

OUTER HEBRIDES - 2050 WHOLE SYSTEM PROPOSALS (ARDMORE – LOCH POOLTIEL OPTIMISATION)

ENGINEERING JUSTIFICATION PAPER

505_SHEPD_HSM_24_ARDMORE- LOCH POOLTIEL	Outer Hebrides Whole System Project Hebrides and Orkney Whole System RIIO-ED2 Re-opener ENGINEERING JUSTIFICATION PAPER		Applies to	
			Distribution	Transmission
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Revision: 0	Classification: Confidential	Issue Date: July 2024	Review Date: N/A	

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Preface

SHEPD submitted the Outer Hebrides 2050 Whole System Proposals EJP and accompanying core narrative document under the HOWSUM window in January 2024,¹ identifying preferred options to replace the existing Ardmore to Loch Carnan subsea cable with a larger one, installing a new cable between Harris and Clachan substations, and laying a second subsea cable alongside the existing Ardmore to Harris route, at a total capital cost of £ [REDACTED] million, spread across the current and subsequent price control periods.

The documents called out potential deliverability risks to the proposals ([REDACTED]) for the proposed section of overhead line network between Dunvegan GSP and the subsea cable landing location at Loch Pooltiel on Skye) [REDACTED].

This EJP has been created to review delivery options, provide updated costs and propose the optimum solution for delivery [REDACTED]. It is an addendum to the Outer Hebrides – 2050 Whole System Proposals EJP submitted in January 2024, detailing our proposal to progress works [REDACTED].

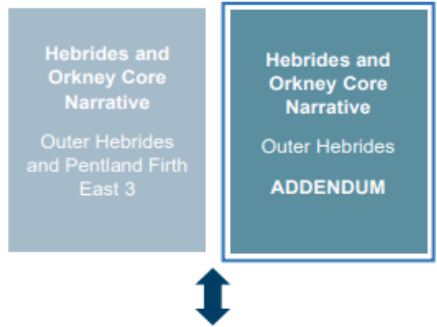
In addition to the original January 2024 submission, this EJP should be read in conjunction with the following supporting documents:

- Appendix 3A – Outer Hebrides 2050 Whole System Proposals EJP (Skye-Uist-Harris) – July 2024 Addendum
- Appendix 3B – Outer Hebrides 2050 Whole System Proposals CBA (Skye-Uist-Harris) – July 2024 Addendum
- Appendix 8B – Outer Hebrides 2050 Whole System Proposals CBA (Ardmore – Loch Pooltiel Optimisation)

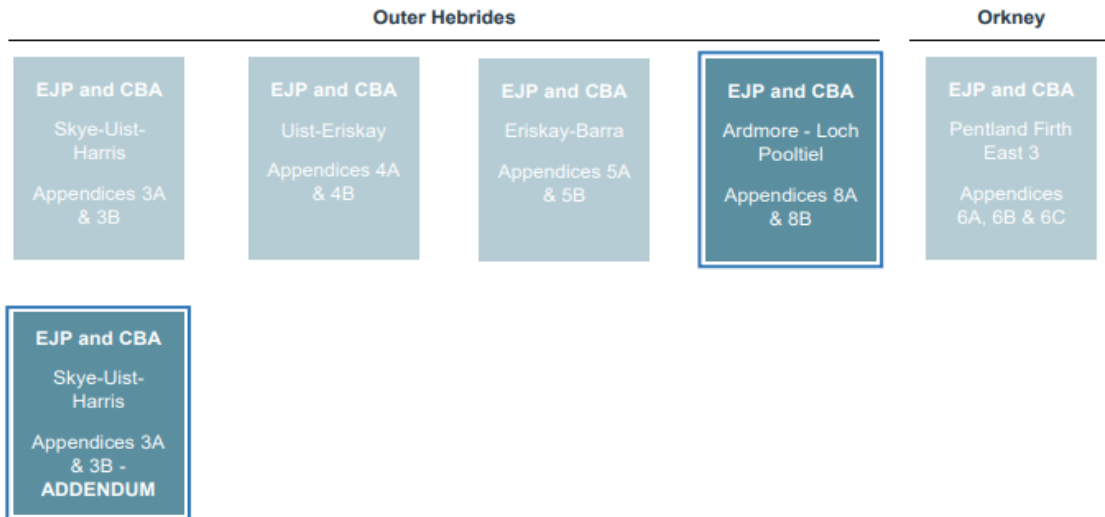
¹ Document reference 501_SHEPD_HSM_24_SKYE-UIST-HARRIS, redacted version published here. [Whole system energy solutions for the Scottish Islands - SSEN](#).

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CORE NARRATIVE



ENGINEERING JUSTIFICATION PAPERS AND COST BENEFIT ANALYSIS



SUPPORTING CONSULTANT REPORTS

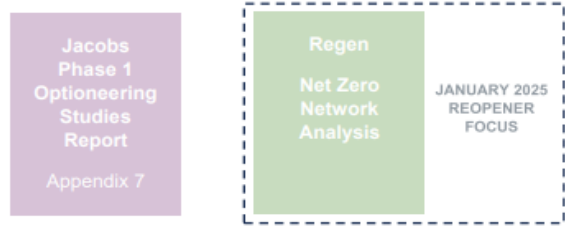


Table 0.1 – HOWSUM 2024 re-opener – July 2024 submission structure

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1 Executive Summary

The purpose of this Engineering Justification Paper (EJP) is to detail options to optimise the delivery of the proposed Dunvegan – Loch Carnan circuit [REDACTED], detailed in our original EJP for the Outer Hebrides submitted in January 2024 (Appendix 3A – Outer Hebrides 2050 Whole System Proposals EJP (Skye-Uist-Harris)).

In that EJP, SHEPD identified Option 18² as the preferred long-term strategy for meeting the region's electricity demands whilst ensuring a resilient network, sufficient capacity, and low carbon footprint. This option involves replacing the existing Ardmore to Loch Carnan subsea cable with a larger one, installing a new cable between Harris and Clachan substations and laying a second subsea cable alongside the existing Ardmore to Harris route. Onshore connections to substations will support each route. This option has been chosen because it is:

- 1) The most cost-effective option with the highest Net Present Value (NPV).
- 2) Ensures future resilience on the Outer Hebrides.
- 3) Meets future demand and generation requirements.
- 4) Provides a credible route to facilitate decarbonisation of our embedded diesel generation fleet.

The investment timeline for this option spans 2025-2035, with the first circuit commissioning in 2027/28 and the last cable being completed in 2035, aligning with the forecasted Distribution Future Energy Scenarios (DFES) demand profile. The total capital cost of this option was estimated for the purpose of our January 2024 submission as £[REDACTED] million, spread across the current and subsequent price control periods.

This paper outlines the deliverability issues identified through the development of the proposed solution [REDACTED] alongside the preferred new 33kV subsea cable from Dunvegan GSP on Skye to Loch Carnan 33kV Sw/STN.

A significant driver for this delivery approach is asset condition. The current 33kV cable running between Skye and South Uist has been in service for 34 years. The average End of Life (EoL) for this cable type is 30 years, therefore the cable has reached its EoL within the current price control period. The asset has been given a Health Index (HI) score 5/5 and a Criticality Index (CI) of 2/5, which means that it has a high probability of failure and needs to be replaced. The risk of asset failure will only increase as the asset is being used passed its EoL and the load on the cable continues to increase. Failure of the cable would result in a lengthy outage during which the Loch Carnan and Barra power stations would need to operate to maintain supplies to the Uists island group. This would be at significant cost and result in significant carbon emissions.

²New Dunvegan – Loch Carnan subsea cable (plus supporting onshore), additional Harris – Clachan subsea cable (plus supporting onshore) and new secondary Ardmore – Harris subsea cable (plus supporting onshore)

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Given the high risk of failure of the existing Ardmore – Loch Carnan 33kV cable we have therefore assessed the relative merits of mitigating this risk through several alternative options. These options have been through CBA analysis accounting for this delivery risk. In this assessment we also consider other benefits of each option including improved resilience of the network on both Skye and the Outer Hebrides.

As a result, our proposals will allow us to progress and energise the new subsea route to Uist via Skye without undue delay, [REDACTED]

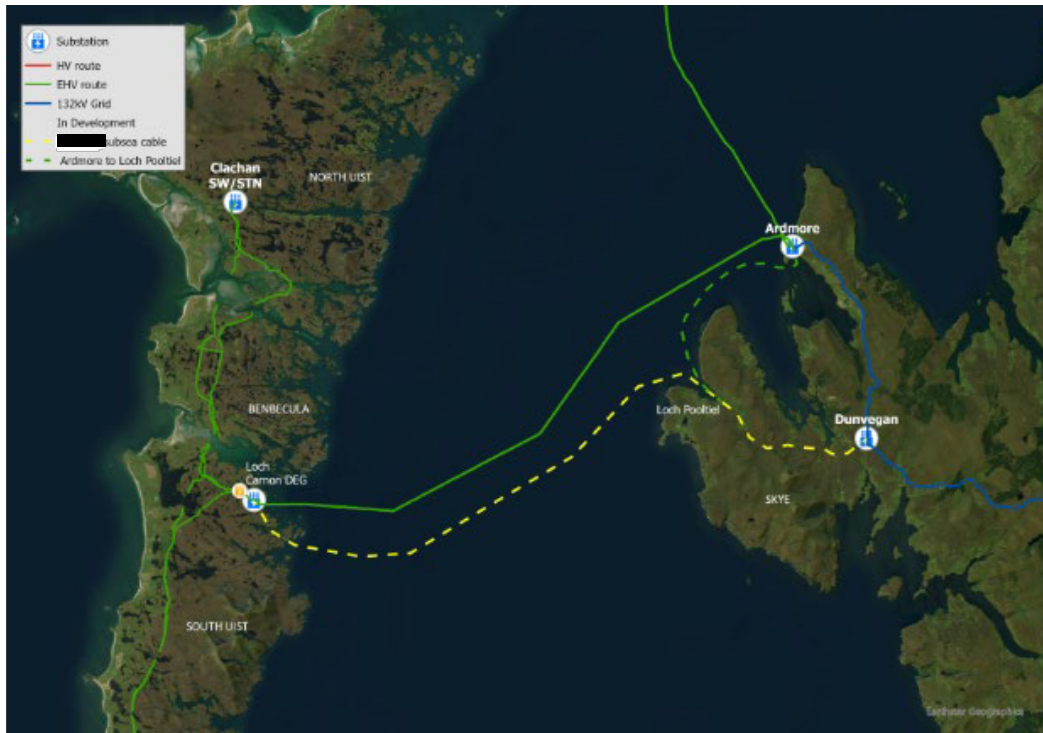


Figure1.1 – HOWSUM 2024 re-opener Preferred Option

2 Investment Summary Table

Name of Scheme/Programme	Outer Hebrides Strategic Investment
Primary Investment Driver	Asset replacement of Ardmore – Loch Carnan 33kV subsea cable

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Scheme reference/ mechanism or category	505_SHEPD_HSM_24_ARDMORE-LOCH POOLTIEL	
Output reference/type	██████ subsea cable ████████████████████	
Cost	£██████ M	
Delivery Year	Between ██████ and ██████	
Reporting Table(s)	R3 – Re-openers (subject to specific activities, costs may fall under other reporting tables)	
Outputs in RIIO ED2 Business Plan	HOWSUM development funding has been provided as part of SHEPD’s RIIO-ED2 settlement for HOWSUM project development costs. For Skye-Uist, development costs in RIIO-ED2 are currently estimated at £██████ m (see also Hebrides and Orkney Whole System Core Narrative, Table 5). We have deducted development costs from the ‘Cost’ and ‘Spend Apportionment’ values in this table to take account of this funding. A refined view of costs are provided in this EJP, building on SHEPD’s submission made in January 2024.	
Spend Apportionment	RIIO-ED2	RIIO-ED3+
	£██████ M	Nil
MVA released	30.9 MVA	

Table 2.1: Investment summary table

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3 Introduction

This Engineering Justification Paper (EJP) sets out SHEPD’s plan to replace the existing subsea electricity cable from Ardmore GSP on Skye to Loch Carnan 33kV Sw/STN on South Uist, to ensure that we continue providing a safe and reliable network and provide sufficient load capacity to enable 2045 net zero targets.

In the Outer Hebrides 2050 Whole System Proposals EJP (Skye-Uist-Harris) we identified our preferred solution as a combination of a new 33kV [REDACTED] subsea cable circuit from Ardmore GSP to Harris GSP, a new 33kV [REDACTED] subsea cable from Harris GSP to Clachan 33kV SW/STN and a new 33kV [REDACTED] subsea cable from Dunvegan GSP to Loch Carnan 33kV SW/STN with only the latter being brought forward for delivery in ED2.

The accompanying core narrative document (Hebrides and Orkney Whole System UM Core Narrative) called out the deliverability risk of the Dunvegan GSP – Loch Carnan 33kV SW/STN overhead line route across Skye [REDACTED]

[REDACTED] This EJP will develop this proposal along with other options that could mitigate delivery risk.

3.1 Geographical Context

Details of the geographical context for this submission can be found in OUTER HEBRIDES - 2050 WHOLE SYSTEM PROPOSALS EJP.

3.2 Uncertainty Mechanism

Background on the uncertainty mechanism and its context for this submission can be found in OUTER HEBRIDES - 2050 WHOLE SYSTEM PROPOSALS EJP.

3.3 Primary Investment Drivers

Background on the primary investment drivers and their context for this submission can be found in OUTER HEBRIDES - 2050 WHOLE SYSTEM PROPOSALS EJP.

3.4 Needs Case

Background on the needs case for this submission can be found in OUTER HEBRIDES - 2050 WHOLE SYSTEM PROPOSALS EJP

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4 Background Information

4.1 Intervention Priorities

Information on our intervention priorities and our Common Network Assets Indices Methodology (CNAIM) can be found in OUTER HEBRIDES - 2050 WHOLE SYSTEM PROPOSALS EJP.

4.2 Existing Asset Conditions

Information on the existing asset condition, health and criticality index can be found in OUTER HEBRIDES - 2050 WHOLE SYSTEM PROPOSALS EJP.

Existing Network Arrangements Details of the existing network arrangements can be found in OUTER HEBRIDES - 2050 WHOLE SYSTEM PROPOSALS EJP.

4.3 Load Forecast

Details of the load forecast and DFES process used in the system analysis of options can be found in OUTER HEBRIDES - 2050 WHOLE SYSTEM PROPOSALS EJP.

4.4 Regional Stakeholder Engagement and Whole Systems Analysis Summary

Details of our stakeholder engagement up to the January 2024 submission can be found in OUTER HEBRIDES - 2050 WHOLE SYSTEM PROPOSALS EJP. This EJP provides an update to our subsequent engagement, in particular that relating to engagement with local communities on Skye regarding the proposed Dunvegan – Loch Pooltiel 33kV overhead line.

4.4.1 Landowner Engagement & Consenting

Following initial contact with the relevant landowners at the proposed landfall site at Milovaig (Loch Pooltiel), the Skye-Uist Replacement project was introduced to the wider community at the Glendale Community Hall as part of SSEN's community engagement event held on the 3rd of June 2024. All parts of the project were discussed and presented with a focus specifically on the landing point at Meanish and Overhead Line route from Loch Pooltiel to Dunvegan. There was a significant turn out from the community with both positive and negative responses to the proposed works.

General engagement with the community and landowners identified along the proposed land portion of the works (including the Overhead Line route) is ongoing [REDACTED]

[REDACTED]

[REDACTED]

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[REDACTED]

[REDACTED]

4.5 Flexible Market Viability

Information on the flexibility market viability and our approach to flex in this submission can be found in OUTER HEBRIDES - 2050 WHOLE SYSTEM PROPOSALS EJP.

4.6 Confidence Table

Table 4.1 provides an indication of our confidence levels in each of the sections which have been analysed/utilised as part of the solution assessment.

Confidence Factor	Certainty (High, Medium, Low)	Comments
Load Forecast	Medium	We are using the 2022 DFES data has been used for the purpose of this study and a predictor of load forecast. However, these are longer term proposals and as such we recognise the potential for variation during the period to 2050.
Existing Asset Condition	High	Offshore ROV inspections and identified HI 5 asset condition.
Existing Operational Issues	Medium	Customers on Skye and the Outer Hebrides are currently supplied via a single transmission circuit.
Connections Activity	Medium	Connections are regularly changing, and new applications can be received at any time. However, we had reasonable certainty based on DFES analysis that demand growth has been accurately captured in the DFES.
Regional Stakeholder engagement	High	Western isles whole system webinars have been held also with the offer of bilateral. Further engagement undertaken through DFES and wider community engagement sessions.
Flexible market Viability	Low	Flexibility as a viable alternative to reinforcement was explored as part of the original optioneering study under Outer Hebrides – 2050 Whole System Proposals EJP. The amount of flexibility which would need to be procured to prevent reinforcement

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Confidence Factor	Certainty (High, Medium, Low)	Comments
		<p>before 2050 is approximately between 3 to 30MVA on average for the options developed.</p> <p>Our 2023 global call for flexibility opened has not highlighted significant volumes of flexibility on the islands today, however we will be considering the future potential in 2025 given its primary use cases are for the later phases of work.</p>
Funding Position	Medium	<p>We have agreement to use the HOWSUM, and the outcome of the submission is subject to Ofgem's assessment.</p> <p>Based on our analysis of island needs we believe we have identified the correct solution for implementation at the correct time.</p> <p>We have now undertaken a tendering exercise to ascertain cable installation costs in order to inform this full regulatory submission and have assessed mitigations to enhance our original recommended solution.</p>

Table 4.1: Confidence table

5 Optioneering

SSEN has identified a preferred whole system solution for the Outer Hebrides through the Outer Hebrides 2050 Whole System Proposals EJP. [REDACTED]

5.1 List of Options

Our optioneering process carried out under Outer Hebrides – 2050 Whole System Proposals EJP fully adhered to the Ofgem Re-opener guidance. This subsequent EJP contains various a number of potential solutions to optimise delivery of the proposed Dunvegan – Loch Carnan circuit [REDACTED]

Option no.	Description
Baseline	Continue with the network interventions outlined in the Outer Hebrides 2050 Whole System Proposals EJP (New Dunvegan – Loch Carnan subsea cable /OHL) as planned. Capital is allocated to ensure that emergency service repair can take place, in the event of failure occurring in RIIO-ED2.

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Option no.	Description
1	Refine the proposed scheme, where the OHL section from Dunvegan GSP to Loch Pooltiel subsea landing point is replaced with a UG cable.
2	Augment proposed scheme with additional subsea route from Loch Pooltiel (Skye) to Ardmore GSP.
3	Progress both overland underground cable and subsea cable sections to deliver a three-ended circuit.
4	Abandon Dunvegan – Loch Pooltiel development and seek funding for Ardmore – Loch Pooltiel – Loch Carnan circuit.

Table 5.1: Options considered

6 Detailed Option Analysis

All options under this EJP have been considered as viable for the investment need.

6.1 Baseline: Do Minimum (Continue with Outer Hebrides 2050 Whole System Proposal)

Option Description

Under this option, there would be no change to the proposed interventions outlined in the Outer Hebrides 2050 Whole System Proposals EJP. We will continue to engage proactively with landowners to complete consenting of the OHL between Dunvegan GSP and the subsea cable landing point at Loch Pooltiel. The proposed solution is outlined below.

Replacing the existing Ardmore to Loch Carnan subsea cable (95mm²) with a larger cable () from Dunvegan to Loch Carnan. It also involves a new cable from the Harris to Clachan substations, via Lochmaddy, and a secondary subsea cable alongside the existing Ardmore to Harris route. Each route will be supported with onshore connections to the substations. The routes are further depicted in Figure 6.1 This will provide N-1 capacity and cater for demand growth until at least 2050.

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Figure 6.1: Baseline Option

Cost

As brought forward in the Outer Hebrides 2050 Whole System Proposal EJP, we are currently only seeking funding for the proposed route from Dunvegan GSP on Skye to Loch Carnan 33kV SW/STN on South Uist at this time. The costs for this intervention are presented below.

Line Items	Route	Cost (£m)
Subsea cable	(Dunvegan - Loch Carnan)	■
Onshore - OHL	(Dunvegan - Loch Carnan)	■
Onshore - Poles	(Dunvegan - Loch Carnan)	■
Onshore - 33kV U/G Cable	(Dunvegan - Loch Carnan)	■

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Substation upgrade - Dunvegan		

Table 6.1: Baseline cost breakdown – RIIO-ED2 only (2021 prices)

These costs have been updated from the original Outer Hebrides 2050 Whole System Proposal EJP following a detailed deliverability assessment and open market tender process for the subsea cable elements.

Limitations

Through the deliverability assessment of all the options considered, it has been identified that the proposed overhead line section from Dunvegan GSP to the subsea cable landing point at Loch Pooltiel [REDACTED]. As per earlier sections, we have completed extensive landowner engagement to consent the proposed OHL, [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

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6.2 Option1: Refinement (OHL section from Dunvegan GSP to Loch Pooltiel subsea landing point is replaced with a UG cable)

Presented in the Outer Hebrides 2050 Whole System Proposal EJP as Option 19 (a sensitivity on Option 18), Option 1 in this EJP is to refine the preferred option, where instead of an overhead circuit on Skye, the 16.5km Dunvegan to Loch Pooltiel onshore circuit is run underground. The subsea section of the Dunvegan to Loch Carnan route is the same, as is the entirety of the Harris to Clachan and Ardmore to Harris routes. This will be subject to study and may require enhanced reactive compensation at the either Dunvegan or Loch Carnan depending on the final specification of the underground cable. The routes are further depicted in Figure 6.2.



Figure 6.2 : Refinement Option route map

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Cost

As brought forward in the Outer Hebrides 2050 Whole System Proposal EJP, we are currently only seeking funding for the proposed route from Dunvegan GSP on Skye to Loch Carnan 33kV SW/STN on South Uist at this time. The costs for this intervention are presented as follows.

Line Items	Route	Cost (£m)
Subsea cable	(Dunvegan - Loch Carnan)	█
Onshore - 33kV U/G Cable	(Dunvegan - Loch Carnan)	█
Substation upgrade - Dunvegan		█
		█

Table 6.3: Option 1 ED2 cost breakdown (2021 prices)

Benefits

The benefit of this option compared to the baseline is the underground section of the Dunvegan to Loch Carnan route. Much of the Isle of Skye, where the underground cable will exist, is a protected Special Area of Conservation, so installing the cable underground rather than on overhead lines will protect the visual amenity of the area. As much of the cabling can be completed in the public highway, █

Limitations

The limitation of the underground cable is that the █

6.3 Option 2: Augmentation (additional subsea route from Loch Pooltiel (Skye) to Ardmore GSP)

The proposal set out in the January 2024 application 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. █

Given the current condition of the cable we have concerns over the potential risk of failure during this period. Therefore, █, we have progressed a subsea cable survey for a potential

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connection between Ardmore GSP and Loch Pooltiel that could act as an alternative connection into the existing Skye network.

The augmentation of this proposal involves replacing the existing Ardmore to Loch Carnan subsea cable (95mm²) with a [REDACTED] cable ([REDACTED]) from Loch Carnan to the landing point at Loch Pooltiel on Skye. This section is then connected to Dunvegan GSP via a 16.5km OHL. We would also install a new [REDACTED] 33kV subsea cable from Ardmore GSP to Loch Pooltiel, [REDACTED], allowing a new subsea route from Skye to South Uist to be energised [REDACTED]. This will be subject to study and may require enhanced reactive compensation at the new switching station depending on the final specification of the underground cable. Following the granting of consent to the OHL route, we will install the proposed route, connecting Dunvegan GSP to both Loch Carnan 33kV SW/STN on South Uist and Ardmore GSP on Skye with the potential to be utilised Has a 3 ended circuit.

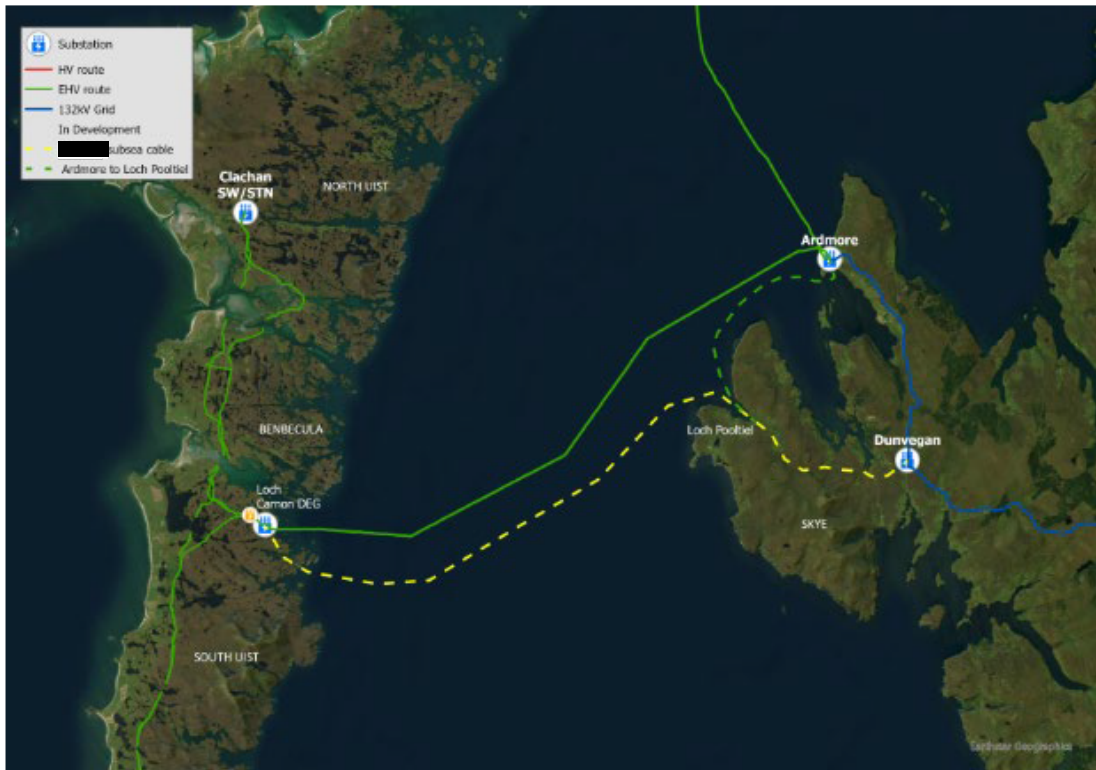


Figure 6.3: Augmented Outer Hebrides 2050 Whole System Proposal including Ardmore – Loch Pooltiel mitigation³

³ The proposed replacement Ardmore – Harris cable is not shown in this figure.

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Cost

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Line Items	Route	Cost (£m)
Subsea cable	(Dunvegan - Loch Carnan)	█
Onshore - OHL	(Dunvegan - Loch Carnan)	█
Onshore - Poles	(Dunvegan - Loch Carnan)	█
Onshore - 33kV U/G Cable	(Dunvegan - Loch Carnan)	█
Subsea cable	(Ardmore – Loch Pooltiel)	█
Substation upgrade - Dunvegan	█	█
Switching Station █		█
		█

Table 6.5: Option 2 ED2 cost breakdown (2021 prices)

Benefits

The proposed augmentation of the original proposal to include the additional subsea route from Ardmore to Loch Pooltiel will facilitate the removal of the existing Ardmore – Loch Carnan 95mm subsea cable (Identified as HI5) █. It removes the risk of needing to deviate dramatically from the preferred whole system solution in the event of a failure of the existing cable.

This option would also have additional operational benefits. It would provide increased resilience to the Uist Archipelago in the event of an outage to either Dunvegan or Ardmore GSPs. These GSPs are currently supplied via a single 132kV circuit from Fort Augustus.

Limitations

The limitation of this option is that it is █.

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6.4 Option 3: Progress both overland underground cable and subsea cable sections to deliver a three-ended circuit.

This option is a sensitivity on option 2. We would alter the proposed scheme set out in the January 2024 submission where instead of an overhead circuit on Skye, the 16.5km Dunvegan to Loch Caran onshore cable is all underground. We would also progress with the augmentation of the proposal and install a new [REDACTED] 33kV subsea cable from Ardmore GSP to Loch Pooltiel, [REDACTED], allowing a new subsea route from Skye to South Uist to be energised [REDACTED]. This will be subject to study and may require enhanced reactive compensation at the switching station for the two circuits depending on the final specification of the cables.

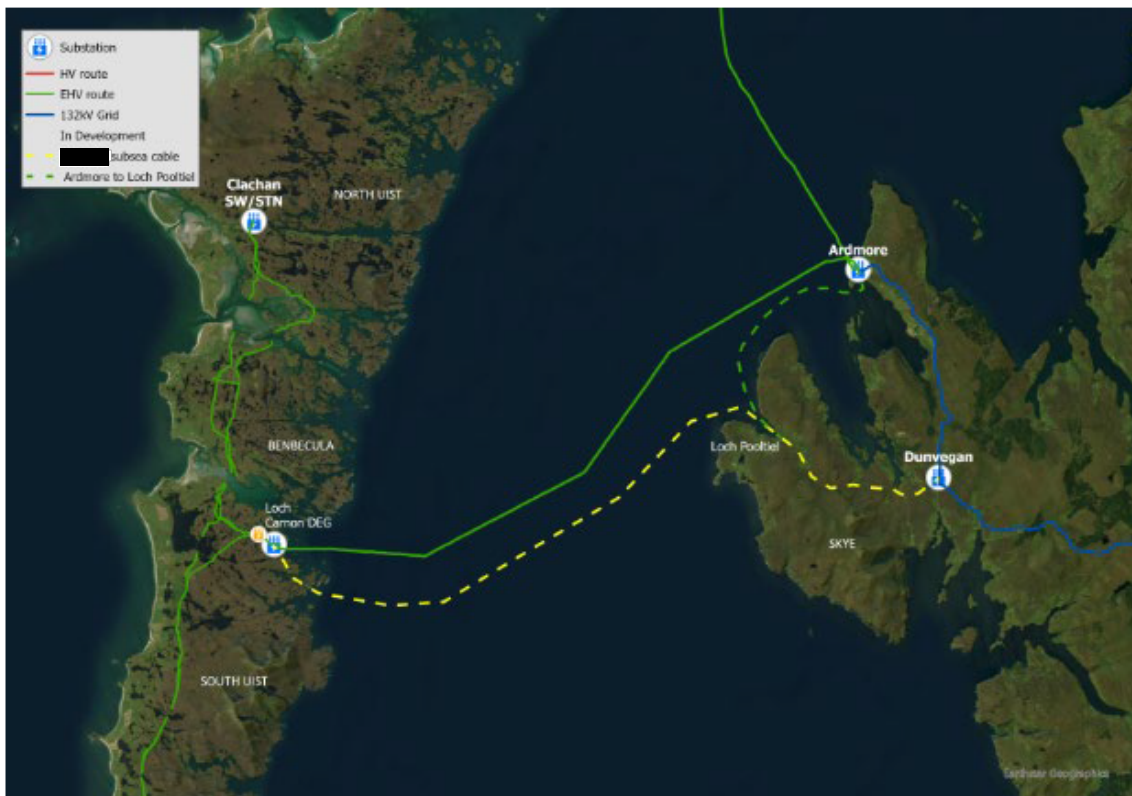


Figure 6.4 : Augmented Outer Hebrides 2050 Whole System Proposal including Ardmore – Loch Pooltiel mitigation

Cost

As brought forward in the Outer Hebrides 2050 Whole System Proposal EJP, we are currently only seeking funding for the proposed route from Dunvegan GSP on Skye to Loch Carnan 33kV SW/STN on South Uist at this time. The costs for this intervention are presented as follows.

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Line Items	Route	Cost (£m)
Subsea cable	(Dunvegan - Loch Carnan)	█
Onshore - 33kV U/G Cable	(Dunvegan - Loch Carnan)	█
Subsea cable	(Ardmore – Loch Pooltiel)	█
Substation upgrade - Dunvegan	█	█
Switching Station █		█
		█

Table 6.7: Option 3 ED2 cost breakdown (2021 prices)

Benefits

The proposed augmentation of the original proposal to include the additional subsea route from Ardmore to Loch Pooltiel will facilitate the removal of the existing Ardmore – Loch Carnan 95mm subsea cable (Identified as HI5) █ as there are █. It removes the risk of needing to deviate dramatically from the preferred whole system solution in the event of a failure of the existing cable.

This option would also have additional operational benefits. It would provide increased resilience to the Uist Archipelago in the event of an outage to either Dunvegan or Ardmore GSPs. These GSPs are currently supplied via a single 132kV circuit from Fort Augustus.

Limitations

The limitation of this option is that it is █, both with the inclusion of the additional subsea cable and the change from OHL to UG cable from Dunvegan GSP.

6.5 Option 4: Abandon Dunvegan – Loch Pooltiel development and seek funding for Ardmore – Loch Pooltiel – Loch Carnan circuit.

In this option, we will revise our original proposal and abandon the overhead line route from Dunvegan GSP to Loch Pooltiel. We will instead install a █ 33kV subsea cable from Ardmore GSP to Loch Pooltiel, followed by a subsequent █ 33kV subsea cable from Loch Pooltiel to Loch Carnan 33kV SW/STN. This will be subject to study and may require enhanced reactive compensation at the either Ardmore or Loch Carnan depending on the final specification of the subsea cable.

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Figure 6.5 : Subsea Only Option route map

Cost

As brought forward in the Outer Hebrides 2050 Whole System Proposal EJP, we are currently only seeking funding for the proposed route from Ardmore GSP on Skye to Loch Carnan 33kV SW/STN on South Uist at this time. The costs for this intervention are presented as follows.

Line Items	Route	Cost (£m)
Subsea cable	(Loch Carnan - Loch Pooltiel)	█
Subsea cable	(Ardmore – Loch Pooltiel)	█
Switching Station █		█
		█

Table 6.9: Option 4 ED2 cost breakdown (2021 prices)

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Benefits

The proposed augmentation of the original proposal to include the additional subsea route from Ardmore to Loch Pooltiel will facilitate the removal of the existing Ardmore – Loch Carnan 95mm subsea cable (Identified as HI5) [REDACTED] as there are [REDACTED]

By opting for an intermediate landing point at Loch Pooltiel, this option also allows for future connections to the greater Skye network as the need arises.

Limitations

The limitation of this option is that [REDACTED], it does not provide the enhanced operational functionality and associated benefits that exists in options 2 and 3.

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7 Optioneering Summary Table

We have undertaken a front-end optioneering style approach based on high quality data, expert informed judgement and financially robust costing appraisals using optioneering. This structured approach to identifying schemes is built on the knowledge gained from various areas of the business and the different licence areas we operate.

Table 7.1 provides an overall summary of the options considered or shortlisted for financial and CBA appraisal and includes options discounted.

Table 7.1: Summary of optioneering

	Delivery date of operable solution	Delivery risk of full project	Overall cost of option	Operability benefits
Baseline	■	■	■	■
Option 1	■	■	■	■
Option 2	■	■	■	■
Option 3	■	■	■	■
Option 4	■	■	■	■

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8 Cost Benefit Analysis

This section will outline the process undertaken and the output of the Cost Benefit Analysis (CBA). We have conducted a full CBA for each option.

The approach that we have taken to conduct the CBA is 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

The capital costs, operating costs and assumptions have been carefully costed, are based on Tendered costs and have been verified by subject matter experts. These are set out in Table 8.1.

8.1 Costs of Investment Options used in the CBA

Displayed in Table 8.1 is the expenditure components, split by Capex and Opex, for the ED2 price control period. The majority of costs is made up of capital costs, with operating costs accounting for a smaller, but significant fraction of total expenditure. The bulk of the operating expenditure for the short-listed options is a consequence of operating the DEG on standby in the event of a fault on the existing HI5 subsea cable to Loch Carnan, which is treated as an operating cost in this table.

	RIIO-ED2		
Option	Capex	Opex	Totex
Baseline	■■■■	■■	■■■■
Option 1	■■■■	■■■■	■■■■
Option 2	■■■■	■■■■	■■■■
Option 3	■■■■	■■■■	■■■■
Option 4	■■■■	■■■■	■■■■

Table 8.1 - Cost summary - 2021 Prices (£m)

The cost summary in Table 8.1 shows that

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All options will be delivered within the RIIO-ED2 price control.

8.2 CBA Results

The output of the CBA is displayed below in Table 8.2.

Option	10 Years	20 years	30 years	45 years	Whole Life (55 years)
Baseline	██████	██████	██████	██████	██████
Option 1	██████	██████	██████	██████	██████
Option 2	██████	██████	██████	██████	██████
Option 3	██████	██████	██████	██████	██████
Option 4	██████	██████	██████	██████	██████

Table 8.2 - Net Present Value at different intervals (£m, 2021 prices)

The NPV is heavily driven by capital expenditure, which therefore logically leads to ██████ producing the most positive result. ██████ displays the least positive NPV, ██████. It should be noted that options ██████ have relatively similar whole life NPV's, however ██████ does not contain the additional operational benefits presented in ██████.

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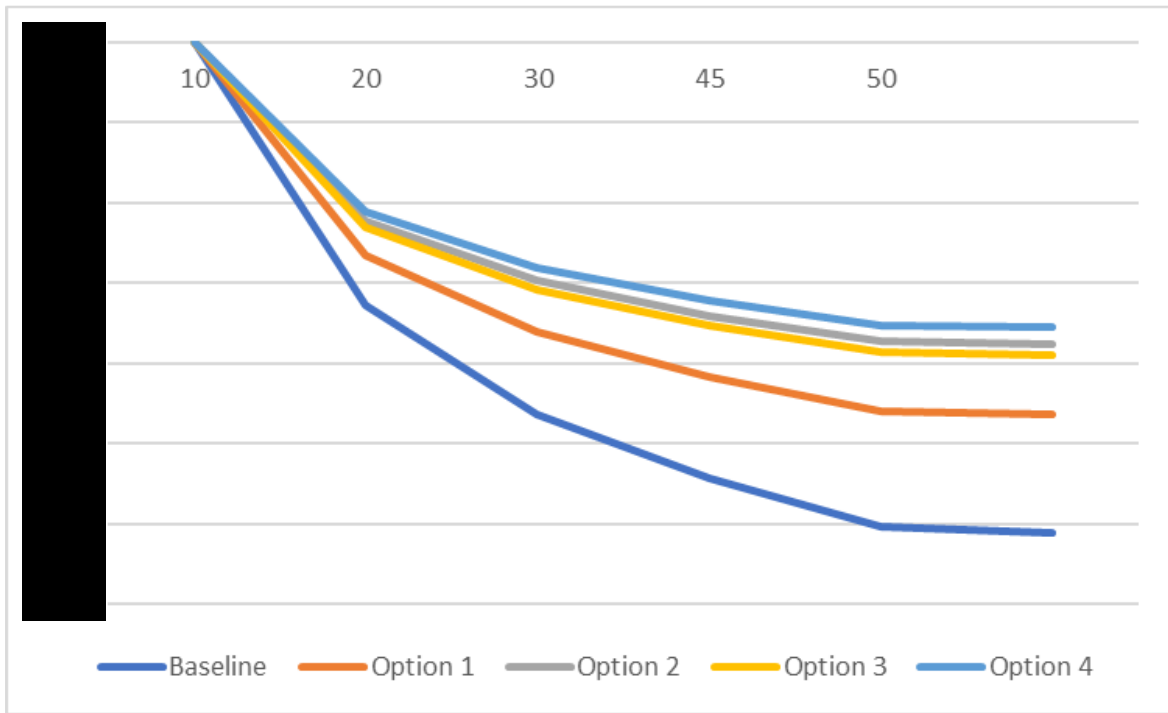


Table 8.3: Option whole life benefits (£m, 2021 prices)

9 Preferred Option

The cost benefit analysis presented in the above section outlines the benefits of [REDACTED]. The lowest three NPV options all include [REDACTED] with the avoided DEG operation costs associated with early energisation of the proposed new subsea route from Skye to Uist having a large impact on the results.

[REDACTED] has the lowest whole life NPV of all the options considered, however [REDACTED] have only marginally higher NPV's with additional operational benefits to the wider network on the Western Isles and Skye.

With its operational advantages, slightly lower CAPEX outlay and better whole life NPV, [REDACTED]

[REDACTED] is being taken forward as the preferred option in this EJP.

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10 Deliverability and Risk

This section will document the approach to delivery, list any potential deliverability constraints and any necessary mitigation strategies that will need to be undertaken to minimise the risk.

The output of this EJP is to replace the existing subsea cable with a new and higher load cable that appropriately reflects the demand and supply of the region, whilst expediting delivery of the solution to mitigate the impact of delayed delivery in the event of a fault on the existing subsea cable.

10.1 Delivery Strategy

The delivery strategy for the overall project is to

[REDACTED]

The supply chain required to deliver the project has been tested through delivery of RIIO-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 subsea cable installation contractors to ensure that the capacity and skills to deliver this project are available.

[REDACTED]

10.1.1 Project plan

The submarine cable programme is to survey the proposed marine routes in 2024 and complete the design and engineering following this, also in 2024.

[REDACTED]

In Figure 12 we set out the project plan for the delivery of this project. This is contingent on an Ofgem determination by end of 2024.

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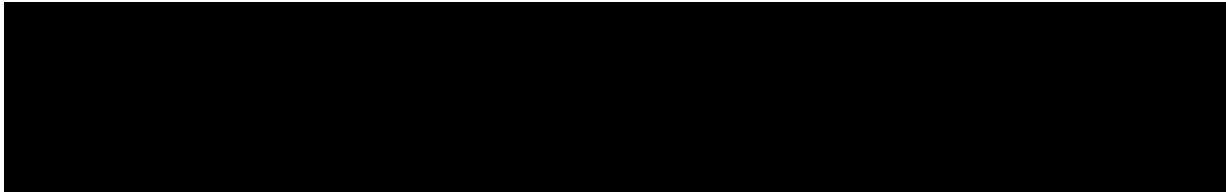


Figure 1: Project Plan timeline

10.2 Procurement and Contracting Strategy

Information on the procurement and contracting strategy for this submission can be found in OUTER HEBRIDES - 2050 WHOLE SYSTEM PROPOSALS EJP. A full list of procurement activities can also be found in **Appendix B**.

10.3 Estimated Cost of Preferred Option

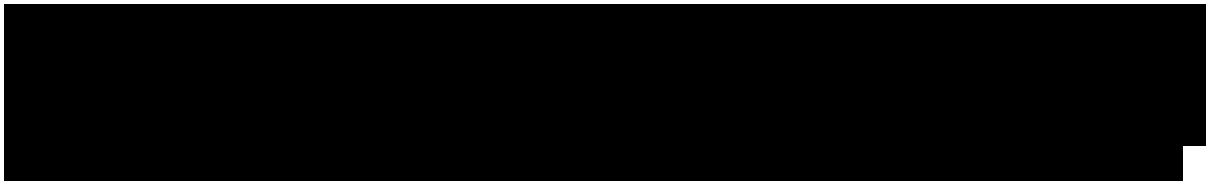


Table 10.1 provides a breakdown of the costs for the preferred option. This is estimated to cost £ [redacted] m [redacted].

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Line Items	Route	Cost (£m)
Subsea cable	(Loch Pooltiel - Loch Carnan)	█
Subsea Cable (Risk)	(Loch Pooltiel - Loch Carnan)	█
Onshore - OHL	(Dunvegan - Loch Carnan)	█
Onshore - Poles	(Dunvegan - Loch Carnan)	█
Onshore - 33kV U/G Cable	(Dunvegan - Loch Carnan)	█
Subsea cable	(Ardmore – Loch Pooltiel)	█
Substation upgrade - Dunvegan	█	█
Switching Station █		█
		█

Table 10.1: Cost breakdown

We have included a standard risk allowance in the costs noted above, discussed further in the Core Narrative Addendum at Section 2.5.

10.3.1 Regional variations in cost

The implementation of subsea cables in the Outer Hebrides presents unique challenges and cost considerations compared to onshore or underground installations. █

10.3.2 Ensuring cost robustness of preferred option

Furthermore, SHEPD has undertaken a comprehensive cost assurance process to ensure the robustness of estimated costs for this EJP. This approach involves various stages of cost validation. █

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10.4 Risks and Mitigations

Risk will be managed in accordance with the SHEPD Large Capital 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 has been determined using Quantitative Cost Risk Analysis to provide a realistic appraisal of the potential value and is currently valued at £ [REDACTED] m (20/21 Prices) as noted above.

10.4.1 Specific Risks and mitigations

Information on the risks and mitigations to be applied to this project can be found in OUTER HEBRIDES - 2050 WHOLE SYSTEM PROPOSALS (ADDENDUM) EJP & Core Narrative document section 2.5.

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11 Conclusion and Recommendation

The current 33kV cable running between Skye and South Uist has been in service for 34 years. The average End of Life (EoL) for this cable type is 30 years, therefore the cable has reached its EoL within the current price control period. The asset has been given a Health Index (HI) score 5/5 and a Criticality Index (CI) of 2/5, which means that it has a high probability of failure and needs to be replaced. The risk of asset failure will only increase as the asset is being used passed its EoL and the load on the cable continues to increase.

In our original EJP for the Outer Hebrides submitted in January 2024 (Appendix 3A – Outer Hebrides 2050 Whole System Proposals EJP (Skye-Uist-Harris)) SHEPD identified Option 18 as the preferred long-term strategy for meeting the region's electricity demands whilst ensuring a resilient network, sufficient capacity, and low carbon footprint.

[REDACTED] have led to us investigate the implementation of options to mitigate delays to project delivery [REDACTED]

That process has determined that [REDACTED] within this EJP [REDACTED] is being taken forward as the preferred option.

This option will allow SHEPD to remove the existing HI5 subsea cable from Ardmore GSP to Loch Carnan GSP [REDACTED] earlier than the original proposal, whilst delivering enhanced operational capabilities with their associated benefits to customers.

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12 References

The documents detailed in Table 12.1, Table 12.2, and Table 12.3, should be used in conjunction with this document.

Table 12.1: Scottish and Southern Electricity Networks Document

Reference	Title
N/A	Hebrides and Orkney Whole System UM Core Narrative (Addendum) Appendix 3A – Outer Hebrides 2050 Whole System Proposals EJP (Skye-Uist-Harris) Addendum

Table 12.2: External Documents

Reference	Title
Nil	

Table 12.3: Miscellaneous Documents

Title
Nil
Nil

13 Revision History

No	Overview of Amendments	Previous Document	Revision	Authorisation
01	Re-submission	* Text *	* Text *	* Text *
02				

505_SHEPD_HSM_24_ARDMORE- LOCH POOLTIEL	Outer Hebrides Whole System Project Hebrides and Orkney Whole System RIIO-ED2 Re-opener ENGINEERING JUSTIFICATION PAPER		Applies to	
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Appendix A Definitions and Abbreviations

Acronym	Definition
BAU	Business As Usual
CBA	Cost Benefit Analysis
CBRM	Condition Based Risk Management
CDM	Construction Design Management
CEM	Common Evaluation Methodology
CEGS	Community Energy Groups
CI	Criticality Index
CMZ	Constrained Management Zone
CNAIM	Common Network Assets Indices Methodology
CPI	Cost Performance Index
CPO	Compulsory Purchase Order
CT	Consumer Transformation
DEG	Distributed Embedded Generation
DFES	Distribution Future Energy Scenarios
DNO	Distribution Network Operator
DTS	Desk Top Survey
EJP	Engineering Justification Paper
EoL	End of Life
EPCI	Engineering, Procurement, Construction, and Installation contract
EV	Earned Value
FES	Future Energy Scenarios
GB	Great Britain
GSP	Grid Supply Point
HI	Health Index
HND	Holistic Network Design
HOWSUM	Hebrides and Orkney Whole System Uncertainty Mechanism
HVDC	High Voltage Direct Current
IIS	Interruptions Incentive Scheme
LA	Local Authority
LW	Leading the Way
MVA	Mega Volt Ampere

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Acronym	Definition
MW	Megawatt
NPV	Net Present Value
OHL	Overhead Line
PO	Purchase Order
PFE	Pentland Firth East
RFI	Request for Information
RIIO-ED1/2	RIIO Electricity Distribution Price Control periods 1 and 2
ROV	Remotely Operated Vehicle
SBT	Science Based Target
SHEPD	Scottish Hydro Electric Power Distribution
SEPD	Southern Energy Power Distribution
SPI	Schedule Performance Index
SSEN	Scottish and Southern Electricity Network
SW/STN	Switching Station
TO	Transmission Operator
UM	Uncertainty Mechanism
VfM	Value for Money

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Appendix B Procurement Activities

Package	Package Description	Procurement Strategy	Comments	Required Completion/Delivery Date
1	Skye to Uist Route Desktop Study (DTS)	[REDACTED]	[REDACTED]	[REDACTED]
2	Fisheries Liaison and Scouting Surveys	[REDACTED]	[REDACTED]	[REDACTED]
3	Offshore Route Surveys	[REDACTED]	[REDACTED]	[REDACTED]

Package	Package Description	Procurement Strategy	Comments	Required Completion/Delivery Date
1	EPCI Contract for Skye to Uist 2 Cable Submarine Cable, Design, Manufacture, Survey & Installation.	[REDACTED]	[REDACTED]	[REDACTED]
2	Shunt Reactor – Plant	[REDACTED]	[REDACTED]	[REDACTED]

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Package	Package Description	Procurement Strategy	Comments	Required Completion/Delivery Date
3	Shunt Reactor – Civils, M&E and Commissioning	[REDACTED]	[REDACTED]	[REDACTED]
4	Surplus cable load in to storage	[REDACTED]		[REDACTED]
5	Professional Services – Cable design Assurance	[REDACTED]	[REDACTED]	[REDACTED]
6	Marine Warranty Surveyor	[REDACTED]	[REDACTED]	[REDACTED]
7	Goods and Equipment Importation	[REDACTED]	[REDACTED]	[REDACTED]
8	Onshore Modification – OHL Works	[REDACTED]	[REDACTED]	[REDACTED]
9	Onshore Environmental Surveys	[REDACTED]	[REDACTED]	[REDACTED]

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Package	Package Description	Procurement Strategy	Comments	Required Completion/Delivery Date
10	Ground Condition Surveys/Trial Pits	[REDACTED]	[REDACTED]	[REDACTED]
11	Commissioning	[REDACTED]	[REDACTED]	[REDACTED]