GREMISTA GRID SUPPLY POINT: STRATEGIC DEVELOPMENT PLAN

Our network serving communities across the Shetland Islands

Draft

January 2025

Scottish & Southern Electricity Networks

1. EXECUTIVE SUMMARY

Scottish and Southern Electricity Networks (SSEN) is taking a strategic approach to the development of its distribution networks. This will help to enable the net zero transition at a local level to the homes, businesses, and communities we serve.

Our Strategic Development Plans (SDPs) incorporate stakeholder feedback on future energy needs through to 2050 and translate these insights into strategic spatial plans for the future distribution network requirements. This enables us to transparently present our future conceptual plans and facilitate discussion with local authorities and other stakeholders. The overall methodology and how this fits into our wider strategic planning process is presented in the Strategic Development Plan Methodology (Strategic Development Plan Methodology (for consultation)).

The focus area of this SDP is that supplied by Lerwick Power Station (LPS) and Gremista Grid Supply Point (GSP) in the Shetland area, as shown below.

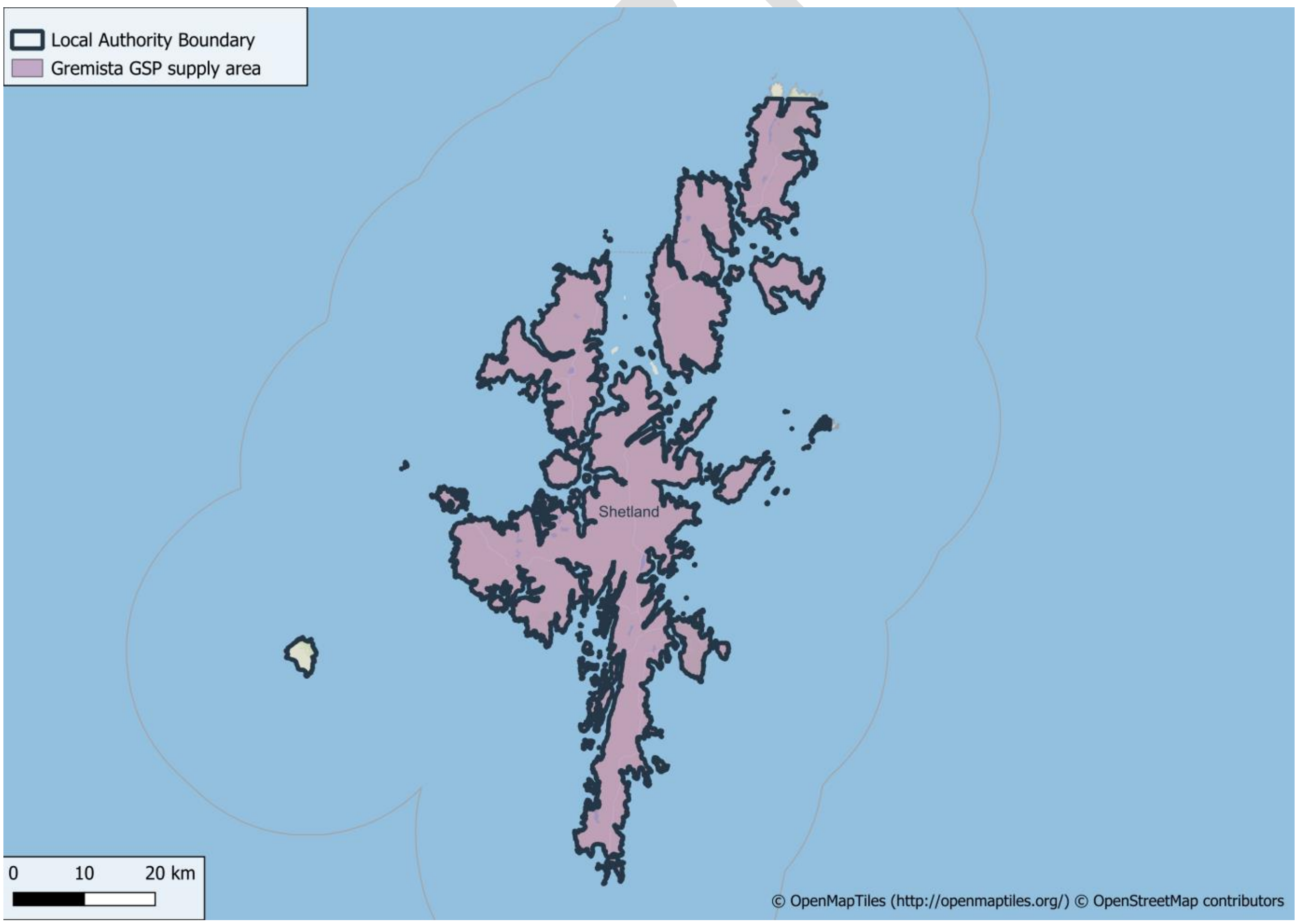

Figure 1 Area of focus for this SDP

This geographic area is within the scope of both the 'Shetland Uncertainty Mechanism (UM)' and has similar drivers to other Scottish Islands which fall within the scope of the 'Hebrides and Orkney Whole System Uncertainty Mechanism' (HOWSUM). These are regulatory mechanisms, forming part of our current price control period agreement with Ofgem, which provides SSEN with a route to apply for additional funding to deliver whole system solutions for net zero and to support the security of supply in the Scottish Islands.

This report documents the stakeholder led plans that are driving net zero and growth in the local area, the resulting electricity demands, and the network needs arising from this. For Gremista GSP and Lerwick Power Station (LPS), significant work has already been triggered through the Distribution Network Option Assessment (DNOA) process and the Shetland UM. Much of this work has strategically been sized to support 2050 projected demands under the Consumer Transformation scenario from the Distribution Future Energy Scenarios (DFES).

As part of this work, we aim to identify further needs for the relevant network study area. For Gremista GSP, further Extra High Voltage (EHV) work has been identified, as well as projections for significant network intervention required across the High Voltage (HV) and Low Voltage (LV) networks to provide capacity through to 2050. This will be reassessed on an annual basis to understand the network impact of updated forecasts.

As a result of the work undertaken for this report, we make recommendations for further study of projects that could enter the DNOA and the HOWSUM process. For this GSP area, seven reinforcements have been recommended for more detailed assessments through the DNOA and HOWSUM processes.

2. INTRODUCTION

This report aims to demonstrate how local, regional, and national targets align with stakeholder perspectives in the area, providing a robust evidence base for load growth through to 2050 across the Shetland Islands, currently supplied out of Lerwick power station (LPS), as shown above in **Figure 1**.

To identify the future requirements of the electricity network, SSEN commission Regen to produce the annual Distribution Future Energy Scenarios (DFES). The DFES analysis is based off the National Energy System Operator (NESO) Future Energy Scenarios (FES) while accounting for more granular stakeholder insights from agencies such as local authorities and new demand and generation connection applications. The DFES provides a forward-looking view of how demand and generation may evolve under four different scenarios as we move towards the national 2050 net zero target. These scenarios are summarised in **Figure 2**. SSEN uses Consumer Transformation as the central case scenario following stakeholder feedback during the RIIO-ED2 development process. This approach is reviewed annually.

We have seen continued customer connection requests across the Shetland Islands. Where this new information has not been captured in the DFES, we aim to consider it as part of our studies to ensure that the projected load more accurately reflects our future expectations.

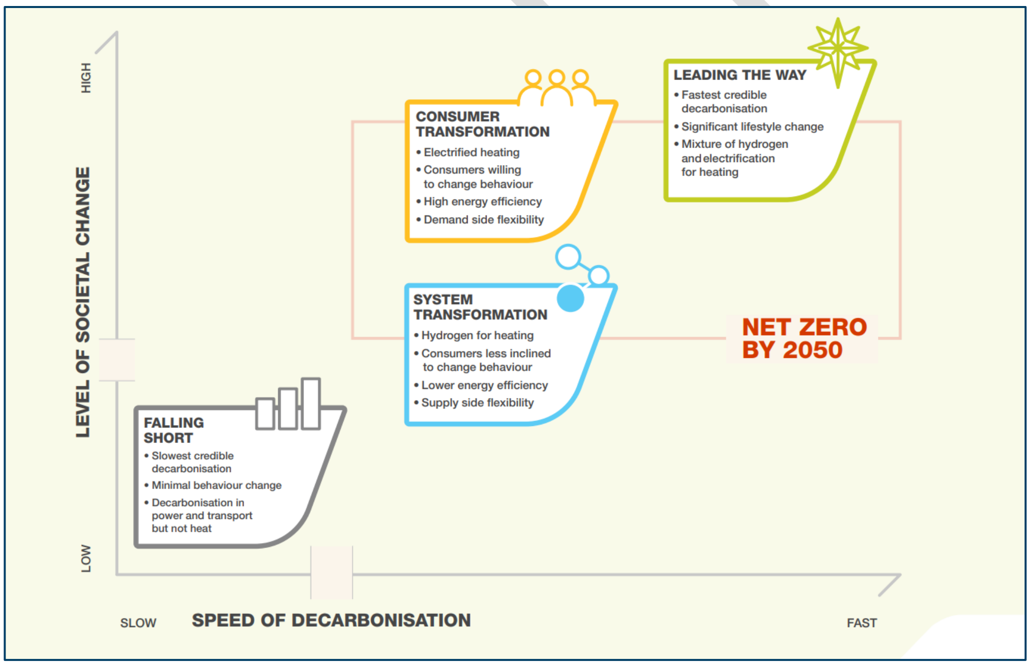

Figure 2 The 4 Future Energy Scenarios adopted for the DFES. Source: ESO FES2023

Using the DFES, power system analysis has been carried out to identify the future system needs of the electricity network. These needs are summarised by identifying the year they are required under each of the four scenarios and the projected 2050 load. The system needs are identified through power system analysis using the Consumer Transformation scenario in alignment with evidence gathered for the SSEN ED2 business plan. Additionally, we model the other three scenarios to understand when these needs arise and what demand projections should be considered if each scenario materialises.

The DNOA process will provide more detailed optioneering for each of these reinforcements, improving stakeholder visibility of the strategic planning process. Opportunities for flexibility procurement will also be highlighted in the DNOA to cultivate the flexibility markets and to align with SSEN's flexibility first approach.

3. STAKEHOLDER ENGAGEMENT AND WHOLE SYSTEM CONSIDERATIONS

3.1. Local Authorities and Local Area Energy Planning

The Shetland Islands currently form an islanded power demand, which is primarily supplied by Lerwick power station (LPS), as shown in **Figure 3.** The development plans for Shetland Islands Council will have a significant impact on the potential future electricity load growth on SSEN's distribution network. As such, it is vital for SSEN to engage with these plans when carrying out strategic network investment.

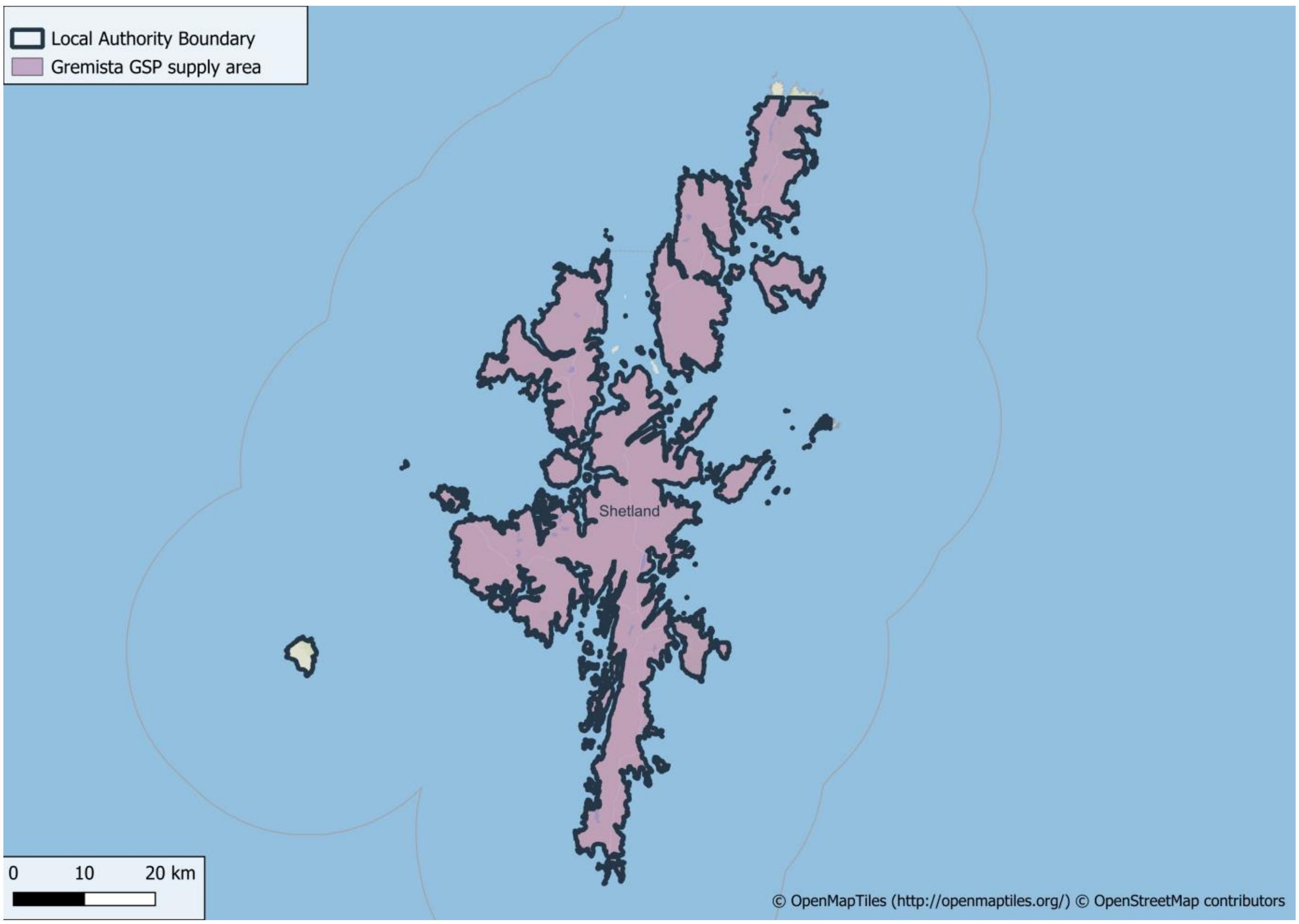

Figure 3 Shetland Islands Council Local Authority Boundaries

3.1.1. Shetland Islands Council

The 2022 Census recorded the population of the Shetland Islands at approximately 22,744. The National Records of Scotland (NRS) more recent mid-year estimates calculated the Shetland Islands population to be 22,940 (NRS' 2021 based Mid-Year Estimates)[1]. The Shetland Islands Council has the second smallest

1 [Rebased population estimates, Scotland, mid-2011 to mid-2021: Data tables | National Records of Scotland (nrscotland.gov.uk)]

population of the 32 council areas in Scotland and covers the twelfth largest administrative area of any Scottish council, comprising nearly 2% of the countries land mass. It has the fourth sparsest population among the Scottish local authorities, with an average population density of 16 persons per square kilometre. The Shetland archipelago consists of around 100 islands, with 16 inhabited (Census 2011): Mainland Shetland, Yell, Unst, Fetlar, Bressay, Whalsay, West Burra, Muckle Roe, Papa Stour, Trondra, East Burra, Fair Isle, Housay, Foula, Bruray and Vaila. The area has a diverse and vibrant economy, driven primarily by the oil and gas industry, fishing, tourism, aquaculture, and renewable energy.

Shetland Islands Council has committed to become a Net Zero organisation by 2045 in alignment with Scottish Government targets. In pursuit of these ambitions, the Council, in collaboration with consultancy firm 'Ricardo', has developed two Net Zero Route maps:

- Shetland Islands Council Net Zero Route Map
- Shetland Net Zero Route Map

Within these route maps three pathways to net zero have been defined and modelled:

- **2030 ambitious pathway –** assumes that significant resources and budget are made available to allow the rapid implementation of measures by 2030. This approach looks to minimise carbon emissions by 2030 with technologies available over that time frame though does not look at decarbonisation beyond 2030 other than through factors outside of the Council's control, e.g. decarbonisation of the national electricity grid. For some emissions sources therefore, the selection of decarbonisation technologies is restricted by technology maturity.
- **2040 pragmatic pathway –** assumes a pragmatic approach to the selection of decarbonisation measures whereby assets are replaced with low carbon alternatives at their end of life, and more cost-effective technologies and approaches are preferred and therefore modelled. All assets that approach their end of life within the scenario timeframe are assumed to be replaced with low carbon alternatives.
- **2040 ambitious pathway -** assumes that significant resources and budget are made available to minimise the Council's emissions by 2040. For several emissions sources therefore, this is likely to require significant transformation to current services and operations.

As suggested by Ricardo, the recommended pathway for the Shetland Islands Council is to follow the 2040 ambitious pathway, which addresses all major emissions sources and aims to achieve a 92% reduction in emissions from the 2019/20 baseline by 2045.

The key takeaways from the Shetland Net Zero Route maps and Pathways modelling are as follows:

- The Green House Gas (GHG) emissions profile for Shetland is notably unique. Unlike most local authorities, where emissions are dominated by energy use in buildings and road transport, Shetland's largest sources of emissions are from land use, energy industries and agriculture.
- 'Peatland restoration – this is the most impactful mitigation measure for Shetland'.
- 'Improving living standards and lowering fuel bills by retrofitting buildings and ensuring that everyone has access to affordable, low carbon heating and energy'.
- Leading the way on sustainable agricultural practices and paludiculture.
- 'Contributing towards the decarbonisation of the wider UK energy system via large-scale renewable energy technologies and storage systems'.
- 'Becoming a hub of innovation for technologies such as green hydrogen, Carbon Capture and Storage (CCS)' and tidal power, which could include a micro-CCS pilot project at the Lerwick Energy Recovery Plant (ERP)'
- 'Electrification of buildings and transport, and connection to the mainland electricity grid, will have a very important role to play in reducing emissions from energy use in Shetland. These could feasibly be reduced

to net zero by 2045 if all fossil fuels are replaced with zero-emission alternatives, such as decarbonised grid electricity or green hydrogen'.

- 'A significant portion of emissions are associated with sectors that are difficult to electrify (e.g. aviation, marine vessels, etc.) or are not associated with energy use at all (e.g. land use and agriculture). At present it is not clear whether there will be technologies available by 2045 that can mitigate these sources of emissions'.
- 'It is therefore likely to be difficult or impossible for area-wide emissions in Shetland to get to net zero by 2045based on currently available technologies or mitigation methods, barring a systemic overhaul of the economy, land uses, consumer habits and social engagement'.[2]

Shetland Islands Council, in line with all other local authorities in Scotland, are required to publish a Local Heat and Energy Efficiency Strategy (LHEES) and delivery plan. This is currently being prepared by the Council and will set out Shetland Islands Council's long-term plan for decarbonising heat in buildings and improving their energy efficiency across the entire region.

3.2. Whole System Considerations

We have worked closely with local stakeholders, customers, market participants, government bodies and SSEN Transmission to build upon our engagement prior to RIIO-ED2, in order to develop an enduring whole system solution to meet the future energy needs of the Shetland Islands and to enable the region to support the transition to net zero through its extensive natural resource potential.

We are supported in this process by both the 'Shetland Uncertainty Mechanism' and the 'Hebrides and Orkney Whole System Uncertainty Mechanism' (HOWSUM) framework. These regulatory mechanisms facilitate exploration of the long-term strategies for decarbonisation and future resilience requirements for relevant island groups and strategic development plans form a key stage in the regulatory submissions for both uncertainty mechanisms. We will be using high level options generated from this report and stakeholder feedback to produce detailed proposals that could form the basis for future regulatory submissions.

Through our whole system considerations, several options have been considered, some of which are based on specific feedback from Island stakeholders. It should be noted that while some of these elements are not yet fully developed today, they have the potential to form part of our longer-term strategic plans:

1. **Traditional Distribution elements:** We have considered how future network needs could be met with additional Distribution investment. It is generally recognised that all islands will need to remain connected to the mainland GB system, necessitating continued need for the Transmission and / or Distribution circuitry and capacity.
2. **Traditional Transmission elements:** We have worked closely with SSEN Transmission to understand their future requirements for the construction of the new Gremista GSP, including its high voltage direct current (HVDC) connection to the Scottish Mainland, and the future of the transmission network on Shetland based on the DFES projections.
3. **Use of new technologies:** We have discussed and will assess the use of new technologies, such as hydrogen and other forms of storage, to help resolve some of the drivers for change.
4. **Use of flexibility:** We consider flexibility as potentially being required as part of all the developed options. For load related drivers, it can help optimise the timing of future investment needs.

2 Council's net zero plan – Shetland Islands Council

5. **Repowering of diesel generators:** The potential to repower our diesel generators at Lerwick power station with green alternatives is being considered as an option to help decarbonise the Scottish islands.

3.2.1. Diesel Embedded Generation (DEG) Decarbonisation

SSEN has also developed a 2050 strategy around the decarbonisation of its Diesel Embedded Generation (DEG) fleet. This is structured around the facilitation of SSEN achieving its Science Based Targets (SBTs) outlined in the RIIO-ED2 business Plan,[3] and meeting the Scottish Government's ambition on NOx emissions from embedded plant.[4]

The application of this strategy will be tailored to each island group, recognising both the needs of the island communities and the status of the existing DEG infrastructure.

3.2.2. Shetland Uncertainty Mechanisms

Addressing the future requirements of local communities formed an important component of our RIIO-ED2 business plan. This was recognised by Ofgem through the introduction of dedicated regulatory mechanisms, including the 'Shetland Uncertainty Mechanism' re-openers. Through this process, it was widely acknowledged that adopting a whole system approach is essential for designing and delivering solutions for the Shetland Islands.

These regulatory mechanisms provide a route for SSEN to seek funding to address the long-term needs of the Shetland Islands. Re-openers allow Ofgem to adjust a licensee's allowances, outputs and delivery dates in response to changing circumstances during the price control period.

The two bespoke reopeners for the Shetland Islands are:

- Shetland Enduring Solution – relating to the various concurrent and related projects and ongoing arrangements to provide long-term security of supply to Shetland following the completion of the Shetland HVDC Link 1 project.
- Shetland Extension Fixed Energy Costs – relating to the associated costs of third-party contracts for power purchase agreements and contingency arrangements where applicable, capital and operating fixed costs for Lerwick Power Station and operating costs for the Shetland Active Network Management system (ANM).

In January 2024, SSEN completed a 2050 strategy for the Shetland Islands, known as the Shetland Enduring Solution, and submitted it to Ofgem for approval. A similar process is now underway for the next window of the Shetland Enduring Solution re-opener, which is in January 2028. We are committed to continually reviewing this strategy and further developing our proposals as new information emerges.
This Strategic Development Plan builds on the 2050 strategy.

3.2.3. Hebrides and Orkney Whole System Uncertainty Mechanism (HOWSUM)

The needs of the geographic area of the Shetland Islands are also aligned with the scope of the 'Hebrides and Orkney Whole System Uncertainty Mechanism' (HOWSUM). This is a regulatory mechanism, forming part of our

3 SSEN Sustainability Strategy

4 Environmental Authorisations (Scotland) Regulations 2018 draft - proposed amendments: consultation - gov.scot

current price control period agreement with Ofgem, which provides SSEN with a route to apply for additional funding to deliver whole system solutions for net zero and to support the security of supply in the Scottish Islands.

3.2.4. Resilience Policy for Island Groups connected by subsea cables

As part of SSEN Distribution Standard Licence Condition (SLC) 24 and the Distribution Code, SSEN is obligated to ensure that certain levels of security are in place as per Engineering Recommendation P2 (EREC P2). Additionally, SLC 24 requires SSEN Distribution demonstrates its compliance with EREC P2 to provide demand centres with resilience in the event of network faults. This ensures that appropriate levels of network resilience are in place to manage different sizes of electricity demand groups.

Subsea cable faults are rare events but can have a big impact on our Island communities. Due to the nature of the environment in which they operate, fault location and repair on a subsea cable can take months. Given the uniqueness of the SSEN subsea network to the UK, EREC P2/8 does not account for the operational realities of faults on the subsea cable networks and as such, a different resilience standard is required. This enhanced resilience standard takes the form of SSEN's newly developed 'Resilience Policy for Island Groups Connected by Subsea Cables' which is explained further below in **Table 1**.

Enhanced resilience considerations applicable to the Shetland Islands include:

- Enhanced resilience standard to the Gremista GSP.
- Enhanced resilience standard to the Yell & Unst island group.

Achieving these future resilience levels is the long-term ambition for our island groups and will be considered in any strategic planning of the island networks, including HOWSUM. It should be noted that this is not a replacement for the existing P2 planning requirements and is not to be retrospectively applied to our existing network.

Forecasted 2050 group demand	**Relevant 2050 P2-8 Category**	**Net Zero Resilience Policy for group demand reliant on subsea cables**
Over 60MW and up to 300MW	D	Group demand secured for sustained long duration N-1 condition[5] through network assets. N-2 condition[6] through a combination of network assets and/or local/mobile generation (including third party).
Over 4MW And up to 60MW	B/C	

5 N-1 or First Circuit Outage (FCO) condition – Planned or unplanned unavailability of a single distribution circuit.

6 N-2 or Second Circuit Outage (SCO) condition – Planned or unplanned unavailability of two distribution circuits.

Forecasted 2050 group demand	Relevant 2050 P2-8 Category	Net Zero Resilience Policy for group demand reliant on subsea cables
Over 1MW And up to 4MW	B	Group demand secured for sustained long duration N-1 condition through a combination of network assets and/or local/mobile generation (including third party).
<1MW	A	N-2 condition managed through use of mobile generation or use of existing generation on island if available.

Table 1 SSEN Group Demand Sizes for Island groups which rely upon subsea cables

3.2.5. Transmission Interactions

There is significant potential and ambition for renewable energy developments in and around the Shetland Islands. SSEN Transmission has received multiple large-scale demand and generation connection applications and expressions of interest for a range of energy technologies including onshore and offshore wind. To facilitate this, SSEN Transmission, in consultation with Shetland stakeholders, is progressing the development of the electricity transmission infrastructure to facilitate these connections. Distribution and Transmission are working closely together in the planning and development of electricity network infrastructure.

In-flight transmission projects

Following completion of the first Shetland HVDC link (600MW) in August 2024, SSEN Transmission is constructing two transmission circuits from the Kergord converter station to Lerwick where they are building the Gremista Grid Supply Point (GSP).

Transmission and Distribution have worked together in the design of the connection between Kergord and Gremista, resulting in sections of the transmission circuits being undergrounded, and some sections of the existing distribution circuits also being undergrounded in order to accommodate transmission and distribution infrastructure in the same corridor.

Transmission and Distribution have also worked together in the design of the GSP, which will link the demand and generation on the existing electricity Distribution network on Shetland to the GB mainland electricity system for the first time, via the 600MW HVDC link, allowing the Lerwick Power Station to be used as back-up power supply.

To enhance the security of supply for Shetland, Distribution and Transmission have also worked together in the initial development of the battery solution to be connected at the Gremista GSP to enable a smooth transition to the back-up supply of Lerwick Power Station in the event of planned or unplanned outage of the HVDC link.

Current and future transmission development plans

In addition to the connections facilitated by the inflight projects, SSEN Transmission is progressing plans to connect further low carbon projects in response to developer applications, and in support of the Shetland Energy Strategy. Onshore applications include large demand and renewable generation on the Shetland main island and on Yell. In addition to this, there is need to connect three ScotWind offshore windfarms located approximately 22 miles east of Shetland in the NE1 Crown Estate Scotland leasing area. Distribution and Transmission continue to work closely together in SSEN Transmission's development of the Shetland Transmission Strategy in line with our whole system licence obligation.

The National Energy System Operator (NESO) recommended in their Beyond 2030 publication,[7] a second HVDC link (1.8GW) to connect Shetland to the GB mainland in Moray to connect the NE1 ScotWind offshore generation. This recommendation will also provide further security of supply, reducing the islands reliance on diesel back up generation and coordinating ScotWind with local generation and demand customers (including strategic demand) on Shetland.

In developing the Shetland Transmission Strategy, Distribution and Transmission are working together on a range of activities including alignment of strategic net zero network requirements, optimal planning of existing and future infrastructure within the identified corridors, engagement with key stakeholders and the regulator. Existing assets may require to be removed or diverted to accommodate future transmission infrastructure within the identified corridors depending on network needs driven by future connections in the area. As the plans progress through strategic planning and development, this open dialogue will be a key component in a successful whole system solution for the Shetland Islands. Therefore, we will continue to engage with SSEN Transmission regarding the evolution of their plans for the Shetland network including any future GSP requirement. Gremista GSP forms part of the overall SSEN Shetland Transmission Strategy.

The Shetland Transmission Strategy consists of:

- Shetland HVDC Link 1 (SHL1)[8]
- Gremista Grid Supply Point (GSP) and 132kV Connection[9]
- Shetland 2 HVDC Link - Shetland to Mainland Scotland 1.8GW HVDC Link (SHL2)[10]
- Shetland on-island transmission network (including connection to Yell)

Shetland HVDC Link 1 (SHL1)

The Shetland HVDC Link 1 (SHL1) project consists of a 132kV high voltage direct current (HVDC) 600MW link, including approximately 260km of cabling - all but 10km of which is in the North Sea. The construction of a 320/132kV double busbar substation and HVDC converter station at Upper Kergord, Shetland, and the addition of a HVDC switching station necessary to facilitate connection to the existing transmission system at Noss Head, Caithness. This project has connected Shetland to the GB electricity network for the first time, unlocking Shetland's renewable potential and enabling the connection of the 443MW Viking Wind Farm to the GB grid. This project was completed in August 2024.

Gremista Grid Supply Point (GSP) and 132kV Connection

The Gremista GSP and 132kV connection project consists of a new 132/33kV Grid Supply Point (GSP) at Gremista with a 22km double circuit 132kV connection, which will be a combination of both underground cable and overhead line, between the Gremista GSP site and Kergord substation. The Gremista GSP will also provide the connection point for a new battery demand side response (DSR) scheme to help support Shetland's ongoing energy requirements and enable the existing Lerwick Power Station to move to standby mode, further supporting the decarbonisation of Shetland. This project is expected to be completed in 2025 and in doing so, will connect Shetland's local electricity distribution network to the GB transmission system for the first time, helping secure the islands future security of supply.

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7 https://www.neso.energy/document/315516/download

8 Shetland HVDC Link - SSEN Transmission (ssen-transmission.co.uk)

9 Gremista GSP (Grid Supply Point) and 132kV Connection - SSEN Transmission (ssen-transmission.co.uk)

10 Early engagement gets underway ahead of potential second Shetland subsea link - SSEN Transmission

Shetland 2 HVDC Link

SSEN Transmission have stated their intention to proceed with the installation of a second HVDC link between Shetland and the Scottish mainland (SHL2) and the construction of an additional substation hub in the north of the Shetland, as outlined in their RIIO-T3 business plan. This will greatly strengthen the network resilience to the region and enable the connection of renewable generation schemes to support both Shetland, Scotland and the wider UK in their net-zero ambitions. This project will consist of a new 525kV HVDC link,1800MW, to be installed between Moray in the north of Scotland transmission network and the Shetland Islands, connecting into a new 400kV Shetland substation which is expected to be located in the industrialised northern region of the Shetland mainland. The development of this second link and associated onshore infrastructure is at the early stages of development and will be subject to extensive public consultation and engagement with local stakeholders.

Shetland on-island transmission network (including connection to Yell)

SSEN Transmission have been actively progressing with their on-island transmission network strategy for the Shetland islands which is needed to join the 1st and 2nd HVDC links (maximizing their capacity for all customer connections) and provide the necessary connection requirements for many renewable energy developments local to Shetland – this includes a cable connection to Yell for contracted onshore wind customers. Strategic optioneering and detailed option development is ongoing, with the strategy to be either a 132kV network or 220kV network. SSEN Transmission have been closely collaborating with a range of stakeholders in the development of this strategy including the Shetland Island Council and SSEN Distribution.

3.3. Ongoing Area developments

Lerwick Power Station (LPS)

Historically Shetland has been unique in terms of its electricity generation and distribution as a self-sustained island with no electrical connection to the Scottish Mainland and the entirety of the Shetland Islands being supplied via diesel generation at Lerwick power station (LPS) and supported by Sullom Voe gas terminal (SVT). This infrastructure is set to change when SSEN Transmission completes the build and energisation of its new Gremista GSP/HVDC interconnection to the mainland. Once energised, the new Gremista GSP will become the new main power, frequency and voltage support for the Shetland, under Network Intact conditions. LPS will then move into standby mode to be ready in case of any HVDC planned and unplanned outages. The islands of Fair Isle and Foula are not connected to the Shetland distribution network, having their own local networks supplied by local generation. The existing distribution system is made up of 33kV, 11kV and LV circuits.

Sullom Voe Terminal (SVT) decarbonisation

Sullom Voe Terminal is an oil and gas terminal located in the north of the Shetland Mainland. It is independently owned and operated on behalf of a consortium of oil and gas companies. SVT handles production from oilfields in the east and west of Shetland basin's receiving oil by pipeline before it is exported from Sullom Voe by Tanker and shipped worldwide. SVT is a generation export customer which contributes to the Shetland electricity network via its gas-fired power station. The station's primary purpose is to supply electricity to the Sullom Voe oil and gas terminal, but it also provides power to the Shetland system through a contractual arrangement with SSEN. The electricity exported to the 33kV distribution network assists in keeping the overall system operating conditions both safe and stable. As part of the decarbonisation of Shetland, SVT are exploring options for their own decarbonisation to become an import only customer. The implications of this potential decarbonisation mean that any future strategic planning for the Shetland Transmission/Distribution systems will have to consider the decarbonisation of SVT at its core, and we continue to engage with key stakeholders on this matter.

3.4. Flexibility Considerations

Through its innovative Constraint Managed Zone (CMZ) initiative in 2016, SSEN was the first UK Distribution Network Operator (DNO) to introduce Flexibility Services in their current commercial format. We are continuing to lead the way in this development, with over 700MW of Flexibility Services being procured in the 23/24 Financial Year.

SSEN uses Flexibility Services to manage areas on our network that would otherwise experience power flows that exceed the network capacity. Flexibility Services are a key tool in the design and operation of the network. They are used to support our network's investment programme by enabling outages to go ahead, optimising the build programme and delaying reinforcement where economical to do so.

SSEN procures Flexibility Services from owners, operators, or aggregators of Distributed Energy Resources (DERs), which can be generators, storage, or demand assets. Services are typically needed at specific locations and times of day where high power flows are expected to occur.

In September 2024, we launched a Request for Information (RFI) to identify new Flexibility Service Participants in a selection of island communities and establish routes to market in this geographical location. The consultation closed on the 20 September 2024, and we are continuing conversations with participants as we develop our procurement strategy in these locations.

Load Managed Areas (LMAs)

Historically we have managed demand in this area using Load Managed Areas (LMAs). These have relied on the use of radio teleswitches to optimise residential heating demand. Moving forwards, we will continue to value this use of flexibility to manage demand, and we are in the process of transitioning to a market-based solution and in the spirit of a Smart and Fair transition, SSEN have committed to removing LMAs during ED2 and ED3.

Active Network Management (ANM)

Active Network Management is a control principle used by the Distribution Network Operator (DNO) to manage power flow on the electricity distribution network in-real time. This is achieved through a control system installed at the customer's point of connection and monitors at dedicated measurement points on the network, comparing real time power flow against the thermal rating of the constrained assets.

We allow ANM connected sites to operate to maximum capacity when it is safe to do so, and any additional Flexibility Services will not change this. We are particularly interested in services that can support local demand when existing DERs lack sufficient capacity. The consideration of overall energy position is also included in the rules for ANM. When ANM connected generation can provide an additional service beyond its standard operating regime, we will seek to explore ways to facilitate participation, for example addition of storage or additional controls to existing connected assets.

There is currently a live ANM scheme operating on the Shetland Distribution network. The Northern Isles New Energy Solutions (NINES) project was an innovation project developed by SSEN aimed at transforming the energy landscape of the Shetland Islands by managing multiple constraints on both the 33kV and 11kV distribution networks. The NINES scheme is now closed to new participants.

There are four generator sites in Shetland connected to the NINES ANM scheme, this means the generation may be restricted below its generating capability due to constraints on our network. The Shetland ANM manages the electricity generation against the demand of local loads to maintain system stability, as we cannot store this electricity on our network.

With the introduction of new transmission infrastructure on Shetland, there is an emerging requirement for the creation of a transmission ANM system, to mitigate the loading on the radial link(s) to the mainland. This would be designed to interact with a new distribution ANM system to manage the export at the GSP boundary[11]. Engagement with the National Energy System Operator (NESO) and SSEN Transmission is ongoing with regards to the future of the Shetland ANM system(s).

11 It is likely that NINES would no longer be subject to the ANM scheme by this time.

4. EXISTING NETWORK INFRASTRUCTURE

4.1. Gremista Grid Supply Point Context

The Gremista GSP distribution network is made up of 33kV, 11kV, and LV circuits. It is a rural network spanning across the Shetland Islands archipelago. While much of the land is used for agricultural purposes, the town of Lerwick introduces a mix of residential, commercial, and industrial land, which is located on the Shetland mainland. In total, the GSP supplies approximately 14,000 customers with the breakdown for each Primary substation shown in **Table 2** below.

Substation Name	Site Type	Number of Customers Served	2023/244 Substation Maximum MVA (Season)
Shetland/Gremista GSP			
Gremista GSP / Lerwick Power Station (LPS)	Grid Supply Point / Power Station	14,438 (TOTAL)	29.29 (Winter)
Brae	Primary Substation	1,013	2.33 (Winter)
Firth	Primary Substation	397	1.34 (Winter)
Gremista Primary	Primary Substation	5,510	9.92 (Winter)
Gutcher	Primary Substation	238	0.69 (Winter)
Mid Yell	Primary Substation	439	0.93 (Winter)
Setter Sandwick	Primary Substation	1,295	2.50 (Winter)
Scalloway	Primary Substation	1,724	3.47 (Winter)
Sumburgh	Primary Substation	595	1.68 (Winter)
Tumblin	Primary Substation	1,119	1.92 (Winter)
Unst	Primary Substation	568	1.51 (Winter)
Voe	Primary Substation	1,540	3.00 (Winter)

Table 2 Customer number breakdown and substation peak demand readings (2024)

There are several SSEN Distribution subsea cables within the Shetland network. These cables are listed in **Table 3** below:

Substation Name	Asset Description	Voltage Level	Circuit Rating (MVA)	Level of Security currently provided
Gremista Primary	Lerwick - Bressay North	HV	5	N-1

Gremista Primary	Lerwick - Bressay South	HV	2.9	N-1
Gremista GSP	Yell - Unst North	EHV (Operates at 11kV)	12	N-1
Gremista GSP	Yell - Unst South	EHV	12	N-1
Gremista GSP	Mossbank - Yell North	EHV	16	N-1
Firth	Mossbank - Yell South	EHV (Operates at 11kV)	14.3	N-1
Gutcher	Yell - Fetlar 2	HV	2.9	-
Scalloway	Clift Sound	HV	2.1	-
Voe	Shetland - West Linga	HV	4.7	-
Voe	West Linga - Whalsay	HV	4.7	-
Voe	Whalsay - Out Skerries	HV	2.9	-
Voe	Shetland - Whalsay	HV	2.9	N-1
Tumblin	Papa Stour – Mainland Shetland	HV	5.6	-

Table 3 SSEN Distribution subsea cable assets on the Shetland Islands

4.2. Current Network Topology

Figure 4 below highlights the existing 33kV network topology in Shetland. As a truly islanded network, the Shetland distribution system is supplied by the diesel-powered generators located at Lerwick Power Station. It is then distributed to the eleven Primary substations via the 33kV distribution network.

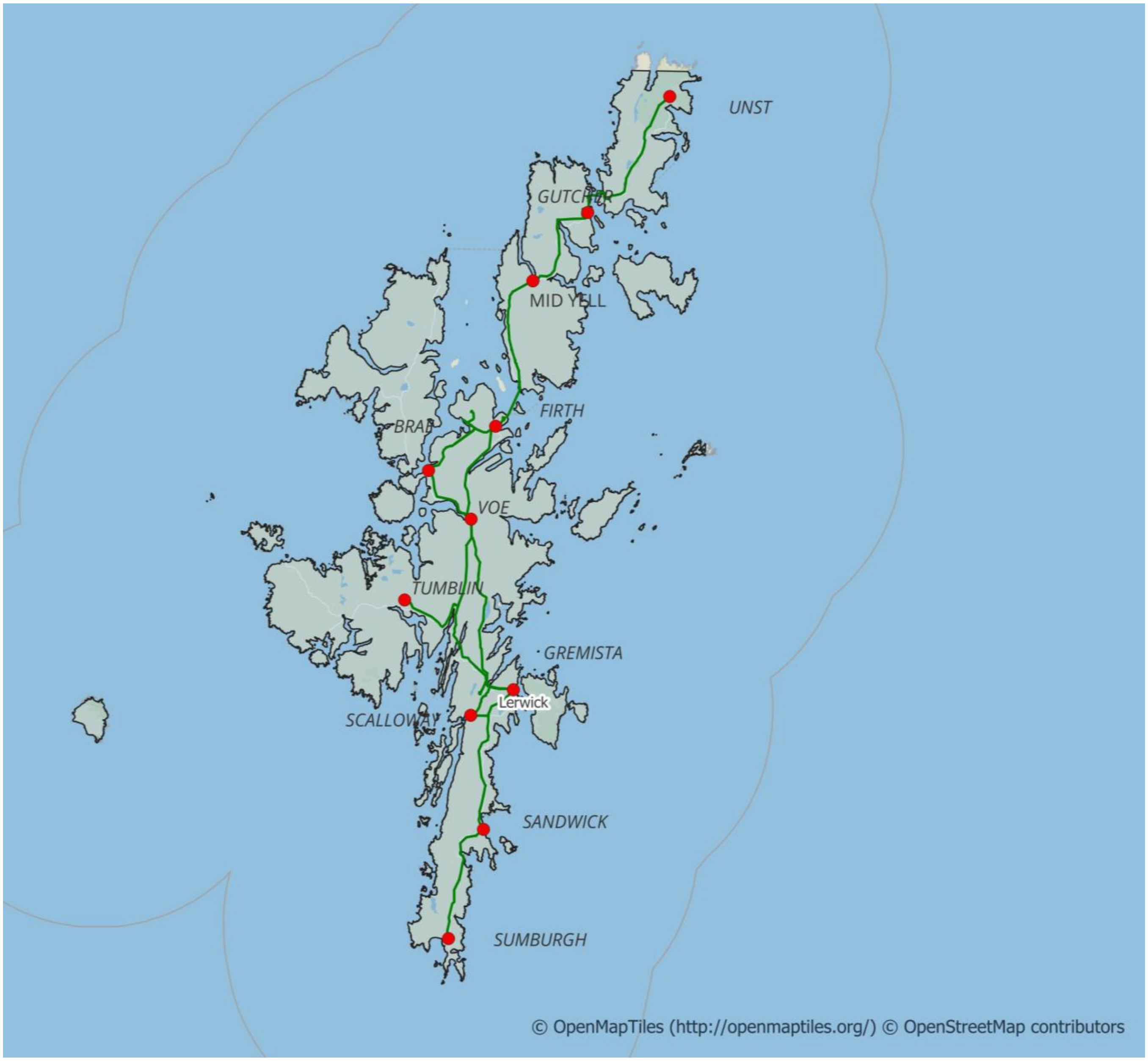


Figure 4 Gremista GSP - Geographic Information System (GIS) View

4.3. Network Schematic

The network schematic in **Figure 5** (below) depicts how the Shetland distribution network is projected to look by 2025.

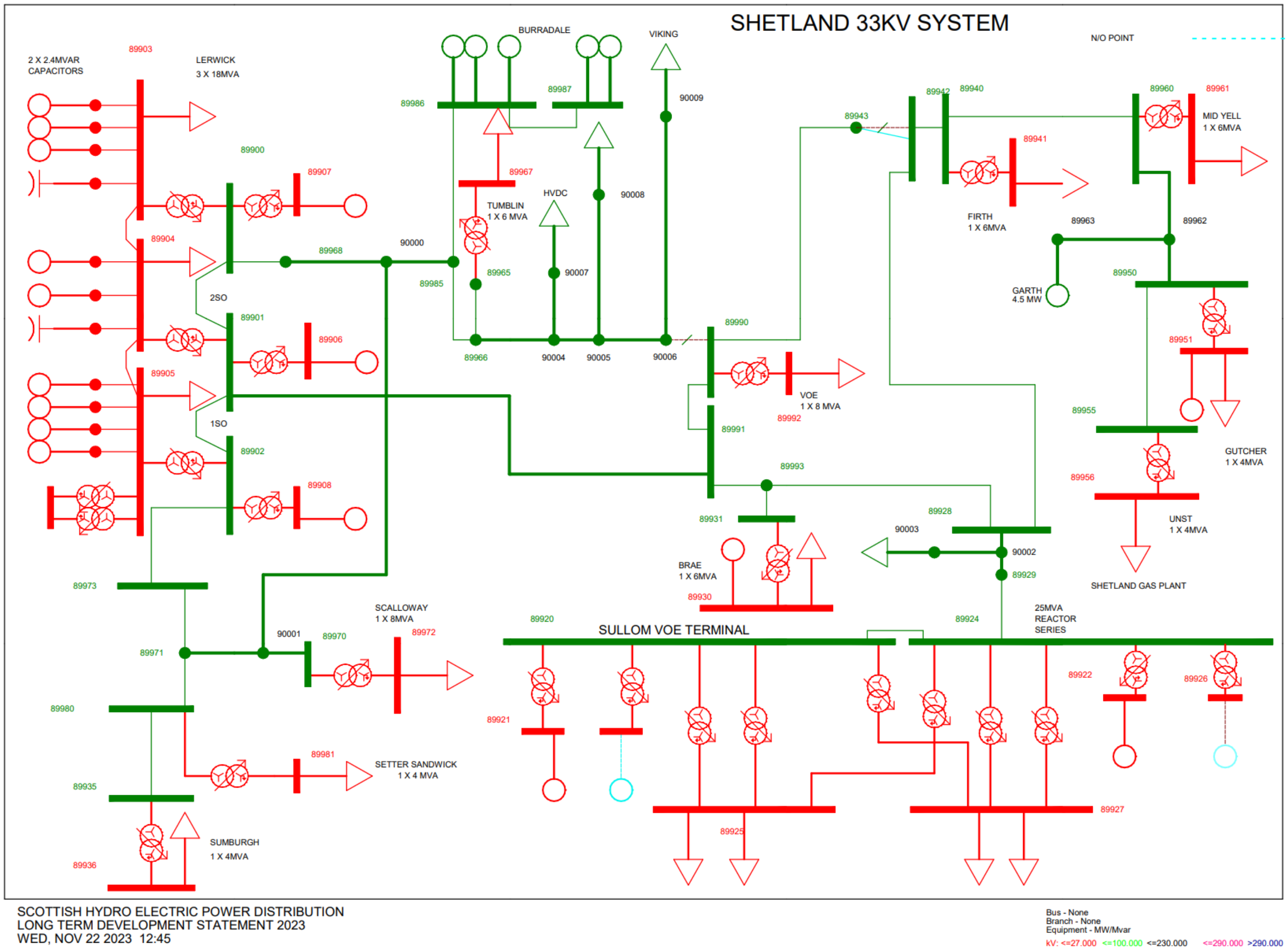


Figure 5 Shetland 33kV network schematic – current running arrangement – transformer nameplate ratings

5. FUTURE ELECTRICITY FORECASTS AT GREMISTA GSP

The following section details load growth across the technologies projected in DFES 2023. DFES 2023 was published in March 2024 and therefore predates more recent industry policy changes such as Clean Power 2030 and the introduction of Regional Energy Strategic Plans (RESPs) by the NESO. These will be addressed in the next iteration of this SDP.

In addition there are important notes on the values presented in this section:

- These projections relate to the GSP supply area highlighted in **Figure 5.**
- Where Megawatt (MW) values are presented in this section, they represent ***total installed capacity.*** When conducting network studies these values are appropriately diversified to represent the coincident maximum demand of the entire system rather than the total sum of all demands.

5.1. Distributed Energy Resource

5.1.1. DFES Projections

Generation

The baseline value for electricity generation on Shetland is as follows: Diesel Generation as the primary electricity generation resource on Shetland is 70.84MW, Hydropower is 0.018MW, Marine is 0.045MW, Onshore Wind is approximately 12.44MW and Solar PV is approximately 0.32MW.

Based on the DFES projections, under the Consumer Transformation scenario, distributed renewable generation across the Gremista GSP group will increase significantly from 101.66MW in the currently connected baseline to 125.13MW in 2050 (as shown in **Figure 6**). We anticipate the decarbonisation of Diesel generation ahead of 2035, with Onshore Wind and Solar PV accounting for most of the distributed generation increase from 2025 onwards.

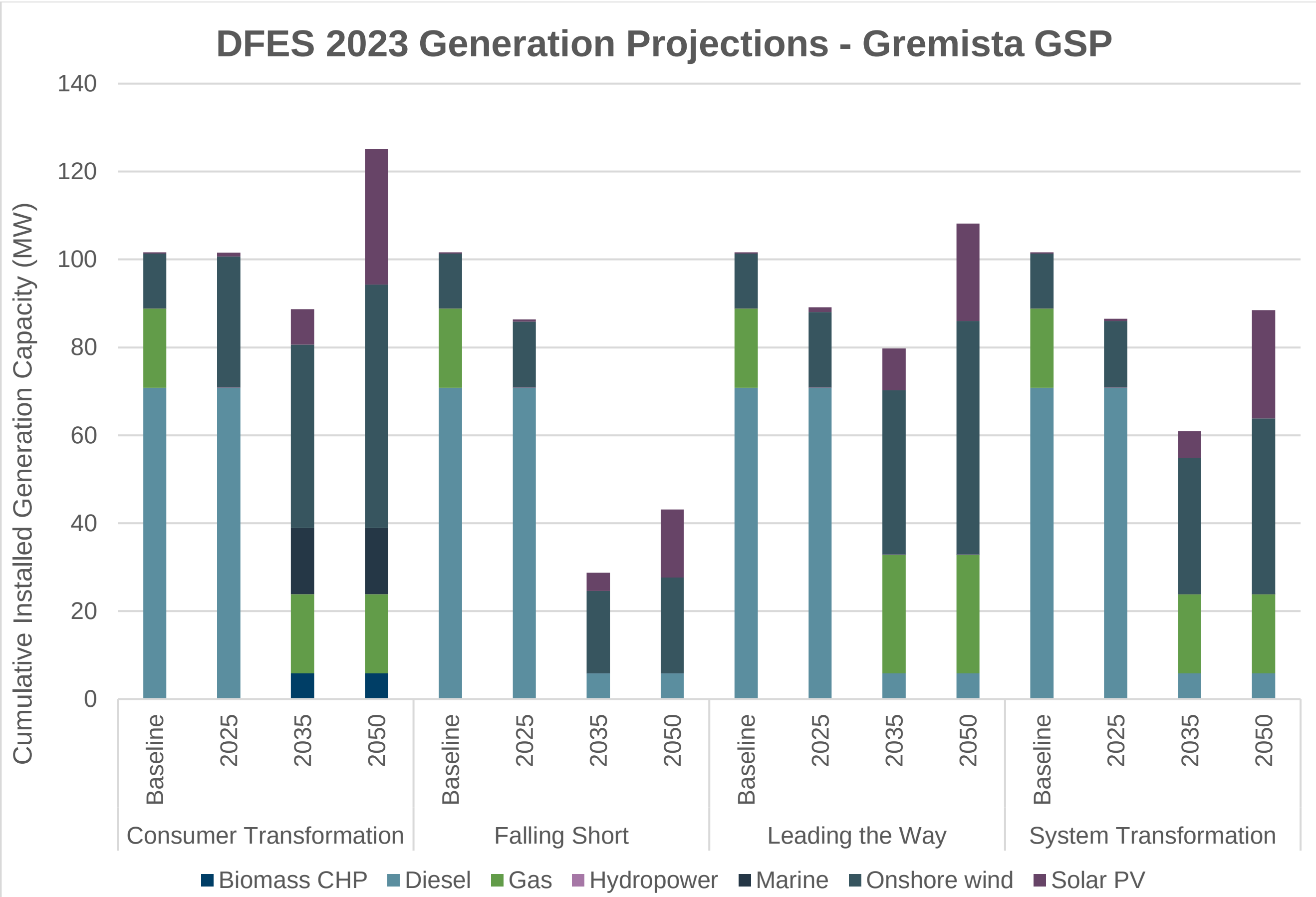


Figure 6 Projected Cumulative Distributed Generation Capacity Gremista GSP (MW). Source: SSEN DFES 2023

Storage

While multiple storage technologies have their projected uptake modelled in the DFES, in the Gremista GSP supply area we see a significant increase in the installation of domestic storage, co-location storage and standalone grid services storage. Domestic storage refers to those 1-15kW in scale, designed to enable households to increase the self-consumption of domestic solar PV, as well as acting as a backup power supply to households in more rural locations. A cumulative storage capacity of approximately 4.20MW is projected by 2050 under the Consumer Transformation scenario (**Figure 7**).

Co-location generation refers to a system where battery storage is located with renewable generation, and this has a cumulative storage capacity of approximately 11.67MW projected by 2050 under the Consumer Transformation scenario. Standalone grid services technology refers to larger battery storage projects, typically multiple megawatt-scale projects that provide balancing, flexibility and support services to the electricity network when instructed.

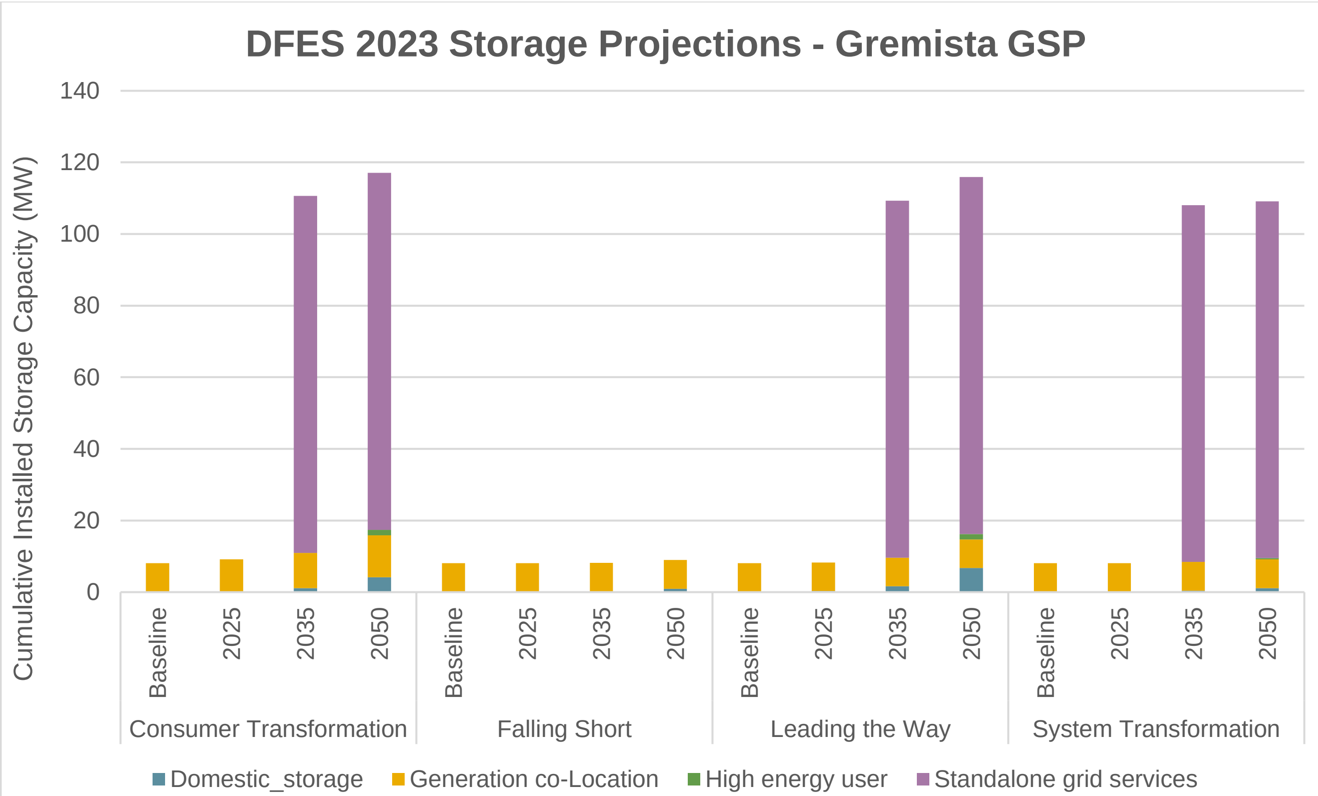


Figure 7 Projected Cumulative Storage Capacity Gremista GSP (MW). Source: SSEN DFES 2023

5.2. Transport Electrification

Future electricity demand from transport could come from three different transport sectors that are on very different timelines. EV charging is expected to see rapid adoption to meet demand from residents and visitors. SSEN is already exploring the development of shore power charging for ferries at key port locations, with other vessels potentially increasing future capacity requirements at these sites (see Section 5.6 for further details). Loganair, which operate flights at the main airport in Sumburgh, is pushing for the electrification on on-ground assets, vehicles, and a longer-term view for aircraft decarbonisation.

5.2.1. DFES Projections

According to SSEN's 2023 DFES analysis, there could be just over 20,830 (CT) EV cars and light goods vehicles (LGVs) registered in the Gremista GSP area by 2050. As the network operator, it is important for SSEN to understand the impact on network driven by the electricity demand of EVs. To do this we can use the projected EV charger capacity (MW) from SSEN's DFES analysis. The SSEN DFES forecasts indicate that the total connected EV charge point capacity under Gremista GSP, excluding off-street domestic chargers, could total 10.93MW (CT) by 2035 (as shown in **Figure 8**) increasing to 13.56MW by 2050.

The uptake of domestic off-street chargers follows a similar trend. By 2035, there could be as many as 6,658 (CT) domestic off-street chargers installed under Gremista GSP with this increasing to approximately 7,253 (CT) by 2050.

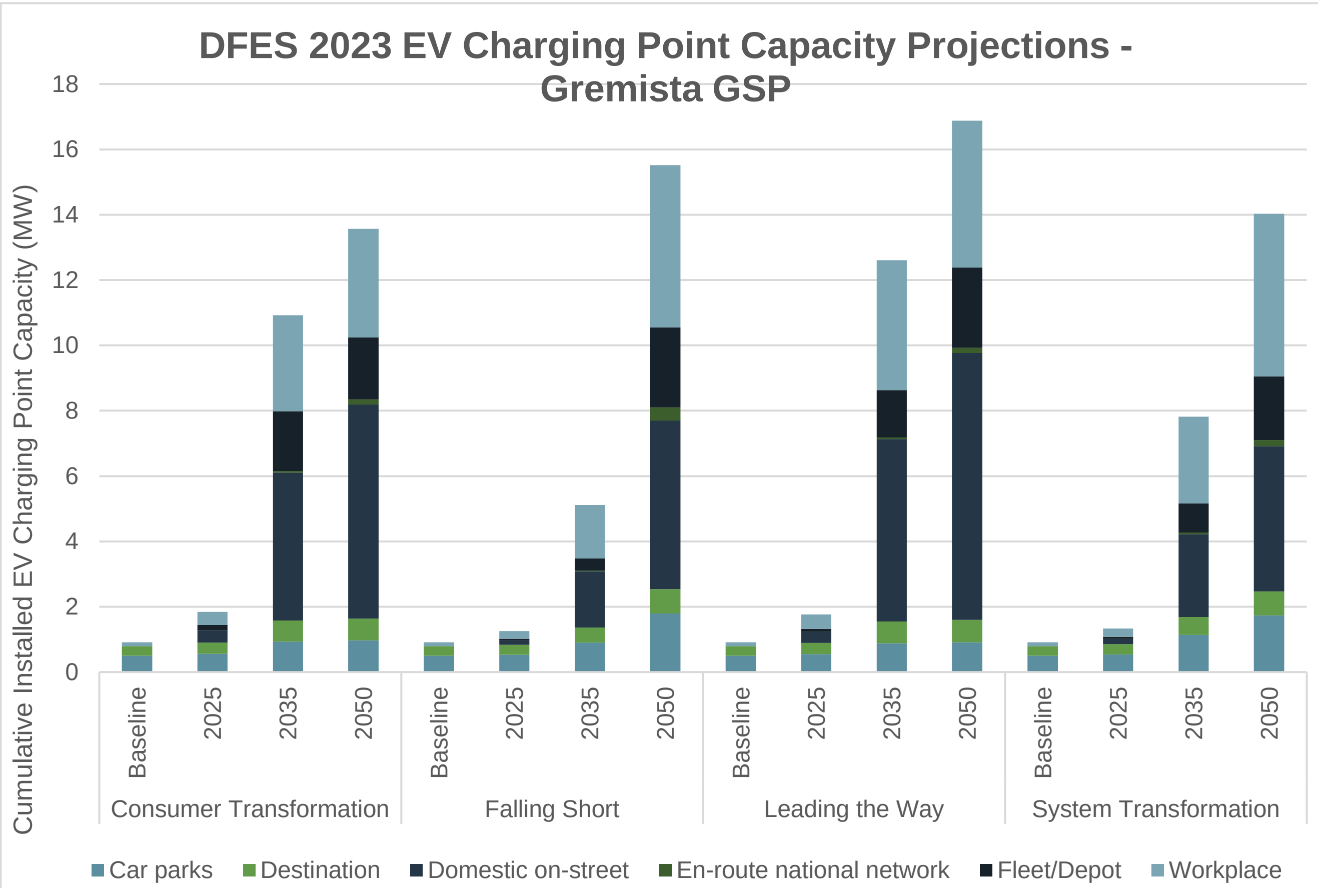


Figure 8 Projected Cumulative EV Charging Point Capacity Projections Gremista GSP (MW). Source: SSEN DFES 2023

5.3. Electrification of heat

The decarbonisation of space heating technologies in homes and businesses will have a significant impact on the future energy system. In Scotland, central heating has historically relied on mains gas & oil (80%) and electric heating (11% including storage heaters).[12] However, most homes in Shetland do not have access to mains gas and rely on oil heating, contributing to the highest levels of fuel poverty in the country. In the main settlement of Lerwick, homes are heated through a local district heating scheme. Shetland Heat & Power (SHEAP) have been operating the Energy Recovery Plant (ERP) for 25 years supplying approximately 1,200 customers. The ERP generates heat by burning local refuse and from the neighbouring Orkney Islands. This generated heat, in the form of hot water, is then circulated through an approximate 40km network of pipes buried through the streets of the main town, Lerwick[13].

Government legislation, including the publication of local authorities' Local Heat and Energy Efficiency Strategies (LHEES)[14], and consumer behaviour are just two of many factors that will impact the future electricity demand

12 Scottish House Condition Survey: 2021.

13 How it works | Shetland Heat Energy & Power

14 Local heat and energy efficiency strategies and delivery plans: guidance - gov.scot (www.gov.scot)

arising from space heating. Shetland Islands Council are still in the process of drafting an LHEES and once published this will help to inform the future projections of heat related demand growth across the Shetland Islands.

5.3.1. DFES Projections

The electrification of heat could create significant new electricity load in Gremista GSP, with the adoption of heat pumps and next generation night storage. The air source heat pumps (domestic and non-domestic) and direct heater units could increase by up to 7,939 (CT) in 2035 steadily rising to 14,043 (CT) by 2050. This excludes air conditioning load which accounts for a total of 772 units by 2050. This is highlighted in **Figure 9** below.

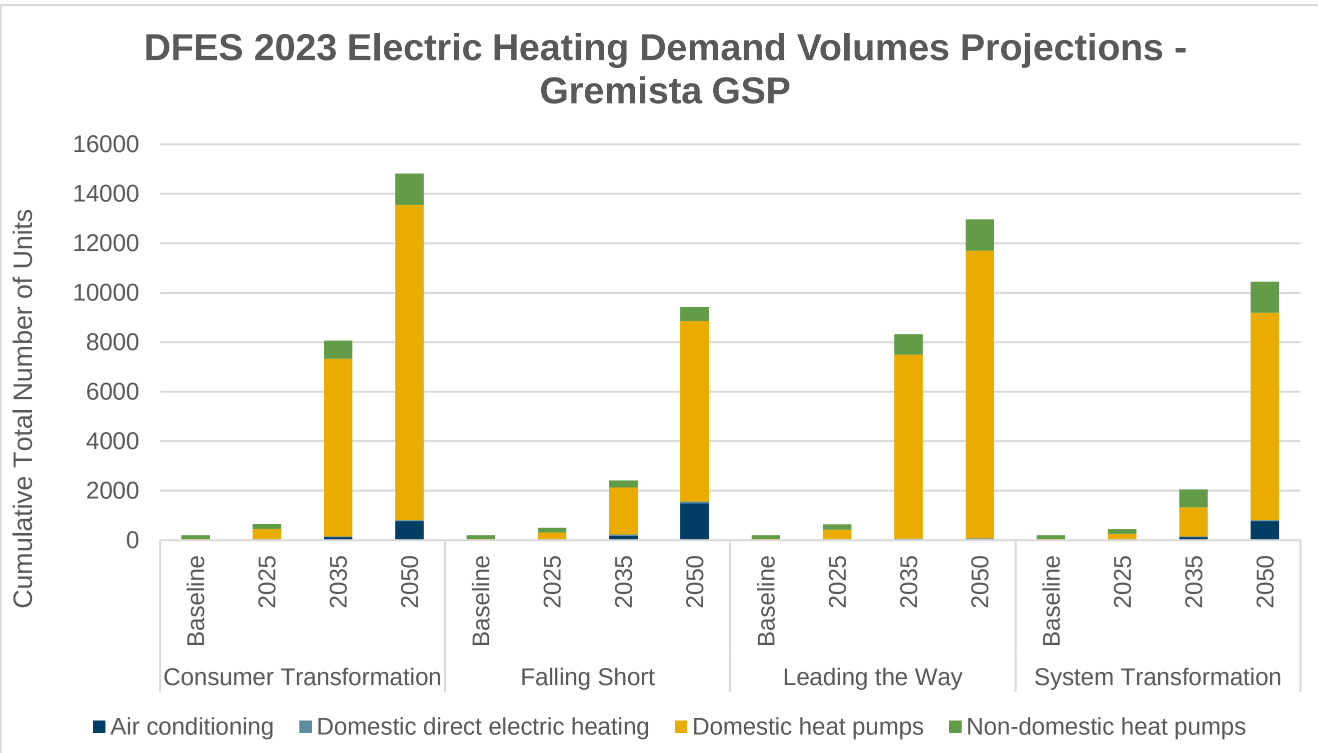


Figure 9 Projected Cumulative Electric Heating Demand Volumes Projections Gremista GSP (units). Source: SSEN DFES 2023

5.4. New building developments

To produce the SSEN DFES, Regen engaged with local authorities to understand their development plans across our licence areas.

5.4.1. DFES Projections

For Gremista GSP, the DFES forecasts the cumulative floorspace of non-domestic new developments. **Figure 10** shows that the two building classifications contributing to the largest floorspace growth are factory and warehouse developments (485,172m^2 by 2050 in all scenarios), and new office space (408,794m^2 by 2050 in all scenarios). The domestic cumulative number of homes is expected to rise from 516 in 2035 (CT) to 611 in 2050(CT).

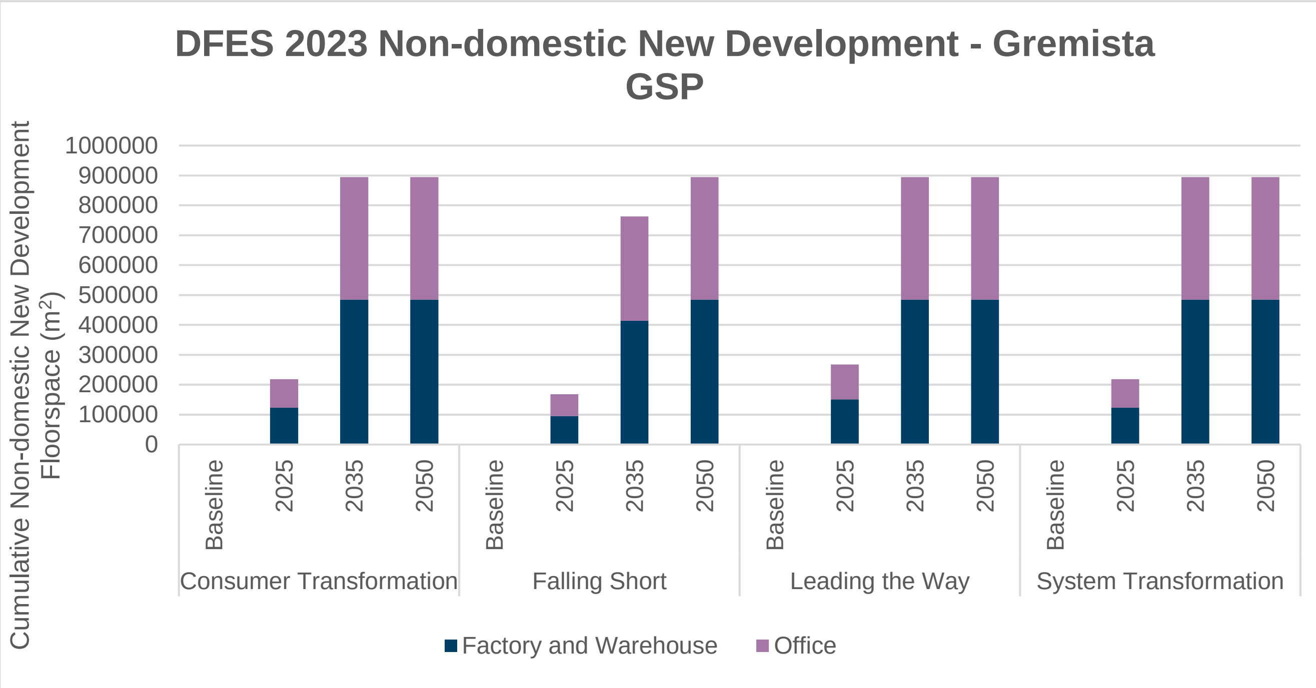


Figure 10 Projected Cumulative Non-Domestic New Building Developments Gremista GSP (Floorspace m^2). Source: SSEN DFES 2023

5.5. Commercial and industrial electrification

The decarbonisation of industries specific to Northern Scotland (i.e. whisky distilleries, fish and seaweed farming) and broader industries (e.g. agriculture and other commercial businesses) indicate there could be a range of potential electrification outcomes for the Shetland Islands. We have identified distilleries, the oil and gas industry and ports as areas of significant future industrial demand growth for the Shetland Islands. Below we summarise these findings and the impacts on our analysis work.

5.5.1. Distilleries

The current and future energy demand of the distilling industry in the Shetland Islands is relatively small with only one registered distillery located in the most northern island of Unst. While electrification of distilleries could increase demand capacity on the distribution network, it is unlikely to significantly impact the overall demand on the local electricity network unless the industry experiences significant expansion in the future.

5.5.2. The oil and gas industry

The oil and gas industry has a significant presence and history within the Shetland Isles. Electrification of its supplies may have a significant impact on future demand requirements, and we will need to work with this sector to understand its needs and the timing of any requirements. Further details on Sullom Voe decarbonisation can be found in Section 3.3.

5.5.3. The port industry

Ferries are a primary mode of maritime transport across the Shetland Islands. As such, the associated use of shore power to charge these vessels could equate to a significant load increase at each of the relevant ferry terminals. In addition to their shore power requirements, the ferries charging profiles and ports' abilities to charge EVs will be major considerations for any network reinforcement. There are ten inter-island ferry routes operated in the Shetland Islands, as well as two Scottish mainland ferry routes operating out of Aberdeen. The freight route sails from Aberdeen directly to Lerwick. The passenger ferry route sails from Aberdeen to Lerwick, stopping at Kirkwall, Orkney, on alternate days. The Inter- Island ferry route map is shown in **Figure 11** below.

The potential growth in electricity load is closely tied to the timeline for changing or replacing individual vessel propulsion systems. Quantifying this timeline is challenging due to uncertainties in technology readiness. However, partial, hybrid, or full electrification, especially for smaller roll-on/roll-off ferries, is being considered as a viable option, rather than alternatives like ammonia or biomethane.

The 'Seachange' Project is a joint initiative with European Marine Energy Centre (EMEC), the Power Networks Demonstration Centre (PNDC), Ricardo and SSEN Distribution which will develop a replicable port level investment model to explore net-zero transition scenarios. This model will not only be used to help identify key network investment requirements, but also to inform and enable ports and their users to plot their most viable decarbonisation pathways enabling their net-zero future. The umbrella of 'Ports' encompasses several other offshore and seafaring industries such as cruise liners, the fishing industry and the offshore wind, oil and gas industries.

We are developing a methodology in alignment with the 'Seachange project' to forecast the electrical demand for ports within the Shetland Islands, which will form part of the system needs in future analysis.

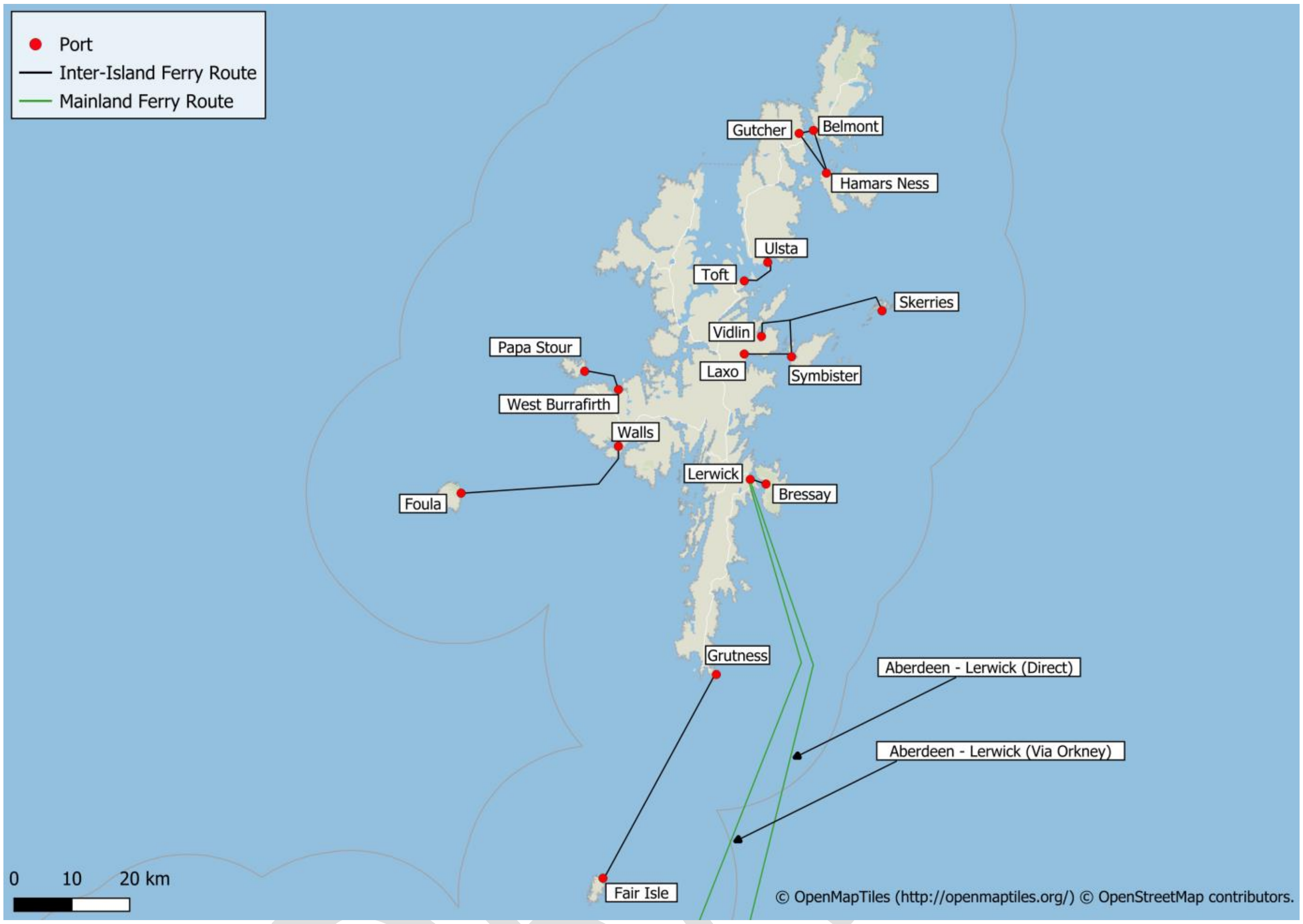


Figure 11 Shetland inter-island ferry route map

5.6. Generation and Demand Projections Summary

5.6.1. Generation Installed Capacity Projections for Gremista GSP

The generation forecasts highlighted in **Appendix B** relate to the cumulative capacity (MW) of distribution connected generation projects across Gremista GSP. The charts are broken down into technology types expected to connect across the network and do not relate to coincident peaks for each technology which will be covered further in our generation analysis and options selection in Section 8.

The generation forecast for Gremista GSP shows large increases in Onshore Wind and Solar PV under the CT and LW scenarios. The levels of generation forecast under the CT indicates a 23% increase from 101.59MW (CT) in 2025 to 125.13MW (CT) in 2050 as shown in Appendix B - Figure 3. The LW scenario indicates the levels of generation forecast on Gremista GSP increases by 21% from 89.10MW (LW) in 2025 to 108.18MW (LW) in 2050 as shown in Appendix B. The ST scenario indicates a far lesser growth of 2% from 86.55MW (ST) in 2025 to 88.46MW (ST) in 2050 as shown in Appendix B.

Table 4 summarises the cumulative future generation capacity needs for the time horizon from baseline to 2050 for the Gremista GSP. This large increase in generation will have significant impacts, and the future network needs to be robust enough to handle this large step change in installed capacity, particularly during the summer period.

Substation	CT Scenario (in MW)			LW Scenario (in MW)		
	2025	2035	2050	2025	2035	2050
Gremista GSP	101.59	88.73	125.13	89.10	79.73	108.18
Substation	**ST Scenario (in MW)**			**FS Scenario (in MW)**		
	2025	2035	2050	2025	2035	2050
Gremista GSP	86.55	60.94	88.46	86.37	28.75	43.16

Table 4 DFES Generation installed capacity forecast for CT, LW, ST and FS scenarios in Gremista GSP

5.6.2. Demand projections at Gremista GSP

All the forecasted demand data at Gremista GSP is highlighted in **Table 5** below.

Appendix C shows forecast demands for each DFES scenario up to 2050. These forecasts represent winter peak demand at each primary substation, with the effect of embedded generation netted off. Information relating to industrial decarbonisation impacts will be added to these values in any detailed analysis undertaken. Demand from EHV contracted connections, which is not captured under the DFES, are also accounted for within the demand forecast. This information is summarized for the demand at Gremista GSP in **Table 5** below.

The network demand for Gremista GSP shows moderate growth due the heat pump forecasts in the DFES Regen analysis. The CT scenario demand shows an increase from 39.68MW in 2024 to 103.59MW in 2050 as shown in Appendix C - Figure which represents a 161% increase over that timeframe. This increase is mostly around Gremista primary substation with heat pump and EV charging capacity uptake increasing steadily over the years. The LW scenario demand shows a similar increase from 40.24MW in 2024 to 102.98MW in 2050 as shown in Appendix C - Figure which represents a 155.9% increase over that timeframe. The Gremista GSP forecasts for the ST and FS scenarios are shown in Appendix C.

Substation	CT Scenario (in MW)				LW Scenario (in MW)			
	2024	2028	2040	2050	2024	2028	2040	2050
DFES demand	**36.93**	**47.09**	**79.43**	**85.52**	**37.49**	**48.02**	**79.87**	**84.91**
Contracted demand	**2.75**	**18.07**	**18.07**	**18.07**	**2.75**	**18.07**	**18.07**	**18.07**
Total	**39.68**	**65.16**	**97.50**	**103.59**	**40.24**	**66.09**	**97.94**	**102.98**
Substation	**ST Scenario (in MW)**				**FS Scenario (in MW)**			
	2024	**2028**	**2040**	**2050**	**2024**	**2028**	**2040**	**2050**
DFES demand	**36.81**	**44.29**	**67.64**	**76.92**	**36.31**	**42.13**	**65.55**	**75.97**
Contracted demand	**2.75**	**18.07**	**18.07**	**18.07**	**2.75**	**18.07**	**18.07**	**18.07**
Total	**39.55**	**62.36**	**85.71**	**94.99**	**34.05**	**60.20**	**83.62**	**94.04**

Table 5 Demand Forecast for CT, LW, ST and FS scenarios in Gremista GSP

6. WORKS IN PROGRESS

6.1. Ongoing works in Gremista GSP

Network interventions can be caused by a variety of different drivers. Examples of common drivers are load-related growth, specific customer connections, and asset health. Across Gremista GSP, these drivers have already triggered network interventions that have progressed to detailed design and delivery. For works to be delivered within the RIIO-ED2 timeframe, these works are assumed to be complete, with any resulting increase in capacity considered to be released.

This report highlights ongoing capital works to meet the demand and generation requirements for Shetland. A summary of existing works is shown in **Table 6** below and further information on the schemes which have recently been through our DNOA process can be found in **Appendix F**. The network considered for long-term modelling is shown below in **Figures 12 – 15.**

ID	Substation	Description	Driver	Forecast completion	Fully resolves future strategic needs to 2050?
1	*Gremista GSP*	*New Gremista GSP and 33kV network integration works (GSP to Gremista 33kV + GSP to network feeders).* *Upgrade and modification of Active Network Management (ANM) system.*	*SSEN Transmission and Load related – pre-dating DNOA Process*	*2026*	
2	*Gremista Primary Substation 33kV Switchroom*	*Replacement of the 33kV outdoor circuit breakers with new 33kV indoor switchboard at Gremista Primary.* *Connection of existing 33kV network feeders, generators and Primary Substation.*	*Load related – pre-dating DNOA Process*	*2025*	
3	*Mid Yell Primary Substation*	*Installation of new 33kV switchboard and Statcom at Mid Yell.*	*Load related – pre-dating DNOA Process*	*2027*	
4	*Scalloway Primary Substation*	*Installation of additional 8MVA Transformer.* *Extension of existing circuit to form a 33kV ring between Scalloway - Sandwick.* *11kV reinforcement works.*	*DNOA Process*	*2029*	
5	*Sandwick Primary Substation*	*Installation of additional 8MVA Transformer.* *Extension of existing circuit to form a 33kV ring between Scalloway - Sandwick.* *11kV reinforcement works.*	*DNOA Process*	*2029*	
6	*Sumburgh Primary Substation*	*Installation of 11kV Voltage Regulator*	*DNOA Process*	*2029*	
7	*Firth Primary Substation*	*New 33kV cable circuit and new outdoor switchgear/switchboard at Firth PSS to create 33kV ring network.*	*Load related – pre-dating DNOA Process*	*2027*	
8	*Brae Primary Substation*	*11kV Overhead Line reinforcement.* *New 11kV Overhead Line spur to Fethaland Lighthouse.* *New HV switching station*	*Resilience (Worst Served Customers scheme)*	*2027*	
9	*Gutcher Primary Substation*	*11kV Overhead Line and subsea cable reinforcement and creation of 11kV ring network to the island of Fetlar.*	*Resilience (Worst Served Customers scheme)*	*2027*	

10	*New Primary Substation*	*New primary substation between Gutcher and Unst, to be located on Unst and Integrated into the existing 33kV and 11kV networks with auto-changeover/APRS schemes.*	*Resilience (Worst Served Customers scheme)*	*2026*	
11	*Gremista GSP*	*33kV subsea cable reinforcement.* *(Mossbank - Yell North)*	*Asset Condition*	*2025*	
12	*Gremista GSP*	*Diversion of existing SSEN Distribution 33kV Overhead Lines between Gremista and Kergord to allow the construction of SSEN Transmission 132kV circuits.*	*Customer Connection*	*2026*	
13	*Sullom Voe Primary Substation*	*SVT demand connection project consisting of:* *Dual 33kV cable circuits Gremista GSP – SVT* *New 33kV switchboard at SVT and Incoming 33kV Circuit breaker's* *New 33kV circuit breakers at Gremista GSP.*	*Customer Connection*	*2027*	

Table 6 Works already triggered through customer connections and the DNOA process

Where the above works are marked as not providing sufficient capacity for 2050 peak demands, it is important to note that this relates to the individual primary substation's firm capacity. When considering the further works identified in this report, the holistic plans provide capacity across the whole Gremista GSP supply area for 2050.

6.2. Network Schematic and GIS View (following completion of above works)

The network considered for long-term modelling is shown below in **Figures 12 –15.**

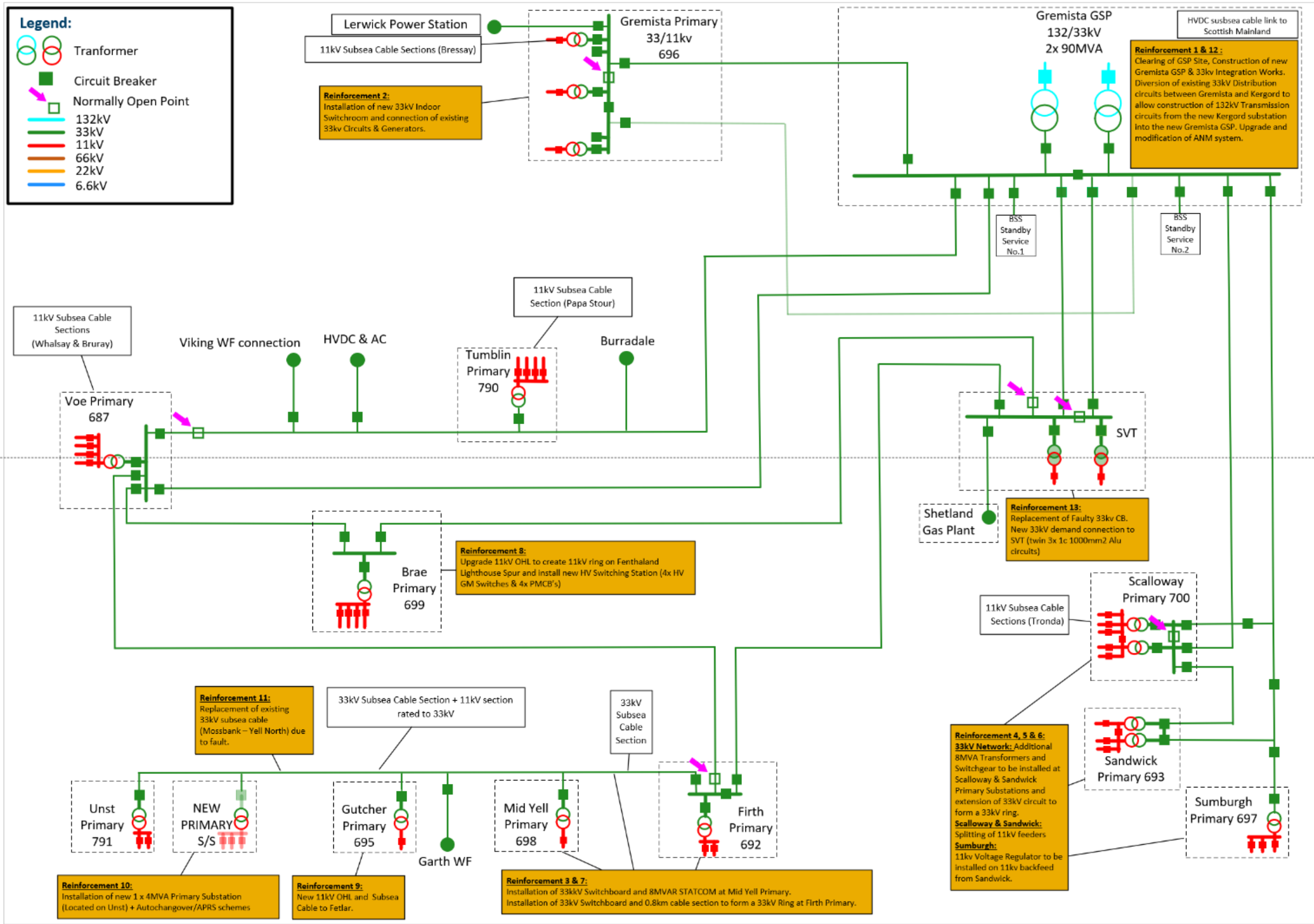


Figure 12 Future Network Development around Gremista GSP

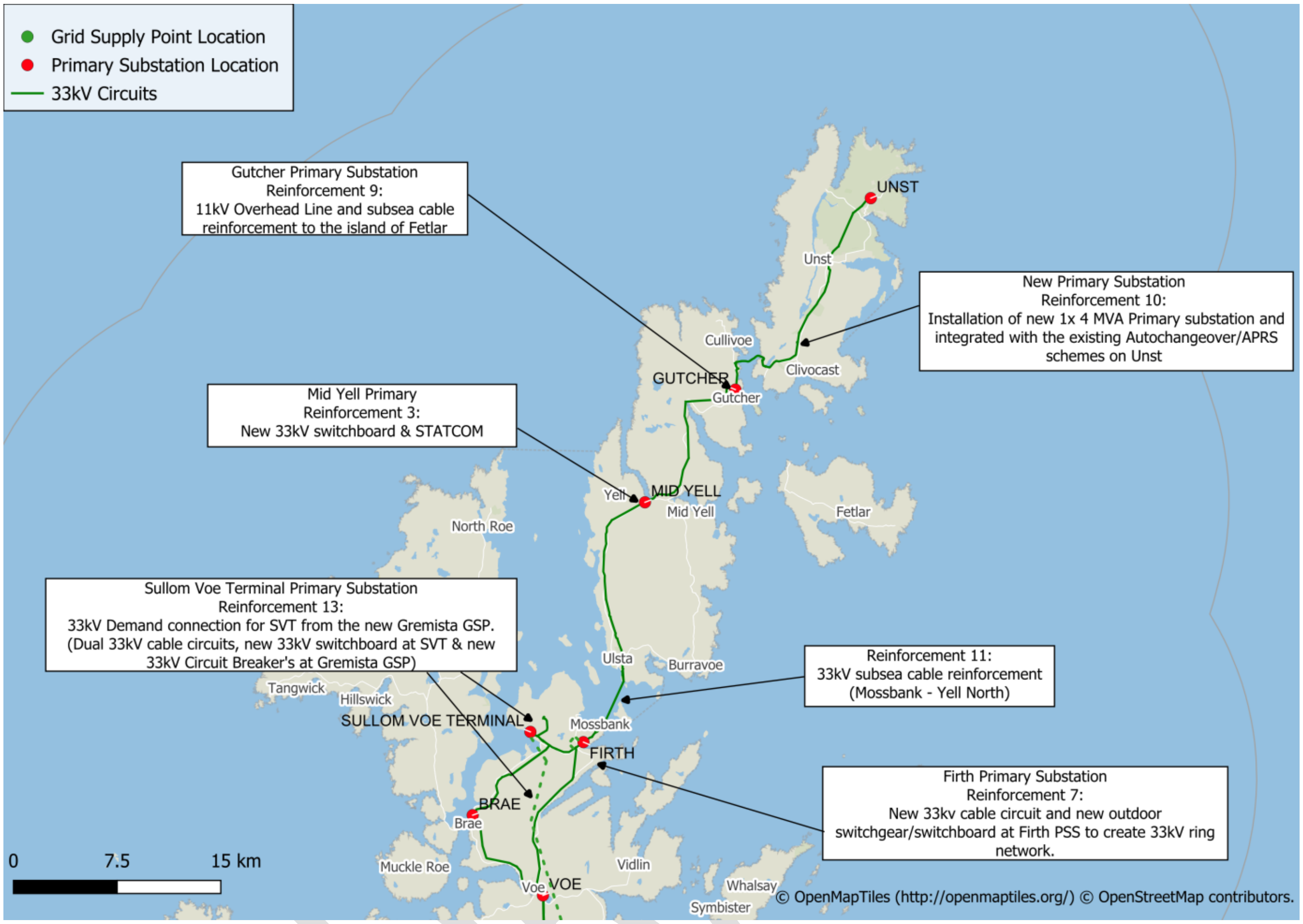


Figure 13 GIS View of Works in Progress and system needs annotated on North Shetland

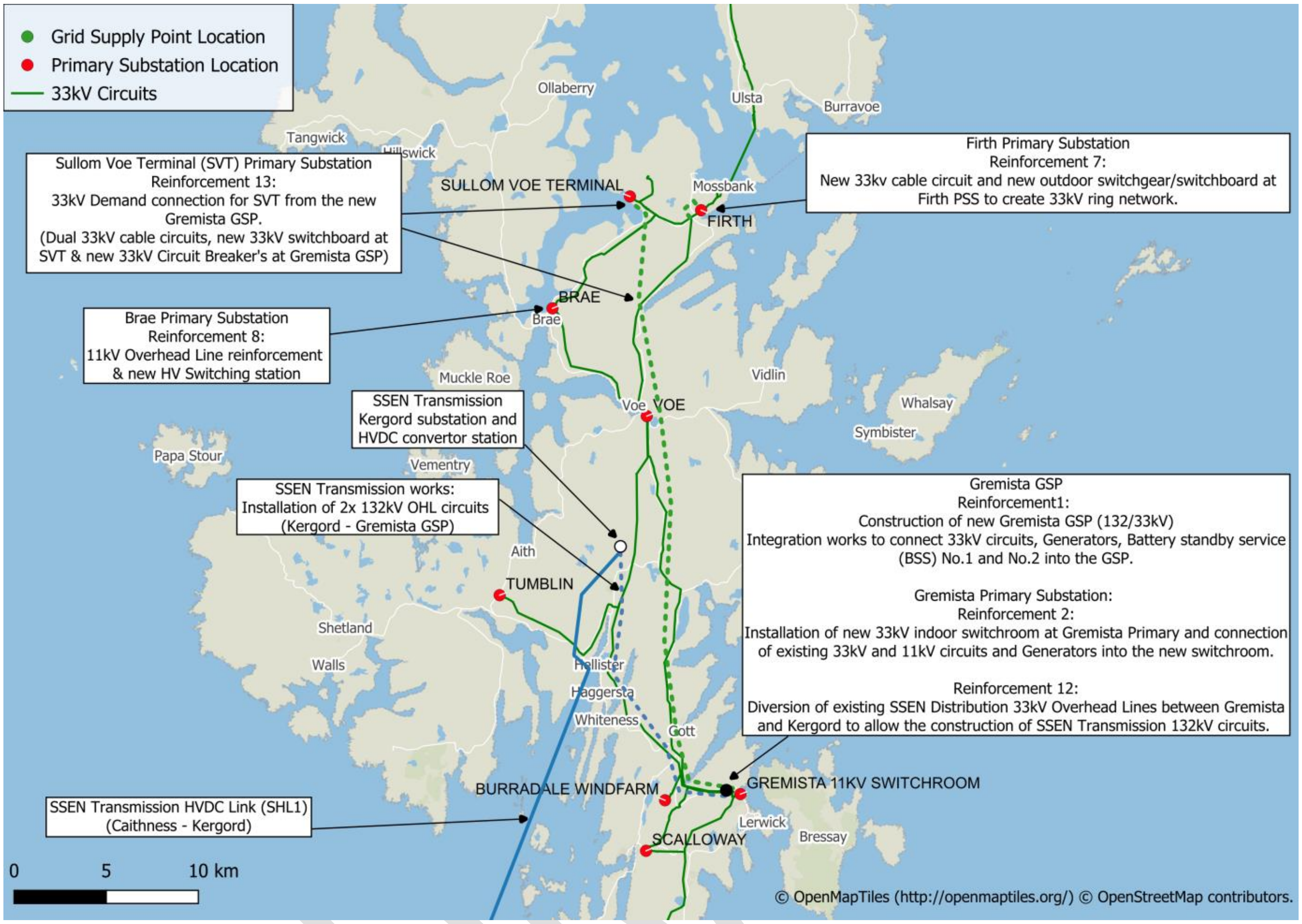


Figure 14 GIS View of Works in Progress and system needs annotated on Central Shetland

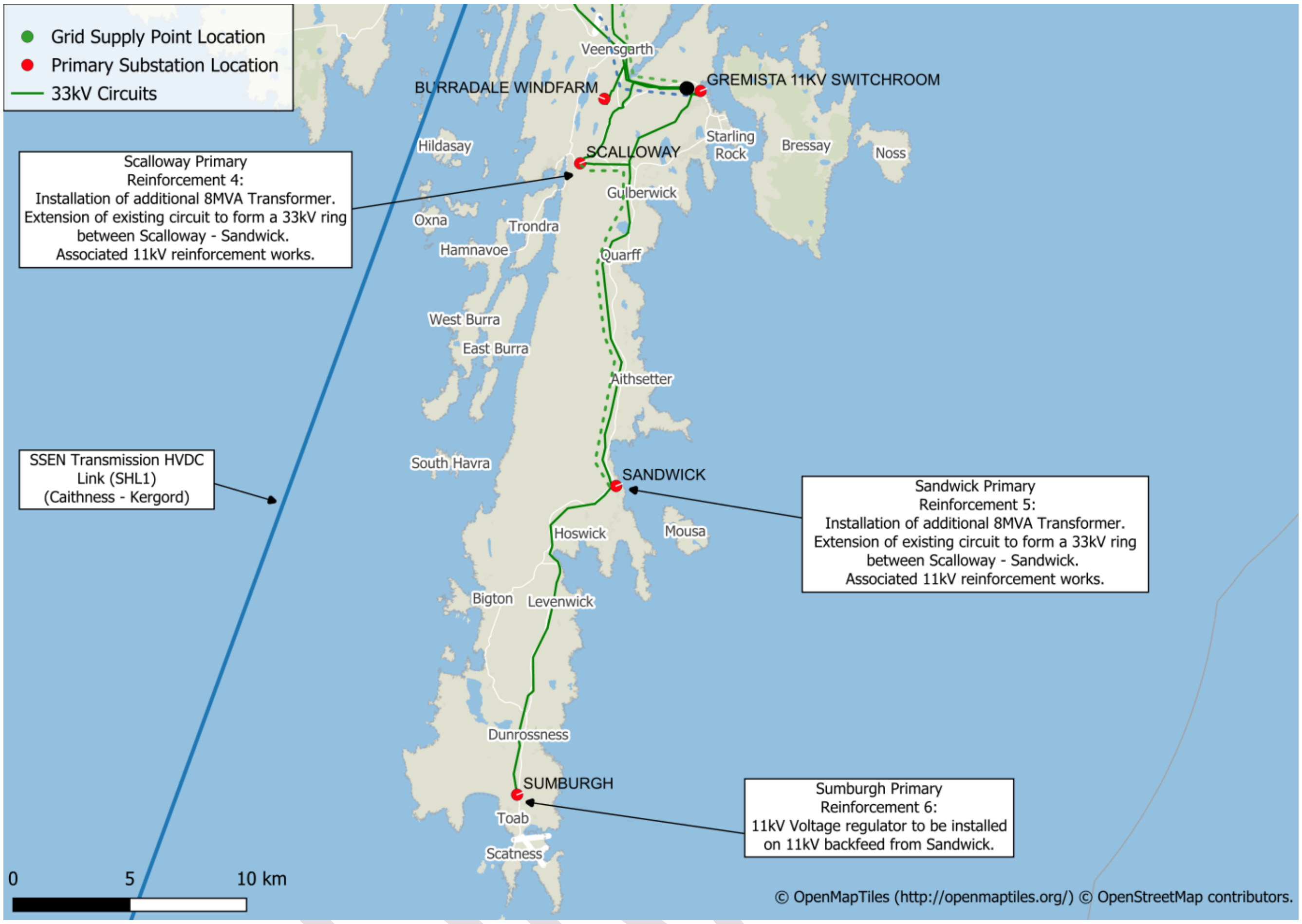


Figure 15 GIS View of Works in Progress and system needs annotated on South Shetland

7. SPATIAL PLANS OF FUTURE NEEDS

In the previous sections we discussed the Regen DFES Demand and Generation forecasts for Gremista GSP. We have used this information to understand what this means for the local networks across the Shetland Islands archipelago. Initially this is developed through the creation of a spatial plan of future system demand needs. These will be augmented in the future to include spatial plans of the generation needs.

We have created spatial plans at a primary substation level (33/11kV) and secondary substation level (11kV/LV). Snapshots are provided for 2028, 2033, 2040, and 2050, allowing for clear visualisation of future system needs beyond the network capacity following completion of triggered works. The chart shown below in **Figure 16** is based on 2023 DFES Consumer Transformation forecasts, shown with additional plans for other DFES scenarios shown in **Appendix D** and **Appendix E**.

7.1. Extra High Voltage/High Voltage Spatial Plans

Figure 17 shows the projected demand headroom or demand capacity shortfall across the illustrative primary substation supply areas. The values are derived from the Network Scenario Headroom report (NSHR), part of the Network Development plan (NDP). Negative values indicate a shortfall in capacity, positive values indicate headroom.

These are presented for each of the four DFES scenarios to understand how the projected availability of demand network capacity changes across each of these scenarios. It should be noted that the NSHR is produced annually and was last published in May 2024. Any work triggered between this date and the time of publication of this report may not be reflected in the future capacity projections.

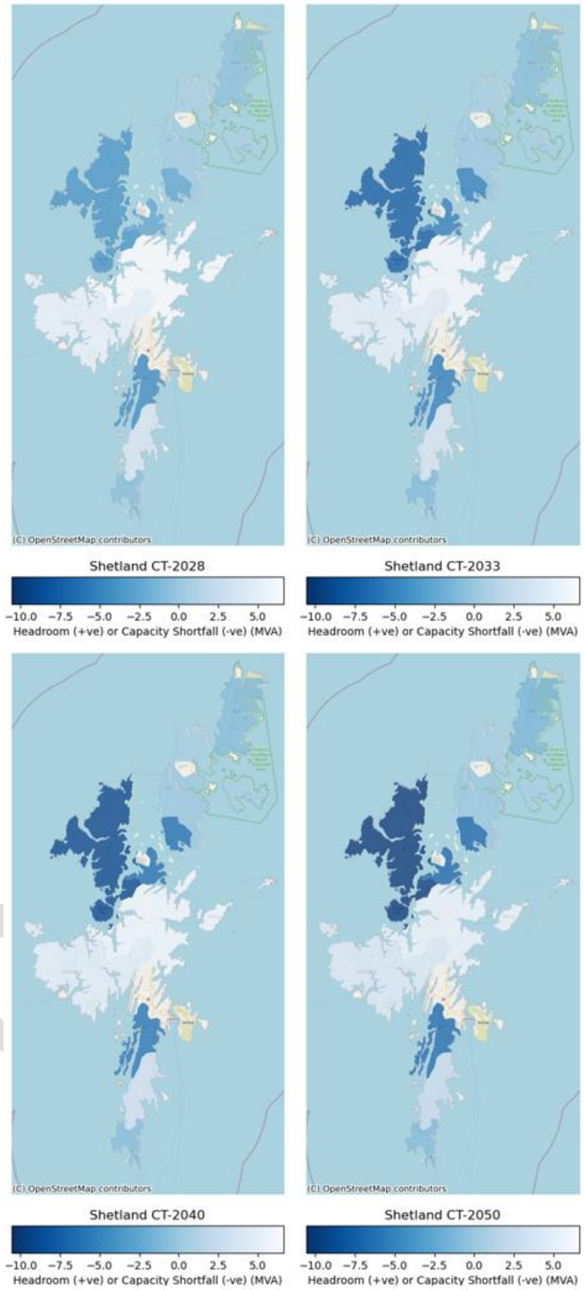


Figure 16 Gremista GSP EHV network spatial plans for CT 2028, 2033, 2040, and 2050

7.2. Existing Network Constraints

On completion of the GSP integration works, there are a few existing network constraints at Gremista GSP, which are described below:

Gremista GSP Constraints: Going forwards supply to the Shetland Islands will be reliant on a single SSEN Transmission HVDC subsea cable supply from the Scottish mainland. The Island will therefore be dependent on generators at Lerwick Power Station for the duration of the HVDC circuit outage.

With the growing demand on the Shetland Islands, coupled with the contracted load awaiting connection, the system requires reinforcement covered by the schemes recommended in Section 6.1 for the RIIO-ED2 price control period. Beyond that, there will be need for further reinforcement works to improve N-2 resilience to the Shetland mainland and the northern islands of Yell and Unst, taking into consideration significant growth from onshore generation and the electrification of the ports industry.

Voltage compliance issues are already present on the Gremista GSP network, particularly in the northern regions of the supply area affecting customers connected to SVT, Firth, Mid Yell, Gutcher and Unst primary substations. The network reinforcement schemes, as described in Section 6.1, partially address these needs for the immediate future, but further intervention works will be required within the RIIO-ED2 price control period and beyond to enable a constraint free network to 2050. Similar voltage issues are also present in the southern network supplying customers connected to Scalloway, Sandwick and Sumburgh primary substations, however these issues will be addressed under the schemes recognized in Section 6.1 ensuring the Gremista south distribution network is compliant up to 2045 based on the 2023 DFES forecast. Further intervention will be required to enable a constraint free network from 2045 to 2050.

7.3. Extra High Voltage Specific System Generation Needs

The Shetland Islands have significant renewable generation potential due to high wind levels, making the region suitable for both onshore and offshore wind projects, as well as tidal generation schemes. There will be an increased level of generation on Shetland, with the onshore wind farm uptake in the region.

The increase in onshore wind farms in the area will drive the need for both distribution and transmission reinforcement, carried out by SSEN Transmission. This may necessitate additional circuits between mainland Scotland and Shetland, new 33kV circuits between existing substations and the Gremista GSP, or the creation of new GSPs and substations to accommodate the increased generation connections. These requirements are detailed in Section 8.

7.4. Extra High Voltage Specific System Demand Needs

There will be a need to carry out reinforcement works around Gremista GSP, specifically at primary substation levels, to meet the projected increases in demand under system intact and N-1 conditions. These Primary substations include Brae, Firth, Gremista, Sandwick and Voe where the demand increases moderately up to 2050.

As the demand increases towards 2050, voltage reinforcement works may also be required to the existing 33kV circuits between Gremista GSP and Voe Primary substation, the SVT 33kV feeders, and the southern circuits to Scalloway Primary substation.

There may also be an arising need to increase the security of supply to the northern islands of Yell and Unst because of the forecasted demand growth exceeding 4MVA before 2050. The supplies to these islands are reliant on subsea cables and this has been accounted for in the options recommended in this strategy.

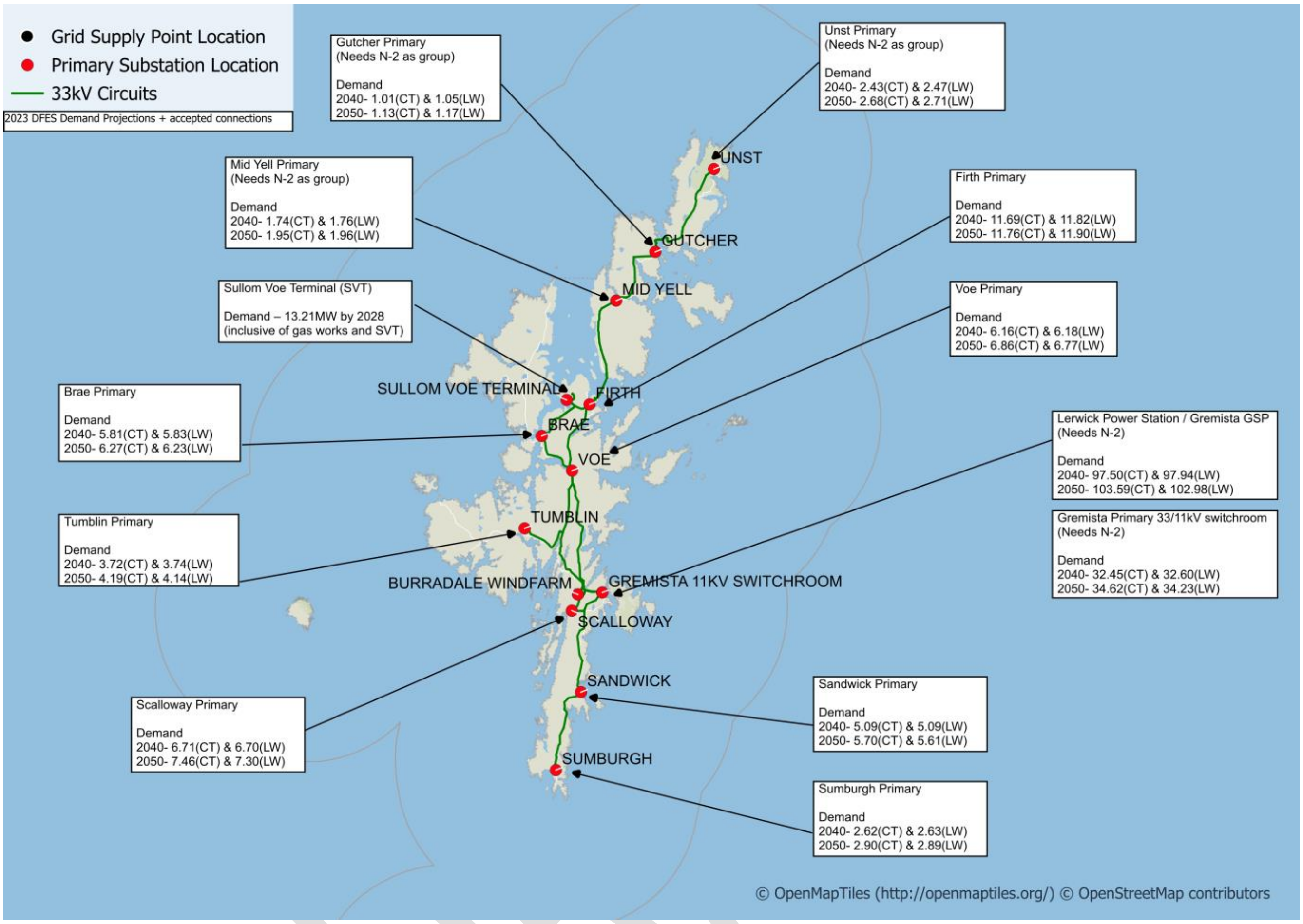


Figure 17 Shetland EHV network demand projections for 2040 and 2050 (Including accepted connections) (Network used for modelling) (CT and LW)

7.5. HV/LV spatial plans

To identify areas where load is growing at a finer granularity, we have used information from the SSEN load model, produced by SSEN's Data and Analytics team. The secondary transformer projected percentage loadings for each of the four DFES scenarios are highlighted below in **Figure 18** and **Appendix E**. As shown in the legend, the points are coloured based on their percentage loading with green being low percentage loading, and darker reds indicate higher percentage loading (see legend for details on loading bands and colouring).

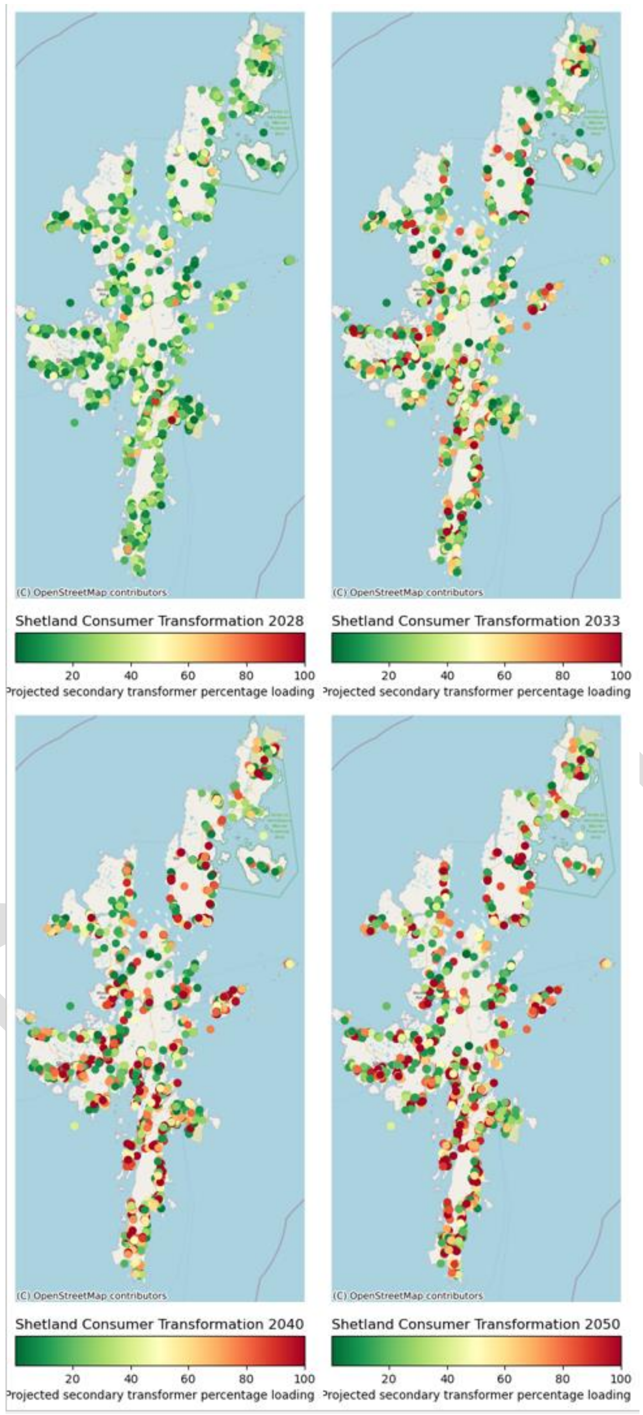


Figure 18 Gremista GSP HV/LV CT spatial plans for 2028, 2033, 2040, and 2050

8. OPTIONS TO RESOLVE SPECIFIC SYSTEM NEEDS

The relevant spatial plans provide offer a strategic view of future system needs. We have reviewed this through power system analysis studies to understand the specific requirements of our EHV networks up to 2050. This analysis has been based on the insights developed from the 2023 DFES alongside other information including known connection applications. Initial needs have been identified using the DFES Consumer Transformation background with sensitivity analysis undertaken against the other three DFES backgrounds.

The options consider scenarios for both summer and winter to ensure the varying demand and support from local generation combinations were all accounted for. Contingency considerations for islands supplied by subsea cables will also be undertaken.

In this section we summarise the more specific needs arising from our future spatial plans. We also propose some initial options to resolve the network constraints. These will be further developed through the DNOA, Shetland UM's and HOWSUM processes, where they will be considered alongside the potential for flexibility.

The section is split into three parts:

1. Future EHV system needs to 2040 – these needs are more certain and therefore we have more clearly defined options to meet the requirements. For needs within the next seven years, we recommend that these are progressed through the DNOA process. In all cases we are proposing solutions that meet the projected requirements for 2050. We also provide a summary of more strategic elements that also need to be considered in these timeframes.

2. Future EHV system needs to 2050 – there is a greater degree of uncertainty of outcomes in this time frame. This also provides more opportunity to work with stakeholders to develop strategic plans and our outline solutions reflect this initial phase of the work as we look to engage with interested parties.

3. Future HV/LV system needs to 2050 – the future needs of the HV and LV networks are locationally specific but can be considered as an aggregated volume. In this section we provide information on our future forecasts for local HV and LV network needs.

8.1. Overall dependencies, risks, and mitigations

There are several overarching risks which could impact the delivery of our strategic plan. Below we outline these risks alongside proposed mitigating actions. We will work with stakeholders to develop these mitigating actions further.

Dependency**:** Works proposed here are dependent on the supply chain required to deliver the projects. This has been tested through delivery of RIIO-ED1 projects and has shown that the supply chain is able to provide the capacity and skills required to deliver these projects. As we continue works in RIIO-ED2 with the increased amount of CAPEX delivery required it is important for us to ensure that the supply chain can continue to deliver.
Risks**:** Works delay potential interventions downstream and/or cannot deliver the subsea cable on time.
Mitigation**:** In response to this we have commenced early market engagement with subsea cable installation contractors to ensure that the capacity and skills to deliver this project are available.

Dependency: Additional transmission works must be triggered before capacity is released for new generation customers.
Risks: In some cases, generation customers must wait for reinforcement to be complete before they are able to connect to the network.
Mitigation: Engagement with SSEN Transmission should be proactive so that the Transmission and Distribution networks can be planned in parallel, enabling efficient capacity release at both levels. This should include development of strategic plans to manage future demand and generation growth and should also include the development of policy to unlock the ability of local and community-based generation to connect. This should help expediate the connections process as and when developments occur.

Dependency: Procurement of new land and consents across Shetland is likely to be necessary.
Risks: Long lead timescales in terms of land consents, procurement and the challenge of finding suitable sites/routes as Shetland is a designated UNESCO Global Geopark with approximately 13.5% of the total area of Shetland is covered by statutory conservation sites.[15]
Mitigation: Identify need ahead of time to allow long timescales for procurement of land.

Dependency: Procurement of flexibility services is required to optimise load related needs.
Risks: Insufficient flexibility in the relevant area to resolve system reinforcement need.
Mitigation: Flexibility viability assessments are carried out as part of the DNOA process. Last build date identified to allow time for traditional reinforcement if procurement for flexibility services is not successful in procuring the required capacity.

8.2. Options to resolve future EHV System Needs to 2040.

The following outputs from the power system analysis indicate where further intervention on the distribution network may be necessary. This could involve asset solutions or flexibility services, and access products might be used to enable project connections ahead of reinforcement delivery while projects are in progress. In some cases, the need has been projected to arise ahead of 2030. In these instances, we recommend that the projects undergo more detailed study through the DNOA process.

Location of proposed intervention	CT Year	ST Year	LW Year	FS Year	CT Worst case asset loading (%)	Network state	Comments
Gremista – Voe circuit 16L5	Ahead of 2028	Ahead of 2030	Ahead of 2027	Ahead of 2029		N-1 outage of Gremista – Voe 13L5 circuit	Voltage Constraint: • Low Voltage at Luggies Knowe 33kV connection. • Low Voltage at pole 265 (Pole Mounted Transformer 33kV connection). • Future thermal constraint in 2043. Potential options to resolve this constraint are:

15 Conservation – Shetland Islands Council

							• Installation of voltage compensation assets (STATCOM), however awareness and consideration of future thermal constraint in 2043 should be factored into optioneering. • New GSP in the north of Shetland and transfer some demand from Gremista GSP. • 33kV Circuit Reinforcement of 16L5 circuit.
Firth 33/11kV Primary Transformer	Ahead of 2028	Ahead of 2028	Ahead of 2028	Ahead of 2029	111%	Intact	Thermal constraint: • 6MVA Primary transformer thermally overload under intact conditions. Potential options to resolve this constraint are: • New primary substation at Scatsta. • New GSP in the north of Shetland and transfer some demand from Gremista GSP.Additional circuit (Gremista – Voe). • Additional Primary Transformer at Firth.
Gremista GSP 132/33kV Transformers	Ahead of 2030	Ahead of 2032	Ahead of 2030	Ahead of 2034	106%	N-1 outage of other Gremista GSP Transformer.	Thermal constraint: • 90MVA Grid Transformers thermally overloaded. Potential options to resolve this constraint are: • Additional Grid Transformer at Gremista GSP. • New GSP in the north of Shetland and transfer some demand from Gremista GSP. • Rating enhancement of Grid Transformers at Gremista GSP.
Sandwick 33/11kV Primary Transformer	Ahead of 2030	Ahead of 2030	Ahead of 2038	Ahead of 2038	145%	under N-1 outage of other Sandwick primary transformer	Thermal constraint: • 4MVA Primary Transformer thermally overloaded. Potential options to resolve this constraint are: • Replace existing transformer with higher rated asset.
Gremista GSP - SVT 33kV feeders	Ahead of 2030	Ahead of 2031	Ahead of 2030	Ahead of 2032	101%	N-1 outage of other Gremista -	Thermal and Voltage Constraints:

						SVT 33kV Feeder	• Circuit is thermally overloaded by year 2030. • Low Voltage at Garth Wind Farm 33kV connection by year 2030. Potential options to resolve this constraint are: • Install a third SVT feeder. • Circuit reinforcement between Gremista – Voe. • Installation of voltage compensation assets (STATCOM). • New GSP in the north of Shetland and then split 33kV network to feed Brae and Voe from the new GSP.
Mossbank-Yell subsea cable circuits	Ahead of 2033	Ahead of 2033	Ahead of 2043	Ahead of 2048		Intact	Network Resilience Constraint: • Mossbank – Yell 33kV subsea cable circuits will require reinforcement as group demand of Yell and Unst will grow above 4MW requiring N-2 resilience for island group and meets demand growth to 2050. Potential options to resolve this constraint are: • Install additional 33kV subsea cable circuit between Mossbank – Yell. • New GSP in the north of Shetland and transfer some demand from Gremista GSP.
Brae 33/11kV Primary Transformer	Ahead of 2036	Ahead of 2036	Ahead of 2045	Ahead of 2049	110%	Intact	Thermal constraint: • 6MVA Primary Transformer thermally overloaded. Potential options to resolve this constraint are: • New primary substation at Scatsta. • Replace existing transformer with higher rated asset. • Additional Primary Transformer at Brae.
Gremista - Voe Circuit 13L5	Ahead of 2037	Ahead of 2036	Ahead of 2047	Ahead of 2049		Intact	Voltage constraint: • Low Voltage at Hill of Withersta 33kV connection. • Low Voltage at Burradale Wind Farm 33kV connection. (N-1)

							• Future thermal constraint in 2047. Potential options to resolve this constraint are: • Installation of voltage compensation assets (STATCOM), however awareness and consideration of future thermal constraint in 2047 should be factored into optioneering. • New GSP in the north of Shetland and transfer some demand from Gremista GSP. • 33kV Circuit Reinforcement of 13L5 circuit.

Table 7 Future EHV system needs projected to arise ahead of 2040.

8.3. Options to resolve future EHV System Needs to 2050.

Additional system needs identified in the DFES 2023 may need addressing ahead of 2050, as highlighted through power system analysis. There is significant uncertainty with forecasts in this time period and works need to be considered alongside the strategies described in the previous section. As the likelihood of these demands being realised increases, the necessary mitigations through asset or flexible solutions should be deployed.

Table 8 below summarises the specific system needs we have identified.

Location of proposed intervention	CT Year	ST Year	LW Year	FS Year	CT Worst case asset loading (%)	Network state	Comments
Gremista 33/11kV Primary Transformers	Ahead of 2042	None	Ahead of 2041	None	105%	Intact and N-1 outage of other Gremista primary transformer.	Thermal constraint: • Primary Transformers thermally overloaded. Potential options to resolve this constraint are: • Replace the three existing transformers with higher rated assets. • Install additional transformer and split 11kV busbar to accommodate increased fault level.
Gremista GSP – Voe Circuit 16L5	Ahead of 2043	None	Ahead of 2046	None	106%	N-1 outage of circuit Gremista – Voe	Thermal constraint: • Circuit 16L5 thermally overloaded. Potential options to resolve this constraint are:

						13L5 circuit.	• New GSP in the north of Shetland and then then transfer some of the demand from Gremista GSP. • 33kV Circuit Reinforcement of 16L5 circuit.
Gremista GSP - Scalloway Circuit 14L5	Ahead of 2045	None	Ahead of 2047	None	104%	N-1 outage of Gremista GSP – Scalloway circuit 13L5	Thermal constraint: • Circuit 14L5 thermally overloaded. Potential options to resolve this constraint are: • Overhead Line circuit reinforcement. • Additional circuit (Gremista – Scalloway). • Improved 11kV backfeed options to share loading under N-1 outage.
Gremista GSP – Voe Circuit 13L5	Ahead of 2047	None	Ahead of 2050	None	104%	N-1 outage of Gremista – Voe 16L5 circuit.	Thermal constraint: • Circuit 13L5 thermally overloaded. Potential options to resolve this constraint are: • New GSP in the north of Shetland and then then transfer some of the demand from Gremista GSP. • 33kV Circuit Reinforcement of 13L5 circuit.

Table 8 Options to resolve system needs between 2041-2050

8.4. Future requirements of the High Voltage and Low Voltage Networks

Our HV/LV spatial plans have shown that there is no clear pattern to future demands on these lower voltage networks. We are therefore planning on a forecast volume basis. This section provides further context on the work for the Gremista GSP high voltage and low voltage network needs up to 2050.

8.4.1. High Voltage Networks

As well as the EHV system needs identified in the previous section, increased integration of low carbon technologies (LCTs) connecting to the distribution network will result in system needs on the High Voltage (HV) and Low Voltage (LV) networks. To provide a view on the impact of these technologies on the distribution network, we have used the load model produced by SSEN's Data and Analytics team.[16]

The load model is a machine learning product which estimates a half-hourly annual demand profile for each household based on a series of demographic, geographic and heating type factors. This enables us to estimate capacity on the electricity network while protecting individual customers data privacy by using modelled data. These insights are then aggregated up the network hierarchy based on the combinations of customers associated with each asset. This view is supplemented with the DFES to highlight the projected impact of LCTs on the network.

For all Primary substations supplied by Gremista GSP, the percentage of Secondary substations where projected peak loading exceeds the nameplate rating of the secondary transformer was taken from the load model data. **Figure 19** demonstrates how this percentage changes under each DFES scenario from now to 2050.

To satisfy these requirements a variety of solutions will need to be investigated. It is likely that a combination of flexibility and asset replacement will be employed to resolve the projected HV system needs. It is important to note that for HV needs, flexibility is likely to be provided through Distributed Energy Resources (DER), Consumer Energy Resources (CER), and domestic/commercial Demand Side Response (DSR). One of the challenges associated with procuring flexibility to High Voltage and Low Voltage system needs is that only a small number of customers can provide a flexible service due to the requirement to be supplied by a specific secondary transformer. As the role of aggregators develops, we may see a shift in the potential for flexibility in an area. Where the magnitude of an overload is too large for flexibility to be feasible, addition of new assets or asset replacement will be necessary.

16 SSEN Open Data Portal, 2023, SSEN Secondary Transformer – Asset Capacity and Low Carbon Technology Growth.

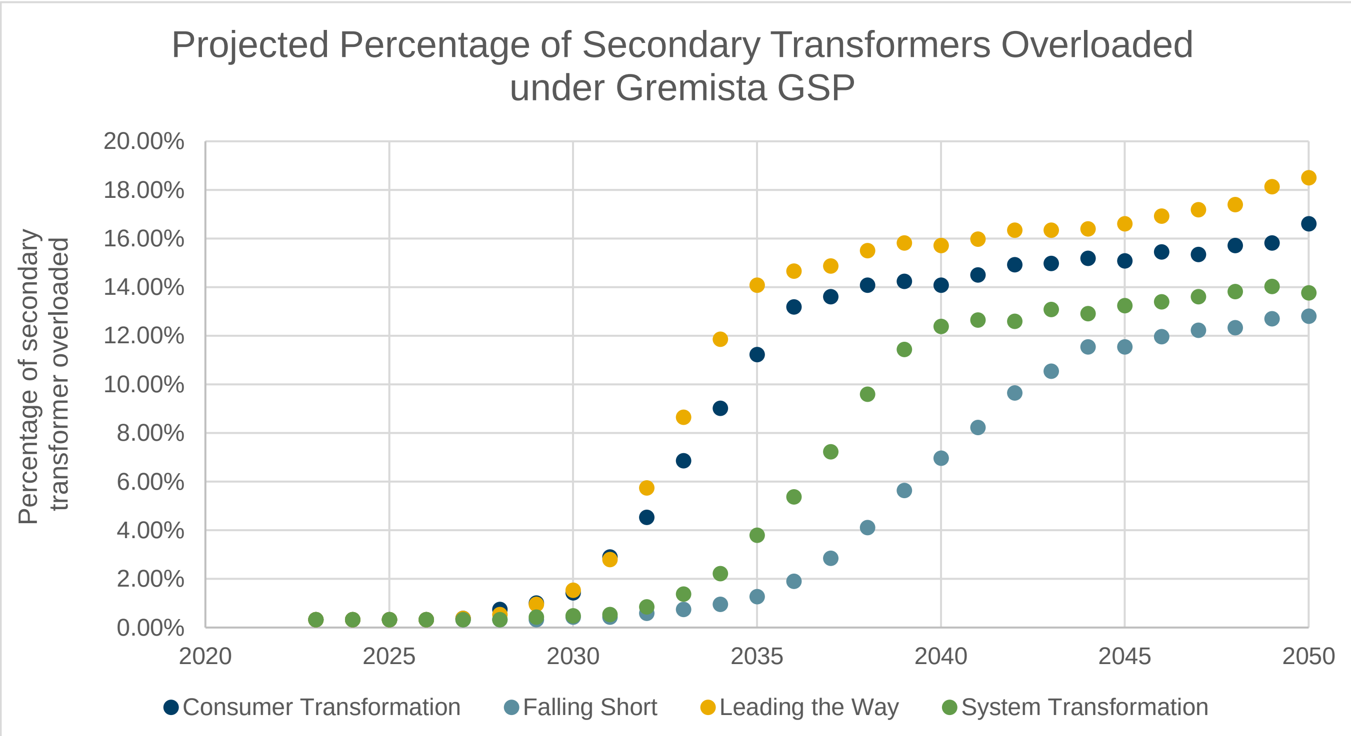


Figure 19 Gremista GSP Projected Secondary Transformer Loading. Source: SSEN Load Model

Considering the Just Transition in HV Development

SSEN is building on the findings from the Vulnerability Future Energy Scenarios (VFES). This innovation project investigated how the use of new foresighting techniques, along with data analytics and expert validation could be used to identify and forecast consumers in vulnerable situations as we move toward net zero. The insights from the VFES enable SSEN to develop the network in a way that genuinely accounts for the levels of vulnerability their customers face in different locations.

One of the outputs from this innovation project was the report produced by the Smith Institute.[17] This work groups Lower layer Super Output Areas (LSOAs)[18] that share similar drivers of vulnerability. The groupings were informed by mathematical analysis of demographic data and of SSEN's priority service register, using machine learning to model the complex relationships that exist between the two. The resulting group numbers and descriptions are shown in **Table 9**.

Group Number & Level of Vulnerability	Description of Group
1 – Very high	Driven up by higher levels of poor health and disability/mental health benefit claimants, reduced by smaller household sizes.

17 VFES Machine Learning Discovery of Vulnerability Signatures Report, Smith Institute, 08/11/2022, (NIA SSEN 0063: VFES – Vulnerability Future Energy Scenarios | SSEN Innovation)

18 Lower layer Super Output Areas (LSOAs) (Statistical geographies - Office for National Statistics)

2 – High	Driven up by larger household sizes, reduced by lower elderly population levels.
3 – High	Driven up by larger elderly population levels, reduced by lower levels of disability and mental health benefit claimants.
4 – Slightly higher than average	Driven up by larger elder population levels and moderately higher provision of care, reduced by smaller household sizes.
5 – Slightly lower than average	Driven down by lower elderly population levels and larger levels of ethnic diversity, increased by higher household sizes and greater provision of care.
6 – Low	Driven down by lower level of bad health and disability/mental health benefit claimants, increased by moderate elderly population levels and household sizes.
7 – Very low	Driven down by substantially lower elderly population levels, less provision of care and a higher level of households in private rented dwellings.

Table 9 VFES Groupings

To understand the vulnerability groupings across the Gremista GSP supply area, we have visualised the LSOA categorisation for the study area. By overlaying secondary transformers that are projected to be overloaded by 2028 (under the Consumer Transformation scenario), we begin to understand the crossover between network capacity needs and areas categorised as high vulnerability through the VFES work. This is shown below in **Figure 20**.

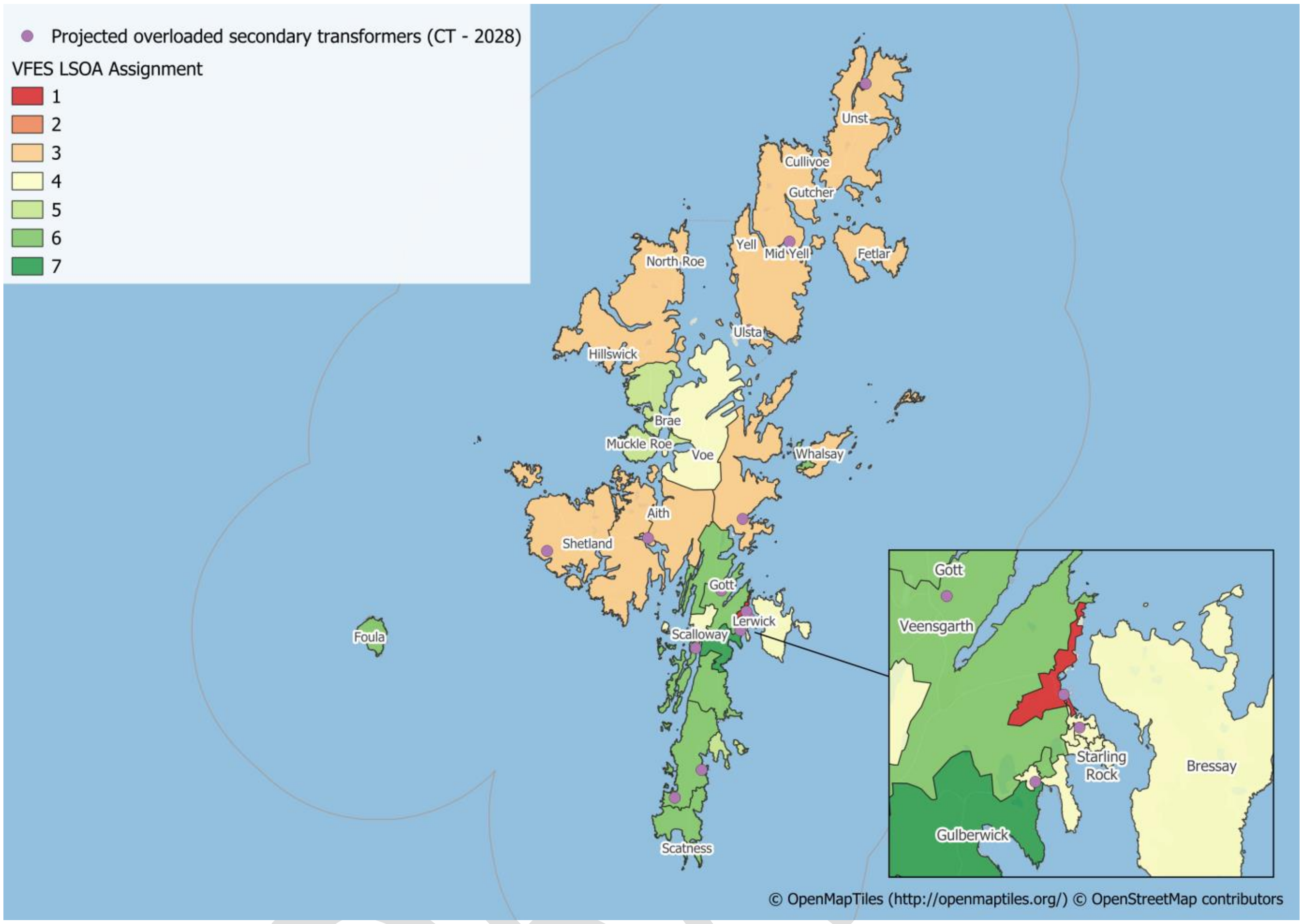


Figure 20 Gremista GSP VFES Output with secondary transformer overlay.

We can see that the majority of the area falls within group 3, indicating high levels of vulnerability. This high level of vulnerability is driven up by a larger elderly population, reduced by lower levels of disability and mental health benefit claimants. In the Gremista GSP area there are several LSOAs that fall into the higher categories of vulnerability (groups 1, 2, and 3), particularly in northern regions of the supply area. We also see a LSOA area falling into the group 1 – very high vulnerability, around Lerwick. This very high vulnerability classification is driven up by higher levels of poor health and disability/mental health benefit claimants, reduced by smaller household sizes.

By overlaying the point locations of secondary transformers projected to be overloaded (in 2028 under the Consumer Transformation scenario), we identify areas that are categorised as more vulnerable and may have capacity shortfalls at the secondary network level.

More vulnerable groups may have lower level of adoption of LCTs and therefore provide less ability to manage overloads through flexibility services. Further, they may point towards areas of social housing where there could be a faster aggregated rollout of LCTs such as heat pumps in the future.

We will use these insights to prioritise heavily loaded areas of our network, ensuring the network remains secure, stable, and resilient in the areas where vulnerable customers would be most impacted by outages.

8.4.2. Low Voltage Networks

Interventions in low voltage networks may be driven by either capacity related or be driven by voltage requirements. We are progressing options to resolve both drivers. From a network perspective the solution typically involves upgrading the number of LV feeders to split/ balance the load and improve voltage, or by installing another substation at the remote end of the LV network. In both instances, flexibility at a local level, especially voltage management products linked to battery export and embedded generation such as solar, is likely to be required alongside traditional reinforcement.

We are leveraging recent innovation work through Project LEO (Local Energy Oxfordshire)[19] and My Electric Avenue[20] to inform this strategy. Enhanced network visibility through Smart meter data analytics and low-cost substation feeder monitoring is also necessary to enable appropriate dispatch of services and network reconfiguration.

Initial analysis indicates that across the study area, *3.18*% of low voltage feeders may need intervention by 2035 and *4.02*% by 2050 under the CT scenario as shown in **Figure 21**. The need is unlikely to be triggered until 2028 onwards. However, due to the timeline to grow the workforce (with jointing skills taking typically four years to be fully competent), it is necessary to start recruitment and initiate programmes ahead of need to be able to deliver the required volumes from 2028 onwards.

19 Project LEO | SSEN Innovation

20 My Electric Avenue |

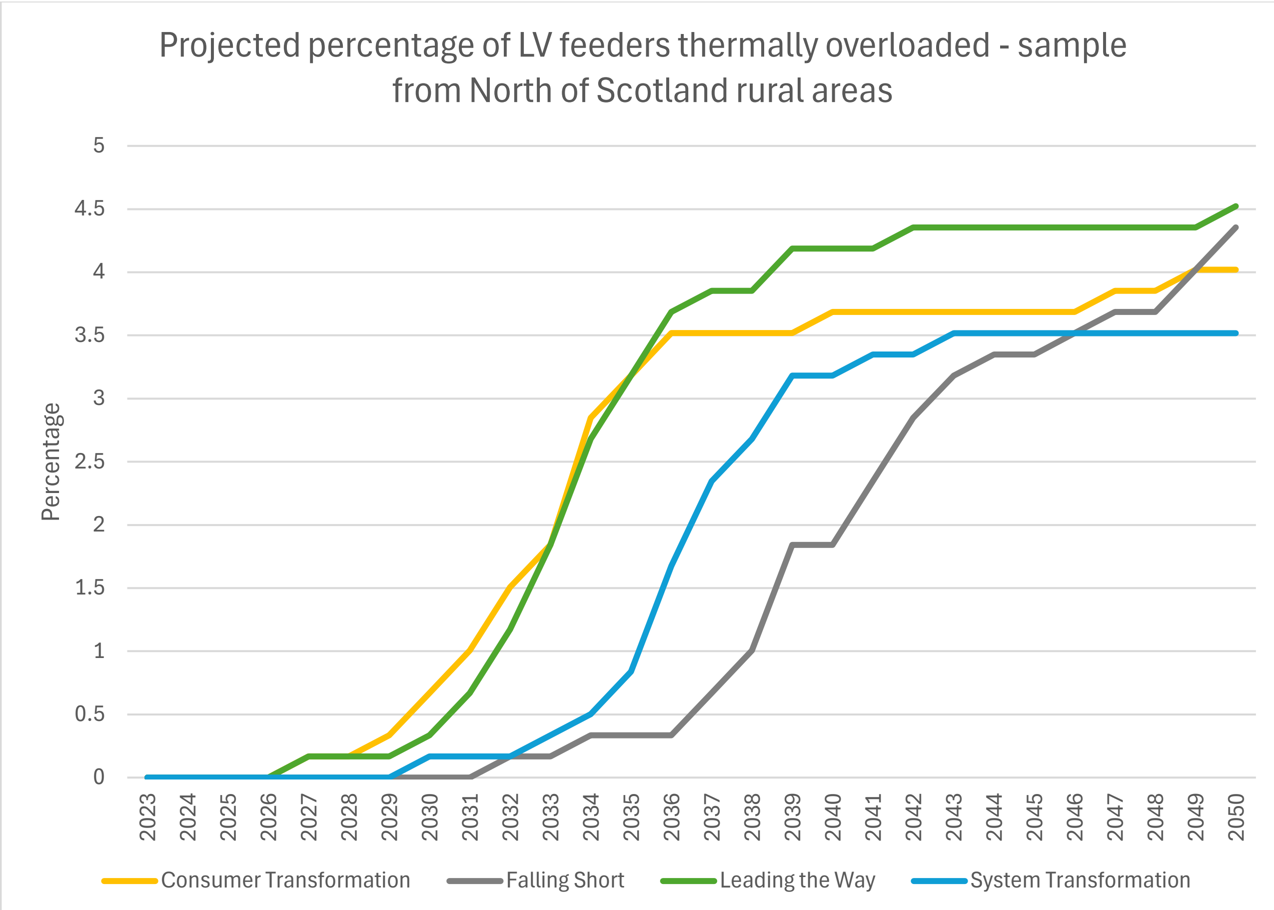


Figure 21 Percentage of LV feeders projected to be overloaded under Gremista GSP

9. RECOMMENDATIONS

The stakeholder engagement insights and the SSEN 2023 DFES analysis provides a robust evidence base for load growth across the Gremista GSP group in both the near and longer term. Load growth across the Shetland Islands is driven by multiple sectors and technologies, impacting not only our EHV network but also driving system needs across all voltage levels.

Across Gremista GSP, a variety of works have already been triggered through the DNOA process and published in the DNOA Outcomes Report. These are driven by customer connections and system needs that will arise this decade but are being developed to meet 2050 needs.

The findings from this report have provided evidence for nine key recommendations:

1. For work identified as necessary in the near term (before 2035), it should be progressed through the DNOA process. Detailed studies will help us understand network requirements more comprehensively and advance these projects where appropriate. This includes the following system needs:
    - Gremista GSP Grid Transformers
    - Gremista GSP – SVT 33kV Feeders
    - Gremista GSP – Voe 33kV circuits
    - Gremista GSP – Scalloway - Sandwick 33kV circuits
    - Firth Primary Transformer
    - Sandwick Primary Transformers
    - Scalloway Primary Transformers

2. Considerations for enhancing the network resilience standard provided to the Shetland Islands should be taken by application of the ‘Resilience Policy for Island Groups Connected By Subsea Cables’. This should consider the reassessment of group demands reliant upon subsea cables as per the latest DFES projections when they become available. The group demand of Yell and Unst is projected to exceed 4MW in the year 2033 and considerations should be made to enhance the resilience to this Island group.

3. It is possible that some of the above constraints may not have a near term system need based on actual load growth, and therefore will not initially result in an DNOA outcome. Annual reassessment will enable us to confirm whether these system needs are likely to arise. When carrying out this annual reassessment, the delivery timelines of the work should be considered alongside the potential for flexibility services to manage network capacity. Consideration should also be given to the development of a strategic plan similar to that deployed for other Scottish island groups from the HOWSUM mechanism.

4. Proactive engagement with island stakeholders should continue to ensure that future needs are fully understood and taken into account in strategic development.

5. Explicit engagement with SSEN Transmission should be progressed regarding the development of transmission infrastructure and the possibility of a future GSP site on Yell.

6. Engagement with SSEN Transmission should be proactive so that alongside delivery of any future SSEN Transmission works (for example: HVDC link SHL2, Transmission ANM), we can plan the distribution network in parallel. This will enable efficient capacity release at both Transmission and

Distribution level. This should include development of strategic plans to understand how Gremista demand can be managed in the event total demand exceeds 100MW. It should also include the development of policy to unlock the ability of local and community-based generation to connect.

7. Proactive engagement between SSEN Distribution, SSEN Transmission & the NESO regarding co-ordination between prospective ANM schemes and the impact of T-D limits at GSPs.

8. While electrification of road travel is captured in DFES building blocks, engagement should take place to better understand the impact of future electrification of ports within the Gremista GSP supply area through the SeaChange project.

9. The connection of low carbon technologies across the HV and LV networks will result in significant demand growth. Where it has been identified that there are overloads projected, mitigations will need to be put in place. There is no clear pattern to low voltage load growth in the Gremista GSP supply area, so we are taking a volume driver approach. This needs to be based on strategic modelling of LV networks to understand the volume of work needed.

Actioning these recommendations will allow SSEN to develop an electricity network that supports local net zero ambitions and enables growth in the local economy.

REVISION HISTORY

No	Overview of Amendments	Previous Document	Revision	Authorisation
1.0	N/A	Strategic Development Plan Template	N/A	*TBC*
Xxxx	Xxxx	Sta	Xxxx	Xxxx

Appendix A – Glossary

ACRONYM	DEFINITION
ANM	Active Network Management
BAU	Business as Usual
CER	Consumer Energy Resources
CMZ	Constraint Managed Zone
CT	Consumer Transformation
DEG	Diesel Embedded Generation
DER	Distributed Energy Resources
DFES	Distribution Future Energy Scenarios
DGAD	Distributed Generation Automatic Disconnection
DNO	Distribution Network Operator
DNOA	Distribution Network Options Assessment
DSR	Demand Side Response
EHV	Extra High Voltage
EJP	Engineering Justification Paper
ER P2	Engineering Recommendation P2
ESO	National Grid Energy System Operator
EV	Electric Vehicle
FES	Future Energy Scenarios
FS	Falling Short
GSPs	Grid Supply Points
HV/LV	High Voltage/Low Voltage
HOWSUM	Hebrides and Orkney Whole System Uncertainty Mechanism
HVO	Hydrotreated Vegetable Oil
LAEP	Local Area Energy Planning
LENZA	Local Energy Net Zero Accelerator
LW	Leading the Way
OHL	Overhead Line
PV	Photovoltaic

MW	Megawatt
MVA	Mega Volt Ampere
NESO	National Energy System Operator
NRS	National Records of Scotland
RIIO-ED1/2	RIIO Electricity Distribution Price Control periods 1 and 2
SBTs	Science Based Targets
SDP	Strategic Development Plan
SHEPD	Scottish Hydro Electric Power Distribution
SLC	Standard Licence Condition
SSEN	Scottish and Southern Electricity Network
ST	System Transformation
SWA	Scottish Whisky Association
WSC	Worst Served Customers

APPENDIX B – GENERATION CAPACITY PROJECTIONS FOR ALL DFES BACKGROUNDS

Gremista GSP – Generation Projection by Primary Substation

This annex shows aggregated forecast generation capacity of distribution connected projects within Gremista GSP.

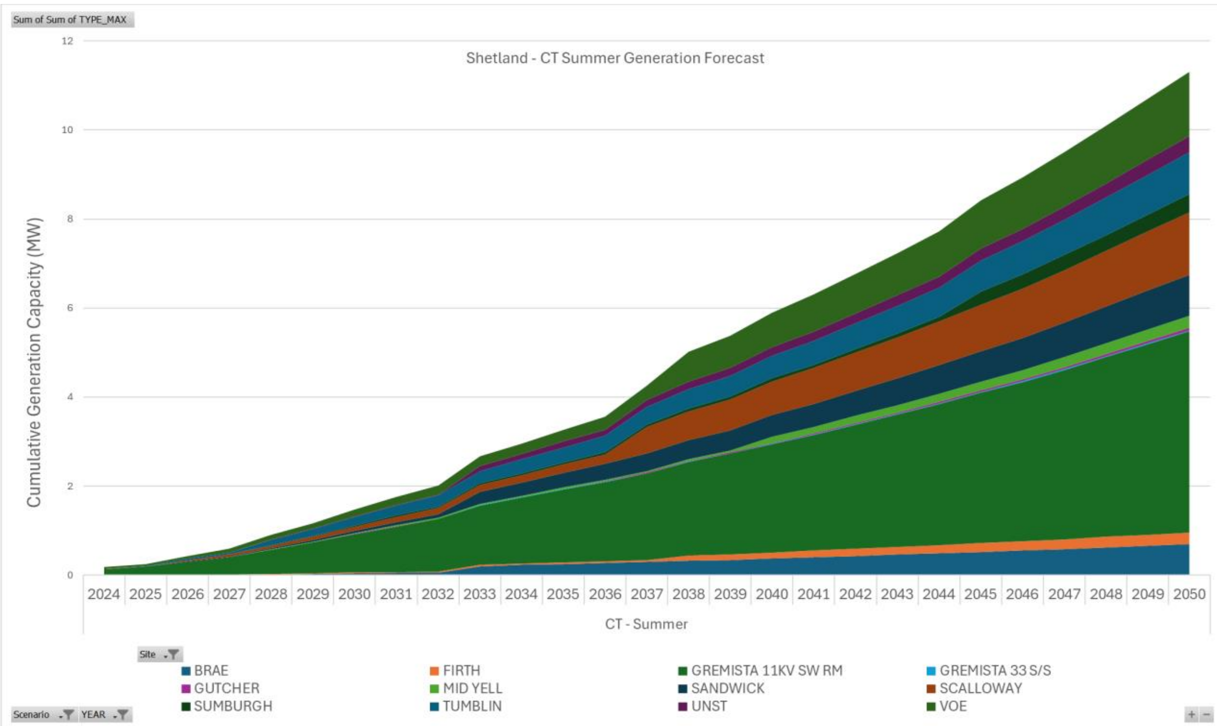


Figure 22 Generation Capacity Projections by Primary Substation for Gremista GSP – CT Source: SSEN DFES 2023

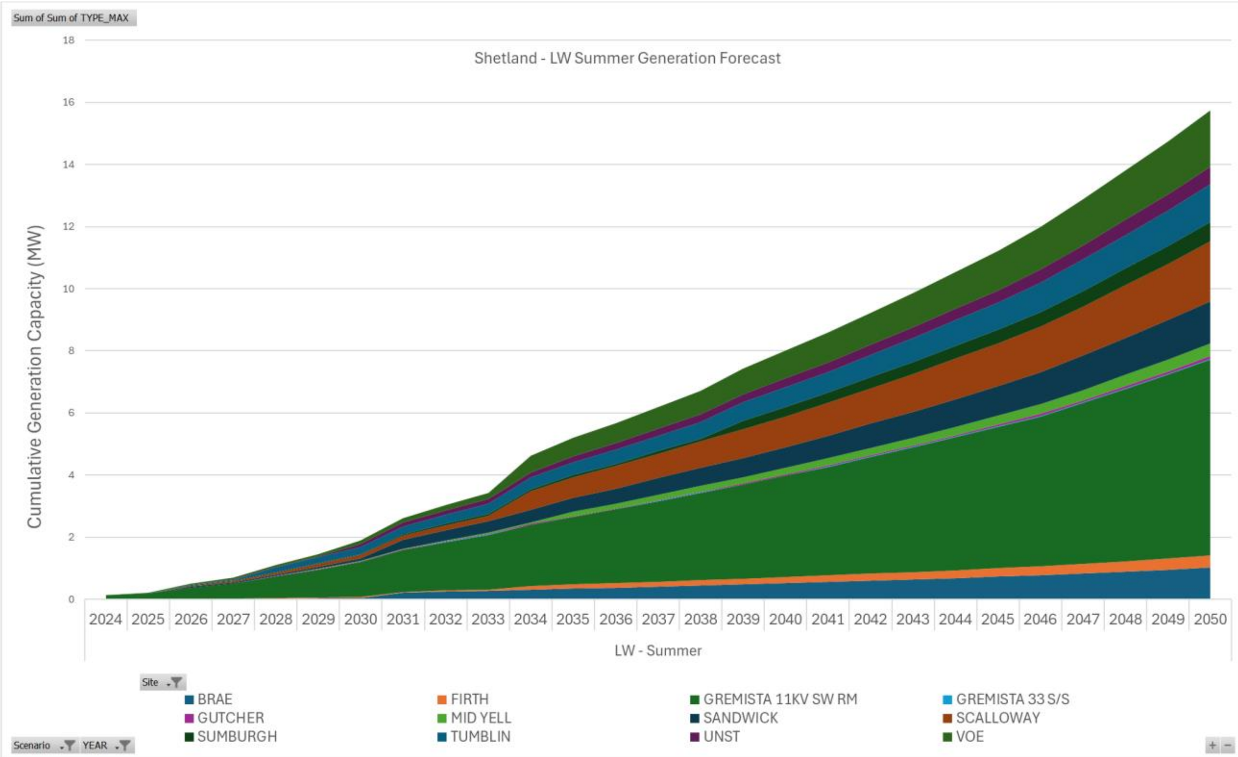


Figure 23 Generation Capacity Projections by Primary Substation for Gremista GSP – LW Source: SSEN DFES 2023

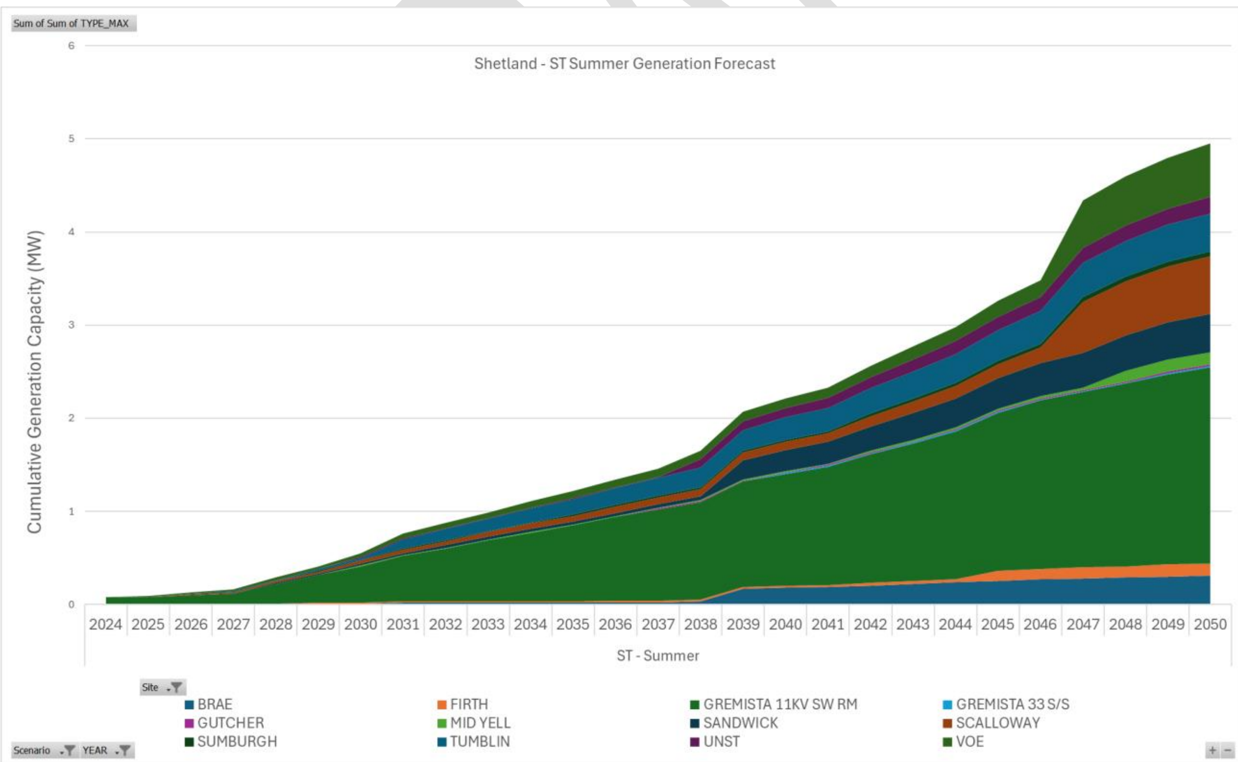


Figure 24 Generation Capacity Projections by Primary Substation for Gremista GSP – ST Source: SSEN DFES 2023

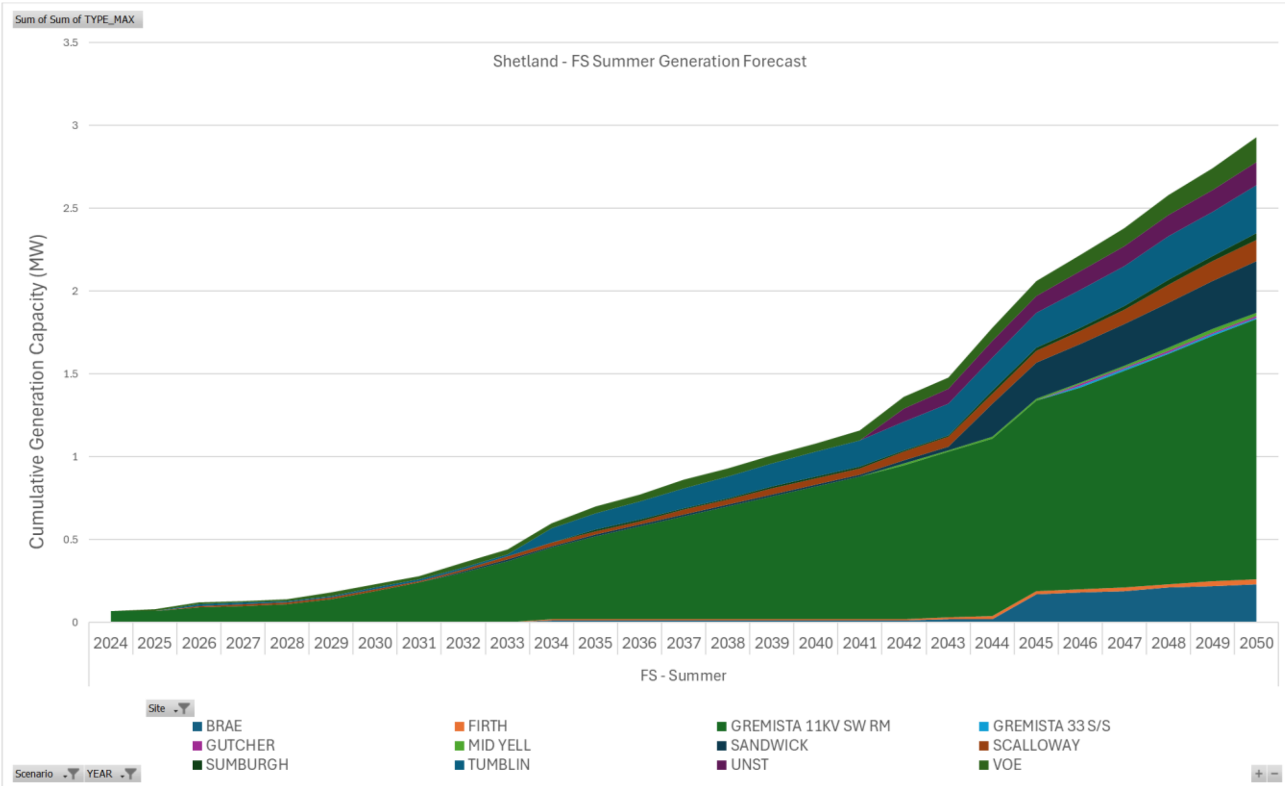


Figure 25 Generation Capacity Projections by Primary Substation for Gremista GSP – FS Source: SSEN DFES 2023

Gremista GSP – Generation Capacity Projections by Technology Type

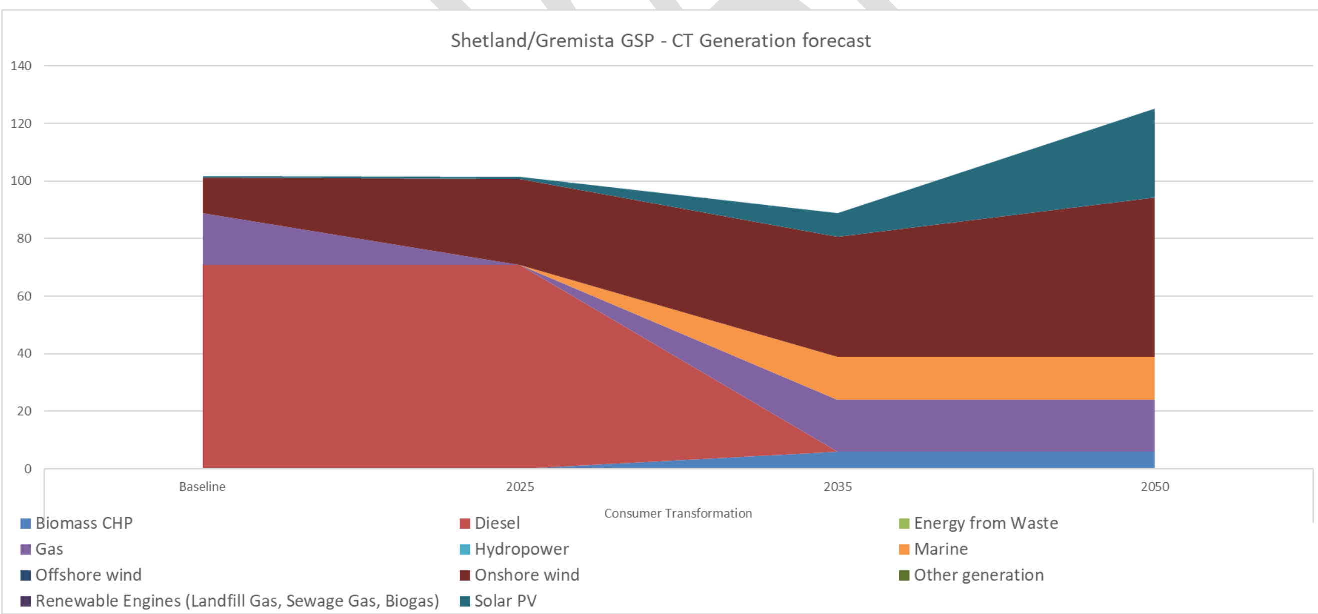


Figure 26 Generation Capacity Projections by Technology for Gremista GSP – CT Source: SSEN DFES 2023

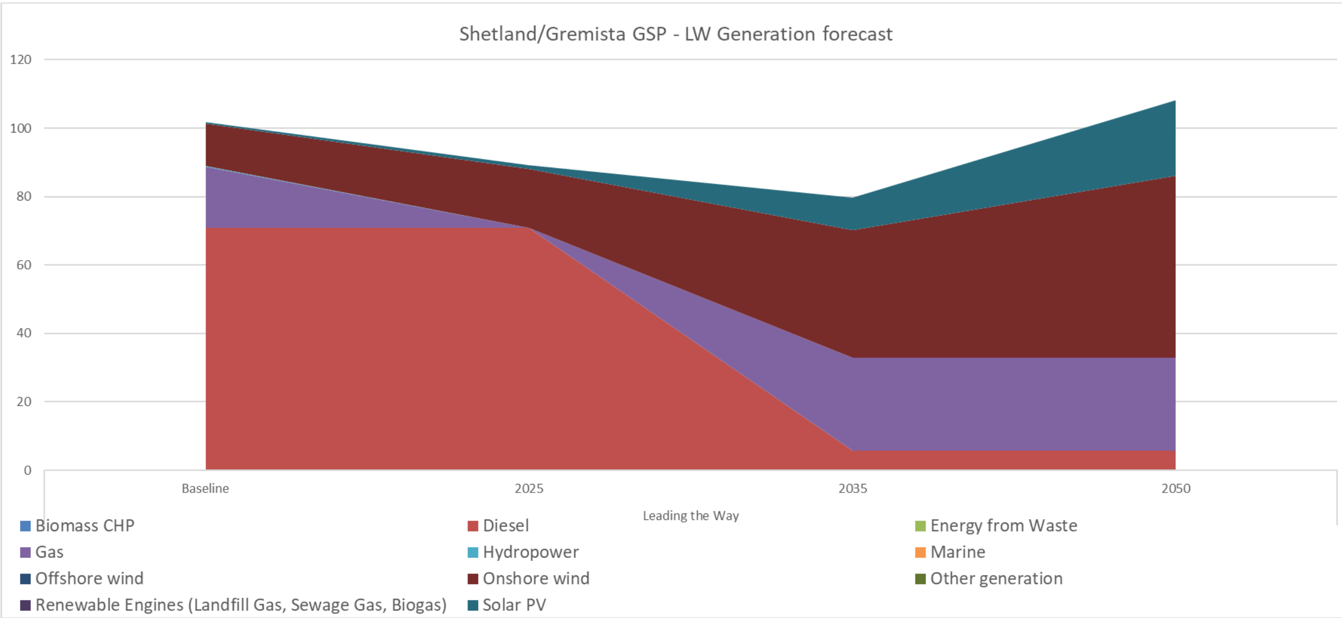


Figure 27 Generation Capacity Projections by Technology for Gremista GSP – LW. Source: SSEN DFES 2023

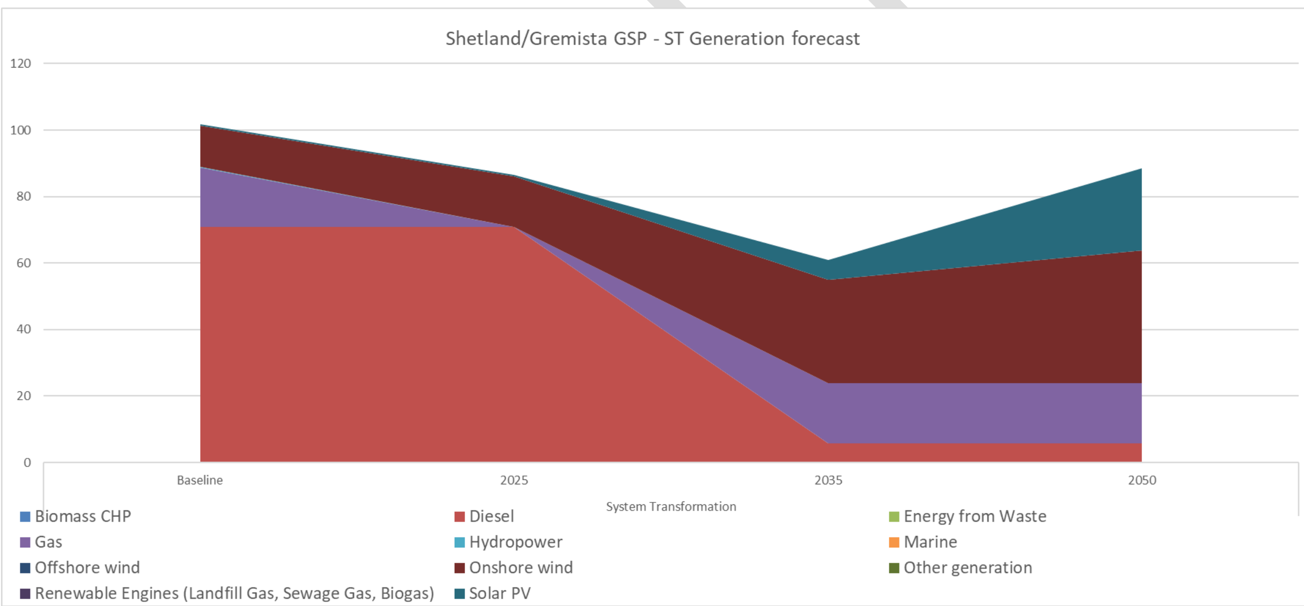


Figure 28 Generation Capacity Projections by Technology for Gremista GSP - ST. Source: SSEN DFES 2023

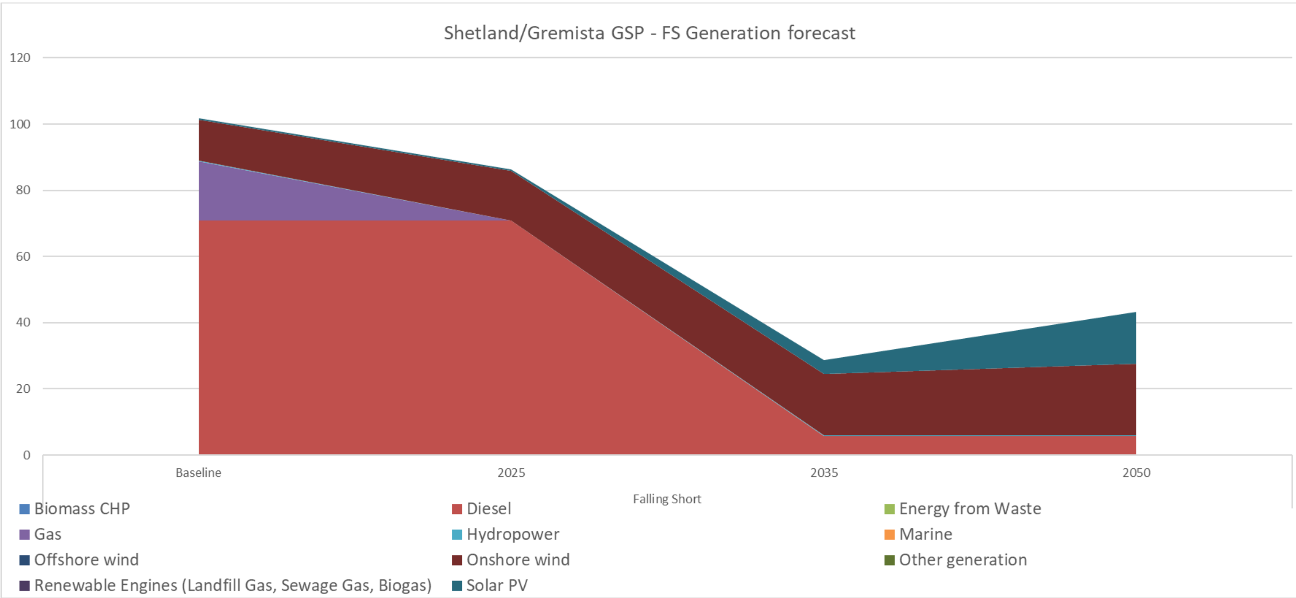


Figure 29 Generation Capacity Projections by Technology for Gremista GSP - FS. Source: SSEN DFES 2023

APPENDIX C – DEMAND FORECASTS FOR ALL DFES BACKGROUNDS

Gremista GSP – Demand Forecast by Primary Substation

This annex shows the winter peak forecast demand for primary substations within Gremista GSP. This data is forecast demand net of embedded generation output. Contracted connections information is added to these totals to give forecast values for the overall GSP.

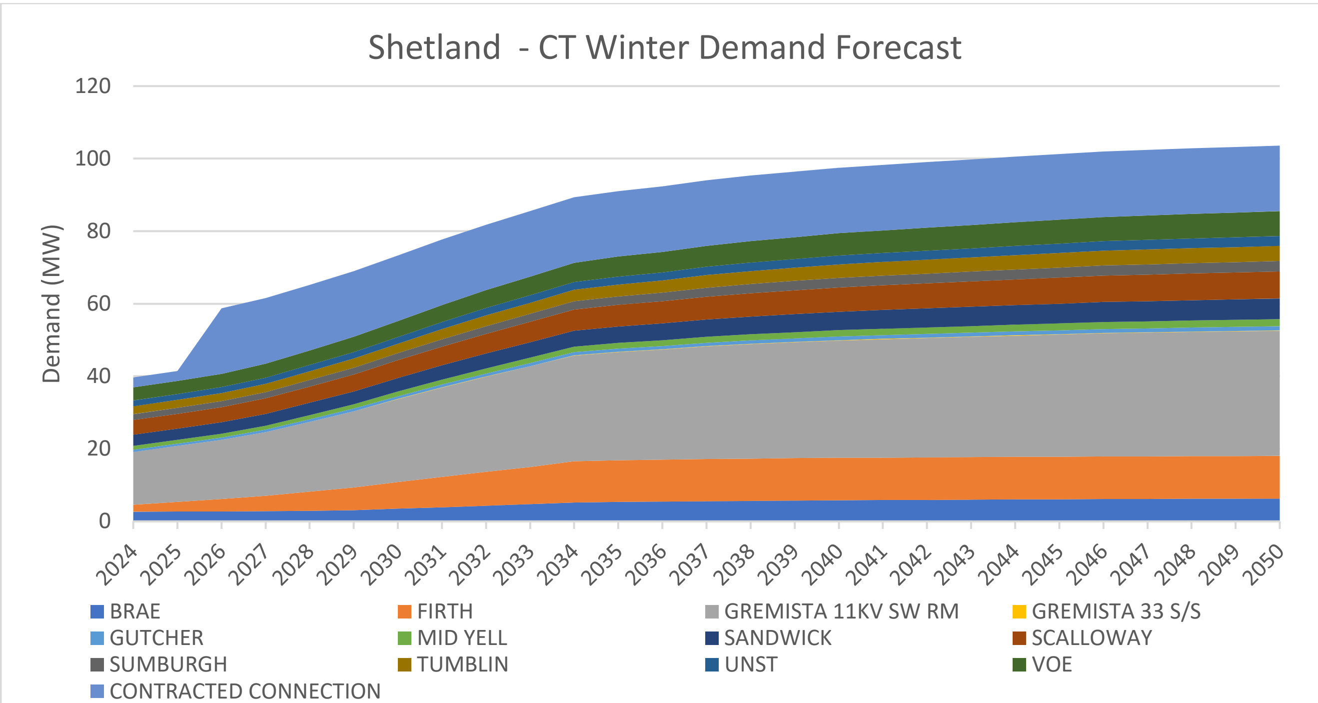


Figure 30 Demand Forecast for Gremista GSP – Breakdown by Primaries - CT (MW). Source DFES 2023

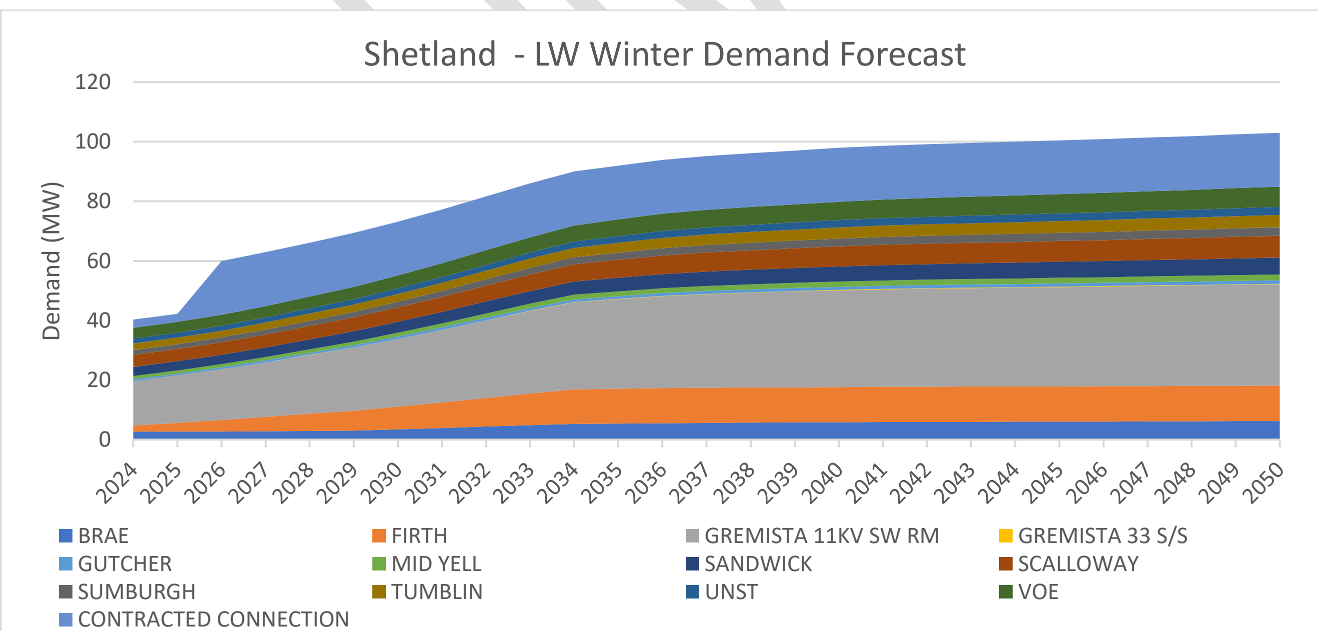


Figure 31 Demand Forecast for Gremista GSP – Breakdown by Primaries - LW (MW). Source DFES 2023

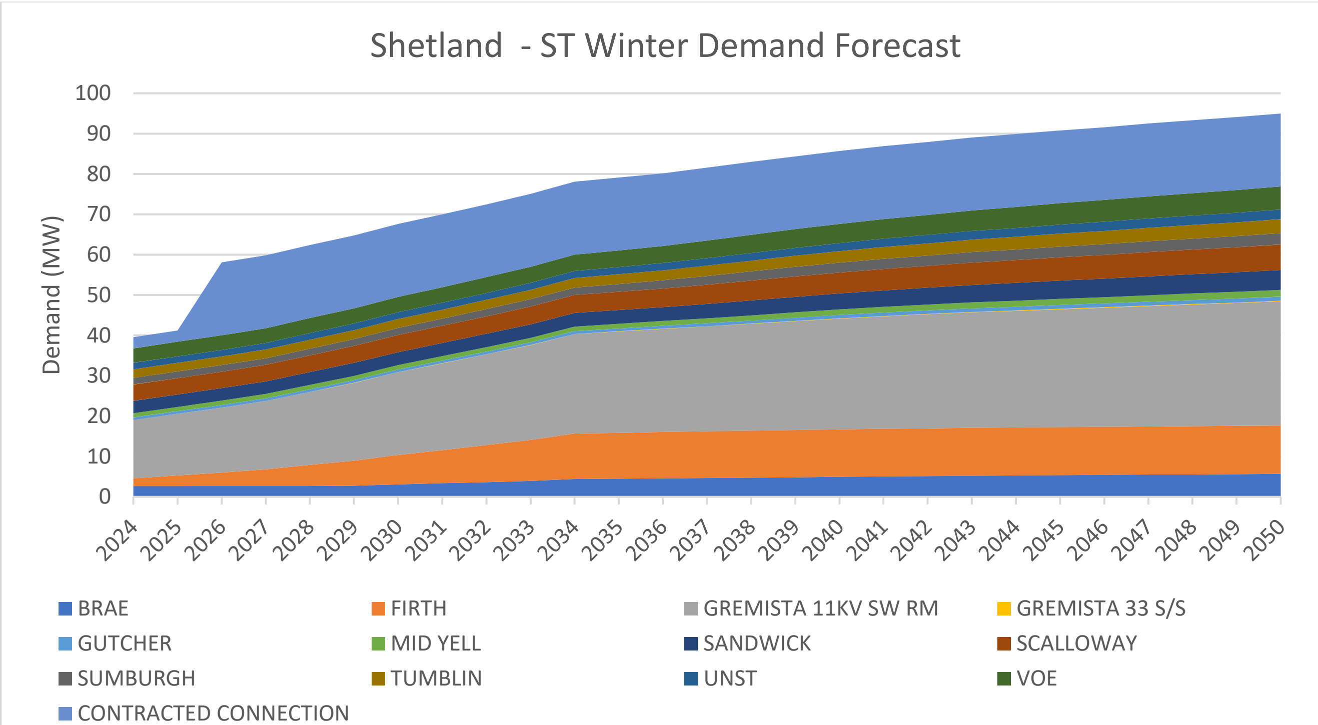


Figure 32 Demand Forecast for Gremista GSP – Breakdown by Primaries - ST (MW). Source DFES 2023

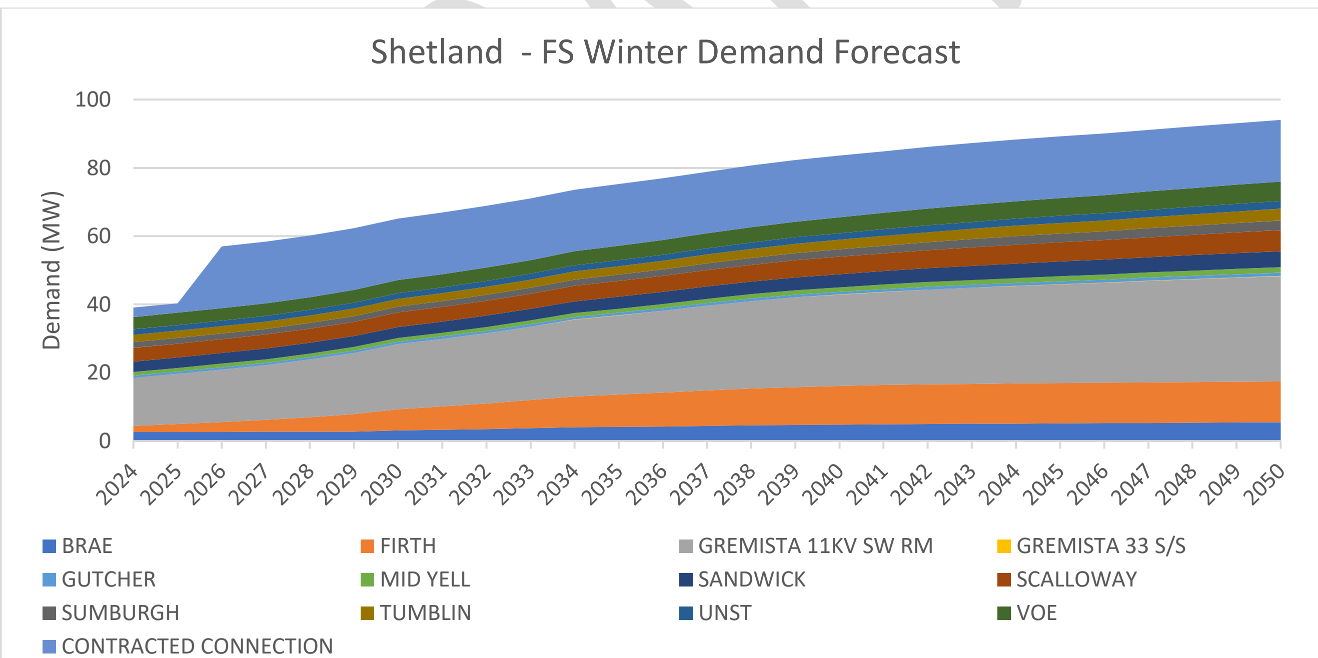


Figure 33 Demand Forecast for Gremista GSP – Breakdown by Primaries - FS (MW). Source DFES 2023

APPENDIX D – COMBINED EHV SPATIAL PLAN (HEADROOM) FORECASTS FOR ALL DFES BACKGROUNDS

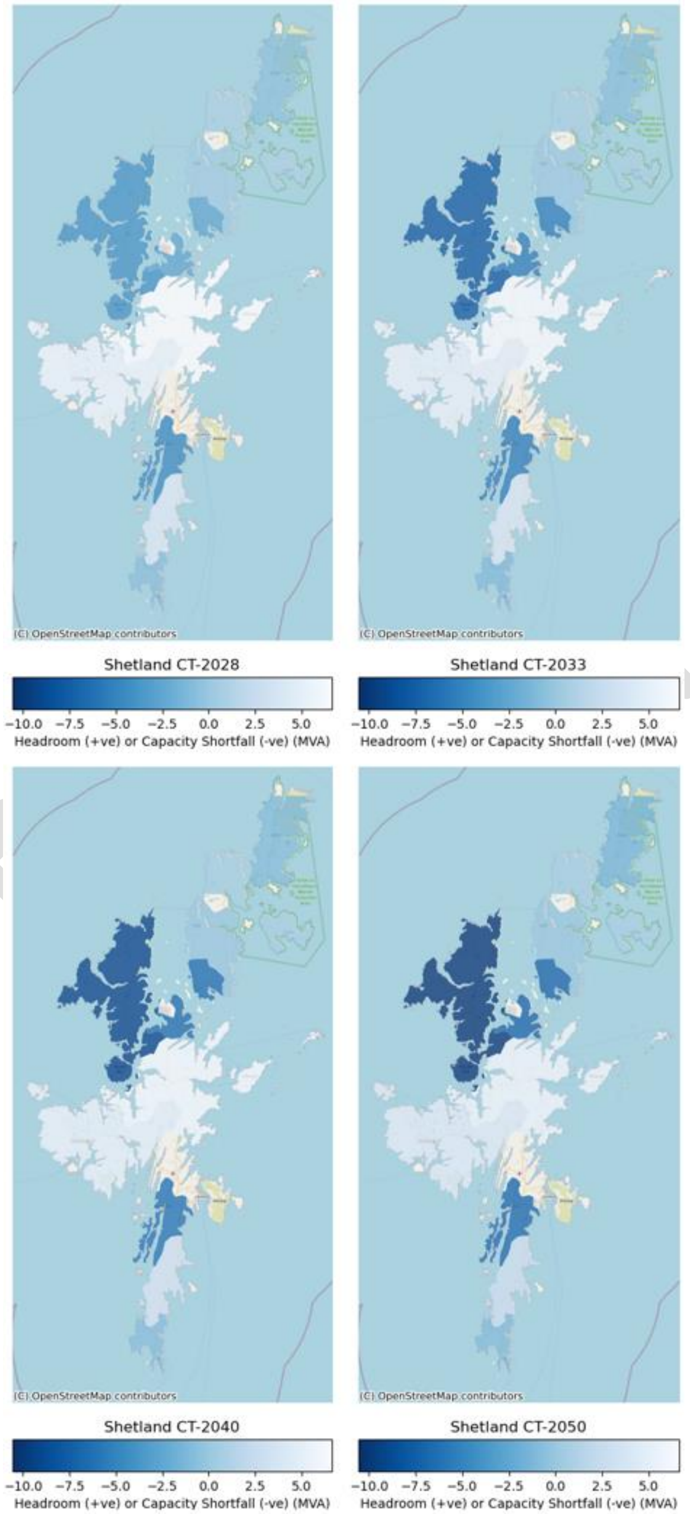


Figure 34 Gremista GSP EHV network spatial plans for CT 2028, 2033, 2040, and 2050

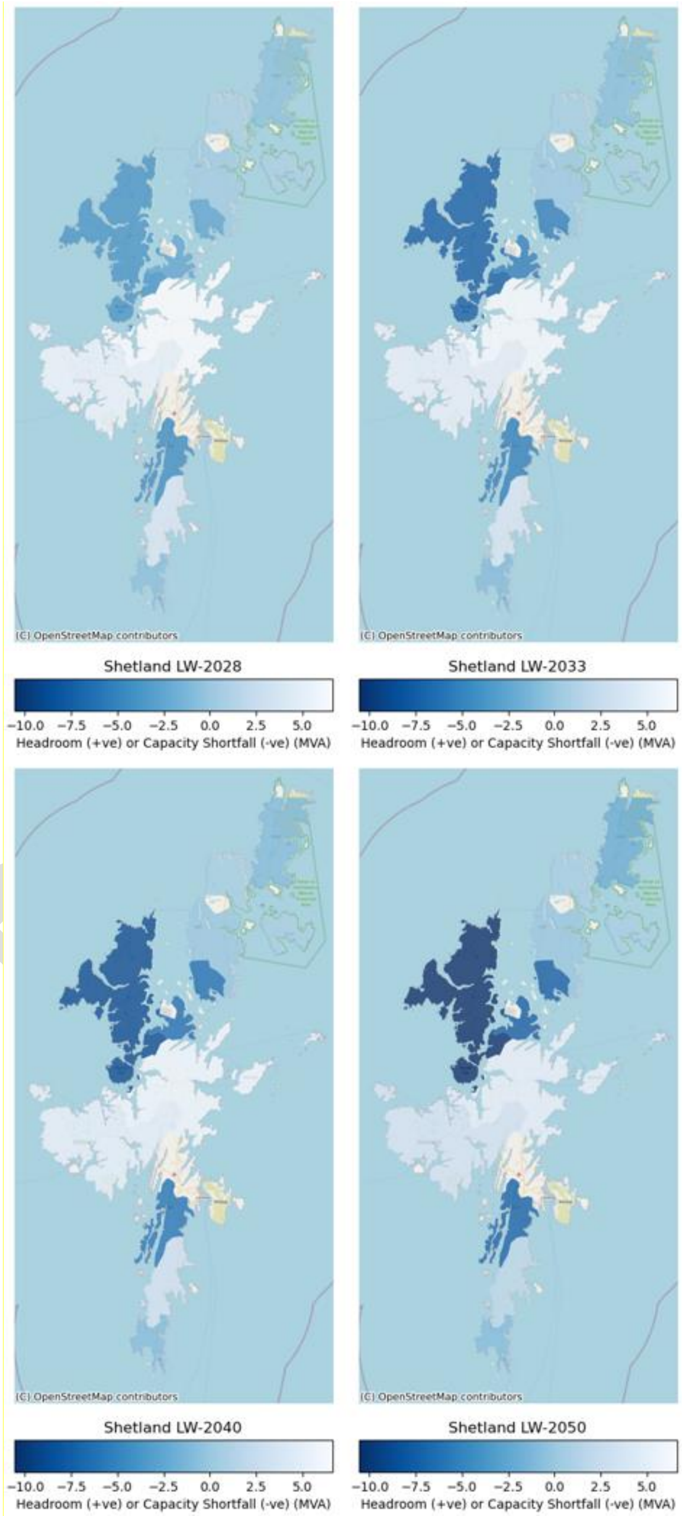


Figure 35 Gremista GSP EHV network spatial plans for LW 2028, 2033, 2040, and 2050

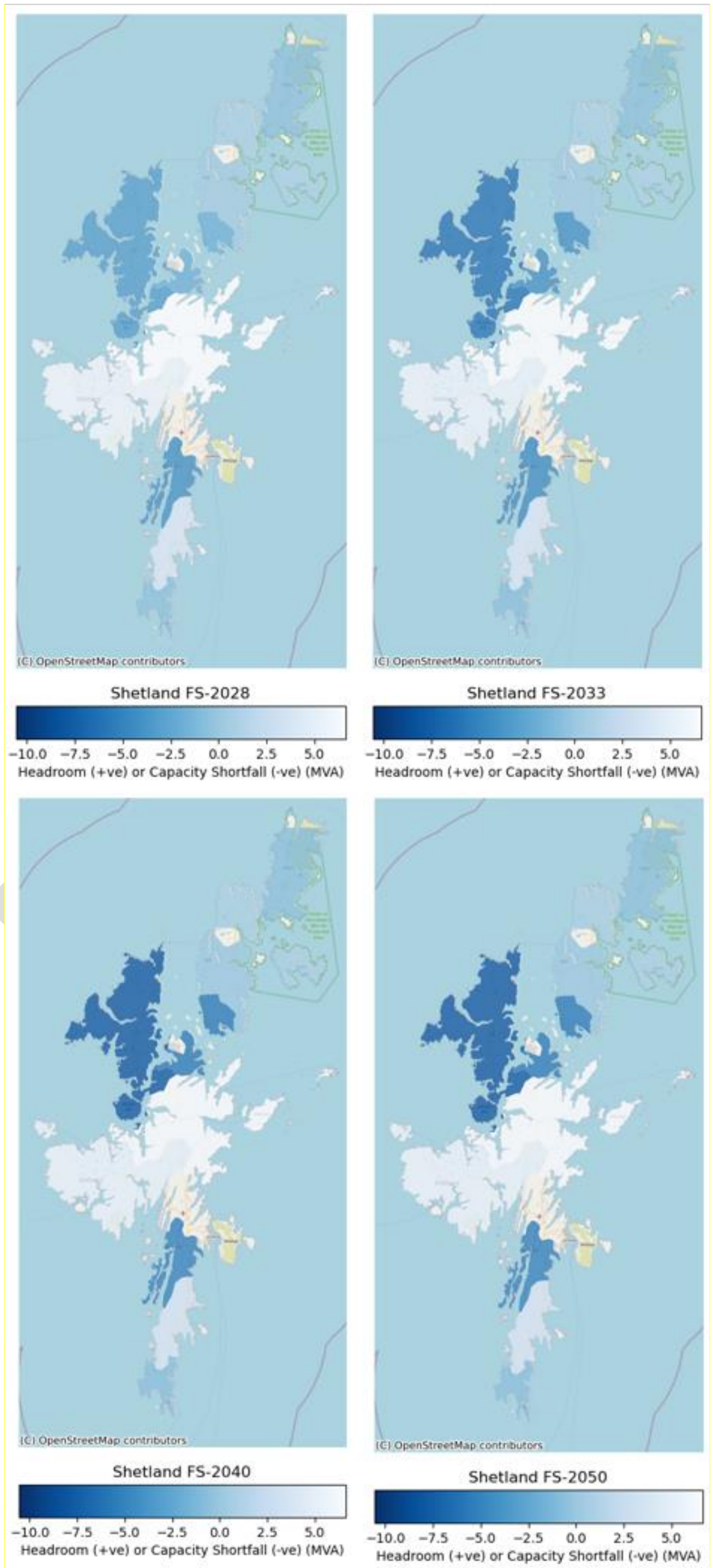


Figure 36 Gremista GSP EHV network spatial plans for FS 2028, 2033, 2040, and 2050

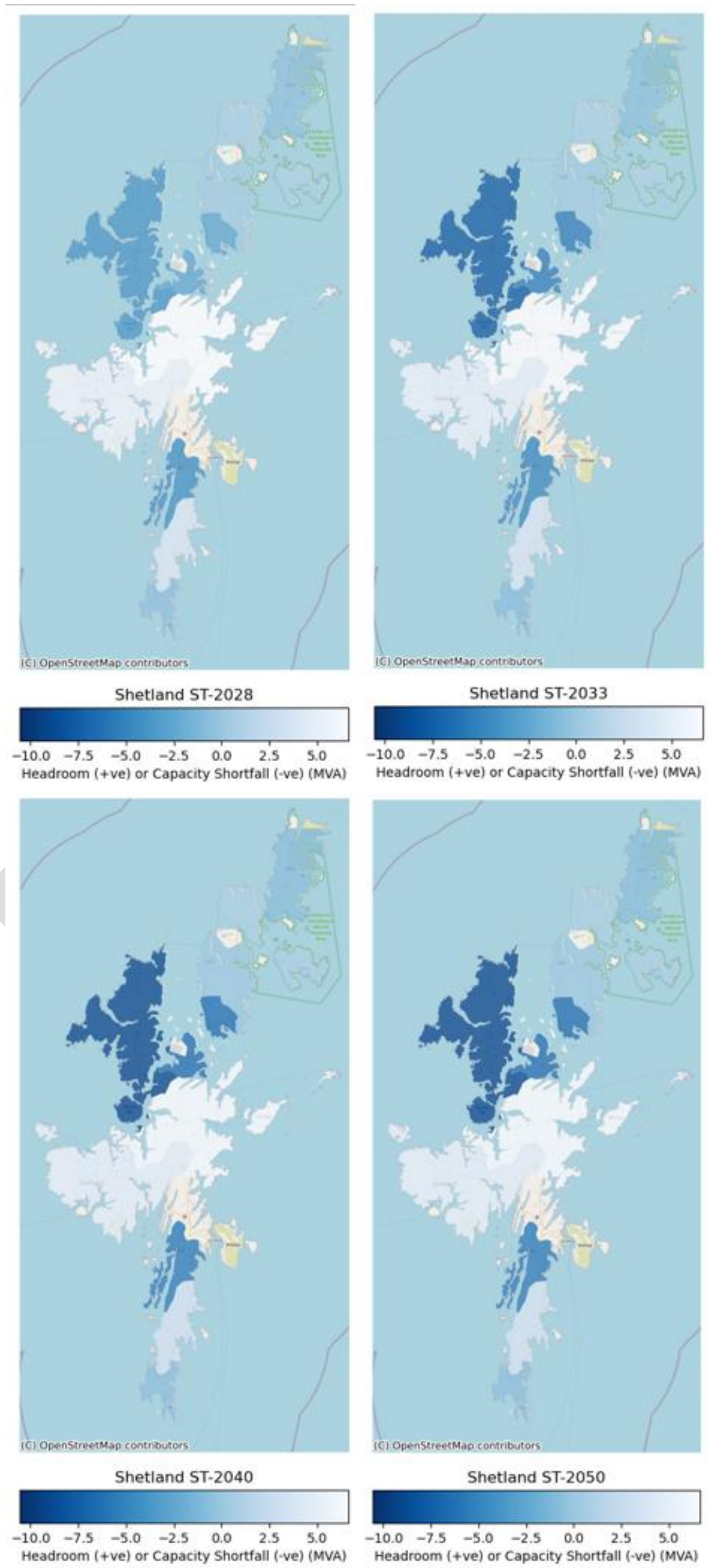


Figure 37 Gremista GSP EHV network spatial plans for ST 2028, 2033, 2040, and 2050

APPENDIX E – COMBINED HV/LV SPATIAL PLAN FORECASTS FOR ALL DFES BACKGROUNDS

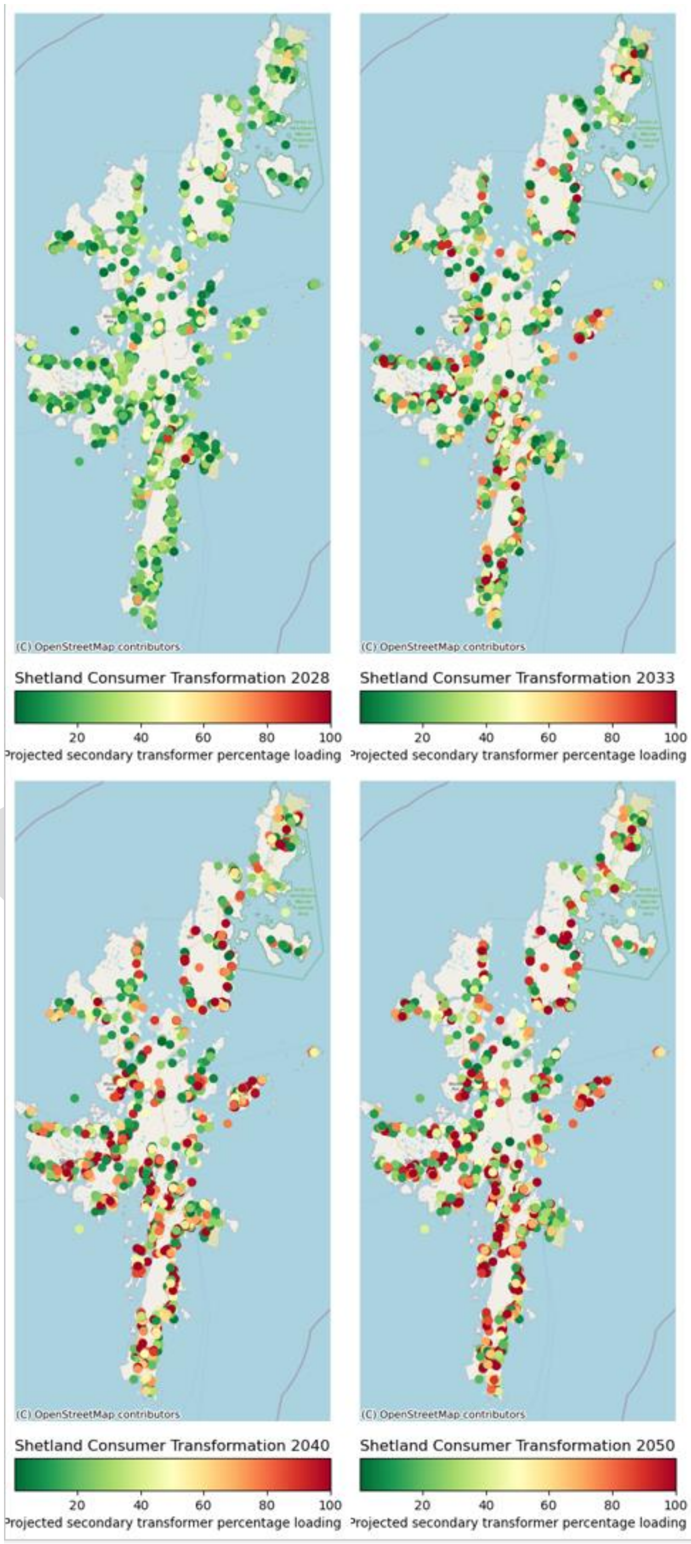


Figure 381 Gremista GSP HV/LV CT spatial plans for 2028, 2033, 2040, and 2050

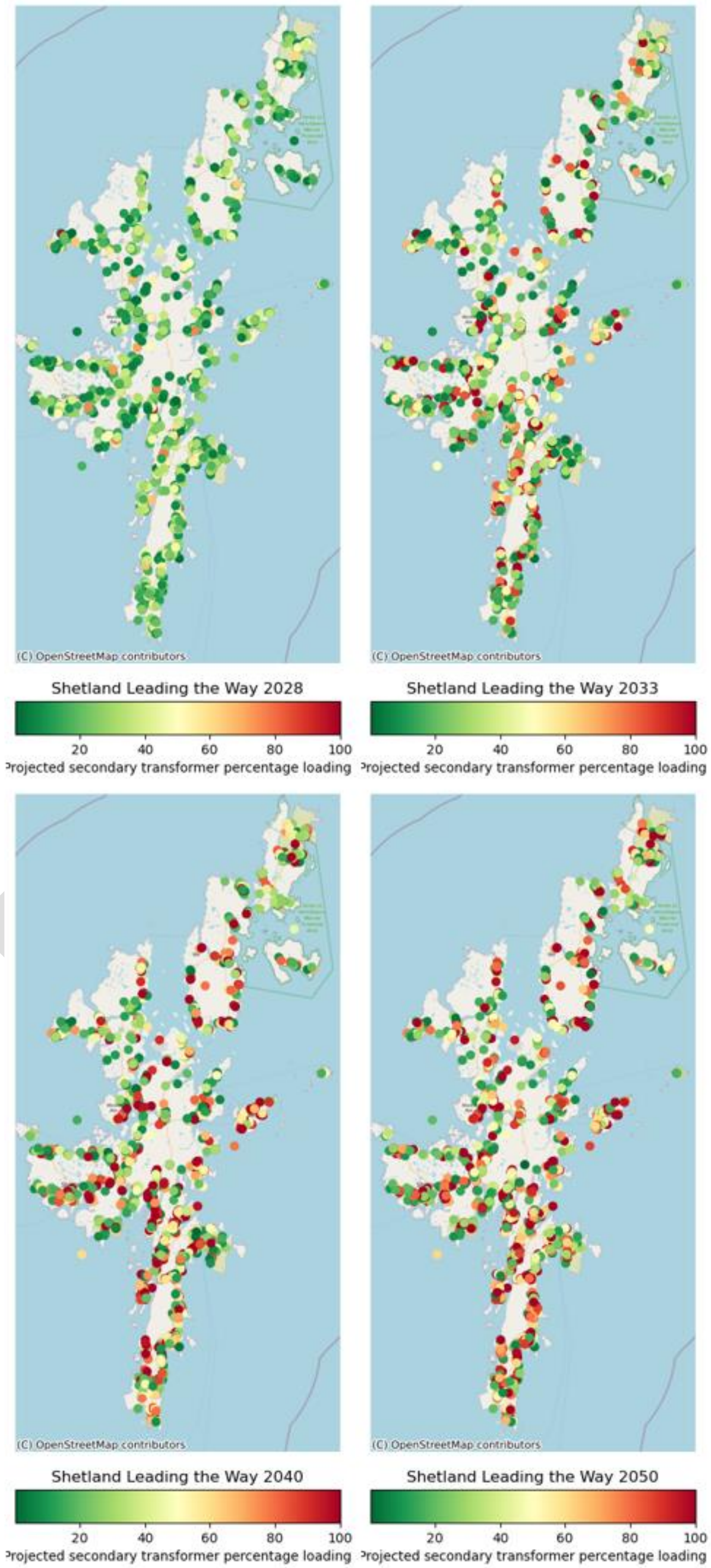


Figure 39 Gremista GSP HV/LV LW spatial plans for 2028, 2033, 2040, and 2050

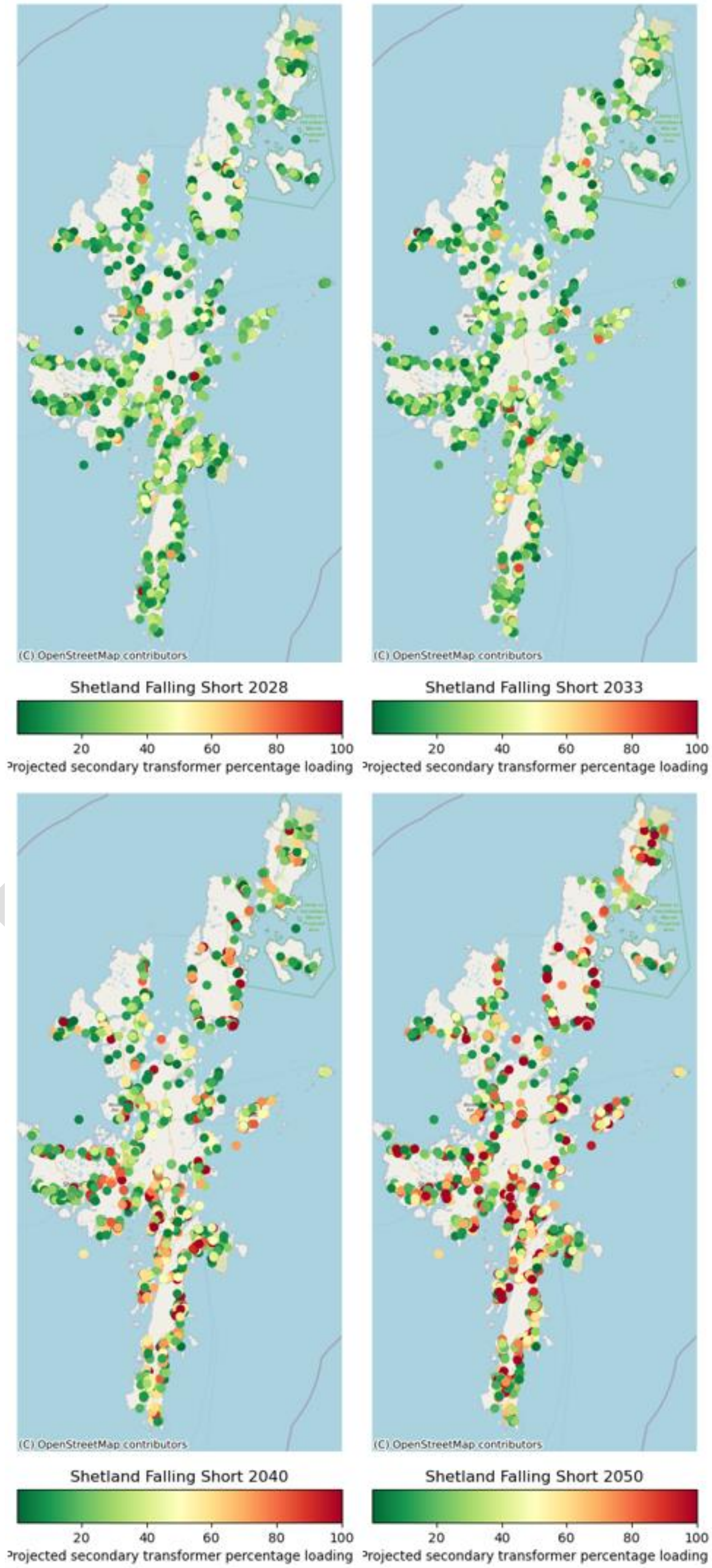


Figure 40 Gremista GSP HV/LV FS spatial plans for 2028, 2033, 2040, and 2050

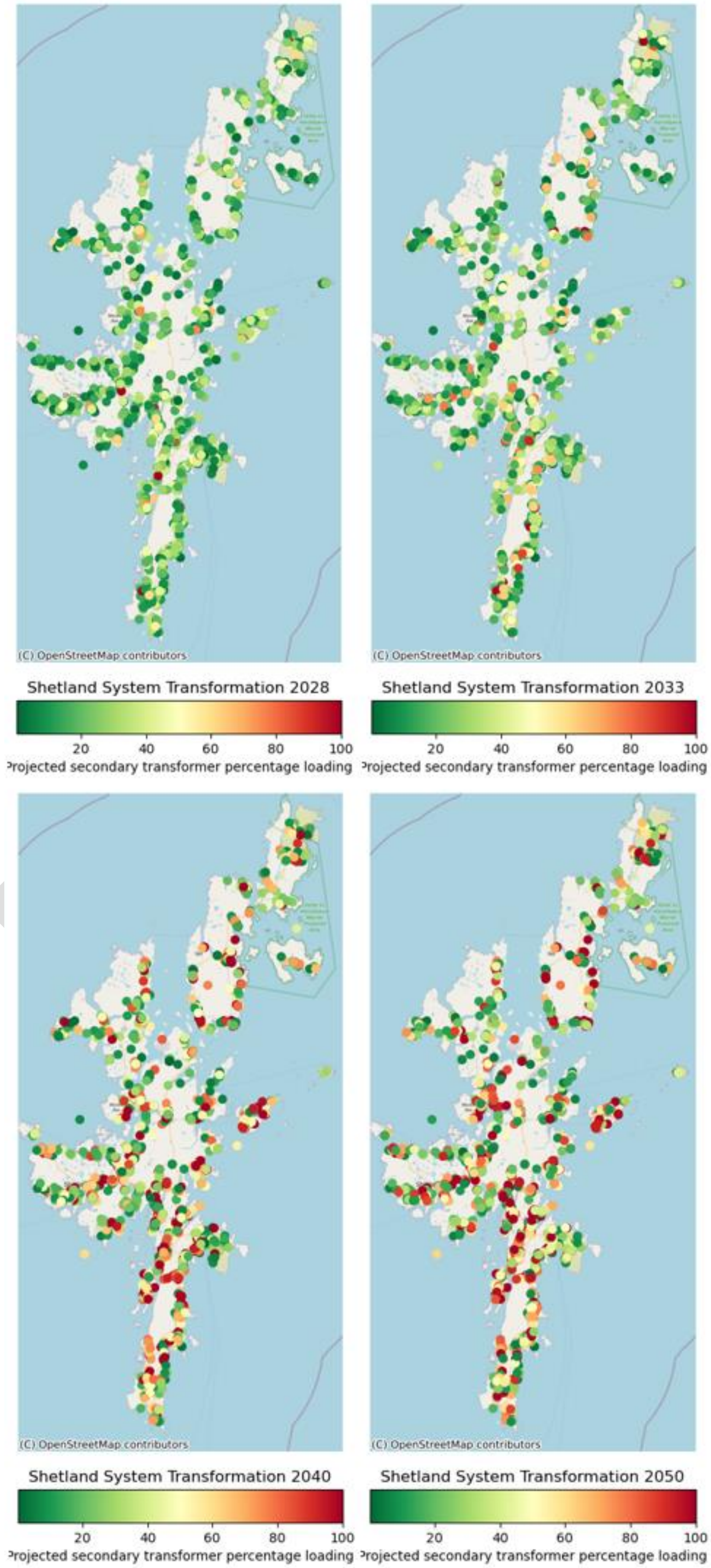
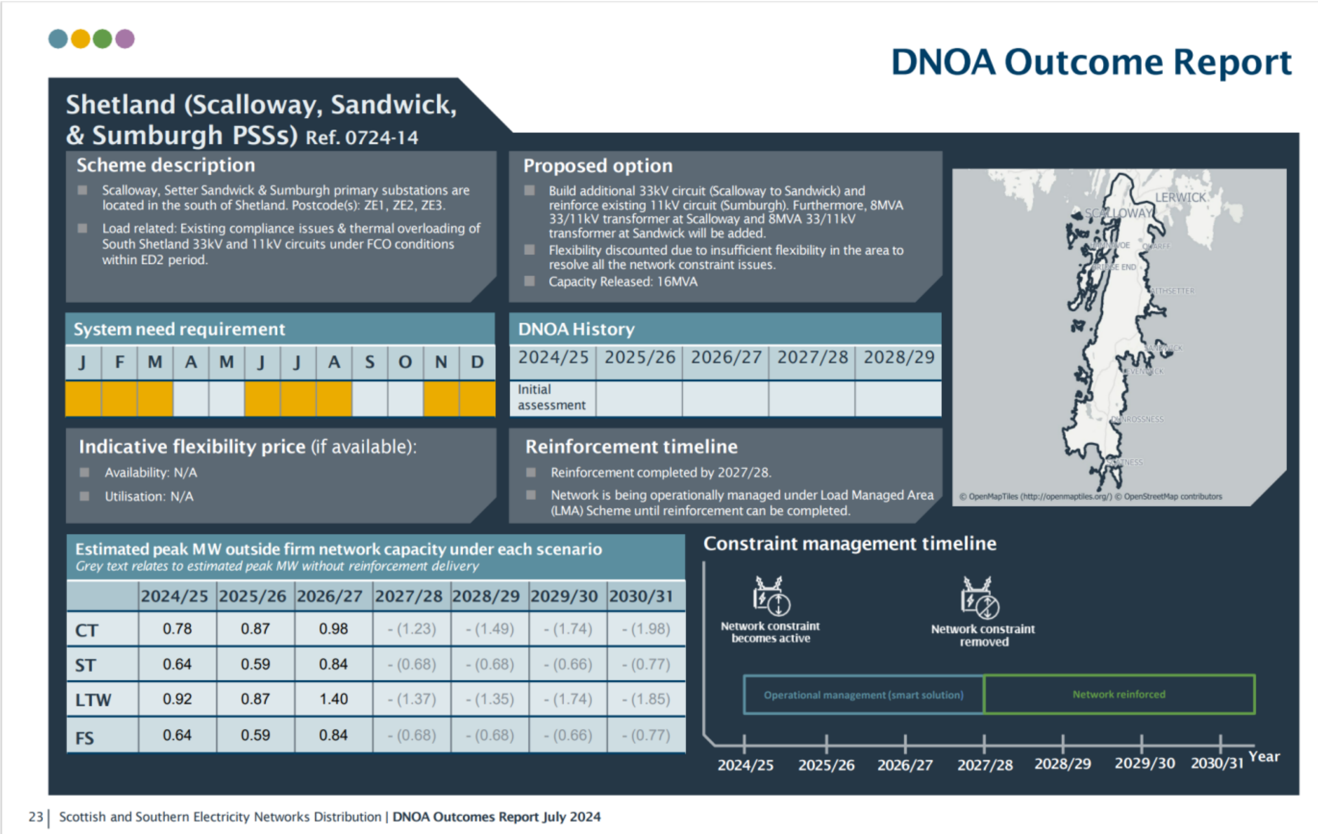


Figure 41 Gremista GSP HV/LV ST spatial plans for 2028, 2033, 2040, and 2050

APPENDIX F – DNOA OUTCOME REPORTS

This annex shows the published DNOA Outcome Reports which are relevant to the Gremista GSP supply area.



DNOA Outcome Report

Shetland (Scalloway, Sandwick, & Sumburgh PSSs) Ref. 0724-14

Scheme description

- Scalloway, Setter Sandwick & Sumburgh primary substations are located in the south of Shetland. Postcode(s): ZE1, ZE2, ZE3.
- Load related: Existing compliance issues & thermal overloading of South Shetland 33kV and 11kV circuits under FCO conditions within ED2 period.

Proposed option

- Build additional 33kV circuit (Scalloway to Sandwick) and reinforce existing 11kV circuit (Sumburgh). Furthermore, 8MVA 33/11kV transformer at Scalloway and 8MVA 33/11kV transformer at Sandwick will be added.
- Flexibility discounted due to insufficient flexibility in the area to resolve all the network constraint issues.
- Capacity Released: 16MVA

System need requirement

J	F	M	A	M	J	J	A	S	O	N	D

DNOA History

2024/25	2025/26	2026/27	2027/28	2028/29
Initial assessment				

Indicative flexibility price (if available):

- Availability: N/A
- Utilisation: N/A

Reinforcement timeline

- Reinforcement completed by 2027/28.
- Network is being operationally managed under Load Managed Area (LMA) Scheme until reinforcement can be completed.

Estimated peak MW outside firm network capacity under each scenario
Grey text relates to estimated peak MW without reinforcement delivery

	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31
CT	0.78	0.87	0.98	- (1.23)	- (1.49)	- (1.74)	- (1.98)
ST	0.64	0.59	0.84	- (0.68)	- (0.68)	- (0.66)	- (0.77)
LTW	0.92	0.87	1.40	- (1.37)	- (1.35)	- (1.74)	- (1.85)
FS	0.64	0.59	0.84	- (0.68)	- (0.68)	- (0.66)	- (0.77)

Constraint management timeline

23 | Scottish and Southern Electricity Networks Distribution | **DNOA Outcomes Report July 2024**

Figure 42 DNOA Outcome Report for Shetland Scalloway, Sandwick & Sumburgh Primary Substations (July 2024)

CONTACT

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