Scottish & Southern Electricity Networks

SSEN Transmission

RIIO-T2 Business Plan T2BP-EJP-0002

Climate Change and Sustainability Engineering Justification Paper

1. Executive Summary

This Engineering Justification Paper sets out the need for a Climate Change Resilience Proposal as SHE Transmission's commitment to support a sustainable future and as outlined in the "Network for Net Zero" Business Plan. This driver requires our network's impact on climate change to reduce by way of controlling the carbon footprint and greenhouse gas emissions at electrical substations.

SHE Transmission has outlined the following deliverables for this approach;

- Install energy efficiency measures at 83 substations,
- Install PV Solar installation at 83 substations,
- Produce a rolling programme of works for desktop studies and modelling for flood prevention works based on new SEPA modelling and study parameters,
- Install EV Charging Points at 32 Substation sites and another 98 elsewhere to support the rollout of our electric vehicle fleet.

The cost to deliver the above option stands at £18.05m. This above cost is based on previous expenditure for similar tasks and will be delivered by the end of the RIIO-T2 Period (2026).

Upon project delivery there are several benefits relating to the RIIO-T2 business goals which have been listed below:

- All project works contribute significantly to SHE Transmission's goal of "One Third reduction in our greenhouse gas emissions" which was stated in the "Network for Net Zero" business plan.
- Alternative energy measures and substation power generation exemplifies SHE Transmission's commitment to efficiency, the project will help contribute to "£100 million in efficiency savings from innovation" also covered in the "Network for Net Zero" business plan.
- An enhanced understanding of flood mitigation will allow SHE Transmission to make the decisions required to achieve the goal to "aim for 100% Transmission network reliability for homes and businesses" outlined in the "Network for Net Zero" Business plan.

This scheme is not flagged as eligible for early or late competition due to it being under Ofgem's £50m and £100m thresholds respectively.

Name of Scheme/Programme	Climate Change and Sustainability
Primary Investment Driver	Resilience
Scheme reference/ mechanism or category	SHNLT2035 SHNLT2036
Output references/type	NLRT2SH2035 NLRT2SH2036
Cost	SHNLT2035 – £16.59m SHNLT2036 - £1.46m
Delivery Year	RIIO-T2.
Reporting Table	SHNLT2035 – D4.3a SHNLT2036 – C2.24
Outputs included in RIIO T1 Business Plan	No

2. Introduction

This Engineering Justification Paper sets out our plans to produce a Climate Change Proposal during the RIIO-T2 period (April 2021 to March 2026).

The Engineering Justification Paper is structured as follows:

Section 3: Need

This section provides an explanation of the "need" for the planned works. It provides evidence of the primary and, where applicable, secondary drivers for undertaking the planned works. Where appropriate it provides background information and/or process outputs that generate or support the "need".

Section 4: Optioneering

This section presents all the options considered to address the "need" that is described in Section 3. Each option considered here is either discounted at this Optioneering stage with supporting reasoning provided or is taken forward for Detailed Analysis in Section 5.

Section 5: Detailed Analysis

This section considers in more detail each of the options taken forward from the Optioneering section. Where appropriate the results of Cost Benefit Analysis are discussed and together with supporting objective and engineering judgement contribute toward the identification of a selected option. The section continues by setting out the costs for the selected option.

Section 6: Conclusion

This section provides summary detail of the selected option. It sets out the scope and outputs, costs and timing of investment and where applicable other key supporting information.

Section 7: Price Control Deliverables and Ring Fencing•

This section provides a view of whether the proposed scheme should be ring-fenced or subject to other funding mechanisms.•

Section 8: Outputs included in RIIO-T1 Business Plan

This section identifies if some or all the outputs were included in the RIIO-T1 Business Plan and provides explanation and justification as to why such outputs are planned to be undertaken in the RIIO-T2 period.

Section 9: References

3. Need

3.1. What is Climate Change?

Since the last ice age, which ended about 11,000 years ago, Earth's climate has been relatively stable with an average global temperature of about 14 °C.

Global temperatures have risen significantly over the 20th and 21st centuries driven primarily by the rise in atmospheric carbon dioxide (CO_2). Since the Industrial Revolution atmospheric CO_2 has increased by over 40% to levels that are unprecedented over the last 800,000 years. This has caused warming throughout the climate system, and multiple indicators show evidence that our climate is changing.

There have been several events that have impacted on the UK or North of Scotland transmission network that could be attributed to climate change.

Some of the worst flooding in recent years occurred across Scotland on 3rdJanuary 2014 when environment agency, SEPA, had almost 40 flood warnings in place and in January 2016, when SEPA issued more than 30 flood warnings, mostly for the Tayside, Angus, and Dundee areas, as well as Aberdeen and Ballater in Aberdeenshire.

The most recent high impact event to affect the transmission network in the north of Scotland was in November 2018 when a significant 1km long landslip occurred near Loch Quoich Dam. It brought down an HV transmission tower and conductors impacting on power supplies to Skye and the Western Isles.

3.2. Operational Emissions

Our holistic stakeholder-led Sustainability Strategy provides a clear vision of a sustainable business. We have set ourselves ambitious targets to deliver this vision and be at the forefront of best practice. In our Business Plan we set out our proposed actions to deliver a truly sustainable transmission network into the next price control and beyond.

One of the goals in our Business Plan is a one-third reduction in our greenhouse gas emissions. By reducing the scope 1 and 2 greenhouse gas emissions from our operations by 33% by 2026, we intend to bring our emissions in line with the 1.5-degree climate science pathway.

In order to achieve this goal, there are three key areas of Operational Emissions where reductions can be made:

- SF_6 Emissions
- Substation Usage
- Operational Transport

3.2.1. SF_6 Emissions

Sulphur Hexafluoride, or SF_6, is a very good insulating medium and, at all transmission voltages, forms the basis of the circuit breaker arc interruption system. However, with a global warming potential (GWP)of c. 23,500 times that of carbon dioxide, it is one of the more potent Greenhouse Gases. As part of its Statutory and Transmission license obligations, SHE Transmission has a number of duties with regards to SF_6, including the obligation in accordance with the requirements of Special License Condition 3E.

Currently, available technology limits alternatives to SF_6, but we have been proactive in installing and trialing these alternatives and will continue to do so throughout RIIO-T2. We will be replacing a proportion of our current fleet of SF_6-containing plant through our risk-based replacement plans. Therefore, this paper does not cover SF_6 reductions.

3.2.2. Substation Electricity Usage

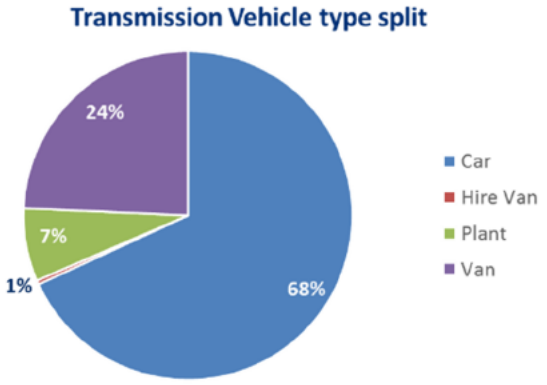
In substations, energy is typically consumed for heating and lighting, dehumidification and cooling equipment, oil pumps, air compressors and battery chargers to maintain secure network operation and resilience.

We have commissioned a study from Napier University, Edinburgh, entitled “Reducing Energy Losses & Greenhouse Gas Emissions from Substations”. The study indicated a number of areas where electricity usage could be substantially reduced or replaced by using renewable technology.

3.2.3. Operational Transport

We have a substantial number of vehicles covering the North of Scotland. An overview of our fleet is shown in Figure 1.

As part of our sustainability goals, and as part of the wider SSE Group, we will move to an all-electric / hybrid vehicle fleet by 2030. These plans mean that we must consider how and where these vehicles are going to be utilised, and how they will be charged.



Car	171
Hire Van	1
Plant	18
Van	61
Grand Total	**251**

Figure 1 - Our Vehicle Fleet

3.3. Flood Mitigation

In RIIO-T1, SHE Transmission risk assessed several grid sites at risk of flooding and carried out works at three sites to introduce risk mitigation measures. This work was based on data provided at the time and the scope of work (Flood Mitigation Works at Grid Substations) was based on guidance produced of the most up to date information.

In the last year new information and guidance has been made available[1] which indicate that the flood risk may be changed as a result of inaction on emissions reduction and improved forecasting methods. We have recognised the need to reappraise the risk, based on this new information, to ensure that previous mitigation measures are adequate to control any change in flooding risk to our grid sites.

4. Optioneering

When reviewing our options in this area, we produced a 3-tier approach to our development, in addition to a "Do Nothing" option.

- **Minimum Requirements**
  - The bare minimum required to keep the lights on and maintain legal/ regulatory compliance.
- **Responsible Operator**
  - A more resilient network for longer term customer benefit.
- **Progressive Network Enabler**
  - An adaptable, sustainable and flexible network providing enhanced value to current and future customers.

The scope, risks and benefits of each of these is laid out below.

4.1. Do Nothing

The minimum requirement in this scenario is to continue to operate the Business as Usual model. This is not feasible as it does not address any of the issues raised in Section 3.

On this basis this option has not been taken forward for detailed analysis.

NOT PROGRESSED TO DETAILED ANALYSIS

4.2. Minimum Requirements

The minimum requirements in this area are focused on flood prevention.

Given the new information received, it is proposed to review all grid substation locations, and provide a Flood Risk Assessment which would take account of the following:

- The impact of flooding on the SHE Transmission System and resultant risks for society.
- Understanding the potential impact of water main bursts, reservoir dam failures and canal bank bursts.
- The impact of groundwater penetrating flood defences is also considered.
- National flood defences and planning requirements reviewed.

- Systematic approach to Flood Risk Assessment and the identification of appropriate protection including;
  - ➢ Conducting Flood Risk Assessments for each Substation, including overland flows
  - ➢ Identification of the flooding impact for each particular site and individual assets;
  - ➢ Establishing if a site will be protected by a National flood protection scheme;
  - ➢ identifying the most appropriate flood protection system for each site.
  - ➢ Levels of acceptable flood risk and implications for investment including a Cost/Benefit assessment that takes into account, Societal Risk.

While this work would revise our understanding of the flood risk to our network, it takes no account of the impact to the environment made by the day-to-day operation of our network.

On this basis, this option has been taken forward for detailed analysis.

PROGRESSED TO DETAILED ANALYSIS

4.3. Responsible Operator

In addition to the proposals discussed in 4.2, the Napier University study has helped direct our decision-making priorities for reduction of losses and environmental impacts within substations.

- At 83 existing sites, we will:
  - Install continuous monitoring of load at all substations to target improvements
  - Install renewable microgeneration at substations where viable
  - Implement an energy efficiency programme for existing substations
- We will design new substations that;
  - Are metered to target and monitor efficiency improvements,
  - Have renewable microgeneration installed, where viable
  - Are as energy efficient as is practicable

The energy efficiency programme the Napier study recommendations:

- Replacement of existing lighting with LED lighting
- Lighting Occupancy Control
- Roof Insulation

- Wall Insulation
- Heating and electrical wiring improvements

We also have the opportunity to apply alternative technologies in substations. The installation of solar PV technologies on substation sites has the potential to replace that normally provided from the local network.

A desktop study of Tealing Super Grid Substation found that there is a potential to install up to 50kWp of solar PV, which could potentially generate some 40,000kWh per annum depending on technology employed. An associated carbon reduction of 14tCO_2 might also be realised. We therefore propose to install PV Solar arrays on 85 substations over the RIIO-T2 period.

On this basis, this option has been taken forward for detailed analysis.

PROGRESSED TO DETAILED ANALYSIS

4.4. Progressive Network Enabler

In addition to the proposals discussed in 4.2 and 4.3, SHE Transmission, as part of the SSE Group, will transition to electric/hybrid vehicles means that we must consider putting Ultra-Fast EV chargers in some strategic sites taking due account of location, travelling distances and available public chargers.

A desktop study has taken place which took the following into account:

- Proximity and number of public charging points
- Average distance travelled
- Frequency of site visits e.g. 400/275/132/33, sites visited more often than remote 132/33 sites.
- Easy access and suitable charging areas out with Operational Safety Zone.

This study has shown that the following charging points are required:

- 2 x 22kW charging points at 32 grid substations to give operational cover and allow for routine / emergency charging of these vehicles as required. These units will be fitted with some metering / charging mechanism to allow for true allocation of costs.

- 98 remote charging points (60 for cars, 38 for operational vehicles)

On this basis, this option has been taken forward for detailed analysis.

PROGRESSED TO DETAILED ANALYSIS

A summary of the above optioneering is shown in Table 1, below.

	Do Nothing	Minimum Requirements	Responsible Operator	Progressive Network Enabler
Substation Energy Usage	✗	✓	✓	✓
Revised Flood Risk Information	✗	✗	✓	✓
Operational Transport	✗	✗	✗	✓

Table 1 - Optioneering Summary

5. Detailed Analysis

This section considers in more detail each of the options taken forward from the Optioneering section. It examines three comparative factors in order to determine the preferred option:

- Risk,
- Stakeholder Requirements, and
- Cost.

5.1. Risk and Benefit Analysis

Due to the nature of this project, risks and benefits involved are not easily quantifiable and are not suitable for traditional Cost Benefit Analysis.

In order to demonstrate the benefits of delivering this project, we have carried out a Risk and Benefit Analysis. For each option taken forward to Detailed Analysis, it looks at the existing risks, the likelihood of these risks being realised, and the severity should that happen. The likelihood and severity combine to give an overall Unmitigated Risk Rating.

Mitigation actions delivered by each option are then identified, and the likelihood and severity are reappraised, resulting in a Mitigated Risk Rating. This exercise was carried out for these proposals.

As can be seen in Table 2, the Unmitigated Risk Rating is “Severe”. Once all the mitigations are taken into account, the Mitigated Risk Rating remains unchanged for the “Minimum Requirement” option, reduces to “High” for “Responsible Operator”, and falls to “Medium” for the “Progressive Network Enabler” works. The full Risk & Benefit Analysis is contained within Appendix A.

				Minimum Requirements	Responsible Operator	Progressive Network Enabler
Risk ID	Risk Title	Risk	Unmitigated Overall Risk Rating	Mitigated Overall Risk Rating	Mitigated Overall Risk Rating	Mitigated Overall Risk Rating
1	Science Based Target	Unable to meet SBT	Severe	Severe	High	High
2	Substation Usage	Substation Usage has continuing impact on climate change. Failure to meet SBT.	Severe	Severe	Low	Low
3	Operational Transport	Operational Transport has a continuing impact on climate change. Insufficient charging points for Operational EVs. Increased fault response times.	Severe	Severe	Severe	Low
4	Flooding	Out of date information may put substations at unnecessary risk	Severe	High	High	High
		OVERALL	**Severe**	**Severe**	**High**	**Medium**

Table 2 - Risk and Benefit Analysis Results

5.2. Stakeholder Engagement

On 5th March 2019, SHE Transmission hosted a stakeholder workshop aimed at gathering feedback to inform its RIIO-T2 strategy on environmental policy. Whilst the proposals outlined in this paper were not specifically consulted upon, the discussions did examine our environmental policies and an overview of SHE Transmission's sustainability strategy was also presented for wider context.

Stakeholders agreed that sustainability should play a key role in SHE Transmission's approach, with several stakeholders expressing an interest in responding to the consultation. They were keen to learn about the context of the consultation and how it fits in with other documents that are currently being consulted on.

5.3. Costs – Minimum Requirements

As described above, this option allows for Flood Risk Assessments to be carried out at 127 sites and for mitigation works to be carried out at ten sites. Costs are based on previous, similar projects.

	Number of Sites	Cost per site (£)	Total Cost
Desktop Assessment	127	[redacted]	[redacted]
Data Acquisition	127	[redacted]	[redacted]
Modelling & Analysis	127	[redacted]	[redacted]
Report & Recommendation			[redacted]
Design & Construction	10	[redacted]	[redacted]
TOTAL			£1,434,500

Table 3 – Minimum Requirements

5.4. Costs – Responsible Operator

The scope of this option covers the "Minimum Requirements" approach, as well as reducing energy consumed at substations and alternative generation. Costs for this approach are taken from Consultancy fees and Napier University's report.

	Number of Sites	Cost per site (£)	Total Cost
Identification & Prioritisation of Sites			[redacted]
LED Replacement	83	[redacted]	[redacted]
Heating & Electrical works	83	[redacted]	[redacted]
Wall Insulation	83	[redacted]	[redacted]
Mineral Wool Roof Insulation	83	[redacted]	[redacted]
Sprayed Roof Insulation	83	[redacted]	[redacted]
Secondary Glazing	83	[redacted]	[redacted]
Metering	83	[redacted]	[redacted]
TOTAL			£6,945,731

Table 4 – Energy Usage Reduction Costs

Also included within this option is the installation of PV Solar panels at 83 Substations. Costs are based on initial discussions with contractors.

	Number of Sites	Cost per site (£)	Total Cost
Desktop Study			[redacted]
Design and Installation	83	[redacted]	[redacted]
TOTAL			£5,803,885

Table 5 – Solar PV Installation Costs

Total costs for this option are £14.18m, excluding oncosts and risk.

5.5. Costs – Progressive Network Enabler

In addition to the preceding option, this also allows for the installation of Ultra-Fast EV Chargers at 32 sites and 98 remote chargers to support the roll-out of our electric transport fleet. Costs are estimated at £2.67m and have been derived through contractor estimates for other, similar projects. The breakdown for these costs is shown in Table 6.

	Number of Sites	Cost per site (£)	Total Cost
Remote Van Chargers	38	[redacted]	[redacted]
Remote Car Chargers	60	[redacted]	[redacted]
2 x Ultra-Fast 22kW Chargers	32	[redacted]	[redacted]
Additional Plant	11	[redacted]	[redacted]
Design & Development			[redacted]
TOTAL			£2,672,100

Table 6 – EV Charging Points Costs

Total costs for each option are shown in Table 7 below.

	Minimum Requirements	Responsible Operator	Progressive Network Enabler
Flood Prevention	[redacted]	[redacted]	[redacted]
Risk & Contingency	[redacted]	[redacted]	[redacted]
SUB-TOTAL	£1,463,190	£1,463,190	£1,463,190
Substation Energy Usage Reduction		[redacted]	[redacted]
Substation PV Solar Panels		[redacted]	[redacted]
EV Charging Points			[redacted]
Risk & Contingency		[redacted]	[redacted]
SUB-TOTAL		£13,004,498	£15,730,157
On Costs	£73,160	£723,390	£859,684
TOTAL	£1,536,350	£15,191,188	£18,053,365

Table 7 - Options Cost

5.6. Proposed Solution

We have examined each of the options in terms of three comparative factors:

- Cost
- Risk Reduction
- Stakeholder Requirements

The Progressive Network Enabler option delivers an improved risk reduction in comparison to the "Responsible Operator" option and better delivers on our targets and goals. It also aligns with Stakeholder Requirements.

6. Conclusion

As a responsible business we have an obligation to not only manage the environmental impact on our network, but the impact of our operations on the environment.

We examined four options, three of which were taken forward for detailed analysis. This detailed analysis determined that the Progressive Network Enabler option was the preferred option.

The scope of this option is:

- Installation of energy efficiency measures at 83 substations,
- Installation of PV Solar installation at 83 substations,
- Production of a rolling programme of works to generate desktop studies and modelling for flood prevention works based on new SEPA modelling and study parameters.
- Installation of EV Charging Points at 32 Substation sites and another 98 elsewhere to support the rollout of our electric vehicle fleet.

This project will be delivered over the course of RIIO-T2 and is estimated to cost £18.05m. This scheme is not flagged as eligible for early or late competition due to it being under Ofgem's £50m and £100m thresholds respectively.

7. Price Control Deliverables and Ring Fencing•

As set out in our Regulatory Framework paper (section 1.12 and Appendix 3) we support a key principle from Citizens Advice – one that guarantees delivery of outcomes equivalent to the funding received - to ensure that RIIO-T2 really deliver for consumers. At the project level this means that if we don't deliver the output, or a materially equivalent outputs, we commit to returning the ex-ante allowance for the output not delivered.

This means that if the funding for Climate Change and Sustainability should be ring-fenced and if it does not go ahead, we will return the allowances of £18.05m in full (minus any justified preconstruction expenditure).

It also means that we commit to delivering the output specified above for the costs of £18.05m. If we do not deliver the output, or a materially equivalent output, we commit to returning a proportion of the ex-ante allowance. The detailed methodology should be decided at when developing the Close Out methodologies but should apply the same principles of uncertainty mechanisms - that any under delivery should be material.

8. Outputs included in RIIO-T1 Plans

There are no outputs associated with this scheme included in our RIIO-T1 plans.

9. References

- *Engineering Technical Report 138 -Issue 3 2018 - Resilience to Flooding of Grid and Primary Substations* -Energy Networks Association.
- *UKCP18 Science Overview* produced by the MET Office.
- *SEPA Flood Maps*
- *SP826 - Flood Prevention & Land Drainage (Scotland) Act 1997* - Responsibilities, Management & Implementation
- *Reducing Energy Losses & Greenhouse Gas Emissions from Substations*, Prof. John Currie & Dr Jon Stinson of the Scottish Energy Centre, Edinburgh Napier University, February 2019
- *SHE-Transmission Environment Stakeholder Workshop Report*

Appendix A

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Project Risk & Benefit Matrix - Minimum Requirements

Risk ID	Risk Title	Risk	Unmitigated Risk Likelihood	Unmitigated Risk Impact	Unmitigated Overall Risk Rating	Mitigation Action	Mitigated Risk Likelihood	Mitigated Risk Impact	Mitigated Overall Risk Rating	Benefits
1	SBT	Unable to meet SBT	Almost Certain	Severe	Severe	None	Almost Certain	Severe	Severe	
2	Substation Usage	Substation Usage has continuing impact on climate change. Failure to meet SBT	Almost Certain	Serious	Severe	None	Almost Certain	Serious	Severe	
3	Operational Transport	Operational Transport has a continuing impact on climate change. Insufficient charging points for Operational EVs. Increased fault response times.	Almost Certain	Serious	Severe	None	Almost Certain	Serious	Severe	
4	Flooding	Out of date information may put substations at unecessary risk	Likely	Severe	Severe	Review all grid substations and provide an FRA	Unlikely	Severe	High	The potential and impact of flooding is known and can be mitigated

Figure 2 - Risk & Benefit Matrix – Minimum Requirements

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Project Risk & Benefit Matrix - Responsible Operator

Risk ID	Risk Title	Risk	Unmitigated Risk Likelihood	Unmitigated Risk Impact	Unmitigated Overall Risk Rating	Mitigation Action	Mitigated Risk Likelihood	Mitigated Risk Impact	Mitigated Overall Risk Rating	Benefits
1	Science Based Target	Unable to meet SBT	Almost Certain	Severe	Severe		Unlikely	Severe	High	
2	Substation Usage	Substation Usage has continuing impact on climate change. Failure to meet SBT	Almost Certain	Serious	Severe	Install continuous monitoring of load at all substations. Install renewable generation where appropriate and implement an energy efficiency programme	Almost Never	Serious	Low	Energy efficiency improvements can be targeted, electricity usage will be reduced
3	Operational Transport	Operational Transport has a continuing impact on climate change. Insufficient charging points for Operational EVs. Increased fault response times.	Almost Certain	Serious	Severe		Almost Certain	Serious	Severe	
4	Flooding	Out of date information may put substations at unecessary risk	Likely	Severe	Severe	Review all grid substations and provide an FRA.	Unlikely	Severe	High	The potential and impact of flooding is known and can be mitigated

Figure 3 - Risk & Benefit Matrix – Responsible Operator

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Project Risk & Benefit Matrix - Progressive Network Enabler

Risk ID	Risk Title	Threat Or Opportunity	Unmitigated Risk Likelihood	Unmitigated Risk Impact	Unmitigated Overall Risk Rating	Mitigation Action	Mitigated Risk Likelihood	Mitigated Risk Impact	Mitigated Overall Risk Rating	Benefits
1	Science Based Target	Unable to meet SBT	Almost Certain	Severe	Severe	Install continuous monitoring of load at all substations, install renewable generation where appropriate and implement an energy efficiency programme Install charging points at substations and other appropriate locations	Hardly Ever	Severe	High	Energy efficiency improvements can be targeted, electricity usage will be reduced Roll out of electric operational fleet is supported
2	Substation Usage	Substation Usage has continuing impact on climate change. Failure to meet SBT	Almost Certain	Serious	Severe	Install continuous monitoring of load at all substations, install renewable generation where appropriate and implement an energy efficiency programme	Almost Never	Serious	Low	Energy efficiency improvements can be targeted, electricity usage will be reduced
3	Operational Transport	Operational Transport has a continuing impact on climate change. Insufficient charging points for Operational EVs. Increased fault response times.	Almost Certain	Serious	Severe	Install charging points at substations and other appropriate locations to support the roll out of electric operational vehicles	Almost Never	Serious	Low	Roll out of electric operational fleet is supported
4	Flooding	Out of date information may put substations at unecessary risk	Likely	Severe	Severe	Review all grid substations and provide an FRA.	Hardly Ever	Severe	High	The potential and impact of flooding is known and can be mitigated

Figure 4 - Risk & Benefit Matrix – Progressive Network Enabler

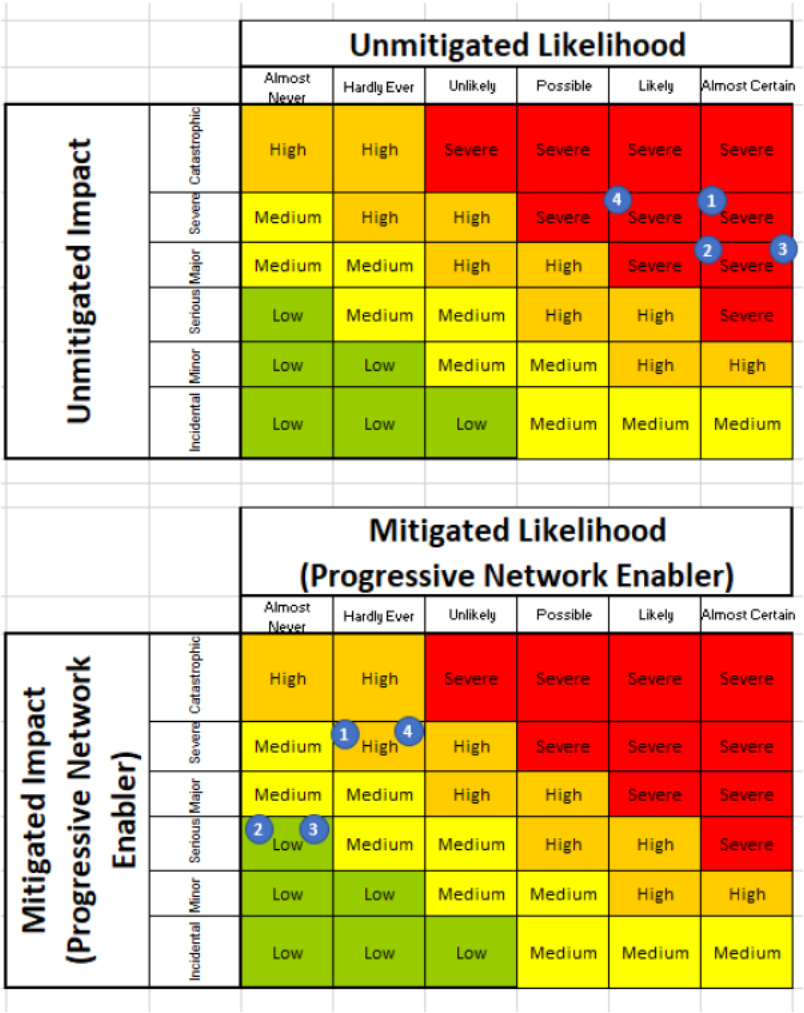

Figure 5 - Risk Heat Maps for Preferred Option