Scottish & Southern Electricity Networks

RIIO-ED2 Engineering Justification Paper (EJP)

Kilninver Primary Substation P2 Compliance Reinforcements

Investment Reference No: 78/SHEPD/LRE/KILNINVER

Contents

Definitions and Abbreviations

Acronym	Definition
AIS	Air-insulated Switchgear
ASCR	Aluminium Conductor Steel Reinforced
BSP	Bulk Supply Point
CBA	Cost Benefit Analysis
CBRM	Condition Based Risk Management
CEM	Common Evaluation Methodology
CI	Customer Interruptions
CML	Customer Minutes Lost
CT	Consumer Transformation
DFES	Distribution Future Energy Scenarios
DNO	Distribution Network Operator
EJP	Engineering Justification Paper
ESA	Electricity Supply Area
EV	Electric Vehicle
FCO	First Circuit Outage
FES	Future Energy Scenarios
GIS	Geographic Information System
GM	Ground Mounted
GSP	Grid Supply Point
HI	Health Index
IDP	Investment Decision Pack
LCT	Low Carbon Technology
LEP	Local Enterprise Partnership
LI	Load Index
LRE	Load Related Expenditure
LW	Leading the Way
NPV	Net Present Value
OHL	Overhead Line
PM	Pole Mounted
PV	Photovoltaics
RSN	Relevant Section of Network
SCO	Second Circuit Outage
SSEN	Scottish and Southern Electricity Network
SP	Steady Progression
ST	System Transformation
XLPE	Cross-linked Polyethylene

1 Executive Summary

This proposed investment will deliver load related investment of £3.44m during the RIIO-ED2 price control at Kilninver primary substation.

The primary investment driver for this scheme is load, specifically an ER P2 compliance issue at Kilninver primary substation. This load related issue is apparent under all four of SHEPD's Distribution Future Energy Scenario (DFES) scenarios and investment is required to provide sufficient capacity in order to progress towards net zero, improve the security of supply standard and facilitate renewable generation and the uptake of low carbon technologies (LCT) such as EVs and Heat Pumps in the Argyll and Bute area.

Argyll and Bute council is currently working in line with Scottish Government targets to reduce greenhouse gases by 75% by 2030 and net-zero emissions by 2045. SHEPD has considered the views and targets of the council through various DFES stakeholder engagement activities.

Kilninver Primary substation is currently derogated from P2/7 under the SHEPD standards of voltage and security of supply[1]. However, given Argyll and Bute Council's own ambitious progression towards Net Zero and the increasing demand on the distribution network, SHEPD believe that rectifying the P2/7 non-compliance is the most appropriate action moving into RIIO-ED2. Without intervention on this scheme, it is expected that existing and future demand on Kilninver Primary would remain without appropriate backfeeding arrangements which may prove a barrier for Net Zero targets with the substation remaining non-compliant with P2.

The EJP considers a range of options to address the P2/7 compliance issues, setting out the options that have been considered and rejected prior to the CBA analysis along with clear rationale for including or excluding each option.

The Cost Benefit Analysis results shown below in table 1 demonstrates that the most cost-effective solution, that delivers the best value for consumers in terms of the 45 years Net Present Value (£m), is option 2 which will installs additional assets onto the network.

Options	Net Present Value (NPV) After 45 Years (£k)	Investment (£k)
Option 2 – Additional Transformer & 33kV OHL line & 11kV Cable (Preferred Option)	-2,042	3,439
Option 3 – Additional Transformer & 33kV OHL line & 11kV Subsea	-3,551	5,280

Table 1: Option Summary

Our CBA quantifies the benefits associated with each option to support our assessment. For this investment scheme the societal benefits are predominantly attributed to avoided losses and the associated reduction in CO2. For our preferred option 2, the monetary associated benefit is £2.15m over the 45-year period.

Our load related investments contribute very minor CI and CML benefits, as result of their low counterfactual health indices and our licence obligations around overloading of the network. A more detailed explanation can be found in our ***Cost Benefit Analysis Process (Annex 15.8)***.

[1] SHEPD "Distribution Planning: Standards of Voltage and Security of Supply" (P0-PS-037)

Following the optioneering and detailed analysis, as set out in this paper, the proposed scope of works for Option 2 is:

Asset	Volume	Costs
33kV OHL (Pole Line) Conductor (km)	9.95	[redacted]
33kV Pole (No.)	142	[redacted]
33kV UG Cable (Non-Pressurised) (km)	0.15	[redacted]
33kV Transformer (GM)	1	[redacted]
33kV CB (Gas Insulated Busbars)(ID)(GM)	1	[redacted]
33kV CB (Air Insulated Busbars)(OD) (GM)	1	[redacted]
33kV Switch (PM)	2	[redacted]
6.6/11kV OHL (Conventional Conductor) (km)	1.52	[redacted]
6.6/11kV Poles (No.)	22	[redacted]
6.6/11kV UG Cable (km)	11.25	[redacted]
6.6/11kV CB (GM) Primary	3	[redacted]
6.6/11kV Switch (PM)	5	[redacted]
6.6/11kV Transformer (GM)	**1**	[redacted]
Total		**£3,439k**

Table 2: Investment Summary

This scheme delivers the following outputs and benefits:

- Provides security of supply levels at Kilninver primary substation which comply with P2/7.
- Facilitate the continued uptake of low carbon technology (LCT) with the Kilninver area and help support the climate change targets of Argyll and Bute Council.
- Facilitates the efficient, economic, and co-ordinated development of our Distribution Network for Net Zero.

The cost to deliver the preferred solution is £3.44m and the works are planned to be completed in 2028. This EJP investment sits within our Net Zero Totex ask.

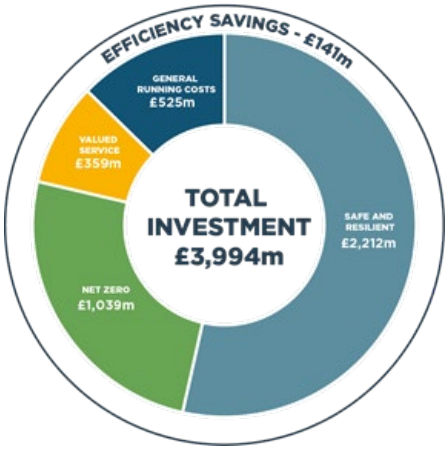

Figure 1: SSEN total investment cost within RIIO ED2

2 Investment Summary Table

The table below provides a high-level summary of this Engineering Justification Paper (EJP) and the Cost and Volume (CV) impacts within SSEN's Business Plan Data Templates.

Name of Scheme	Kilninver Primary Substation P2 Compliance Reinforcements		
Primary Investment Driver	Load – P2 Compliance		
Scheme reference	78/SHEPD/LRE/KILNIVER		
Output reference/type	33kV UG Cable (Non-Pressurised) 33kV OHL (Pole Line) Conductor 33kV Pole 33kV CB (Air Insulated Busbars) (OD) (GM) 33kV CB (Gas Insulated Busbars) (ID)(GM) 33kV Switch (PM) 33kV Transformer (GM) 6.6/11kV Transformer (GM) 6.6/11kV CB (GM) Primary 6.6/11kV Switch (PM) 6.6/11kV OHL (Conventional Conductor) 6.6/11kV Poles 6.6/11kV UG Cable		
Cost	£3.44m		
Delivery year	2027/28		
Reporting Table	CV1: Primary Reinforcement		
Outputs included in RIIO ED1 Business Plan	No		
Spend apportionment	**ED1**	**ED2**	**ED3+**
	0	£3.44m	0

Table 3: Investment Summary

3 Introduction

Our ***Load Related Plan Build and Strategy (Annex 10.1)***[2] sets out our methodology for assessing load-related expenditure and describes how we use the Distribution Future Energy Scenarios (DFES) 2020 as the basis for our proposals. We have established a baseline view of demand, providing a robust projection of the drivers of load-related expenditure for the ED2 period. Our ex-ante baseline funding request is based on the minimum investment required under all credible scenarios and is strongly supported by our stakeholders. Our plan will create smart, flexible, local energy networks that facilitate the accelerated progress towards net zero – with an increased focus on collaboration and whole-systems approaches.

This investment is a component of our strategic goal of 'Accelerating progress towards a net zero world'.

Section 4 of this Engineering Justification Paper (EJP) describes our proposed load related investment plan for the reinforcement of Kilninver Primary Substation in RIIO-ED2. The primary driver considered within this paper is load related P2/7 compliance issues under existing demand which are worsened by forecast demand growth from our stakeholder supported Distribution Future Energy Scenario (DFES).

This EJP provides high-level background information for this proposed scheme explaining the existing network arranges, the load growth forecasts through the Distribution Future Energy Scenarios (DFES) and setting out the need for this project. The Detailed Analysis section of the EJP describes the network studies undertaken, detailing the results which further justify the need of the proposed investment.

Section 5 provides an exhaustive list of the options considered through the optioneering process to establish the most economic and efficient solution. Each option is described in detail, with the EJP setting out the justification for those options which are deemed unviable solutions, and therefore not taken forward to the Cost Benefit Analysis.

Section 6, Cost Benefit Analysis (CBA) Summary, provides the comparative results of all the options considered within the CBA and sets out the rationale and justification for the preferred solution. This section also describes how we have established the cost efficiency of the plan with reference to the unit costs that have been chosen.

Finally, **Section 7** of this EJP also sets out the deliverability of the plan for RIIO-ED2 and this proposed investment.

4 Background Information and Analysis

4.1 Existing Network Arrangement

There are three 33kV circuits between Taynuilt Grid (303) and Tullich Switching Station (325), they are supplied from circuit breakers 2L5, 3L5 and 6L5. Kilninver Primary (322) and Kilmelford Primary (304) are supplied via a single 33 kV circuit (3L5) from Tullich Switching Station (325). Scammadale Primary (340) and other pole-mounted transformers (PMTs) are also supplied from it. Kilninver Primary has a single 33/11 kV transformer rated at 2.5 MVA and supply 852 customers.

Kilninver primary supplies one 11kV feeder (001). There is no 11kV back-feed. The existing network arrangement is shown in Figure 2.

[2] ***SECTION D: (Chapter 10), Responding to the net zero Opportunity, (Annex 10.1), Load Related Plan Build and Strategy***

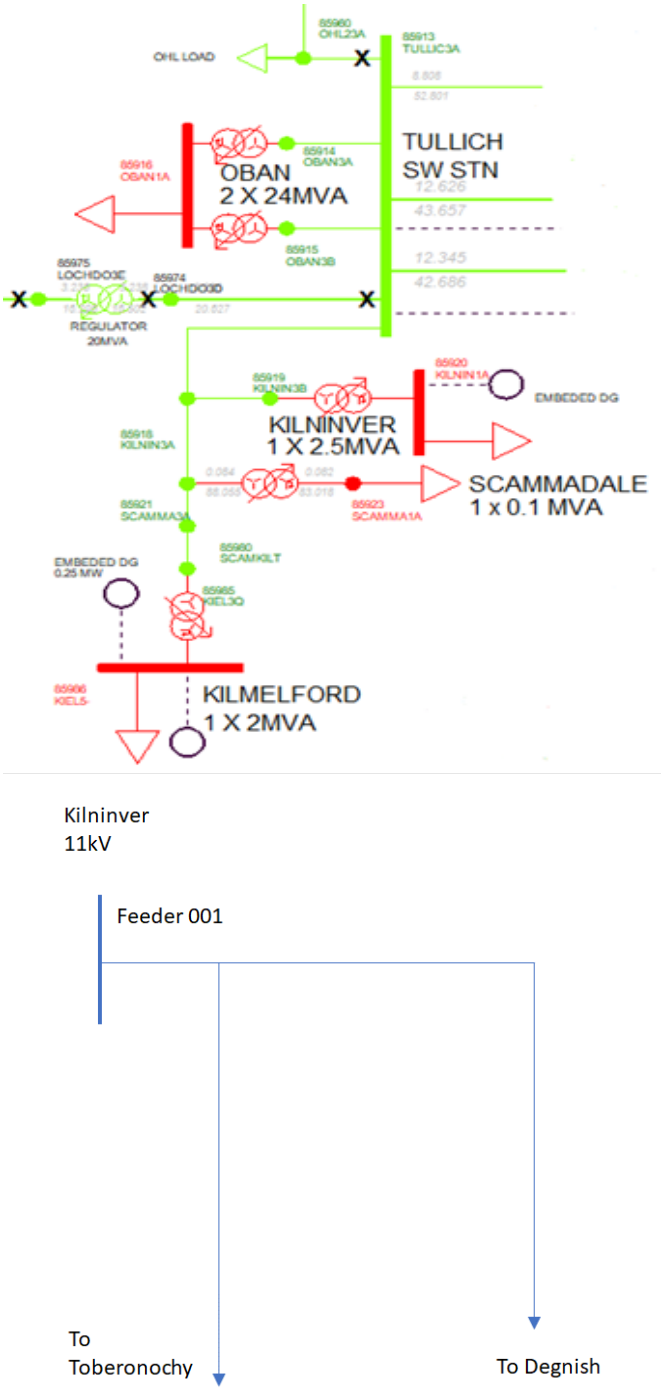

Figure 2: Kilninver Network Arrangement SLD.

4.2 Local Area Energy Plan (LAEP)

Argyll and Bute's council has adopted a Decarbonisation Plan that explains how council services will focus on being environmentally responsible in their day to day work. While no single organisation can tackle climate change in isolation, the Decarbonisation Plan sets out the council's intention to lead the way in Argyll and Bute. The plan sets out its achievements to date and its intentions for the future.

The council is currently working in line with Scottish Government targets to reduce greenhouse gases by 75% by 2030 and net-zero emissions by 2045[3].

Over the past four years alone, the council, and key partners, have reduced CO2 equivalent output by over 4,000 tonnes per annum.

Contributing to this achievement has been:

- Adopting renewable energy for council buildings, including biomass boilers and solar panels.
- Constructing the Miss Hoolie wind turbine to power the Glengorm waste disposal site, on Mull.
- Switching to LED streetlights, saving energy and carbon emissions.
- Reducing the amount of waste going to landfill by 13% since 2009.
- Replacing 10% of the council fleet with electric or hybrid vehicles so that 46 diesel vehicles will be removed.
- Ensuring that, since 2016, 1,123 households have benefitted from measures that make homes warmer, reduce energy bills and decrease carbon emissions.

This plan will see fast growth of demand in the region and the network development shall need to meet the requirements of future demands. In contrast, the focus on new LCTs also presents significant opportunities for the provision of locally sourced flexibility services.

Argyll and Bute Council's targets around low carbon system are expected to have a significant impact on demand growth within the area. This impact visible within the SHEPD DFES projections and directly contributes to the need for investment discussed within this paper.

4.3 Demand and Generation Forecast

SHEPD have carried out extensive scenario studies through the Distribution Future Energy Scenarios (DFES) which is based on the National Grid's Future Energy Scenarios (FES) 2020 and local stakeholder input. The DFES comprises of four potential pathways for the future of energy, based on how much energy may be needed and where it might come from. The variables for the four scenarios are driven by government policy, economics and consumer attitudes related to the speed of decarbonisation and the level of decentralisation of the energy industry. SHEPD have worked closely with their partner Regen to develop the forecasts between 2020 and 2050 through enhanced engagement with the local authorities, local enterprise partnerships (LEPs), devolved governments, community energy groups and other stakeholders.

Based on the enhanced stakeholder engagement feedback, SHEPD have chosen Consumer Transformation as the baseline scenario for investment. SHEPD are protecting customers from the impact of forecasting uncertainties through baseline funding only including load related investment required in the first two years in the RIIO-ED2 period unless it is also required by other net zero scenarios. Full details on our DFES methodology, stakeholder input and regulatory treatments of load related investment can be found in the ***Load Related Plan Build and Strategy (Annex 10.1)***.

[3] https://www.argyll-bute.gov.uk/news/2020/nov/argyll-and-bute-council-reaffirms-its-commitment-tackling-climate-change

Table 4 and Table 5 below shows the demand projections in MW of three primary substations under the Consumer Transformation (CT) and Steady Progression (ST) scenarios.

Substation	Baseline	ED1			ED2					Future		
	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29	29/30	30/31
KILMELFORD PS	1.9	1.91	1.92	1.92	1.92	1.93	1.94	1.95	1.95	1.96	1.97	1.99
KILNINVER	1.9	1.93	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94
SCAMMADALE	0.079	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.09	0.09

Table 4: Demand projection for winter peak ST scenario (MW)

Substation	Baseline	ED1			ED2					Future		
	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29	29/30	30/31
KILMELFORD PS	1.9	1.91	1.92	1.92	1.93	1.96	2.00	2.05	2.09	2.15	2.21	2.27
KILNINVER	1.9	1.93	1.94	1.94	1.94	1.94	1.94	1.95	1.99	2.08	2.18	2.28
SCAMMADALE	0.079	0.08	0.08	0.08	0.08	0.08	0.09	0.09	0.09	0.10	0.10	0.11

Table 5: Demand projection for winter peak CT scenario (MW)

Peak demand at Kilninver primary substation is expected to increase by approximately 0.1MW (CT) from 2019/20 to 2027/28. Currently there is 0.8 MW of connected to Kilninver with a further 1.0 MW of new generation planned for to connect within ED2.

4.4 Thermal Flow and Voltage Analysis

Kilninver, Kilmelford and Scammadale primary substations are supplied by one 33kV circuit from Tullich switching substation. Last three years' data showed there were significant faults occurred on this circuit that led to an average 185 customer interruptions (CI) and 20,350 customer minutes lost (CMI) for each fault. With the further demand growth in ED2, it is expected that the CI/CML per fault would continue to rise under the existing feeding arrangement.

Kilninver primary substation is currently derrogated from P2/7 under our standards of voltage and security of supply[4]. For a fault on the 11kV feeder, Kilninver 33/11 kV transformer or the 33kV feeder; all customers will be off supply while repairs are carried out, or until mobile generation can be connected, as there are no 11 kV back-feeds. This strongly supports the need for reinforcement at Kilninver primary substation to resolve the security of supply issues. With the proposed option in ED2, the issues described above would be mitigated and Kilninver primary substation would be P2 compliant.

The 33kV voltage at Kilninver Primary is above the ESQCR limits of ±6% (0.94 per unit) with the Kilmelford generator running in winter.

4.5 Fault Level Assessment

Fault levels remain within the existing switchgear ratings.

4.6 Network Analysis Summary

The analysis above strengthens the argument for intervention at Kilninver substation within RIIO-ED2 on top of the overall driver to become compliant with P2. The DFES forecasted increase in demand, and in turn the increased reliance on the network will impact a larger number of customers and become more severe considering the LCT uptake.

[4] SHEPD "Distribution Planning: Standards of Voltage and Security of Supply" (P0-PS-037)

5 Summary of Options Considered

This section of the report sets out the investment options that were considered to resolve the P2 compliance issue at Kilninver Substation. As described below, a holistic approach is taken to ensure investment options that represent best value for money for network customers are identified.

5.1 Whole System Considerations

We have additionally considered the potential for using Whole System solutions (involving collaboration with third parties) to deliver this investment programme. We set out our assessment in Appendix 3. This follows our standardised approach for embedding Whole System considerations into our load and non-load investment decisions (in line with Ofgem's ED2 business plan guidance), as described in our ***Whole System (Annex 12.1)***.

Our assessment enables us to take a proportionate consideration of Whole System options, based on the feasibility of such options existing and materiality of the costs involved.

In this case, our Whole Systems assessment finds that this programme is not expected to have any wider Whole System interactions and there are no feasible Whole Systems solutions.

5.2 Summary of Options

The table below provides a high-level summary of the four investment options under consideration along with the advantages and disadvantages associated with each option. A more detailed description of each option is then provided within the proceeding sub-sections.

Option	Description	Advantages	Disadvantages	Results
1. Load Transfer	Monitor demand development	Low cost and workload.	Does not increase network capacity. Reinforcement may still be required. Not P2 compliant.	Considered but not progressed to CBA
2. Additional Transformer & 33kV OHL line & 11kV Cable	To make P2 compliant, new equipment will be added into existing network. This involves: • A new asset of 2.5MVA 33kV transformer at Kilninver Primary Substation. • 10.1km 33kV circuits between Tullich Switching Substation to Kilninver Primary. • New 11.25km 11kV cable and 1.52km 11kV OHL re-conducted.	Increase network resilience. P2 Compliant. Shorter outage time. Long term benefit.	Additional land purchase could be required at Kilninver. .	Taken forward to CBA (The Preferred Option)

	• 11kV voltage regulator.			
3. Additional Transformer & 33kV OHL line & 11kV Subsea	To make P2 compliant, new equipment will be added into existing network. This involves: • A new asset of 2.5MVA 33kV transformer at Kilninver Primary Substation. • 10.1km 33kV circuits between Tullich Switching Substation to Kilninver Primary. • New 6.6km 11kV cable and 2km subsea cable, Re-conduct 9.2km 11kV OHL. • 11kV voltage regulator.	Improve the interconnection of 11kV feeders. Increase network resilience. P2 Compliant. Shorter outage time. Long term benefit.	Additional land purchase could be required at Kilninver. 11 kV Subsea cable route could be difficult and trigger high costs.	Taken forward to CBA
4. Flexibility Solution	Flexible service contracts to reduce peak demand and defer capital investment	Utilising existing network capacity	Uncertainty of securing participants. Reinforcement may still be required.	Considered, CBA proved unsuccessful.

Table 6: Summary of Primary Switchgear Investment Options

5.3 Option Analysis

5.3.1 Option 1: Load Transfer

Kilninver Primary is not interconnected at 11kV to nearby primary substations. For a fault on the 11kV feeder, Kilninver 33/11 kV transformer or the 33kV feeder; all customers will be off supply for repair time. This option carries a significant amount of risk and may result in increased CIs, CMLs and non-compliance with ER P2. This option keeps Kilninver primary substation to be LI 5 and IT is not aligning with our asset management strategy. For this reason, the do-nothing option has been deemed not viable due to the risk associated with this option.

5.3.2 Option 2: Additional Transformer & 33kV OHL line & 11kV Cable– The Preferred Option

This option looks to install an additional 2.5MVA 33/11kV transformer at the Kilninver substation. This would increase the firm capacity of the Kilninver primary substation and hence would enable power to be restored for a transformer outage condition.

In order to improve redundancy for a circuit outage on the 33kV Tullich - Kilninver circuit, the new transformer would need to be supplied via a new 33kV UG (0.15km) and OHL (9.95km) from Tullich Switching Station to Kilninver Primary (300mm^2 Al XLPE and 38mm^2 Cu). A minimum winter rating of 201A is required. The proposed network arrangement is shown in Figure 3.

To make Kilninver P2 compliant, new 11kV OHL route feeder (11.25km) is connected from Kilninver Primary to the Balvicar pole-mounted circuit breaker (PMCB) at pole 114. A minimum winter rating of 399 A is required.

Existing OHL of 1.52km from Tigh An Truish (pole 61) to Clachan Seil Housing tee (pole 78) and from before Oban Seil Farm (pole 83) to Jones Ardencaple (pole 85) is proposed to be re-conducted from 16mm^2 Cu to 70mm^2 Cu. The proposed network arrangement is shown in Figure 4. A minimum winter rating of 304A is required.

To mitigate the voltage issues on 11 kV feeder 001, it is proposed to install a bi-directional 2x100A voltage regulator after pole 85. This option will improve Kilninver substation to be LI 1.

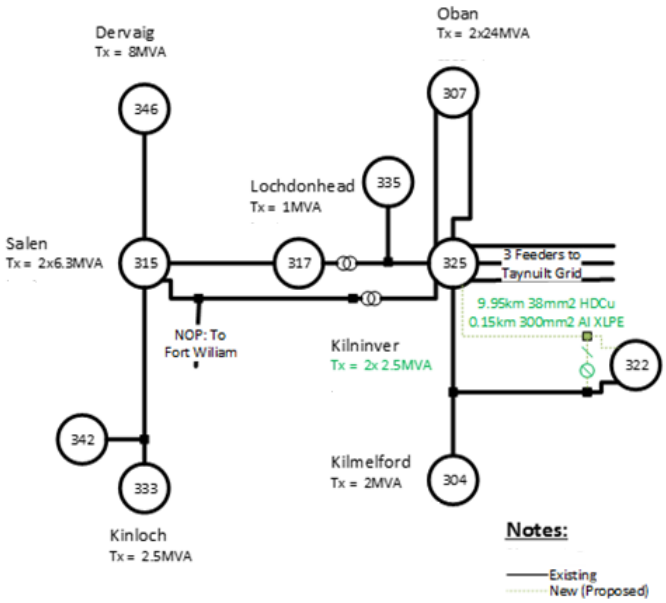

Figure 3: The new circuit fed to Kilninver.

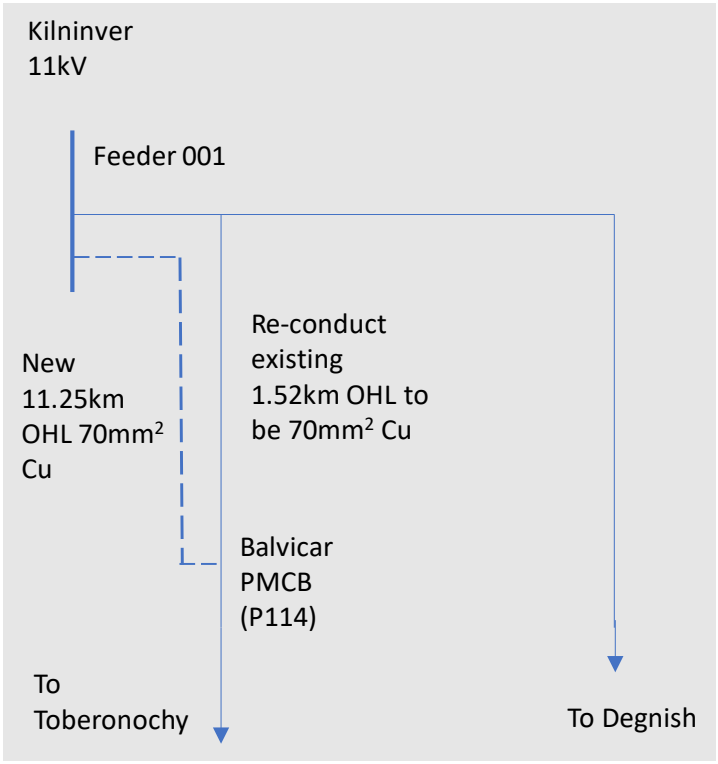

Figure 4: The 11kV Network Fed from Kilninver.

5.3.3 Option 3: Additional Transformer & 33kV OHL line & 11kV Subsea

This option looks to install an additional 2.5MVA 33/11kV transformer at the Kilninver substation. This would increase the firm capacity of the Kilninver primary substation and hence would enable power to be restored for a transformer outage condition.

In order to improve redundancy for a circuit outage on the 33kV Tullich - Kilninver circuit, the new transformer would need to be supplied via a new 33kV UG (0.15km) and OHL (9.9 km) from Tullich Switching Station to Kilninver Primary (300mm^2 Al XLPE and 38mm^2 Cu).

To make Kilninver P2 compliant, new 11kV cable (300mm^2 Al XLPE) road route feeder (5.1km) is connected from Kilninver Primary to beyond the Auchnasaull tee at pole 52. New 1km of 11kV cable is connected from

Degnish Fish Farm to the Degnish coast. New 0.5 km of 11 kV cable is connected from Ardinamar coast to Ardinamir. New 2km of 11kV submarine cable is connected from the Degnish coast to Ardinamar coast (95mm^2 Cu subsea cable).

Existing OHL of 8.1km from pole 52 to Degnish Fish Farm is proposed to be re-conducted to 70mm^2 Cu (from split to three phase). Existing OHL of 1.1km from pole 179 to Ardinamir is proposed to be re-conducted to 70mm^2 Cu (from split to three phase). The proposed network arrangement is shown in Figure 5.

To mitigate the voltage issues on 11kV feeder 001, it is proposed to install a bi-directional 2x100A voltage regulator between pole 105 to pole 109.

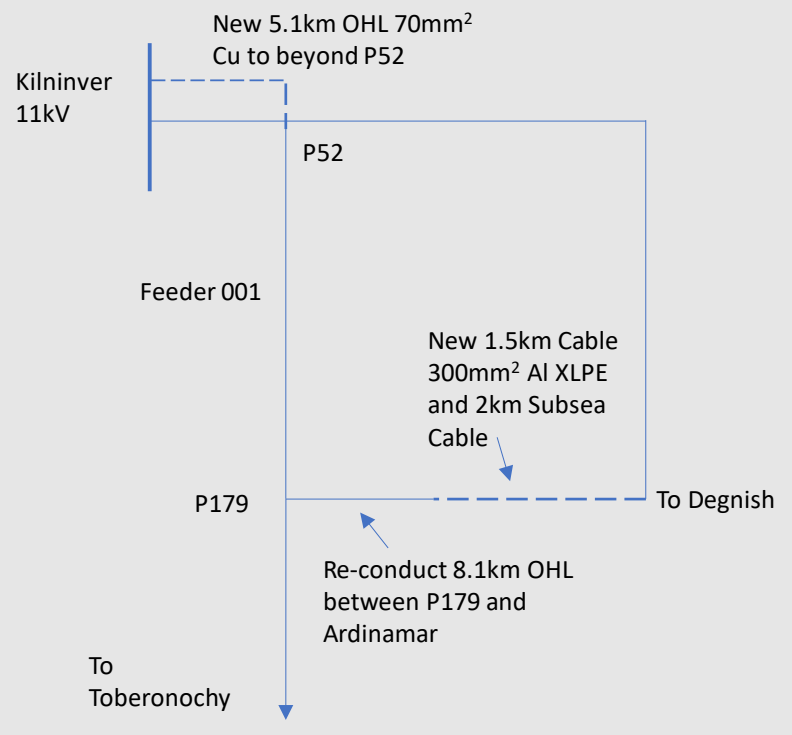

Figure 5: The 11kV Network Fed from Kilninver.

5.3.4 Option 4: Flexible Solution

This option considers utilising customer generation capacity to actively manage the peak power flow on existing assets. This will allow SHEPD to utilise the existing network effectively and may defer or remove the need for reinforcement action

Figure 6 below shows that the peak demand at Kilninver Primary in 2027/28. As there is no 11kV backfeed capability, the substation will lose the supply over the winter months with a requirement between 0-2MVA.

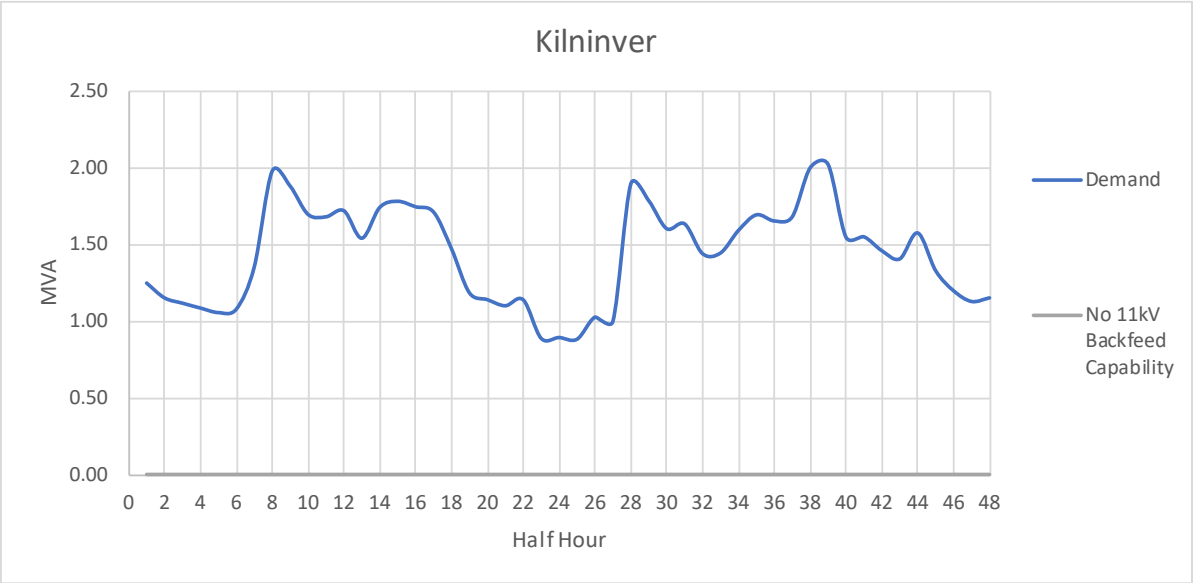

Figure 6: Kilninver peak demand 2027/28 without flexibility services.

The Baringa CBA model [5] has been also used to assess if there is any benefit on deferring the reinforcement. The methodology behind the CBA is described in more detail in the ***Load related Plan Build and Strategy (Annex 10.1).***

The CEM framework evaluates options around timing of network investments, in particular taking into account:

- the range of different options available (e.g., reinforcing the network, using flexibility, or doing nothing);
- the time periods in which actions can be taken; and
- the existence of uncertainty, and the impact of incremental information which becomes available over time.

The MW exceedance, the daily and annual overload hours (Table 7) and the flexibility unit costs of £150 per MW per hour and £150 per MWh were used as input parameters in the CEM CBA model (full details of the flexibility methodology can be found in the ***Load related Plan Build and Strategy (Annex 10.1).***.

	2020	2021	2022	2023	2024	2025	2026	2027	2028
Hrs/day required	0	0	0	0	0	0	24	24	24
Days/yr required	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0
Utilisation (MWh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	770.0

Table 7: Estimated dispatch requirements for flexibility solution

Flexibility services could be used to reduce the peak demand forecast and it is estimated that no reinforcements could be deferred (shown in Figure 7).

[5] https://www.energynetworks.org/assets/images/Resource%20library/ON20-WS1A-P1%20Common%20Evaluation%20Methodology-PUBLISHED.23.12.20.pdf

Overall NPV of deferral	Optimal length of baseline deferral (years)	NPV of optimal deferral
Flexibility under CT	Baseline	£0
Flexibility under ST	Baseline	£0
Flexibility under SP	Baseline	£0
Flexibility under LW	Baseline	£0

Figure 7: Net benefit of deferring reinforcement.

Despite our commitment to the Flexibility First approach, in the scenario for Kilniver, the current assessment has concluded that Flexibility will not mitigate the P2 compliance issue. In addition to delivering this investment in 2027/28 , using the CEM Framework, circuit loading detail and updated DFES scenarios to we will review potential applications of Flexibility. It is critical to note that the P2 compliance will remain the key objective for this scheme, as such current Flexible Services cannot currently be considered as an enduring solution, , but flexibility may provide OPEX benefits to SSEN and our customers during scheme delivery by;

a) Avoiding/reducing the risk of outages during planned works through load/generation management
b) Avoiding/reducing the need for Mobile Diesel Generation in planned or unplanned outage scenarios
c) Reducing the scale of the works through the implementation of a 'Hybrid' scheme, part reinforcement and part Flexibility.

These opportunities will be reviewed, and Flexibility secured should the CEM Framework CBA prove a positive benefit, with justification of the decisions/reviews presented as required.

Further detail of our Flexibility First approach and assessment methodology can be found in ***DSO Strategy (Annex 11.1) Appendix F - Delivering Value through Flexibility.***

6 Summary of Cost Benefit Analysis (CBA)

This section provides an overview of the results from the Cost Benefit Analysis (CBA). This detailed exercise has been undertaken to support the investment strategies discussed within this EJP.

6.1 CBA of investment options:

Ofgem's RIIO-ED2 standard CBA template was used to assess costs and benefits of the conventional options for each option individually. Capital reinforcement costs, CI/CML penalties, network losses and other societal benefits are the key parameters used in the options progressed. The customer interruptions / customer minutes lost (CI/CML) were calculated based on the improvement of health conditions of the assets and the probability of a failure.

Further information on our Cost Benefit Analysis (CBA) approach is set out within our ***Cost Benefit Analysis Process (Annex 15.8)***.

6.2 CBA Results

The CBA results below, demonstrate that the most cost-effective solution is option 2 'Additional Transformer & 33kV OHL line & 11kV Cable', as it has the least NPV against the required investment. It is clear that the investment reduces the CI's at Kilninver Substation immediately within RIIO-ED2, while providing efficient and enduring long-term security of supply as we move towards a Net Zero network. Therefore, based on the CBA results option 2 is preferred solution to address the P2/7 compliance issue in 2027/28.

Summary of Cost

Options	Unit	2024	2025	2026	2027	2028	ED3+	Total £k
Option 2 – Additional Transformer & 33kV OHL line & 11kV Cable (Preferred Option)	**£k**	0	0	0	0	3,439	0	3,439
Option 3 – Additional Transformer & 33kV OHL line & 11kV Subsea	**£k**	0	0	0	0	5,280	0	5,280

Cost Benefit Analysis comparisons

Options	Net Present Value (NPV) After 45 Years (£k)	Investment (£k)
Option 2 – Additional Transformer & 33kV OHL line & 11kV Cable (Preferred Option)	-2,042	3,439
Option 3 – Additional Transformer & 33kV OHL line & 11kV Subsea	-3,551	5,280

6.3 Options Summary

Option 1 is the lowest capital costs and may appear to be the attractive option. However, this option does not provide sufficient capability to meet the projected network requirements and is not considered a cost effective long-term solution.

Option 4 does not provide the required level of security of supply through the use of flexibility solution.

The only remaining options which satisfy the P2 compliance requirements are option 2 and 3. These options both provide the required security of supply through additional assets at Kilninver substation. Option 2 benefits from only requiring 11kV cable, rather than needing a 11kV subsea cable required for Option 3 which comes at a higher cost.

Therefore, option 2 is the preferred solution.

6.4 Costing Approach

Our RIIO ED2 Business Plan costs are derived from our outturn RIIO ED1 expenditure. We have modified costs per activity, capturing and reporting those adjustments in our cost-book. By tying our costs back to reported outturn, real life data has been used which provides multiple data points both SSEN and the Regulator can use to benchmark costs efficiently.

It provides a high level of cost confidence in our Business Plan cost forecast for RIIO ED2. Through our benchmarking analysis, we recognised that not all Non-Load related RIIO-ED1 actual unit costs sit within the upper quartile efficiency band. Where this is the case, we have applied a catch-up efficiency to those cost categories.

Further detail on our unit cost approach, cost efficiency and cost confidence for RIIO-ED2 can be found within our ***Cost Efficiency (Annex 15.1)***[6]. Following our draft Business Plan, we have continued to develop project scopes and costs, utilising valuable stakeholder feedback. We have included developments of our Commercial Strategy within the updated project scope and delivery strategy.

[6] ***Cost Efficiency (Annex 15.1)***

7 Deliverability and Risk

Between our draft and final Business Plans we have carried out a more detailed deliverability assessment of our overall plan as a package and its component investments. Using our draft Business Plan investment and phasing as a baseline we have followed our deliverability assessment methodology. We have assessed any potential delivery constraints to our plan based on:

- In-house workforce capacity and skills constraints based on the our planned recruitment and training profile and planned sourcing mix as well as the efficiencies we have built into our Business Plan ***(detailed in our Workforce Resilience Strategy in (Annex 16.3)*** and ***Cost Efficiency (Annex 15.1)***
- Assessment of the specific lead and delivery timelines for the asset classes in our planned schemes
- We have evaluated our sourcing mix where there were known delivery constraints to assess opportunities to alleviate any constraints through outsourcing
- We have engaged our supply chain detailed in our ***Supply Chain Strategy (Annex 16.2)*** to explore how the supply chain could support us to efficiently deliver greater volumes of work and how we could implement a range of alternative contracting strategies to deliver this
- We have also engaged with the supply chain on the delivery of work volumes that sit within Uncertainty Mechanisms to ensure we have plans in place to deliver this work if and when the need arises
- We have carried out flexibility assessments at all voltage levels in order to understand when we can defer reinforcement through paying for flexibility services, therefore ensuring our investment profile is deliverable and at the lowest cost to consumers see ***Flexibility within Load Related Plan Build and Strategy (Annex 10.1***)
- We have assessed the synergies between our planned load, non-load and environmental investments to most efficiently plan the scheduling of work and minimise disruption to consumers

This investment scheme is part of the wider load-related investment portfolio in RIIO-ED2. SSEN have developed a strategy to deliver a much larger volume of work in comparison with the level of investment in ED1. We have engaged with our supply chain to negotiate the most effective unit costs and we have taken measures to ensure we secure a future workforce with the right skills and competencies to deliver capital projects in ED2.

In ED1, SHEPD have delivered a number of 33kV and 11kV OHL projects using internal workforce. The experience and skills acquired from these projects lay the foundation for the delivery of the proposed option within this paper.

To mitigate the risks of this project, the following de-risking approaches will be adopted:

- Procurement time for the OHL: Use of framework contracts for delivery of works and material procurement
- Sufficient OHL survey work needs to be carried out in short timescales to enable the design to be carried out in a timely manner.

This scheme was originally included in our baseline for delivery during the RIIO-ED1 period, however, delivery constraints alongside the existing derogation means it is not economic or efficient to progress with this project within RIIO-ED1. Our decision to defer this scheme means that, where necessary, we are able to use this allowance to efficiently deliver other projects which may have arisen within RIIO-ED1. This allows us to continually meet the requirements of our network and the needs of our customers throughout the price control.

8 Conclusion

This EJP has raised the need for load related investment at Kilninver Primary substation within the ED2 price control period. This need for investment is driven by the existing non-compliance with P2/7 and is further justified by the forecasted demand increase. To avoid security of supply issues for customers on Kilninver Primary, reinforcement is proposed to remove this non-compliance.

Four investment options have been considered and the preferred solution involves a combination of adding in new asset of 2.5MVA transformer at Kilninver primary substation and installing 10.1km of 33kV circuit, 11.25km of 11kV cable and re-conducting 1.52km 11kV OHL. All options are supported by a Cost Benefit Analysis (CBA) which provides further breakdown of economic viability over a 45-year period. The preferred option will improve Kilninver primary substation to an LI 1.

The proposed ED2 investment with the combined scheme total of £3.44m. It is proposed that all reinforcement is carried out in the 2027/28 financial year to minimise the risk of thermal overload and network non-compliance.

Appendix 1: Geographic Views

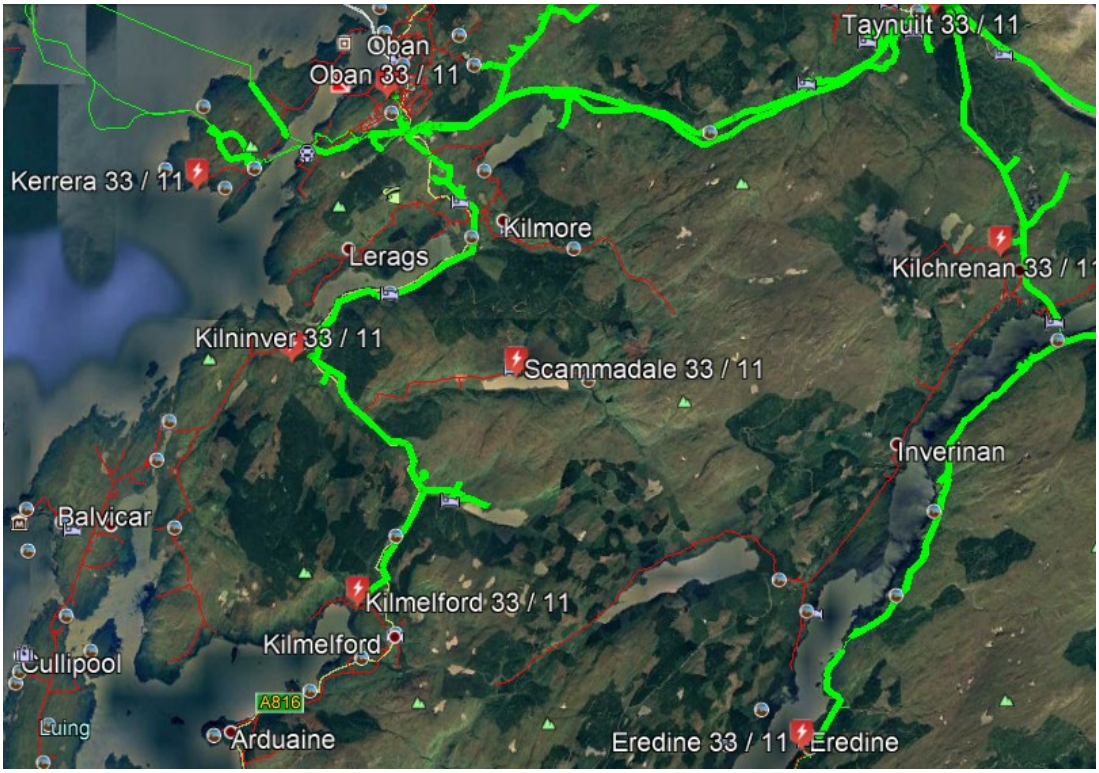

Figure 8: Kilninver Primary Substation.

Appendix 2: Relevant Policy, Standards, and Operational Restrictions

The policies, manuals and standards and operational restrictions relevant to the content of this paper.

Policy Number	Policy Name / Description
TG-NET-OHL-010	Load Ratings of Overhead Lines – Data Sheet
TG-NET-OHL-012	Short Circuit Ratings of Overhead Lines – Data Sheet
TG-NET-OHL-104	Electrical Constants for Overhead Lines- Data Sheet
TG-NET-CAB-009	Load Ratings of LV to 33kV Underground Cables – Design Data
TG-NET-CAB-010	Electrical Constants for LV to 33 kV Underground Cables- Data Sheet
TG-NET-CAB-011	Short Circuit Ratings of 6.6kV to 33kV Underground Cables - Design Data

Table 8: Relevant documents

Appendix 3: Whole Systems consideration

In augmenting our decision-making processes to consider Whole System solutions, we have introduced an assessment to identify where a Whole Systems CBA would be a useful decision-making tool for ED2 load and non-load schemes. While our work with the ENA to undertake Whole Systems CBAs is ongoing, we have introduced the 'Whole Systems CBA test' to identify where a scheme may be suitable for a Whole Systems CBA to be conducted. Where a Whole Systems CBA is determined to be a useful decision-making tool, these would be conducted in addition to the standard Ofgem CBA and/or SSEN's flexibility CBA. We have introduced this test in line with Ofgem's expectations for "proportionality when submitting a Whole System CBA. For example, smaller or simple projects following the standard CBA template, whereas larger or more complex projects requiring bespoke analytical approaches" (Ofgem BPG, section 4.28, p.34).

The 'Whole Systems CBA test' involves assessing each investment scheme of over £2m (the threshold to develop an EJP for load and non-load investments) against 5 tests. These 5 tests help determine whether a Whole Systems CBA is a useful decision-making tool based on the characteristics of the scheme, including whether it will have wider cross sector or societal impacts.

Details on each of the tests are provided in case study 6 in ***Whole Systems (Annex 12.1).*** Tests 1-3 are aligned with the ENA's guidance for Whole System CBA tests. We have added Tests 4 and 5 to clarify whether a Whole Systems CBA is required based on the materiality / proportionality of the investment (Test 4) and whether a flexibility CBA only is sufficient (Test 5). Table 10 below outlines our Whole Systems CBA test for Kilninver Reinforcements.

Scheme	Test 1: Are there Whole Systems interactions, or is there potential for it?	Test 2: Could a Whole Systems CBA drive you to make a different decision?	Test 3: Is a Whole Systems CBA reasonable?	Test 4 - Is the project valued at over £2m?	Test 5 - Is the investment plan related to procuring flexible solutions only?
Kilninver Reinforcements	No – We consider there to be limited potential for Whole Systems interactions with third parties to deliver this investment programme, and accordingly we do not consider there to be potential for Whole Systems solution(s).	No – As noted under Test 1 we do not consider there to be potential for Whole Systems solution(s) in this case.	No – As noted under Test 1 we do not consider there to be potential for Whole Systems solution(s) in this case.	Yes	No

Table 9: Whole Systems CBA test for Kilninver Reinforcements

As the result of tests 1, 2 and 3 above is "No", a Whole Systems CBA is not required for this investment. It is not expected to have any wider Whole System interactions or potential Whole Systems solutions.