Scottish & Southern Electricity Networks

RIIO ED2 Engineering Justification Paper (EJP) Reduction of Losses

Substation Building Improvements

Investment Reference No: 6/SSEPD/ENV/LOSSES

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1 Executive Summary

Our ***Environmental Action Plan (EAP) (Annex 13.1)*** sets out our methodology that we propose to undertake during the RIIO-ED2 period in response to increasingly ambitious environmental drivers and stakeholder expectations. Ofgem have introduced a requirement to prepare an EAP as part of our RIIO-ED2 submission and setting a Science Based Target (SBT) is one of these minimum requirements for the EAP.

This paper sets out our plans to undertake refurbishment works to 44 existing substations ranging from 33kV to 132kV in our SHEPD and SEPD areas. This is in response to increasingly ambitious environmental drivers and stakeholder expectations, which will significantly reduce Carbon (CO_2) emissions in our SHEPD and SEPD network areas. The primary driver for this scheme is Sustainability.

Following optioneering and detailed analysis, as set out in this paper, the proposed scope of works are:

- Carry out refurbishment works to 44 substations in SHEPD and SEPD

The cost to deliver the preferred solution is £[redacted] and the works are planned to be completed over RIIO-ED2.

This scheme delivers the following output and benefit:

- Reducing substation electricity consumption and as a result reducing losses and CO_2 emissions

2 Summary Table

Table 1: Investment Summary

Name of Scheme/Programme	Substation Building Improvements
Primary Investment Driver	The primary investment driver is Sustainability. • Reducing substation electricity consumption and as a result reducing losses and CO_2 emissions
Scheme reference/ mechanism or category	6/SSEPD/ENV/LOSSES
Output references/type	Substation Building Improvements
Delivery Year	RIIO-ED2
Reporting Table	Business Plan Data Tables • C5 – Non-Operational Property • M4 Losses Snapshot • Annual Environmental Action Plan Report
Outputs included in RIIO ED1 Business Plan	No
Cost	£[redacted] SHEPD £[redacted] SEPD

	Licenced Area	ED1 (£m)	ED2 (£m)	ED3+ (£m)
Spend Apportionment	**SEPD**		£[redacted]	
	SHEPD		£[redacted]	
Delivery Year	RIIO-ED2 (2024 – 2028)			

3 Introduction

3.1 Background to investment

This engineering justification paper (EJP) sets out our plans to undertake refurbishment works to existing substations during the RIIO-ED2 period. The planned work will take place over 19 substations ranging from 33kV to 132kV in SHEPD and SEPD. Works to a further 25 sites will also be required to meet our science-based target, these 25 sites are yet to be identified so high-level estimates have been made for the purposes of this paper. The upgrade works include a variety of measures to improve asset health and reduce on site electricity consumption, such as better control of lighting and room heating, reducing internal/external lighting levels, improvement of building fabric thermal performance and onsite generation.

The substations chosen for refurbishment have been selected due to the large volume of traffic using the sites. The assets have a mixture of welfare rooms, manned offices and other facilities.

3.2 Investment drivers

The primary investment driver for undertaking works on the substations is sustainability, more specifically to reduce substation electricity consumption. Reducing substation electricity consumption will reduce network losses and therefore associated CO_2 emissions. This is key in contributing towards our Science-Based Target (SBT) of at least a 35% reduction in our combined Scope 1 & 2 emissions by the end of RIIO-ED2, 55% reduction by 2033 and an ambition of meeting Net Zero by 2045 in a credible and transparent way.

In addition, many of the substations have not had works carried out on them since they were constructed. These works will improve the asset health.

3.3 Reasons for the timing

The timing of this investment aligns to our EAP and SBT set out above. It is important that we act now to start reducing CO_2 emissions. Undertaking improvements to substations will help with this and offers not only carbon reduction, but cost savings that will be passed on as a reduction in customers' bills. These investments deliver environmental and economic benefits and are clear schemes to start with in RIIO-ED2.

3.4 Expected outputs and year of delivery

The outputs will be surveys of the substations and the implementation of the applicable carbon saving measures for each substation. The surveys will be carried out at the start of RIIO-ED2 and delivery of the works phased over the course of this Price Control period.

4 Background Information

4.1 Substation Improvements

In substations, uncontrolled energy is typically consumed for heating and lighting, dehumidification and cooling equipment, oil pumps, air compressors and battery chargers to maintain secure network operation and resilience. The power supplies to substations are usually derived from the grid transformer and associated auxiliary/earthing transformers. Presently, these supplies are unmetered and substation demand is therefore not accounted for separately, while still contributing to network losses.

SSEN Transmission commissioned the [redacted] at [redacted] to carry out a study on a typical substation in order to better understand electricity consumption at substations. This is being used to inform a wider strategy for substation loss reduction. Further information on this is provided in section 3.6 of the document.

4.2 Licence Obligations and Environmental Action Plan Minimum Requirements

As part of RIIO-ED2, Ofgem have introduced a requirement for DNOs to submit an EAP. The EAP must meet minimum requirements for decarbonising the energy system and set a SBT to reduce greenhouse gas emissions. Our SBT has been confirmed by the Science Based Target Initiative (SBTi) and we are aiming for at least a 35% reduction in our Scope 1 & 2 emissions by the end of RIIO-ED2, 55% reduction by 2033 and an ambition of meeting Net Zero by 2045 in a credible and transparent way. It is important that we act now to meet this target.

4.3 Investment Drivers

The primary investment driver for undertaking works on the substations is to reduce substation electricity consumption. Reducing substation electricity consumption will reduce network losses and therefore associated CO_2 emissions. This will help us meet their targets set out above in the EAP as well as their licence obligations.

1. Sustainability – reduction in CO_2 emissions

In total, losses make up 91% of our Distribution's Business Carbon Footprint (BCF) (Scope 1 & 2). Uncontrolled energy losses from substations contributes to technical losses. Where substation buildings have been refurbished, the substation electricity consumption will reduce. This energy saving equates to a reduction in carbon emissions that will contribute to our SBTs in the EAP. For one substation, the example in Tealing, energy savings were ~110,000 kWh/yr and 38t CO_2e. Scaling this to other substations across the network provides significant potential to reduce emissions, see analysis and cost section.

There are also a number of secondary drivers and benefits to the investment set out below:

2. Reduction of losses - reducing customers' bills

In addition to the environmental benefit, a reduction in losses contributes to a reduction in customers' bills. The upgrades at Tealing are estimated to save £[redacted] per year which again provides savings potential when scaled across a number of substations, see analysis and cost section.

3. Improved asset health / building comfort

Improvements to the buildings will improve the asset health and the comfort of staff using these substations.

4. Stakeholder priority

Reducing BCF was the top priority for SHEPD and SEPD when stakeholders were asked to rank environmental priorities.

4.4 Stakeholder Engagement Feedback

We have undertaken the following stakeholder events. In total there were 193 attendees with a range of representation from customers, utility companies, developers, environmental representatives, charities and town councils. During the events the following subjects were put to our stakeholders. A summary is presented below of the feedback. The full report is also available.

Table 2: Stakeholder Engagement Summary

1. **Stakeholder Event**	**2.** **Date**	**3.** **Relevant Topics**	**4.** **Stakeholders Attending**
5. Distribution Annual Workshop North	6. 4th September 2020 7. October 2020	8. Sustainability – helping the UK meet its net zero emissions targets 9. Maintaining a reliable and resilient network for the future	10. 4
11. Distribution Annual Workshop South	12. 3rd September 2020 13. 0th September 2020	14. Sustainability – helping the UK meet its net zero emissions targets **15.** Maintaining a reliable and resilient network for the future	16. 09

Question:

On a scale of 1-5, how ambitious do you think SSEN should be in the following environmental areas?

1 = Remain as we are (in ED1), 3 = Pace with the Paris Agreement, 5 = Accelerating Net Zero

Stakeholder Feedback:

Business carbon footprint score 4.56 (South)
Business carbon footprint score 4.36 (North)

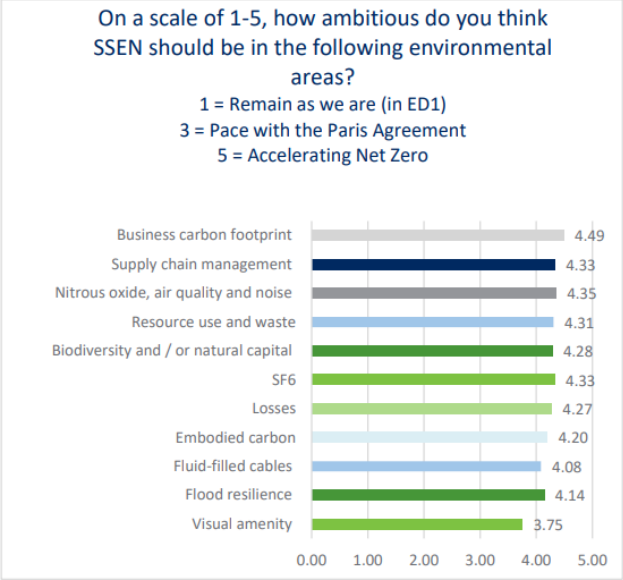

Figure 1: Stakeholder Feedback - Environmental Ambition

Out of all 11 environmental areas, BCF came out top for North and South to be the area where SSEN should be the most ambitious. It was reiterated that SSEN should strive to be as ambitious as possible with its targets, particularly as this would encourage and mandate similar behaviours throughout the supply chain. Many delegates confirmed their confidence in SBTs and reported their own organisations' commitments to follow the science on reaching Net Zero.

Following the stakeholder events, it is clear that SSEN's stakeholders want SSEN to be as ambitious as possible to reach net zero. SSEN have committed to the SBTi to set an SBT to reduce greenhouse gas emissions. The work that will happen as part of this EJP will contribute towards the reduction in our greenhouse gas emissions by reducing substation electricity use.

Subject 2: SSEN's Sustainability Strategy and Net Zero Targets

Stakeholder Feedback: In both Scotland and England, stakeholders wanted SSEN to be as ambitious as possible with its sustainability strategy and Net Zero targets. This was reflected in the electronic voting, where 93% opted for either 'accelerating Net Zero' or 'achieving Net Zero'. In both licence areas, during the 18 discussions option 4 (accelerate Net Zero) was advocated as the stretch, or ideal, target, and option 3 (achieve Net Zero) was seen as potentially the more realistic goal. Delegates felt that strong leadership was lacking from central government in this area and urged SSEN to step up, work together with other DNOs and LEPs, and forge the way. Affordability was raised as an issue, however, with many calling for transparency in terms of how this level of ambition would affect consumer bills.

Substation upgrades reduce energy consumption and therefore reduce CO_2 emissions and losses which results in reduced consumer bills. There are options in this EJP where measures can be implemented at low cost and will meet stakeholder desires to accelerate Net-Zero whilst ensuring consumer bills are not impacted.

4.5 Assets applicable

19 substations including 3 in SHEPD and 16 in SEPD have been selected for building improvements. These substations have been selected as a large volume of traffic use due to manned offices, welfare rooms and additional facilities. In order to meet our SBT we have estimated works for an additional 25 sites will be

required - 10 in SHEPD and 15 in SHEPD. All of our substations have unique qualities therefore, we will review interventions at each substation throughout RIIO-ED2 to ensure we are doing all we can at each site to maximise the benefits available.

The 19 substations already identified for upgrade works are listed below including details of the site and its location. The building footprint has been estimated using our EO system (online mapping tool) so there may be fluctuations when the sites are analysed in more detail.

For the additional 25 sites not yet identified, the average substation footprint for SHEPD and SEPD has been used.

Table 3: Substations identified for upgrade works

Substation Name	Location	Size	Building footprint (m2)*
Wootton Road	SEPD-Ridgeway	33kV	330
Andover Local Grid	SEPD-Ridgeway	33kV	393
Dorcan South	SEPD-Ridgeway	33kV	233
Norrington	SEPD-Ridgeway	33kV	345
Lovelace Road	SEPD-Ridgeway	33kV	213
Headington	SEPD-Ridgeway	33kV	326
Northolt	SEPD-Thames Valley	33kV	441
Taplow	SEPD-Thames Valley	33kV	302
Burghfield Grid	SEPD-Thames Valley	132kV	434
High Wycombe Grid	SEPD-Thames Valley	132kV	139
Thatcham Grid	SEPD-Thames Valley	132kV	282
Green Park	SEPD-Thames Valley	33kV	173
Nuffield	SEPD-Thames Valley	33kV	41
Southcote	SEPD-Thames Valley	33kV	97
Hunston	SEPD-South East	132kV & 33kV	349
Haslingbourne	SEPD-South East	33kV	393
Dunblane	SHEPD-North	33kV	126
Milnathort	SHEPD-North	33kV	133
Forres	SHEPD-North	33kV	139

4.6 Evidence supporting investment / Asset condition

4.6.1 Tealing Substation Study

SSEN Transmission commissioned the [redacted] at [redacted] to carry out a study on a typical substation in order to better understand electricity consumption at substations. This is being used to inform a wider strategy for substation loss reduction. The methodology involved the recording of real-time energy and temperature data. This was used to calibrate a dynamic simulation model and extrapolate annualised output. The substation selected was Tealing (Dundee) which has three buildings. The site provides the 275kV and 132kV network. Therefore, the data from the study can be transferred to Distribution level.

An annual energy profile was developed for the site including consumption for different activities such as heating and lighting. A simple Cost Benefit Analysis (CBA) for each intervention measure was developed. These were aggregated to provide a realistic overall energy reduction metric for this substation archetype.

The interventions that were used as part of the Tealing study were:

- **Roof/exposed metal** – Sprayed insulation
- **Roof/loft insulation** – 270mm Mineral fibre or equivalent
- **Wall** – External cladding
- **Windows** – Secondary glazing
- **LED lighting** – upgrade of current T8 lighting
- **Lighting occupancy controls** – sensors to reduce time lights are on

Other measures recommended but not analysed for Tealing were:

- Applying/adjusting controls on heating systems
- Onsite generation e.g. solar photovoltaic (PV)

4.6.2 Intervention measures

Based on the findings from the Tealing study including the payback period and CO_2 saving, the below intervention measures are suggested to be rolled out across other substations. In the optioneering section different combinations of these measures are considered. The intervention measures would be required to be completed at all sites applicable to see the benefit through a reduction in substation electricity use.

- **Roof/exposed metal** – Sprayed insulation
- **Double Glazing** – replace windows with more energy efficient units
- **Heating occupancy timers** – turns panel heater on and off
- **Lighting occupancy controls** – sensors to reduce time lights are on

We have been working with [redacted] to develop building archetypes that will allow more detailed estimates of measures applicable at each site, potential energy savings and the investment required.

The table below shows the measures that have been examined by [redacted]. The estimation of carbon savings was based on an assumption that each kWh of grid electricity produces 0.181 $kgCO_2$ - 2020 figure (ReNEWS, 2020). Cost savings were estimated based on a notional unit cost of [redacted]/kWh provided by SSEN. Both cost and carbon figures are proportional, so a measure with a high carbon saving will also have a high cost saving.

Strathclyde have examined additional measures to the ones currently proposed in this paper as we will continue to determine the most effective measures for our substations.

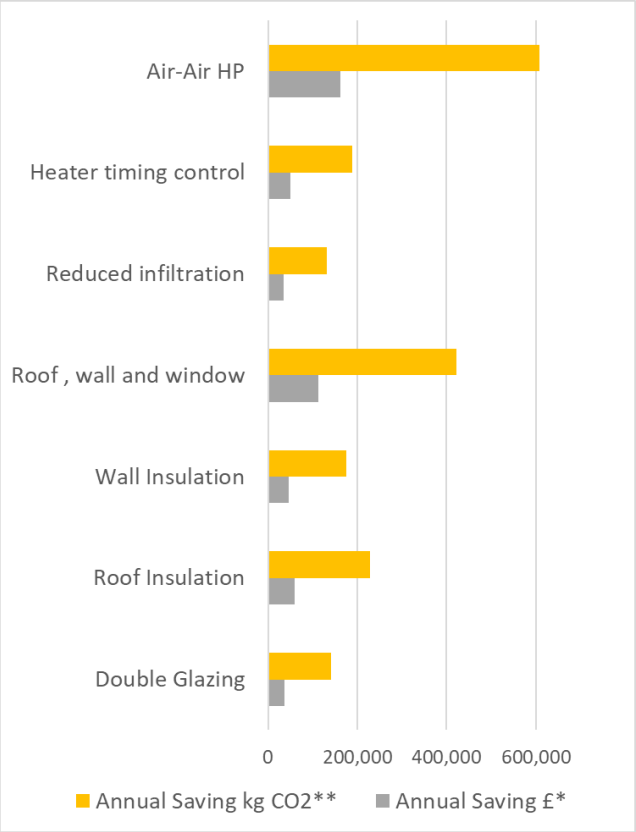

Figure 2: Carbon Savings in T and £

The following measures have been identified for each substation based on the Tealing study and continued work with [redacted].

Table 4: Measures Identified

Substation Name	Spray roof insulation	Double glazing	Heating occupancy timers	Lighting occupancy controls
Wootton Road	Y	Y	Y	Y
Andover Local Grid	Y	Y	Y	Y
Dorcan South	Y	Y	Y	Y
Norrington	Y	Y	Y	Y
Lovelace Road	Y	Y	Y	Y
Headington	Y	Y	Y	Y
Northolt	Y	Y	Y	Y
Taplow	Y	Y	Y	Y
Burghfield Grid	Y	Y	Y	Y
High Wycombe Grid	Y	Y	Y	Y
Thatcham Grid	Y	Y	Y	Y
Green Park	Y	Y	Y	Y
Nuffield	Y	Y	Y	Y
Southcote	Y	Y	Y	Y
Hunston	Y	Y	Y	Y
Haslingbourne	Y	Y	Y	Y
Dunblane	Y	Y	Y	Y
Milnathort	Y	Y	Y	Y

Forres	Y	Y	Y	Y

The findings above have been scaled to the further 25 substations yet to be identified.

5 Optioneering – Investment Under Consideration

The table below summarised the options considered for upgrading the substations.

Table 5: Optioneering

Option	Description	Status
1	Do Nothing	Base case
2	Do Minimum – upgrade substations with key measures	Progressed
3	Upgrade substations with key and additional measures	Preferred
4	Upgrade substations as per do minimum with investigation of additional measures	Not progressed - further investigation required

5.1 Do Nothing

This option would mean no upgrade works to the substations and the current electricity consumption in the substations would remain as is. This option should not be progressed as it does not offer a reduction in greenhouse gas emissions and therefore does not contribute to our SBT.

Base case - not recommended.

5.2 Option 1 - Do Minimum - upgrade substations with key measures

This option would result in upgrading all 19 substations but only with measures that have a payback less than 10 years. This option would therefore not only deliver CO_2 savings, but also a return on investment. The upgrades would include the below measures for each building where they are relevant:

- Spray roof insulation – roof/exposed metal sprayed with insulation
- Install lighting occupancy sensors

For the 25 sites yet to be identified the findings have been scaled.

Option 2 Progressed.

5.3 Option 2 - Upgrade substations with key and additional measures

This option would upgrade all 19 substations with not only the measures in option 1, but also double glazing and heating occupancy timers. This option will deliver CO_2 savings, and a higher return on investment. The upgrades would include the below measures for each building where they are relevant:

- Spray roof insulation – roof/exposed metal sprayed with insulation
- Install lighting occupancy sensors
- Heating occupancy
- Double glazing

For the 25 sites yet to be identified the findings have been scaled.

Option 3 Progressed – recommended option.

5.4 Option 3: Upgrade as per do minimum with investigation of additional measures

This option is as per option 2, but with additional measures such as installation of PV panels, installing EV charging points, ground source heat pumps for building heating and small-scale wind turbines. These measures require further investigation. This would require site specific surveys to be undertaken to assess suitability of physical space, LVAC Board replacement/upgrade and climate conditions at site. As a result, this option is not being progressed at present and will be researched further before funding is requested.

Option 4 Not progressed – further investigation required.

6 Analysis & Cost

6.1 Approach

A CBA has been undertaken to support the investment strategy. Analysis has been undertaken on the costs and benefits of the proposed upgrade measures for the substations over the lifetime of the investment.

A comparison is made to the base case which is Do Nothing (no improvements to the substations). The Ofgem tool has been used to build this CBA and includes for the following cost and benefit elements. The assumptions for these areas are stated in the tool and in the below assumptions section. The complete CBA is also included within the Substation Improvements Investment Decision Pack (IDP) ***- 6/SSEPD/ENV/LOSSES***.

Cost and benefit elements in CBA

- Capex costs
  - Survey and set up costs for each site
  - Investment for implementing each measure – based on average cost per m^2
- Opex costs – estimated electricity consumption of the sites (25 years)
  - Based on average consumption per m^2 for Tealing
  - Converted to cost based on Ofgem electricity losses price (£[redacted] /MWh)
- Opex savings for each measure (25 years)
  - Based on average energy savings per m^2
  - Energy savings converted to cost savings based on Ofgem electricity losses price (£[redacted]/MWh)
- Carbon saving (tCO_2). Carbon saving based on the energy saving for implementing each and electricity emissions factor. This has been converted to a financial value based on Ofgem carbon prices and included in the NPV.
- NPV 25 yrs (as measures are likely to be specified for a 25-year life)

6.2 Assumptions

The tables below show the estimated unit costs and energy savings for the intervention measures.

Table 6: Unit Costs and Energy Savings for Intervention Measures

Area	Unit cost	Energy saving	Comment
Spray roof insulation (£/m²)	£[redacted] /m2	85 kWh/m^2	*Benchmark calculated from Napier study at Tealing/ Strathclyde*

Double glazing	£[redacted] per window	465kWh/unit	*Benchmark calculated from Napier study at Tealing/ Strathclyde*
Lighting occupancy sensors (£/unit)	£[redacted] / unit	788 kWh/unit	*Benchmark calculated from Napier study at Tealing/ Strathclyde*
Heating Occupancy (£/unit)	£[redacted] /unit	663kWh/unit	*Benchmark calculated from Napier study at Tealing/ Strathclyde*

Table 7: Energy Consumption on Site

Area	Assumption	Comment
Energy consumption on site	285 kWh/m^2	*Based on average consumption per m^2 for Tealing buildings in Napier study*
Energy price	£[redacted] / kWh	*Based on Ofgem loses price*
Electricity emissions factor	0.28 kg CO_2 / kWh	*Based on UK Gov data*

6.3 Results

The table below summarises the results of the CBA analysis.

Table 8: CBA Summary

Option	Description	Measures	# subs. upgraded	Capex (discounted)	Opex saving (25yr life)	CO_2 saving kg (25yr life)	NPV (25 years)	NPV (45 years)
Do nothing	Do Nothing	None	None	Not viable	Not viable	Not viable	**Not viable**	**Not viable**
1	Do Minimum – upgrade substations with key measures	All (x2)	19 + 25 *25 extra prorated*	£[redacted]	£[redacted]	57,377 t CO_2e	£[redacted]	£[redacted]
2	Upgrade all substations with all measures	All (x4)	19 + 25 *25 extra prorated*	£[redacted]	£[redacted]	115,444tCO_2e	£[redacted]	£[redacted]
3	Upgrade with minimum requirements with investigation of additional measures	Not progressed	Not progressed	Not progressed	Not progressed	**Not progressed**	**Not progressed**	**Not progressed**

The results of the CBA show the capex costs are more for option 2. The same number of substations are upgraded in both options. This is because the of the additional measures added in option 2

The graph below shows how the NPV progresses over time for SHEPD and SEPD.

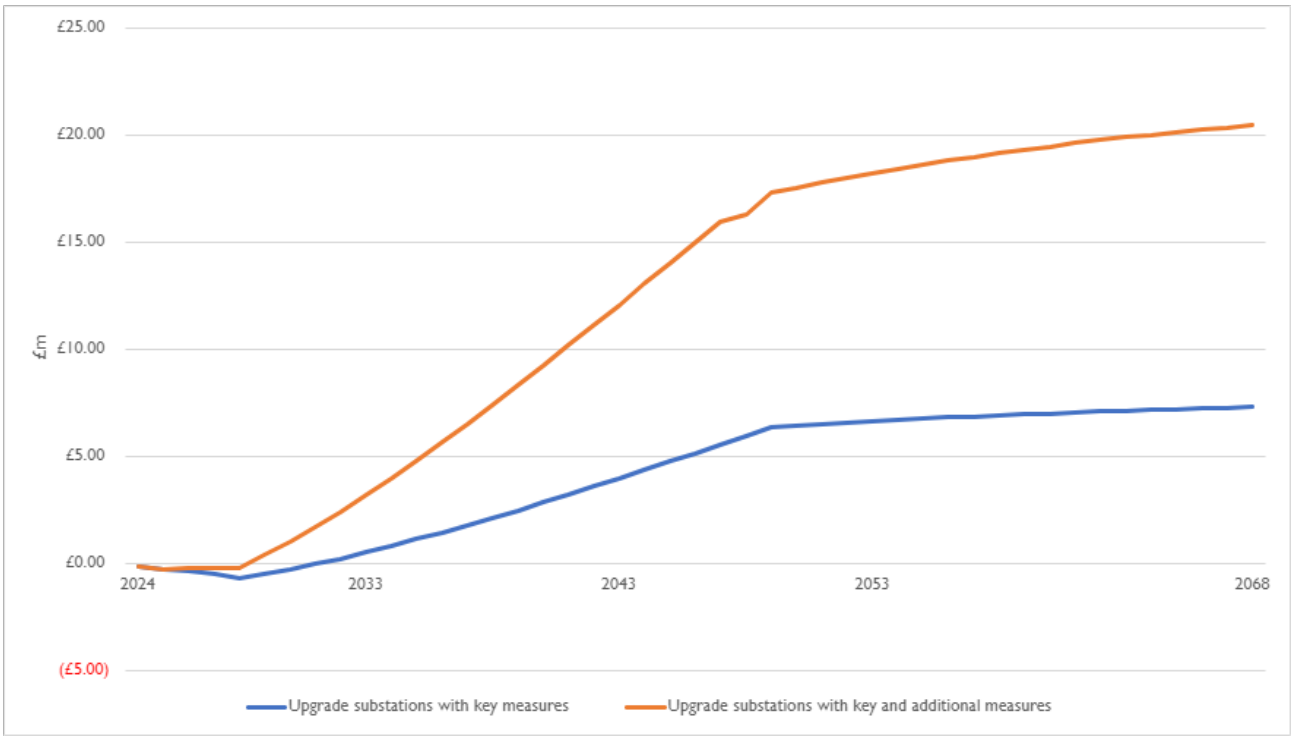

Figure 3: NPV Progress over Time

6.4 Preferred option

Do nothing does not deliver CO_2 savings nor cost savings. Therefore, Option do nothing should not be considered.

Upgrading the substations delivers CO_2 savings and saves opex. The preferred option is Option 2 – this involves applying four measures to all substations including spray insulation, double glazing, lighting occupancy sensors and heating occupancy timers. This option has the highest and delivers the required CO_2 savings to help reach net-zero. In addition, at this stage the opex savings and carbon savings are conservative high-level estimates. Therefore, the benefits could be greater when actual consumption data is collected from site.

7 Deliverability & Risk

Our ***Ensuring Deliverability and a Resilient Workforce (Chapter 16)*** describes our approach to evidencing the deliverability of our overall plan as a package, and its individual components. Testing of our EJPs has prioritised assessment of efficiency and capacity, and this has ensured that we can demonstrate a credible plan to move from SSEN's RIIO-ED1 performance to our target RIIO-ED2 efficiency. We have also demonstrated that SSEN's in-house and contractor options can, or will through investment or managed change, provide the capacity and skills at the right time, in the right locations.

Our deliverability testing has identified a major strategic opportunity which is relevant to all EJPs:

- In RIIO-ED2 SSEN will change the way Capital Expenditure is delivered, maximising synergies within the network to minimise disruptions for our customers. This is particularly relevant for a Price Control period where volumes of work are increasing across all work types.
- The principle is to develop and deliver Programmes of work, manage risk and complexity at Programme level and to develop strategic relationships with our Suppliers and Partners to enable efficiency realisation.
- The Commercial strategy will explore the creation of Work Banks (WB) and identify key constraints. The Load work will be the primary diver for a WB, supplemented by Non-Load work at a given Primary Substation. This approach will capitalise on synergies between the Load and Non-Load work, whereby the associated downstream work from a Primary Substation will maximise outage utilisation, enabling the programme to touch the network in a controlled manner with the objective of touching the network once. Where there is no Primary Load scheme to support the Non-Load work, these will be considered and packaged separately, either insourced or outsourced dependant on volume, size and complexity.
- Transparency with the Supplier in terms of constraints, challenges, outage planning and engineering standards will capitalise on efficiencies, supported by a robust contracting strategy.

The specific considerations for deliverability based on the scope of this EJP are detailed below:

- Training
- Location including access issues and civils
- Supply chain
- Work phasing and project interdependencies
- System interfaces for controls, Network operation and SCADA

7.1 Outputs

The outputs from this work will be surveys of all substations identified and the implementation of the works identified to reduce energy consumption where applicable. For the preferred option, the works will involve spray insulation, double glazing, lighting occupancy sensors and heating occupancy timers to monitor energy consumption. Detailed below are the steps that we will follow to deliver these outputs.

- Desk-top study of substations
- Site surveys – building surveys, energy efficiency, electrical etc.
- Optioneering to test best options for each site
- Concept design
- Detailed design
- Procurement
- Works on site to install measures
- Ongoing benefits management - to check measures are implemented correctly and are delivering savings.

7.2 RIIO-ED2 BPDT Figures

The total RIIO-ED2 planned spend is £[redacted] (not discounted) of which £[redacted] is for SHEPD and £[redacted] for SEPD.

SHEPD includes 3 identified sites and a further 10 which are to be confirmed. SEPD includes 16 sites and a further 15 which are to be confirmed. The costs have been allocated over the course of RIIO-ED2. This equates to the delivery of works for on average 3 substation per year for SHEPD and 6 substations per year for SEPD.

The largest substations will be surveyed and completed first as these substations are expected to have higher energy consumption and therefore greater potential for cost and carbon savings. At present the sites yet to be identified have been included in 2027 for SHEPD and 2028 for SEPD.

SHEDP – CV22

Table 9: SHEPD Annual Spend ED2

Asset Category	Unit	2024	2025	2026	2027	2028	Total
Substation building improvements (SHEPD)	#	1	1	1	10*		**13**
	£	£[redacted]	£[redacted]	£[redacted]	£[redacted]		£[redacted]

*sites to be identified

Phasing is yet to be determined following inspections. This is a typical estimate of the spend.

SEDP – CV22

Table 10: SEPD Annual Spend ED2

Substation building improvements (SHEPD)	Unit	2024	2025	2026	2027	2028	Total
Substation building improvements (SEPD)	#	4	4	4	4	15*	**31**
	£	£[redacted]	£[redacted]	£[redacted]	£[redacted]	£[redacted]	£[redacted]

*sites to be identified

Phasing is yet to be determined following inspections. This is a typical estimate of the spend.

7.3 RIIO-ED1 Track Record

This work has not been carried out before in RIIO-ED1.

7.4 Risks/constraints

A survey is required for each site. In the absence of survey results, assumptions have been made on the measures applicable and the area for installation. Measures like lighting occupancy will only deliver the full benefit if the site is well utilised. No energy data is available from the sites so the opex and carbon savings are estimated, these savings could increase or decrease after surveys. This may impact returns and change the works to be carried out at each site.

8 Conclusion

The purpose of this EJP has been to describe the overarching investment strategy that we intend to take during RIIO-ED2 for the non-load related upgrade of the substations. This will reduce the substations energy consumption, and therefore reduce losses and CO_2 emissions. This will contribute towards our SBT.

A background into the substations has been provided. Currently, 19 substations have been identified for works and a further 25 are to be added. The upgrades to reduce energy usage include insulation and lighting occupancy sensors for the preferred option.

4 investment options have been described and assessed through a CBA to determine the most appropriate solution. Not all these options are considered viable.

- Option Do Nothing: Do Nothing – **base case, not recommended**
- Option 1: Do Minimum – upgrade substations with key measures – **progressed**
- Option 2: Upgrade substations with key and additional measures – **recommended**
- Option 3: Upgrade substations as per do minimum with investigation of additional measures – **not progressed as further investigation required**

The preferred option is option 2, upgrade the substations with 4 key measures - spray roof insulation, double glazing, heating occupancy timers and installing lighting occupancy sensors. This results in significant carbon savings over 25 years of 115,444 tCO_2.

The volumes that have been identified are the same for all options, 19 substations with upgrades with findings scaled to a further 25 sites. During RIIO-ED2 each asset will be surveyed prior to the works being carried out to understand the works applicable and for the 25 additional sites work will be undertaken to identify the most appropriate substations which will then be surveyed and works undertaken.

For our preferred option 2, the total investment is £[redacted] of which £[redacted] is for SHEPD and £[redacted] for SEPD throughout RIIO-ED2.

9 Appendix 1: List of costings per site

Table 11: Costings/Site

Substation	Intervention Measure				
	Spray roof insulation	Lighting Occupancy Sensors	Heating Occupancy	Double Glazing	Contractor Costs
Wootton Road	£[redacted]	£[redacted]	£[redacted]	£[redacted]	£[redacted]
Andover Local Grid	£[redacted]	£[redacted]	£[redacted]	£[redacted]	£[redacted]
Dorcan South	£[redacted]	£[redacted]	£[redacted]	£[redacted]	£[redacted]
Norrington	£[redacted]	£[redacted]	£[redacted]	£[redacted]	£[redacted]
Lovelace Road	£[redacted]	£[redacted]	£[redacted]	£[redacted]	£[redacted]
Headington	£[redacted]	£[redacted]	£[redacted]	£[redacted]	£[redacted]
Northolt	£[redacted]	£[redacted]	£[redacted]	£[redacted]	£[redacted]
Taplow	£[redacted]	£[redacted]	£[redacted]	£[redacted]	£[redacted]
Burghfield Grid	£[redacted]	£[redacted]	£[redacted]	£[redacted]	£[redacted]
High Wycombe Grid	£[redacted]	£[redacted]	£[redacted]	£[redacted]	£[redacted]
Thatcham Grid	£[redacted]	£[redacted]	£[redacted]	£[redacted]	£[redacted]
Green Park	£[redacted]	£[redacted]	£[redacted]	£[redacted]	£[redacted]
Nuffield	£[redacted]	£[redacted]	£[redacted]	£[redacted]	£[redacted]
Southcote	£[redacted]	£[redacted]	£[redacted]	£[redacted]	£[redacted]
Hunston	£[redacted]	£[redacted]	£[redacted]	£[redacted]	£[redacted]
Haslingbourne	£[redacted]	£[redacted]	£[redacted]	£[redacted]	£[redacted]
Dunblane	£[redacted]	£[redacted]	£[redacted]	£[redacted]	£[redacted]

Milnathort	£[redacted]	£[redacted]	£[redacted]	£[redacted]	£[redacted]
Forres	£[redacted]	£[redacted]	£[redacted]	£[redacted]	£[redacted]
Additional 25 sites	£[redacted]	£[redacted]	£[redacted]	£[redacted]	£[redacted]
TOTAL COSTS	£[redacted]	£[redacted]	£[redacted]	£[redacted]	£[redacted]