STORM ARWEN UNCERTAINTY MECHANISM

SSEN Distribution Core Narrative

January 2024

Scottish & Southern Electricity Networks

CONTENTS

DEFINITIONS AND ABBREVIATIONS

Acronym	Definition	Acronym	Definition
ABSW	Air break switch	APRS	Automatic Packet Reporting System
BAU	Business as usual	BEIS	Department for Business Energy and Industrial Strategy
CB	Circuit breaker	CBA	Cost Benefit Analysis
CIs	Customer Interruptions	CMLs	Customer Minutes Lost
CO2	Carbon Dioxide	CVR	Cost, Volume and Revenue reporting pack
DFA-Plus	Distribution Fault Anticipation	DIA	Direct Internet Access
DNO	Distribution Network Operator	DSO	Distribution System Operator
E3C	Energy Emergencies Executive	ENA	Energy Networks Association
ESQCR	Electricity Safety, Quality and Continuity Regulations	ETR 132	Engineering Technical Report 132
FPI	Fault Passage Indicator	GIS	Geographic Information System
GPS	Global Positioning System	HEO	High Earth Orbit
HI	Health Index	HV	High Voltage
kV	kilovolts - 1,000 volts	LEO	Low Earth Orbit
LiDAR	Light Detection and Ranging	LRE	Load Related Expenditure
LV	Low Voltage	MEO	Medium Earth Orbit
NEOP	National Electricity Outage Portal	NGED	National Grid Electricity Distribution
NIA	Network Innovation Allowance	NPV	Net present value
Ofgem	Office of Gas and Electricity Markets	OHL	Overhead line
PCD	Price Control Deliverable	PM	Pole mounted
PMCB	Pole-mounted circuit breaker	PMR	Portable Mobile Radio
PoC	Proof of Concept	PQR	Power Quality Recording device
RFI	Request for information	RIIO-ED2	The second RIIO (revenue = incentives + innovation + outputs) electricity distribution price control, running from 1 April 2023 to 31 March 2028
RIIO-ED3	The third RIIO (revenue = incentives + innovation + outputs) electricity distribution price control, running from 1 April 2028 to 31 March 2033	ROLR	Restoring Overhead Line Resilience project

SEPD	Southern Electricity Power Distribution	SHEPD	Scottish Hydro Electricity Power Distribution
SIM	Subscriber Identity Module	SMS	Short Message Service
SPEN	Scottish Power Energy Networks	SRN	Shared Rural Network
SSEN	Scottish and Southern Electricity Networks	UKPN	UK Power Networks
UM	Uncertainty Mechanism	Wi-Fi	Networking technology that uses radio waves to provide wireless high-speed Internet access

ABOUT SSEN DISTRIBUTION

Who We Are

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

We serve some of the most diverse and unique geographies across the UK, and keep customers and communities connected whilst developing the flexible electricity network vital to achieving Net Zero. Our network serves some of the UK's most remote communities, as well as some of the most densely populated. Our two networks cover the greatest land mass of any of the UK's Distribution Network Operators, covering 72 local authority areas and 75,000km^2 of extremely diverse terrain.

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

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

EXECUTIVE SUMMARY

Introduction

As a Distribution Network Operator (DNO), we know the effect that severe weather can have on our network, and the impact that causes our customers. We have always sought to minimise that impact where we can by investing in our network to make it resilient to strong winds, extreme rain and snowfall, and other meteorological challenges. We have a skilled and well-trained workforce that is ready to respond in times of severe weather, to restore supplies as quickly and as safely as possible.

Despite these measures, some severe weather causes unprecedented impacts. Storm Arwen in November 2021 was an exceptional storm, bringing extremely strong winds to much of the UK which left over a million households without power. For SSEN Distribution (SSEN), the storm had a particular impact on our SHEPD network, which saw some of the highest wind speeds recorded in Storm Arwen. Here, large sections of our overhead lines were affected by trees brought down in the storm. Power cuts to particularly remote communities were made even more challenging by the persistently bad weather, exacerbating issues with access and communication routes. In total, just under 144,000 customers were off power during the storm.

We worked hard to restore supplies as quickly and as safely as possible, whilst making sure we kept our customers informed of when they would be back on supply. However, a once-in-a-generation even such as this provides the opportunity to improve our performance in preparing for and responding to storms of this nature. We welcomed the reports by Ofgem and the Energy Emergencies Executive (E3C) outlining a series of recommendations for the energy industry in how to better serve our customers in future storm events.

Actions targeted in this submission

Our submission focuses on the Ofgem and E3C recommendations that most closely relate to the challenges that we faced during Storm Arwen, and where we have a clear plan for how we can deliver improvements. Under this Storm Arwen submission we are asking for **£10.48m additional funding (in 2020-21 price base)** to deliver these improvements. All the measures in this submission are important in addressing the fallout of Storm Arwen and helping us prepare for future storms, which may become more frequent as we see the impact of climate change. We have sought to cover a range of activities that will help us deliver a better service for our customers in the future.

Our **Restoring Overhead Line Resilience** (ROLR) project focuses on managing the risk left by Storm Arwen in areas of our network that pass through dense forestry. The project targets actions in managing sites where the storm created new areas of risk, often by bringing down large swathes of trees to leave those closest to the line exposed to the wind. The project follows on from activities we carried out through a shareholder-funded project and will target the sites most at risk across SHEPD. In total, we are asking for **£2.08m** to carry out a dedicated survey of the network, invest in additional machinery, and manage the delivery of this work across the remainder of RIIO-ED2. We will manage this project in parallel with our existing programme of resilience activities, to supplement our business as usual work.

The **HV Feeder Monitoring** project targets investment in technology that will improve our ability to locate faults on the HV network. Storm Arwen challenged our field staff's ability to accurately locate a fault. This project takes steps to address that by providing more detailed information about the possible location of the fault. This will reduce the time taken to identify and fix the fault, meaning customers are back on supply more quickly. We are asking for **£6.65m** to deploy these devices across both our SHEPD and SEPD networks and use the information to improve our overall response time during storms.

Through the **Wood Pole Assessment Tool** project, we will roll out dedicated, scientific tools that give consistent and accurate measurements of the condition of a wood pole. The tools make it easier and more consistent to record pole health, giving us better information on where to target interventions. Deploying the tools across the business will give us a better overall understanding of the health of wood poles across our network. We are seeking **£0.95m** to purchase and deploy these tools across SHEPD and SEPD, giving us a more up to date and consistent dataset on the condition of our wood poles and ensure we target replacement at those assets that most need it.

Effective communication with our field staff was, at times, particularly difficult during Storm Arwen. Blackspots in the mobile phone network meant our staff had to travel away from the fault to speak with the control centre and enable the restoration of supplies. We are seeking **£0.65m** to trial the use of **Low Earth Orbit satellite communication systems** that can be deployed in both mobile and fixed locations, before rolling it out more widely across our networks. This technology will speed up our restoration times in these locations, and could be used to provide remote communities with a communication hub in some scenarios.

Finally, after initial discussions with Scottish Power Energy Networks (SPEN), we have explored opportunities to provide **interconnection across the network boundary**. This will target specific sites where this solution benefits both DNOs, giving an additional layer of resilience and an opportunity to provide better service for customers. We are asking for **£0.14m** to carry out this work at four sites in SHEPD, and will use the learnings from this work to explore opportunities around the network boundary of SEPD.

As outlined under the 'Activities not included' section, our network was affected by six named storms between October 2023 and January 2024. These storms caused a range of issues across the network, including severe flooding at sites that had not been identified as being at risk before these events. These unanticipated impacts reinforce the need to consider how the price control can enable us to respond to these events and provide network resilience as new risks emerge. We strongly support the introduction of an additional window under this mechanism to facilitate DNOs in making their networks resilient to extreme weather events.

Conclusion

Storm Arwen provided a stark reminder of the need for all DNOs prepare for, and respond to, severe weather events in the best way possible. Through this reopener we are targeting specific actions that will result in tangible benefits both for our customers and our staff in operating and maintaining the network. We have focused on projects that will deliver results quickly, and that are directly linked to the recommendations provided by Ofgem and the E3C and that can be delivered within RIIO-ED2.

MEETING OFGEM'S REQUIREMENTS

Ofgem Re-Opener requirements

The following tables set out where we meet Ofgem's Re-Opener Licence and Guidance requirements in this submission.

Ofgem Re-Opener Licence requirement	Requirement met?	Where / how addressed
The application must set out the changes to the way in which the licensee operates its Distribution Business and the associated costs.	✓	Introduction Demonstration of needs case/ problem statement
The application must set out the modifications to the value of SARt 1 being sought.	✓	Cost information Summary of Cost Benefit Analysis
The application must explain the basis for calculating any modifications requested to allowances and the profiling of those allowances.	✓	Cost information
The application must provide such detailed supporting evidence as is reasonable in the circumstances.	✓	Demonstration of needs case/ problem statement
The application must relate to changes agreed on or after 1 December 2021.	✓	We have only considered changes to activities that have resulted from Storm Arwen, and that are beyond our Business Plan (submitted in November 2021)
The application must be confined to costs incurred or expected to be incurred on or after 1 April 2023.	✓	All references to costs are those that will be incurred after 1 April 2023. For ROLR, pre-April 2023 costs are provided for context, but are not included in the adjustment being sought.
The application must take account of other allowed expenditure that could be avoided or reduced as a result of the circumstances set out.	✓	Relevant project sections

Table 1: Mapping Ofgem's Re-Opener Licence requirements

Ofgem Re-Opener Guidance requirement	Requirement met?	Where addressed
Needs Case and Preferred Option	✓	Each project has a dedicated Needs case section
Stakeholder Engagement and Whole System Opportunities	✓	Stakeholder Engagement section
Cost Information	✓	Each project has a dedicated breakdown of costs and associated justification
Cost Benefit Analysis and Engineering Justifications	✓	Each project has a dedicated breakdown of costs and associated justification

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

Ofgem Feedback

Table 3 sets out Ofgem's feedback to date on the aspects covered by the re-opener submission, and where we address this feedback.

Ofgem feedback on project	Where addressed	How addressed	Feedback resolved?
Ensure there is clarity that all projects are going beyond BAU activities	Relevant project sections	We have made clear references to how this work will be delivered separately from our BAU programmes of work, as well as setting out the need for this additional activity over and above our business plan.	Yes
Ensure there are clear links to the Ofgem and E3C recommendations	Relevant project sections	We have linked each project to at least one recommendation, and stated that recommendation at the top of each section	Yes
Clarity on the optioneering we have carried out	Relevant project sections	Where appropriate, we have set out the options that we have considered alongside the proposed approach. For projects that relate to technology procurement, we have given a summary of the alternative technologies and their features and highlighted that we will choose the most appropriate technology at the time of procurement or roll out.	Yes

Table 3: Mapping Ofgem's feedback

ADJUSTMENT SUMMARY

Table 4 provides a high level summary of the adjustment relevant to this re-opener submission. All costs throughout this document are given in 2020-21 prices.

Adjustment summary (£m)		2023/24	2024/25	2025/26	2026/27	2027/28	Total
Baseline RIIO-ED2 allowances		0	0	0	0	0	0
Allowance adjustment							
Totex	ROLR (SHEPD)	0	1.03	0.35	0.35	0.35	2.08
	ROLR (SEPD)	0	0	0	0	0	0
	HV Feeder Monitoring (SHEPD)	0	0.02	0.50	0.56	0.61	1.70
	HV Feeder Monitoring (SEPD)	0	0.07	1.46	1.65	1.78	4.96
	Wood Pole Assessment Tool (SHEPD)	0	0.19	0.09	0.09	0.04	0.42
	Wood Pole Assessment Tool (SEPD)	0	0.23	0.12	0.12	0.05	0.54
	Satellite Communication System (SHEPD)	0	0.25	0.14	0	0	0.39
	Satellite Communication System (SEPD)	0	0.17	0.09	0	0	0.26
	Cross DNO interconnection (SHEPD)	0	0	0.09	0.06	0	0.14
	Cross DNO interconnection (SEPD)	0	0	0	0	0	0
	Total	**0**	**1.97**	**2.85**	**2.84**	**2.82**	**10.48**

Table 4: Adjustment summary

INTRODUCTION

Impact of Storm Arwen on SSEN

Storm Arwen brought severe winds to the UK between 26 and 27 November 2021. These affected the north and east of Scotland particularly badly: wind speeds over 70mph were widely reported across the UK, and gusts of over 100mph were recorded in parts of Northern Scotland. According to the Met Office, this was one of the most powerful winter storms in recent times, and the conditions brought unprecedented challenges to Distribution Network Operators (DNOs). The storm brought down thousands of trees across the north of the UK, bringing major disruption to electricity supplies. Over a million homes experienced a power cut, and more than 100,000 homes were off supply for several days.[1] The impacts extended to other infrastructure across the UK, with rail services disrupted or cancelled, roads blocked due to falling trees or snow, ferry services cancelled and schools across Aberdeenshire closed in the aftermath of the storm.

For SSEN, this meant our customers, communities and operations were affected by far greater damage to our networks than we had seen before. As Ofgem's final report showed, there were almost 10,000 faults across the UK, with strong winds and fallen or broken trees causing over 80% of these incidents. We had 2,273 faults affecting nearly 144,000 customers in our licence areas.

Recommendations

Ofgem and the Department for Business, Energy and Industrial Strategy's Energy Emergencies Executive Committee (E3C) carried out their own reviews[2] of how the industry responded to the storm. These reviews sought to identify lessons to be learned and actions to be taken to better prepare for, and respond to, future severe weather events. Both reports produced a set of clear recommendations for how the industry could improve; a summary of the relevant recommendations are provided in Table 5 below.

Ofgem reference	E3C reference	Recommendation	Delivery Date	Status
1	E2	E3C should review current network infrastructure standards and guidance, including those for vegetation management and overhead line designs, to identify economic and efficient improvements that could increase network resilience to severe weather events.	Sep-22	Completed
2		DNOs and Ofgem should commission a review into how pole health is assessed, to identify changes, to identify changes that will improve pole condition reporting.	Jul-22	Completed
3		E3C should assess the feasibility and benefits of developing a standard-based approach to organisational resilience to improve the speed of customer restoration during severe weather events.	Sep-22	In progress

1 https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/interesting/2021/2021_07_storm_arwen.pdf
2 E3C report is available here: Storm Arwen review: final report (publishing.service.gov.uk)
Ofgem's initial report is available here: Interim report on the review into the networks' response to Storm Arwen_0.pdf (ofgem.gov.uk)
Ofgem's final report is available here: Final report on the review into network' response to Storm Arwen (ofgem.gov.uk)

6	R1	E3C should review and update industry best practice for identifying faults and assessing the extent of network damage, to reduce customer restoration times. (Including the role of smart meter data and technology in this)	Apr-23	In progress
8	R2	E3C should identify options to enhance the use of mobile generators in reducing the length of power disruptions.	Aug-22	Completed
9	CM1	E3C should review and update “reasonable worst-case scenario” planning assumptions for customer call volumes.	Aug-22	Completed
13	CM4	DNOs should improve their assumptions for estimating restoration times and improve the quality of their communication to customers, so that customers can make informed choices about meeting their needs	Sep-22	Completed
	R3	Energy Network Operators should share best practices to ensure they each have a suite of resilient communications systems, considering developments in the telecommunications sector.	Sep-22	Completed
14		DNOs, in consultation with local resilience partners, should develop principles-based industry guidance on best practice in the provision of welfare support	Sep-22	Completed
15		DNOs should work with local resilience partners to agree clear roles and responsibilities during severe weather events.	Sep-22	Completed
17		DNOs to adopt lessons learned from 2021/2022 storms in their processes, to enable timely and accurate compensation payments to customers.	Sep-22	Completed
18		DNOs to develop more robust mechanisms to enable the delivery of compensation payments at scale	Sep-22	Completed

Table 5: Ofgem and E3C recommendations

Timings relative to RIIO-ED2 Business Plan

Storm Arwen struck in the same week that DNOs were submitting final RIIO-ED2 Business Plans to Ofgem, ahead of the assessment that would be summarised in the Draft Determinations. The complete set of Ofgem and E3C recommendations were not published until June 2022. We were therefore not able to incorporate lessons learned or additional activities that Storm Arwen identified within our overall business plan for RIIO-ED2.

We undertook a review of the Ofgem and E3C recommendations once they were published, and identified actions that we could take to address some of the issues and damage from the storm. This was a shareholder-funded programme of work, agreed with Ofgem as part of the review into our performance during the storm. Through this programme we spent around £2.5m in the remainder of RIIO-ED1 across a range of projects covering communications, mobile generation, and network resilience. This funding covered activities up to the end of the RIIO-ED1 price control, to deal with the most urgent issues left by Storm Arwen. Once we had addressed those issues, our focus was on delivering our RIIO-ED2 business plan.

Focus of this application

We have engaged with other DNOs in the run up to this reopener, to understand how we can best align our applications across the industry. This, along with discussions with Ofgem, helped us identify the appropriate interventions to target and to ensure that we deliver on the Ofgem and E3C recommendations.

The impacts of Storm Arwen were not universal, but we have taken a joined-up approach across DNOs where possible. We have focused our application on interventions that will deliver the most effective solutions to the issues that Storm Arwen brought to our licence areas. These measures will help us prepare for future storms.

We have, therefore, focused on the most relevant recommendations to us – such as:

- estimating restoration times and improving the quality of communication to our customers (Ofgem recommendation 13; E3C recommendation CM4);
- assessing pole health reporting pole condition (Ofgem recommendation 2); and
- standards and approaches relating to vegetation management and overhead line designs to increase network resilience to severe weather events (Ofgem recommendation 1; E3C recommendation E2).

This submission comprises five projects which, taken together, represent the activities most appropriate to meet the recommendations set out by Ofgem and the E3C. These projects go beyond the scope of 'business as usual' (BAU) activities that were funded through baseline allowances for RIIO-ED2.

We considered a range of activities that may have contributed to the challenge of meeting the recommendations from Ofgem and the E3C. We have developed a set of projects that will result in tangible benefits, both for our staff in operating and maintaining the network and, ultimately, for our customers. These projects will go a long way in mitigating the challenges that we face during storm conditions.

These projects as they are quick to deploy across the business; we expect to be able to start work shortly after receiving confirmation of funding. This could mean that we, and our customers, could start realising the benefits of this work for the 2024-25 winter period. We have included a high level summary of these activities, and the relevant recommendations they address, in Table 6 below.

Element	High level summary	Relevant recommendations	Total cost (2020-21 prices)
Restoring Overhead Line Resilience	Additional resilience work at sites across SHEPD through tree harvesting, to address new risk induced by Storm Arwen. This includes costs of new equipment, and a project manager to oversee the work.	E3C to review network infrastructure standards and guidance, including those for vegetation management and overhead line designs, to identify improvements that could increase network resilience to severe weather events. (Ofgem Recommendation 1, and E3C recommendation E2)	£2.08m
HV Feeder Monitoring	Installation of monitoring devices (or equivalent) on [redacted] 11kV and 33kV feeders to help better pinpoint fault locations and improve restoration times.	E3C should review and update industry best practice for identifying faults and assessing the extent of network damage, to reduce customer restoration times. (Ofgem Recommendation 6, E3C recommendation R1)	£6.65m

Wood Pole Assessment Tool	Purchase of [redacted] devices to be used by field staff to better assess the condition of wooden poles, helping to improve how wood pole health is collected and data used to inform more efficient asset replacement.	DNOs and Ofgem should commission a review into how pole health is assessed, to identify changes that will improve pole condition reporting. (Ofgem Recommendation 2)	£0.95m
Satellite Communication Systems	Purchase and associated subscription costs of satellite communication units that provide more robust communication links for remote sites, substations and field staff.	DNOs should improve assumptions for estimating restoration times and improve the quality of their communication to customers. (Ofgem Recommendation 13, E3C recommendation CM4) DNOs should share best practices to ensure they have a suite of resilient communications systems (E3C recommendation R3)	£0.65m
Cross DNO interconnection	Creating interconnection across DNO boundaries for sites of strategic importance for both parties, to increase network resilience.	E3C to review network infrastructure standards and guidance, including those for vegetation management and overhead line designs, to identify improvements that could increase network resilience to severe weather events. (Ofgem Recommendation 1, and E3C recommendation E2)	£0.14m
Total			**£10.48m**

Table 6: Summary of the programmes of work making up this submission.

Activities not included

We have only included activities in our application that directly relate to the Storm Arwen recommendations from Ofgem and the E3C. However, this is an important opportunity to flag the need to ensure the price control retains the flexibility to allow DNOs to seek additional allowances for new risks or actions that severe weather may identify. This is especially true where we cannot manage these risks within existing price control allowances. The Storm Arwen reopener is a good example of how the price control can allow DNOs to put forward considered and well justified proposals to deliver better outcomes for customers and deliver additional resilience.

We encourage Ofgem to introduce a second window under this mechanism, to enable DNOs to put forward proposals that may cover other recommendations not included in this window. This kind of reopener is a useful tool that enables DNOs to respond to events that could not be planned for preparing for the price control. This includes developing programmes of work to address new or enhanced risks that have come about through severe weather events that were not foreseen ahead of their occurrence.

For example, in October and November 2023 two consecutive storms impacted our networks. Storm Babet brought exceptional rainfall to parts of eastern Scotland during October; the Met Office issued two red warnings for rain. This was highlighted by the county of Angus experiencing the wettest day on record since 1891. This culminated in significant flooding of many homes and businesses, particularly around Brechin where flooding overtopped the defences that were in place. Around 30,000 homes across northern Scotland lost power during the storm.[3]

Storm Ciaran followed in early November, bringing damaging wind to much of the south coast of England. The rainfall during this storm exacerbated existing flooding problems, causing many rivers to burst their banks.[4] This was particularly true for sites in our SEPD licence area; for example, the entire yard of a primary substation around Bognor Regis flooded after a river near the site burst its banks. This had the potential to disrupt supplies to over 30,000 customers, including critical wastewater treatment facilities. Figure 1 below shows the extent of the flooding at this site.

Figure 1: Flooded yard at Bognor Regis

This site had not been identified as being at risk of flooding (including on the Environment Agency's latest flood maps) before this event, and there was no prior storm or flooding incident that suggested the site would be at risk. We now know that other factors, including the lack of dredging of the local river, contributed to the situation which ultimately was caused by the significant rainfall over the previous months.

Four more named storms followed in December 2023 (Storm Gerrit) and January 2024 (Storm Henk, Storm Isha[5] and Storm Jocelyn). All these events show the new and additional risks that severe weather can add to our network, including the type of risks that were not covered by the Storm Arwen recommendations (such as flooding). These new risks can also have impacts on sites that we have not previously identified as being at risk or in need of intervention. The sheer number of large storms in such a short period of time reinforces the need to review how DNOs are funded to deliver resilience activities through the price controls.

Since the start of RIIO-ED2 we have been improving the data we hold on the prevalence of ash trees around our network, and the effect of ash dieback on those trees. Getting a better understanding of how the disease spreads among trees close to our assets will give us a better understanding of the risk they pose, especially

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3 https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/interesting/2023/2023_08_storm_babet.pdf

4 https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/interesting/2023/2023_09_storm_ciaran.pdf

5 A red warning for wind was issued for northeast Scotland during Storm Isha.

during storm conditions. We expect this to highlight new areas of our networks where the risk of trees falling onto the line has significantly increased compared with our baseline plan, and will therefore require additional intervention. We are developing a robust dataset to support this, as well as working with external experts on ash dieback to further understand this issue. At this stage we have not included these activities in our application, but we also believe this is an important risk that both network companies and Ofgem should continue to monitor. This is especially true as climate change and international travel means new pests and diseases are affecting vegetation around the UK.

Our submission only includes proposals where we have a high degree of confidence in the need, and where the supporting evidence and the link to the Storm Arwen recommendations are established. However, we are aware of other areas where we believe confidence levels will increase within RIIO-ED2. We therefore support a second reopener window for other areas that can be fully developed into high-confidence proposals which will deliver on the Storm Arwen recommendations. This window could also be used where we deliver the expected volumes of work early, and have an opportunity to deliver more over the remainder of the price control.

For example, DNOs have agreed that the national shared power cut map (NEOP) is not developed enough for inclusion in this current Storm Arwen reopener window. As this project develops, costs would directly relate to Recommendation 11 from Ofgem, and we would support these costs being captured under a later Storm Arwen reopener window.

Monitoring deliverables

Since the projects that we have included within our submission do not meet the criteria to be considered as a Price Control Deliverable (PCD),[6] we propose that the funding for these projects is treated on a ‘use it or lose it’ basis, similar to the Visual Amenity scheme. Progress in delivering these projects could be monitored through annual reporting and assessed at the end of the price control, comparing overall delivery with that funded through the reopener. We propose all DNOs work with Ofgem to confirm the details of how this would work in practice, including any necessary documentation to support this approach.

To enable this, we propose that an additional memo table is added to the Cost, Volumes and Revenue Reporting Pack (CVR Pack). We will populate this as part of the annual CVR submission, including associated commentary on progress against delivery. We have included a possible template in Annex A, as part of this submission.

6 The RIIO-ED2 Methodology Decision set out that the threshold for a PCD would be set at £15m.

RESTORING OVERHEAD LINE RESILIENCE (ROLR)

The following section sets out how the ROLR project meets Ofgem's requirements as set out in the guidance, and provides the detail for our ask of £2.08m.

Ofgem content checklist:	**Met?**
All Re-opener applications must include a needs case whether or not this is a specified requirement of the relevant Re-opener licence condition or specific Re-opener Guidance. The needs case must contain the following:	✓
<u>Alignment with overall business strategy and commitments:</u> The application must include a clear statement of how the proposed expenditure aligns with the licensee's future business strategy, including consideration of how it relates to the licensee's RIIO-2 licence or other statutory obligations and, if relevant, its business plan for future price control periods.	✓
<u>Demonstration of needs case / problem statement:</u> The application must include a clear statement as to the need for the proposed expenditure or the problem the licensee is trying to address in the context of its significance for consumers, network assets, and wider society. The affected consumers or assets must be identified, and the associated risk being addressed quantified, where possible.	✓
As well as demonstrating the needs case, the application must also provide the rationale for the level of expenditure proposed and why this level should be regarded as being efficient.	✓
<u>Consideration of options and methodology for selection of the preferred option</u> The application must include a clear description of the list of options considered and the selection process undertaken to reach the preferred option. This must include the following, subject to being able to provide this (see guidance section 3.3):	✓
a clear description of the various options considered, setting out the key features of each option, this should include options considered that were not ultimately adopted	✓
a 'do minimum' option to act as a counterfactual to demonstrate the financial impact of no additional investment or programme expenditure taking place	✓
an option to delay proposed capital expenditure recognising the option value of such delay	**N/A**
a market-based option, where there is a valid market-based option (for example the use of commercial arrangements such as the use of interruptible contracts as an alternative to network reinforcement)	✓
a clear statement of the criteria used to assess the various options and the assessment of each option against these criteria	✓
a brief description of the process used to select the options: either the internal process (for which relevant documents should be included) or the existing industry process	✓
an appropriate sensitivity analysis, using relevant statistical or other techniques	**N/A**
a clear summary of any Cost Benefit Analysis / Engineering Justification that should be carried out in accordance with guidance requirements (see paras 3.22, 3.23)	**N/A**

a justification for the proposed timing of additional expenditure	✓
Detail on the preferred option The application must include a clear description of the preferred option, sufficient to allow Ofgem to make an informed decision on if the preferred option is suitable. This must include all of the following, subject to being able to provide this (see guidance section 3.3):	✓
a clear description of the key features of the preferred option including how that option will address the issues set out in the demonstration of needs case / problem statement	✓
a clear statement of the benefits to customers, both quantitative and qualitative, of the preferred option	✓
if the preferred option is predicated on a particular scenario, a clear description of the scenario	**N/A**
a clear statement of the key benefits of the preferred option along with any drawbacks identified	✓
a register of the various assets or programmes of work that will be impacted by implementation of the preferred option	**N/A**
evidence of the technical feasibility of the preferred option, using technical annexes as appropriate	✓

Alignment with Business Strategy and Commitments

Tree cutting and vegetation management play a key part of our Business Strategy, as outlined in Section C of our RIIO-ED2 Business Plan. An effective tree cutting programme helps us to manage the risks on our network, as well as contributing wider benefits including reliability improvements. Further details on our approach are set out in Chapter 7 of our Business Plan.[7] We also recognise that tree-cutting can have an environmental impact, and our Environmental Action Plan details the various steps we have in place to offset the environmental impact of our activities, including that associated with tree cutting.[8]

Demonstration of Needs Case / Problem Statement

Analysis by the National Forest Inventory indicates that SHEPD has 4,946km of 11kV and 1,791km of 33kV of overhead line network within tree falling distance. Managing these trees falls outside of the mandatory safety requirements associated with the Electricity Safety, Quality, and Continuity Regulations (ESQCR). We also require landowner cooperation to allow us to remove these trees. This activity often comes at the inconvenience of the landowner, and we therefore need to explore options for minimising that inconvenience where possible.

Storm Arwen highlighted the challenges associated with operating and maintaining overhead lines that run through or alongside areas of dense woodland. During the storm, our network suffered severe damage, particularly in the North Caledonia region of SHEPD. This damage was caused in different ways, ranging from small pockets of damage caused by individual trees to large swathes of damage in the commercial tree crops that cover large sections of Scotland. Figure 2 below shows the coverage of woodland areas across the Grampian Region of Scotland.

7 Maintaining a Resilient Network (Chapter 7)

8 Environmental Action Plan (Annex 13.1)

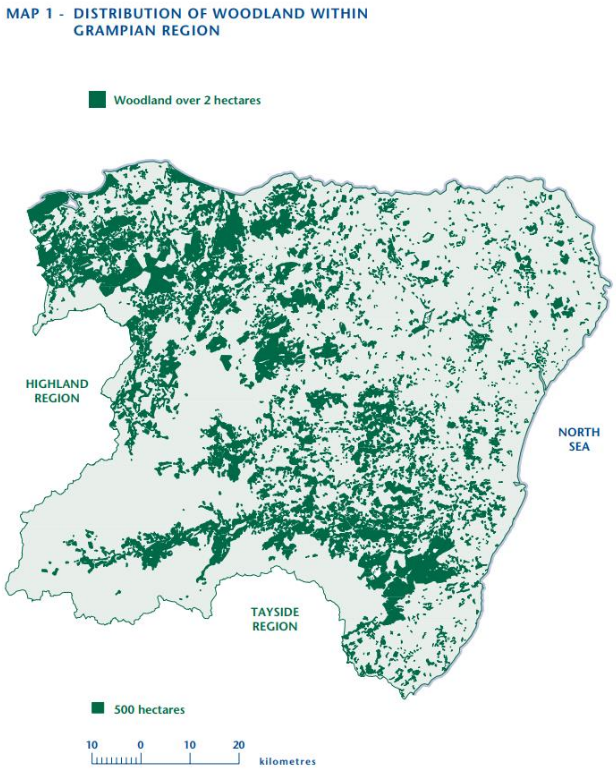

Figure 2: Map of the Grampian region of Scotland, showing woodland (dark green) areas over 2 hectares.

It was initially thought 4,000 hectares of woodland had been affected during storm Arwen, but that has now been revised to 8,000 hectares, or about 16 million trees. In most cases, these were associated with both state- and privately-owned forestry crops run for commercial return. These crops include non-native species that are more susceptible to windthrow,[9] rapidly de-stabilising as individual trees fail. In many cases, crops which didn't entirely fail during storm Arwen developed endemic windthrow resulting in ongoing tree related faults.

Both Ofgem and the E3C included a specific recommendation[10] on how the relevant industry standards could be reviewed to increase overhead line resilience to severe weather storms. Those standards include recommendations of measures that DNOs can take to ensure networks are able to withstand severe weather, including vegetation management approaches to support that resilience.

Other storms in addition to Storm Arwen have also caused damage to our overhead line network. Subsequent named storms including Barra (December 2021), Corrie and Malik (January 2022) also caused severe damage to both our licence areas. Table 7 below summarises the impact of these four storms on our network and our customers.

9 This refers to trees that are uprooted and knocked over by the wind.

10 Ofgem recommendation 1, and E3C recommendation E2

Measure	Impact
Customers interrupted	309,000
Customer minutes lost	395,000,000
Guaranteed Standards payments (severe weather standard)	£15m
Staff overtime	More than 6,000 hours logged
Customer Welfare	Over 25,000 meals & 50,000 hot drinks provided

Table 7: impact of named storms on SSEN networks.

While all storms have an impact on overhead lines, Storm Arwen brought particular challenges with long lasting effects on the network. We have addressed the most pressing risks through a dedicated programme of capital investment on our 33kV network, focusing on the most urgent sites. These are the sites which proved to be a weak point in the network during the storm, and which provided the most immediate benefit from an intervention.

However, there are remaining sites across the network which either pose an existing risk, or which will become a risk in a future storm event as a direct result of the damage caused by Storm Arwen. Some of these sites are the source of continued customer complaints due to repeat interruptions. We have not been able to address these issues through our existing maintenance programme, nor through our Worst Served Customer programme since this programme is focused on improving underlying performance issues, rather than improving storm resilience. This project aims to address the issues at these sites by managing the trees that surround the network.

The photographs in Figure 3 and Appendix 1 show the types of sites that are at the heart of these complaints. In many cases Storm Arwen damaged large swathes of trees but left those closest to the line still standing. The remaining trees are no longer protected from the wind and are exposed from all directions.[11] This means they present a new storm resilience risk that did not exist before Storm Arwen. Addressing these sites would not fall under our business as usual (BAU) maintenance tree cutting work as they are currently further away from the overhead line than our clearance and cutting specifications of three metres. Under ETR 132, we cannot cut healthy trees since the risk assessment points towards managing diseased trees. ETR 132 allows tree cutting outside of the three metre clearance where the falling distance of a diseased tree would impact the network. We are therefore looking to carry out more mechanised cutting to tackle healthy trees within the falling distance of the line, where these have been identified as a risk to the network since Storm Arwen.

11 These trees would only be disturbed again during another storm event, as proven during Storm Barra, Malik, Corrie, Babet & Gerrit.

Figure 3: Healthy trees turned into a network threat due to the domino effect of Storm Arwen damage

Since we only identified these sites after we submitted our business plan, they were not funded in our price control settlement. If we reprioritised our ETR 132 programme of work to cover these sites, this would come at the expense of sites identified and prioritised as part of the business plan. Carrying out this dedicated project will ensure we can undertake work at all sites where we have assessed the risk is high, without compromising our ability to deliver our BAU work.

We plan to address these sites through this project in RIIO-ED2, primarily with specialist equipment to reduce the impact on customers. By working with the commercial tree growers and their harvesting programmes, we expect to facilitate better and more targeted planned operations to meet both parties' needs. We are considering this as part of a longer-term approach to managing the network's resilience to severe weather conditions.

It is worth noting that the Scottish Government's forestry strategy 2019-2029[12] seeks to increase the forest estate from its 2018 level of 18.5% of land area, to 21% by 2032. This means around 190,000 hectares of new planting will be needed, 32,000 of which had been delivered by the publication of their 2022 progress report.[13] With no legislation protecting the overhead powerline network from forestry development, it is likely that we will see increased pressure on the network from the presence of dense forestry as this strategy is delivered.

ETR 132 requirements

All network operators, including DNOs, are expected to improve the resilience of overhead networks under abnormal weather conditions, by following ETR 132. This sets out a risk-based methodology that provides guidance on how to improve the resilience of overhead networks to severe weather. The faults that typically occur in these conditions are often caused by the proximity of vegetation to our overhead lines. This means we need to consider how to make the network resilient to problems caused by falling trees and/or wind-blown tree

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12 https://forestry.gov.scot/publications/373-scotland-s-forestry-strategy-2019-2029/viewdocument/373

13 https://forestry.gov.scot/publications/1443-scotlands-forestry-strategy-progress-report-2019-2022/viewdocument/1443

branches. Where an assessment under ETR 132 identifies a tree as being at 'high risk' to the network, we remove that tree or manage it so that it cannot fall onto the network (by reducing its height).

ETR 132 recognises that there may be restrictions on the amount of tree cutting and/or removal that can be carried out. It considers other options, alongside resilience tree cutting, for enhancing the resilience of overhead lines to storms. These include construction choices for overhead lines (whether using wood poles or towers), enhanced network protection or automation, and network diversion and undergrounding.

Consideration of Options

Following Storm Arwen, we established a £1.2m shareholder-funded programme of work to target the most at-risk parts of our network, including areas that posed a new threat to the network.[14] The project identified 371 sites, and funded interventions in the highest priority sites. Of these 371 sites, we surveyed 85 and intervened in 19. The interventions took the form of reinforcement on strategic points of our 33kV network and installing high voltage underground cable to replace the overhead spans at risk.

For the remaining sites, we have considered a range of options as outlined in Table 8.

Option	Detail	Sites to address	Cost
1 – Do nothing	Operate the network in its current state. Respond reactively to the faults that occur to restore supplies quickly and safely.	None	N/A
2 – Work on all identified sites	Work on all sites identified through a mixture of maintenance, harvesting and capital solutions.	352	£10.2m
3 – Work on maintenance sites only	Work on only sites that need a 'maintenance' solution.	183 - Delivery timing would be driven by the four-year maintenance cycle.	£1m
4 – Work on capital investment sites only	Work only on those sites requiring a capital investment. Prioritise this work for delivery [redacted]. Would require a large investment.	56 - These would be added to the portfolio of sites to be addressed, for consideration by Asset Management.	£7.6m
5 – Work on harvesting sites only	Work at those sites only requiring tree harvesting solutions. Allow us to address the more challenging sites. Would need investment in additional machinery to deliver this work.	131 (using a specialist equipment). Our existing machines are fully utilised in delivering our planned programme of works.	£2.08m

Table 8: Summary of options for ETR 132 work.

Assessment of options

Table 9 provides a summary of the assessment against some key criteria.

14 By new threat we mean a risk that did not exist before Storm Arwen, and one which we had not included in our RIIO-ED2 business plan programme of works.

Option	Reduces most risk	Cost	Deliverability
1. Do Nothing			
2. Work on all identified sites			
3. Maintenance sites only			
4. Capital investment sites only			
5. Harvesting sites only			

Table 9: Assessment summary of options for ETR 132 work

Option 1 – do nothing
This is the cheapest approach where we leave the sites identified as being at risk following Storm Arwen as they are, and respond to any faults there on a reactive basis. This would not address the recommendation from Ofgem and the E3C, and would leave customers exposed to the effects of severe weather. We do not consider this a viable option.

Option 2 – work on all identified sites
Carrying out work at all the sites we identified following Storm Arwen would ensure we address all the risk we are aware of. This would be a comprehensive project that prepares this part of the network for future storm events, carrying out different solutions at each site depending on its need.

This is a high cost approach, needing three different strands of work covering maintenance solutions, harvesting solutions, and capital investment. We would not be able to deliver this project without compromising the delivery of our BAU work funded through RIIO-ED2. We would need to use contractors to be able to deliver the capital elements of this work. [redacted]. This combination means we are not confident that we would be able to deliver this work over the course of RIIO-ED2.

Option 3 – maintenance sites only
This would involve working at only those sites that need a 'maintenance' solution, carrying out hand cutting to remove vegetation from within three metres of the overhead line. Typically lower cost solutions which would reduce our overall cost of delivery, these would allow us to target some of the risk left by Storm Arwen. Through this approach, we would be able to intervene at around half the sites we identified following Storm Arwen.

However, this approach would leave some of the highest risk sites unaddressed, meaning the network is still exposed to the risk left by Storm Arwen. While this approach would allow us to target a high volume of sites, we would need additional staff to deliver this work due to existing commitments from our own internal staff and contract partners. [redacted] it is therefore likely that this approach would compromise delivery of our BAU work funded through the price control. We therefore do not consider this a viable option.

Option 4 – capital investment sites only
This would involve working on only those sites that require a capital investment solution, such as diverting existing lines or undergrounding overhead lines. These solutions may deliver long-term resilience in these locations. We would need to prioritise this for delivery and, as outlined under Option 2, this would rely on contractors for delivery.

This would also be a high cost approach. These are the most expensive interventions, [redacted]. In some sites, the topography and geological conditions mean undergrounding is a circuit is very difficult. [redacted], [redacted]. It would be very challenging to add additional sites to our portfolio of work to deliver. The alternative would be to deliver these sites in place of those projects funded through our BAU programme. The combination of high cost, impact on BAU work and low delivery confidence mean we do not consider this a viable option.

Option 5: Harvesting sites only
This option will target those high risk sites where we can deliver resilience solutions by removing or cutting back the trees around the network that pose a risk to our assets. This also allows us to deliver this work without affecting delivery of our existing ED2 programme of works, meaning we can target this investment in a way that will best serve the network.

Our existing equipment is already fully utilised in delivering our RIIO-ED2 programme, and diverting it to focus on these sites would mean we are not able to deliver our underlying maintenance work. The complex nature of many of the new sites, and the dangers presented by caught up trees, means we will need to use specialist equipment to manage the risk at these sites. For example, we will need to invest in an additional live line harvester to safely remove trees within falling distance of the overhead network, without interrupting customers or putting our colleagues or the public at risk. We would also need to procure a Merlo[15] to remove trees (either wholly or in part) at sites across our network. This will also ensure we are reducing the risk to our staff or the public, and we can target its deployment to the most suitable scenarios. Finally, we will need a mulcher to address those areas with lower lying vegetation and/or smaller trees that still pose a risk to the network.

Working in these circumstances requires specialist skills and a dedicated team to manage the overall project. The most effective way to deliver these interventions would be through separate, dedicated resources. We have good framework contracts in place with specialist contractors, meaning we can access the resources needed to deliver this extra programme of work. [redacted] we are therefore confident that we could secure the resources we need. We will also appoint a dedicated project manager to oversee and coordinate the delivery of this extra work.

We recognise that this option addresses only around a third of those sites identified following Storm Arwen. We believe this represents an appropriate balance between addressing the sites most at risk without affecting delivery of our BAU work. We will continue to monitor the remaining sites identified and intervene where we can.

Preferred Option

Option 5 is our preferred option – it is the most cost effective solution for managing the risk to the network following Storm Arwen. Of the options which are deliverable in RIIO-ED2, it delivers the best value to customers in terms of addressing some of the higher risk sites and has the least impact on delivery of BAU work.
As part of this project, we will conduct an additional helicopter survey of the entire North Caledonia 33kV overhead line network to re-assess the condition of adjacent vegetation. This will help us to:

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15 The Most Versatile, Compact Tree Removal Machine - Merlo Roto | Merlo (ams-merlo.com)

a) validate the success of work delivered since Arwen;
b) check for windthrow creep or expansion of the damaged crop areas not yet harvested; and
c) check for new crop damage that has developed since the last post-Storm Arwen flight.

We will also conduct a further helicopter survey of priority sections of the 11kV network, focusing on areas with high density commercial forestry and high volumes of tree-related faults. As with the survey of the 33kV network, this will help us assess the condition of the network in these crucial locations.

There are two main drivers for the additional surveys: to give us the most up to date information on the condition of the sites that we need to address; and to identify opportunities for third parties (i.e. landowners) to manage sites themselves. This will make sure we are targeting interventions at the most at risk sites, which we will supplement with proactive engagement with those stakeholders with an interest in the sites around our assets.

Once the surveys have identified the full extent of work required, a mixture of live line hand cutting and utilisation of additional machinery will be deployed to remove the risk to the network. Our existing machines (which include a live line harvester, [16] a Merlo[17] and a mulcher[18]) have proven the benefits they can deliver in relation to network risk and fault performance (as well as staff safety and environmental impact[19]), but are fully utilised in delivering our existing projects. We would therefore need to deploy additional machines to deliver this work. We believe we would be able to procure them within six months of funding being confirmed and, in combination with a dedicated project manager to run the project, would be able to start work on these sites.

Where our overhead lines run through areas of commercial forestry, our interests and those of landowners do not always fully align. In reviewing the situation following Storm Arwen, we have identified further opportunities to engage with the forest managers to explore whether the type and/or location of trees planted could be organised in a way that reduces the risk to our assets. This has the potential to reduce the impact of trees on our network, and reduce our overall operating costs (and therefore costs to our customers). It will also benefit the landowners by reducing the number of trees we need to cut to meet statutory obligations and/or industry guidance. We will continue to explore how we manage this issue through RIIO-ED2 and into RIIO-ED3.

At this stage, we anticipate that we will address an initial 131 sites out of the 371 sites identified following Storm Arwen over the remainder of RIIO-ED2; the helicopter surveys will validate this. We will prioritise sites for intervention based on the risk they pose to the network, in accordance with the ETR 132 risk guidance.

Cost breakdown

As set out above, we expect to carry out tree harvesting work at 131 sites across our network, following a helicopter survey. We will need to purchase an additional live line harvester, a Merlo and a mulcher, and appoint a dedicated project manager. The project manager will oversee delivery of the measures outlined here, and keep this work separate from our BAU tree cutting activities. We will not be able to deliver this project without this dedicated resource. A breakdown of these costs is given in Table 10.

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16 [redacted]

17 [redacted], which can safely dismantle any tree while minimising danger to the workforce.

18 [redacted]. This particular remote-controlled mulcher has now proven its capabilities within our BAU operations.

19 The use of these machines has reduced CO_2 emissions from operations associated with third-party forestry works by over 9,000 tonnes, by removing the need for diesel generation.

Types	Average solution cost	Volume	Cost
Harvesting op. costs	£[redacted]	[redacted]	£[redacted]
Helicopter Survey	£[redacted]	[redacted]	£[redacted]
Mechanisation investment			
Plant	**Cost**	**Units**	**Cost**
Merlo	£[redacted]	[redacted]	£[redacted]
Live Line Harvester	£[redacted]	[redacted]	£[redacted]
Mulcher	£[redacted]	[redacted]	£[redacted]
Project Management			
Project Manager	£[redacted]	[redacted]	£[redacted]
Total cost			**£2,080,060**

Table 10: A breakdown of the costs for the ROLR project.

Cost recovery arrangements

We will report these costs through C6 – Vehicles and Transport, and CV29 – Tree Cutting of the CVR pack, and in the proposed Mx – Storm Arwen monitoring memo table (included in Annex A). The cost of buying the additional machinery will be reported in C6; the ongoing costs of carrying out the harvesting work will be reported in CV29. Table 11 sets out our proposed phasing of this expenditure.

RIIO-ED2	23/24	24/25	25/26	26/27	27/28
SHEPD	-	£[redacted]	£[redacted]	£[redacted]	£[redacted]

Table 11: Phasing of expenditure in RIIO-ED2

Expected outcomes

Removal of windblow sites created due to Storm Arwen will provide several benefits to the network, and how we manage these sites.

The main benefit is the reduction in vegetation-related faults during severe weather in North Caledonia. This will lead to a better overall quality of service for customers served by this part of the network, monitored in the form of lower Customer Interruptions (CIs) and Customer Minutes Lost (CMLs). During severe weather, we do not see this IIS performance benefit when we meet Severe Weather Exceptional Event threshold, meaning there is no business case to fund this work through that incentive.

Fewer faults during severe weather will bring two additional benefits. First, a reduction in the number of customer complaints that we receive in relation to faults on this part of the network. Second, we will be able to use the resources that would otherwise have been dedicated to fixing these faults on other parts of the network. We would expect this to mean a reduction in CI and CML values for other parts of the network too, though this will always depend on the nature of any storms and the skills required to fix any faults that do occur. The scale of any benefits that this realises is dependent on the type and scale of faults that occur. This uncertainty means there is no business case to fund this project elsewhere in the price control.

We also expect this project to bring benefits in terms of our ability to deliver these additional works concurrently with our programme of work to meet our baseline commitments. As set out, having a separate and dedicated project to address the sites affected by Storm Arwen alongside our existing work means we can target the investment where it is most needed. This will ensure our customers get the level of service we committed to delivering as part of our RIIO-ED2 business plan.

Finally, we expect this project to facilitate more active discussion and planning of work with landowners around our overhead lines. We are keen to explore opportunities for planning where trees are planted around our assets, to reduce the impact of storms on both our assets and the commercial crops managed by private landowners. Having a targeted project for these sites will enable more active discussions with landowners to agree how we can work better together in the future to avoid the need for lots of trees to be felled to reduce the risk to our assets. We believe this will reduce the impact of storms on both SSEN and the private landowners.

Conclusion

An investment of £2.08m will mean we can address the greatest risks to the overhead line network induced by Storm Arwen. This means we can meet Ofgem and the E3C's recommendation around identifying improvements that could increase network resilience to severe weather events. Without this targeted project, the vegetation around our overhead line network will continue to pose a risk to our assets and reduce our network's overall resilience.

The North Caledonia region of SHEPD faces a virtually unique challenge on the overhead line network. Large scale, dense commercial forestry means the risk of tree-related faults is always present. That risk is exacerbated during storm conditions, when strong and persistent winds have the potential to bring down large numbers of trees around our overhead lines. Storm Arwen showed how real this risk is, and that clearing fallen trees in these environments requires specialist skills and equipment.

We have identified around 350 sites which pose a threat to the network as a direct result of Storm Arwen. The ROLR project takes steps to address the risks at some of the highest priority sites. Informed by an additional helicopter survey of the overhead lines, we will target these sites with appropriate measures to manage that risk. This will reduce the impact of future storms on customers served by these parts of the network.

In addition, the Scottish Government's Forestry Strategy means commercial forestry in Scotland is likely to expand. Energy network assets have limited protection from the existing legislation, and any expansion of forestry is likely to mean more of our assets are within or in close proximity to high density woodlands. This therefore demands a change in how we manage our network, and how we work with landowners and the Government to facilitate increased forestry whilst maintaining a reliable network. The ROLR project helps us begin discussions with landowners, by targeting sites that were affected by Storm Arwen. We can use that to engage around future forestry plans and how we manage our network as we plan for RIIO-ED3. We believe there needs to be a focus on:

- Improved legislation and guidance to the forestry sector, to help reduce the impact of forestry on electricity networks. This will involve granting more rights or Forestry exemptions under the Electricity Act, or for better controls for how close commercial crops are planted to the network. It could also include guidance on woodland design options that are compatible with network needs.
- A new wayleave strategy that targets priority sections of the network, working with existing woodland managers to modify forest design to reduce the volume of high risk commercial crop in close proximity to

our assets. This may result in a need for additional budgets to allow woodland managers to be compensated for commercial loss, and the creation of servitudes to secure land rights. It would also require additional investment in specialist land/forestry managers to liaise with landowners and commercial growers to deliver modified forest management plans that deliver network resilience. We will explore this through the Wayleaves and Diversions Uncertainty Mechanism.

HV FEEDER MONITORING

The following section sets out how the HV feeder monitoring project meets Ofgem's requirements as set out in the guidance, and provides the detail for our ask of £6.65m.

Ofgem content checklist:	Met?
All Re-opener applications must include a needs case whether or not this is a specified requirement of the relevant Re-opener licence condition or specific Re-opener Guidance. The needs case must contain the following:	✓
Alignment with overall business strategy and commitments: The application must include a clear statement of how the proposed expenditure aligns with the licensee's future business strategy, including consideration of how it relates to the licensee's RIIO-2 licence or other statutory obligations and, if relevant, its business plan for future price control periods.	✓
Demonstration of needs case / problem statement: The application must include a clear statement as to the need for the proposed expenditure or the problem the licensee is trying to address in the context of its significance for consumers, network assets, and wider society. The affected consumers or assets must be identified, and the associated risk being addressed quantified, where possible.	✓
As well as demonstrating the needs case, the application must also provide the rationale for the level of expenditure proposed and why this level should be regarded as being efficient.	✓
Consideration of options and methodology for selection of the preferred option The application must include a clear description of the list of options considered and the selection process undertaken to reach the preferred option. This must include the following, subject to being able to provide this (see guidance section 3.3):	✓
a clear description of the various options considered, setting out the key features of each option, this should include options considered that were not ultimately adopted	✓
a 'do minimum' option to act as a counterfactual to demonstrate the financial impact of no additional investment or programme expenditure taking place	✓
an option to delay proposed capital expenditure recognising the option value of such delay	**N/A**
a market-based option, where there is a valid market-based option (for example the use of commercial arrangements such as the use of interruptible contracts as an alternative to network reinforcement)	✓
a clear statement of the criteria used to assess the various options and the assessment of each option against these criteria	✓
a brief description of the process used to select the options: either the internal process (for which relevant documents should be included) or the existing industry process	✓
an appropriate sensitivity analysis, using relevant statistical or other techniques	**N/A**
a clear summary of any Cost Benefit Analysis / Engineering Justification that should be carried out in accordance with guidance requirements (see paras 3.22, 3.23)	✓
a justification for the proposed timing of additional expenditure	✓

<u>Detail on the preferred option</u> The application must include a clear description of the preferred option, sufficient to allow Ofgem to make an informed decision on if the preferred option is suitable. This must include all of the following, subject to being able to provide this (see guidance section 3.3):	✓
a clear description of the key features of the preferred option including how that option will address the issues set out in the demonstration of needs case / problem statement	✓
a clear statement of the benefits to customers, both quantitative and qualitative, of the preferred option	✓
if the preferred option is predicated on a particular scenario, a clear description of the scenario	**N/A**
a clear statement of the key benefits of the preferred option along with any drawbacks identified	✓
a register of the various assets or programmes of work that will be impacted by implementation of the preferred option	**N/A**
evidence of the technical feasibility of the preferred option, using technical annexes as appropriate	✓

Alignment with Business Strategy and Commitments

The Interruptions Incentive Scheme drives DNOs to minimise the number and duration of faults on their network, to reduce the impact on customers. This is a priority during storms, and we have a particular focus on restoring vulnerable customers' supplies as quickly and safely as possible. The Broad Measure of Customer Service also drives DNOs to provide good quality customer service. That includes our ability to provide good quality and accurate information to customers in relation to faults. Customers often tell us that they want an accurate estimated time of restoration, even if that is a worst case scenario, as it helps them prepare accordingly. These two incentives work together to drive us to keep customers informed about when their supplies will be restored, and to work quickly and safely to get everyone back on supply.

DNOs use a range of measures to reduce outage times, such as automation and remote control switching, or the use of protection relays to identify faults and minimise their impact. For certain locations on the network, and especially during storms, there is a limit to what can be achieved remotely, and a repair is the only option to restore supplies. Knowing where the fault is located is crucial to this process.

Demonstration of Needs Case / Problem Statement

Storm Arwen Review and Recommendations

Two of the E3C and Ofgem recommendations focused on the process for "*identifying faults and assessing the extent of network damage*",[20] aimed at reducing restoration times and the impact on customers.

GHD's report into the DNOs' response to Storm Arwen identifies that most customer restorations within 24 hours (77.4% in SSEN's case) were carried out through network switching.[21] Longer restoration times for other customers were driven by a combination of the volume of repairs required, travel and access difficulties, the wide-ranging extent of the areas impacted, the resources available and their utilisation. The report concludes that the effective deployment of resources was a major factor in influencing progress in supply restoration.

20 Ofgem recommendation 6 and E3C recommendation R1

21 GHD - Storm Arwen Review Main Report.pdf (ofgem.gov.uk)

We use a range of measures to reduce outage times, such as automation and remote control switching, or the use of protection relays to identify faults and minimise their impact. For certain network locations, and especially during storms, there is a limit to what can be achieved remotely, and a repair is the only option to restore supplies. Accurate fault location can reduce outage times for customers who cannot be restored by automation.

Identifying a fault's location depends on several factors, such as notifications from customers that they have lost power, and signals from devices such as Fault Passage Indicators (FPIs) and Pole Mounted Circuit Breakers (PMCBs). These indicate the area(s) of the network that are affected by the fault, and can give some indication of the specific location of the fault. However, this still leaves a relatively large section of the network that must be inspected, usually on foot. This can be even more difficult at night and/or during storm conditions.

Technology development

HV feeder monitoring technologies help improve the visibility of defects on the network, leading to more accurate detection and pinpointing of fault locations. This enables the following functions:

- **Control Room** – Control Engineers are better informed when making decisions and planning switching operations to restore supplies; and
- **Operational staff** – more accurate dispatch of field staff to fault locations, either by eliminating the need for a line patrol or reducing the length of network that needs to be patrolled to identify fault locations.

During storms, where there are high volumes of network damage instances affecting large numbers of customers, improvements to our understanding of where faults are can have a notable improvement on restoration times. Increased visibility of fault locations helps to prioritise resource allocation for repairs and reduce the time needed for damage location and line patrols.

In 2019, SSEN partnered with UKPN to trial [redacted] tool as part of the HV Feeder Monitoring Network Innovation Allowance (NIA) Project.[22] The trial results were extremely positive, demonstrating the ability to better locate faults and, in some cases, anticipate faults before they result in an outage. This gave us confidence in the use of this type of technology. We are now in a position where rolling this solution out at key sites across our networks can deliver targeted benefits in the terms of improved restoration times during storm conditions. However, our baseline RIIO-ED2 allowances are already allocated to other work.

Technical solution

The technical solution we are targeting [redacted]. [redacted] captures highly granular real time current and voltage data, and uses high-precision waveform analysis to monitor the condition of the circuit (see Figure 4). Some more sophisticated options capture very high-resolution data which can then be assessed using proprietary analysis techniques to predict the location of possible degradation before they result in an outage.

The findings of this analysis are reported through a web-based interface, emails or SMS. Trained users can review waveform data of the fault occurring, to identify likely cause characteristics, as well as modelling waveforms to ascertain possible or likely locations within 30 minutes. Targeted investigations can then be carried out without the need for time-consuming line patrols, helping restore customer supplies sooner. There will also be added visibility of what potentially caused the fault, such as overhead lines down, trees impacting the network, insulator failure, plant failure, animals etc.

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22 HV Feeder monitoring to pre-empt faults | ENA Innovation Portal (energynetworks.org)

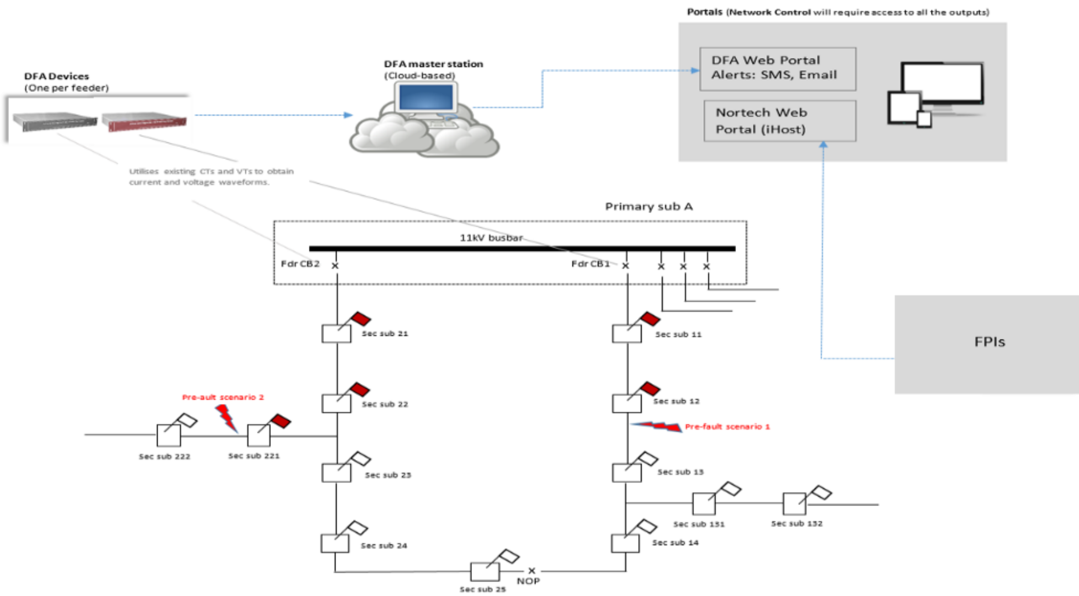

Figure 4: Simplified diagram of the DFA-Plus configuration on the network. Other devices may vary, but are likely to follow a similar configuration

There may be scope to use some of the data our control rooms already receive, overlapped with information from the monitoring technology we plan to install. This combination of information would help us make more granular assessments of where a fault occurred. For example, if the information from the monitoring technology suggests a fault is in location A or B, we may be able to use our control room data to help identify which of the two sites is most likely.

We will also look to deploy these monitoring devices alongside projects or functionality that have been funded through baseline RIIO-ED2 allowances. For example, we have work in train to explore how Power Quality Recording (PQR) devices can be most effectively used across the network. While PQRs help us understand what is happening on the network, they do not (on their own) give us the detailed information we need to locate faults more accurately. Therefore, deploying feeder monitoring technology alongside these existing projects will give us additional functionality and visibility of the network that we are not able to achieve with BAU funding.

There is a growing field of HV feeder monitoring technology as the market matures. This has partly been driven by the outcomes of innovation projects on the electricity networks, and partly due to supplier development. The devices below provide similar fault detection abilities [redacted]; all are FPIs in their core form, which would be used alongside the FPIs we have on the network already.[23] The combination of existing devices and additional data from new technology will be brought together to support fault location. We recently issued a Request for Information (RFI) to the market looking for vendors who could supply products of this type; we had 19 responses. Some examples are summarised in Table 12.

23 FPIs can give additional data which can be used to supplement, or in some specific cases directly feed, a fault location algorithm.

Technology	Description	Features
Megger MS5000	FPIs that attach to overhead lines.	Designed for fault location, isolation and service restoration. They detect and report abnormal events such as surges and current/voltage drops.
Nortech Smart Navigator 2.0 Fault Passage Indicator	FPIs that attach to overhead lines.	Provides directional overcurrent and earth fault indication, conductor temperature monitoring, and directional power flow detection.
Kelvatek Linesight	Overhead Line HV Monitoring solution that is attached to wood poles	Detects signatures of developing issues, identifies where a fault will occur before any outages, and can locate developing issues and faults. It can also identify and locate nested faults during storms.
EMS	Web-enabled multi-functional power monitoring system	Records, analyses and classifies faults. It is linked to GIS to derive possible fault locations, and records and analyses transient and self-clearing faults; if common locations are identified these can be repaired before a permanent fault occurs.

Table 12: Summary of other HV feeder monitoring technologies.

The RFI has been helpful in informing the cost point of devices for this submission. However, we plan to run a full, technology agnostic procurement exercise if awarded funding. Consequently, we have focused on the scale of roll out rather than the technology type.

Options considered

We have considered a range of roll out options against a counterfactual of 'Do Nothing'; table 13 provides a summary of these. All options are informed by the results of the RFI, outlined in the next section.

Option	Description
1. Do Nothing	No roll out of the HV monitoring technology
2. Low level roll out in ED2 ([redacted] of network)	A small roll out [redacted] in both networks, to provide further learning ahead of a broader roll out in RIIO-ED3
3. Moderate roll out in ED2 ([redacted] of network)	More substantial roll out [redacted] across SSEN. CBA models rollout onto those circuits that provide the greatest benefit.
4. Roll out to [redacted] **in ED2** ([redacted] of network)	Large scale roll out [redacted]. Roll out would be similar to Option 3 but with greater coverage provided.

Table 13: Roll out options for HV Feeder monitoring.

Options assessment

We have undertaken both quantitative and qualitative analysis on the options to arrive at a preferred option.

Quantitative assessment

Our quantitative assessment focused on the benefits case for installing a monitoring device at each feeder. This assessment looked at the expected benefits in the form of CML savings at each feeder, based on its fault history over the previous five years. We analysed the faults by type and assessed the scenarios where we respond to a fault that has occurred (known as 'post-fault' scenarios). We are aware that the technology can provide some support in pre-fault identification, and we will be analysing the information that comes from these devices to understand how we can act on this in the future.

For the post-fault scenarios, we used historical data to look at the types of faults that could not be predicted and how the monitoring device could be used to provide enhanced fault location for field staff. This would result in a faster restoration time and a better customer experience of being back on supply more quickly. Therefore, the benefit for this scenario was based on a reduced CML for each fault that had occurred; though in an Exceptional Event, we would not receive this benefit due to the exclusion of these faults from our overall performance.

Based on this information, we ranked the feeders by value to identify where the greatest benefit from installing monitoring devices would be. This analysis identified that over [redacted] feeders would be cost beneficial, across both our licence areas, based on average cost per feeder and our medium use case.

Qualitative assessment

We do not have internal resource available to install and set up the monitoring devices. Consequently, we will be relying on contractors to do this. Based on engagement with them to understand capacity, they have assured us they can install around [redacted] across the RIIO-ED2 period, [redacted].

Preferred option

Based on this analysis, Option 3 (Moderate roll out in ED2) is our preferred option. Engagement with the supply chain gives us confidence that we can deliver this scenario, but higher volumes (as per Option 4) would carry significant deliverability risk. Since we are confident that we can deliver Option 3, there is limited benefit in modelling Option 2. We have undertaken a CBA (as set out in the next section) to test the benefit case for this scale of roll out under a high, medium, and low scenarios.

Cost Benefit Analysis (CBA)

Assumptions used in the CBA

We assumed that each type of fault anticipation technology will produce very similar benefits; we do not expect there to be material differences between the devices from various companies. The returns from the RFI have not been fully evaluated at the time of submission, but we have examined the prices of two vendors (one from the lower end of the range, and one from the higher end) in the cost benefit analyses.

We focused the CBA on restoration times, but following deployment we will explore how data from the technology can provide insights into how we can avoid faults; this is a recent development from this technology, and we are still understanding what this means in practice. Benefits in that scenario may be deliverable, but we cannot quantify them at this stage.

We used actual fault data from the previous five years, averaged to provide a single year value. These models allowed us to rank feeders by the benefit they could deliver, and identified over [redacted] feeders that would provide an overall benefit with a monitoring device installed.[24] On this basis, rollout of this technology becomes about deliverability and how many feeders we can realistically install these devices on.

Other assumptions we made in the CBA include:

- [redacted];
- Each device will take around a week to install, check and test, before being integrated with our systems to allow us to monitor the data (over time we expect to be able to carry out simultaneous installations at some points);
- Each device has a 15 year lifespan;
- The data used for SHEPD included the impact of Storm Arwen meaning that the CBA assumes there will be a similar event on each of the modelled feeders once every five years;
- The data for other storms was included in the data modelled; and
- We ran three levels of optimism for the efficiency of the technology in reducing faults and outage times. These are shown in Table 14 below.

Scenario	Case	% use[25]	Time saving[26]
Post fault - reducing outage times	Low	[redacted]	[redacted]
	Medium	[redacted]	[redacted]
	High	[redacted]	[redacted]

Table 14: Summary CBA scenarios.

We expect that we can deliver the medium case, given funding for dedicated staff to monitor the feeder monitoring systems, based on our current experience with the DFA-Plus devices we have trialled on our network. The high and low cases illustrate the value the HV feeder monitors would bring if the BAU performance is better or worse than expected and are modelled to stress test the benefits case for the chosen level of roll out.

The costs of the more expensive device, from Suppler 2, produced a positive benefits case in SHEPD in only the High case scenario (it had a positive benefits case for SEPD in all scenarios). Given we want to roll out the device on the same basis across our licence areas, and the high case is a higher risk roll out scenario, we have discounted the more expensive device as being viable. Therefore, we have only taken forward the modelling for the device from Supplier 1.

The benefits tables are shown below. On this basis, we are satisfied that the HV feeder monitoring technology provided benefit at the price quoted by Supplier 1.

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24 For the medium use case. For the low use case the analysis identified [redacted] feeders that would provide an overall benefit; for the high case this was [redacted] feeders.

25 This relates to how often a report from the feeder monitors will be used as the primary tool to locate a fault on the feeders they are installed on

26 This is the average reduction in outage time per customer as a result of tinding a fault more quickly

Option no.	Options considered	NPVs based on payback periods				
		10 years	20 years	30 years	45 years	Whole Life NPV
1	Low case - SHEPD	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
2	Medium case - SHEPD	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
3	High case - SHEPD	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
1	Low case - SEPD	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
2	Medium case - SEPD	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
3	High case - SEPD	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Table 15: Benefits table for Supplier 1 across the different scenarios.

Costs and Roll Out

We plan to install monitoring devices on [redacted] feeders across our network: [redacted]. This is based on ranking all feeders across SSEN based on their benefit; the top [redacted] then determined where the devices will be installed. [redacted]. As we will rely on contractors to help install the devices, we have had initial discussions with our existing partner in this space on their ability to meet this plan. They have confirmed that this volume of work is feasible over the remainder of RIIO-ED2, but at the upper limit of what is realistically deliverable.

We will target those feeders that will provide the greatest benefit, based on historical performance data. This will support us in fault finding scenarios, particularly during storms, delivering a better service for our customers through reduced restoration times. It may also allow underlying improvements to security of supplies for our customers due to the ability to detect pre-fault activity.

We have also included the cost of a project manager to oversee the procurement and rollout of the devices, and delivery of the overall project. We will look to get them in place as soon as the funding is confirmed, so they can be ready to begin rollout from the start of the 2025-26 year. Similarly, we will need a technical design manager in place to ensure that the technical requirements for installing the devices at each location are met. As with the project manager we will look to get them in place in the 2024-25 year, ready for rollout in 2025-26. Finally, we will need additional analysts to monitor and analyse the data from the devices as they are rolled out onto the network. We will appoint two analysts in 2025-26 [redacted] and an additional analyst in [redacted] 2026-27.

We need to complete final testing of the different technologies before we make a final decision on which device to roll out. Full evaluation of the returns from the RFI may find that a different supplier provides a better product (and higher benefits) for our needs at a different price. [redacted]. This is an uncertainty associated with entering a relatively immature marketplace where clear market leaders are not yet apparent. Customers will be protected from any underspend against these costs through the use it or lose it mechanism which we are proposing for all Arwen costs.

Cost breakdown	Per Feeder	Gross Total
Unit	£[redacted]	£[redacted]
Installation	£[redacted]	£[redacted]
Installation project manager(s)	£[redacted]	£[redacted]
IT Integration	£[redacted]	£[redacted]
Technical design manager(s)	£[redacted]	£[redacted]
Licensing and subscription costs	£[redacted]	£[redacted]
Data costs	£[redacted]	£[redacted]
Analysts	£[redacted]	£[redacted]
Total		**£6,652,104**

Table 16: Summary of the HV feeder monitoring rollout costs

We anticipate that staff recruitment and training for the fault analysis work would take six to nine months. Procuring the devices will happen alongside this, following a competitive tender exercise and is expected to take around six months. We expect the installation of the devices could then start from the beginning of 2025/26, [redacted], with some simultaneous installations across the three years [redacted]. This gives a total roll out time of 42 months from the funding being awarded to the technology being fully deployed, but we would start to realise benefits as soon as devices are installed on the network.

Cost recovery arrangements

We will report these costs in Table CV15 – QoS and North of Scotland Resilience of the CVR pack, as well as in the proposed Mx – Storm Arwen monitoring memo table (included in Annex A). Table 17 sets out our proposed phasing of these costs.

RIIO-ED2	23/24	24/25	25/26	26/27	27/28
SEPD		£[redacted]	£[redacted]	£[redacted]	£[redacted]
SHEPD		£[redacted]	£[redacted]	£[redacted]	£[redacted]

Table 17: Phasing of expenditure in RIIO-ED2

Outputs

As set out under the details of the CBA and the assumptions we have made, we expect the deployment of monitoring equipment across parts of our HV network will deliver:

- CML savings in responding to faults (though we will not see this benefit as storm faults are excluded from our overall performance); and
- Improved overall customer experience of being off supply, through quicker restoration times.

Conclusion

Accurately finding faults and getting staff to these locations quickly and safely is one of the main challenges we face during storms. For many parts of the network, the information we currently have available gives staff a general area of the fault, meaning they need to spend time walking the lines to find its exact location.

The HV feeder monitoring device will improve the information we receive on fault locations. Staff can use that information to go directly to that site and begin working on the repair straight away, without needing to spend time looking for the right place. Customers' supplies will therefore be restored quicker, and we will reduce the time our staff are exposed to storm conditions. This will also bring efficiencies in our costs of finding and fixing faults, and free up more resource to be able to address other faults once a repair is complete.

Both Ofgem and the E3C included a recommendation that DNOs should improve the process for finding faults and assessing network damage. The HV feeder monitoring device is an efficient and effective tool that we can use to help meet this recommendation. We plan to install [redacted] of these devices across our networks over the remainder of RIIO-ED2. This will enhance our storm response capabilities, improving the level of service we can deliver for our customers.

WOOD POLE ASSESSMENT TOOL

The following section sets out how the wood pole assessment tool project meets Ofgem's requirements as set out in the guidance, and provides the detail for our ask of £0.95m.

Ofgem content checklist:	Met?
All Re-opener applications must include a needs case whether or not this is a specified requirement of the relevant Re-opener licence condition or specific Re-opener Guidance. The needs case must contain the following:	✓
Alignment with overall business strategy and commitments: The application must include a clear statement of how the proposed expenditure aligns with the licensee's future business strategy, including consideration of how it relates to the licensee's RIIO-2 licence or other statutory obligations and, if relevant, its business plan for future price control periods.	✓
Demonstration of needs case / problem statement: The application must include a clear statement as to the need for the proposed expenditure or the problem the licensee is trying to address in the context of its significance for consumers, network assets, and wider society. The affected consumers or assets must be identified, and the associated risk being addressed quantified, where possible.	✓
As well as demonstrating the needs case, the application must also provide the rationale for the level of expenditure proposed and why this level should be regarded as being efficient.	✓
Consideration of options and methodology for selection of the preferred option The application must include a clear description of the list of options considered and the selection process undertaken to reach the preferred option. This must include the following, subject to being able to provide this (see guidance section 3.3):	✓
a clear description of the various options considered, setting out the key features of each option, this should include options considered that were not ultimately adopted	✓
a 'do minimum' option to act as a counterfactual to demonstrate the financial impact of no additional investment or programme expenditure taking place	✓
an option to delay proposed capital expenditure recognising the option value of such delay	**N/A**
a market-based option, where there is a valid market-based option (for example the use of commercial arrangements such as the use of interruptible contracts as an alternative to network reinforcement)	✓
a clear statement of the criteria used to assess the various options and the assessment of each option against these criteria	✓
a brief description of the process used to select the options: either the internal process (for which relevant documents should be included) or the existing industry process	✓
an appropriate sensitivity analysis, using relevant statistical or other techniques	**N/A**
a clear summary of any Cost Benefit Analysis / Engineering Justification that should be carried out in accordance with guidance requirements (see paras 3.22, 3.23)	✓
a justification for the proposed timing of additional expenditure	✓

Detail on the preferred option The application must include a clear description of the preferred option, sufficient to allow Ofgem to make an informed decision on if the preferred option is suitable. This must include all of the following, subject to being able to provide this (see guidance section 3.3):	✓
a clear description of the key features of the preferred option including how that option will address the issues set out in the demonstration of needs case / problem statement	✓
a clear statement of the benefits to customers, both quantitative and qualitative, of the preferred option	✓
if the preferred option is predicated on a particular scenario, a clear description of the scenario	✓
a clear statement of the key benefits of the preferred option along with any drawbacks identified	✓
a register of the various assets or programmes of work that will be impacted by implementation of the preferred option	**N/A**
evidence of the technical feasibility of the preferred option, using technical annexes as appropriate	✓

Alignment with overall business strategy and commitments

One of our business plan commitments[27] sets out that we will intervene in our network assets with the highest probability of failure, reducing longer-term risk compared to a future without intervention. Wood poles are an integral network asset, and understanding the probability failure for these is key to how we target our interventions in an efficient and effective way.

Demonstration of Needs Case / Problem Statement

Storm Arwen Review and Recommendations

The E3C and Ofgem recommendations covered areas such system resilience, planning and preparation and incident handling. The wood pole assessment tool project will improve our performance regarding Ofgem's recommendation number 2: *"DNOs and Ofgem should commission a review into how pole health is assessed, to identify changes, to identify changes that will improve pole condition reporting."*

GHD's report into the DNOs' response to Storm Arwen concluded that a pole's age was a probable factor in whether it was likely to fail during a storm. By contrast, the report also concluded that the Health Index (HI) of a wood pole was not necessarily a factor in whether it would break. The report highlights that DNOs have a significant number of poles in service that are more than 50 years old, and that 50%-80% of all wood poles damaged by Arwen were over 40 years old. According to GHD, this indicates that the mechanical strength of a pole degrade over time, but that a pole's age is not considered in the assessment of pole condition. We agree with GHD's suggestion that a scientific and objective assessment of pole condition would provide better asset data, which would in turn drive more accurate and efficient investment decisions, bringing the potential to reduce storm damage in the future.

Wood pole condition assessment

Wood poles are typically assessed by a trained asset inspector who uses a standard hammer to hit the pole and listens to the resulting sound. The assessor then makes a judgement of that sound to determine the level of

27 Commitment RR2, as set out in our RIIO-ED2 business plan.

decay in the pole and grades it 1-4 as set out in Table 18. The sound perception of the person doing the testing is key to determining the result of the test, meaning consistently assigning that sound to a decay Grade is more difficult. This also means it is difficult to generate objective and reliable assessments of pole health across a DNO's network. A standard hammer is unable to provide granular detail of a pole's condition, and the results of the test need to be manually reported into an asset database.

Grade	Description
1 - No deterioration / damage	No obvious signs of decay or other forms of deterioration
2 – Normal wear	The pole has signs of ageing, but no signs of decay or damage to the surface
3 – Some deterioration / damage	Such as decay spots and minor damage to the surface
4 – Substantial deterioration / damage	Evidence of significant decay and defects (e.g. holes)

Table 18: Grading of wood poles' condition

Consideration of options

We have been looking at tools that can provide a more objective and consistent assessment of pole health. We have trialled technologies through our innovation programme, and these are now mature enough to be rolled out into operations. The different tools are outlined below; all are similar in function.

SMART HAMMER

The Smart Hammer tool was trialled under an SSEN NIA project of the same name.[28] There are other technologies that provide similar condition assessment capabilities. We will consider deploying these instead of Smart Hammer should they prove to be a better fit. However, for the purposes of this application, we have only discussed the Smart Hammer in detail, rather than try to give details of the all the similar technologies. The different costs are, however, detailed in the CBA section.

The Smart Hammer enables consistent and reliable wood pole inspections that can be conducted in an objective way. The testing can be done by almost any member of trained field staff, rather than needing to rely on the specialist skills of an asset inspector. This means the tool can be used by a wide range of operators. The inspection results are recorded digitally, giving granular real-time data on the health of that pole, making it an affordable and simple tool for field staff to use.

28 NIA SSEN 0044: Smart Hammer | SSEN Innovation (ssen-innovation.co.uk)

Figure 5: images of the Smart Hammer tool

Practical use in the field
The tool works by detecting defective wood within the pole, by measuring the response of [redacted] the head of the hammer. When the tool strikes the pole, it rapidly decelerates and stops, before accelerating back from the pole as part of the recoil. These three stages are shown in [redacted] Figure 6: [redacted].

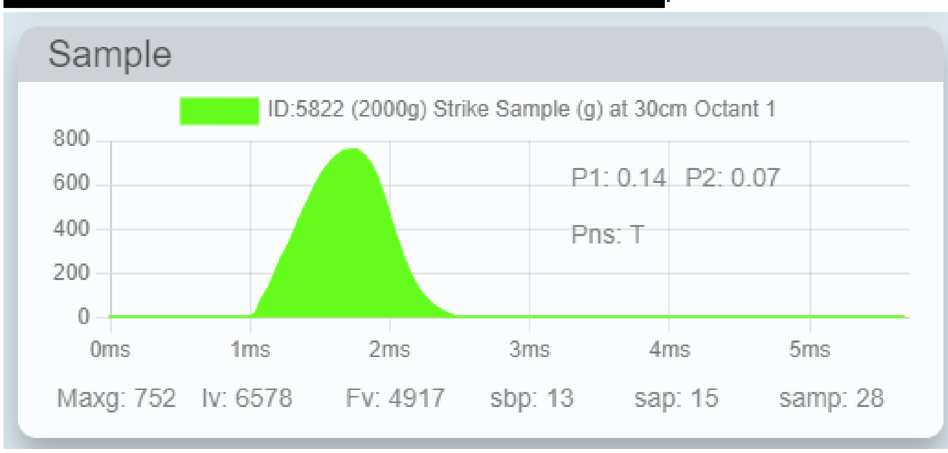

Figure 6: Output pulse for a good condition pole.

[redacted]. For a good (as new) pole, the graph should have an almost-symmetrical profile as in the figure above.

For a poor condition pole, such as one with surface rot, the resulting graph will take a different shape. Figure 7 highlights this: [redacted]. This results in a much wider peak and a notably asymmetrical graph profile. There may also be secondary 'lobes' (peaks) on the tail of the graph as the pole shell vibrates after the initial strike, giving another indication that the pole is in poor condition.

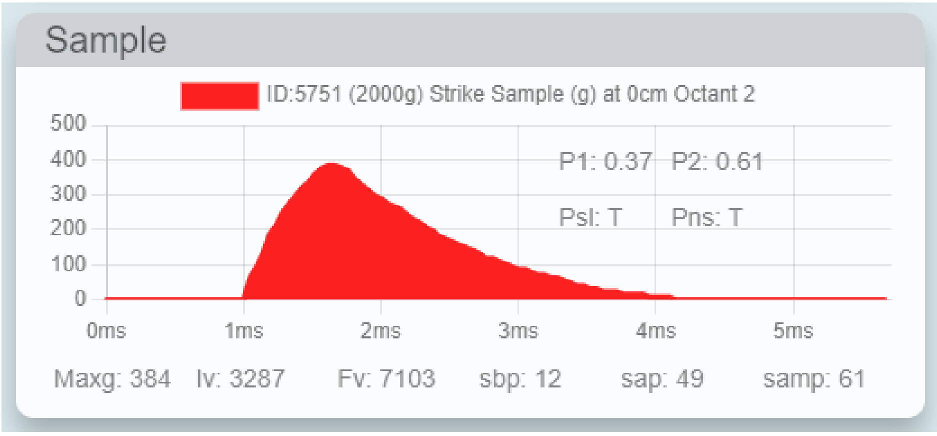

Figure 7: Output pulse for a poor condition pole

Data collection

The Smart Hammer works with a bespoke mobile application. The tool connects to the app via Bluetooth, and the user selects the type of survey they will carry out on the wood pole. There is the option to carry out a 'full survey' or to use the 'explore mode' which allows the test to focus on a specific area of concern on the pole.

For day-to-day pole inspections in 'full survey' mode, the operator needs to input basic information on the pole to allow that data to be linked back to an asset management system. The app then records each strike made on the pole; this could be up to 56 strikes for a single pole.[29] This information is used to determine the level of decay in the pole, and to assign an asset health score to that pole.

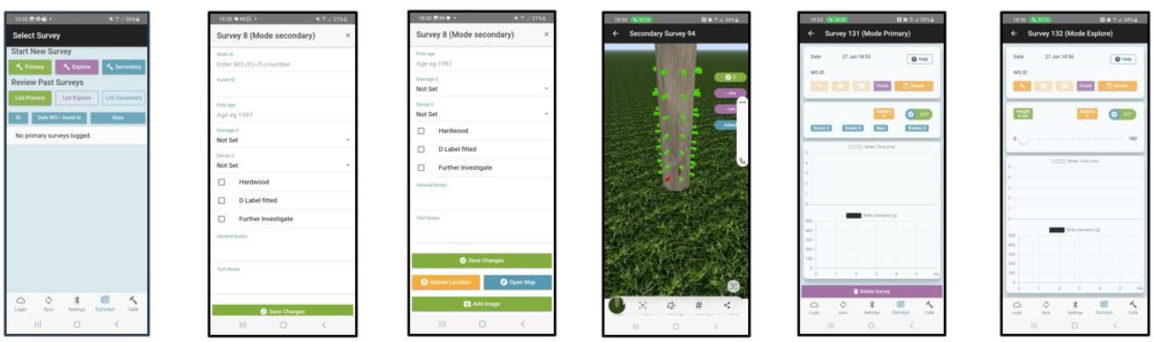

Figure 8: screenshots of the mobile application used with the Smart Hammer tool.

By comparison, a trained asset inspector would typically follow the process set out in Figure 9 below. This involves hitting the pole around its circumference from ground level up to around 2.5 metres above ground level and back down again. This gives a similar number of strikes of the pole through this test.

29 Typically the pole is struck eight times around its circumference, across seven different levels – each level is a foot above the one below, meaning the pole is tested between one and eight feet from the ground.

5.1 Hammer test

This consists of striking the pole a series of sharp blows with a wooden shafted 1kg or 2 lbs hammer. Lighter hammers shall not be used. Each blow shall be made with such force as to leave a temporary impression in the pole surface. This is particularly important around the ground line area (up to 300 mm above ground level) where decay will be particularly apparent.

The pole should be struck with a series of sharp, but moderate blows with the hammer. Sounding should begin at ground level and continue fully around the pole circumference. Repeat the process spirally around the pole circumference with a vertical spiral pitch of not more than 300mm to a height of approximately 2.5m above ground level (normally as high as can be reached when standing on the ground) as shown in Figure 1

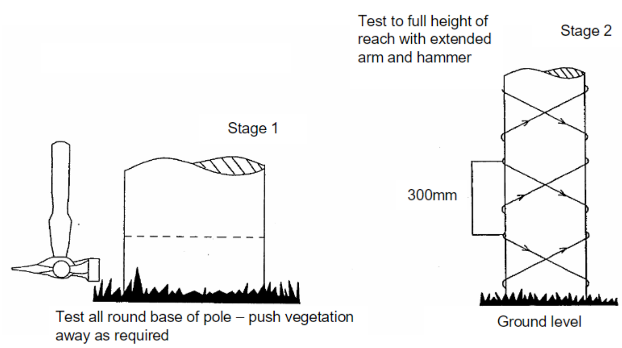

Figure 9: Extract from the ENA's guide to the structural testing of wood poles

RESIDRILL

The IML-RESI measuring instrument (ResiDrill, Figure 10) has been designed for use on wooden materials, to meet the special requirements of practical examination of trees, structural timbers, poles, and wooden structural materials. The RESI System is based on the principle of measuring the drilling resistance of a material. A drilling needle is inserted in the wood under constant drive. While drilling, the energy needed is measured depending on the drilling depth of the needle. This generates information about structures, inner defects or residual walls of trees and wooden constructions.

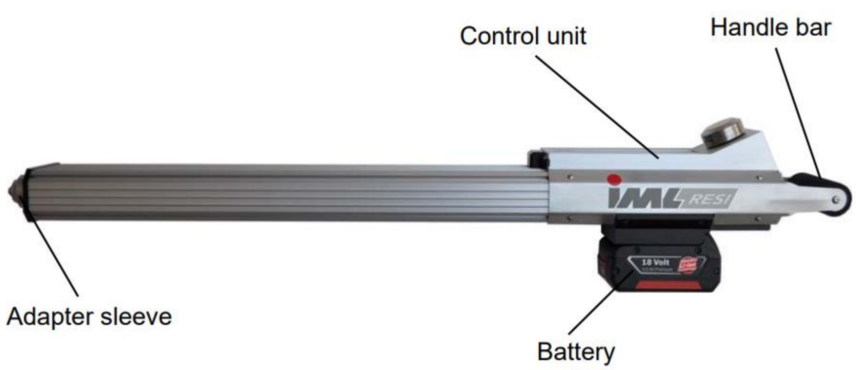

Figure 10: the ResiDrill

Depending on the instrument series, data can be recorded electronically and then transmitted, evaluated and processed. Figure 11 is an image of the on screen display; in this example two partial voids can be seen between points five and three.

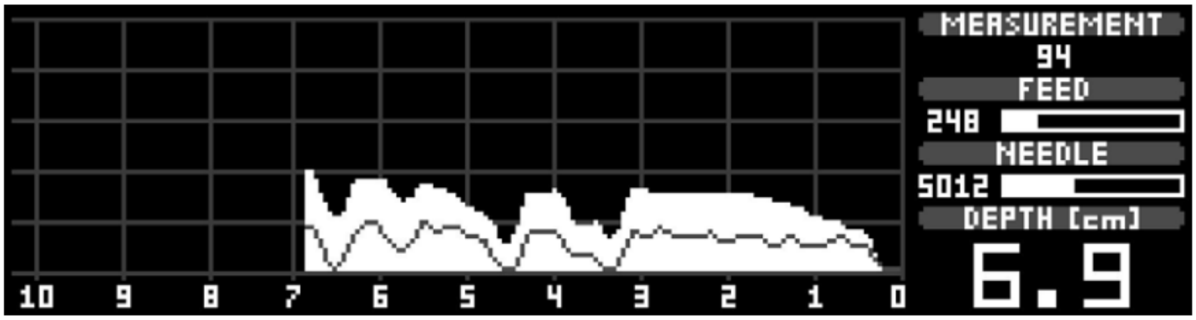

Figure 11: Screen capture of a measurement. The two dips between 3 and 5 show potential issues.

ResiDrills are not self-explanatory, and require qualified interpretation. Any conclusions about the examined object (e.g. pole) are subject to the interpretation of the person who does the examination. Practically speaking, the tool is heavy and can be cumbersome to transport across varied terrain. Despite this, one of the main benefits of the ResiDrill is that it takes direct measurements from sampling the wood that makes up the pole. This means it can produce more definitive measurements of the pole's condition.

PURL TESTER

The EA Technology PURL (Purl Tester) has been developed and refined over many years. It is a rugged, easy to use hand-held instrument using ultrasonic techniques to detect and locate rot in utility wooden poles. Using accompanying software, it produces a cross section of the pole and calculates its residual strength. The tool consists of a transmitter that sends ultrasonic signals through the pole to a receiver.

Placing the receiver and transmitter at three positions around the circumference of the pole means any decay present can be identified and its extent determined (see Figure 12). The residual strength of a pole is calculated from the data collected using associated software developed for this purpose. However, this process can be time intensive to carry out.

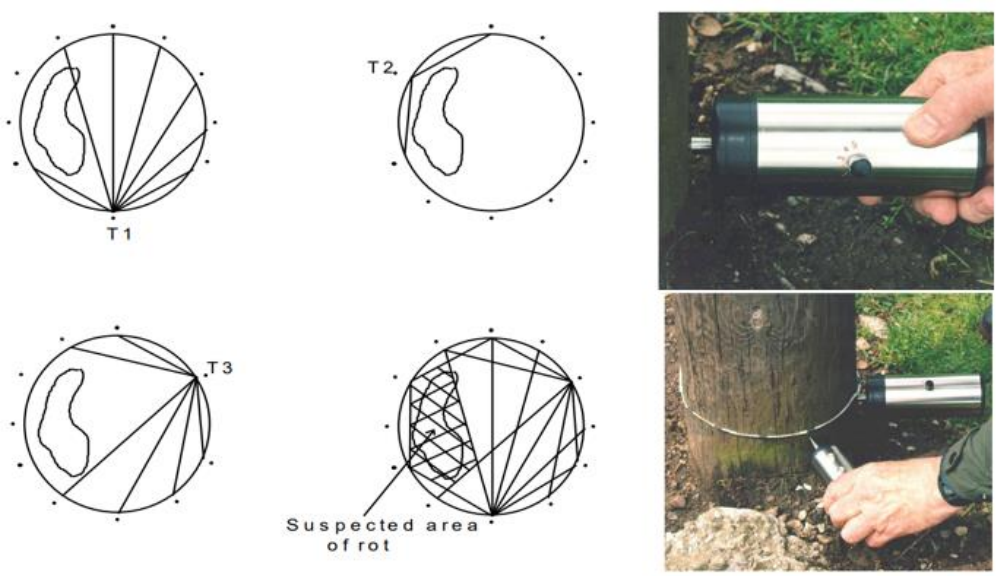

Figure 12: Left: schematic of the Purl Tester signals through a cross section of a pole; top right: the transmitter; bottom right; the Purl Tester set up on a pole (with including the receiver).

THOR HAMMER

The Thor Hammer is similar to the Smart Hammer. It is a non-destructive testing system that uniquely assesses both the strength and serviceability of a pole along its entire length (i.e. from the base all the way to the top). This is done in a single test.

The device assesses the data from the test and produces a traffic light colour-coded indication of the pole's condition, as well as the strength of the pole's foundation. Each test is tagged with the GPS location of the asset, and all the data is uploaded to a cloud-based data portal. This means the data can be accessed and used as soon as it is uploaded.

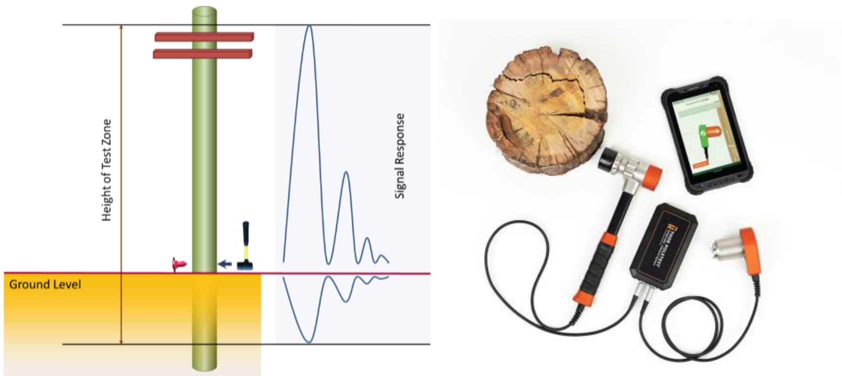

Figure 13: Thor Hammer (right) and a representation of the test

The Thor Hammer is comparable to the Smart Hammer in many ways. However, it is more expensive to purchase and deploy, and it is generally considered more difficult to use than the Smart Hammer, without providing any additional benefits.

Preferred technology

[redacted]. Before committing to this tool, we will carry out full testing and result validation of each of the devices to help determine the right tool to procure.

We also believe there is merit in combining this tool with another tool, to cross-reference and validate the results from the technology. [redacted]. [redacted]. By using two devices across our network, we reduce the risk of being dependent on a single technology for all the tests, and can use the two tools to calibrate and confirm test results.

Cost Benefit Analysis

Rollout options – modelled scenarios

We have modelled several different rollout [redacted]. [redacted]. All scenarios haver a better outcome than the Baseline Scenario.

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

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

[redacted]. [redacted].

The CBA outputs are shown in the table below. It should be noted that all outcomes are positive in comparison to the Baseline Scenario and all are substantially better. This gives us confidence that any other procurement strategy currently not considered will also produce benefits.

Option no.	Options considered	DNO spend within ED2	NPVs based on payback periods				
			10 years	20 years	30 years	45 years	Whole Life NPV
1	Baseline Scenario - Continue as we currently do	£[redacted]	£[redacted]	£[redacted]	£[redacted]	£[redacted]	£[redacted]
2	[redacted] - Roll out to [redacted] at a cost of £[redacted] per device	£[redacted]	£[redacted]	£[redacted]	£[redacted]	£[redacted]	£[redacted]
3	[redacted] for all operatives [redacted] at £[redacted] per device, plus [redacted] at £[redacted] per device	£[redacted]	£[redacted]	£[redacted]	£[redacted]	£[redacted]	£[redacted]
4	[redacted] for all [redacted] at £[redacted] per device plus [redacted] for all [redacted] at £[redacted] per device	£[redacted]	£[redacted]	£[redacted]	£[redacted]	£[redacted]	£[redacted]

Table 19: Summary of the CBA outputs

Preferred option - rollout

Our preferred option is Option 3 – [redacted]. This approach will mean we can deploy this technology across a wide range of our field staff, giving us the greatest coverage of wood poles. While this option does not provide the highest benefit in the cost benefit analysis, we consider there are a number of unquantified benefits [redacted]. [redacted]. [redacted].

Expected benefits

One of the main benefits of the [redacted] is that it can be used by a wide range of field staff, once they have had the necessary introductory training. Testing wood poles without this tool relies on qualified and specially trained asset inspectors, who inspect and test a range of asset types. By deploying this tool, we can equip more staff to test wood poles and collect information on their condition (and, therefore, increase our database on asset condition). In doing this, we will become less dependent on the expertise of asset inspectors to inspect these assets, who can instead focus on other equipment.

[redacted]. The use of a scientifically validated tool means we can have greater confidence in the results of these tests and, therefore, condition of our assets. [redacted]. A sample of the poles tested were removed and dissected to give an unambiguous measure of their true condition. These tests showed a strong correlation between the results of all three tools and the pole dissection tests, giving us the confidence that all three tools produce valid results.[30] [redacted].

Having more consistent and reliable information on the health of our wooden poles should allow us to better target interventions and prevent unexpected failures. This means the network will be better able to withstand the impact of extreme weather events.

UNEXPECTED POLE FAILURES

Currently, on average, we experience [redacted] HV pole failures a year due to age and wear, over the last 4 years. These result in outages for our customers and contribute to our overall CI and CML performance. Unplanned replacement of these poles brings increased costs compared with planned replacements. We believe that rolling out these tools will reduce the number of unplanned pole failures in storm conditions by [redacted] per year, for eight years (assuming an eight year inspection cycle).

There will also be ongoing benefits as poles that age or decay more quickly than expected are identified and can be replaced in a planned job, and we will have a better understanding of how different types of pole degrade over time. The CBA accounts for these benefits as described above but only counts [redacted] poles being identified a year; this allows for the fact that inspections take place throughout the year and some failures may still occur. We also recognise that we may, in some instances, require a planned interruption or use of temporary generation to replace these poles. We have therefore only counted [redacted] of the potential IIS benefits.

MIS-GRADED POLES

We estimate that the current manual method of testing poles is approximately [redacted] accurate, meaning roughly [redacted] of our poles are currently mis-graded. We are focusing on Grade 3 and 4 poles as these have a material impact on our pole replacement approach. This suggests that a proportion of Grade 4 poles are Grade 3 and sound; conversely, a proportion of Grade 3 poles left in-situ on the network are actually Grade 4 and at risk of failure. [redacted]. [redacted]. [redacted]. [redacted].

Having even more accurate data will help with our investment assessments for wood poles. We have assumed that the number of mis-graded poles on our network will reduce with the deployment of [redacted], [redacted]

30 All three tools also outperformed the original asset inspection with normal hammer.

[redacted]. This will therefore reduce the number of healthy assets that are inadvertently replaced early, and the number of unexpected pole failures due to aging and wear. We estimate that this will reduce the amount of unexpected pole failures by [redacted].

[redacted]. [redacted]. [redacted]. As outlined above, it will take eight years to reassess our catalogue of poles so the benefits will amount to one eighth for eight years. After this, no additional benefits will be accrued.

Conversely, we believe that some Grade [redacted] poles will be re-graded as Grade [redacted] due to [redacted]. We assume the same error rate as above [redacted]. There will be a cost for replacing these poles and therefore the benefit in the CBA will be the difference between the two scenarios.

After the eight years we expect that no mis-grading of poles will occur due to continued use of the tool in assessing the condition of our wood poles.

OPERATIONAL BENEFITS

As well as driving efficiencies within the business, [redacted] will bring important safety benefits. An objective assessment of a wood pole's health will give staff greater confidence in, and understanding of the condition of, the asset(s) they are working on. Additionally, the amount of data harvested with the [redacted] will enhance our knowledge and accuracy of asset health, including the ability to [redacted], complete desktop studies into the health of a pole and improve our accuracy in forecasting investment requirements.

Costs and Roll Out

We are requesting a total of £0.95m to roll out [redacted] to our staff, as well as the cost of other supporting elements as detailed in Table 20. The unit costs given here were towards the lower end of the results from the RFI.

Cost item	Units	Unit cost	Gross Total
Purchase of Smart Hammers	[redacted]	£[redacted]	£[redacted]
IT Integration	[redacted]	£[redacted]	£[redacted]
Staff Training			£[redacted]
Annual Subscription	[redacted]	£[redacted]	£[redacted]
Purchase of ResiDrills	[redacted]	£[redacted]	£[redacted]
Total			£954,303

Table 20: Cost elements for the Wood Pole Assessment Tool project

We anticipate that we can start procuring the tools once funding is confirmed, with a view to [redacted] by the end of the 2024-25 year. The remaining [redacted] will be procured and rolled out over the course of RIIO-ED2. Staff training for using these tools will be phased over three years, and necessary

IT integration will happen at the start of the project. We therefore expect that rollout could begin within six months of funding being confirmed, and the full rollout complete by the end of RIIO-ED2.

Cost recovery arrangements

We will report these costs in Tables C7 – Small Tools, Equipment, Plant and Machinery (Non-operational) and CV30 – Inspections of the CVR pack, as well as in the proposed Mx – Storm Arwen monitoring memo table (included in Annex A). We will report the cost of buying the devices in C7, and the ongoing inspection costs using the tools in CV30. Table 21 sets out our proposed phasing of these costs. We have split the costs between SHEPD and SEPD based on the split of staff who will use the [redacted] as appropriate.

RIIO-ED2	23/24	24/25	25/26	26/27	27/28
SEPD	-	£[redacted]	£[redacted]	£[redacted]	£[redacted]
SHEPD	-	£[redacted]	£[redacted]	£[redacted]	£[redacted]

Table 21: Expenditure phasing for in RIIO-ED2 for the Wood Pole Assessment Tool project

Outputs

We expect to achieve the following benefits from rolling out the tool across SSEN:

- A reduction in the number of unexpected pole failures by an average of [redacted] per year – measured using information in the HV fault data files;
- We will reduce the number of poles unnecessarily replaced due to being mis-graded as Grade [redacted]s. This will be netted off against an increased number of poles replaced due to being mis-graded as Grade [redacted]s when they are Grade [redacted]s. It will be harder to measure this change due to the sheer scale of poles that are correctly replaced due to deterioration.

Conclusion

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

We are confident that issuing these devices to our pole inspectors and linesmen will deliver a number of benefits. It will reduce the number of unexpected pole failures by ensuring that the poles are objectively assessed and graded. This will lead to more deteriorated poles being removed from the network under planned conditions with no or minimal interruption to customers, rather than failing and causing customer interruptions. This is particularly relevant to storm conditions where the severe weather can expose any weaknesses in the poles leading to large numbers of pole failures and more interruptions for our customers.

Rolling out these devices will drive more efficient investment decisions and pole replacement strategies, by ensuring that we are replacing those poles that are sufficiently deteriorated to warrant replacement. This will deliver savings compared to the current method of operation.

Our funding request of £0.95m represents a modest outlay to deliver significant benefits, improving data accuracy, efficiency of investment, and safety. Pertinently for this reopener, this project will help deliver greater network resilience during storms, reducing the number of outages and delivering better service for customers.

SATELLITE COMMUNICATION SYSTEMS

The following section sets out how the satellite communication systems project meets Ofgem's requirements as set out in the guidance, and provides the detail for our ask of £0.65m.

Ofgem content checklist:	**Met?**
All Re-opener applications must include a needs case whether or not this is a specified requirement of the relevant Re-opener licence condition or specific Re-opener Guidance. The needs case must contain the following:	✓
Alignment with overall business strategy and commitments: The application must include a clear statement of how the proposed expenditure aligns with the licensee's future business strategy, including consideration of how it relates to the licensee's RIIO-2 licence or other statutory obligations and, if relevant, its business plan for future price control periods.	✓
Demonstration of needs case / problem statement: The application must include a clear statement as to the need for the proposed expenditure or the problem the licensee is trying to address in the context of its significance for consumers, network assets, and wider society. The affected consumers or assets must be identified, and the associated risk being addressed quantified, where possible.	✓
As well as demonstrating the needs case, the application must also provide the rationale for the level of expenditure proposed and why this level should be regarded as being efficient.	✓
Consideration of options and methodology for selection of the preferred option The application must include a clear description of the list of options considered and the selection process undertaken to reach the preferred option. This must include the following, subject to being able to provide this (see guidance section 3.3):	✓
a clear description of the various options considered, setting out the key features of each option, this should include options considered that were not ultimately adopted	✓
a 'do minimum' option to act as a counterfactual to demonstrate the financial impact of no additional investment or programme expenditure taking place	✓
an option to delay proposed capital expenditure recognising the option value of such delay	**N/A**
a market-based option, where there is a valid market-based option (for example the use of commercial arrangements such as the use of interruptible contracts as an alternative to network reinforcement)	✓
a clear statement of the criteria used to assess the various options and the assessment of each option against these criteria	✓
a brief description of the process used to select the options: either the internal process (for which relevant documents should be included) or the existing industry process	✓
an appropriate sensitivity analysis, using relevant statistical or other techniques	**N/A**
a clear summary of any Cost Benefit Analysis / Engineering Justification that should be carried out in accordance with guidance requirements (see paras 3.22, 3.23)	**N/A**
a justification for the proposed timing of additional expenditure	✓

<u>Detail on the preferred option</u> The application must include a clear description of the preferred option, sufficient to allow Ofgem to make an informed decision on if the preferred option is suitable. This must include all of the following, subject to being able to provide this (see guidance section 3.3):	✓
a clear description of the key features of the preferred option including how that option will address the issues set out in the demonstration of needs case / problem statement	✓
a clear statement of the benefits to customers, both quantitative and qualitative, of the preferred option	✓
if the preferred option is predicated on a particular scenario, a clear description of the scenario	✓
a clear statement of the key benefits of the preferred option along with any drawbacks identified	✓
a register of the various assets or programmes of work that will be impacted by implementation of the preferred option	**N/A**
evidence of the technical feasibility of the preferred option, using technical annexes as appropriate	✓

Alignment with Business Strategy and Commitments

A core element of our operational strategy is to efficiently deploy staff in the areas where they are required. We need to be able to dispatch our staff promptly, especially when responding to faults, to intervene on the network safely and effectively. Similarly, we need our staff to be able to report the completion of jobs to the control room, to enable necessary network switching that restores power as soon and as safely as possible.

Our field teams mainly use mobile phone technology to communicate with each other and the control rooms. Generally, this works well, and enables staff to access the digitally stored work orders necessary to carry out the job. In certain locations, however, there is a total lack of network signal. These "notspots" (or blackspots) mean our staff need to travel out of the area to gain mobile signal. This impacts the efficient operation of the business and means that customers can face longer interruption times than necessary.

Demonstration of Needs Case / Problem Statement

The lack of network signal was particularly apparent during Storm Arwen when the severe weather took many mobile phone masts out of service, either directly or due to a loss of power. Some staff were dealing with multiple faults in areas with no mobile phone coverage, meaning they had to make repeated trips to get mobile coverage, report that repairs were complete, and then be re-tasked back into the blackspot area for their next job. The E3C report recognised this and included recommendation R3 in relation to this issue: "*DNOs should share best practices to ensure they have a suite of resilient communications systems*".

In planning for future storms (and day to day operation in some remote areas), we need to consider alternatives to mobile communication systems. We know that there will never be 100% mobile coverage in either of our network areas, despite initiatives that are underway. We also know that there is a greater potential for extreme storms driven by an increasingly unstable climate, which means we are likely to face the communication challenges presented during Arwen on a more regular basis without any intervention.

Network communication

SSEN's network operations are dependent on both data and voice calls to carry out standard operational tasks, including all stages of fault restoration. Within the initial fault diagnosis and identification, field staff require real-time information to restore supplies, such as:

- access to live network drawings to carry out safe operations and understand local feeding arrangements;
- additional information from operatives in the area to broaden or narrow a search area;
- knowledge of switching activities that are being carried out; and
- giving resource and material requirements to back-office staff.

Field staff need to be able to update customer-facing teams on their progress and support those teams in delivering good customer service. Once restoration is complete, our staff need to capture asset data, network changes and restoration times at the point of work. In areas without mobile phone coverage, they need to travel to find a signal to or complete their work. This can increase the overall restoration time which reduces the quality of service we provide to our customers, and increases our costs of operating the network.

The area of Ballater and Braemar is a good example of the impact that Storm Arwen had on mobile networks. The storm caused significant damage to both the electricity and mobile phone networks; at the peak of the disruption, an area of c.310 square miles was without mobile coverage.

SHARED RURAL NETWORK (SRN)

This is an initiative being developed by the four major mobile network operators and Government working together to upgrade mobile phone networks, share infrastructure and build new sites.[31] Even when this is complete in 2027 there will still be areas where coverage is poor (see the yellow and orange sections on the maps in Figure 14); only 84% of the UK will have 4G coverage through this programme. By its own admission, the SRN will still leave parts of the UK without a reliable mobile broadband connection. The programme expects to improve geographic coverage to 79% of Areas of Outstanding Natural Beauty and 74% in National Parks, but this still leaves at least a fifth of those areas without a connection.

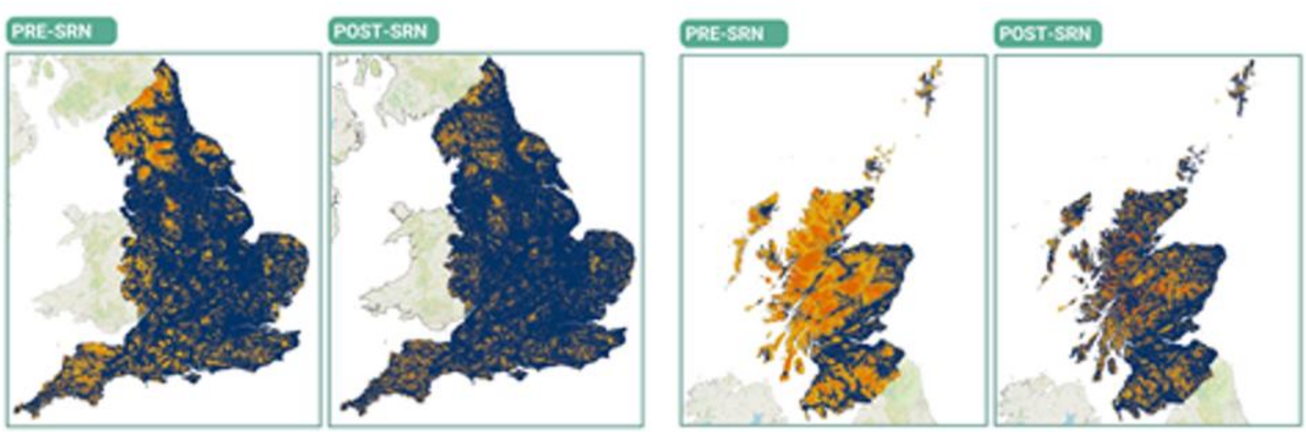

Figure 14: network connectivity pre-and post-SRN. Blue areas are where 4G coverage will be available from all four operators; yellow areas show partial not-spots (areas with 4G coverage from at least one operator, but not all four); orange areas show total not-spots (areas with no 4G coverage from any operator).

31 Home - Shared Rural Network (srn.org.uk)

This means areas of poor coverage will still be an issue across our network even after the completion of the SRN. While plans can be made to work around these issues in day to day operations, the situation will be exacerbated during storm conditions when the phone masts may no longer operate. This is not an issue that can be solved purely by changing mobile phone provider or accessing more than one provider. Since the SRN project involves shared infrastructure, when one phone mast is down, multiple providers will lose coverage.

RIIO-ED2 Allowances for improved communication
As part of our RIIO-ED2 business plan submission, we included around £16m to cover Digital Communications more broadly. This is part of a broad aspiration to improve connectivity across the SSEN Distribution estate, and covers internet access, connectivity at stores, call centres, remote sites and main sites. As detailed below, much of this will be targeted at improving internet connectivity at fixed sites through improved fibre connections. The activities identified under this reopener are not already funded through the wider Digital Communications project.

Driver(s) for improving communication routes

Poor mobile phone coverage has a direct consequence on our field staff's ability to do their jobs efficiently and effectively, especially during storm conditions. This affects our overall speed of response to faults, increases our operating costs in these circumstances, and delivers a lower level of service for our customers.

Improvements to communication will allow quicker and more accurate data capture across the network. This data ultimately feeds information that is accessed by customers (for example on the estimated time of restoration) and data that is reported to Ofgem (in the form of the duration of individual faults, and costs associated with fault repairs). Better communication also removes the need for staff to leave the site of the fault allowing them to focus on supply restoration. This will significantly improve the safety of staff working in the field, by reducing the time spent driving between locations. This is true in all circumstances, but especially in storms.

As we continue the transition to DSO, an increasing range of staff will need real time data on asset condition, circuit connectivity and their distribution loads. This information will also need to be accessed by asset management teams, designers, framework partners and external commercial interests. This means more data than ever before will be fed to and from our systems, often in commercially sensitive time frames, deepening our dependence on mobile coverage to download that information and upload new, live information when operating and maintaining the network.

Consideration of Options - technology

To address the challenges of poor and unreliable communication, we have investigated options to make us less dependent on mobile phone coverage and improve our communication routes.

PORTABLE MOBILE RADIOS AND SATELLITE PHONES

We have previously considered the use of Portable Mobile Radios (PMRs), which can improve coverage for voice calls. PMRs are not able to transmit data,[32] meaning they can only provide a limited amount of support and would need to be deployed alongside a technology that could transmit data. This is likely to mean it would be an inefficient solution to adopt, and we have therefore discounted this as a viable solution.

We have also previously tested high orbit satellite phones (see later section for description of different orbit types) as an alternative to mobile phones in the field. These would work in theory, being easily deployable

32 Data transmission is key to provide field staff with access to crucial network information and systems that enable the effective location and identification of assets. Data transmission is also important to mitigate risks around safety and lone working

across field staff who work in remote areas. However, in practice the devices have challenges around latency[33] and the cost of data use, both of which have stifled this technology being adopted. Developments in the use of satellite connectivity also mean these are at risk of becoming obsolete in the short to medium term. We therefore do not consider this a viable solution.

DUAL SIM – FIELD ONLY

SSEN field staff have [redacted] SIM cards in both mobile phone and tablet devices. This allows them to make calls and access key network information through work-related applications over the [redacted] network. Due to the number of blackspots, users often need to travel to find signal to carry out activities.

To address this, we are in the process of sourcing a second SIM card from another supplier ([redacted]), which will utilise dual SIM capability (Option 2 in Table 22). This will allow users to use [redacted] as the primary network, and [redacted] as the backup network. This should provide a good solution in the short term in addressing some of the black spots and generally improving connectivity, but we will not be able to achieve 100% connectivity in all areas. The SRN project may mean we are able to improve on our expected coverage through the combination of mobile networks, but the known limitations of the SRN project mean it is unlikely we will be able to address all the known (and any future) blackspots in the mobile networks.

During storm conditions the same challenges arise as mobile phone masts can fail even where the existing coverage is good, causing blackspots. Despite this being a cost effective option, we are not confident that it will address the issues of communication blackspots during storm conditions, and therefore do not consider it a viable long-term solution. We will, however, continue to explore whether this could provide some additional support to field teams in the short term, ahead of any longer-term solution being adopted.

FIBRE DIRECT INTERNET ACCESS – FIXED ONLY

We have [redacted] sites across our networks that require Wi-Fi for staff working in those areas. For mainland sites with good surrounding infrastructure, this solution requires a new Openreach fibre cable to increase the bandwidth (Option 3 in Table 22 below). This is a technically and economically feasible solution, which has been tested across a number of use cases, and we have a project in place to adopt this for these sites.

However, in some of the remote areas that we work in, such as the Scottish islands, it is too expensive or not technically feasible to lay new fibre cables. This is often due to the length of cable that would need to be installed, significantly increasing both the cost and technical challenge of installing and maintaining a fibre cable. Since installing fibre in these locations is not a viable option, staff continue to work within the constraints of weak, slow connectivity in these areas.

In these scenarios, we need to consider how we can give these locations a secure and reliable high speed connection that would negate the need for long cables, or connections to existing communications infrastructure. This is explored further under the next option.

LOW EARTH ORBIT TECHNOLOGY – FIXED AND FIELD

The development of Low Earth Orbit (LEO) technology means that satellite connectivity is starting to become a renewed option. Satellites are characterised primarily by the altitude at which they orbit Earth, the shape of the orbit and the angle to the equator. They are grouped into three categories:

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33 This refers to the delays that occur before or during data transfer. For example there may be a delay between instructing the device to transfer the data, and that transfer starting.

- **High Earth Orbit** (HEO) satellites are positioned at or above an altitude of 35,786 kilometres. Their geosynchronous orbit results in a satellite that stays in place over a fixed spot on the ground.
- **Medium Earth Orbit** (MEO) satellites orbit anywhere below HEO but above 2,000 km. They form the basis of many media and telecommunications networks and the current GPS system.
- **Low Earth Orbit** (LEO) satellites orbit at or below 2,000 km above the earth.

Progress in the number of LEO satellites in operation, and the communication technology employed by these satellites, means that LEO technology can now be deployed where mobile networks are not available or not reliable. They also allow for more reliable and robust communication and data transfer, by providing a direct link between the devices using them and the satellite, rather than relying on additional masts or towers to provide the connection. Figure 15 presents the difference between LEO technology and mobile networks.

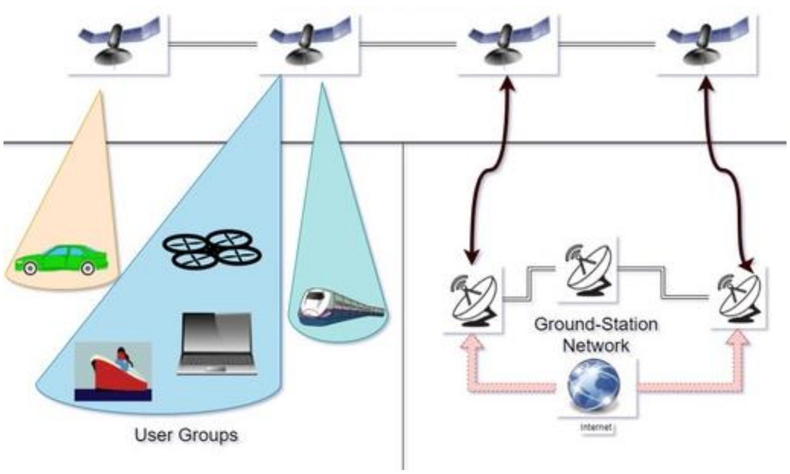

Figure 15: LEO technology can provide a direct and robust link to a satellite (as shown on the left), rather than relying on masts or towers to provide that connection (shown on the right).

For many years, satellite connectivity in general has been expensive and subject to high latencies and packet loss,[34] especially compared to wired connectivity. It has typically been used in ships, planes, and facilities far from urban areas, such as pipeline monitoring stations and remote mines. Satellites as a secondary connection have been used in places where only one wired connectivity provider was available. The availability of 4G and 5G cellular data services in recent years has reduced the use case in some scenarios.

However, as LEO satellite networks have been developed and utilised more, bandwidth costs, packet loss and latency[35] have all reduced. Using satellites for primary or secondary connectivity is also becoming more affordable. In many uses, satellite performance is on par with available wired or cellular connectivity, and it has now emerged as a potential replacement for 4G and 5G.

As set out above, advances in the use of LEO technology have increased the viability of this option for use on our network, both to improve communication for (and with) field staff in areas of limited mobile coverage, and as a connection for remote depots needing high bandwidth Wi-Fi (as set out under Fibre DIA above). Developments in this space also include the potential use of a handheld LEO satellite device.

34 Packets are small units of data transmitted over a network from a particular source to a destination. Packet loss occurs when a network packet fails to reach its expected destination, resulting in information loss.

35 The altitude of LEO satellites is less than one-tenth of the HEO altitude and of even some MEO systems. This means that LEO latency is around 10% of previous systems, at around 30 to 50 milliseconds.

In practical terms, utilising LEO technology on our network would come in different forms. For example, for remote depots needing high bandwidth Wi-Fi, the most likely solution would be to install a LEO-connected satellite receiver at the depot, along with any necessary hardware, providing a secure Wi-Fi signal for users to connect to at that site. This would give those sites their own direct connection to a satellite, meaning they are very unlikely to lose that connection during storm conditions.

For field staff, the LEO connection could come in one of two forms. The first is similar to the fixed locations, whereby a satellite receiver is installed on a van and provides a Wi-Fi signal for users to connect to with their existing device(s). The second, which is less certain at this stage as the technology is still being developed, comes in the form of a mobile device with its own direct LEO connection. The development of these devices is ongoing, and we expect there to be viable options on the market in the next 18-24 months.

Option	Description	Coverage Improvement	Outcome
1. Do nothing	Continue using [redacted] as the sole mobile network for mobile, and existing arrangements for fixed locations	No improvement. Wait for shared rural network to improve coverage for field staff. Fixed locations continue to experience poor connections in remote areas	Users will have large not spots until 2027 where SRN improvement is expected to occur. Users in remote fixed locations cannot carry out IT systems-based work, with reduced opportunities for collaboration.
2. Dual SIM (EE)	Utilise dual SIM capability by using [redacted] network for field staff.	Some improvement, giving staff access to both [redacted] and [redacted] networks, up to the limits of the SRN project by the end of 2027. This will not improve in areas not covered by either network, or areas covered by masts that lose power during storms.	Users have reduced not spots but not perfect connectivity
3. DIA-Fibre	Install fibre connection at remote sites with poor connection	Improved connection at remote sites	Users have better connectivity where this is possible. However it is a costly solution and is poor value for money in remote or island depots. In some locations it is not technically or economically feasible to install.
4. Low Earth Orbit	Deployment of LEO technology in both mobile and fixed scenarios.	100% coverage	Users have full connectivity and can access information at point of all work, for both fixed and mobile locations.

Table 22: connectivity options

Detail on the Preferred Option

Our preferred option is to deploy LEO technology for both fixed locations and field staff. As set out above, we believe this technology will provide the most robust and reliable connection in all weather conditions for our staff.

For our fixed sites, this is a more cost effective solution than installing DIA-fibre these remote locations, as well as being more technically feasible as it relies only on the installation of the satellite receiver (and any associated hardware for that site).

For our field staff, this is a more comprehensive solution than relying on Dual SIM capabilities or alternative satellite technology. We are considering the best way to deploy this technology, and propose that we start with a pilot rollout of existing satellite technology.

Rollout of technology

Pilot study

While we are confident that LEO technology is the right solution to provide more robust communication for our staff, we have yet to put it into practice on our network. Before committing to a full roll out, we plan to carry out a pilot deployment of the technology. This will install the technology in fixed locations with known communication issues, as well as installing a satellite receiver in vans covering areas where mobile reception is poor.

This pilot will give us crucial feedback on how LEO technology works for our network and our staff, and to make sure it is a viable solution for the challenges we face. It will give us the opportunity to stress test it in different scenarios, to understand whether any adaptations are needed ahead of full rollout, as well as whether there is scope for its deployment in other scenarios too. We expect the pilot stage to take [redacted] months to install the devices, and a further [redacted] months to fully test the system. During this time we will monitor the technology's use, as well as any developments in the marketplace (particularly around handheld LEO devices) to ensure we do not miss any new devices that may meet our needs.

The pilot will provide us with learning to inform broader roll out and what is the optimum mix of the technologies outlined in Table 22. As the technology continues to scale, we are also hopeful of securing a lower price at the end of the pilot than we could do at present.

FIXED LOCATIONS

We will test the devices at [redacted] fixed locations. These are sites with known communication issues or poor quality internet connection where fibre DIA is not viable. While we have sites in mind for this stage, we will assess all potential sites before deploying it, to make sure we are choosing the best sites for this stage.

We will also look to choose sites where we can thoroughly test the technology's ability to meet our needs – such as those with high volumes of data transmission or large numbers of staff working there. We will also look to install the devices across sites with varying additional hardware needs, so we can understand the different scenarios in which the satellite receivers may need to be installed.

This should allow us to test the technology in a range of scenarios, covering BAU activities and storm conditions should they occur. We expect this will mean we can see its viability for both planned and reactive work. We will measure how effective it is at fixed locations through a combination of user experience feedback and upload/download speed tests.

FIELD ROLLOUT

Similar to the fixed locations, for the field devices we will install the technology in up to [redacted] vehicles used by staff working in areas with known communication blackspots. These will likely be vehicles used by switchers, but we may use other staff as well to cover a range of deployment scenarios.

This will allow us to see how viable the technology is in having a more robust connection with the control centre, as well as understand its limitations or any adaptations we need to make in the installation. It will also give us the chance to test whether the technology could be used in other scenarios, such as providing support for remote communities in contacting friends or relatives.

As with the fixed locations, this pilot will mean we can test the technology across a range of scenarios, including BAU activities, planned work and reactive work to fix faults. We also expect this to cover storm response scenarios, but that will depend on whether these areas are affected by storms during the pilot. We will measure how effective the technology is through a combination of user experience feedback, and detailed upload/ download speed tests. We will also look to measure the amount of 'non-productive' time for field staff, to give an indication of how much time is spent driving to find a signal. Where possible we will capture information around CML savings, signal availability, and any other metrics that help us understand the viability of the technology.

Part of this stage will be to test how this deployment works in practice, and to see whether alternative LEO technology developments may be more suitable. For example, we are aware that a handheld LEO device is being developed and may be available in the next [redacted] months. This has the potential to be a more suitable solution than a satellite receiver in a van, as we could deploy these devices to all staff who work in areas of poor mobile signal (rather than just those with a suitable vehicle). However, since these devices are still being developed, we are reluctant to commit to one approach over another for full rollout at this stage. We will evaluate the findings of the pilot, alongside any developments from the marketplace, before considering which is the most appropriate solution to deploy.

Expected outcomes

Assuming the successful implementation of this technology, we expect to see a number of outcomes, including:

- Instant access to information at the point of need;
- Reduced travel to find connectivity;
- Improved communications between field and depot/control room staff;
- More reliable and consistent connectivity across a range of sites; and
- Additional welfare support to communities in areas of poor or reduced mobile phone connectivity.

All these outcomes will support our staff in restoring the network during storm conditions, as well as in their day to day operations. Reducing the amount of time spent travelling to different locations to find a mobile phone signal will also bring operational safety benefits (since staff will spend less time driving and being exposed to storm conditions). We expect to see some reduced operational costs (in the form of time, mileage, and vehicle maintenance) associated with fault repair in these parts of the network.

LEO technology will shore up the communication routes between key teams, assets and locations that are vital to the operation and maintenance of the network. Improved communications are crucial to the efficient and effective operation of the network, especially during storms when it is crucial to restore supplies as quickly and as safely as possible.

We believe this technology could also be used to help communities cut off during storms. It may be possible to be use this technology to provide a Wi-Fi signal that customers can connect to, to communicate with friends and family outside of the area. This would be particularly applicable where mobile and/or landline connectivity had been lost during storm conditions. We will test these outcomes in the pilot which will then inform the benefits case for broader roll out.

Costs and Roll Out

We have selected pilot locations based on known problem areas, as well as proximity to support personnel. The installation and unit costs of the pilot are set below, based on the cost of sourcing them from the suppliers. The pilot scope will define the wider implementation strategy and approach across the regions, taking into consideration operational requirements and impacts. This will help refine our overall costs for a full implementation across our networks. We have provided our expected costs for each stage in Table 23 below; the annual service costs, and the unit and installation costs are the average values from the results of a tender for this service that closed in late January 2024.[36]

Due to the scale and technical skill to mount hardware to vehicles, we will need to rely on suppliers carrying out the work. We have factored this into the overall cost, rather than trying to use our existing staff or requesting funding for extra staff to carry out installation.

At this point we are only seeking funding to cover the pilot study, which comprises the cost of purchasing the assets, and the data and service costs for two years. This will allow us to test the devices over two winters, and ensure we have sufficient data to be able to validate the findings.

Item	Units	Unit and installation	Annual data	Annual service cost	Total cost
Pilot Fixed	[redacted]	£[redacted]	£[redacted]	£[redacted]	£[redacted]
Pilot Mobile	[redacted]	£[redacted]	£ [redacted]	£[redacted]	£[redacted]
Pilot Total					**£646,608**

Table 23: summary of costs for the Satellite Communications System project.

As outlined as part of this submission, we consider this is an example of where a second Storm Arwen window would be helpful in enabling earlier delivery of resilience benefits to customers. Based on the results of the pilot, we would then use the second window to fund a wider rollout of the technology, whilst considering any developments in the market in the intervening time.

Cost recovery arrangements

We will report these costs through C4 –IT &Telecoms (Non Operational) of the CVR pack, and in the proposed Mx – Storm Arwen monitoring memo table (included in Annex A). Table 24 sets out our proposed phasing of these costs. We have weighted the roll out of sites for the pilot study towards SHEPD (60%) in recognition of the widespread communication issues here; SEPD also has communication challenges, but these are less widespread. This split is reflected in the costs in Table 24.

RIIO-ED2	23/24	24/25	25/26	26/27	27/28
SHEPD	-	£[redacted]	£[redacted]	-	-
SEPD	-	£[redacted]	£[redacted]	-	-

Table 24: Phasing of expenditure in RIIO-ED2

36 For the service cost, we took the average of the costs that we received for those (not all respondents provided these costs). The unit and installation costs for fixed locations was also the average for the two different location types – mainland and islands.

Conclusion

We know from experience that reliable communication across our network can be a challenge, particularly during storms. Finding a range of solutions that gives our staff confidence in the technology they use to communicate with each other is key to improving the service we provide for our customers. We believe that LEO technology will give our staff the connectivity they need to be able to generate real time updates and capture the data needed to operate the network, and this £0.65m project will allow us to test this technology on our network across a range of scenarios, through a focused pilot study. This study is expected to show how the technology will remove or reduce any time lags in updates to core systems, and ensure field staff, customers and back-office staff have access to the latest information. This will help us to improve both the estimated and actual restoration times we provide to customers. It will also generate efficiencies in how we communicate across the business, ultimately resulting in an improved level of service to our customers.

Better real time data capture will help us to improve our decision making and ensure we have more up to date asset condition data. This will also help us to identify opportunities for continuous improvement in providing value-for-money services and investment.

As we move to becoming a DSO, we will need to manage load across the network. We will depend on real-time data across the network to effectively manage our assets and the system we are in control of, as well as to carry out the required maintenance and/or investment to support the journey to Net Zero. During storms, improved communication routes will support our staff in restoring supplies as quickly and as safely as possible, ultimately reducing the amount of time that customers are off supply.

Finally, better connectivity will mean staff working in very remote and rural areas will be more assured about their ability to request support or raise the alarm in times of emergency. This opportunity extends to our customer service, as we can improve our response and ability to raise concerns of emerging situations that a customer could raise to field staff as a result of network outage.

We are only seeking funding to test this technology through a pilot deployment at this stage. This pilot will target specific scenarios where we can understand better the way in which this technology can be utilised. We expect this approach to deliver real benefits in how we operate the network, as well as giving us the opportunity to extend our welfare support during storms by using the technology to form a communication hub for more remote communities otherwise cut off. The results of the pilot will inform the most effective approach to improving our communications during storms, either through this technology or alternatives that may come through the market in the meantime.

CROSS DNO INTERCONNECTION

The following section sets out how the cross-DNO interconnection project meets Ofgem's requirements as set out in the guidance, and provides the detail for our ask of £0.14m.

Ofgem content checklist:	Met?
All Re-opener applications must include a needs case whether or not this is a specified requirement of the relevant Re-opener licence condition or specific Re-opener Guidance. The needs case must contain the following:	✓
<u>Alignment with overall business strategy and commitments:</u> The application must include a clear statement of how the proposed expenditure aligns with the licensee's future business strategy, including consideration of how it relates to the licensee's RIIO-2 licence or other statutory obligations and, if relevant, its business plan for future price control periods.	✓
<u>Demonstration of needs case / problem statement:</u> The application must include a clear statement as to the need for the proposed expenditure or the problem the licensee is trying to address in the context of its significance for consumers, network assets, and wider society. The affected consumers or assets must be identified, and the associated risk being addressed quantified, where possible.	✓
As well as demonstrating the needs case, the application must also provide the rationale for the level of expenditure proposed and why this level should be regarded as being efficient.	✓
<u>Consideration of options and methodology for selection of the preferred option</u> The application must include a clear description of the list of options considered and the selection process undertaken to reach the preferred option. This must include the following, subject to being able to provide this (see guidance section 3.3):	✓
a clear description of the various options considered, setting out the key features of each option, this should include options considered that were not ultimately adopted	✓
a 'do minimum' option to act as a counterfactual to demonstrate the financial impact of no additional investment or programme expenditure taking place	**N/A**
an option to delay proposed capital expenditure recognising the option value of such delay	**N/A**
a market-based option, where there is a valid market-based option (for example the use of commercial arrangements such as the use of interruptible contracts as an alternative to network reinforcement)	**N/A**
a clear statement of the criteria used to assess the various options and the assessment of each option against these criteria	✓
a brief description of the process used to select the options: either the internal process (for which relevant documents should be included) or the existing industry process	✓
an appropriate sensitivity analysis, using relevant statistical or other techniques	**N/A**
a clear summary of any Cost Benefit Analysis / Engineering Justification that should be carried out in accordance with guidance requirements (see paras 3.22, 3.23)	**N/A**
a justification for the proposed timing of additional expenditure	✓

<u>Detail on the preferred option</u> The application must include a clear description of the preferred option, sufficient to allow Ofgem to make an informed decision on if the preferred option is suitable. This must include all of the following, subject to being able to provide this (see guidance section 3.3):	✓
a clear description of the key features of the preferred option including how that option will address the issues set out in the demonstration of needs case / problem statement	✓
a clear statement of the benefits to customers, both quantitative and qualitative, of the preferred option	✓
if the preferred option is predicated on a particular scenario, a clear description of the scenario	**N/A**
a clear statement of the key benefits of the preferred option along with any drawbacks identified	✓
a register of the various assets or programmes of work that will be impacted by implementation of the preferred option	✓
evidence of the technical feasibility of the preferred option, using technical annexes as appropriate	✓

Alignment with Business Strategy and Commitments

As set out in our RIIO-ED2 Business Plan, network reliability is one of the highest priorities for stakeholders, behind value for money. It is therefore crucial that we look for cost effective ways to provide network reliability in all different scenarios across our network, particularly for those areas that experience more power cuts than others.

For some parts of the network, balancing the need to provide additional resilience to severe weather with the need to ensure we are investing efficiently can be a challenge. This is particularly true for more remote or isolated parts of the network, as well as those areas that serve smaller numbers of customers.

However, when considering solutions for these assets and the customers that they supply, it is important to look at the distribution networks as a whole, and not necessarily be confined to the assets we own. Where there are opportunities for collaboration with other DNOs to provide increased resilience for both companies' customers, we are keen to explore how these can be put into practice.

Demonstration of Needs Case / Problem Statement

In certain circumstances, especially at the peripheries where the network can be at the end of a long section of overhead line, it can be difficult to provide sufficient network resilience to storms. In these circumstances, these parts of the network may feed only a small number of customers, or may not be in close-enough proximity to other sites to be able to feasibly put in place additional connections with other network assets.

In some cases our network assets are close to those of other DNOs and the network is in a similar situation, or there is sufficient infrastructure to provide an additional connection. In these cases, it could be possible to provide a route of interconnection between the two DNOs' assets, thereby giving an additional source of resilience for customers connected to these assets.

Providing additional resilience to these customers would reduce the impact that severe weather may have on these parts of the network, and lead to an overall improvement in the service these customers receive. For a relatively small investment from the DNOs, it is also possible that this would reduce the need to fix faults during storm conditions and would bring operational efficiencies in managing the network.

Ofgem and the E3C recognised the importance of ensuring that DNOs are exploring opportunities to improve the networks' resilience to severe weather, as well as working together to support customers. Ofgem Recommendation 1 and E3C Recommendation E2 focused on steps that could be taken to "identify economic and efficient improvements that could increase network resilience to severe weather events". Similarly Ofgem Recommendation 7 and E3C Recommendation R5 also encouraged DNOs to "identify other appropriate areas where mutual aid could be appropriately and effectively deployed to reduce customer restoration times and enhance customer support during power outages." This project addresses both recommendations.

Methodology for selecting the Preferred Options

Through engagement with SP Energy Networks (SPEN), we have considered the opportunities to install additional network interconnection between our networks, in certain locations. That has been targeted at sites where one or both sides are currently supported by a single in-feed, but with the potential for a low cost second in-feed to be made available from the neighbouring DNO. This has been focused on the network boundary with our SHEPD licence.[37]

Through focused sessions with SPEN, looking at the area around SHEPD's southern boundary, we were able to identify an initial list of sites that may be suitable for intervention. This process, carried out using a GIS-based map of the HV network, resulted in [redacted] potential sites.

From there, both SSEN and SPEN assessed each site's suitability, including the potential length of any interconnection, the distance to the nearest depot or switcher, and any nearby existing automated plant. The number of customers supplied by this part of the network was considered. That assessment resulted in a High, Medium or Low rating for the site from each DNO. Sites which require a definite upgrade (for example from single phase to three phase), or have geographical obstacles (such as rivers) or other obstacles (such as trunk roads) were also weighted lower, even if these would provide network benefit. This was to focus on those sites that could be delivered relatively easily.

Sites classified as 'Low' were those which offered little to no benefit to one (or both DNOs), or where they presented deliverability issues. Those sites where both DNOs rated it High or Medium were then taken forward for further consideration. This looked at the optimal location to interconnect into each network, and any associated switchgear needs. It also included a consideration of potential splits of ownership and costs for these solutions.

This approach identified four sites that could be taken forward to provide interconnection between the two networks. The sites, and the suggested solutions, are set out in the next section. For the four sites, we have agreed to split the costs of the interconnection evenly with SPEN. The unit costs set out here are sourced from SPEN's bottom-up unit cost tool, which are broadly in line with Ofgem's 'best view' from the Final Determinations.

Any additional reinforcement costs that may be driven by this interconnection work will be taken on by the relevant DNO. We are undertaking load studies with SPEN to assess if any upstream reinforcement will be

37 This was a project that SPEN brought to us in mid/late November 2023. We started exploring whether we could carry out a similar exercise for SEPD, at the borders with UKPN and NGED, but due to staff availability and the number of storms that affected our network around that time, we have been unable to progress with solutions at this stage. We will continue to explore the possibilities for interconnection and consider the best way to fund any solutions that we identify.

required to utilise the interconnection at the four proposed sites. We are not seeking any funding for this reinforcement through this submission. Since this reinforcement will be driven by the additional load that may affect these parts of the network, we will seek to fund this work through the Load Related Expenditure uncertainty mechanism (LRE UM) later in the ED2 price control, if required.

Detail on the Preferred Option

Below we set out the detail on each of the four sties we are applying for funding for.

[redacted] – [redacted]

Summary	SPEN	SSEN
Beneficial rating	Medium	Low
Number of customers	[redacted]	[redacted]
Comment on site	[redacted].	[redacted]

Table 25: Summary of the interconnection for [redacted] – [redacted]

While this site is assessed as a 'low' beneficial rating for SSEN, driven mainly by [redacted], it would [redacted] provide additional resilience to SPEN's network and ranked as medium benefit to SPEN. On this basis, it has been selected to be taken forward.

The interconnection solution would be fairly simple, installing around [redacted] of 11kV Overhead line, associated poles, and the necessary protection equipment. These are detailed in Table 26, alongside the total cost for the interconnection across both SPEN and SSEN.

Asset Category	Volumes	Proposed Owner	Unit Cost	Total Project Cost	SSEN Cost
6.6/11kV CB (PM)	[redacted]	[redacted]	£[redacted]	£[redacted]	£[redacted]
6.6/11kV OHL (Conventional)	[redacted]	[redacted]	£[redacted]	£[redacted]	£[redacted]
6.6/11kV Pole	[redacted]	[redacted]	£[redacted]	£[redacted]	£[redacted]
6.6/11kV Switchgear - Other (PM) ABSW	[redacted]	[redacted]	£[redacted]	£[redacted]	£[redacted]
Total Cost				£95,523	**£47,762**

Table 26: Interconnection costs for [redacted] – [redacted]

[redacted] - [redacted]

Summary	SPEN	SSEN
Beneficial rating	High	Medium
Number of customers	[redacted]	[redacted]
Comment on site	[redacted]	[redacted]

Table 27: Summary of the interconnection for [redacted] – [redacted]

This site would provide a good benefit for both SPEN and SSEN. The SSEN side of the network is well connected, though there are manual switching points (rather than automatic).

The interconnection solution would be relatively similar, installing around [redacted] of 11kV Overhead line, associated poles, and the necessary protection equipment. These are detailed in Table 28, alongside the total cost for the interconnection across both SPEN and SSEN.

Asset Category	Volumes	Proposed Owner	Unit Cost	Total Project Cost	SSEN Cost
6.6/11kV CB (PM)	[redacted]	[redacted]	£[redacted]	£[redacted]	£[redacted]
6.6/11kV OHL (Conventional)	[redacted]	[redacted]	£[redacted]	£[redacted]	£[redacted]
6.6/11kV Pole	[redacted]	[redacted]	£[redacted]	£[redacted]	£[redacted]
6.6/11kV Switchgear - Other (PM) ABSW	[redacted]	[redacted]	£[redacted]	£[redacted]	£[redacted]
Total Cost				£78,657	**£39,329**

Table 28: Interconnection costs for [redacted] – [redacted]

[redacted] - [redacted]

Summary	SPEN	SSEN
Beneficial rating	-	High
Number of customers	[redacted]	[redacted]
Comment on site	[redacted]	[redacted]. [redacted]

Table 29: Summary of the interconnection for [redacted] – [redacted]

This site would provide a good benefit for both SPEN and SSEN. The SSEN side of the network is [redacted]. [redacted]. On SPEN's side of the interconnection, although it is a rural area there are options available for [redacted]. As before, given the resilience an interconnection could provide to both networks, it has been selected to be taken forward.

The interconnection solution would be relatively similar to other sites, needing overhead line, associated poles, and the necessary protection equipment. These are detailed in Table 30, alongside the total cost for the interconnection across both SPEN and SSEN.

Asset Category	Volumes	Proposed Owner	Unit Cost	Total Project Cost	SSEN Cost
6.6/11kV CB (PM)	[redacted]	[redacted]	£[redacted]	£[redacted]	£[redacted]
6.6/11kV OHL (Conventional)	[redacted]	[redacted]	£[redacted]	£[redacted]	£[redacted]
6.6/11kV Pole	[redacted]	[redacted]	£[redacted]	£[redacted]	£[redacted]
6.6/11kV Switchgear - Other (PM) ABSW	[redacted]	[redacted]	£[redacted]	£[redacted]	£[redacted]
Total Cost				£61,790	**£30,895**

Table 30: Interconnection costs for [redacted] – [redacted]

[redacted] - [redacted]

Summary	SPEN	SSEN
Beneficial rating	-	Medium
Number of customers	[redacted]	[redacted]
Comment on site	[redacted].	[redacted]

Table 31: Summary of the interconnection for [redacted] – [redacted]

This site would provide a good benefit for both SPEN and SSEN. The SSEN side of the network is connected at [redacted]. This means it would provide a good connection in a remote part of the network. Again on SPEN's side of the interconnection, there are options available for [redacted]. As before, given the resilience an interconnection could provide to both networks, it has been selected to be taken forward.

The interconnection solution would be relatively similar to other sites, needing overhead line, associated poles, and the necessary protection equipment. These are detailed in Table 32, alongside the total cost for the interconnection across both SPEN and SSEN.

Asset Category	Volumes	Proposed Owner	Unit Cost	Total Project Cost	SSEN Cost
6.6/11kV CB (PM)	[redacted]	[redacted]	£[redacted]	£[redacted]	£[redacted]
6.6/11kV OHL (Conventional)	[redacted]	[redacted]	£[redacted]	£[redacted]	£[redacted]
6.6/11kV Pole	[redacted]	[redacted]	£[redacted]	£[redacted]	£[redacted]
6.6/11kV Switchgear - Other (PM) ABSW	[redacted]	[redacted]	£[redacted]	£[redacted]	£[redacted]
Total Cost				£52,088	**£26,044**

Table 32: Interconnection costs for [redacted] – [redacted]

Cost Recovery Arrangements

We will report these costs through CV15 – QoS and North of Scotland Resilience of the CVR pack, and in the proposed Mx – Storm Arwen monitoring memo table (included in Annex A). Table 33 sets out our proposed phasing of these costs.

RIIO-ED2	23/24	24/25	25/26	26/27	27/28
SHEPD	-	-	£[redacted]	£[redacted]	-

Table 33: Phasing of expenditure in RIIO-ED2

Conclusion

Providing interconnection at these four sites would be a quick and low-cost form of additional resilience to customers served by these parts of the network. These are customers who are often exposed to the effects of storms, and for whom a quick restoration is difficult to provide. At a cost of £0.14m, this represents a very efficient way of providing these customers with a better level of service, as well as supporting another DNO in managing their network and resources in response to storms. As set out, we will work up any reinforcement needs for the three sites that will need additional works and include these in the overall LRE reopener.

STAKEHOLDER ENGAGEMENT AND WHOLE SYSTEM OPPORTUNITIES

Ofgem content checklist:	Met?
The application must include an explanation of how stakeholder engagement contributed to the identification and design of the preferred option. This stakeholder engagement may be limited to those categories of stakeholder who are materially impacted by the choice of preferred option. Where there are opportunities to collaborate with other network companies on whole system issues, this must be reflected in the analysis and evidence provided.	✓

Stakeholder Engagement

As outlined in the Enhanced Engagement Strategy annex to our RIIO-ED2 Business Plan,[38] our stakeholder engagement mission statement is at the heart of our strategy. Our aim is to ensure that we carry out engagement that is purposeful, accessible and dynamic, and to use collaborative partnerships to achieve positive and tangible outcomes for our customers and our stakeholders.

We have proactively engaged with other DNOs and Ofgem in the run up to this application more generally, with a view to understanding where we can achieve consensus across the industry in the applications under this mechanism. It has also ensured that the industry is in line with Ofgem's expectations for this mechanism. Similarly, we have worked closely with other DNOs to understand how we can link up with and support other DNOs in utilising opportunities to work together to increase the resilience of our networks to storm conditions.

The projects we have identified have limited material impact on wider stakeholders and, therefore, have not needed stakeholder engagement at this stage. This is mainly because the projects are focused on the rollout of technology that has limited impact on our stakeholders, but rather improves the way we run and manage the network.

For the cross-DNO interconnection project in particular, we have worked closely with SPEN to identify opportunities that will allow both networks to provide additional resilience to customers across the network boundaries. Through this work we have been able to look at the networks from a whole-system perspective, and identify sites that are susceptible to long-duration restoration times. That engagement has meant we can build on the work we are doing to manage our own network, whilst also preparing for future storm events. We have had initial discussions with UKPN and National Grid about carrying out a similar exercise across the network boundaries that we share with them, but due to the timing of this work and the impact of the named storms during November 2023, December 2023 and January 2024, we have not been able to progress this work as we had hoped in time for this application. However, we will continue exploring this opportunity as we move forward through the price control.

It is likely that, in delivering these investments, we will need to engage with a range of stakeholders at the point of delivery. We will continue to look for opportunities to engage with stakeholders who may be impacted by these projects as they progress into delivery. For the ROLR project, we will engage with the landowners where commercial forestry is prevalent once we have identified the specific sites where we will need to intervene. This will enable us to target our engagement to those most affected by our work, and mean we can provide the certainty to them of knowing whether we are able to carry out the work we are proposing.

38 A_3.1_Enhanced_Engagement_Strategy_Ofgem_CLEANFINAL_REDACTED.pdf (ssenfuture.co.uk)

Stakeholder Engagement to Date

DNO working groups

Cross-DNO working groups were held in August 2023 and November 2023 focused on garnering views across the industry on the type of projects to be pursuing, and identifying key questions that we needed to raise with Ofgem. This engagement resulted in consensus around projects that would fit the description of the reopener, as well as agreement on which projects to exclude from all DNOs' applications.

Ofgem feedback session

This was a bilateral meeting where we ran through our proposed approach with Ofgem, giving an indication of the type of projects that we would include in our application, as well as our estimated costs for each project. It gave an opportunity for Ofgem to provide initial feedback on our proposals, and help us focus on Ofgem's priorities. Following that engagement, we tailored the details of the proposals to ensure they were in line with Ofgem's expectations.

CONCLUSION

Ofgem content checklist:	Met?
This section will provide a concise, succinct summary of main conclusions and recommendations contained within the main text of the EJP.	✓

As set out through this application, Storm Arwen had a notable impact on both our network assets and the way we operate and maintain our networks. This storm in particular highlighted some of the challenges we face when dealing with severe weather. The recommendations from Ofgem and the E3C provide a good framework for DNOs to identify measures that will lead to better service for customers in the future.

We have identified five projects, **at a total cost of £10.48m**, targeting different elements of the challenges we faced through Storm Arwen. We have designed each of these projects to address one or more recommendations from Ofgem and the E3C, and have focused on ways to realise benefits in time preparing for future storms. As a high-level summary the projects are:

- **Restoring overhead line resilience (£2.08m):** carrying out additional resilience work at sites across SHEPD through tree harvesting, to address new risk induced by Storm Arwen.
- **HV feeder monitoring (£6.65m):** Installation of [redacted] HV feeder monitoring devices on 11kV and 33kV feeders to help better pinpoint fault locations and improve restoration times.
- **Wood pole assessment tool (£0.95m)**: Roll out of [redacted] to field staff to better assess the condition of wooden poles, helping to improve how wood pole health is collected and data used to inform more efficient asset replacement.
- **Satellite communication systems (£0.65m):** Trial of satellite communication units that provide more robust communication links for remote sites, substations and field staff.
- **Cross-DNO Interconnection (£0.14m):** Creating interconnection across DNO boundaries for sites of strategic importance for both parties, to increase network resilience.

We have also sought to tackle a variety of issues. These range from managing the resilience risk of the network to vegetation, through to identifying opportunities to identify and respond to faults more efficiently during storm conditions. These solutions represent an efficient and effective way to meet the recommendations set out by Ofgem and the E3C, whilst ensuring we are still able to deliver our baseline activities funded through our RIIO-ED2 allowances.

We have assessed the deliverability of each project, and set out volumes of work that we are confident we can deliver over the remaining years of RIIO-ED2. Where available, we have used recent market engagement to understand the cost of rolling out different technology types. Each project therefore outlines an efficient, informed, and realistic investment plan to help us improve the way we prepare for, and respond to, future storms.

Finally, we will continue to build on these programmes of work throughout ED2 where possible. We strongly support the introduction of a second reopener window for Storm Arwen expenditure. This would allow all DNOs to further explore opportunities to deliver additional resilience and benefits to our customers during storms. For SSEN, a second window would give us the opportunity to deliver additional projects that we were not able to work up into high-confidence proposals in time for this reopener. We believe a second window is an important tool that will allow all DNOs to target investment where it is needed as we manage the challenges brought about by severe weather.

APPENDIX 1 – TREE DAMAGE SUPPORTING PHOTOS

Severely damaged treeline within falling distance of an 11kV line

Tree crop damaged during Storm Arwen, leaving an unprotected tree line adjacent to our Network


Large commercial forestry crop devastated by Storm Arwen adjacent overhead network

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