | PlusZero

### Pentland Firth East 3

PFE3 has been delivered in 2023/24 and all of the costs associated with the project will be reported in year 2023/24.

## 2.5. Expected outputs

Table 7 details key expected outputs associated with our recommended interventions.

| Project element | Key outputs | Forecast delivery dates[1] |
|---|---|---|
| **Skye – Uist – Harris** | New 33kV subsea cable and Overhead line Skye – Uist | Forecast delivery 2027/28[2] |
| | New 33kV subsea cable Skye – Harris | Forecast delivery 2032 |
| | New 33kV subsea cable and Overhead line Harris – Uist | Forecast delivery 2035 |
| **South Uist – Eriskay** | New land-based South Uist – Eriskay 11kV solution through existing causeway.<br>New 11kV OHL and 11kV U/G Cable.<br>Abandon existing subsea cable | Forecast delivery 2026/27 |
| **Eriskay – Barra** | New 11kV subsea cable | Forecast delivery 2027 |
| **Pentland Firth East 3** | New 33kV subsea cable<br>New 33kV shunt reactor | Delivered 2023/24 |

[1] Delivery dates are estimated, not wholly within our control and will be refined as projects are further developed.
[2] Delivery date subject to consenting approval of overhead route through Skye. We are in parallel progressing a subsea alternative that could be used to accelerate the programme to delivery in 2026.

Table 7: Expected key outputs and years of delivery for January 2024 HOWSUM application interventions

# 3. NEEDS CASE AND PREFERRED OPTION

## 3.1. Alignment with business strategy and commitments

Drafting the SHEPD RIIO-ED2 Business Plan was a multi-year process of gathering extensive stakeholder feedback through targeted engagement, coupled together with robust asset health data. This was done using standard Common Network Asset Indices Methodology (CNAIM)[11:] 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. The Business Plan concluded that proactive strategic investment is required on the subsea and islands networks of the Hebrides and Orkney islands. We have continued and deepened our HOWSUM-focused stakeholder engagement further in recent months through webinars and bilaterals.

Through our RIIO-ED2 Business Plan stakeholder engagement, our Outer Hebrides communities and stakeholders requested the following:


Figure 7: RIIO-ED2 Outer Hebrides stakeholder engagement

In addition, a key requirement from SHEPD's perspective is to consider the above stakeholder requirements in assessing the future Outer Hebrides network, while also considering how we can reduce our reliance on the four diesel-driven embedded generation standby stations strategically positioned to provide back-up generation in the event of a subsea cable fault.

In RIIO-ED2 we are taking a more strategic view of our future network requirements to ensure we can provide the needs and future capacity requirements of the communities we serve. The approach we are taking for HOWSUM is consistent with this approach and is described in further detail here and in Section 4.

## 3.2. Alignment with licence, statutory obligations and business plan for future price control periods

The solutions recommended under the HOWSUM re-opener application are being selected on the basis of their ability to form part of a long-term, whole system solution for the Outer Hebrides, which is an explicit requirement

[11] DNO Common Network Asset Indices Methodology (ofgem.gov.uk)

upon SHEPD further to its RIIO-ED2 licence obligations, and which are sized to meet island needs under 2045 net zero scenarios.

The core solutions being proposed as part of this re-opener application include subsea cables and onshore network assets. The subsea cables will have a minimum manufacturer's design life of 25 years, with a view to achieving a 45-year installed asset life with detailed route engineering and cable protection. Onshore assets will look to achieve the anticipated asset life as recorded in the CNAIM V2.1. This means that, subject to unexpected asset failure, these solutions should continue to fulfil their respective roles and not require replacement or further intervention through multiple future price control periods.

As part of the options assessment, consideration has been given to the long-term need to secure network supplies and ensure the network can meet P2/8 compliance. This includes consideration of the longer-term needs for system resilience on the islands including both the impacts of subsea cable failure on island supplies and the current reliance on diesel generation to provide emergency back-ups. From this we have developed a specific policy for the long-term level of resilience required for Scottish islands. Further details can be found in Section 3.4.2.3 of this document.

## 3.3. Demonstration of needs case / problem statement

Through our analysis of the Outer Hebrides network, we have identified four core drivers for change. These are summarised below. The key drivers applicable to the individual projects recommended in this application are set out in Section 3.5, with more detail included in the respective project EJPs and CBAs:

- **Skye** – **Uist** – **Harris:** Appendix 3A – Outer Hebrides 2050 Whole System Proposals EJP (Skye – Uist – Harris), Appendix 3B – Outer Hebrides 2050 Whole System Proposals CBA (Skye – Uist – Harris) and Appendix 7 – Jacobs Phase 1: Optioneering Studies Report
- **Uist** – **Eriskay:** Appendix 4A – Uist – Eriskay EJP and Appendix 4B – Uist – Eriskay CBA
- **Eriskay** – **Barra:** Appendix 5A – Eriskay – Barra EJP and Appendix 5B – Eriskay – Barra CBA
- **PFE3:** Appendix 6A – Pentland Firth East 3 EJP, Appendix 6B – Pentland Firth East 3 CBA LW and Appendix 6C – Pentland Firth East 3 CBA CT

This is a complex multifaceted problem that needs a whole system approach to developing a long-term strategy. As such we have taken into account a variety of external factors including transmission developments, the potential use of flexibility services and opportunities through new technologies such as hydrogen storage. These are described further in Section 4.2.

### Subsea cable asset condition

The primary driver for our works under this re-opener application is to replace end of life submarine cables. These cables exist in extreme conditions and failure of a cable can take many months to locate and repair or in worst case scenarios completely replace.

### Decarbonisation of our diesel generation fleet

Our diesel-powered DEG units are critical to managing island resilience and remaining compliant with both network planning standard P2/8[12] and the Distribution Code[13] on security of supply for these islands[14]. However, emissions from our DEG is one of the most significant controllable components 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 to 2045 and delivering a 1.5-degree carbon reduction pathway in line with our Science Based Target commitments.

### Future demand and generation requirements

Investment in new subsea assets is costly, and we need to ensure we are developing a network that meets stakeholders' needs through to 2050. We have considered this through two elements:

1. Load growth - electrification of heat, transport and industrial processes on the islands and their impact on future demand requirements.
2. Generation growth - the Hebrides, Orkney and surrounding waters have significant potential for wind, and tidal.

### Continued island resilience

Resilience conditions for Scottish islands are unique given the geographies and potential lengthy system outages in the unlikely event of a subsea cable fault. We have developed a specific net zero policy for the treatment of these island groups recognising the impacts of decarbonisation on electrification of heat and transport.

## 3.4. Overarching methodology for identifying needs and options

SSEN has a defined approach in the strategic development of its distribution networks to enable net zero at a local level[15]. This approach is referred to as the Net Zero Strategic Planning Process. The aim of the Net Zero Strategic Planning Process is to provide the capacity on the network to deliver net zero by 2045 whilst retaining a clear focus on safety and reliability.

Factors considered in our approach include the need to take a flexibility first approach ensuring that we're making appropriate use of flexibility services to deliver efficient whole system solutions at the optimum time. We also recognise the importance of stakeholder evidence to ensure the network develops to meet the needs of our customers of today and tomorrow.

This approach extends to Scottish islands and we have trialled this new approach in our development of proposals relating to relevant RIIO-ED2 uncertainty mechanisms including the HOWSUM.

Our networks differ vastly across our licence areas, recognising the very different communities we serve. Whilst our overarching approach to strategic development is sufficiently broad to encompass most conditions there may be specific requirements that warrant a more tailored approach. One such example is the connections to our island

12 ENA EREC P2 Issue 8 (dcode.org.uk)

13 Specifically PO-PS-037 in Distribution Code Annex 1; Microsoft Word - Section 11 Notice - Schedule 2 - POPS037.doc (Ofgem.gov.uk)

14 For Lewis and Harris and also smaller parts of these networks, exemptions are in place.

15 distribution-network-options-assessment-dnoa---making-decisions-on-the-future-use-of-flexibility.pdf (ssen.co.uk)

communities. Our national process accounts for this and notes that in such instances a cross-functional project group will be established. In such cases the specific scope of the work is agreed at this stage depending on the unique conditions. Our approach to stakeholder input will also be agreed at this stage.

In the case of Scottish islands, this has involved specific strategies around subsea cables, whilst accounting for demand and generation growth on the islands and continued security of supply. In this section we explain these specific strategies and describe how we have taken a whole system view to their net zero strategies. This approach has been adopted in our strategies for both Shetland and the Outer Hebrides. In 2024 we will continue to refine this approach to develop net zero strategies for both Orkney and the Inner Hebrides ahead of our 2025 HOWSUM re-opener application.

### 3.4.1. Overarching process overview

Our high-level Net Zero Strategic Planning Process consists of a number of stages which enable us to understand the future local energy landscape, assess the need for change and develop and assess options to resolve these needs.

This same process has been used in the development of our long-term strategies for Scottish islands. However, recognising the uniqueness of these geographies and the needs of HOWSUM, we have tailored our approach to reflect specific drivers and the feedback of those communities.

The high-level approach is shown in the flow chart at Figure 8. We have also noted the specific activities that fit within the Outer Hebrides recommendation and help guide the reader through our development process.

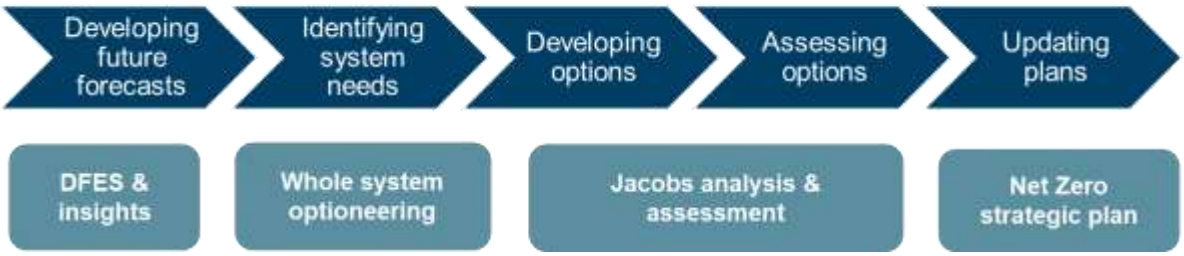


Figure 8: Net Zero strategic planning process overview

#### 1. Developing future forecasts

Forecasts are derived from our Distribution Future Energy Scenarios (DFES). The scenarios are revised annually working closely with stakeholders to understand their future energy needs up to 2050. We also consider our connections pipeline to enhance these forecasts. The DFES considers four credible pathways to 2050. We consider all four scenarios from a system needs perspective but currently take the Consumer Transformation (CT) scenario as a credible ‘best view’ of future requirements. We use this scenario as the basis of our Net Zero Strategic Planning process but test the sensitivity of this model through use of the other three scenarios.

#### 2. Identifying future system needs

This stage comprises three interlinked elements:

- Power system analysis to understand system constraints out to 2050. These will identify load-related system needs and will consider both winter peak and summer minimum requirements.
- Engagement with SMEs across the business to understand other drivers for investment including asset-based data.
- Specific feedback from stakeholders over and above that captured in our DFES forecasts.

#### 3. Developing options to resolve

We establish a cross-functional team to review the system needs and identify potential options to resolve. These are then further tested and refined with other internal experts and stakeholders to get their input. This results in a range of options to be assessed including potentially both network and non-network options.

#### 4. Assessment of options

Options are assessed through a two-stage approach:

- Technical assessment - Options are technically assessed through both power system analysis and construction deliverability assessment.
- Cost-benefit assessment – Options are commercially assessed through CBA. As part of this process, we assess the potential for flexibility to resolve the system need and time when any investment would be optimal.

#### 5. Updating plans

Assessed proposals form part of our strategic investment plan. This plan sets a best view of future network and flexibility requirements out to net zero. It is reviewed annually following changes to the DFES output and to review potential connections changes.

Projects are taken forwards from the strategic investment plan when works are triggered. These triggering criteria may either be:

- Pro-active / low regret anticipatory triggers - where the need may be certain and there is consumer value for bringing work forward. This could also include cases where the incremental cost of building additional capacity is outweighed by the costs of additional later works or when completing works together may result in significant cost efficiencies.
- Scenario-based anticipatory triggers - where there is a clear long-term need but less certainty on timing, location and solution scope.

### 3.4.2. Scottish islands methodology

When assessing the islands we have an upfront focus on island-specific insights and forecasts, to augment and deepen those developed under the Net Zero Strategy Planning Process methodology. We carry out this process through analysis of our knowledge of the relevant networks through our System Planning and Connections activities, direct stakeholder engagement, and key insights work.

In terms of identifying future system needs, we focus on the four key drivers for the islands listed in Section 3.3, taking account of the specific assets and arrangements in place. There is also an in-depth focus on whole systems

impacts and interactions. These specific adaptations we are taking in developing strategies for the Scottish islands are set out below.

#### 3.4.2.1. ISLAND-SPECIFIC INSIGHTS AND FORECASTS

In this section we provide further context on the drivers for change for the Outer Hebrides between now and 2050. These have been tested with stakeholders through webinars and bilateral meetings. This approach has been welcomed by stakeholders with a good level of support for the drivers identified.

Recognising the unique nature of Scottish islands, we have worked with Regen to specifically engage with islands stakeholders and communities. This includes both bilateral discussions with a wide range of stakeholders as well as a dedicated roundtable event. Regen has also joined SHEPD-hosted island stakeholder webinars. From this Regen have drawn up specific insights on the developments of each island group. We have used these to inform both development of future system needs on the islands and also the development of options, critically including the timing of when these options will be needed.

Regen has collated its evidence through analysis of existing and historic project pipeline data and scenario projections, online research, direct engagement and as part of SHEPD's broader engagement whole energy system island engagement. This specifically involves insights into the following:

- Marine vessel decarbonisation/electrification
- Whisky distillery decarbonisation
- Any stand-out commercial developments
- Relevant considerations from marine/offshore wind industry developments on the islands

#### 3.4.2.2. IDENTIFYING FUTURE SYSTEM NEEDS

Some drivers for change for Scottish islands are consistent with those that apply more widely on the mainland. These include asset condition, load growth and the potential for additional generation connections. However, stakeholders have identified further drivers with material relevance for Scottish islands:

- *Diesel generator decarbonisation* – this is a significant source of carbon emissions for SHEPD and developing long term solutions to eliminate reliance on diesel-based DEG is crucial to remaining on the pathway to net zero to 2045.
- *System resilience* – repairs or replacements of cable faults can take a significant period of time and there is a need to ensure we are able to keep the lights on to island communities, particularly as diesel generators are phased out.

We have worked with Regen to gain deeper understanding of both the future demand and generation requirements for the Outer Hebrides and also to gain insights on the ability of new technologies to provide opportunities to support the energy mix on the islands. Regen's work has looked extensively into future generation and demand requirements and will be a significant reference source for us as we develop our analysis over the coming year and our January 2025 HOWSUM re-opener application.

A particular focus has been industrial decarbonisation with insights gained from the whisky, aviation, maritime vessel, aquaculture, agriculture, and textiles industries. Whilst there is significant support for the need to decarbonise, the nature of industrial decarbonisation is still emerging. It is likely that electrification will play a

significant role, however we are also aware that there is also opportunity for hydrogen development. Regen's report on future energy needs for the Outer Hebrides is available for reference.[16]

We have also engaged Comhairle nan Eilean Siar (CnES) through their Responsible research and Innovation Policy Experimentations for Energy Transition (RIPEET) pilot project for the Outer Hebrides.[17] This project is funded through the EU's Horizon 2020 programme and investigates potential policies for the energy transition.

We have particularly engaged with CnES on plans to decarbonise local heating supplies on the islands. Whilst the project is making good progress this is still an emerging area and we are also engaging with SGN on future plans for Stornoway's off-gas grid networks which is similarly uncertain.

CnES also provides good opportunity for engagement with community energy schemes and the requirements of the island communities. We will look to strengthen these links as our long-term strategy develops.

#### 3.4.2.3. CONTINUED ISLAND RESILIENCE AND DECARBONISATION OF OUR DIESEL GENERATION FLEET

Longer term needs for the Outer Hebrides are interconnected with the future of the existing diesel generation fleet. These generators provide valued back-up supplies for the islands in the event of network outages. Our diesel-powered DEG units were established in the 1950s 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. Whilst acting only as a last resort, DEG units are currently required to ensure compliance with both Engineering Recommendation P2[18] and the Distribution Code[19] on security of supply for these islands.[20] However emissions from our DEG have the potential to significantly impact our carbon footprint in the event that they are required to run. As such, developing long term solutions to eliminate reliance on diesel based DEG is important to remaining on the pathway to net zero to 2045 and delivering a 1.5-degree carbon reduction pathway in line with our Science Based Target commitments.

Going forwards we see this level of resilience, currently offered through subsea and on-island arrangements, as a minimum requirement for island communities. With greater electrification of both heat and transport sectors, the value placed on secure and reliable electricity supplies will only increase. Whilst subsea cable faults are rare, location and repair to a fault on a subsea cable can take months to resolve. Given the uniqueness of this situation in the context of the wider GB distribution networks, this is not something presently accounted for in Engineering Recommendation P2/8 which generally infers much shorter repair times for both first and second outage conditions.

We have therefore assessed the level of resilience we currently provide to each of our island groups connected solely via subsea cables through Engineering Recommendation P2/8 and developed a policy applicable to all of our islands investment going forward based on the demand group sizes. This policy only applies to consideration of the loss of the connecting subsea cable(s), i.e. rather than the mainland network or on-island networks. Table 8 summarises this policy.

16 Outer Hebrides Net Zero Load Growth Evidence Summary Report (ssen.co.uk)

17 Outer Hebrides | RIPEET Project

18 ENA EREC P2 Issue 8 (dcode.org.uk)

19 Specifically PO-PS-037 in Distribution Code Annex 1; Microsoft Word - Section 11 Notice - Schedule 2 - POPS037.doc (Ofgem.gov.uk)

20 For Lewis and Harris and also smaller parts of these networks, exemptions are in place.

| Island Group fed by subsea cable[21] | DFES (CT) Forecast 2050 island group demand | Relevant 2050 P2-8 Category | Net Zero Resilience Policy for island groups fed solely by subsea cables |
|---|---|---|---|
| Shetland | 95MVA | D | Group demand secured for sustained long duration N-2 condition through a combination of network assets and local generation (including third party). |
| Orkney | 61MVA | D | |
| Lewis & Harris | 45MVA | C | |
| Uists, Benbecula, Eriskay & Barra | 15MVA | C | |
| Mull, Coll & Tiree | 13MVA | C | |
| Islay, Jura & Colonsay | 13MVA | C | |
| Barra | 3MVA | B | Group demand secured for sustained long duration N-1 condition through a combination of network assets and local generation (including third party). N-2 condition potentially managed through use of portable generation or use of existing generation on island if available. |
| Tiree & Coll | 3MVA | B | |
| Colonsay | >1MVA | A | |

Table 8: Summary of SHEPD Island Net Zero Resilience Policy

This standard is technology-neutral (i.e. the resilience could be met by network assets, third party solutions, or repowered DEG) recognising that specific instances will apply unique to each island group and the long-term solution may differ between island groups of similar demand size.

For island groups with demand greater than 4MW we will ensure that they have sufficient capability to maintain supplies for loss of two in-feeding subsea cable circuits. This could be achieved through a third cable circuit or the use of on-island energy sources including third party assets with associated control functionality. Such generation must be capable of securing island demands for a long-sustained period and during all seasons and weather conditions.

For island groups with demand of 4MW or below we would ensure sufficient capacity existed to manage the loss of a single subsea cable circuit. This could be achieved through a second cable circuit or the use of on-island energy sources including third party assets. Again, such generation must be capable of securing island demands for a long-sustained period and during all seasons and weather conditions. In the unlikely event of the loss of this contingency during a system outage then we would look to have mobilised portable generation in advance to restore supplies. This could also be achieved through the use of local island generation if available.

For many island groups there may still be a requirement to operate a network disconnected from the main GB system (i.e. in islanded mode). We would need to have the appropriate control infrastructure in place to achieve this relevant to the specific needs of that island group.

Achieving these future resilience levels is a longer-term ambition for many of our island groups and will support the reduction in dependency of diesel as a back-up solution. However, we also recognise the inherent uncertainty

21 This table illustrates the treatment of island groups within the scope of the HOWSUM re-opener.

in future energy needs for the Outer Hebrides, and the ongoing reliance on subsea cables, with the associated need for alternative island-based arrangements. Therefore, we are seeking to extend the operational lives of existing DEG assets where necessary. This will include looking at the potential for operation of engines on alternative fuels, and we are actively monitoring this area to understand developments and maturity with regards to performance, supply chain, and storage.

We will also consider market-based solutions that can provide the necessary services. However, we are conscious of the nascent nature of new technologies such as hydrogen that could help provide long duration third party solutions for our resilience needs. Our global calls for flexibility to date have not identified any appropriate existing or pipeline services. Our phased approach to delivery in our net zero strategic plan for the Outer Hebrides will allow time for such new technologies to mature and inform whether they can credibly help support the security of supply for the Outer Hebrides. This will in turn inform the form and scale of any future network reinforcement. Such longer duration forms of flexibility are more appropriate for the provision of resilience for Scottish islands given the resulting long duration need for such a service. We will monitor our next global call for flexibility in summer 2024 for potential service providers in the Outer Hebrides and review the potential for more focused flexibility service provision, and any associated engagement, ahead of our January 2025 HOWSUM application. In addition, we will engage with stakeholders to understand the current status and future potential for long duration flexibility in the Outer Hebrides.

We have been engaging with the Scottish Government on use of diesel in back-up plant and have been working with them as they develop their Climate Change Plan (CCP). As currently drafted, their commitment is to 'Support the work of SHEPD to reduce reliance on diesel power stations through establishing new interconnectors between islands and mainland, and through exploring the use of alternative, non-fossil fuel-based solutions to diesel for back-up supply.'

One exception is at Battery Point at Stornoway. Battery Point KVSS engines (2MWx 4) were installed in 1952 and are at the end of their operational life, leaving the site with a potential 8MW future capacity risk. One engine has already faulted beyond economical repair. The remaining two engines are midway through a 12,000-hour overhaul programme due to extended running during the 2020/21 Skye – Harris submarine cable failure. This has now been completed on one engine with the remaining overhaul planned in the next financial year. Due to age, it is increasingly difficult to source spare parts – the internal condition of these engines is also unknown until they are overhauled. Future operational management cannot be guaranteed. All engines have poor environmental performance and are the last selected engines in the running profile. KVSS engines are approximately 32% efficient, other Mirrlees engines are 38% and Wartsila is 44%. This results in significantly more fuel being required and therefore more $CO_2$ being released. [redacted].

[redacted] We recognise that alternative options that could improve network resilience are several years away from delivery. This includes both new technologies and also the HVDC link to Stornoway. We will therefore continue to develop plans in 2024 to potentially replace the engines at Battery Point at a new location within our existing DEG site at Arnish which is consistent with our RIIO-ED2 business plan, and the funding agreed with Ofgem for this purpose. Any new engines will have better environmental performance and will be compliant with the Medium Combustion Plant Directive (MCPD) and other applicable environmental legislation, which is also likely to require abatement. This work will be carried out in co-ordination with the HOWSUM development work to ensure a co-ordinated strategy for the Outer Hebrides.

### 3.4.3. Whole System optioneering and considerations

A number of options have been considered, some based on specific feedback from island stakeholders. It should be noted that some of these elements are not sufficiently mature today, but potentially form part of our longer-term strategic development. All elements will be further considered in the development of our 2025 HOWSUM application.

1. **Distribution network elements** – We have considered how future network needs could be met with additional distribution investment. It is generally recognised that all islands will need to remain connected to the mainland GB system so there is a definite need for continued network circuitry and capacity. Capacity requirements will need to be able to meet forecast demand and generation requirements. The need for additional infrastructure to meet future resilience requirements has also been considered.
2. **Transmission network elements** – We have worked closely with SSEN Transmission to understand their future requirements and how these impact distribution system needs including system resilience. We have also considered the potential for a 132kV connection to the islands in the future.
3. **Use of new technologies** – We have discussed with stakeholders the use of new technologies such as hydrogen and other forms of storage to help resolve some of the drivers for change. Such technologies may be able to provide the longer duration forms of flexibility that we would require to manage system resilience in the unlikely event of a subsea cable failure.
4. **Use of flexibility** – We see flexibility as potentially being required as part of all developed options. For load related drivers, it can help optimise the timing of future investment needs and this is where we see a primary use case. Our recent global call for flexibility has not highlighted significant volumes of flexibility on the islands today, however we will be considering the future potential in our 2025 HOWSUM application. It is more challenging to obtain the longer duration forms of flexibility that would be needed to manage system resilience; however, we will continue to work with stakeholders to review these developments.
5. **Repowering of diesel generators** – The future of our DEG units need to be considered alongside over methods of providing resilience to the island groups. Specific DEG options include clean repowering to reduce emissions, mothballing to reduce reliance and usage but retain availability, or removal of units. We will consider these options further in our 2025 HOWSUM application.

### 3.4.4. Technical and commercial assessment of options

For the Skye – Uist – Harris project, we have employed Jacobs to undertake both a technical and commercial assessment of intervention options. Further details of their work can be found in Appendices 3A, 3B and 7 forming part of this submission. Jacobs is utilising a similar methodology to that on the mainland. In addition, we are coordinating our strategic plans for Scottish islands with those on related areas of the mainland.

### 3.4.5. Rationale for phasing interventions

The recommended solutions for Skye – Uist, Uist – Eriskay, Eriskay – Barra and Pentland Firth East 3 included in this January 2024 application have met the triggering criterion applied in our strategic investment planning process to define when works should be taken forwards for delivery.

We do not see immediate triggers for the remaining elements of our 2050 strategic plan for the Outer Hebrides. As such we are not seeking approval for these elements at this time. However, we will be reviewing our 2050 strategic plan ahead of the 2025 HOWSUM application, and other works may feed into this plan. This stakeholder supported approach allows us to monitor future requirements on the Outer Hebrides (as well as Orkney and the Inner Hebrides) including the potential of new technologies to support Scottish islands in the future.

### 3.4.6. Approach to documenting the needs case, option development and preferred option description for specific options

Sections 3.5, 3.6 and 3.8 of this document describe the specific needs case, option development and preferred option descriptions for each of the four elements forming this HOWSUM application. This is consistent with the EJPs included in this application. Three of these elements are discrete works on specific cables and the sections reflect this scope of work. These are:

- Eriskay – Barra 11kV cable augmentation
- South Uist – Eriskay 11kV cable replacement
- PFE3 33kV cable replacement

The fourth element of work relates to Outer Hebrides 2050 Whole System Proposals (Skye – Uist – Harris). This is a much more significant piece of work considering the longer-term needs of the Outer Hebrides. Sections 3.5 and 3.6 reflect this level of work.

The preferred option of the Outer Hebrides 2050 Whole System Proposals is made up of:

- the Skye – South Uist cable replacement, for which we are seeking approval of the needs case and technical recommendation in this application, with the cost submission to follow in summer 2024; and
- two elements for which we are not seeking funding in this application, namely a second 33kV circuit between Ardmore and Harris GSPs, and a 33kV circuit between Harris and Lochmaddy, which will be captured in future funding applications.

Sections 3.8.1.1 to 3.8.1.5 cover all three of these elements. The Deliverability section, Section 3.8.1.7, is limited to the Skye – South Uist cable replacement element reflecting its need to progress to delivery at this time.

The augmentation of Eriskay – Barra 11kV cable and replacement of South Uist – Eriskay 11kV cable also affect the network in the Outer Hebrides. However, these are discrete works affecting islands on the periphery of the island group. As such the works are least regrets activities required under all options considered in the scoping of the Outer Hebrides 2050 Whole System Proposals.

## 3.5. Specific needs cases / problem statements

The specific needs cases are described in Table 9 for the defined elements included in this application (namely Outer Hebrides 2050 Whole System Proposals (Skye – Uist – Harris), Uist – Eriskay, Eriskay – Barra and Pentland Firth East 3). A common primary driver for all these elements is asset condition. SHEPD measures asset condition scoring using a Health Index (HI) score. This HI will range between 1 and 5 with 1 being as new and 5 being end of life/critical. The health index score is calculated using a number of cable characteristics and condition input data

following the CNAIM v2.1. Table 9 below sets out a summary of current and future conditions of key assets targeted by the interventions.

| Asset | Current asset condition | Future asset condition |
|---|---|---|
| SHEPD_64 Skye – South Uist | Currently HI5C2 | Cable already HI5 and will only deteriorate further. |
| SHEPD_52 South Uist – Eriskay | Current HI3C2 | Future HI4C2 (HI5 by Jan 2032 – was previously Jan 2029) |
| SHEPD_127 Eriskay – Barra 2 | HI3C2 | Future HI5C2 by end of RIIO-ED2 |
| SHEPD_166 PFE2 | Cable was HI1C2 at time of failure. | Cable would have been deemed HI5C2 but already removed from service. |

Table 9: Current and future conditions of relevant assets

### 3.5.1. Specific needs case - Outer Hebrides 2050 Whole System Proposals (Skye – Uist – Harris)

#### 3.5.1.1. SUBSEA ASSET CONDITION

In this regulatory application we are seeking technical approval for the replacement of the 33kV subsea cable between Skye (Ardmore) and South Uist (Dunvegan). The current 33kV cable running between Skye and South Uist has been in service for 31 years. This cable has now reached the end of its serviceable life and is recorded as an HI5 cable. SHEPD has concerns over the cable's ability to continue to provide a reliable and secure connection to the islands and wish the replace the asset to alleviate the health concerns. In case of asset failure at this point SHEPD would have no technically ready alternatives with which to respond other than using fossil fuel generation to provide power to the island residents. This not only slows SHEPD's ambitions to achieve net zero, but generating electricity from fossil fuels is a more expensive source of power compared to wind and solar.

### 3.5.2. Specific needs case - South Uist – Eriskay

The South Uist – Eriskay subsea cable is a 95 mm² PILC 'H' SWA 11 kV cable and is 2.75 km long. The cable was installed in 1987 and as such has been in service for 37 years. The cable is rated at 4.7MVA and is currently connected between East Kilbride on South Uist and Rhuban on Eriskay. The cable is supplied from Pollachar 33/11 kV Primary substation on South Uist and provides supplies to 1,052 customers on Eriskay and Barra, as well as some other smaller islands.

This cable has been identified as requiring intervention during the RIIO-ED2 price control period to ensure an acceptable level of risk is maintained on the SHEPD network. Through network assessment this cable has been found to have a high network risk and associated impact costs should the cable fail in service, and although currently only an HI3 cable, has been deemed in need of replacement to reduce the associated probability of failure and risk associated with the wider network. The cable is forecast to become an HI5 asset in 2032/33 within ED3.

It is very difficult, in this location, to perform a full visual inspection of the subsea cable. This is due to the shallow water depth and the shifting nature of the marine environment sediment offshore. This means the cable is covered/buried for the majority of the route most of the time. Shore ends do become exposed on a semi-regular basis and have had maintenance to re-protect and bury in the intertidal zone. Given it is difficult to see the subsea cable it is hard to determine the physical external condition to derive a definitive condition score. The cable could therefore be in a much poorer condition than the current data would suggest, and given the cable is 37 years old and has significantly exceeded the design life of a cable of this type SHEPD intend to replace the cable to reduce network risk.

### 3.5.3. Specific needs case - Eriskay – Barra

The Eriskay – Barra 2 11kV subsea cable is a is a 33 kV 95 mm² XLPE SWA [redacted] operating at 11kV and has been in service for 10 years. Visual inspections have confirmed the cable is in a poor condition which is contributing to the current cable Health Index (HI) of 3 with a Criticality index (C) of 2. The cable HI is predicted to further increase over RIIO-ED2 reaching end of life HI5 by January 2027. Additionally, of the six cable routes that were installed in the same year with this cable type , three have failed during the RIIO-ED1 period with a fourth, Coll – Tiree, being augmented as part of SHEPDs subsea RIIO-ED2 baseline CAPEX.

This existing Eriskay – Barra 2 cable is the only network connection to Barra and Vatersay. Should a failure occur on the cable this would result in high impact cost, given the nature of the radial circuit, the number of customers supplied, and that Barra power station would be required to run to maintain supplies until the cable could be repaired or replaced.

The current proposal is to augment the existing cable with a second similar sized cable which would provide two independent connections to the island group, whilst the existing cable remains in service. Should a single cable fail, the second cable would be able to provide for the group demand of the islands, reducing the requirement to operate Barra Power Station.

### 3.5.4. Specific needs case - Pentland Firth East 3

The existing PFE2 cable failed in service in 2021, which meant that the Orkney islands were down to a single mainland connection. Intervention was required to rectify the fault and return the network to normal network conditions. SHEPD assessed the possibility of repairing the PFE2 cable but through fault analysis and interrogation this was deemed not to be the preferred solution.

SHEPD then progressed with analysis of viable solutions and the consequent installation of a new PFE3 cable to remove the fault condition from the network and secure network import and export to Orkney.

## 3.7. Consideration of options and methodology for selection of the preferred option

### 3.7.1. Options considered - Outer Hebrides 2050 Whole System Proposals (Skye – Uist – Harris)

Consistent with both our Net Zero Strategic Planning Process and the requirements of HOWSUM we have undertaken a broader perspective on the future needs for the Outer Hebrides, ensuring we take a whole system view. This view has considered requirements out to 2050 with a central case based on the CT scenario.

From this we have worked with engineering consultancy Jacobs to develop a range of future options for network requirements on the islands. These options are detailed in Appendix 7 and summarised in Appendices 3A and 3B.

Jacobs initially identified 32 options for a strategic plan and this was reduced through power system analysis to 14 options that were technically feasible. The different subsea cable routes considered within these options is shown in Figure 9.

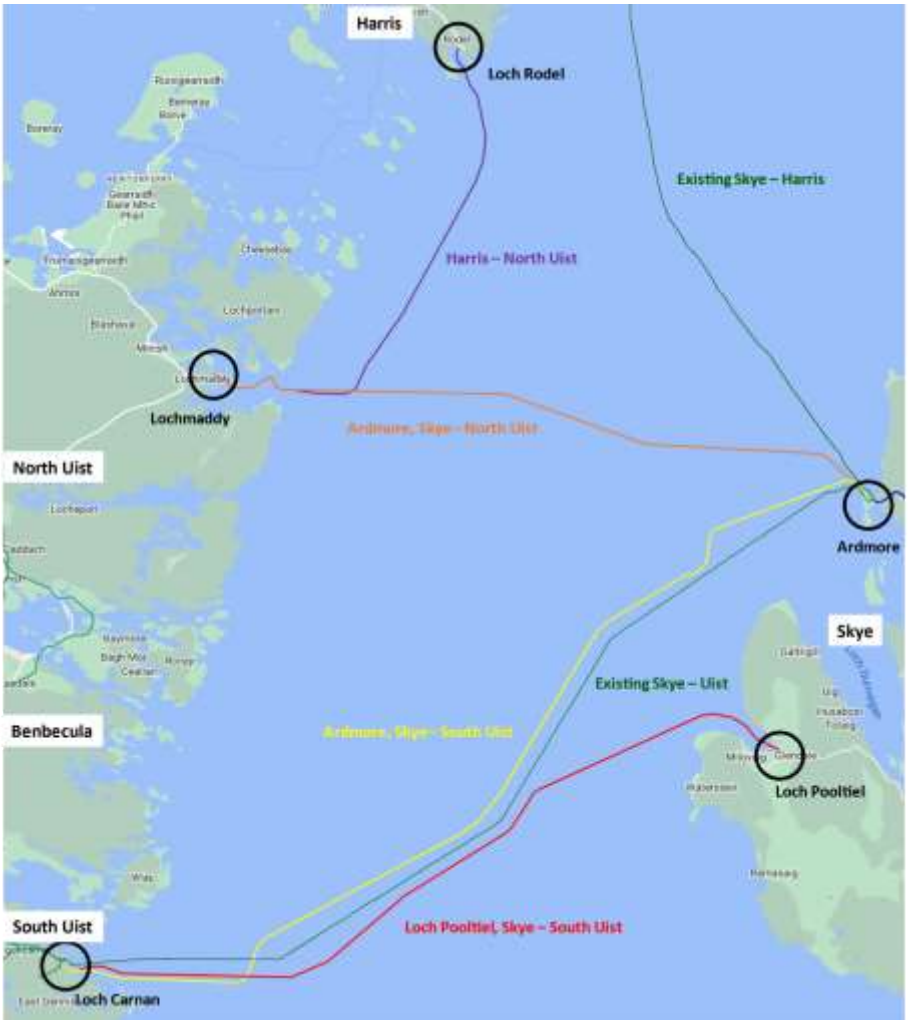


Figure 9: Map of assessed cable options for Skye – Uist – Harris

The options are summarised in Table 10. All the options have been assessed to ensure they are technically feasible, and the options that fulfil the criteria have been passed onto CBA for further assessment.

| Option name | Summary |
|---|---|
| Replace Ardmore – Loch Carnan subsea cable with two larger cables & new Ardmore – Harris subsea cable | • Add new two Ardmore – Loch Carnan subsea cables.<br>• Add new subsea cable/OHL from Admore to Harris. |
| Replace Ardmore – Loch Carnan subsea cable with two larger cables & new 132kV feeder from Ardmore – Harris subsea cable | • Add new two Ardmore – Loch Carnan subsea cables.<br>• Add new 132kV subsea/OHL from Admore to Harris. |
| Replace Ardmore – Loch Carnan subsea cable with larger cable and add a new larger size cable / OHL Ardmore – Clachan & new Ardmore – Harris subsea cable | • Add new Ardmore – Loch Carnan subsea cable.<br>• Add new subsea cable/OHL from Admore to Clachan.<br>• Add new subsea cable/OHL from Admore to Harris |
| Replace Ardmore – Loch Carnan subsea cable with larger cable and add a new larger size cable / OHL Ardmore – Clachan & new 132kV feeder from Ardmore – Harris subsea cables | • Add new Ardmore – Loch Carnan subsea cable.<br>• Add new subsea cable/OHL from Admore to Clachan.<br>• Add new 132kV subsea/OHL from Admore to Harris. |
| Remove Ardmore – Loch Carnan subsea cable and replace with Dunvegan – Loch Carnan OHL/subsea cable and Ardmore – Clachan subsea cable / OHL & new Ardmore – Harris subsea cable | • Decommission the existing Ardmore – Loch Carnan subsea cable.<br>• Add Dunvegan – Loch Carnan OHL/subsea cable.<br>• Add Ardmore – Clachan OHL/subsea cable.<br>• Add new subsea cable/OHL from Ardmore to Harris. |
| Remove Ardmore – Loch Carnan subsea cable and replace with Dunvegan – Loch Carnan OHL/subsea cable and Ardmore – Clachan subsea cable / OHL & new 132kV feeder from Ardmore – Harris subsea cable | • Decommission the existing Ardmore – Loch Carnan subsea cable.<br>• Add Dunvegan – Loch Carnan OHL/subsea cable.<br>• Add Ardmore – Clachan OHL/subsea cable.<br>• Add new 132kV subsea/OHL from Ardmore to Harris |
| New Dunvegan – Loch Carnan subsea cable /OHL, additional Harris – Clachan subsea cable / OHL & new Ardmore – Harris subsea cable | • Decommission the existing Ardmore – Loch Carnan subsea cable.<br>• Add Dunvegan – Loch Carnan OHL/subsea cable.<br>• Add Harris – Lochmaddy subsea cable plus new OHL from Lochmaddy to Clachan.<br>• Add new subsea cable/OHL from Admore to Harris. |
| New Dunvegan – Loch Carnan subsea cable and additional underground line onshore, additional Harris – Clachan subsea cable / OHL & new Ardmore – Harris subsea cable | • Decommission the existing Ardmore – Loch Carnan subsea cable.<br>• Add Dunvegan – Loch Carnan OHL/subsea cable.<br>• Add Harris – Lochmaddy subsea cable plus new OHL from Lochmaddy to Clachan.<br>• Add new subsea cable/OHL from Admore to Harris |
| New Dunvegan – Loch Carnan subsea cable, additional Harris – Clachan subsea cable / OHL & new 132kV feeder from Ardmore – Harris subsea cable | • Decommission the existing Ardmore – Loch Carnan subsea cable.<br>• Add Dunvegan – Loch Carnan OHL/subsea cable. |

| Option name | Summary |
|---|---|
| | • Add Harris – Lochmaddy subsea cable plus new OHL from Lochmaddy to Clachan.<br>• Add new 132kV subsea/OHL from Admore to Harris. |
| New Ardmore – Loch Carnan subsea cable and additional Dunvegan – Loch Carnan OHL/subsea cable & new Ardmore – Harris subsea cable | • Add new Ardmore – Loch Carnan subsea cable.<br>• Add Dunvegan – Loch Carnan OHL/subsea cable.<br>• Add new subsea cable/OHL from Admore to Harris. |
| New Ardmore – Loch Carnan subsea cable and additional Dunvegan – Loch Carnan OHL/subsea cable & new 132kV feeder from Ardmore – Harris subsea cable | • Add new Ardmore – Loch Carnan subsea cable.<br>• Add Dunvegan – Loch Carnan OHL/subsea cable.<br>• Add new 132kV subsea/OHL from Admore to Harris. |
| New Ardmore – Loch Carnan subsea cable & new Ardmore – Harris subsea cable | • Add Ardmore – Loch Carnan subsea cable.<br>• Add new subsea cable/OHL from Admore to Harris.<br>• Add Harris – Lochmaddy subsea cable plus new OHL from Lochmaddy to Clachan. |
| New Ardmore – Loch Carnan subsea cable, additional Dunvegan – Loch Carnan OHL/subsea cable, additional Harris – Clachan subsea cable / OHL & new Ardmore – Harris subsea cable | • Add Ardmore – Loch Carnan subsea cable.<br>• Add Dunvegan – Loch Carnan OHL/subsea cable.<br>• Add Harris – Lochmaddy subsea cable plus new OHL from Lochmaddy to Clachan.<br>• Add new subsea cable/OHL from Admore to Harris |
| New Ardmore – Loch Carnan subsea cable, additional Dunvegan – Loch Carnan OHL/subsea cable, additional Harris – Clachan subsea cable / OHL & new 132kV feeder from Ardmore – Harris subsea cable | • Add Ardmore – Loch Carnan subsea cable.<br>• Add Dunvegan – Loch Carnan OHL/subsea cable.<br>• Add Harris – Lochmaddy subsea cable plus new OHL from Lochmaddy to Clachan.<br>• • Add new subsea cable/OHL from Admore to Harris |

Table 10: Options considered for Skye – Uist – Harris intervention

#### 3.7.1.1. ‘DO- MINIMUM’ (OPTION 1)

In addition to the above 14 options consideration was also given to a ‘do minimum’ option.

Under this option, there would be no replacement of the existing subsea cable from Ardmore GSP on Skye to Loch Carnan 33kV Sw/STN on Uist. Instead, SHEPD would allocate capital to ensure that in the event of a cable failure during RIIO-ED2, SHEPD would have the required financial resources to secure emergency service repair teams and the associated components needed for cable repairs.

Opting for a reactive approach is inherently more expensive than proactively addressing the risk through asset replacement. In this scenario, SHEPD would need to swiftly secure an emergency repair team and procure necessary parts as quickly as possible, without the ability to negotiate prices or leverage advantages from advance orders and bulk purchases.

This option presents several significant limitations to broader decarbonisation on the Outer Hebrides. Firstly, it would not create the additional network capacity needed for the islands to decarbonise or additional generation to connect. Whilst this may be a credible option in the short term, it would not be viable as a strategic position for

2050. Secondly it does not help SHEPD decarbonise its diesel generation fleet by maintaining current reliance levels of our DEG.

Finally, it poses a substantial risk to consumers in the event of a fault, as the downtime would result in severe disruptions to their power supply. Additionally, the approach is costly and inefficient, involving the expensive procurement of emergency services and replacement cables without the benefits of advanced planning and cost-effective purchasing. As a single-circuit solution, it maintains a dependency on a single cable, introducing vulnerabilities in the event of unforeseen failures or maintenance, which could impact the reliability of the power supply for consumers.

The projected duration for repairing the asset is 2 years, signifying that both our private and industrial customers would face substantial disruptions due to the outage. During this downtime, it would also be necessary to run Loch Carnan power station to continue meeting the islands' demand, resulting in running costs of around £23 million and 39,000 $tCO_2$ per annum.

#### 3.7.1.2. DEFERRAL OPTION

SHEPD has considered deferring the investment for the Skye – Uist cable to RIIO-ED3, taking cognisance of the current HI5 status of the existing cable. Our analysis confirms that the investment should take place now and not be deferred to a later price control.

#### 3.7.1.3. MARKET-BASED OPTION

**Use of flexibility to defer investment**

In this section we discuss the current status of flexibility in the Outer Hebrides and where there may be potential future opportunities to use flexibility to defer network investment. The primary driver for all elements of this 2024 application is asset condition; hence we are not proposing the use of flexibility at this time. However, flexibility could have a bearing on the timing of future network investment in the Outer Hebrides and on our long-term DEG strategy and requirements, both of which will be assessed in more detail over 2024 and addressed in our January 2025 HOWSUM reopener application.

**Current status of flexibility in the Outer Hebrides**

In September 2023 SSEN launched a network-wide call for flexibility[22] covering both licence areas, open to owners, operators and aggregators of generation, storage or demand assets and suppliers. This process is for services over 10kW but is not tailored to specific islands needs. We have only had minimal responses from providers on the Outer Hebrides at this time.

A further tender round is being launched in early summer which will also be informative. We will review the potential role of flexibility, and engage with relevant stakeholders, ahead of our January 2025 application.

**Potential future application analysis**

- **Deferring network investment between Ardmore and Harris GSPs**

We have considered the future demand needs at Harris and Stornoway grid over the medium-term, and the consequential requirements for reinforcement of the network between Skye and Harris. Our analysis, shown in Figure 10, suggests that demand would exceed the rating of the existing 33kV 500mm$^2$ cable by 2032. Flexibility

22 Flexibility Services - SSEN

could play a role here in deferring this reinforcement to the optimal time and will assess this opportunity further ahead of our January 2025 application.

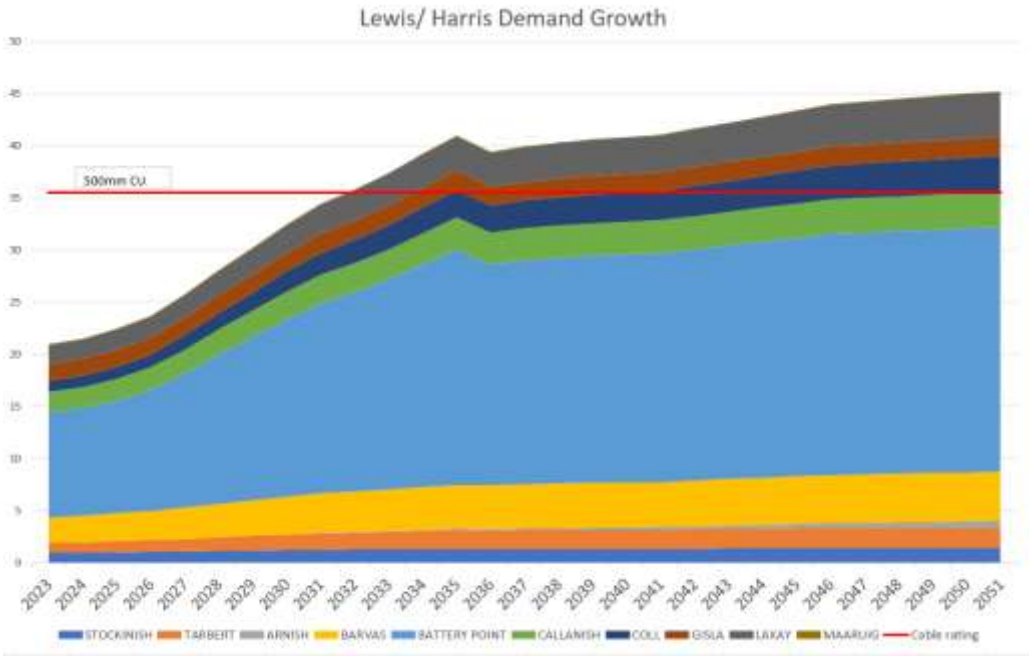


Figure 10: Lewis / Harris demand growth - 2022 DFES

- **Deferring network investment between Dunvegan and Loch Carnan**

We have similarly considered future demand requirements for the Uist archipelago. DFES have projected a significant demand increase due to a potential spaceport in the area. This would drive a need for cable uprating in 2029 to meet the revised demand – see Figure 11. However, we have examined the potential demand for this development in more detail considering demand requirements for other similar developments. In response we have reduced our demand forecasts considerably such that the load driver for the Uist archipelago does not become active until the 2040s – see Figure 12. In both cases the projected demands would be adequately supported by the proposed 300sqmm subsea cable (required on an asset condition basis) and the need for flexibility services is unlikely.

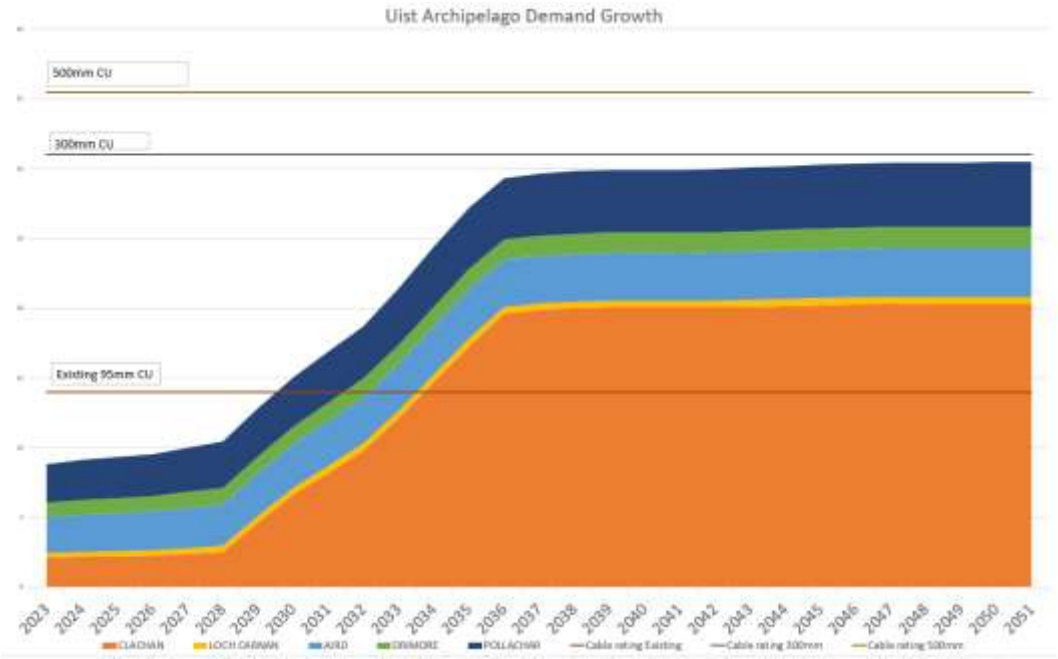


Figure 11: Original Uist archipelago demand growth - 2022 DFES

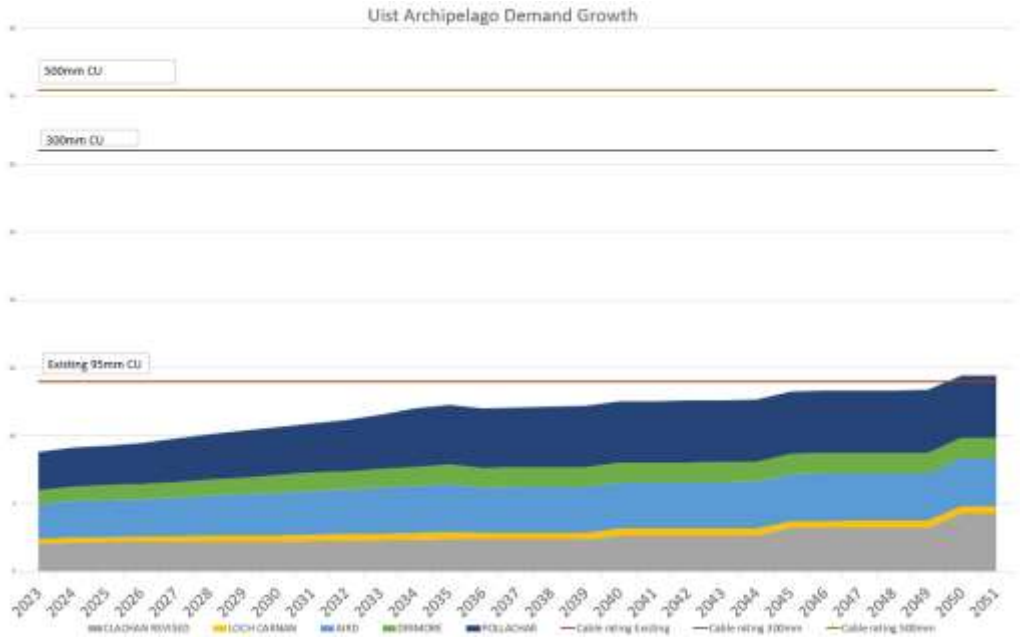


Figure 12: Revised Uist archipelago demand growth - 2022 DFES

### 3.7.2. Options considered - South Uist – Eriskay

We have considered a number of options to improve the security of supply of the existing connection arrangements between Uist and Eriskay, whilst ensuring that any future solution has the system capacity to provide for long term demand and generation out to 2050, based on CT 2022 DFES data. These options are summarised in Table 11.

All the options have been assessed to ensure they are technically feasible, and the options that fulfil the criteria have been passed onto CBA for further assessment.

| Options | Description | Technically Feasible |
|---|---|---|
| 1. Do-Minimum – Replace on failure. | Continue to operate the existing cable until it fails, at which time the cable would be replaced. | Yes |
| 2. Planned replacement during RIIO-ED2. | Replace the existing subsea cable with a new 95mm$^2$ cable. | Yes |
| 3. Replace with a larger 185 mm$^2$ cable. | Replace the existing subsea cable with a new larger 185mm$^2$ cable. | Yes |
| 4. Augmentation with a similar sized cable. | Install a new 95mm$^2$ cable but maintain the existing cable in service. | Yes |
| 5. Augmentation with a larger cable. | Install a new larger capacity cable but maintain the existing cable in service. | Yes |
| 6. Installation of two new cables on the existing route. | Replace the existing subsea cable with two new subsea cables. | Yes |
| 7. Installation of an underground cable following a land route through the Eriskay causeway. | Replace the existing subsea cable with new OHL and underground cable assets utilising a causeway crossing. | Yes |
| 8. Installation of an underground cable following a land route through the Eriskay causeway, but with installation deferred to end of ED3. | Replace the existing subsea cable with new OHL and underground cable assets utilising a causeway crossing. Carry out the works at the end of ED3. | Yes |

Table 11: South Uist – Eriskay options list

#### 3.7.2.1. ‘DO-MINIMUM’ OPTION

The “Do Minimum” option is for the repair or replacement of the cable to be performed upon failure. This aligns with option 1 in the options assessment. SHEPD would continue to operate the existing cable until it fails and then perform a replacement. The timeline for these works would be unknown and depend on the date of fault, this could defer expenditure for an uncertain period of time, but costs would be higher when the fault occurs. This option would also incur all the associated impact costs of failure (e.g. operating costs of DEG).

#### 3.7.2.2. DEFERRAL OPTION

SHEPD has considered the preferred option for this cable and run a sensitivity on deferring the investment to the end of RIIO-ED3, taking cognisance of the current HI3 status of the existing cable. This analysis confirms that the investment should take place now and not be deferred to a later price control.

#### 3.7.2.3. MARKET-BASED OPTION

This investment decision is being driven through an associated network risk and security of supply perspective as part of SHEPD's whole system planning. SHEPD is committed to considering flexible alternatives to traditional engineering solutions on our networks. SHEPD requires to maintain this connection as part of the wider 11kV network supplying Eriskay, Barra and Vatersay. This element of network infrastructure is also key to any future planned removal of Barra power station. There are a number of emerging technologies which may be possible considerations for flexibility as part of a long-term solution however the islands of Eriskay, Barra and Vatersay have limited flexible generation installed at the moment. This is an area which will be continually assessed and may be utilised in the future.

### 3.7.3. Options considered - Eriskay – Barra

We have considered a number of options to improve the security of supply of the existing connection arrangements between Eriskay and Barra, whilst ensuring that any future solution has the system capacity to provide for long term demand and generation out to 2050, based on CT 2022 DFES data. These are summarised in Table 12. All the options have been assessed to ensure they are technically feasible, and the options that fulfil the criteria have been passed onto CBA for further assessment.

| Options | Description | Technically Feasible |
|---|---|---|
| 1. Do-Minimum – Replace on failure. | Continue to operate the existing cable until it fails, at which time the cable would be replaced. | Yes |
| 2. Planned replacement during RIIO-ED2. | Replace the existing subsea cable with a new 95mm$^2$ cable. | Yes |
| 3. Replace with a larger 185 mm$^2$ cable. | Replace the existing subsea cable with a new larger 185mm$^2$ cable. | Yes |
| 4. Augmentation with a similar sized cable. | Install a new 95mm$^2$ cable but maintain the existing cable in service. | Yes |
| 5. Augmentation with a larger cable. | Install a new larger capacity cable but maintain the existing cable in service. | Yes |
| 6. Installation of two new cables on the existing route. | Replace the existing subsea cable with two new subsea cables. | Yes |

Table 12: Eriskay – Barra Options list

#### 3.7.3.1. 'DO-MINIMUM' OPTION

The "Do Minimum" Option is for the repair or replacement of the cable to be performed upon failure, this relates to option 1 in the options assessment. SHEPD would continue to operate the existing cable until it fails and then perform a replacement. The timeline for these works would be unknown and depend on the date of fault, this could defer expenditure indefinitely, but costs would be higher when the fault occurs, this option would also incur all the associated impact costs of failure.

#### 3.7.3.2. DEFERRAL OPTION

SHEPD could choose to defer the installation of the preferred solution, however this will only further increase network risk and the possibility of incurring a fault and associated impact costs. The current cable is already deteriorated and will reach end of life by the end of this price control. Deferral of intervention at this stage will put unnecessary risk on the network and our customers and therefore investment must take place now to minimise the risk. Therefore, this option has not been included within SHEPDs detailed options analysis.

#### 3.7.3.3. MARKET-BASED OPTION

This investment decision is being driven through an asset health, associated network risk and security of supply perspective as part of SHEPD's whole system planning. SHEPD is committed to considering flexible alternatives to traditional engineering solutions on our networks. SHEPD requires to maintain this connection as part of the wider 11kV network supplying Eriskay, Barra and Vatersay. This element of network infrastructure is also key to any future planned removal of Barra power station. There are a number of emerging technologies which may be possible considerations for flexibility as part of a long-term solution however the Islands of Eriskay, Barra and Vatersay have limited flexible generation installed at the moment. This is an area which will be continually assessed and may be utilised in the future.

### 3.7.4. Options considered - Pentland Firth East 3

The PFE3 cable optioneering must be viewed slightly differently to the other investments proposed in this application. All other investments are proactive, planned investments whereas the PFE3 intervention has required to take place in response to a fault. This has meant a much quicker response has been required to reduce network risk and restore the network to normal conditions.

In its optioneering for PFE3 SHEPD identified all plausible solutions which could be delivered immediately, and could also form part of future long term whole system arrangements, whilst not precluding any such future arrangements.

SHEPD developed a long list of options, contained in Table 13, which were identified as likely to be possible future whole system solutions. SHEPD assessed a direct cable replacement for the existing failed asset and determined it as a no-regret option, whilst being a key part and enabler of future whole system solutions.

Following assessment of the immediate need to replace the existing cable now, SHEPD undertook further options analysis for the cable replacement to assess the size of the new cable installation. Details are included in Table 14.

| Future Scenario | Meets future demand | Provides security | Technical redines s | Short term needs met | Feasible Solution |
|---|---|---|---|---|---|
| 1. Low carbon on-island solution | Uncertain | No | Uncertain | No | No |
| 2. Single distribution link | No | No | Yes | Yes | No |
| 3. Two distribution links | Yes | No | Yes | Yes | No |
| 4. Two distribution links plus on-island solution | Uncertain | Yes | Uncertain | Yes | Uncertain |
| 5. Three distribution links | Yes | Yes | Yes | Yes | Yes |
| 6. Two distribution links and a Transmission link | Yes | Yes | Yes | Yes | Yes |
| 7. One distribution link and a Transmission link | Yes | No | Yes | Yes | No |
| 8. One D-Link, One T-Link & and on-island solution | Yes | Uncertain | Uncertain | Uncertain | Uncertain |
| 9. One transmission link and on island solution | Yes | Uncertain | Uncertain | No | No |
| 10. Two transmission links | Yes | Yes | Yes | No | No |

Table 13: Identifying feasible long-term options for Orkney

| Options | | Description | Advantages | Disadvantages |
|---|---|---|---|---|
| 1. | 400mm$^2$ | Replace the existing faulty PFE2 400mm$^2$ cable with a new 400mm$^2$ cable. | Would be cheapest option. Meets immediate network requirements. Is type test approved. SHEPD has installed before. | Would be close to capacity under normal conditions following PFW intervention. Would not provide long term N-1 capability on its own. |
| 2. | 500mm$^2$ | Replace the existing faulty PFE2 400mm$^2$ cable with a new 500mm$^2$ cable. | Provides additional headroom over the 400mm$^2$ cable. Meets immediate requirements. Is type test approved. SHEPD has installed before. | Slightly more expensive than 400mm$^2$ option, [redacted] Reduced bending radius versus 400mm$^2$ makes installation slightly more challenging. Would not provide long term N-1 capability on its own. |
| 3. | 630mm$^2$ | Replace the existing faulty PFE2 400mm$^2$ cable with a new 630mm$^2$ cable. | Would have a greater capacity than both other options. | More expensive than both other options. Has no type test for SHEPD. Would delay project by up to 2 years. Would be most expensive option. Full network requires undergrounding with new underground cable to release future capacity. Increases cable handling issues and makes installation more challenging with reduced bending radius. Would not provide long term N-1 capability on its own. |

Table 14: Cable sizing options for PFE3

#### 3.7.4.1. ‘DO-MINIMUM’ OPTION

At present SHEPD remains compliant with P2/8 due to the presence of two distribution subsea cables, with KPS available on standby in the event of an outage of one of these main import / export routes to Orkney. With the PFE2 cable having failed, this well-established contingency was enacted.

SHEPD could have chosen to continue to operate the Orkney network in a single cable supply with KPS providing peak lopping capability. This configuration would not be P2 compliant and would significantly reduce the export capability from the island, constraining generators significantly already on an ANM scheme. This was, and remains, an unacceptable outcome.

Therefore, as a minimum SHEPD was required to repair or replace the cable. Following a cut and recover campaign of the faulty section of cable, repair was concluded as not being a long-term feasible option and therefore end to end cable replacement was the only acceptable “do- minimum” option.

In order to restore network security and mitigate the risks and costs associated with potential diesel supply, the minimum intervention was to re-install a second submarine cable between mainland Scotland and Hoy. SHEPD progressed with the minimum required intervention. Further details on optioneering are contained in the PFE3 specific Appendix 6A – Pentland Firth East 3 EJP, Appendix 6B – Pentland Firth East 3 CBA LW and Appendix 6C – Pentland Firth East 3 CBA CT.

#### 3.7.4.2. DEFERRAL OPTION

SHEPD had no option to defer investment in this instance. This was due to the network being in a fault condition with a very high network risk present to security of supply and export routes to Orkney. In this case any delay to investment significantly increased risk to network customers.

#### 3.7.4.3. MARKET-BASED OPTION

Appendix 6A – Pentland Firth East 3 EJP highlights the uncertainty of market capability to provide on-demand services for significant periods of time at the capacities and level of reliability needed. This is an area which is developing in the Orkney Isles and will be further evaluated and considered as part of SHEPD’s 2024 whole system analysis that will be presented in the HOWSUM reopener application in 2025.

### 3.7.5. Methodology, criteria and process for technical optioneering

Our general method of technical optioneering is to undertake power system analysis considering the future demand and generation patterns and looking out to the appropriate time horizon. We assess the operation of the system at different times of year (e.g. winter peak demand and summer maximum generation export) to test the technical viability of both needs and any proposals. We consider all electrical assessments during this work such as power flow, voltage, fault level and stability.

To compliment this, we may also look more deeply at forecast demands on specific areas of the network particularly radial feeds. This allows us to understand the future capacity requirements of our network.

Below we provide further context on assessments for each of the specific work elements in this application. The criteria used to assess options is detailed in the individual EJPs and CBAs for the projects.

**Outer Hebrides 2050 Whole System Proposals (Skye – Uist – Harris)**

The methodology for assessing the options for the Outer Hebrides 2050 Whole System Proposals (Skye – Uist – Harris) starts with considering the options identified by the Jacobs whole system study. Early engineering feasibility studies were completed based on these options to identify which submarine cable routes were possible. These feasibility studies were done by consultants OceanIQ. The studies focused on factors along the proposed cable route that will constrain and influence cable processes, affect system integrity, and control cost. Based on perceived risk, the studies have provided us with sufficient information to identify the most suitable marine cable routes for the Skye – Uist – Harris works.

Given the existing network infrastructure already in place on Skye, Harris, and Lewis, 132kV cable options have also been considered as part of the overall options analysis and cost benefit analysis.

SHEPD had proposed as part of the RIIO-ED2 Business Plan submission to install two new circuits between Skye and Uist. A study has been completed to expand on the optioneering that has previously been undertaken to consider the following factors:

- Review alternative options to support the health index improvement on the existing subsea cable connection to Uist. This includes power system analysis to confirm the feasibility of alternative options to support the demand and generation in Uist together with any one or two subsea cable connections between Skye and Uist.
- Use the latest baseline DFES demand and generation data in all studies and update the previous studies using this data.
- Explore any other viable options based on coordination with other energy network companies and system operators, adopting a whole system solution.

Technically feasible options were subsequently progressed through CBA to determine the NPV of each option. Jacobs' approach was to conduct the CBA in a manner strictly aligned to the guidance given by Ofgem utilising the latest guidance document and CBA model.

- RIIO-ED2 Engineering Justification Paper Guidance
- Re-opener Guidance and Application Requirements Document
- RIIO-ED2 Cost Benefit Analysis (CBA) Guidance
- RIIO-ED2 Data Templates and Associated Instructions and Guidance Ofgem

Cost data was obtained through use of recent historical costs verified by subject matter experts, in addition to unit rates. Assessments for this project were undertaken by Jacobs. Jacobs also completed an internal assurance process as part of this work.

More detail is included in Appendix 3A – Outer Hebrides 2050 Whole System Proposals EJP (Skye – Uist – Harris), Appendix 3B – Outer Hebrides 2050 Whole System Proposals CBA (Skye – Uist – Harris) and Appendix 7 – Jacobs Phase 1: Optioneering Studies Report.

### South Uist – Eriskay

SHEPD has well established network arrangements between South Uist and Eriskay. SHEPD has been able to identify all possible crossing options between the islands using the traditional approaches to subsea cable replacement.

SHEPD had proposed as part of the draft RIIO-ED2 Business Plan submission to install a new submarine cable between South Uist and Eriskay. Following further evaluation of the optioneering, an additional option to install a land-based solution using a fixed causeway connection between the islands was identified.

As part of the optioneering phase relevant to this application the following criteria were used to gauge the suitability of each option:

- The ability of each of the options to provide long term security of supply for the network, including under normal and N-1 scenarios.
- The ability of the solutions to meet future demand and generation requirements using the latest CT DFES demand and generation data.
- The ability to deliver the solution within the price control period.
- The benefits of the solution to the long-term islands strategy and network make up.
- The suitability of the option to support network de-carbonisation.

All options which were identified were assessed as being credible technical solutions. Based on network studies, it was also confirmed that all cable sizes considered could provide for long term loading requirements. Therefore, the process of further assessing the options was based upon results of CBA.

This considered aspects including the capex and opex elements of the solutions, and the reduction in network risk associated with network outages alongside potential constraint generation. The outputs of the CBA assisted in evaluating the best solution to be progressed.

More detail is included in Appendix 4A – Uist – Eriskay EJP and Appendix 4B – Uist – Eriskay CBA.

### Eriskay – Barra

Again, SHEPD has well established network arrangements between Eriskay and Barra. SHEPD has been able to identify all possible crossing options between the islands using the traditional approaches to subsea cable replacement. SHEPD had proposed as part of the draft RIIO-ED2 Business Plan submission to install a new submarine cable between Eriskay and Barra.

As part of the optioneering phase relevant to this application the following criteria were used to gauge the suitability of each option:

- The ability of each of the options to provide long term security of supply for the network, including under normal and N-1 scenarios.
- The ability of the solutions to meet future demand and generation requirements using the latest CT DFES demand and generation data.
- The ability to deliver the solution within the price control period.
- The benefits of the solution to the long-term islands strategy and network make up.
- The suitability of the option to support network de-carbonisation.

All options which were identified were assessed as being credible technical solutions. Based on network studies, it was also confirmed that all cable sizes considered could provide for long term loading requirements. Therefore, the process of further assessing the options was based upon results of CBA.

This considered aspects including the capex and opex elements of the solutions, and the reduction in network risk associated with network outages alongside potential constraint generation. The outputs of the CBA assisted in evaluating the best solution to be progressed.

More detail is included in Appendix 5A – Eriskay – Barra EJP and Appendix 5B – Eriskay – Barra CBA.

### Pentland Firth East 3

In the context of the PFE2 failure and the immediate need to implement fault restoration, a long list of long-term core options were identified. These were possible future long term, whole system solutions that could support the network out to 2050 and beyond. Reflecting the fault situation, these options were initially assessed against the following criteria:

- Is the option capable of meeting future demand?
- Does the option meet planning standards to provide part of the islands' long-term N-1 security?
- Does / will the option meet technical readiness requirements?
- Does this option meet the short-term needs for Orkney? If we plan for this eventuality now, will the supplies on Orkney be secure in the short term?

These criteria were used to narrow down options to those which were viable, and we then assessed if replacement of the PFE2 cable with a similar distribution cable limited any viable future solutions. It was concluded that it would not, on the basis that a distribution cable would be required in all viable long-term whole system solutions for the Orkney islands.

Subsequent criteria were then applied to assess which cable size should be installed as part of the fault restoration, targeting cable sizes which:

- Provide for short term capacity and security needs.
- Do not limit solutions to provide for long term future demand requirements.
- Can be delivered immediately.
- Enable future whole system solutions.

SHEPD's long list of options for the PFE2 replacement were assessed on a qualitative basis, looking at future network scenarios and the ability of the solution to meet the assessing criteria.

Further network systems studies and analysis were conducted confirming the suitability of the network solution to provide for long term network normal conditions. SHEPD are aware that further works will be required to support the long-term network security of the Orkney islands based upon the predicted load growth in the area. This is something which will be assessed and evaluated as part of 2024 whole system analysis and submitted in our 2025 HOWSUM application.

Cable sizing options were then progressed to the CBA to determine the optimum cable size.

Further system studies indicated that a new 5MVAr shunt reactor would require to be installed alongside the new distribution cable to reduce the capacitive charging current of the circuit and protect the associated switchgear.

### Potential for 66kV uprating

Currently SHEPD has no 66kV assets on the distribution network. However where appropriate, and as circuit loadings require, we will consider alternative distribution voltages for network infrastructure as part of whole system analysis and future installation projects.

The loading requirements for the South Uist – Eriskay & Eriskay – Barra cables do not require the consideration of a 66kV solution as these cables currently operate at 11kV with suitable capacity and headroom on 11kV cables.

A 66kV solution could be considered as part of the wider Skye – Uist – Harris solution, however given the current infrastructure at either end of the current 33kV cable, consideration has been given to 132kV cable as an alternative to a 33kV solution. We have considered that should we wish to operate a 66kV cable between Skye

and Harris, that we would likely procure a 132kV cable and operate at 66kV. If this is the case, given the existing infrastructure and the additional infrastructure that would be required to operate a 66kV cable, it would be likely that a 132kV solution would be put in place instead. Therefore, a 66kV solution has not been included at this stage within the detailed options assessment and analysis for the Skye – Uist – Harris project.

66kV was considered under the PFE3 project initially, however, given delivery timescales and concerns over security of supply for Orkney whilst the PFE2 cable was in fault, a 66kV solution was determined not to be feasible as part of the PFE3 installation. 66kV will be considered in future whole system analysis for the Orkney Isles, taking place across 2024, which will determine the long-term whole system picture for the island group.

#### Potential for HDD solutions

SHEPD will always assess whether there is a need for a subsea cable asset as this infrastructure is expensive and difficult to inspect and maintain, as well as resulting in long outage times should a fault occur. For shorter distances <1.4km, SHEPD may also consider a horizontal directional drill (HDD) to tunnel under the marine environment and remove the asset from the sea. For the interventions proposed HDD is not a technically feasible option given the distances involved between the islands. Therefore, this option was not considered within the options assessments.

For all projects, cost-benefit assessments have also been carried out, and consider the following specific benefit criteria:

- Carbon output from running relevant DEG (tCO2e pa)
- Customer interruptions and customer minutes lost
- Circuit losses (MWhr/year)

More detail on CBA is included in each project appendix.

### 3.7.6. Sensitivity analysis

The following sensitivity analyses have been undertaken.

#### Outer Hebrides 2050 Whole System Proposals (Skye – Uist – Harris)

Sensitivity analysis was carried out on the preferred option through undergrounding of onshore cable to Dunvegan, instead of OHL, in consideration of the visual impact and potential consenting issues. The analysis concluded that the proposed solution (including the change from overhead line to underground cable) still had the lowest negative Net Present Value (NPV) of the technically feasible options assessed. Further detail is included in the Outer Hebrides EJP.

#### South Uist – Eriskay

A sensitivity analysis was conducted on the South Uist – Eriskay project, considering if the preferred solution should be deferred into RIIO-ED3, given the current HI3 rating of the cable. This analysis concluded that it was better to invest now within RIIO-ED2 rather than defer the investment. Further detail is included in the Uist – Eriskay CBA.

## 3.7.7. CBAs and EJPs

### Outer Hebrides 2050 Whole System Proposals (Skye – Uist – Harris)

Jacobs carried out CBA on each of the 14 technically feasible options developed in their optioneering process. From this Jacobs have taken forwards the five options with the highest NPVs for inclusion in the EJP. The CBA results for these five options is summarised in Table 15. Option 18 is the preferred option which has been taken forwards at this time. The detail is set out in Appendices 3A, 3B and 7.

| Option | Description | 10 years | 20 years | 30 years | 45 years | Whole life (55 years) |
|---|---|---|---|---|---|---|
| **Option 11** | Replace Ardmore – Loch Carnan subsea cable with larger cable and add a new larger size cable / OHL Ardmore – Clachan & new Ardmore – Harris subsea cables | 5.73 | (27.73) | (47.01) | (62.45) | **(71.77)** |
| **Option 14** | Remove Ardmore – Loch Carnan subsea cable and replace with Dunvegan – Loch Carnan OHL/subsea cable and Ardmore – Clachan subsea cable / OHL & new Ardmore – Harris subsea cables | 10.91 | (18.37) | (35.14) | (48.36) | **(56.36)** |
| **Option 18** | New Dunvegan – Loch Carnan subsea cable /OHL, additional Harris – Clachan subsea cable / OHL & new Ardmore – Harris subsea cables | 10.77 | (16.22) | (31.44) | (43.21) | **(50.43)** |
| **Option 19** | New Dunvegan – Loch Carnan subsea cable and additional underground line onshore, additional Harris – Clachan subsea cable / OHL & new Ardmore – Harris subsea cables | 9.05 | (19.00) | (34.83) | (47.07) | **(54.75)** |
| **Option 26** | Remove Ardmore – Loch Carnan subsea cable and replace with new Ardmore – Loch Carnan subsea cable and Ardmore – Clachan subsea cable / OHL & new Ardmore – Harris subsea cables | 5.70 | (25.84) | (43.80) | (57.97) | **(65.22)** |

Table 15: Net Present Value at different intervals (£m, 2021 prices)

#### Uist – Eriskay, Eriskay – Barra

The cost estimates that have been presented for delivery of the submarine cable have been compiled using Ofgem unit rates. More detail is included in Section 6 and the Uist – Eriskay and Eriskay – Barra on the CBAs and EJPs.

#### PFE3

The CBA and EJP are included at Appendices 6A and 6B.

### 3.7.8. Additional expenditure

Justification for the proposed timing of additional expenditure is captured within the programme information this section and within the individual project EJPs.

## 3.8. Detail on the preferred options

### 3.8.1. Preferred option - Outer Hebrides 2050 Whole System Proposals (Skye – Uist – Harris)

More information on the Skye – Uist analysis is available in the Skye – Uist EJP and CBA at Appendices 3A and 3B., and the Jacobs' Optioneering Report at Appendix 7.

#### 3.8.1.1. DESCRIPTION OF KEY FEATURES

The preferred option entails removing the existing Ardmore to Loch Carnan subsea cable (33kV 95mm$^2$) and replacing with a larger cable (33kV 300mm$^2$) on an alternative route from Dunvegan to Loch Carnan. It also involves the installation of a new cable (33kV 300mm$^2$) from Harris GSP to Clachan 33kV Sw/STN, via Lochmaddy, and a secondary subsea cable (33kV 500mm$^2$) augmenting the existing Ardmore to Harris route. This additional circuitry is shown in Figure 13.


Figure 13: Preferred Option Skye – Uist – Harris

The proposed option provides additional resilience to the Outer Hebrides through provision of a potential ring arrangement between Dunvegan, Ardmore, Harris and Loch Carnan. This will reduce our long-term reliance on DEG and help us decarbonise this source of emissions. We recommend the delivery of the Dunvegan – Loch Carnan project in RIIO-ED2, with the further two key project elements estimated to be progressed by 2032 and 2035 – see Table 7.

#### 3.8.1.2. RATIONALE FOR EFFICIENT EXPENDITURE

We note that our formal cost submission on Skye – Uist – Harris will be made to Ofgem in later summer 2024 and will contain detail on these aspects.

We have considered the opportunity for aligning the timing of delivery of all three cables proposed in this EJP. Feedback from our subsea cable project team is that each of these cables requires a significant length of cable which would likely take up the majority of the capacity on a regular sized vessel. Therefore, it is unlikely that we will see significant economies through aligning works. Further, through bringing forwards the Harris – Ardmore and Harris – Lochmaddy cable installations we will lose any future optionality and we are mindful of the potential variability of future demand and generation pathways given recent feedback from stakeholders. Hence, it is most efficient to take forwards the installation of Dunvegan – Loch Carnan only at this time.

### 3.8.1.3. BENEFITS TO CUSTOMERS

The preferred option will facilitate the decarbonisation of homes and businesses across the Outer Hebrides and support the potential connection of additional generation projects at a distribution level.

The preferred option will provide a more reliable network to the island group ensuring P2-8 compliance without the current level of reliance on the embedded generation sites that support the existing network. This more secure network arrangement will minimise restoration times in the event of a 33kV subsea cable fault. The reduced reliance on embedded diesel generation also delivers societal benefits with a reduction in carbon emissions envisaged, especially in fault situations.

The preferred solution will require a 33kV overhead line to be installed between Loch Pooltiel and Dunvegan GSP. Whilst supporting a lower cost solution this has the potential to have consenting challenges which could delay completion of the work. A mitigation is being developed and is discussed at Section 3.8.6.

### 3.8.1.4. SCENARIO RELEVANT TO PREFERRED OPTIONS

The preferred option provides sufficient distribution network capacity for the Outer Hebrides to meet future demand and generation requirements according to our 2022 DFES CT background.

The preferred option outlined in this paper is predicated on the expected availability of the proposed (pre-engineering approved) HVDC link, owned and operated by SSEN Transmission, by 2030.

### 3.8.1.5. IMPACTED ASSETS OR PROGRAMMES OF WORK

Relevant substation assets affected by the proposed works to deliver the Outer Hebrides 2050 Whole System Proposals (Skye – Uist – Harris) are shown in Table 16. Relevant transmission works are set out in Section 4.2.1 of this report. As shown, this captures impacts driven by both the interventions recommended to be progressed within RIIO-ED2, and those which are proposed to be taken forward at later dates.

| Asset | Related Works | Delivery Date |
|---|---|---|
| Dunvegan GSP (substation reinforcement) | Dunvegan – Loch Carnan 33kV 300mm Subsea cable and overhead line | 2027/28 |
| Ardmore 33kV switchboard and additional grid transformer | Ardmore – Harris 33kV 500mm Subsea cable | 2032 |
| Harris GSP (substation reinforcement) | Ardmore – Harris 33kV 500mm Subsea cable | 2032 |
| Clachan 33kV Sw/STN (substation reinforcement) | Harris – Clachan 33kV 300mm Subsea cable and overhead line | 2035 |

Table 16: Assets impacted by Skye – Harris – Uist proposals

### 3.8.1.6. TECHNICAL FEASIBILITY

The preferred option has been technically assessed as per Section 3.7.1. Further detail on technical feasibility is set out in the Skye – Uist – Harris EJP and CBA at Appendices 3A and 3B, and Jacob's Optioneering Report at Appendix 7. The proposed subsea route will be assessed during 2024 in parallel with this technical submission.

### 3.8.1.7. PROJECT DELIVERY AND MONITORING PLAN

#### Approach to project delivery

The projects will be delivered in accordance with a Safety and Health Plan, an Environmental Management Plan, and a Project Execution Plan which defines the scope, delivery strategy, objectives, and drivers, and validates assumptions. Within the Execution Plan, the Project Schedule details key activities and interfaces, which are aligned to the Business Case commitments whilst change control processes, constructability and operability reviews, and Project Commissioning Phase considerations are defined and documented. Communications interfaces, community, and public relations, legal, reporting and consent issues are also clearly identified, and subsequent actions defined.

As the Client, and in compliance with statutory and legislative requirements, specifically the Construction (Design and Management) Regulations, SHEPD will appoint a construction phase Principal Contractor who will liaise with other Contractors appointed by the Client or others (as necessary) in developing safe systems of work whilst taking responsibility for the planning, managing and coordination of project delivery.

From an environmental perspective both archaeological and ecological surveys will be undertaken, and any relevant restrictions imposed observed.

A Risk Management Plan will be produced by the project Risk Manager and owned by the Project Director. Examples of key risks include, but are not limited to, the nature of the terrain whereby there is a risk that excess rock will be uncovered during excavations leading to increase in cost; due to the geographical nature and / or limited road infrastructure of the site there is a risk that severe weather could result in reduced productivity, access constraints or full shutdown and despite agreements being in place, there is a risk that access to site is not possible (potentially due to landowner difficulties, weather, issues with access route) incurring delay costs.

#### Delivery strategy

The delivery strategy for the overall project is to deliver [redacted].

The supply chain required to deliver the project has been tested through delivery of ED1 projects. This has shown that the supply chain is able to provide the capacity and skills required to deliver these projects. As we move into RIIO-ED2 with the increased amount of CAPEX delivery required it is important for us to ensure that the supply chain can continue to deliver. In response to this we have commenced early market engagement with submarine cable installation Contractors to ensure that the capacity and skills to deliver this project are available.

To deliver the submarine cable package we will [redacted]. The marine route surveys will be progressed with a separate Contractor to make use of the advanced development funding from Ofgem and inform the detailed design.

The challenges for delivery of the submarine cable include limited vessel availability suitable to install the lengths of submarine cable proposed. [redacted]. This can be managed through early engagement and commitment to Contractors to secure the equipment availability required. [redacted].

### Managing and monitoring delivery

The project will be managed under SSE's Large Capital Project (LCP) governance framework.[23] This framework ensures that all large capital investment projects for the SSE Group are governed, developed, approved and executed in a safe, consistent, sustainable and effective manner.

Delivery of the project will be led by the Project Manager who will manage a project team made up of key disciplines such as Engineering, Consents, Procurement & Commercial, Safety, Environmental and Planning. This project team will be supported by other disciplines such as Quality, Operational Personnel, Risk Management, and others as required.

The dedicated Project Planner will set the project baseline programme at the beginning of the project and monitor progress throughout. Progress will be informed by the project team and by Contractors who will submit their programmes to the project planner regularly identifying any delays and changes.

To manage cost there will be procurement, insurance and legal reviews held at each key stage of the project. This will define the contract strategy and ensure that SHEPD will work in current market conditions to negotiate contracts which protect SHEPD and manage risks appropriately. Costs will be estimated at each stage of the project and will include tendered costs to achieve accurate estimates. Regular review of expenditure and forecast will be done throughout the project to monitor this and deliver the project within budget.

Risk will be managed in accordance with the LCP Governance framework to ensure risks are identified, assessed, mitigated, and monitored. This is done using a risk management system that the project team uses to capture this process and to review the risks regularly. The risk cost will be determined using Quantitative Cost Risk Analysis to provide a realistic appraisal of the potential value.

### Project delivery programme

The submarine cable programme is to survey the proposed marine routes in 2024 and complete the design and engineering following this in the same year. On completion of the design, all consent applications will be prepared and applied for in 2025. Procurement of the submarine cable is planned to commence mid to end of 2025 enabling completion of installation of the cable during 2026. More detail on programme is included in Appendices 3A and 3B.

### Procurement and commercial strategy

There are several complexities associated with the Skye – Uist cable replacement project which requires consideration in context of the procurement strategy and process. [redacted].

A Request for Information (RFI) was issued to the market in August 2023 to gauge interest in the project, confirm vessel availability and manufacturing capacity. Suppliers were identified via Achilles System, which was also used for issue of the RFI. [redacted] In due course and when the preferred technical solution is confirmed - a formal competitive Invitation to Tender (ITT) will be issued via SHEPD procurement portal - Jaggaer.

23 Group Large Capital Project Policy (sse.com)

- **Procurement challenges**

[redacted]

– *Location*: The Outer Hebrides has various logistical challenges due to its remote location including but not limited to accessibility, small local supply chain, marine/environmental/ecological challenges, variable, and uncertain weather conditions due to proximity to the Atlantic.

– *Market conditions*:

  - [redacted]
    - [redacted].
    - [redacted].
    - [redacted].
  - [redacted]
    - [redacted].

– *Supply chain:*

  - Oversubscribed offshore cable installation market as illustrated in Figure 14 and Figure 15 – [redacted].
  - Capacity / capability of cable manufacturers – the cable must have SHEPD Technical Authority approval and no factory joints. The Technical Authority specifies the requirements of any cable which is to be connected to the SHEPD network. In this instance the requirement is that the cable is type tested which involves an electrical and mechanical test of the fully manufactured cable. A Type Test certificate can be applied to cables of the same design with a smaller cross-sectional area but not larger. [redacted]. Due to previous faults and cable failures, SHEPD will not accept cables with factory joints. Factory joints are connections between extrusion lengths manufactured under controlled factory conditions, however this would be a weaker part of the cable length and it has been proven that faults are more likely to arise in factory joints which is the rationale for these not being accepted. However, some manufacturers cannot guarantee this requirement due to their manufacturing process or limitations with their equipment – particularly for longer cable lengths.

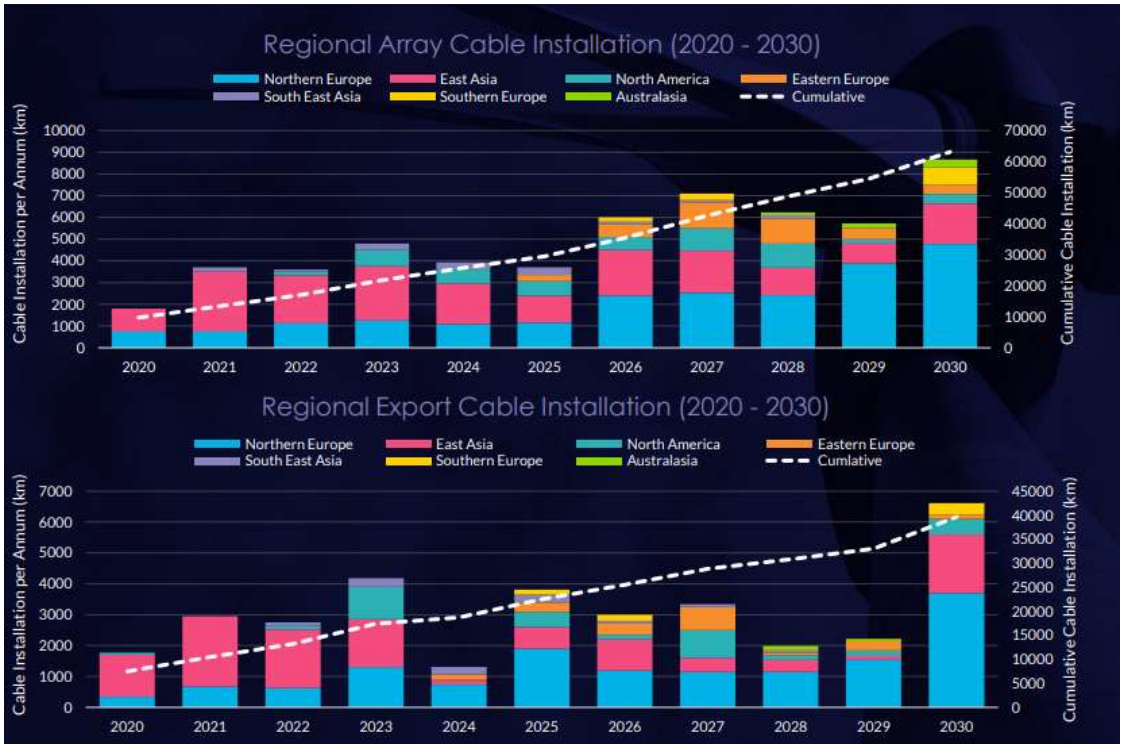


Figure 14: Regional cable installation growth (Source: Archer Knight, 2023)

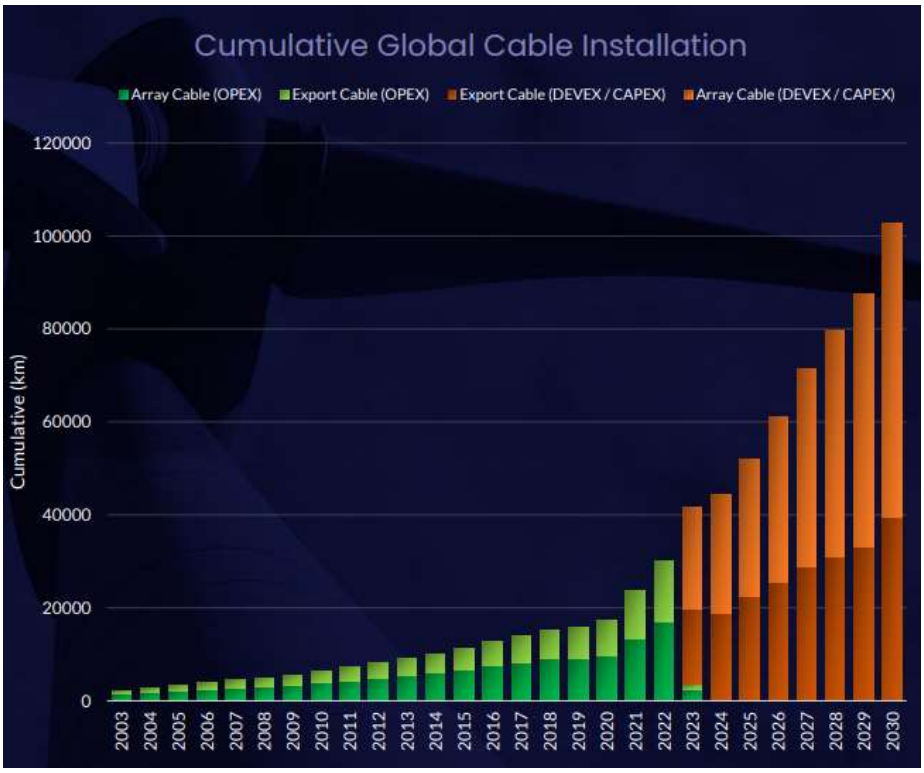


Figure 15: Cumulative global cable installation growth (Source: Archer Knight, 2023)

- **Contracting approach - subsea**

The section highlights the contracting approach undertaken by SHEPD for the Skye to Uist subsea cable replacement. It highlights the key activities, completed to date and key activities to be progressed.

It should be noted that SHEPD is required to comply with the Utilities Contract (Scotland) Regulations 2016 and as such a regulated tender process for the Skye – Uist subsea cable replacement shall be followed.

[redacted]

Information received in the RFI has been used to inform the procurement timeline and for understanding of when certain procurement activities must be achieved.

In the meantime, and to progress the project, it is proposed to issue a standalone contract for the offshore route surveys. The ITT for this was issued in November 2023. This information shall be used to confirm the suitability of individual and routes and shall eventually be passed onto installation contractor for them to complete the route design. [redacted].

[redacted]

- [redacted]
- [redacted]
- [redacted]

[redacted]

- [redacted]

Table 17 sets out currently identified procurement activities remaining for the Skye – Uist project.

| Package | Package Description | Procurement Strategy | Comments | Required Completion / Delivery Date |
|---|---|---|---|---|
| 1 | [redacted] | [redacted] | [redacted] | [redacted] |
| 2 | [redacted] | [redacted] | [redacted] | [redacted] |

| Package | Package Description | Procurement Strategy | Comments | Required Completion / Delivery Date |
|---|---|---|---|---|
| 3 | [redacted] | [redacted] | [redacted] | [redacted] |

Table 17: Skye – Uist subsea procurement activities completed to date

- [redacted]

Table 18 sets out currently identified procurement activities remaining for the Skye – Uist project.

| Package | Package Description | Procurement Strategy | Comments | Required Completion / Delivery Date |
|---|---|---|---|---|
| 1 | [redacted] | [redacted] | [redacted] | [redacted] |
| 2 | [redacted] | [redacted] | [redacted] | [redacted] |
| 3 | [redacted] | [redacted] | [redacted] | [redacted] |
| 4 | [redacted] | [redacted] | | [redacted] |
| 5 | [redacted] | [redacted] | [redacted] | [redacted] |
| 6 | [redacted] | [redacted] | [redacted] | [redacted] |
| 7 | [redacted] | [redacted] | [redacted] | [redacted] |
| 8 | [redacted] | [redacted] | [redacted] | [redacted] |
| 9 | [redacted] | [redacted] | [redacted] | [redacted] |
| 10 | [redacted] | [redacted] | [redacted] | [redacted] |

| Package | Package Description | Procurement Strategy | Comments | Required Completion / Delivery Date |
|---|---|---|---|---|
| 11 | Commissioning | SHEPD Internal Resource | SHEPD Internal Resource | Early engagement with Region to be prioritised. |

Table 18: Skye – Uist subsea procurement activities remaining

- **Contracting approach - onshore**

SHEPD will use the build framework contracts it currently has in place together with stand alone NEC ECC 3 contracts where required for packages of works for linear and substation works. This will also include design, consent and build packages to provide efficiency and reduce cost. The materials will be procured utilising framework in place with approved suppliers for linear and substation plants and these will be free issued to reduce cost and risk to the delivery.

**Work carried out to date**

The purpose of the marine engineering desktop studies is to progress early engineering of the potential submarine cable routes. These have been completed and the studies have identified potential routes which can now be surveyed.

The marine survey which will be a significant percentage of the development funding has now been issued out to tender with the intention to progress marine surveys when the weather allows in spring 2024.

Aside from the procurement activities noted in this section, other ongoing works as part of the development funding include environmental onshore and offshore desktop studies to understand the environmental constraints associated with the project.

## 3.8.2. Preferred option - South Uist – Eriskay

It is proposed to replace this subsea cable with a land-based cable along the Eriskay Causeway. This work will be executed by the team in the Region. At the time of writing there are no planned procurement activities for this scope. It is likely that these works will be conducted by SHEPD internal staff or by using local regional contractors for OHL construction or onshore cabling activities. Suitable contracts will be put in place should external support be required. More information is available in the Uist – Eriskay EJP and CBA at Appendices 4A and 4B.

### 3.8.2.1. DESCRIPTION OF KEY FEATURES

Key components of the project are as follows:

- Installation of circa 1.3km of 11kV OHL on South Uist including a terminal pole.
- Installation of circa 2.3km of 11kV underground cable from the newly established terminal pole, to Eriskay through the island causeway.
- Decommissioning of the existing South Uist – Eriskay 11kV submarine cable.

This option will remove the high-risk subsea cable from the network and provide a more secure, more accessible onshore network. This option will provide longer anticipated asset life and reduce inspection and maintenance costs.

### 3.8.2.2. RATIONALE FOR EFFICIENT EXPENDITURE

Cost benefit analysis was carried out for all options identified in Section 3.7.2. This option would be significantly cheaper than any of the submarine cable solutions and is estimated at around [redacted] This is the cheapest option whilst delivering maximum consumer and network benefits. This solution is also anticipated to have an extended asset life over a subsea cable solution.

### 3.8.2.3. BENEFITS TO CUSTOMERS

Several subsea cable circuits have failed during RIIO-ED1, causing significant impact on customer interruptions, constrained generation, and have resulted in impact costs for temporary generation and CO2 emissions. The recommendation that the existing subsea cable is replaced with a land-based solution, including a causeway crossing will improve circuit reliability resulting in fewer and shorter customer interruptions.

### 3.8.2.4. SCENARIO RELEVANT TO PREFERRED OPTIONS

The studies are predicated on the DFES generation and demand data for 2022.

### 3.8.2.5. IMPACTED ASSETS OR PROGRAMMES OF WORK

The proposed solution does not have a material impact on any existing network assets with the exception of the disposal of the existing subsea cable.

### 3.8.2.6. TECHNICAL FEASIBILITY

Network studies have considered demand growth on the circuits out to 2050 in line with the CT DFES scenarios. These studies highlight no thermal or voltage issues associated with the new proposed onshore solution.

The studies also confirmed that the new overland route can support the 11kV network onto Barra and surrounding islands, under worst case N-1 contingencies.

SHEPD also has similar network infrastructure installed on the West side of the causeway. These assets have been installed for a number of years and proves the viability and technical feasibility of a solution of this type.

### 3.8.2.7. PROJECT DELIVERY AND MONITORING PLAN

#### Project delivery

SHEPD has a precedence and confirmation that this type of solution can be installed in this location, as a similar circuit route is already installed in the West side of the causeway crossing. There will be challenges on installation due to the geographical location and topography of the area associated with the project, but these are more around the rate of progress rather than the deliverability of the solution. SHEPD have high confidence in being able to deliver the proposed investment.

#### Delivery strategy

The aspects of the proposed solution are business as usual activities for SHEPD. There are challenges associated with the installation of the new onshore cable surrounding the design deviations, but these are manageable, especially given the long-term benefits of the solution.

### Managing and monitoring delivery

Delivery of the project will be led by the Project Manager who will manage a project team made up of key disciplines such as Engineering, Consents, Procurement & Commercial, Safety, Environmental and Planning. This project team will be supported by other disciplines such as Quality, Operational Personnel, Risk Management, and others as required.

### Project delivery programme

It is proposed that this solution will be designed and consented throughout 2025/26 with installation to take place in later 2026/27.

### Procurement and commercial strategy

It is proposed to replace this subsea cable with a land-based cable along the Eriskay Causeway. This work shall be executed by SHEPD's team in the local Region. At the time of writing there are no planned procurement activities for this scope. It is likely that these works will be conducted by SHEPD internal staff or by using local regional contractors for OHL construction or onshore cabling activities. Suitable contracts will be put in place should external support be required.

### Work carried out to date

Initial discussions have been held with the Western Isles Council engineers regarding the installation of a cable across the South Uist – Eriskay cause way including a crossing of a small bridge section. The council engineers have no initial objections to the project proposal. These discussions will be progressed through detailed design.

## 3.8.3. Preferred option - Eriskay – Barra

SHEPD has conducted options assessment and CBA analysis to support the intervention on the existing Eriskay – Barra 2 subsea cable. This analysis suggests that SHEPD should augment the existing cable with a new similar sized subsea cable, within the RIIO-ED2 price control period. More information is available in the Eriskay – Barra EJP and CBA at Appendices 5A and 5B.

#### 3.8.3.1. DESCRIPTION OF KEY FEATURES

Installation of a new 11kV 95 mm² XLPE Cu DWA subsea cable and retaining the existing cable in service.

#### 3.8.3.2. RATIONALE FOR EFFICIENT EXPENDITURE

Cost benefit analysis was carried out for all options identified in Section 3.7.3. This analysis has concluded that the preferred option (Augmentation with a similar sized cable), within RIIO-ED2, is the preferred solution based upon NPVs, whilst delivering maximum consumer and network benefits.

#### 3.8.3.3. BENEFITS TO CUSTOMERS

As the studies confirmed that the new cable can support the 11kV network and surrounding islands, under worst case N-1 contingencies. this intervention will improve circuit reliability and network security for customers whilst ensuring project costs can be as efficient as possible through planned intervention.

#### 3.8.3.4. SCENARIO RELEVANT TO PREFERRED OPTIONS

The studies are predicated on the CT DFES generation and demand data for 2022.

#### 3.8.3.5. IMPACTED ASSETS OR PROGRAMMES OF WORK

The proposed solution does not have a material impact on any existing network assets. SHEPD may choose to reconfigure the existing network feeding arrangements following installation to allow quicker restoration in the event of a fault, but this will be determined through the detailed design phase of works.

#### 3.8.3.6. TECHNICAL FEASIBILITY

Network studies conducted on PSS Sincal confirm that a 95mm$^2$ 11kV subsea cable will be suitable for network requirements out to 2050 based on DFES forecasts. This is based on utilising stock 11kV 95mm$^2$ cable rated up to 5.62MVA.

Network studies have considered demand growth on the circuits out to 2050 in line with the CT DFES scenarios. These studies highlight no thermal or voltage issues associated with the new proposed solution.

#### 3.8.3.7. PROJECT DELIVERY AND MONITORING PLAN

**Project delivery**

SHEPD has delivered a number of projects of this type for a number of years over a number of price controls. There is also a well-established specialist internal subsea cables team who will be managing the surveying, design and installation of this project.

**Delivery strategy**

SHEPD has existing and well-established frameworks in place to allow us to deliver these works as part of business-as-usual activities. SHEPD will soon be looking to establish a new framework for subsea cable installation and may use this project as one of the bidding exercises for possible new framework partners.

Marine desktop studies will be commenced in 2024 to allow surveys to be progressed in 2025. Installation of the submarine cables would be targeted in the summer months of 2027 however SHEPD would look to bundle these cables with other projects to reduce mobilisation and demobilisation costs.

The delivery strategy for the project is to free issue stock submarine cable to an Installation Contractor. SHEPD currently hold submarine cable that is suitable for the proposed solution and would utilise this on the project. Survey, design and engineering would either be managed by SHEPD or the Installation Contractor depending on market availability and the approved contracting strategy. For this project there are minimal onshore works required and therefore this will be managed by the SHEPD subsea delivery team. The delivery team will engage directly with the regional delivery teams or a third-party contractor if required to complete these small scopes.

**Managing and monitoring delivery**

Delivery of the project will be led by the Project Manager who will manage a project team made up of key disciplines such as Engineering, Consents, Procurement & Commercial, Safety, Environmental and Planning. This project team will be supported by other disciplines such as Quality, Operational Personnel, Risk Management, and others as required.

**Project delivery programme**

It is proposed that this solution will be designed and consented throughout 2025/26 with installation to take place in later 2026/27.

### Procurement and commercial strategy

In consideration of the length and location of this cable replacement, it is proposed to execute this project under the standard subsea cable asset replacement process. SSE maintains a regulated Framework Contract with several suppliers. In the event of an identified asset replacement or cable fault, Framework Contractors are approached to provide a technical and commercial proposal for performance of the work (a mini competitive tender). The existing Framework shall expire in August 2025 and retender is in currently in the early stages. Therefore, it is likely that the installation of this cable shall be competitively tendered under the new framework.

It is proposed to utilise stock cable for this requirement, therefore negating the need for cable procurement. It is likely that this cable replacement will be done later in the RIIO-ED2 price control period therefore procurement activities to date and planned are minimal.

| Package | Package Description | Procurement Strategy | Comments | Required Completion / Delivery Date |
|---|---|---|---|---|
| 1 | Eriskay to Barra Route Desktop Study (DTS) | Mini Competitive Tender | Tender to be issued to known Engineering and Route Designers | December 2025 |

Table 19: Procurement activities to be completed 2025

## 3.8.4. Preferred option - Pentland Firth East 3

PFE1 was replaced by PFE2 in November 2020. Following a review of several replacement options, a 400mm$^2$ cable option was identified as the preferred solution further to cost analysis and considering our ability to deliver the required outputs associated with replacing the existing cable. The cable in this option will be rated to a minimum of 30MVA. PFE2 failed in January 2021 and SHEPD's assessments determined it was preferable from technical and value for money perspectives to replace, rather than repair, PFE2, and progressed with the selection and procurement of a larger cable, Pentland Firth East 3 (PFE3). More information is available in the PFE3 EJP and CBA at Appendices 5A and 5B.

### 3.8.4.1. DESCRIPTION OF KEY FEATURES

The new PFE3 cable was installed in the summer of 2023 and energised at the end of September 2023. The cable is a 500mm$^2$ Cu XLPE DWA Cable with a rating of 35.5MVA and is classified as HI1C2. This solution removed the security of supply risk to customers, returning the network to normal conditions.

### 3.8.4.2. RATIONALE FOR EFFICIENT EXPENDITURE

As part of the fault restoration optioneering, a number of CBAs were produced utilising the Ofgem standard template.

- First CBA - Repair / Replace
- Second CBA - Repair / Replace / Cut and Recover

Following this analysis, it was concluded that a replacement cable would be required.

- Third CBA - Cable Sizing (4 CBAs produced considering 2020 & 2021 LW & CT DFES scenarios)

All options identified in Section 3.7.4 were considered in the third CBA. This analysis has concluded that the preferred option (Replacement with a 500mm$^2$ Cu XLPE DWA Cable), is the preferred solution based upon NPVs, whilst delivering maximum consumer and network benefits including short term capacity and security needs.

This project has been subject to an open market competitive tender and subsequently evaluated to ensure the most efficient and technically capable bid was selected. SHEPD has subsequently delivered the project for less than the initial project estimate, which was based on the tender returns.

#### 3.8.4.3. BENEFITS TO CUSTOMERS

The PFE3 subsea cable provides one of the main connections between mainland Scotland and the Orkney Isles, in conjunction with the Pentland Firth West cable (PFW). The benefits associated with delivery of this project are significant and include improved asset health and reliability, contribution to security of supply and meeting demand and generation needs as part of a whole system solution out to 2050 and beyond.

#### 3.8.4.4. SCENARIO RELEVANT TO PREFERRED OPTIONS

The investment decision has been taken on the basis of the 2021 CT and LW DFES data, which was the latest available at the time of the decisions.

#### 3.8.4.5. IMPACTED ASSETS OR PROGRAMMES OF WORK

The proposed solution does not have a material impact on any existing network assets with the exception of the disposal of the existing PFE2 subsea cable. This solution will now feature as a part of any future long term whole system solution.

#### 3.8.4.6. TECHNICAL FEASIBILITY

SHEPD's long list of options for the PFE2 replacement were assessed on a qualitative basis, looking at future network scenarios and the ability of the solution to meet the assessing criteria.

Further network systems studies and analysis were conducted confirming the suitability of the network solution to provide for long term network normal conditions. SHEPD are aware that further works will be required to support the long-term network security of the Orkney islands based upon the predicted load growth in the area.

SHEPD has had three previous subsea cables installed in this area and are therefore confident that it was a technically feasible solution. The project has now subsequently been installed and energised.

#### 3.8.4.7. PROJECT DELIVERY AND MONITORING PLAN

**Project delivery**

An EPCI (Engineering, Procurement, Construction, and Installation) contract was awarded in November 2022 to the principal contractor for design, route surveys, supply and installation of the submarine cable system. The project was energised in September 2023. Detail is included in Table 20.

**Delivery strategy**

For the investment proposed under our subsea cable related EJPs, we have been developing our RIIO-ED2 Commercial & Deliverability Strategy and engaging with our supply chain to ensure we can deliver the solutions proposed, while identifying and managing the risks presented by the complex and challenging nature of the projects.

### Managing and monitoring delivery

Further details can be found in Appendix 6A – Pentland Firth East 3 EJP.

### Project delivery programme

The delivery programme for PFE3 is included at Table 20. All works have been completed.

| Key activities | Approximate dates |
|---|---|
| 1. Mobilise for Murkle Bay site set-up | 21 Jun 2023 |
| 2. Mobilise for Rackwick Bay site set-up | 28 Jun 2023 |
| 3. Mobilise PLGR Vessel | 22 Jun 2023 |
| 4. Mobilise MPV and load rock-bags | 28 June and 01 July |
| 5. Cable pull-in, lay and complete pull-in | 04 July to 15 July 12 |
| 6. Mobilise TSV | 02 July |
| 7. Cable Load-in at Nigg | 16 July to 19 July 23 |
| 8. Shunt Reactor delivered at Thurso | 31 July 23 |
| 9. Submarine cable jointed and CIS installed | 28 Aug 23 |
| 10. Submarine cable buried and stabilised | 28 Aug 23 |
| 11. Shunt reactor civil and elec. works completed | 08 Sep 23 |
| 12. Outage to energise cable and Reactor | 18 Sep to 30 Sep 23 |

Table 20: PFE3 delivery activities

### Work carried out to date

The PFE replacement submarine cable and shunt reactor at Thurso South were both energised in September 2023 ahead of the baseline programme.

## 3.8.5. Resources

An Execution Resource Review will be carried out that finalises the project structures and teams, ensuring that all key roles are resourced, including the appointment of Suitably Qualified and Experienced Personnel (SQEP) for Site Supervision and Quality intervention roles.

## 3.8.7. Mitigation measures

### Governance arrangements

Delivery governance forums are established that are used to manage delivery performance and to provide assurance to key external stakeholders. Any agreed mitigation measures that can be taken to address deviation from the project delivery plan are decided within this project delivery governance that comprises of:

- Programme Performance Review (monthly with follow up on key issues after two weeks, if required): forum to review a 'by exception' summary of project delivery performance, key risks and to identify decisions or issues for escalation.
- Portfolio Performance Review (monthly): forum to review in-month performance, escalated project delivery issues, near term planning lookahead, successes and lessons learned in month and resources and supply-chain planning.
- Large Capital Delivery (LCD) Performance Review (monthly): forum to review in-month and in-year performance, Large Capital Project Committee (LCPC) project performance and report readiness, near term planning look-ahead, escalated programme issues, successes and lessons learned and resources and supply-chain planning.
- Large Capital Project Committee (monthly): reporting to provide a summary of LCPC Project delivery performance.
- Materials Review Group (monthly): Forum to discuss current lead-time schedule considerations for projects including long lead items and to inform procurement of changes to pipeline of materials required as projects exit the design stage.
- Risk Review Group (monthly): forum to discuss risk exposure for projects, covering escalation and drawdown, including to / from programme and portfolio levels.
- Change Assurance Panel (fortnightly): forum to review and validate the accuracy and quality of the change information within submitted Baseline Change Control Forms. They will also provide assurance of the proposed cost, schedule, and risk impact assessment.

### Specific mitigation measures for Dunvegan – Loch Carnan development

The current proposal would see a 33kV overhead line constructed across Skye from Dunvegan GSP to Loch Pooltiel and connected to a new subsea cable to Loch Carnan. Whilst we are currently forecasting this work to be delivered in 2027/28 there is significant uncertainty with consenting timescales and the need for visual mitigations along the proposed route. Given the current condition of the cable we have concerns over the potential risk of failure during this period. Therefore, to mitigate both risks we are progressing a subsea cable survey for a potential connection between Ardmore GSP and Loch Pooltiel that could act as an alternative connection into the existing Skye network.

## 3.8.8. Reporting mechanisms

Reviewed within the governance forums detailed above, performance metrics measure the activity and overall performance of how work is delivered. These core performance metrics represent a minimum set necessary to adequately assess delivery performance and comprise of cost, schedule, risk, and change. Status reporting is an indicator of a project's position in relation to its ability to deliver its objectives for example in respect of time, cost

and quality. Clear, concise, and consistent report narrative is important at all levels so that key stakeholders can resolve escalated issues and understand the drivers of performance trends.

### 3.8.9. Comparison with RIIO-ED2 Business Plan position

Table 21 summarises SHEPD and Ofgem positions on the interventions at RIIO-ED2 Business Plan stage, and any changes made to these.

| Area | Original proposal | Ofgem position | Current proposal |
|---|---|---|---|
| Uist – Eriskay | Like-for-like cable replacement | Unjustified - Demand forecasts show existing cable sufficient beyond ED3 hence no requirement to increase capacity. Cable expected to reach HI5 in the first year of ED3. | Lower cost, land-based cable replacement |
| Eriskay – Barra | Augmented solution | Justified - Cable forecast to be HI5 by end of RIIO-ED2 due to fast rate of deterioration (evidenced by surveys). SHEPD preferred option to augment existing cable with new cable of same rating to return to a two-cable set up for remainder of existing cable life is highest NPV and maximises use of the existing assets. | Augmented solution |
| Skye – Uist | Ardmore – Lochmaddy & Dunvegan – Loch Carnan | Unjustified – on basis that demand growth not forecast to exceed single cable capability until post 2030. Optioneering does not appear to consider staggered delivery of preferred option. Not a significant difference in NPV between one cable and replacing with two separate cables. | Dunvegan – Loch Carnan with additional future investments Proposed for ED3 and beyond based on demand profiles out to 2050. |

Table 21: Summary of changes to Outer Hebrides projects between RIIO-ED2 BP and HOWSUM re-opener application

The reasons for affirming or changing recommended solutions are detailed in this application.

# 4. STAKEHOLDER ENGAGEMENT AND WHOLE SYSTEM OPPORTUNITIES

## 4.1. Stakeholder engagement

This section of the EJP describes the stakeholder engagement strategy that has been implemented to inform our RIIO-ED2 submissions, and more specifically the proposed investment for the project. This includes the engagement activities that have been undertaken, the stakeholder groups that have been approached, and the feedback that has been gathered from this stakeholder engagement.

The intention of this exercise was to identify the appetite from our stakeholders for us to carry out the investment described within this document during RIIO-ED2 to improve the condition of our network assets and the quality of supply for customers during RIIO-ED2 and beyond.

### 4.1.1. Our RIIO-ED2 stakeholder engagement strategy

We recognise that thorough stakeholder engagement is a critical part of our preparation for network interventions. As such, an engagement plan has been implemented and dynamically adapted over time to gather feedback from a diverse range of stakeholders as the Outer Hebrides proposals have evolved.

#### 4.1.1.1. RIIO-ED2 BUSINESS PLAN ENGAGEMENT

As part of our RIIO-ED2 planning we carried out a programme of Enhanced Engagement during the period August 2020 to December 2021.

The intention of this exercise was to identify the appetite from our stakeholders for us to carry out the investment described within this document during RIIO-ED2 to improve the condition of our network assets and the quality of supply for customers during RIIO-ED2 and beyond.

During the final phase of Testing and Acceptance of our plans we refined our final Scottish Islands strategy and outputs, which involved direct testing of the strategy, outputs and costs with 219 island stakeholders over 10 events during which we gathered 98 stakeholder insights.

Relevant outputs from this work include the following:

***Phase 3 – Business Plan Refinement***

- **Supporting our remote communities**
    - Stakeholders were keen to see an increase of storage and demand flexibility on the islands to make the best use of local renewable generation, while also reducing the need for network reinforcement and improving the reliability of supply.
    - Stakeholders were highly encouraged with our increased investment in subsea connectivity between islands and mainland.

- **Uncertainty Mechanisms**
    - While stakeholders supported the investment in subsea cables to improve island connectivity, it was noted that storage and flexibility should be considered to reduce the need for network reinforcement on Scottish islands and improve the reliability of supply.

### *Phase 4 – Testing and Acceptance*

- **Supporting our remote communities**
    - Stakeholders thought the ambition and comprehensiveness of the Supporting the Scottish Islands strategy and outputs had built on the lessons from ED1 and represented value for money.
    - Stakeholders sought enhanced engagement on future network capacity and resilience of supply options; ensuring that local communities are part of the consultation process, including on innovation opportunities for reducing costs and replacing diesel generation.
    - UM to apply to RIIO-ED2 expenditure supported and represented value for money. Stakeholders sought further clarity on how the mechanism would apply, suggesting criteria could include cost, benefit and net zero impacts.
- **Uncertainty Mechanisms**
    - Discussion on UMs focused on their application and their role in reducing uncertainty. Stakeholders tended to be supportive of proposed UMs, especially around managing known unknowns.
    - Scottish islands - balance was right on the uncertainty mechanism, and that it provided value for customers; urged the RIIO-ED2 approach should not be 'like for like' but rather a commitment to optionality, benefit and costs taking into account local generation options and wider impacts on net zero.
    - 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 RIIO-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.

In response we added the Hebrides and Orkney Whole Systems Uncertainty Mechanism to our strategy, as 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.

Further key insights from our early RIIO-ED2 engagement are summarised in the Scottish Islands Strategy document.[24]

24 Scottish Islands Strategy | RIIO-ED2 Business Plan Annex 8.1

## 4.1.2. Recent engagement

We have continued to engage with stakeholders on the future energy needs for the Outer Hebrides. This includes Regen engagement primarily aimed at informing the 2023 DFES, whilst also providing insights for the Outer Hebrides strategy report accompanying this application.

### 4.1.2.1. WEBINAR - OCTOBER 2023

We also ran a specific webinar[25] focused on the Outer Hebrides on 18th October 2023. Twenty stakeholders attended this event with their feedback informing our overall approach and the material within this application. The event provided background on the local network, the drivers for change, and our approach to developing options.

- All stakeholders acknowledged our work to assess the drivers, with around half believing we had assessed the drivers appropriately.
- Whilst no stakeholders disagreed with our approach to developing future system needs and solutions, 50% remained unsure.
- Stakeholders noted the challenges in forecasting future generation connections and also noted the limited potential of flexibility services from wind generation.
- The need for continued community engagement and consideration was stressed. Stakeholders reiterated the potential for community energy projects.
- The use of smart grid technology was also raised along with the potential for demand management, particularly of heating systems.

### 4.1.2.2. WEBINAR – DECEMBER 2023

On 11th December 2023 we held an additional webinar[26] to provide an update on our progress on Whole System energy options for the Outer Hebrides and seek additional views from stakeholders. Twelve stakeholders attended this event with their feedback informing our overall approach and the material within this application.

We asked what other areas stakeholders would like us to consider in the development of longer-term needs for the Outer Hebrides. Stakeholder responses were:

- Harris to North Uist connection
- Interface with alternative energy vectors (inter- as opposed to intra - industry approach and not just restricted to electricity
- Additional export capacity for Uist / Barra community generation
- Greater consideration of the aspirations of community groups who want to generate electricity
- Community Energy pipeline and repowering capacity

Ninety percent of stakeholders said they are supportive of our approach to progress immediate needs now whilst continuing to develop the future requirements for the Outer Hebrides in parallel, with no stakeholders disagreeing with our approach, as shown in Figure 16.

25 Event Details | SSEN Scottish Islands Whole System energy solutions webinar - Western Isles (engage-360.co.uk)

26 Event Details | SSEN Update on Whole System energy options for Outer Hebrides (engage-360.co.uk)

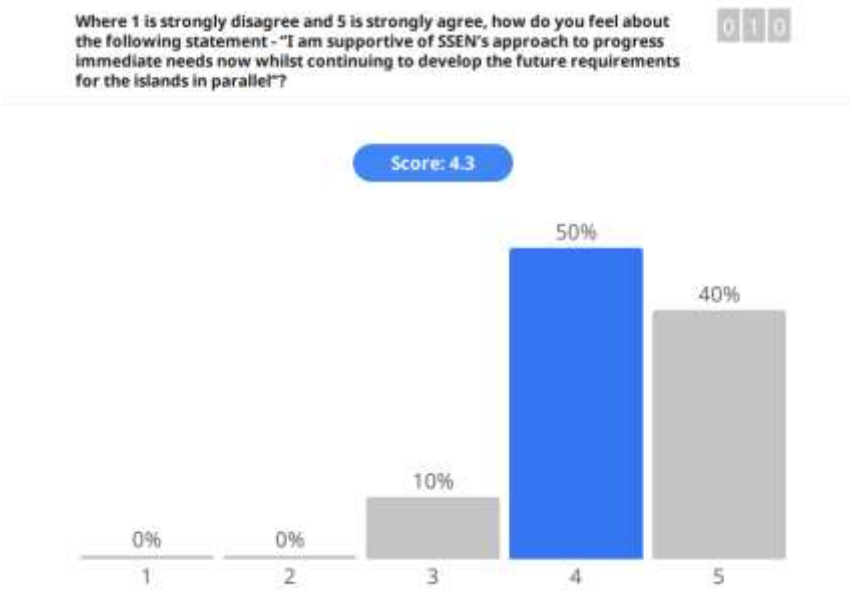


Figure 16: Stakeholder feedback on SHEPD phased approach

#### 4.1.2.3. BILATERAL ENGAGEMENT – 2023/24

In addition to the bilaterals listed below Regen have also engaged in many bilateral engagements in the development of their insights report.

- Scottish Whisky Association – 24th October: Discussion on the range of decarbonisation strategies employed by distilleries both on islands and the mainland.
- Outer Hebrides Council – 23rd November: Discussion on current status of the RIPEET project and how it fits alongside HOWSUM.
- SSEN Transmission – 1st December: We provided an overview of Regen's insights work and asked for their feedback and input.

### 4.1.3. Stakeholder engagement feedback

Our primary source of feedback has been our dedicated Outer Hebrides webinar held in October 2023. This alongside further feedback from bilateral discussions has shaped the work we have undertaken through the remainder of the Autumn period and ultimately this application document. Table 22 sets out key feedback and our responses to date.

| YOU SAID | WE DID |
|---|---|
| You need further clarity on our plans and there is a need for continued engagement. | We have offered additional opportunities to engage with us through dedicated bilateral discussions and held a follow up webinar to update you on our progress. We will hold further engagement through 2024 ahead of our January 2025 re-opener application. |
| We need to consider the community energy pipeline | We worked with Regen to more greatly engage with local communities and industries to understand future requirements and opportunities, and ensured this information was reflected in our Distribution Future Energy Scenarios. |
| We need to consider the use of smart grid technology including for demand users | Smart grid technologies for demand users can be used to facilitate flexibility services. We are assessing the role of flexibility in all of our interventions and are considering the use of demand flexibility services specifically as a tool that would allow us to optimise the efficient timing of network investment between Harris and Lewis. |
| You highlighted the potential need for a link between North Uist and Harris | This potential requirement is now captured in our longer-term strategy for the Outer Hebrides. |
| We need to consider the interface with alternative energy vectors | We have engaged with the Outer Hebrides Responsible research and Innovation Policy Experimentations for Energy Transition (RIPEET) project[27] to understand potential future opportunities and synergies. We are discussing future decarbonisation strategies with different industries on the islands to better appreciate potential pathways. Our work with Regen is identifying a range of potential touchpoints with alternative energy vectors. |

Table 22: Acting on stakeholder feedback under the HOWSUM workstream

## 4.2. Whole System opportunities

We have consciously identified, assessed and selected options through a whole system lens to take account of energy requirements in 2050, as well as the interactions with Transmission, embedded generation and potential future energy sources and demands. The solutions recommended under the HOWSUM re-opener application are being selected on the basis of their ability to form part of a long-term, whole system solution for the Outer Hebrides, which is an explicit requirement upon SHEPD further to its RIIO-ED2 licence obligations.

At this stage we are seeking funding for elements whose primary driver is asset condition. These will see replacement solutions for life-expired cables for the islands of Uist, Barra and Eriskay. As part of our work, we have taken a broader view of the future needs of these islands from both generation and demand perspectives and have sized replacement assets accordingly.

27 Outer Hebrides | RIPEET Project

Our longer-term plans reflect the whole system potential for the Outer Hebrides, and this becomes an important factor in both the timing of the solution and the detail of the solution itself.

In Section 3 we discuss the future energy requirements, the potential for third party solutions to meet our resilience needs and the potential use of flexibility to defer investment. In this section we discuss some of the other whole system factors that we have considered in the development of this application.

## 4.2.1. Interactions with Transmission works

### 4.2.1.1. TRANMISSION INTERACTIONS - OUTER HEBRIDES

It is critical to ensure that a whole system view is taken of the future requirements for the Outer Hebrides. We have engaged with SSEN Transmission to understand future planned Transmission works affecting the Outer Hebrides and how they may impact our developments. The existing Transmission network for Skye and the Outer Hebrides is shown in Figure 17 for reference.


Figure 17: Existing transmission network on Skye and Outer Hebrides

There are significant transmission works planned for this part of the GB transmission system.

Pivotal to this work is the planned Western Isles 1.8GW HVDC link from Beauly to Arnish. This work, one of SSEN Transmission's Pathway to 2030 Investments[28] will re-configure the transmission supply to the Outer Hebrides by creating a second infeed to the island group. This will mean that our connections at Stornoway and Harris GSPs will be fed from Arnish, as shown in Figure 18.

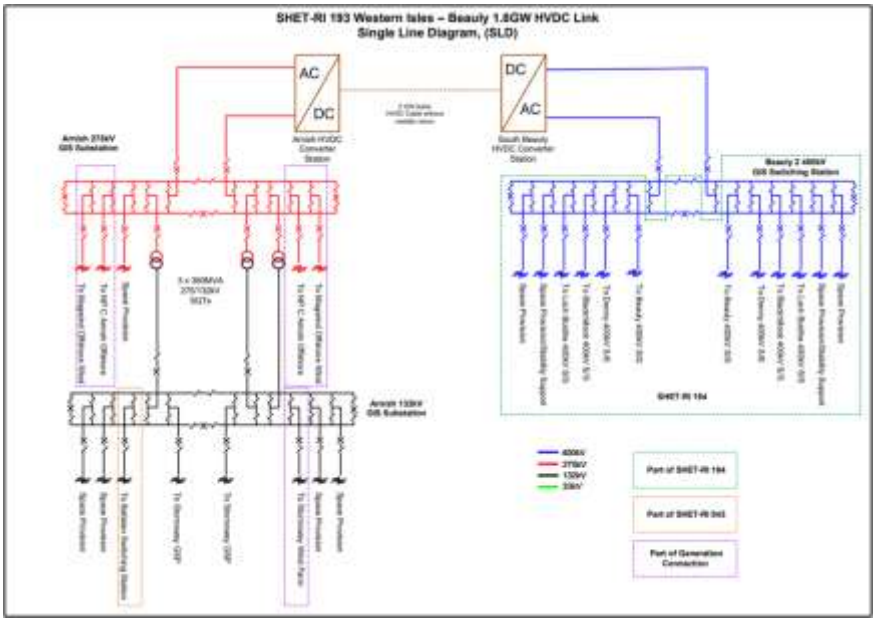


Figure 18: Future network configuration at Arnish, Outer Hebrides

[redacted] The network on Skye up to and including Ardmore GSP will continue to be fed from the Skye 132kV radial circuit although we are aware of planned upgrade works to this route to improve both resilience and capacity of this route[29]. We understand that this work will be completed later in this decade (i.e. pre HVDC link commissioning). It should be noted that the Uist archipelago would continue to be fed from Ardmore GSP once the HVDC link commissions and that has influenced operational running arrangements in Jacobs' work.

We have also shared with SSEN Transmission options that would see the Ardmore – Harris 33kV cable replaced by a larger 132kV cable.

#### 4.2.1.2. TRANSMISSION INTERACTIONS – ORKNEY

As part of the fault restoration of the PFE2 cable, SHEPD engaged with SSEN Transmission around future proposals for the Orkney Islands group. This was to help aid the long listing of possible future whole system scenarios which may develop as we progress forwards. Further engagement is planned to take place across 2024 as part of the wider Orkney Whole system analysis to determine the final long-term solution for the Islands.

28 https://www.ssen-transmission.co.uk/contentassets/1327d870d19242eb9163580602b9aa71/main-north-of-scotland-electricity-transmission-network-in-2030-1.png
29 https://www.ssen-transmission.co.uk/projects/project-map/skye-reinforcement/

SSEN Transmission are to install a new 220kV 220MW AC connection from near Dounreay to a new GSP near Finstown. The final network operational arrangements are still being determined and will be further refined through co-ordination with SSEN Transmission.

### 4.2.2. Implications of Load Managed Areas

Load Managed Areas (LMAs) are a legacy arrangement under which SHEPD has been able to manage load in a constrained area by shifting load on domestic storage heaters. The technology underpinning this system is approaching end of life and cannot be replaced as critical parts are no longer manufactured.

SHEPD control LMAs through the Radio Teleswitch System (RTS) which was introduced to manage the load profile of storage heaters and water heating, and has been highly successful, not only in diversifying demand but in providing consumers with access to cheaper overnight tariffs to charge their storage heaters.

As part of RIIO-ED2 we have committed to review the application of LMAs in SHEPD's licence area, removing them where possible. The effect this will have on the Outer Hebridean network demand is currently under review and will be quantified in our continuing development of the demand profile for the Outer Hebridean network going forward.

### 4.2.3. Relevance of community energy projects

We have engaged with stakeholders through both webinars and bilateral meetings to understand the current status of community energy projects on the Outer Hebrides and its future potential.

There is over 23MW of community energy schemes currently operational in the region with this being dominated by onshore wind generation. Such relatively significant volumes show the potential for community energy schemes to help support the future energy needs of the Outer Hebrides.

From a DSO perspective this could either be in the form of flexibility services to defer the need for network investment or for longer term services to provide energy in the event of a power outage. Key to achieving both these opportunities is the ability to store excess wind generation for use in other time periods. We are interested in the development of hydrogen solutions on the islands and have engaged with the RIPEET project. We will continue to monitor progress to understand how and when such developments could feed into our Net Zero strategic plan.

### 4.2.4. Future whole system analyses as part of HOWSUM

We have undertaken significant investigations to understand the future energy needs of the Outer Hebrides and their impacts on future networks requirements.

In 2024 we will extend this work in the following ways:

- Undertake similar analysis of the future energy needs of the Inner Hebrides and Orkney to develop long term strategies for these island groups.
- Enhance our views of the future needs of the Outer Hebrides through:

- Further analysis of the resilience needs of each island and how we can find an appropriate balance between network and third-party solutions.
- Detailed flexibility assessment of the future potential markets on Harris and Lewis.
- Further engagement on cross vector developments including engagement with both SGN and the RIPEET project.
- Extrapolation of Regen's island assessments to better model future industrial decarbonisation on the islands.

### 4.2.5. HOWSUM Whole System methodology

In Section 3 we describe our Net Zero Strategic Planning Process (shown in Figure 19 for reference). Our whole system methodology is contained within this process as follows:

- Developing future forecasts and identifying system needs – understanding the potential energy pathways to Net Zero and their implications for future energy & network needs for the Outer Hebrides. This involves significant stakeholder engagement to understand decarbonisation strategies and timelines.
- Developing options – considering both network and non-network solutions to our system needs including the use of flexibility. Developing options including other energy vectors such as transmission.
- Assessing options – Taking a whole system view of the benefits that can be derived from each option such as cost of carbon.


Figure 19: Net Zero strategic planning process overview

### 4.2.6. Future work being assessed under HOWSUM mechanism

We are now in the process of tendering out the solution for the Skye – South Uist cable replacement, and as such this application represents the first stage of the re-opener process for this work and focuses on outlining the needs case for investment and the preferred solution. This will be followed by a second stage application, which will outline costs, in summer 2024. We propose to work closely with Ofgem and our stakeholders in the interim to ensure that the needs case and proposed solution is well-understood and tested. We hope that this approach will help expedite Ofgem's decision making process allowing us to move quickly with delivery.

At this time, we anticipate our January 2025 application will be comprised of the following elements:

- Orkney whole system solution to 2050

- A 2050 whole system solution for the Inner Hebridean island groups of Mainland – Islay – Jura – Colonsay and Mainland – Mull – Coll – Tiree
- Updated plans for our 2050 whole system solution for the Outer Hebrides (North Uist – Harris and Skye – Harris)

# 5. COST INFORMATION

## 5.1. Allowance adjustment

Table 23 sets out the allowance adjustment sought under this re-opener application.

| Adjustment summary (£m, 2020/21 price base) | 2023/24 | 2024/25 | 2025/26 | 2026/27 | 2027/28 | Total |
|---|---|---|---|---|---|---|
| Skye – Uist | - | - | - | [redacted]* | [redacted]* | [redacted]* |
| South Uist – Eriskay | - | - | - | [redacted] | - | [redacted] |
| Eriskay – Barra | - | - | - | [redacted] | - | [redacted] |
| Pentland Firth East 3 | [redacted] | - | - | - | - | [redacted] |
| **Total adjustment (excl. Skye-Uist costs and development costs)** | [redacted] | **-** | **-** | [redacted] | **-** | **£46.28m** |

**Notes:**
* These are estimated costs provided prior to carrying our procurement process. SHEPD will submit its costs for the specific Skye – Uist element for assessment by the 31st July 2024.
All values are net of development costs already funded through RIIO-ED2 HOWSUM Development Funding.

Table 23: Project and allowance adjustment summary

### 5.1.1. Demonstrating additionality

#### 5.1.1.1. HOWSUM DEVELOPMENT FUNDING

A baseline allowance for development funding associated with HOWSUM projects was allowed by Ofgem in its RIIO-ED2 Final Determinations, recognising that the projects contained within the HOWSUM were excluded from baseline allowances, and SHEPD required to progress works ahead of applying for further funding through the mechanism. SHEPD confirmed to Ofgem costs associated with preparatory works for the HOWSUM programme of activities. This led to the agreement of baseline development funding of £20.6m covering the following activities in Table 24:

| Activity | Detail | Indicative allowance component |
|---|---|---|
| Offshore surveys | Route surveys and geophysical samples | £18m |
| Third-party surveys and samples | Earthing studies, remote utility survey, landfall / peat probing and cable routing surveys, environmental studies, overhead line and | £1m |

| Activity | Detail | Indicative allowance component |
|---|---|---|
| | onshore route surveys, substation / existing network modification survey | |
| Engineering and whole system feasibility studies | Feasibility assessment, consenting activities, engineering | £1m |

Table 24: HOWSUM development funding breakdown

It is our understanding that it is intended that the development funding associated with proposed projects should be netted off from requested additional HOWSUM funding. We have assessed the amount of development funding which relates to the specific projects recommended to be funded under this re-opener application. A summary of this value is set out in Table 6, replicated in Table 25 below. Development costs have therefore been deducted from the total funding request in this application.

| Adjustment summary (£m, 2020/21) | 2023/24 | 2024/25 | 2025/26 | 2026/27 | 2027/28 | Total |
|---|---|---|---|---|---|---|
| **Baseline RIIO-ED2 allowances:** | | | | | | |
| **HOWSUM development funding** | | | | | | £20.63m |
| **Adjustment request:** | | | | | | |
| **Skye – Uist** | - | - | - | [redacted] | [redacted] | [redacted] |
| – *Development costs* | [redacted] | [redacted] | [redacted] | - | - | [redacted] |
| **Uist – Eriskay** | - | - | - | [redacted] | - | [redacted] |
| – *Development costs* | - | - | [redacted] | - | - | [redacted] |
| **Eriskay – Barra** | - | - | - | [redacted] | - | [redacted] |
| – *Development costs* | - | - | [redacted] | - | - | [redacted] |
| **Pentland Firth East 3** | [redacted] | - | - | - | - | [redacted] |
| – *Development costs* | - | - | - | - | - | - |
| **Total adjustment (excl. development and Skye – Uist costs)** | [redacted] | **-** | **-** | [redacted] | **-** | **£46.28m** |
| – ***Total development costs*** | [redacted] | [redacted] | [redacted] | **-** | **-** | ***£13.2m*** |

**Notes:**
1. The HOWSUM Development Funding provision of £20.6m was provided to cover development funding for HOWSUM-eligible projects. See Section 5.1 for more information.
2. No formal funding request for the Skye – Uist project is included in this re-opener application, and all cost values are estimated. SHEPD will submit its costs for this specific element for assessment later in 2024.
3. Pentland Firth East 3 development costs are not covered by the HOWSUM Development Funding provision.

Table 25: Adjustment summary, identifying HOWSUM development funding relevant to this application

## 5.1.2. Cost efficiency

### 5.1.2.1. COST EFFICIENCY - SKYE – UIST

For Skye – Uist the cost estimate is based on a unit rate derived from the actual costs incurred in delivery of the PFE3 project noting that Skye – Uist is intended to utilise the same contracting model. It should be noted that the estimate is not based on tendered prices and uses the length of cable determined from the submarine cable early engineering desktop studies. As discussed in this application, the cost information provided for Skye – Uist is provided for indicative purposes and will be replaced later in 2024 with our formal cost submission for this project.

### 5.1.2.2. COST EFFICIENCY - PFE3

In terms of costs requested at this application window, SHEPD is submitting actual delivered costs for the PFE3 project, which was delivered ahead of schedule and materially below the initial cost estimate and tender price. SHEPD undertook a full competitive regulated tender on the open market, outside of our usual framework, to maximise competition and contractor availability. The final bid which won the work was the best overall submission when undergoing tender evaluation but was also the lowest cost.

Through effective contract and project management SHEPD was able [redacted] delivering the works as efficiently as possible based on the available installation market.

### 5.1.2.3. COST EFFICIENCY - SOUTH UIST – ERISKAY

SHEPD is seeking to recover costs for these works based on SHEPD's internal RIIO-ED2 unit rates for the associated onshore assets which aligns with the costs of recent comparable works. South Uist – Eriskay will progress with an over land solution, delivering a resilient network whilst minimising CAPEX outlay. SHEPD has well established onshore delivery solutions and contract partners which will be utilised in the design and installation of this solution. SHEPD will also look to schedule works alongside other baseline network CAPEX and OPEX works to maximise contractor utilisation, reduce outage impacts on customers and obtain the most efficient project delivery. The SHEPD unit rates are prices that SHEPD is physically seeing for project delivery across the whole network area. Given that these works will take place on the islands it is likely that costs would be even higher than the allowed Ofgem average unit rate which is provided. SHEPD will deliver the works as efficiently as possible through the use of established framework contracts and competitive tender/mini tender events.

### 5.1.2.4. COST EFFICIENCY - ERISKAY – BARRA 2

SHEPD propose to recover costs of these works on the basis of Ofgem's defined RIIO-ED2 unit rate for HV subsea cable, which is close to our own submitted unit rate. Following acceptance of this project and granting of allowance the SHEPD submarine cables delivery team will look to partner these works up with other baseline project to deliver a "campaign of cables" ensuring project efficiency is maximised across the whole investment portfolio. [redacted]

SHEPD will also free issue the cable to the contractor reducing costs on cable procurement and project management. [redacted].

[redacted]

[redacted]

### 5.1.3. Assumptions and data sources

**Subsea cable cost data**

The cost estimates that have been presented for delivery of the submarine cables have been compiled in two different ways. For the Eriskay Barra project the cost estimate is based upon the Ofgem unit rates with inflation indexes being applied. For Skye – Uist the cost estimate is based on a unit rate derived from the actual costs incurred in delivery of the PFE3 project noting that Skye – Uist is intended to utilise the same contracting model. It should be noted that the estimate is not based on tendered prices and uses the length of cable determined from the submarine cable early engineering desktop studies.

A summary of key cost data utilised in our analysis is in Table 26. More detail on our cost assumptions is included in the accompanying EJPs and CBAs.

| Cost type | Cost assumptions | Justification |
|---|---|---|
| Skye – Uist options (subsea cables and associated works comparable to PFE3) | PFE3 based unit rate estimate [redacted] | [redacted] PFE3 is the most recent subsea cable benchmark available at relevant cable scale. We have proposed to confirm tender costs later in 2024 -inclusion of this estimate is our current best option ahead of confirming these values. [redacted] |
| Skye – Uist options (Onshore Overhead & underground cable) | SHEPD internal unit rates for 2023/24 | SHEPD unit rates are more representative of actual incurred costs than Ofgem unit rates for onshore works. Island works likely to be higher cost than the average unit rate allowed by Ofgem. Costs requested for specific project and cannot be made up over price control project spread. |
| Skye – Uist options (Substation works) | SHEPD internal unit rates for 2023/24 plus additional assumption on possible land acquisition and civils works from Aultbea – Ullapool | |
| Eriskay – Barra (subsea cables and associated works at smaller scale) | Ofgem FD unit rates for HV cables | For this specific project the Ofgem unit rate for HV cables is considered fairly reflective of relevant outturn project costs. This is based on initial estimates for the baseline Coll – Tiree 11kV works which SHEPD have received indicative contractor costs for but are still being agreed. |
| Onshore costs (including Uist – Eriskay) | SHEPD internal unit rates for 2023/24 | SHEPD unit rates are more representative of actual incurred costs than Ofgem unit rates for onshore works. |

| Cost type | Cost assumptions | Justification |
|---|---|---|
| PFE3 costs | Actual incurred costs to date, plus estimate to completion | Incurred costs. Delivered costs at less than execution cost estimate. Initial estimate was the cheapest of the submitted tender bids and evaluation. |

Table 26: Core cost assumptions

### 5.1.4. Key cost drivers

#### Subsea

The key cost drivers for HOWSUM projects requiring submarine cables will be survey, supply, installation, and protection of the submarine cables. The supply of the submarine cable will be driven primarily by the cost of materials, resources, manufacturing, and transport of the submarine cable from the manufacturing location to the work site.

The survey, installation and protection of the submarine cable will be driven primarily by the cost of vessels and the duration of time they are required to complete the works. Multiple vessels and equipment are required to complete the works. To survey it will require vessels and different equipment for geophysical and geotechnical surveys to map the seabed and inform environmental and ground conditions. For installation and protection of the submarine cable it will require a Cable Lay Vessel, Trenching Vessel/Equipment, Support Vessels, and a Boulder Clearance Vessel. Some of these vessels may be combined depending on the Contractors offer however different equipment will be required for each activity. Weather can have a significant impact on the duration of these vessels and contributes to the overall cost.

The level of cost anticipated to be incurred for cable protection will not be fully known until a completed cable route design is finalised, including on bottom stability study (OBSS) and cable burial risk assessment (CBRA). Upon completion of the route design these protection costs will be more firm, however the length of time to protect will not be fully known until installation takes place and confirmation attained that cable burial has been able to achieve the target design depth. Further burial passes may be required in order to meet the target depth in all locations which could result in increased costs with more vessel days on site.

#### Onshore

Onshore substation works will likely incur the highest cost of all onshore elements. This is due to the potential requirement to construct new substation buildings to house the required equipment and with associated land purchase costs. Additional uncertainty around cost will remain until a detailed design is produced. The current costs are based upon current SHEPD internal unit rates and works will be subjected to a competitive tender to acquire competitive prices and actual market value.

#### 5.1.4.1. DATA FROM SIMILAR PROJECTS

Table 27 details examples of cost data from similar projects. See also Section 5.1.3 and Table 26.

| Project | Commentary on similarities |
|---|---|
| PFE3 | This was a long length subsea cable delivered through EPCI. This is the most recent delivered project by SHEPD and was subject to competitive tender. This is used to produce an estimate for the Skye – Uist works |

Table 27: Data from similar projects

### 5.1.5. Areas of ongoing uncertainty

There are a significant number of risks associated with delivering large capital projects, particularly where operations take place offshore in harsh environmental conditions. General areas of uncertainty include the following:

- Cable Installation/Protection vessel availability – particularly to allow work to be completed in months with preferred weather conditions.
- Cable manufacturing capacity. Market very tight and cable will need to comply with Design Authority limiting suppliers – current.
- [redacted]
- [redacted]

Some of the key areas of uncertainties associated with each project that may have a significant impact on delivery are noted below.

Weather for subsea survey and operations can extend the length of time required to survey, install, and protect the submarine cables as well as increasing costs. Allowances will be made for the weather cost if the risk remains with SHEPD or if the risk is transferred to the Contractor, the lump sum cost for weather will be agreed in the contract. To mitigate the risks associated with extending the programme, SHEPD will target the summer months where possible. Targeting the summer months does depend on vessel availability from contractors which is a risk considering the oversubscribed market. Early market engagement and commitment will be required to mitigate this risk.

Fishing is an area of uncertainty on these subsea projects and can impact cost and the programme duration. Depending on where fishing activities are conducted it can affect the planned route, what protection of the submarine cable is required, and costs associated with compensation. This has been and will continue to be mitigated through engagement with the relevant fishery organisations, designing the route appropriately and consulting with relevant stakeholders, surveys, and securing a Construction Marine Licence from Marine Scotland. Marine desktop route studies have been completed which consider fishing activity and engagement with the relevant fishery organisations is ongoing.

[redacted]

[redacted]. Manufacturing timelines are an uncertainty depending on the size/type of cable selected and the type tests required if using a design not previously approved by SHEPD. [redacted].

**Skye – Uist mitigation**

The preferred solution would see a 33kV overhead line constructed across Skye from Dunvegan GSP to Loch Pooltiel and connected to a new subsea cable to Loch Carnan. Whilst we are currently forecasting this work to be delivered in 2027/28 [redacted] Given the current condition of the cable we have concerns over the potential risk of failure during this period. Therefore, to mitigate both risks we are progressing a subsea cable survey for a potential connection between Ardmore GSP and Loch Pooltiel that could act as an alternative connection into the existing Skye network.

#### 5.1.5.1. SENSITIVITY ANALYSIS

As part of the CBA process, we have completed sensitivity analysis to include the effects of phasing our infrastructure investments versus delivering the proposed project as a single piece of work.

Sensitivity analysis has been conducted on the South Uist – Eriskay cable project. This is due to the existing cable currently having an HI3 rating. Analysis has been conducted considering the effects of deferring investment to the end of ED3 and measuring the effect of option NPVs through the CBA.

### 5.1.6. Risk register

The South Uist – Eriskay section of this application contains an additional risk allowance. Given the geological make-up of the landscape where this project will be delivered, there is a high risk that cabling and OHL construction will be slow, with higher than usual unit rates experienced through the delivery. [redacted]

# 6. COST BENEFIT ANALYSIS AND ENGINEERING JUSTIFICATIONS

## 6.1. Cost Benefit Analysis and Engineering Justification Papers

We have provided Engineering Justification Papers and Cost Benefit Analysis for all of the proposed interventions recommended in this re-opener, namely Skye – Uist – Harris (excluding formal cost submission), Uist – Eriskay, Eriskay – Barra, and Pentland Firth East 3.

This section of the report provides an overview of the CBAs undertaken. This represents the output of the detailed exercises undertaken to support the recommended investment strategies summarised within the EJPs and this document.

More detail on all aspects is included in the Skye – Uist (Appendices 3A and 3B), Uist – Eriskay (Appendices 4A and 4B), Eriskay – Barra (Appendices 5A and 5B) and PFE3 (Appendices 6A and 6B EJPs and CBAs, as well as the earlier sections of this document.

## 6.2. Summary of Engineering Justification Papers

### Engineering Justification Papers – Outer Hebrides

The EJPs accompanying this core narrative document considers a range of options to address the heath index, DFES demand and decarbonisation needs of the Outer Hebridean network, setting out the options that have been considered and rejected prior to the CBA, and the short list of those options included within the analysis, with a clear rationale for including or excluding each option. The options are then further refined into whole system schemes that meet the demands and address the drivers for change on the islands networks out to 2050.

### Engineering Justification Papers – Pentland Firth East 3

The Pentland Firth 3 EJP accompanying this core narrative document considers the viable range of options to resolve the urgent need of the Orkney islands faced when PFE2 failed. The document sets out the options that were considered and rejected prior to the CBA, the short list of those options included within the analysis, with a clear rationale for including or excluding each option, and the solution which was ultimately selected.

## 6.3. Summary of Cost Benefit Analysis

To demonstrate the circumstances that would justify the selection of each investment option, a CBA has been produced for each.

## 6.3.1. Skye – Uist – Harris CBA

All options that are considered technically feasible (as outlined in Section 3.7.1) have been assessed through CBA. The results of this analysis are described below.

### 6.3.1.1. SKYE – UIST – HARRIS OPTION COSTS

The total combined costs for the options are shown in Table 28. These costs are based on a combination of SHEPD Internal unit rates (C1) and assumed subsea cable unit rates based on actual delivered costs for the PFE3 subsea cable works. The costs also include expected substation reinforcement works to facilitate the installation of the proposed subsea cable routes.

| **Options** | [redacted] |
|---|---|
| Option 8 | [redacted] |
| Option 11 | [redacted] |
| Option 14 | [redacted] |
| Option 23 | [redacted] |
| Option 18 | [redacted] |
| Option 28 | [redacted] |
| Option 9 | [redacted] |
| Option 12 | [redacted] |
| Option 15 | [redacted] |
| Option 24 | [redacted] |
| Option 20 | [redacted] |
| Option 29 | [redacted] |
| Option 26 | [redacted] |

Table 28: Skye – Uist – Harris option summary costs

Table 28 demonstrates that the least cost option for spend in RIIO-ED2 is Option 18:

- 9 - Replace existing cable with two new cables: Remove Ardmore – Loch Carnan subsea cable and replace with Dunvegan – Loch Carnan OHL/subsea cable; and install new subsea cable with new OHL from Harris GSP to Clachan 33kV SW/STN.
- 16. Augmentation with 500mm - Existing and Ardmore – Harris subsea cables.

Please refer to Table 10 and the Skye – Uist – Harris EJP and CBA for option detail.

#### 6.3.1.2. SKYE – UIST – HARRIS CBA COMPARISONS

Table 29 sets out the 10- and 45-year NPVs of options assessed for Skye – Uist – Harris. Due to the relatively small customer numbers on the Outer Hebrides, all CBAs return negative NPVs for the options considered, however option 11/16 has been identified as the lowest negative NPV.

Through the deliverability assessment of the options, option 18 was identified as being potentially difficult to consent given the requirement for a new 33kV overhead line section through the West of Skye. As such, a sensitivity analysis was carried out to assess the options NPV should we install an underground cable section in lieu of overhead line. The results below show that in this scenario, option 18 still remains the lowest negative NPV of the technically feasible options identified.

Option 18 is therefore presented as the preferred solution, however we propose to mitigate the risk of consenting issues by a subsea cable survey for a potential connection between Ardmore GSP and Loch Pooltiel that could act as an alternative connection into the existing Skye network as detailed in Section 5.1.5.

| Options | NPV after 10 years (£m) | NPV after 45 years (£m) |
|---|---|---|
| Option 8 | £4.94 | (£76.74) |
| Option 11 | £5.73 | (£62.45) |
| Option 14 | £10.91 | (£48.36) |
| Option 23 | £4.41 | (£69.47) |
| Option 18 | £10.77 | (£43.21) |
| Option 19 | £9.05 | (£47.07) |
| Option 28 | £0.68 | (£116.80) |
| Option 9 | (£18.52) | (£157.60) |
| Option 12 | (£18.37) | (£143.80) |
| Option 15 | (£12.34) | (£126.82) |
| Option 24 | (£19.70) | (£150.82) |
| Option 20 | (£13.94) | (£126.62) |
| Option 29 | (£24.04) | (£200.21) |
| Option 26 | £5.70 | (£57.97) |

Table 29: Comparison of Skye – Uist – Harris options CBA

## 6.3.2. South Uist – Eriskay CBA

All options that are considered technically feasible have been assessed through CBA, this includes all of the options that were considered at the time of the draft business plan submission, and the subsequent new option to replace with a land-based solution. The results of this analysis are described below.

### 6.3.2.1. SOUTH UIST – ERISKAY OPTION COSTS

Table 30 sets out the costs of options assessed for Uist – Eriskay using SHEPD anticipated costs for subsea cable replacement and utilising internal SHEPD unit rates for land-based assets. The least cost option is to replace the existing asset with a land-based solution. Further details of the options assessment and associated costs are provided in the project specific EJP.

| **Options** | [redacted] |
|---|---|
| Option 1 | [redacted] |
| Option 2 | [redacted] |
| Option 3 | [redacted] |
| Option 4 | [redacted] |
| Option 5 | [redacted] |
| Option 6 | [redacted] |
| Option 7 | [redacted] |
| Option 8 | [redacted] |

Table 30: Uist – Eriskay option summary costs

### 6.3.2.2. SOUTH UIST – ERISKAY CBA COMPARISONS

Table 31 sets out the 10- and 45-year NPVs of options assessed for Uist – Eriskay.

These NPV outputs confirm that the least cost options also have the highest NPV. A further sensitivity was conducted through option 8, which allowed for a deferment in expenditure to the end of ED3. The CBA and associated NPVs show that conducting the investment now in RIIO-ED2 is the better than deferring to a later price control.

| **Options** | **NPV after 10 years (£m)** | **NPV after 45 years (£m)** |
|---|---|---|
| Do-Minimum – Replace on failure. | (1.96m) | (4.85m) |
| Planned replacement during RIIO-ED2. | (1.77m) | (4.20m) |

| Options | NPV after 10 years (£m) | NPV after 45 years (£m) |
|---|---|---|
| Replace with a larger 185 mm² cable. | (1.85m) | (4.40m) |
| Augmentation with a similar sized cable. | (1.78m) | (4.22m) |
| Augmentation with a larger cable. | (1.86m) | (4.42m) |
| Installation of two new cables on the existing route. | (3.26m) | (7.82m) |
| Installation of an underground cable following a land route through the Eriskay causeway. | (0.05m) | (0.15m) |
| Installation of an underground cable following a land route through the Eriskay causeway deferred to end of ED3 | (0.08m) | (0.01m) |

Table 31: Comparison of Uist – Eriskay options CBA

## 6.3.3. Eriskay – Barra CBA

All options that are considered technically feasible have been assessed through CBA, this includes all of the options that were considered at the time of the draft business plan submission. No further investment options have been identified over and above the draft submission options. The results of this analysis are described below.

### 6.3.3.1. ERISKAY – BARRA OPTION COSTS

Table 32 sets out the costs of options assessed for Eriskay – Barra.

The option costs have been developed utilising the Ofgem allowed unit rate for HV subsea cables. This unit rate is thought to be relatively reflective of the price anticipated to be seen to deliver a cable replacement of this length. Option 2 has the lowest spend within RIIO-ED2 closely followed by Option 4.

| Options | [redacted] |
|---|---|
| Option 1 | [redacted] |
| Option 2 | [redacted] |
| Option 3 | [redacted] |
| Option 4 | [redacted] |
| Option 5 | [redacted] |
| Option 6 | [redacted] |

Table 32: Eriskay – Barra option summary costs

#### 6.3.3.2. ERISKAY – BARRA CBA COMPARISONS

Table 33 sets out the 10- and 45-year NPVs of options assessed for Eriskay – Barra.

Following the outputs from the CBA the NPVs indicate that it is better to take the slightly higher spend option 4 as the preferred solution in this case. This option, although slightly more expensive, provides additional benefits over option 2, resulting in an improved NPV. Option 4 has been selected as the preferred option.

| Options | NPV after 10 years (£m) | NPV after 45 years (£m) |
|---|---|---|
| Do-Minimum – Replace on failure | (£3.29m) | (£8.02m) |
| Planned replacement during RIIO-ED2 | (£2.46m) | (£10.67m) |
| Replace with a larger 185 mm² cable | (£2.71m) | (£10.07m) |
| Augmentation with a similar sized cable | (£2.42m) | (£11.11m) |
| Augmentation with a larger cable | (£2.67m) | (£10.51m) |
| Installation of two new cables on the existing route | (£6.55m) | (£1.68m) |

Table 33: Comparison of Eriskay – Barra options CBA

## 6.3.4. PFE3 CBA

All of the credible technical options identified at the start of the fault restoration project have progressed through the CBA. This analysis considered the CAPEX and OPEX costs of the solution versus the benefits of each of the options.

#### 6.3.4.1. PFE3 OPTION COSTS

Table 34 sets out the costs of the proposed total options costs related the PFE3 assessment.

This includes the CAPEX associated with the future four cable arrangement passing from the Mainland to Hoy and on to Mainland Orkney. This considers the costs associated with the sizing of PFE, PFW, O-H South and O-H North, when considering the optimal size of the solution.

| Option | [redacted] |
|---|---|
| Option 1 | [redacted] |
| Option 2 | [redacted] |
| Option 3 | [redacted] |
| Option 4 | [redacted] |

Table 34: PFE3 option summary costs

### 6.3.4.2. PFE3 CBA COMPARISONS

Table 35 sets out the 10- and 45-year NPVs of options assessed for PFE3 under the LW DFES scenario.

The results of this analysis and the output NPVs were based on the latest 2021 DFES available at the time and was the most appropriate to consider within the analysis. Under both LW and CT it was confirmed that in all scenarios the new PFE3 cable should be a 500mm$^2$ Cu XLPE DWA cable, option 4.

| Options | NPV after 10 years (£m) | NPV after 45 years (£m) |
|---|---|---|
| 400mm PFE and 400mm PFW. 400mm O-H Centre, 400mm O-H South | (24.75) | (47.24) |
| 400mm PFE and 500mm PFW. 400mm O-H Centre & 500mm O-H South | (24.73) | (46.98) |
| 500mm PFE and 500mm PFW. 400mm O-H Centre & 500mm O-H South | (24.64) | (46.66) |
| 500mm PFE and 500mm PFW. 500mm O-H Centre & 500mm O-H South | (24.64) | (46.62) |

Table 35: Comparison of PFE3 options Leading the Way CBA

# 7. CONCLUSION

This application document details our proposals for the future distribution network requirements connecting the Outer Hebrides archipelago. It also contains information relating to the replacement of the Pentland Firth East 33kV cable supplying the Orkney island group.

In this application document we have described our Net Zero Strategic Plan for the Outer Hebrides including the future infrastructure requirements. This consists of:

- **Replacement of the existing life expired 33kV subsea cable between Ardmore and Loch Carnan with a new 33kV circuit between Dunvegan on Skye and Loch Carnan.** This cable has been sized to meet the future needs of the Uist archipelago. It will consist of approximately 37.6km of subsea cable, 15km of overhead line and 1.5km of onshore underground cable. This element is required to be delivered now on an asset condition basis. We are using development funding to survey routes for the new cable between Loch Pooltiel and Loch Carnan. We will also survey a route between Ardmore and Loch Pooltiel to act as a potential contingency should the existing cable between Ardmore and Loch Carnan fail before being taken out of service. As agreed with Ofgem costs for the Dunvegan – Loch Carnan circuit element will be submitted later this summer following the results of the associated tender exercise.
- **An additional 33kV cable between Ardmore and Harris GSPs to meet future demand on Harris and Lewis.** No approval is sought for this element at this time as works are not needed to be progressed till later this decade. We will review the needs case in 2024 including the use of flexibility to potentially defer the work to an optimum point.
- **An additional 33kV circuit between Harris GSP and Lochmaddy.** This will enable greater resilience between Harris and the Uists reducing our reliance on DEG. No approval is sought for this element at this time and the needs case will continue to be reviewed in 2024 ahead of the 2025 HOWSUM application.

These elements are summarised in the map at Figure 20 showing the 2050 view of the Outer Hebrides network.


Figure 20: Current vision for Outer Hebrides network, 2050

In addition, in this application we have described needs, optioneering and proposed solutions for the replacement of the following two subsea cables connecting islands at the southern end of the Uist archipelago. Whilst forming part of the Outer Hebrides the works are unaffected by the whole system strategy.

- **Eriskay – Barra 11kV cable augmentation**– installation of a second 10.7km Eriskay – Barra cable to support intervention on the existing cable. It is not proposed to remove the existing cable until after failure. The installation of the new cable is programmed for mid-2027 though could move if more efficient to bundle with other works as part of a wider campaign of installations.
- **South Uist – Eriskay 11kV cable replacement** – replacement of existing subsea cable with land-based cable across the Eriskay Causeway and associated decommissioning of existing 11kV submarine cable. This will be designed and consented through 2025/26 with installation in later 2026/27.

Finally, this application document has also provided context on the **replacement of the Pentland Firth East 3 33kV subsea cable** connecting Orkney with mainland Scotland. This is to allow SHEPD to recover costs from the completed cable replacement following failure of Pentland Firth East 2 cable in January 2021. In our optioneering assessment we confirmed that, in all potential future solution scenarios identifiable at the time, a distribution cable would be required. We sized PFE3 to meet the latest net zero-compliant LW and CT DFES. PFE3 forms a core component of the future whole system solution for the Orkney islands, which SHEPD will assess in detail in 2024 ahead of its application at the second HOWSUM re-opener window in 2025.

### Summary of funding request

| Adjustment summary (£m, 2020/21 price base) | 2023/24 | 2024/25 | 2025/26 | 2026/27 | 2027/28 | Total |
|---|---|---|---|---|---|---|
| Skye – Uist | - | - | - | [redacted]* | [redacted]* | [redacted]* |
| South Uist – Eriskay | - | - | - | [redacted] | - | [redacted] |
| Eriskay – Barra | - | - | - | [redacted] | - | [redacted] |
| Pentland Firth East 3 | [redacted] | - | - | - | - | [redacted] |
| **Total adjustment (excl. Skye-Uist costs and development costs)** | [redacted] | **-** | **-** | [redacted] | **-** | **£46.28m** |

**Notes:**
* These are estimated costs provided prior to carrying our procurement process. SHEPD will submit its costs for the specific Skye – Uist element for assessment by the 31st July 2024.
All values are net of development costs already funded through RIIO-ED2 HOWSUM Development Funding.

Table 36: Project and allowance adjustment summary

# APPENDIX 1 – DEFINITIONS AND ABBREVIATIONS

| Acronym | Definition | Acronym | Definition |
|---|---|---|---|
| AC | Alternating current | MVA | Mega Volt Ampere |
| ANM | Active Network Management | MW | Megawatt |
| CBA | Cost Benefit Analysis | NEC ECC 3 | NEC3 Engineering and Construction Contract |
| CBRA | Cable burial risk assessment | NOx | Nitrogen oxides |
| Capex | Capital expenditure | NPV | Net Present Value |
| CCP | Climate Change Plan | OHL | Overhead line |
| CIS | Cable system, Installation and Service | OBSS | On Bottom Stability Study |
| CNAIM | Common Network Asset Indices Methodology (CNAIM | Opex | Operating expenditure |
| CnES | Comhairle nan Eilean Siar | PFE | Pentland Firth East |
| CAR | Construction All Risks (CAR) insurance | PFE1 | Pentland Firth East 1 cable |
| CT | Consumer Transformation | PFE2 | Pentland Firth East 2 cable |
| DD | Ofgem RIIO-ED2 Draft Determinations | PFE3 | Pentland Firth East 3 cable |
| DEG | Distributed Embedded Generation | PFW | Pentland Firth West cable |
| DFES | Distribution Future Energy Scenarios | PILC | Paper-Insulated Lead-Covered cable |
| DSO | Distribution System Operator | PLGR | Pre-Lay Grapnel Run vessel service |
| DTS | Desk top study | PO | Purchase order |
| DWA | Double Galvanised Steel Wire Armour cable | PPM | Parts Per Million |
| EJP | Engineering Justification Paper | PSS Sincal | Simulation and analysis software for distribution and industrial planning |
| EPCI | Engineering, Procurement, Construction, and Installation contract | P2/8 | Engineering Recommendation P2 Issue 8 2023 |
| FD | Ofgem RIIO-ED2 Final Determinations | RTS | Radio Teleswitch System (RTS) |
| GB | Great Britain | RFI | Request For Information |
| GSP | Grid Supply Point | RIIO ED | Electricity distribution price control period (currently ED2 - 2023-2028) |
| HDD | Horizontal Directional Drilling | RIPEET | Responsible research and Innovation Policy Experimentations for Energy Transition |
| HI | Health Index | SBT | Science Based Target |
| HOWSUM | Hebrides and Orkney Whole System Uncertainty Mechanism | SCR | Selective Catalytic Reduction |

| Acronym | Definition | Acronym | Definition |
|---|---|---|---|
| HV | High Voltage | SEPA | Scottish Environment Protection Agency |
| HVDC | High Voltage Direct Current | SEPD | Southern Electric Power Distribution |
| ITT | Invitation To Tender | SGN | Scotia Gas Networks |
| KPS | Kirkwall Power Station | SHEPD | Scottish Hydro Electric Power Distribution |
| kV | Kilovolts | SSE | Scottish and Southern Energy |
| LCD | Large Capital Delivery | SSEN-D | Distribution company of Scottish and Southern Electricity Networks |
| LCPC | Large Capital Project Committee | SSEN-T | Transmission company of Scottish and Southern Electricity Networks |
| LCP | Large Capital Project | Sw/STN | Switching Station |
| LMA | Load Managed Area | SWA | Steel Wire Armoured cable |
| LW | Leading the Way DFES scenario | U/G | Underground |
| MCPD | Medium Combustion Plant Directive | UM | Uncertainty Mechanism |
| MPV | Multi Purpose Vessel | XLPE | Cross-Linked Polyethylene Cable |

# APPENDIX 2 – HOWSUM DEVELOPMENT FUNDING

Ofgem determined to allow £20.6m in RIIO-ED2 ex ante development funding to undertake the prerequisite pre-construction works identified by SHEPD. These works include:

- Offshore - Route Surveys and Geophysical Samples
- 3rd Party - Earthing studies
- 3rd Party - Remote Utility Surveys
- 3rd Party - Landfall, Peat Probing and Cable Routing Surveys
- 3rd Party - Environmental Studies
- 3rd Party - Overhead Line and Existing Network Modification Surveys
- Internal Engineering - Feasibility Studies
- Internal Engineering - Wayleaves and Approvals
- Internal Engineering - Consenting Activities

The HOWS Overall Solution which includes system studies and engagement with the ET sector and generators as required:

- HOWS Overall Solution (whole system analysis and studies) - Outer Hebrides
- HOWS Overall Solution (whole system analysis and studies) - Inner Hebrides
- HOWS Overall Solution (whole system analysis and studies) - Orkney

# EXTERNAL APPENDICES

APPENDIX 3A – OUTER HEBRIDES 2050 WHOLE SYSTEM PROPOSALS EJP (SKYE – UIST – HARRIS)

APPENDIX 3B – OUTER HEBRIDES 2050 WHOLE SYSTEM PROPOSALS CBA (SKYE – UIST – HARRIS)

APPENDIX 4A – UIST – ERISKAY EJP

APPENDIX 4B – UIST – ERISKAY CBA

APPENDIX 5A – ERISKAY – BARRA EJP

APPENDIX 5B – ERISKAY – BARRA CBA

APPENDIX 6A – PENTLAND FIRTH EAST 3 EJP

APPENDIX 6B – PENTLAND FIRTH EAST 3 CBA LW

APPENDIX 6C – PENTLAND FIRTH EAST 3 CBA CT

APPENDIX 7 – JACOBS OPTIONEERING REPORT

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