FORT AUGUSTUS 132KV SUPPLY AREA: STRATEGIC DEVELOPMENT PLAN

Our network serving communities across the Central Scottish Highland area

Draft for Consultation

October 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 - January 2025).

The focus area of this SDP is that supplied by Ceannacroc, Fasnakyle, Fort Augustus, Fort William, Kinlochleven and Quoich Grid Supply Points (GSPs) that make up the Fort Augustus 132kV substation supply area. These GSPs supply customers located in the Central Scottish Highland area, as shown below. The Isle of Skye and Outer Hebrides are also supplied from the Fort Augustus 132kV substation but are covered in a separate Outer Hebrides & Skye SDP. The scope of this report concentrates on the Scottish mainland GSPs supplied via the Fort Augustus 132kV substation.

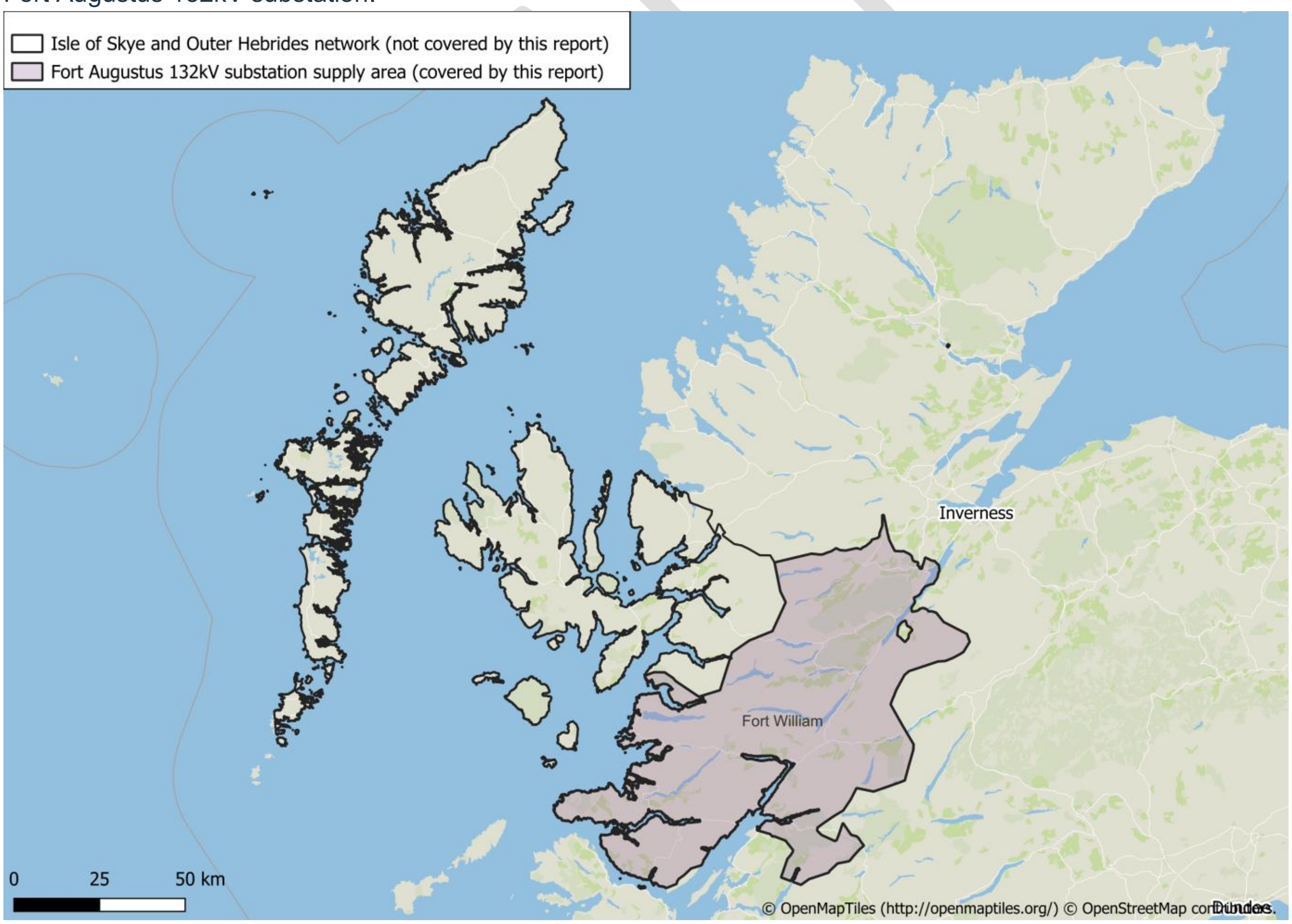


Figure 1 Geographic area covered by this report.

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. Plans across the central Scottish Highlands have been considered in preparation of this plan. Some reinforcement work has been triggered in this area through the Distribution Network Options Assessment (DNOA) process.

This SDP utilises the Distribution Future Energy Scenarios (DFES) to understand the pathway to a 2050 network that can support net zero and growth in the local economy. Recommendations from this report outline the initial steps that we believe should be taken on that pathway to develop the network in an efficient and stakeholder-led way.

2. INTRODUCTION

The aim of this report is to demonstrate how local, regional, and national targets link with other stakeholder views in the area to provide a robust evidence base for load growth out to 2050 across the Ceannacroc Fasnakyle, Fort Augustus, Fort William, Kinlochleven and Quoich (GSPs) that make up the Fort Augustus 132kV substation supply area. A GSP is an interface point with the national transmission system where SSEN then take power to local homes and businesses within a geographic area. In this SDP a number of such GSPs have been grouped by electrical connection to cover a larger area. Context for the area this represents is shown above in **Figure 1**. This report was produced in alignment with SSEN's Strategic Development Plan methodology[1]. The methodology report outlines the process that we follow in the development of our Strategic Development Plans and should be referred to alongside this report.

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 on 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. Due to the timing of when this report was produced, this SDP has been informed by the analysis undertaken as part of the DFES 2023. DFES 2023 consists for four different scenarios which are summarised in **Figure 2**. SSEN currently use Consumer Transformation as the central case scenario following stakeholder feedback during the RIIO-ED2 development process. This position is reviewed annually. The 2024 DFES outlines three new pathways (Holistic Transition, Electric Engagement, and Hydrogen Evolution) that achieve net zero by 2050 against a Counterfactual. Further detail on DFES 2024 can be found in Appendix B and in the DFES 2024 reports.

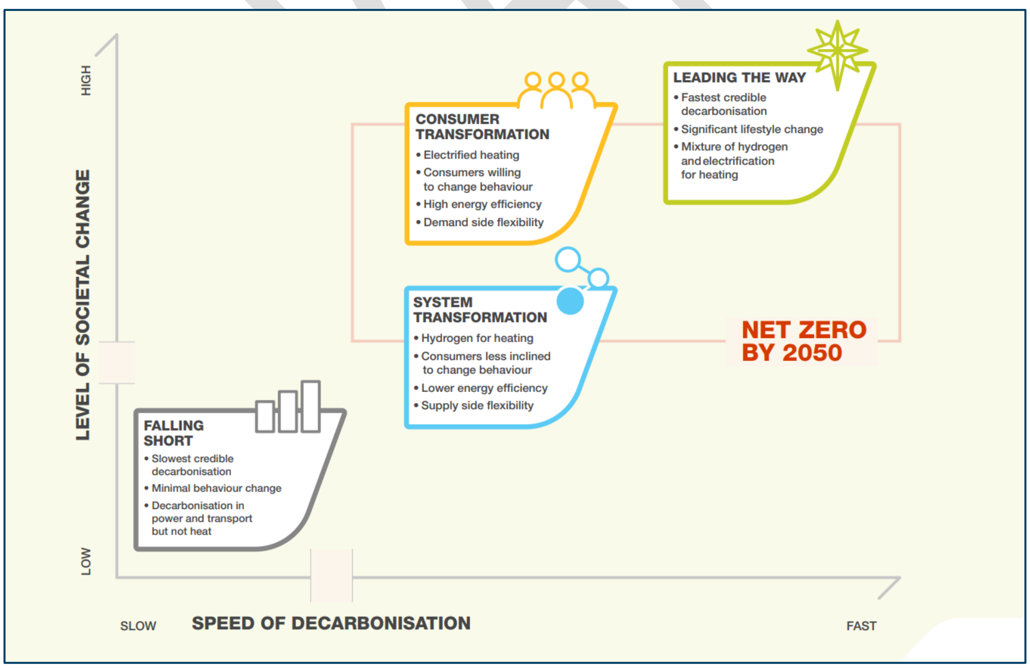


Figure 2 DFES 2023 Scenarios. Source: ESO FES2023

1 Strategic Development Plan Methodology - January 2025

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. We also model across the other three scenarios to understand when these needs arise and what demand projections should be considered if each scenario materialises.

The DNOA process provides 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 approach to flexibility.

3. STAKEHOLDER ENGAGEMENT AND WHOLE SYSTEM CONSIDERATIONS

3.1. Local Authorities and Local Area Energy Planning

The electrical network covered by this SDP supplies the Highland Council (as shown in **Figure 3**). The Highland Council's development plans will significantly impact the potential future electricity load growth on SSEN's distribution network. Therefore, it is crucial for SSEN to engage with these plans when carrying out strategic network investments.

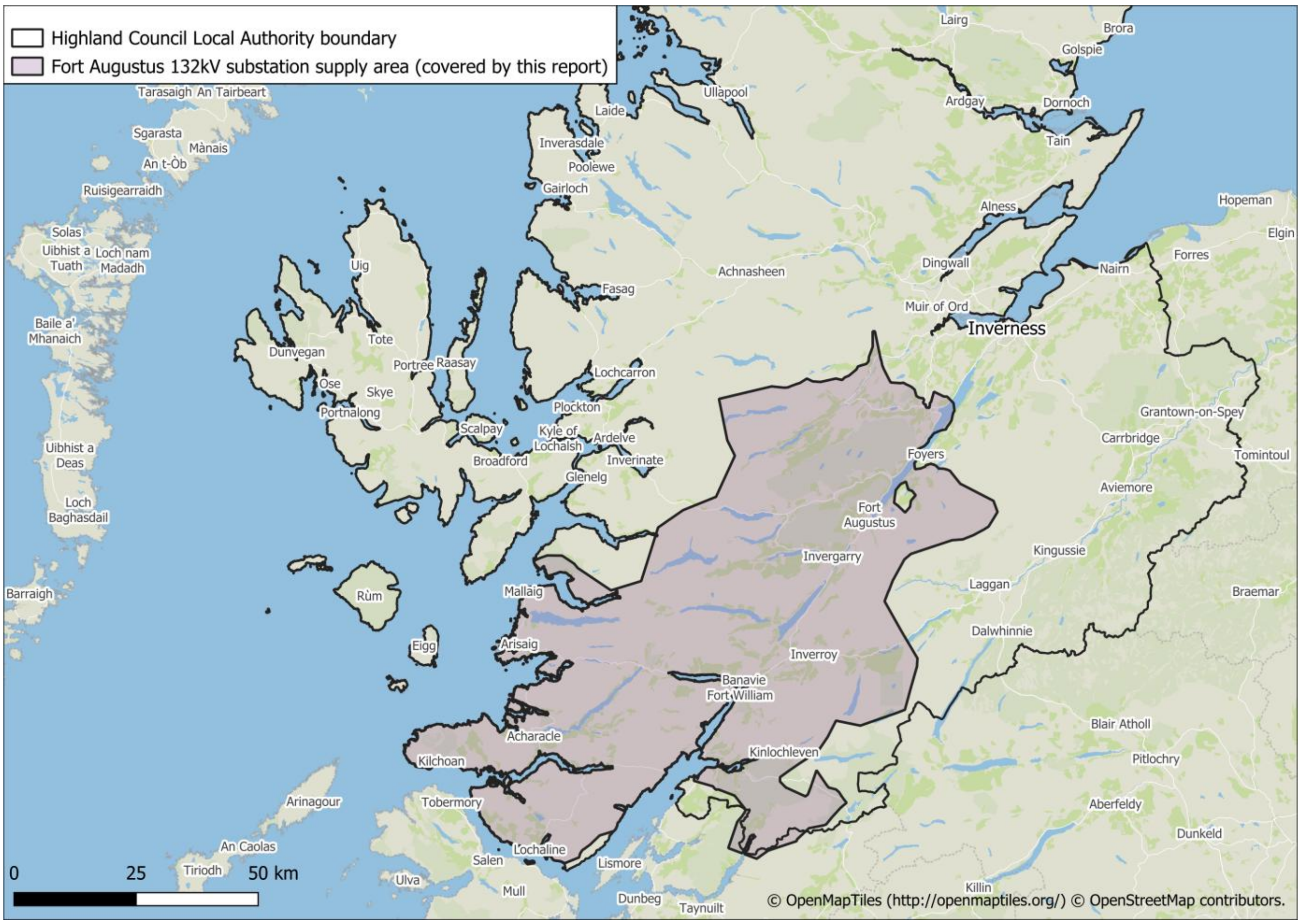


Figure 3 Highland Council Local Authority Boundaries and Fort Augustus 132kV substation supply area

3.1.1. Highland Council

The Highland Council serves a third of the land area of Scotland, which includes some of the most remote and sparsely populated parts of the UK mainland. The total estimated population at mid-year 2023 for Highland

Council was 236,330, which is the seventh highest population of the 32 local authorities in Scotland. The Highlands have seen significant population growth over the past 30 years by 13.9% between 2001 and 2021[2].

Highland Council has published their Net Zero Strategy[3] which includes a route map to net zero by 2045, with key interim targets to reduce emissions by at least 75% by 2030 and at least 90% by 2040[4]. This is in line with the Scottish Government's national target. Areas of focus from this strategy that are of particular interest to SSEN include:

- Improving energy efficiency across the Council's estate.
- Identifying and developing opportunities arising from renewable energy generation.
- Rationalising the fleet and replacing vehicles with low-emission alternatives.

Highland Council has also published their Local Heat and Energy Efficiency Strategy (LHEES) and Delivery Plan[5] which sets out their ambition for a place-based approach to planning and delivery of heat decarbonisation in the region. The North of Scotland, encompassing Aberdeen City, Aberdeenshire, Moray, and Highland Councils, have also been awarded £6.86 million in grant funding from the £30 million Scottish Government Electric Vehicle Infrastructure Fund, effective from Spring 2025[6].

SSEN also work closely with regional stakeholders such as the Highlands and Islands Enterprise (HIE), an economic and community development agency for the area, which is a non-departmental public body of the Scottish Government.

3.2. Whole System Considerations

The Fort Augustus 132kV supply area is experiencing high levels of battery storage and generation connection applications. The impact of Clean Power 2030 on connections relating to current works and future system needs will need to be carefully considered and this SDP will be updated in future iterations accordingly.

3.2.1. 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.

The percentage of customers currently subject to LMA requirements are outlined in Table 1 below.

Substation Name	Site Type	% of RTS customers
Ceannacroc GSP	Grid Supply Point	No LMA data available
Fasnakyle GSP	Grid Supply Point	16.93%

2 City_Region_Deal_Annual_Report_2024.pdf

3 Net Zero Strategy | Climate change | The Highland Council

4 Net Zero Strategy | Climate change | The Highland Council

5 Local Heat and Energy Efficiency Strategy and Delivery Plan | The Local Heat and Energy Efficiency Strategy | The Highland Council

6 Electric Vehicle Infrastructure Fund | Transport Scotland

Fort Augustus GSP	Grid Supply Point	16.20%
Fort William GSP	Grid Supply Point	14.94%
Kinlochleven GSP	Grid Supply Point	10.30%
Quoich GSP	Grid Supply Point	No LMA data available

Table 1 Number of LMA customers subject to RTS (2024)

3.2.2. Transmission Interactions

Due to the significant potential for renewable energy resources across the central highlands and the Fort Augustus 132kV supply area there is a list of contracted generation connections due to connect to the transmission network. To facilitate this, SSEN Transmission currently have a strong presence in the central highland region, with a large portfolio of works to be delivered to facilitate these connections and support the drive towards net zero. The portfolio of projects ranges from those already delivered or underway to those in various stages of planning and development.

Building on the strong historic relationship, there remains an open dialogue between SSEN Distribution and Transmission regarding the portfolio. As the future plans pass through strategic planning and development processes, this open dialogue will be a key component in a successful whole system solution for the central highlands area. SSEN Distribution will continue to engage with SSEN Transmission regarding the evolution of their plans for the network covered by this SDP.

The supply area covered by this SDP forms part of the overall SSEN Transmission Strategy.

The Transmission Strategy consists of seven projects that are relevant to the Fort Augustus 132kV supply area:

- Fort Augustus substation 400kV upgrade/reinforcement[7]
- Coire Glas Connection[8]
- Bingally 400kV Substation[9]
- Quoich Power Station to Switching Station OHL Replacement[10]
- Glenmoriston Grid Transformer Replacement[11]
- Foyers Substation Extension Works[12]
- Ceannacroc GSP 2

7 Fort Augustus Substation 400kV Upgrade - SSEN Transmission

8 Coire Glas Connection Project - SSEN Transmission

9 Bingally 400kV Substation - SSEN Transmission

10 Quoich Power Station to Switching Station OHL Replacement - SSEN Transmission

11 Glenmoriston GT Replacement - SSEN Transmission

12 Foyers Substation Works - SSEN Transmission

Fort Augustus substation 400kV upgrade/reinforcement

To support the continued growth in onshore and offshore renewables across the north of Scotland, supporting the country's drive towards Net Zero, investment in network infrastructure is needed to connect this renewable power and transport it from source to areas of demand across the country. Extensive studies have confirmed the need to upgrade the second circuit of the Beauly – Denny overhead line (OHL) from 275kV to 400kV. To do this, SSEN Transmission require two new 400kV substations as well as modifications or extensions to other substations along the Beauly – Denny route.

The Fort Augustus substation 400kV upgrade project involves upgrades to the existing substation at Auchterawe. The proposals include the replacement of the existing transformers at the substation, space provision for two reactors (to support blackstart requirements), the removal of some existing 275kV equipment and new equipment to facilitate the new Coire Glas connection via the new Loch Lundie substation. This proposal will supersede the existing planning consent for a 275kV extension. Fort Augustus substation is pivotal to our network upgrade plans in the North of Scotland and there are multiple projects connecting into the substation. For further information on our projects in Fort Augustus, please see the Fort Augustus Hub webpage.[13] This project is in refinement with planning applications submitted to the Highland Council and project plans currently being finalised ahead of moving this project into delivery. Forecasted completion dates are yet to be confirmed.

Coire Glas Connection

SSEN Transmission have received a Transmission Owner Agreement to connect the Coire Glas Pumped Hydro Scheme to the Transmission network. The scheme will be the first large-scale pumped storage scheme to be developed in the UK for more than 30 years and has a potential capacity of up to 1500 Megawatts (MW), supporting the UK's drive towards Net Zero by 2050. A degree of rationalisation of the existing infrastructure will form part of these works. The scheme is located southwest of Laggan Locks, near to Loch Lochy, Highland.

Bingally 400kV Substation

Similarly to the proposed upgrade of Fort Augustus substation to 400kV, the installation of a new substation at Bingally is also required. Bingally 400kV substation is located southwest of Cannich, near Tomich, approximately 6km from the existing Fasnakyle 275kV substation. The new substation will house more sophisticated switching capability than is present in the existing 275kV substation, which requires significantly more space than either existing substation can currently accommodate. With Planning applications submitted in Autumn 2024 this project is currently in refinement wile project plans are finalised. Forecasted completion dates are yet to be confirmed.

Quoich Power Station to Switching Station OHL Replacement

The existing 132kV switching station at Quoich Tee contains obsolete equipment that has reached end of life, and it is no longer possible to obtain spare parts for some of the switchgear. This site forms a critical part of the electrical infrastructure supplying Skye and the Western Isles, and a replacement is essential to ensure security of electricity supply and to allow for the connection of renewable generation. The new equipment will be installed within the existing substation whilst keeping the connection to Skye and the Western Isles operating during the construction period. Further work will be required in future regulatory periods following the completion of the new overhead line to Skye, and the changes to the site are being designed to accommodate this work without the need to further extend the site in the future. This project is in refinement and project plans are being finalized ahead of it moving into delivery. Forecasted completion dates are yet to be confirmed.

---

13 Fort Augustus Hub - SSEN Transmission

Glenmoriston Grid Transformer Replacement

The Glenmoriston Substation Works involve replacement of the existing grid transformer (GT). A condition assessment highlighted the transformer is showing signs of degradation and needs to be replaced. No other condition related issues have been identified at this substation. This project is in early development where the project details are being refined. Forecasted completion dates are yet to be confirmed.

Foyers Substation Works

The project is to replace the existing transformers at the Foyers pumped storage hydro-electric power station substation. This includes replacing the existing underground cable connection between the substation and the existing Foyers switching station with a new underground cable. To accommodate this upgrade the Foyers switching station also requires an extension on one side. The two existing transformers at Foyers Power Station, which convert the 18kV output to 275kV for export to the transmission network are coming to the end of their operational life and need replacement. This project is currently in the assessment stage with completion dates yet to be confirmed.

Ceannacroc GSP 2

A new GSP has been triggered at Ceannacroc because of large, contracted generation and battery storage connections. The construction of Ceannacroc 2 GSP will be deliverable by SSEN Transmission but is still in early conception.

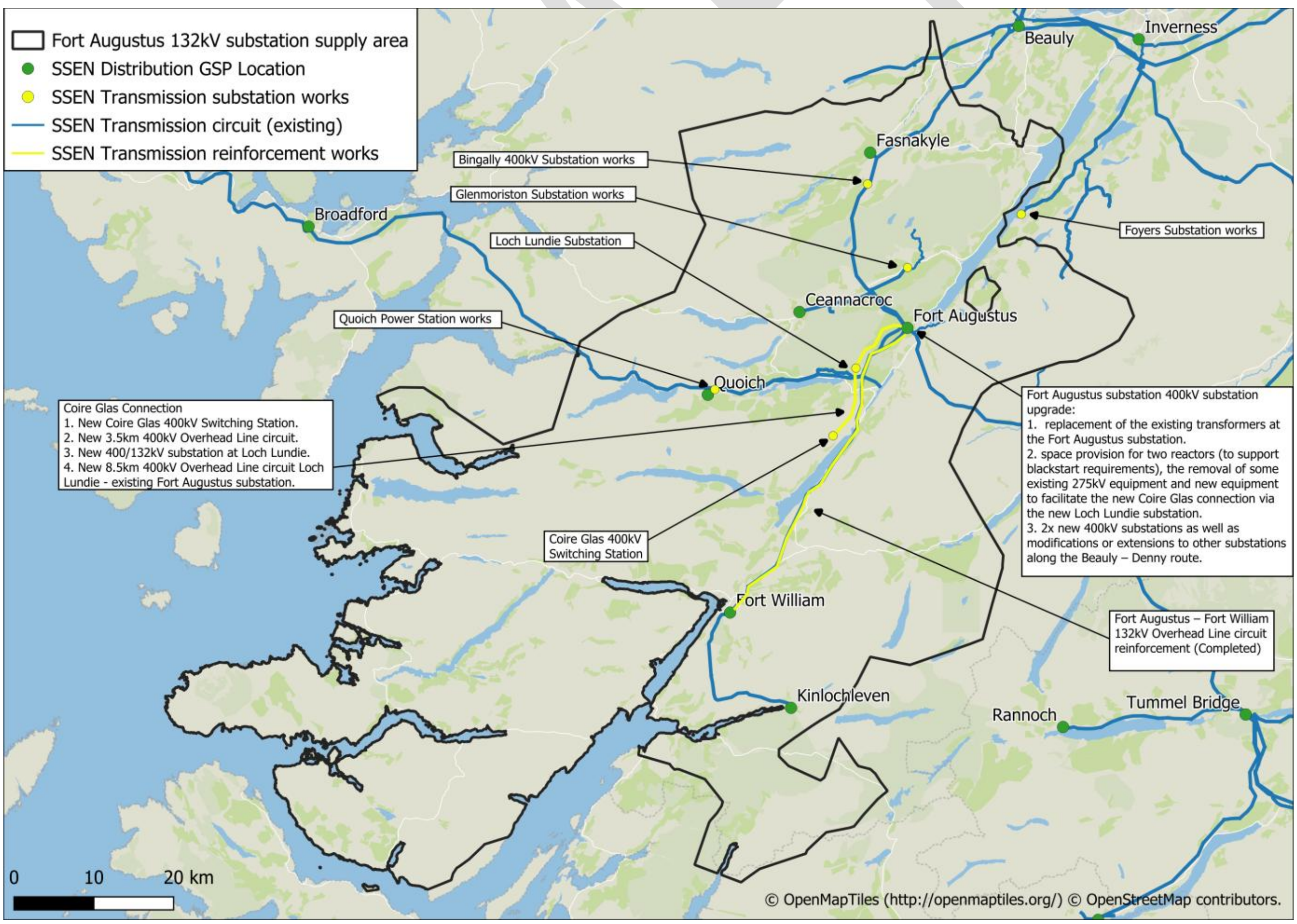


Figure 4 Transmission Infrastructure planned within the Fort Augustus 132kV supply area

3.2.3. Security of Supply

Engineering Recommendation P2/8 requires Distribution Network Operators to maintain security of supply to its connected customers in line with the standards laid out in that document, depending on the total demand of the substation. Scottish Hydro Electric Power Distribution (SHEPD) electricity distribution network includes several networks that were installed in the period 1950 - late 1980s to provide the first mains electricity supplies to rural communities. These networks were installed on a minimum cost basis and did not meet the standards laid out in Engineering Recommendation P2/8. It was previously considered uneconomic to improve them and these were therefore determined to be exempt from the Engineering Recommendation P2/8. In the context of decarbonisation and increased reliance on electricity, as demand rises in these areas, this position will be reviewed for larger demand groups and where justified the exemption will be removed.

3.3. Flexibility Considerations

SSEN procures Flexibility Services from owners, operators, or aggregators of Distributed Energy Resources (DERs) or Consumer Energy Resources (CERs), which can be generators, storage, or demand assets. These services are needed in areas of the network which have capacity constraints at particular times or under certain circumstances. SSEN purchases Flexibility Services from all types of providers (e.g. domestic or commercial). Information on the process of procurement and how to participate are published on the Flexibility Services website and information on real time decision making on which providers are dispatched can be found in the Operational Decision-Making document.[14,15]

SSEN regularly recruits new Flexibility Services providers and increases the procured Flexibility Services with the latest bidding round for long term requirements held in August 2024 and recruitment through the Mini-Competition process in October 2024.

Across the Fort Augustus 132kV supply area where flexibility has previously been procured is shown below in **Figure 5**. This map shows all Flexibility Services procured, which covers requirements beyond those identified

14 SSEN, Flexibility Services Procurement (Flexibility Services Procurement - SSEN)

15 SSEN, 02/2024, Operational Decision Making (ODM), (SSEN Operational Decision Making ODM)

for managing the deferral of reinforcement.

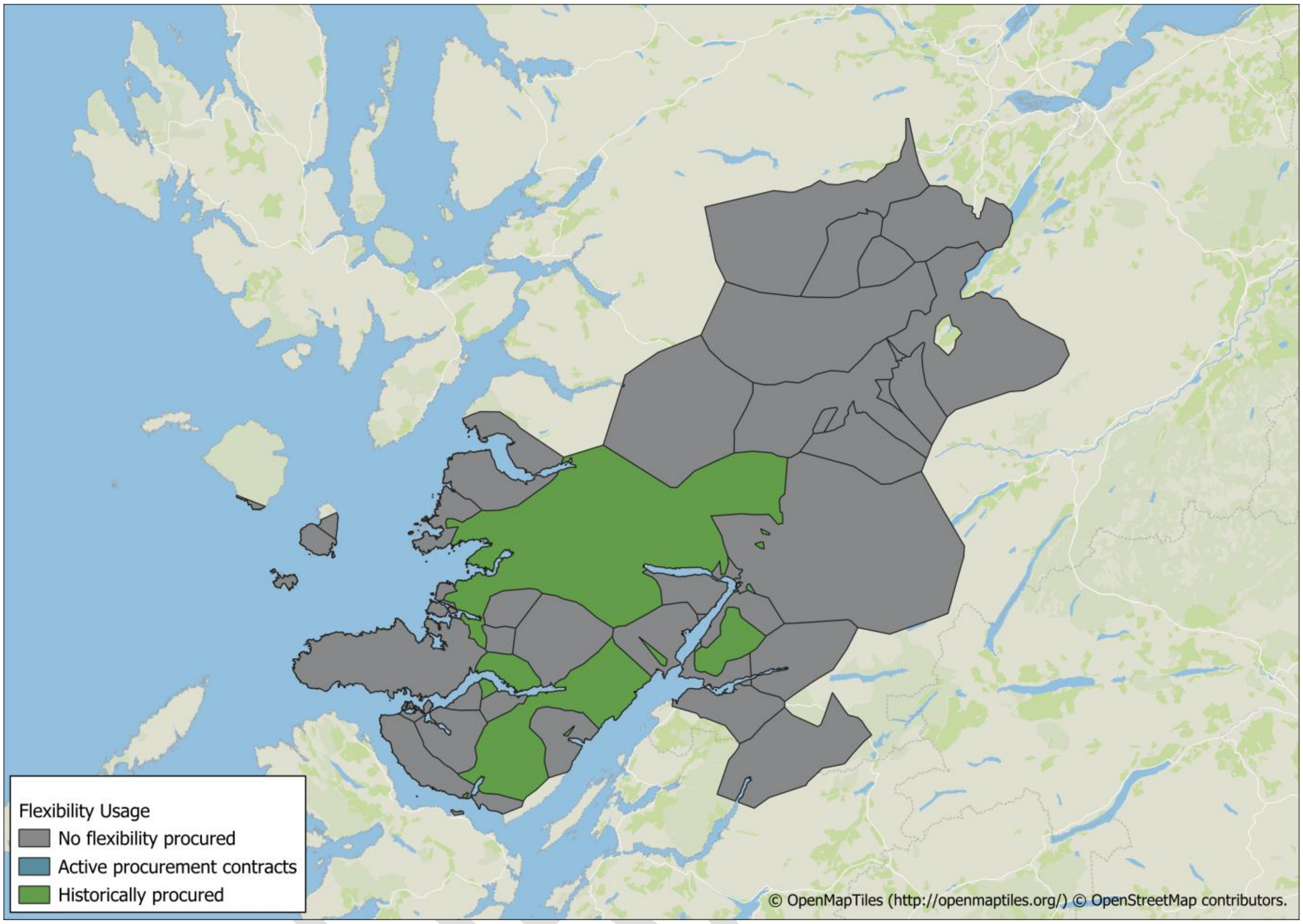


Figure 5 Flexibility procurement areas across Fort Augustus 132kV substation supply area

4. EXISTING NETWORK INFRASTRUCTURE

4.1. Fort Augustus 132kV Supply Area Context

The Fort Augustus 132kV supply area network is made up of 275kV, 132kV, 33kV, 11kV, and LV circuits. It is a mix of rural and urban network spanning across the Scottish highland region. While much of the land is used for agricultural purposes, there is a mix of residential, commercial, and industrial land, which is located throughout the supply area. In total, the Fort Augustus 132kV supply area supplies approximately 15,726 customers with the breakdown for each Grid Supply Point shown in **Table 2** below. A further breakdown by primary substation can be found in **Appendix A**.

Substation Name	Site Type	Number of Customers Served	2023/24 Substation Maximum MVA (Season)
Ceannacroc GSP	Grid Supply Point	250	1.91MVA (Winter)
Fasnakyle GSP	Grid Supply Point	351	0.30MVA (Winter)
Fort Augustus GSP	Grid Supply Point	2,354	5.81MVA (Winter)
Fort William GSP	Grid Supply Point	11,308	29.58MVA (Winter)
Kinlochleven GSP	Grid Supply Point	1,444	1.63MVA (Winter)
Quoich GSP	Grid Supply Point	19	0.49MVA (Winter)
TOTAL		15,726	39.73MVA (Winter)

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

4.2. Current Network Topology

Figure 6 below highlights the existing 33kV network topology in the Fort Augustus 132kV supply area. The SSEN Transmission network supplies the distribution network at various Grid Supply Point (GSP) sites. It is then distributed to the primary substations via the 33kV distribution network.

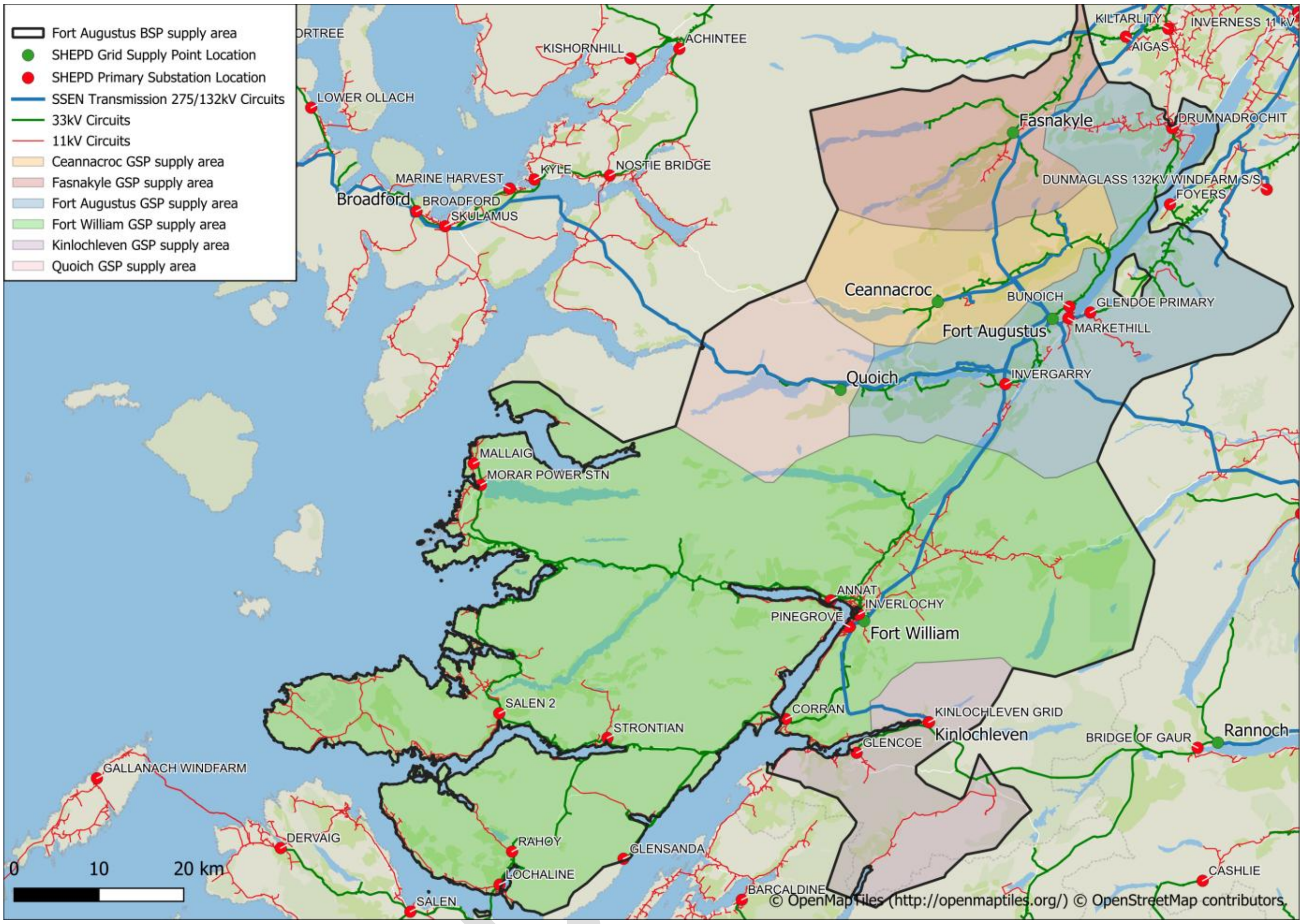


Figure 6 Fort Augustus 132/33kV network by GSP supply area

4.3. Network Schematic

The network schematics in **Figures 7-12** (below) depict the existing 33kV distribution network at Ceannacroc, Fasnakyle, Fort Augustus, Fort William, Kinlochleven and Quoich GSPs.

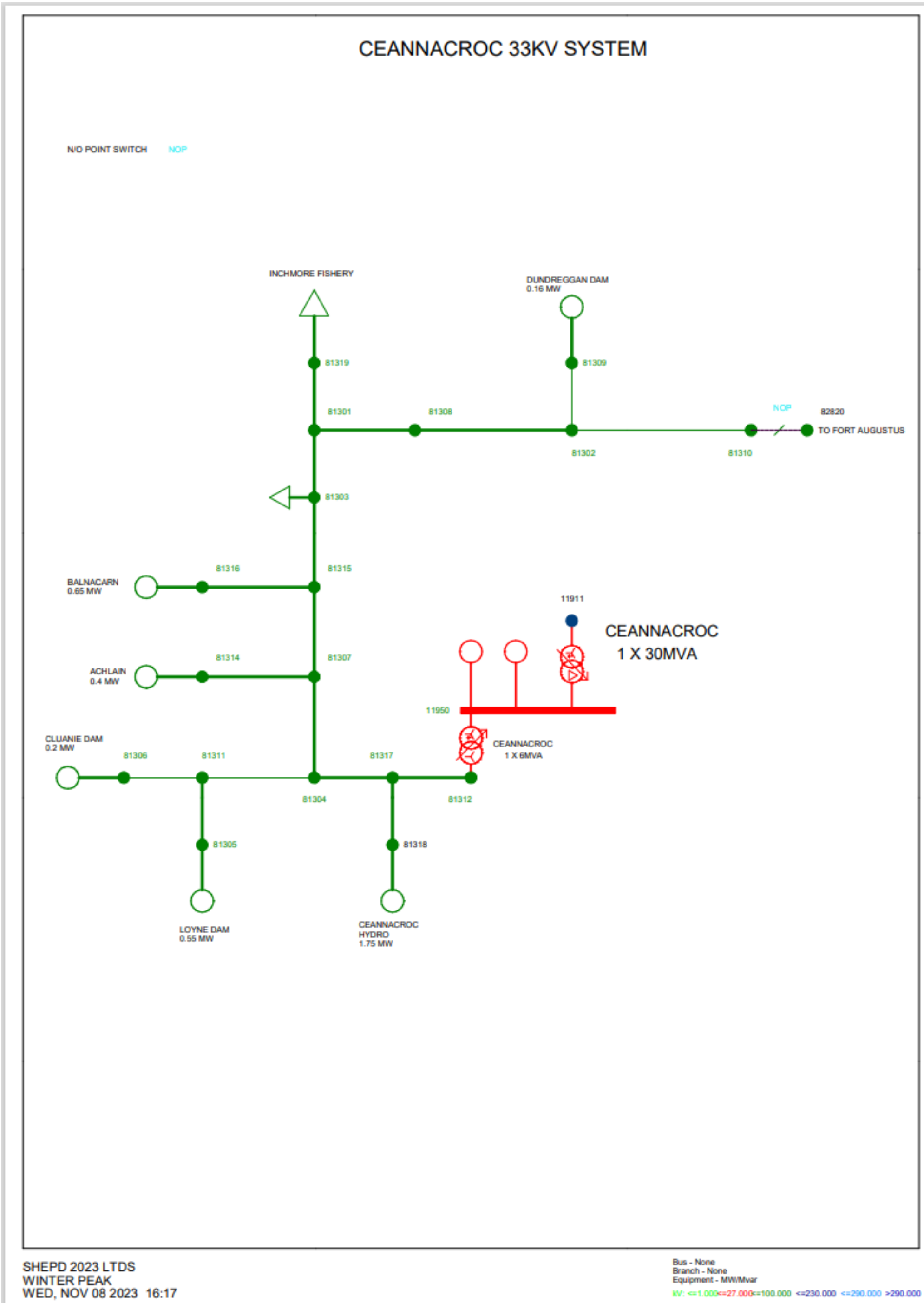


Figure 7 Existing Ceannacroc 33kV network schematic

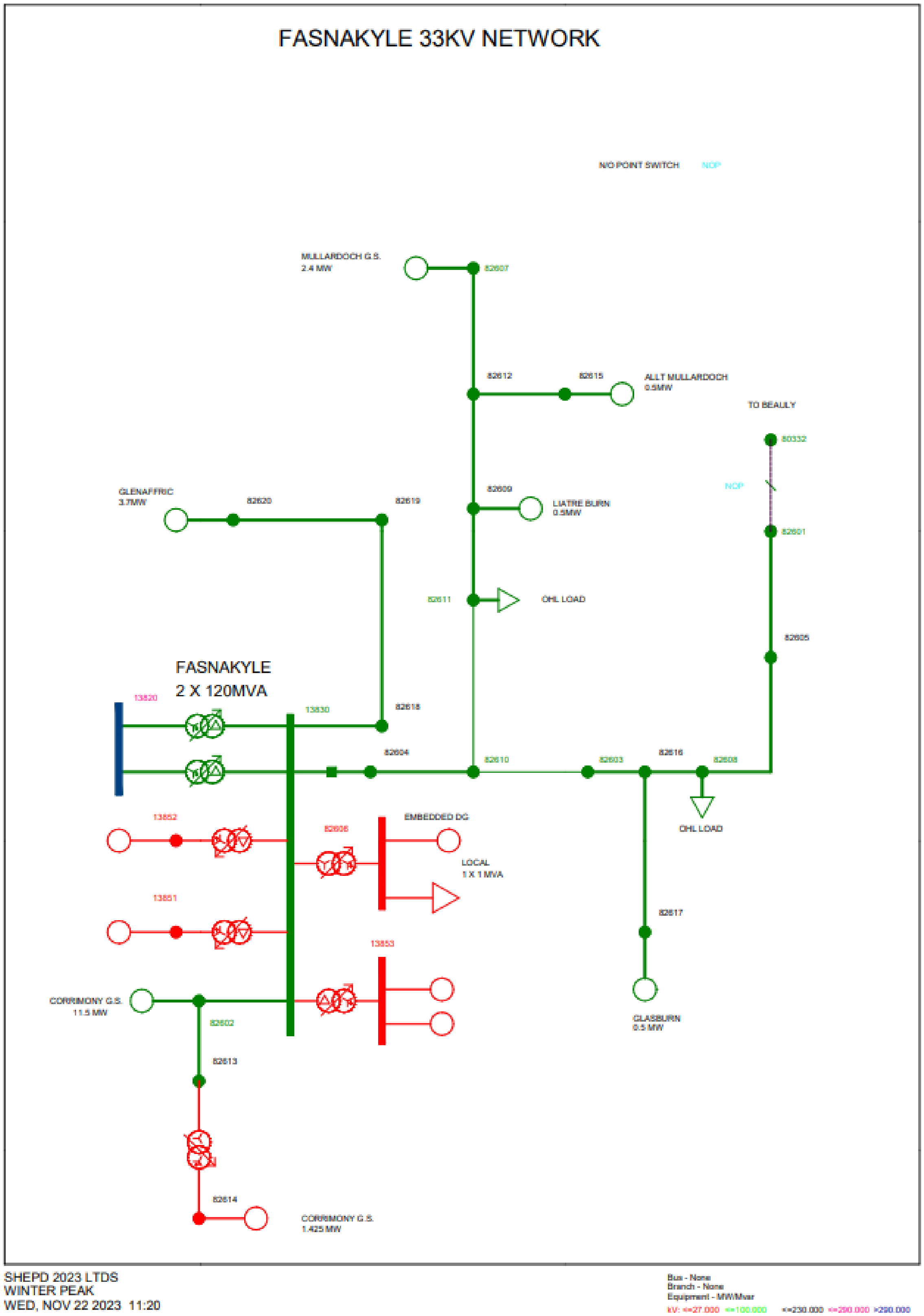


Figure 8 Existing Fasnakyle 33kV network schematic

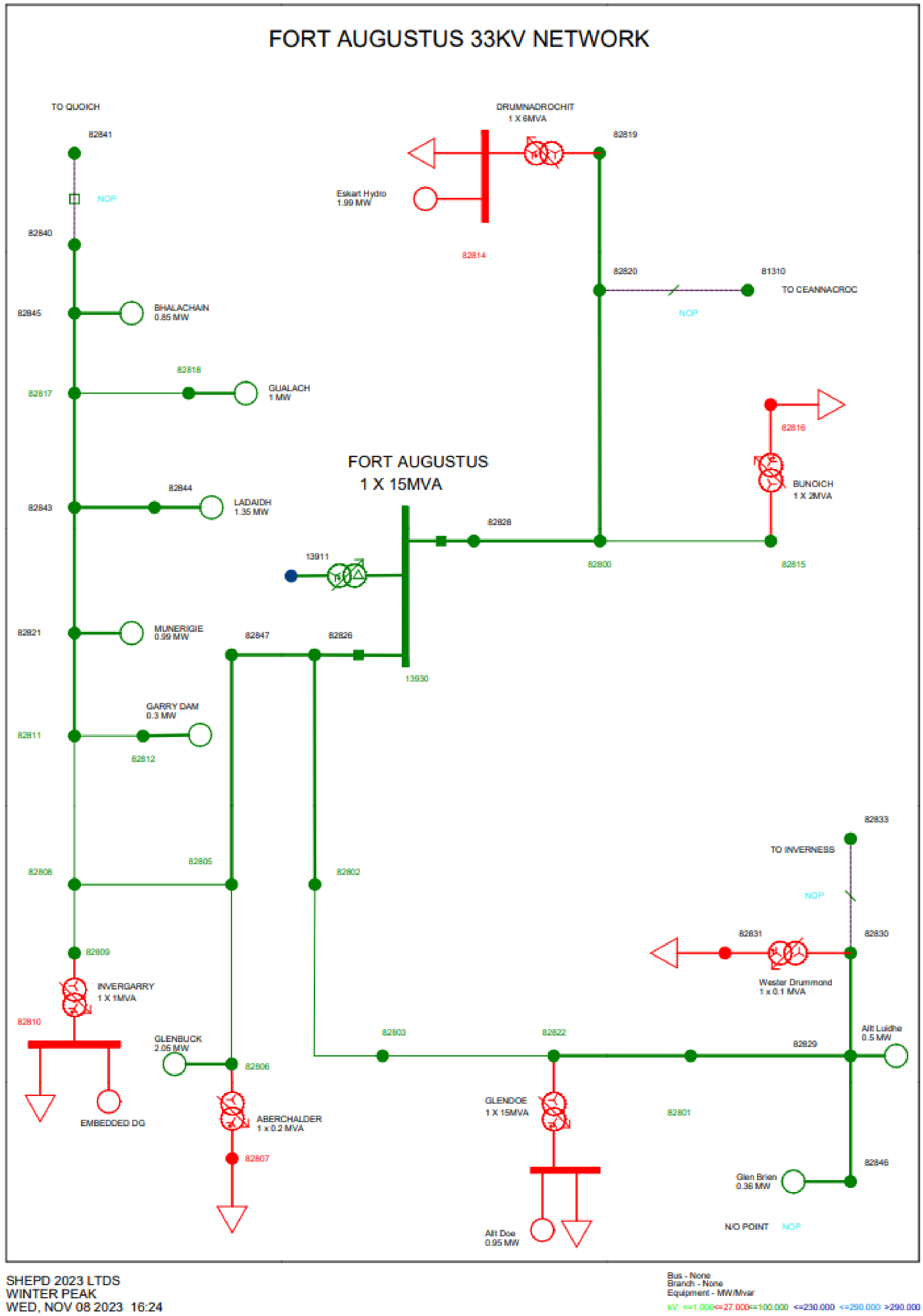


Figure 9 Existing Fort Augustus 33kV network schematic

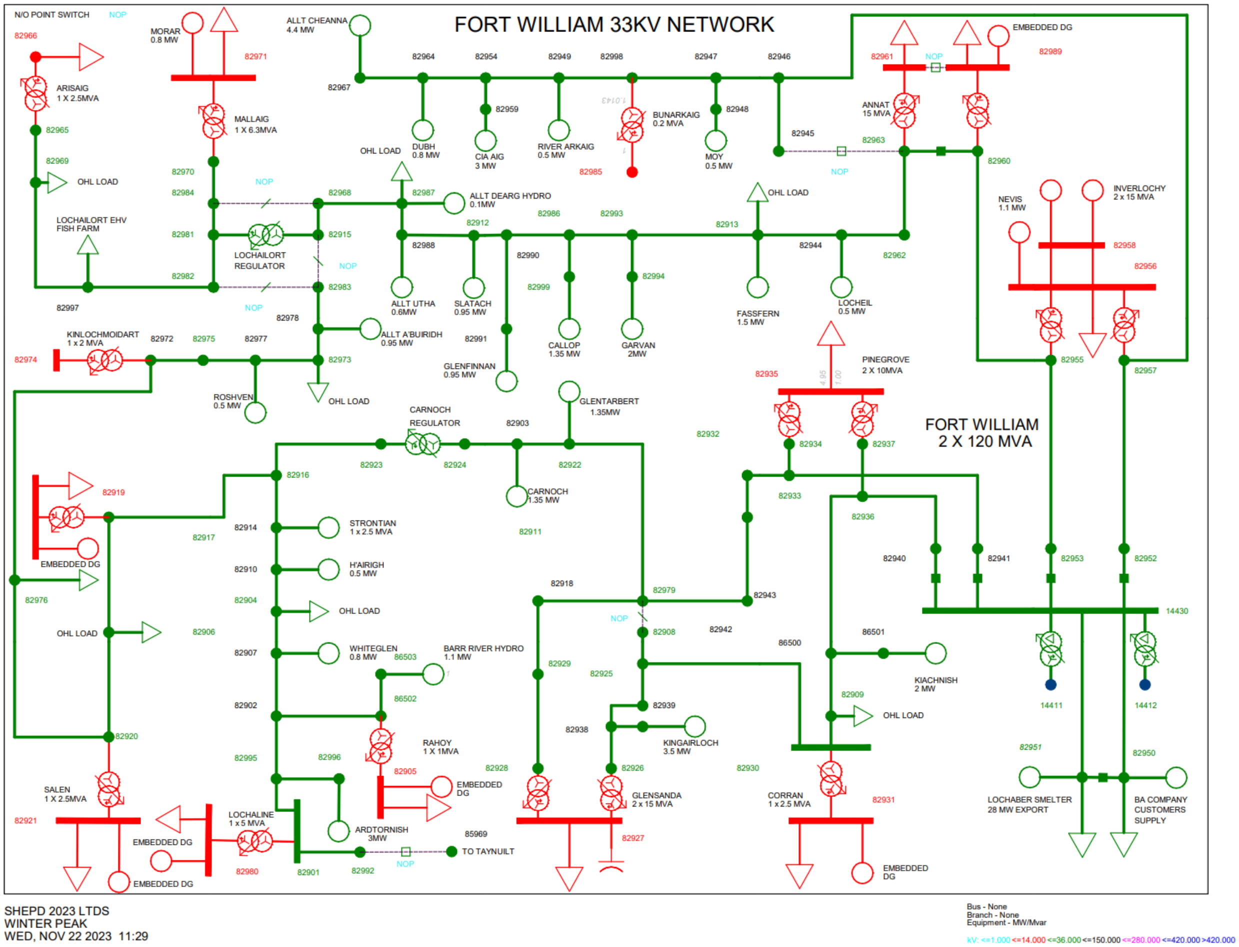


Figure 10 Existing Fort William 33kV network schematic

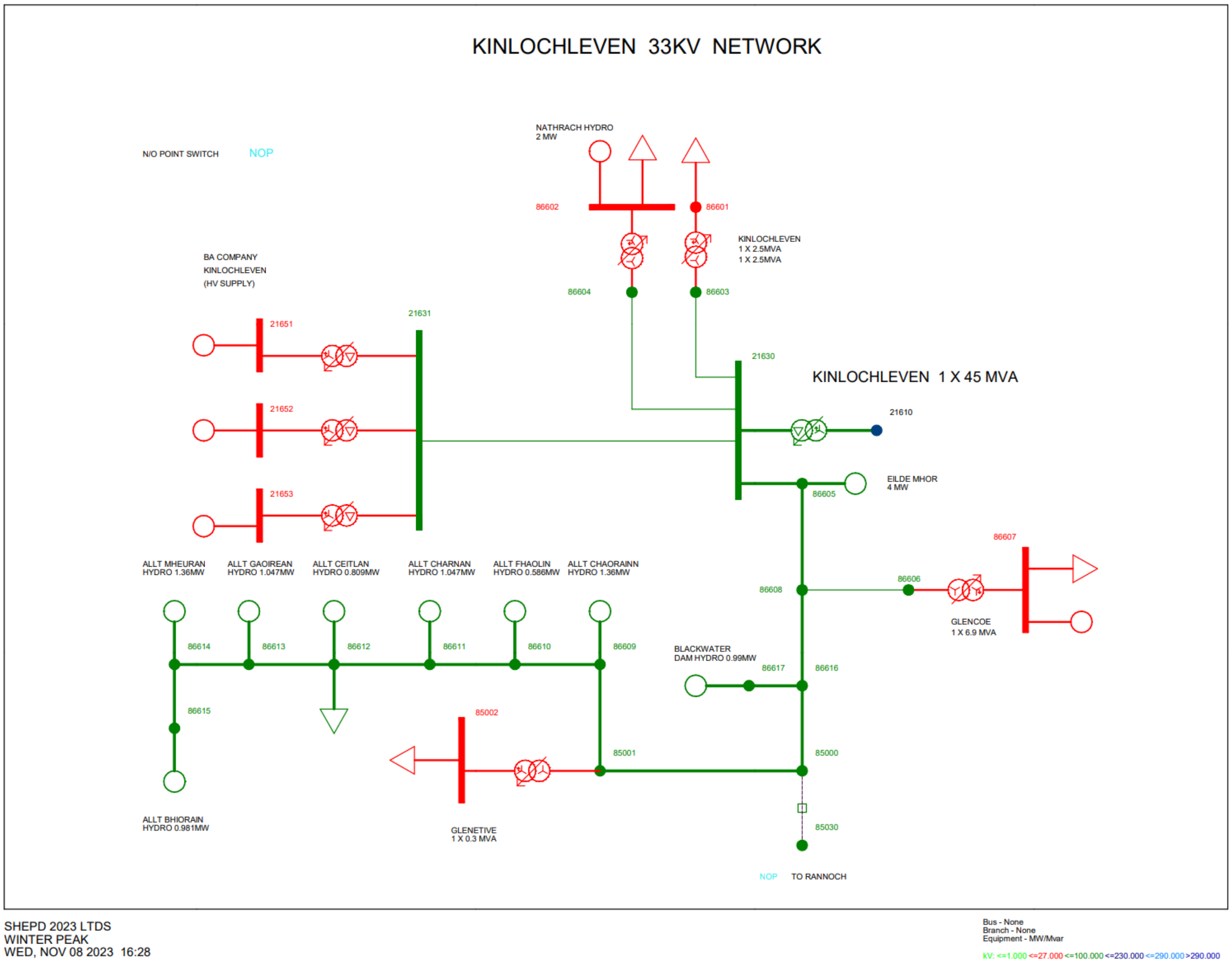


Figure 11 Existing Kinlochleven 33kV network schematic

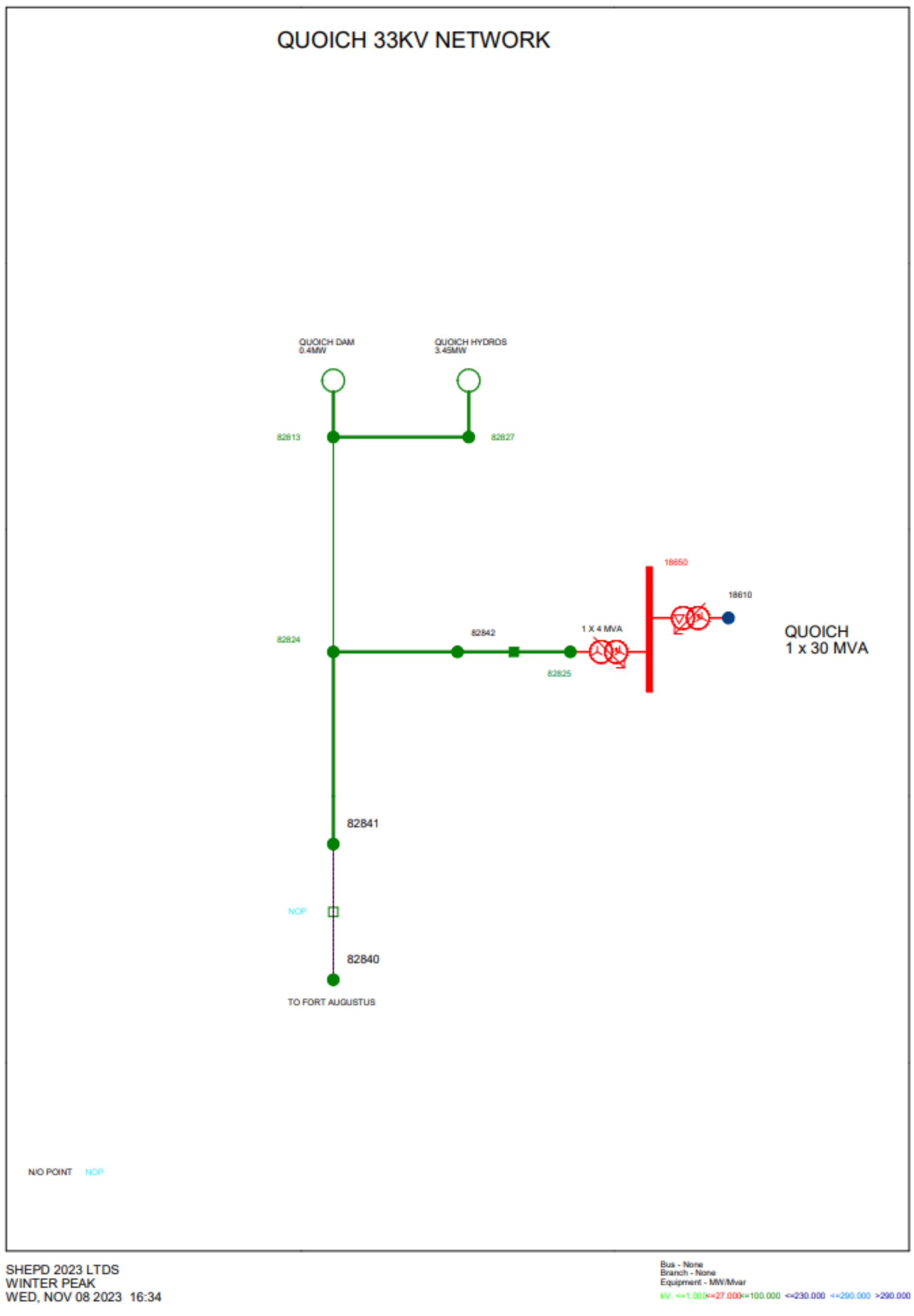


Figure 12 Existing Quoich 33kV network schematic

5. FUTURE ELECTRICITY FORECASTS FOR THE FORT AUGUSTUS 132KV SUPPLY AREA

The following section details load growth across the technologies projected in the Distribution Future Energy Scenarios 2023[16]. There are important notes on the values presented here:

- The load growth described in this section is based upon DFES 2023 to align with the DFES data used to analyse network needs in this report. DFES 2024 insights are now available and can be found in Appendix B. It should also be noted that the detailed analysis suggested as part of this report will be carried out using DFES 2024.
- This SDP and the analysis conducted has been completed ahead of any changes arising from Clean Power 2030.
- These projections relate to the GSP supply area highlighted in **Figure 3** and are not directly aligned to a particular local authority.
- Values displayed within this section are future projections of technologies connecting to the distribution network.
- Where MW values are presented in this section, they represent total installed capacity. When conducting network studies these values are appropriately diversified to estimate the coincident maximum demand of the entire system rather than the total sum of all demands. This accounts for the fact that not all demand load connected to the network peaks at the same time.

For future iterations of the DFES, additional work will be carried out to ensure that the demand projections are rationalised against any developing LAEPs across the study area.

5.1. Distributed Energy Resource

5.1.1. DFES Projections

Generation

The baseline value for electricity generation connected to the local distribution networks within the Fort Augustus 132kV supply area is 298.24MW. Hydropower is the primary electricity generation resource with an installed capacity of 277.17MW, with onshore wind and solar PV contributing 19.42MW and 1.54MW respectively to the installed generation capacity of the currently connected baseline for electricity generation.

Based on the DFES projections, under the Consumer Transformation scenario, distributed renewable generation across the Fort Augustus 132kV supply area will increase significantly from 298.241MW in the currently connected baseline to 496.17MW in 2050 (as shown in **Figure 4**). We anticipate solar PV and onshore wind, accounting for most of the distributed generation increase from 2025 onwards.

16 SSEN Distribution Future Energy Scenarios 2023

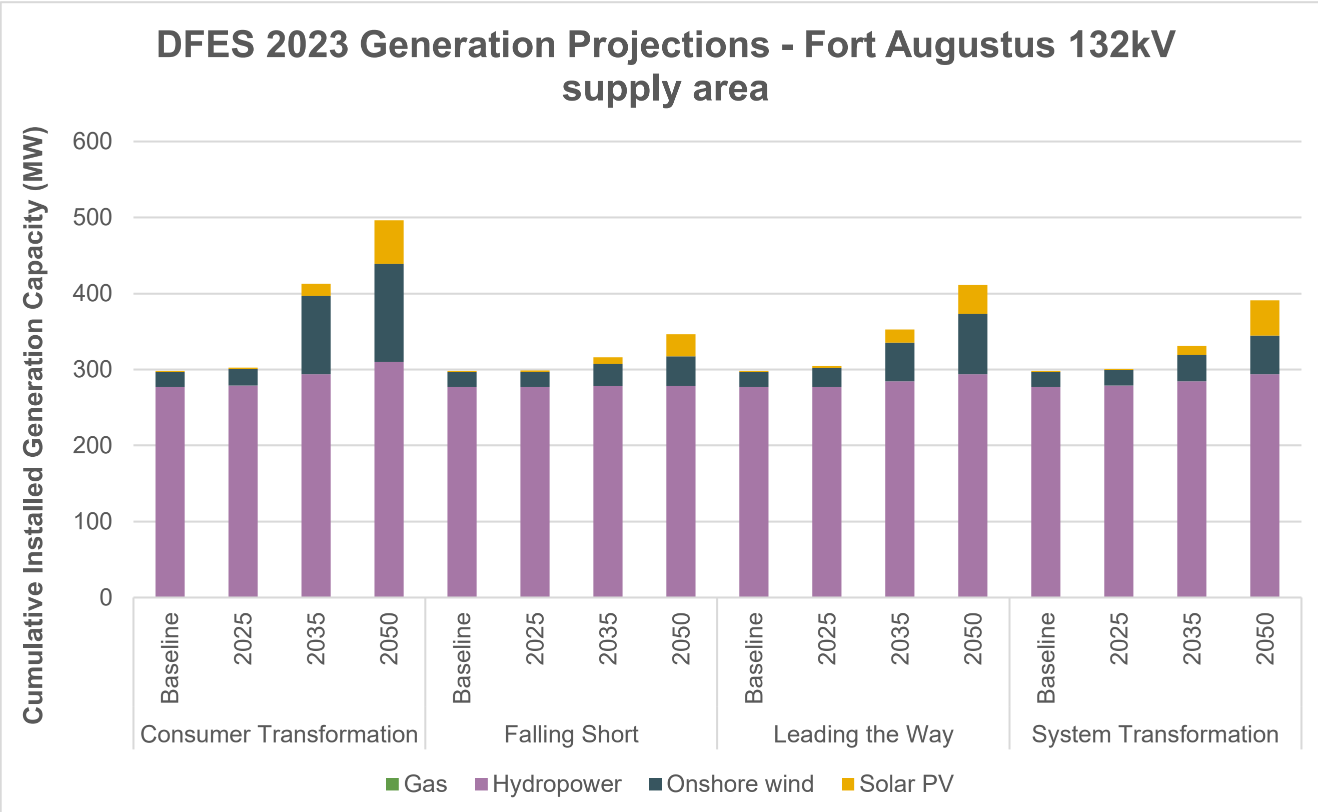


Figure 4 Projected cumulative distributed generation capacity across Fort Augustus 132kV supply area. Source: SSEN DFES 2023

Storage

A cumulative storage capacity of approximately 111.55MW is projected by 2050 under the Consumer Transformation scenario. We anticipate standalone grid services to account for the vast majority of the predicted increase in storage capacity, forecasting a cumulative storage capacity of approximately 99.8MW by 2050 under the Consumer Transformation scenario.

The DFES forecasts a small increase in domestic storage users with a cumulative storage capacity of approximately 4.56MW projected by 2050 under the CT scenario with generation co location storage at 5.17MW under CT scenario by 2050.

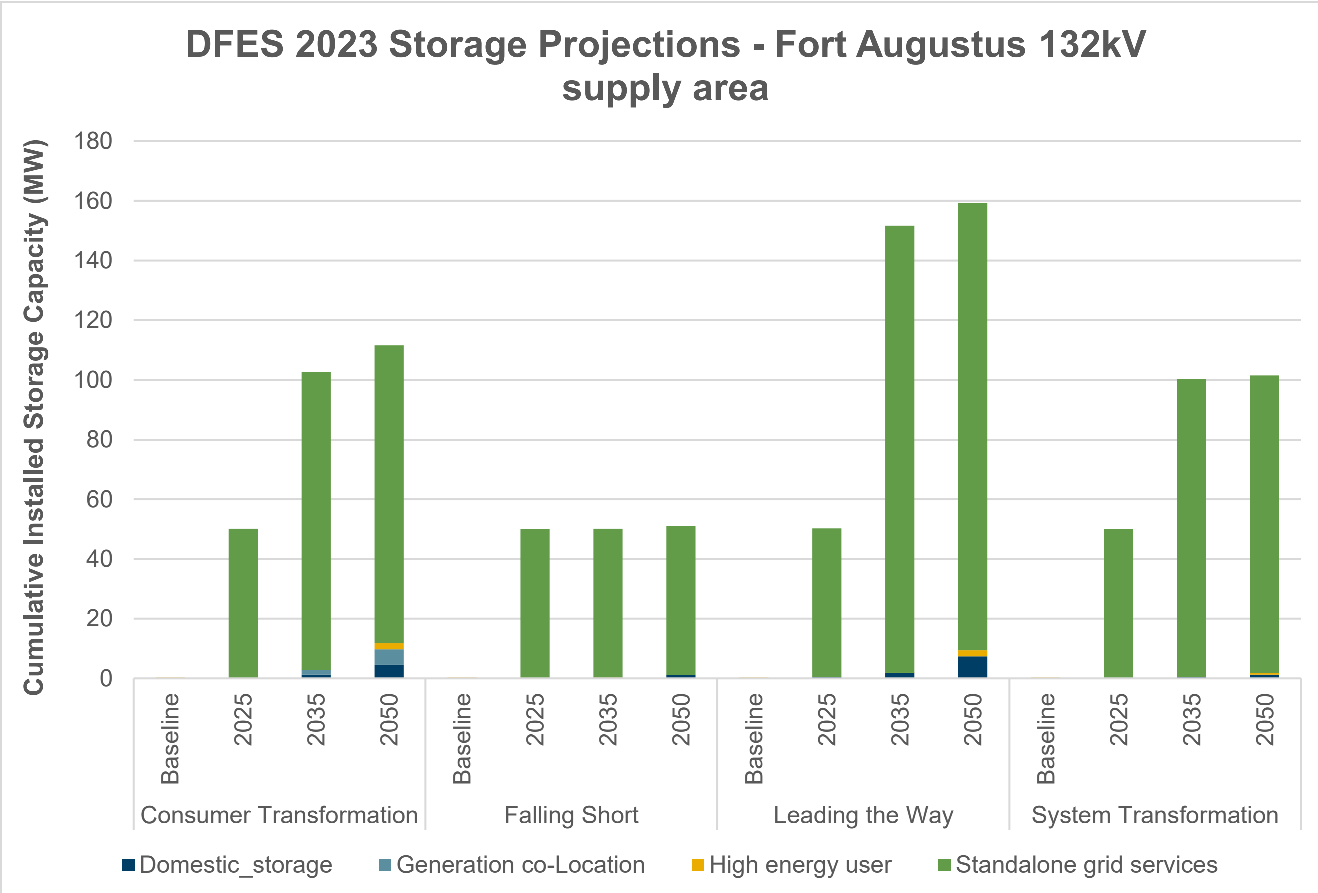


Figure 5 Projected Cumulative Storage Capacity Fort Augustus 132kV supply area. Source: SSEN DFES 2023

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). With only one registered airstrip situated within the Fort Augustus 132kV supply area; located at Glendoe, Fort Augustus, we do not anticipate any significant air travel decarbonisation to be realised on the Fort Augustus EHV network.

5.2.1. DFES Projections

According to SSEN's 2023 DFES analysis, there could be just over 13,705 (CT) EV cars and light goods vehicles (LGVs) registered in the Fort Augustus 132kV supply 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 in the Fort Augustus 132kV supply area, excluding off-street domestic chargers, could total 11.98MW (CT) by 2035 (as shown in **Figure 6**) increasing to 15.46MW by 2050.

The uptake of domestic off-street chargers follows a similar trend. By 2035, there could be as many as 6,692 (CT) domestic off-street chargers installed in the Fort Augustus 132kV supply area with this increasing to approximately 7,268 (CT) by 2050.

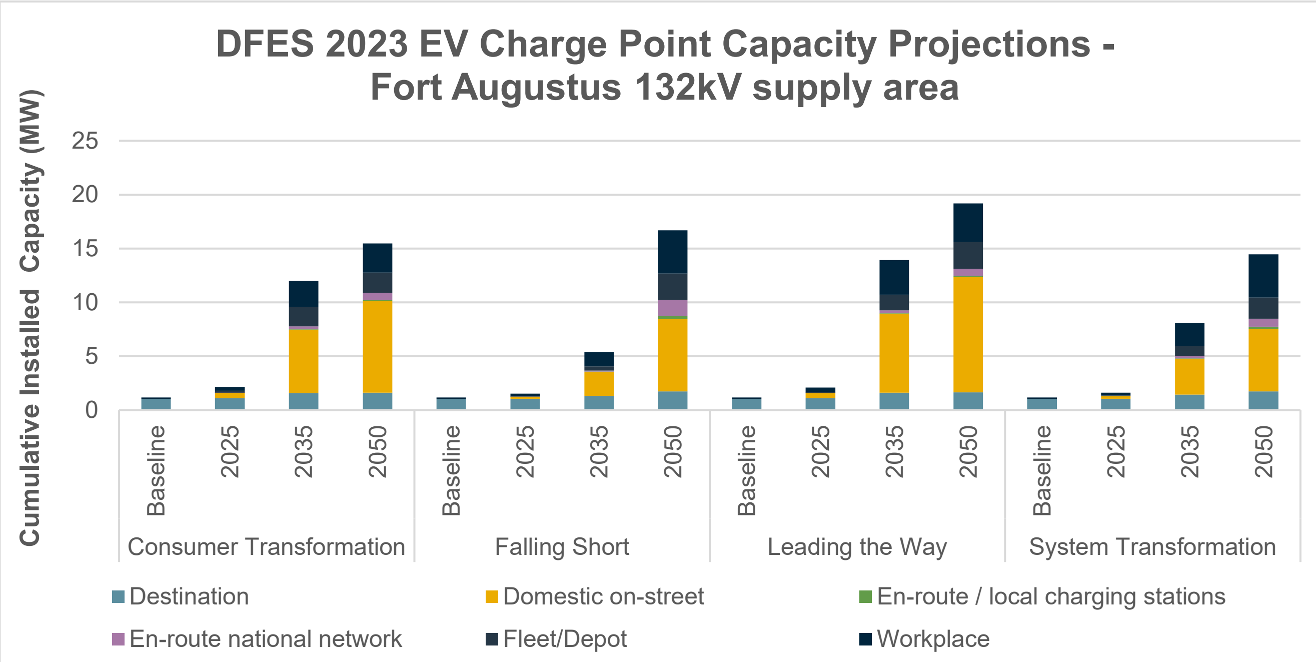


Figure 6 Projected Cumulative EV Charging Point Capacity Projections Fort Augustus 132kV supply area.

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. Historically in Scotland, central heating has historically relied on mains gas & oil (80%) and electric heating (11% including storage heaters).[17] Government legislation, including the publication of local authorities' Local Heat and Energy Efficiency Strategies (LHEES)[18], and consumer behaviour are just two of many factors that will impact the future electricity demand arising from space heating.

Within the Highland Council area, 35% of domestic properties rely on mains gas, which is significantly less than the national average for Scotland. 61% of domestic dwellings are beyond the reach of the gas grid network, with electricity being the main fuel type for heating across the non-domestic stock.[19]

5.3.1. DFES Projections

The electrification of heat could create significant new electricity load in Fort Augustus 132kV supply area, 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 to approximately 9,624 (CT) in 2035 steadily rising to 13,662 (CT) by 2050. This excludes air conditioning load which accounts for a total of 852 units by 2050. This is

17 Scottish House Condition Survey: 2021.

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

19 Public Consultation Report | Local Heat and Energy Efficiency Strategy (LHEES)

highlighted in **Figure 7** below.

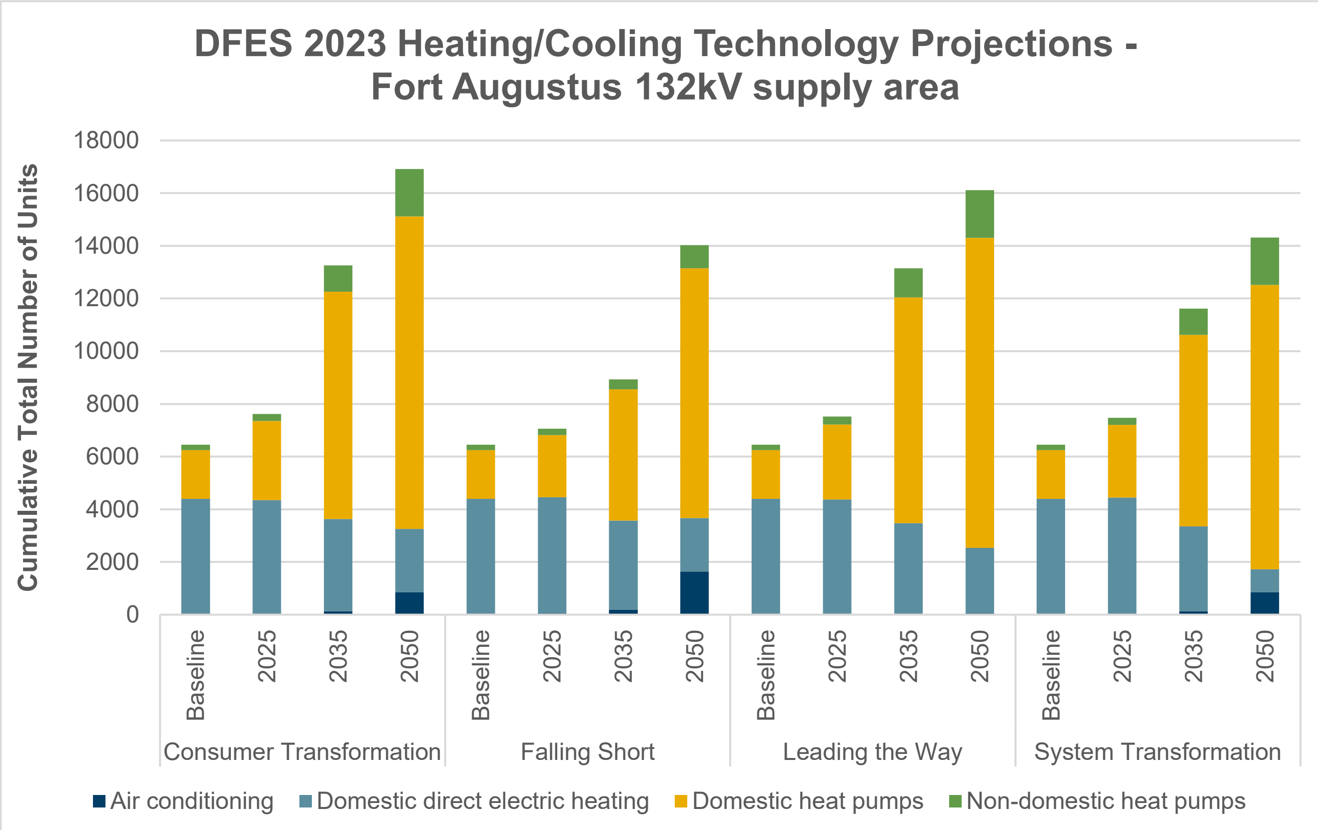


Figure 7 Projected number of heating/cooling technologies across the Fort Augustus 132kV supply area. Source: SSEN DFES 2023

5.4. New building developments

A key stage in producing the DFES is engagement with local authorities. On an annual basis local authorities provide their current best view on new development plans to inform these projections. The results presented here are the information shared by local authorities during the DFES 2023 development process. Where we do not have responses from local authorities these values are determined from published documents for example adopted local plans.

5.4.1. DFES Projections

In the Fort Augustus 132kV supply area, the total number of new domestic developments (number of homes) is projected to be approximately 1,015 by 2050 (CT)).

The DFES also includes projections for different types of non-domestic floorspace with the breakdown for this presented in **Figure 8**. Please note that as this information is directly fed from local authorities the projections are closely aligned across the four scenarios.

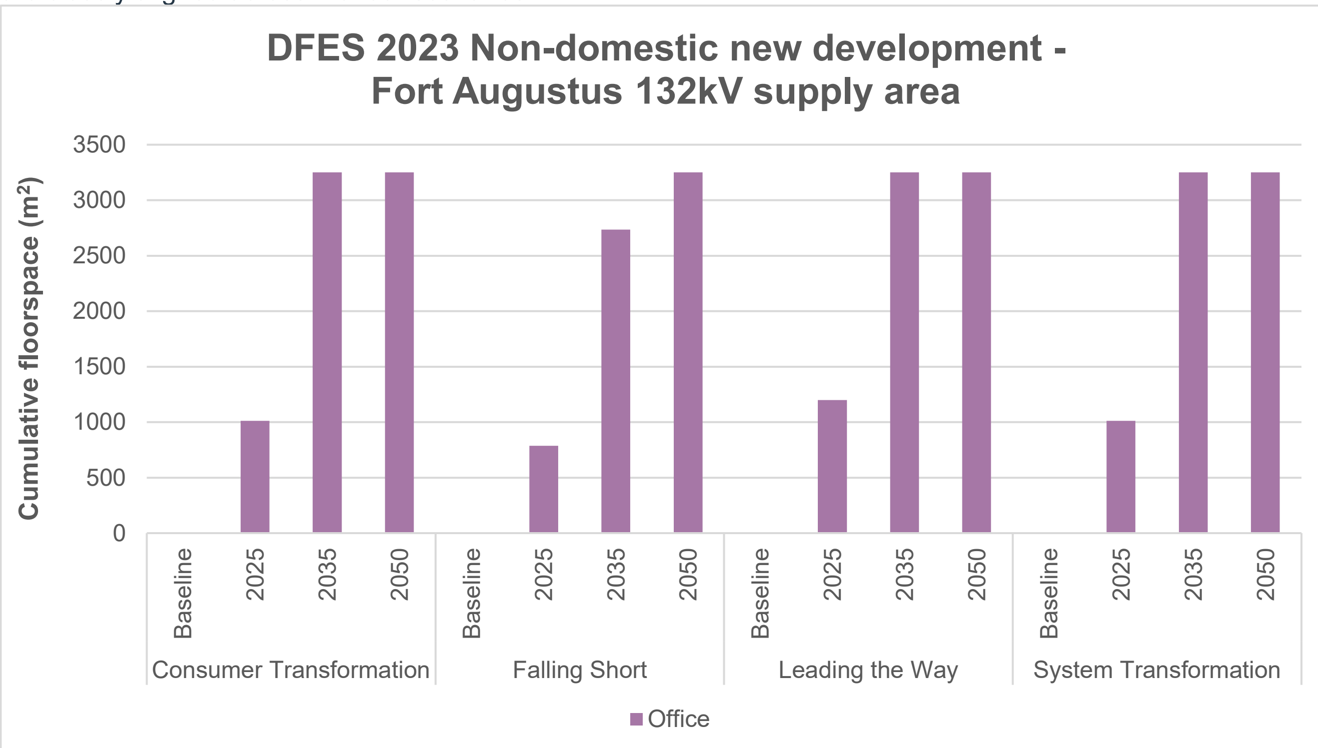


Figure 8 Projected non-domestic new development across the Fort Augustus 132kV supply area. Source: SSEN DFES 2023

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 Fort Augustus 132kV supply area. We have identified distilleries and ports as areas of potential significant future industrial demand growth for the region. 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 within the Fort Augustus 132kV supply area is relatively small with only three registered distilleries located in the region. 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.
The registered distilleries within the Fort Augustus 132kV supply area are:

- Ardnamurchan Distillery
- Ben Nevis Distillery
- Ncn'ean Distillery

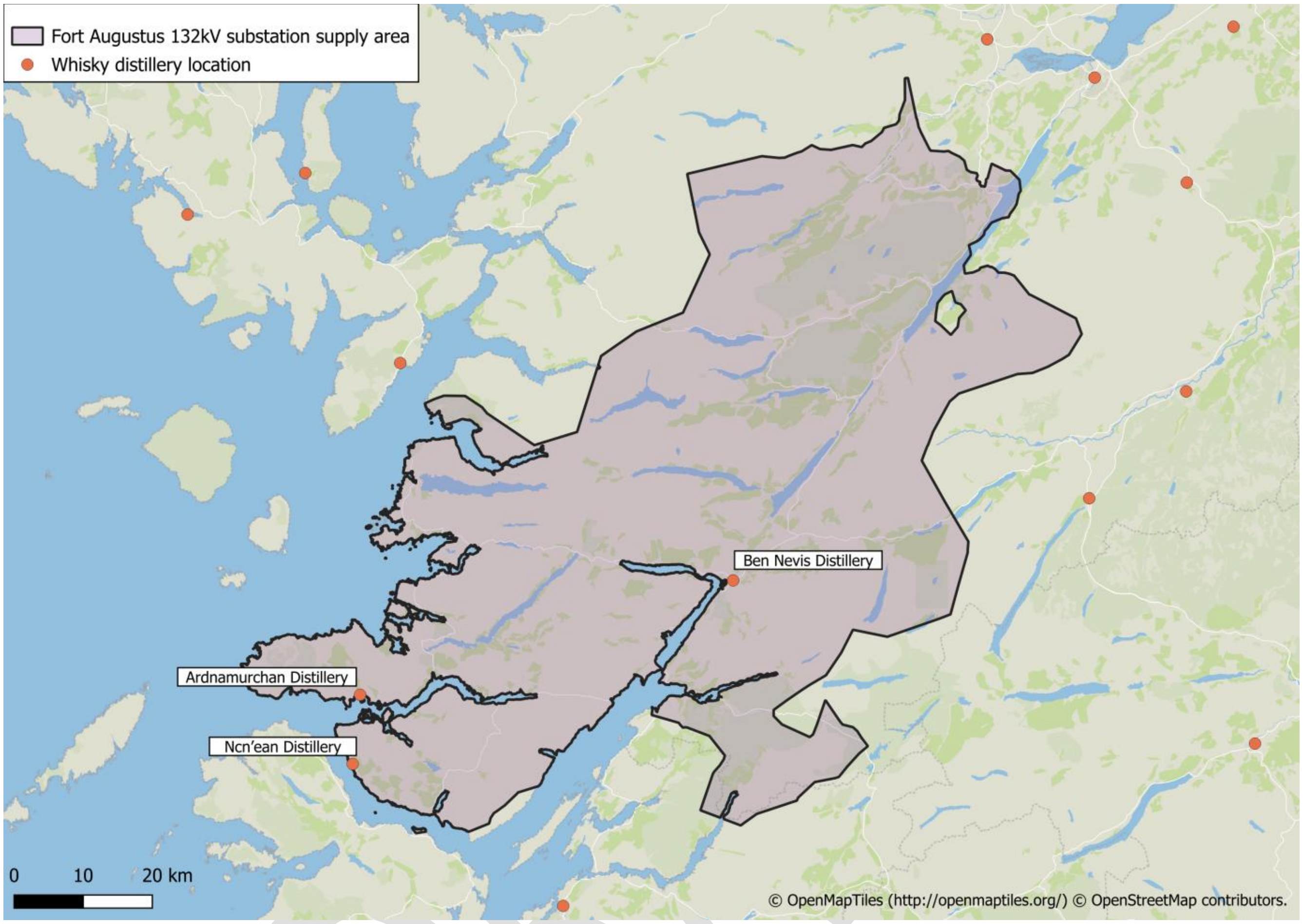


Figure 9 Fort Augustus 132kV substation supply area registered whisky distillery location map

5.5.2. Ports

Ferries are a primary mode of maritime transport across the Scottish Highlands and 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 15 ferry routes operated in the central highland region, falling within the Fort Augustus 132kV supply area. The ferry route map is shown in **Figure 10** 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 central highland area, which will form part of the system needs in future analysis.

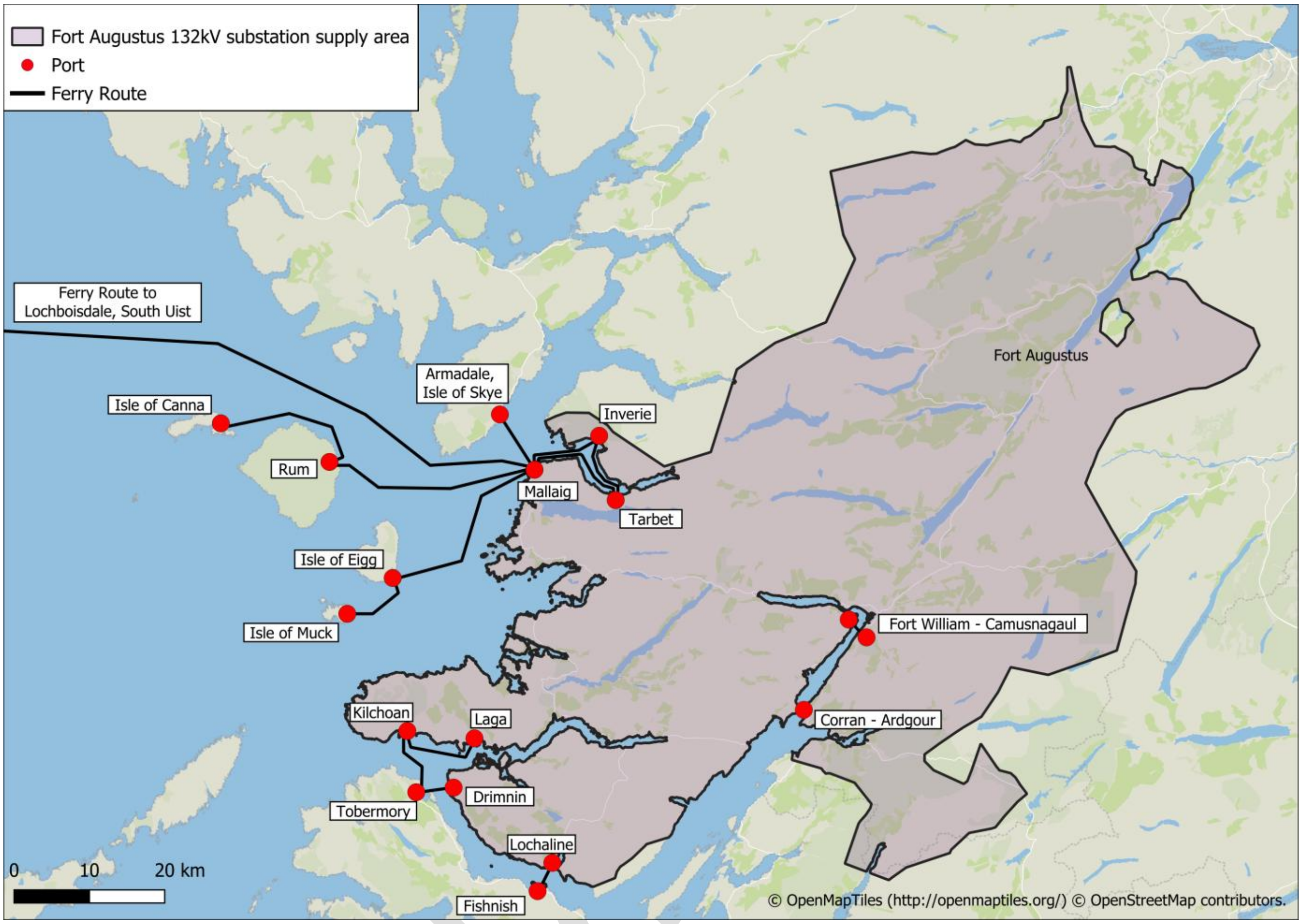


Figure 10 Fort Augustus 132kV supply area ports and ferry route map

5.5.1. Agriculture

Decarbonisation of the agricultural sector is an important consideration in this geographic area. SSEN leads the innovation project 'Future Agricultural Resilience Mapping' (FARM)[20] which aims to understand the future energy requirements and means of decarbonising the domestic farming industry. This sector is currently still largely dependent on fossil fuels, and the project will support its investigations into the impact of food production on the electricity distribution system, to work out where reinforcement is needed. A data-driven tool to inform network planning will be devised and through this work, FARM will address the gap between the energy demands for food production and future network planning.

20 FARM | SSEN Innovation

6. WORKS IN PROGRESS

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 the Fort Augustus 132kV supply area, 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 within the Fort Augustus 132kV supply area. A summary of existing works is shown in **Table 3** 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 Figure .

ID (Schematic Reference)	Substation	Description	Driver	Forecast completion	Fully resolves future strategic needs to 2050?
		Ceannacroc GSP 2			
1	New Ceannacroc GSP 2	Connection of 71.6MW Bunloinn generation scheme to the new Cennacroc GSP 2. Connection of 50MW Ceannacroc estate BESS battery storage scheme to the new Cennacroc GSP 2.	Customer Connection	2029 & 2027	
		Fasnakyle GSP			
2	Fasnakyle GSP	1.2MVA demand connection split across two sites. Site 1: 400kVA demand connecting to Fasnakyle Primary Local 11kV network. Site 2: 800kVA demand connecting to Fasnakyle 33kV circuit 10L5.	Customer Connection	TBC	
3	Fasnakyle GSP	Connection of 65MW Fasnakyle BESS battery storage scheme connecting onto the Fasnakyle	Customer Connection	TBC	

		GSP 33kV board via a new dedicated feed. [21] (Distribution contracted) Connection of 65MW Fasnakyle Battery storage scheme connecting onto the Fasnakyle GSP 33kV board via a new dedicated feed. (Transmission contracted) Connection of 62.4MW Windfarm connecting onto the Fasnakyle GSP 33kV board via a new dedicated feed. (Yet to be quoted)			
Fort Augustus GSP					
4	Fort Augustus GSP Circuits	Corie Glas Upper Works Hatchery, Invergarry: 33kV OHL reinforcement (32mm CU) (1.5km) Install 3x Circuit breakers at Point of supply. Coire Glas Lower Works Kilfinnan, Spean Bridge: New 33kV switchroom containing (10 x Circuit breakers possibly) Install 3 x 33kv Circuit breakers Install 23km 33kv cable connection (1 x 630mm AL) Divert existing 33kv cable into new 33kV switchroom (1x 630 AL) (Connection to SSEN Transmission network via the new Loch Lundie transmission substation).	Customer Connection	2027	
5	Fort Augustus GSP	Connection of Auchterawe BESS Scheme Battery Storage scheme connecting to the Fort Augustus GSP 33kV board via a new dedicated feed.	Customer Connection	TBC	

21 Note: It should be understood that Fasnakyle 33kV board is owned by SSEN Transmission.

		(Distribution contracted)			
6	Fort Augustus GSP	Connection of 49.9MW Millennium East windfarm generation scheme, connecting onto the Fort Augustus GSP 33kV board via a new dedicated feed. (Transmission contracted)	Customer Connection	2026	
Fort William GSP					
7	Fort William GSP – 33kV Circuit	Reinforcement of the 2x existing (Kilmalieu – Glensanda) Subsea cables, including the undergrounding of OHL on shoresides at Loch A'Choire. 6.4km (North Cable) 7.0km (South Cable)	Asset Health/ Condition	2025	
8	Salen 2 PSS	Reinforcement of Salen 2 primary transformer. Establish a new 1 x 4MVA primary substation in the vicinity of Loch Mudle (Salen 3 primary substation). Reinforcement of the existing overhead line between Salen 2 primary substation and Acharacle and construction of new 33kV overhead line circuit to connect the new primary substation. (23km).	DNOA Process	2027	
9	Lochailort Regulator site	Installation of 2 x 4MVAr STATCOMs & 5 x 33kV circuit breakers at Lochailort regulator site.	Load related – pre-dating DNOA Process	2026	
10	Inverlochy primary substation	Connecting Inverlochy PSS via 2 x new dedicated 33kV cable circuits. Reinforcement of the 2 x 33kV Inverlochy primary transformers.	Load related – pre-dating DNOA Process	2028	
11	Fort William GSP	Reinforcement of Fort William 33KV circuits 3L5 and 6L5.	Load related – pre-dating	2028	

		Circuit 3L5 - 2.6km 33kV cable installation (Fort William GSP – Pinegrove Primary Substation) + Reinforcement of 13.38km 33kV overhead line to 100mm2 Cu conductor. Circuit 6L5 – First Section of existing overhead line between source circuit breaker and Corran PSS uprated to run at 75^{o}C.	DNOA Process		
12	Fort William GSP	Connection of Spean Bridge BESS battery storage scheme connecting to the Fort William GSP 33kV board via a new dedicated feed.	Customer Connection	TBC	

Table 3 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 Fort Augustus 132kV substation supply area for 2050.

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

The network considered for long-term modelling is shown below in Figure .

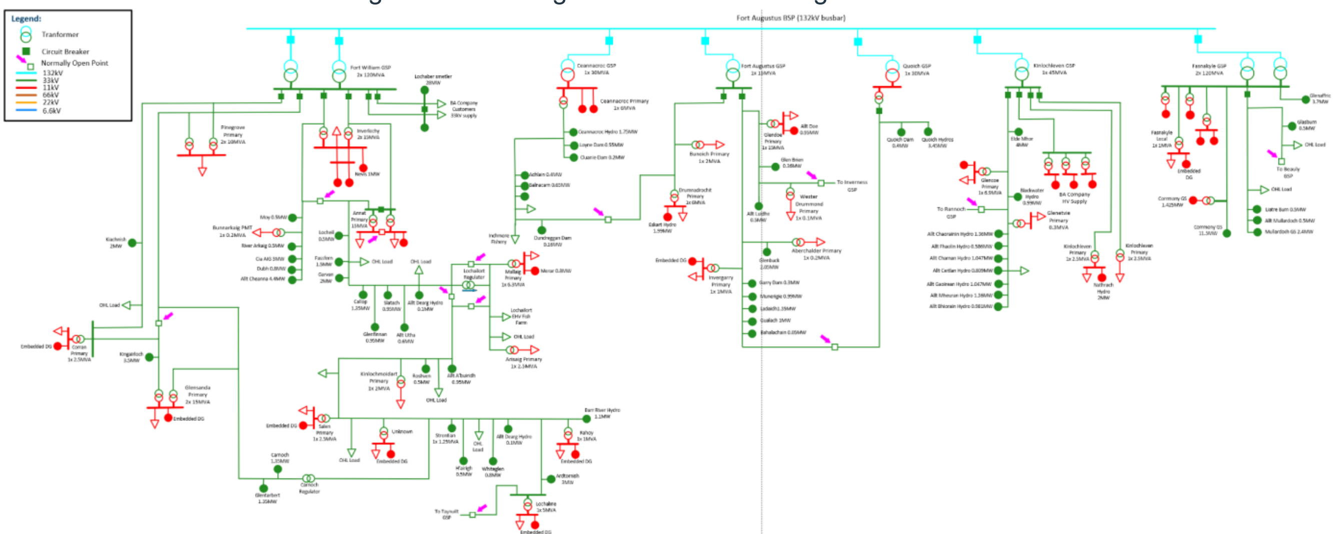


Figure 11 Existing distribution network around Fort Augustus 132kV supply area

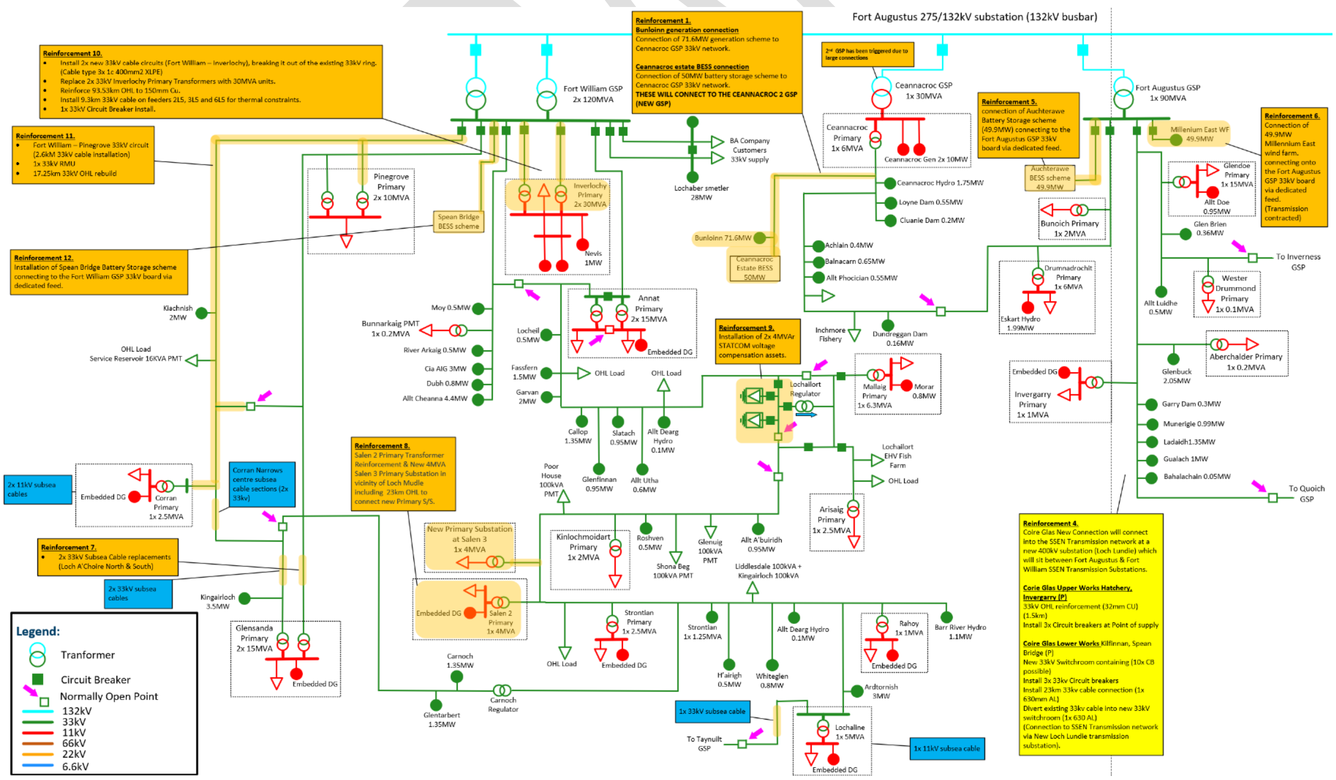


Figure 12 Future distribution network development around Fort Augustus 132kV supply area – Part 1

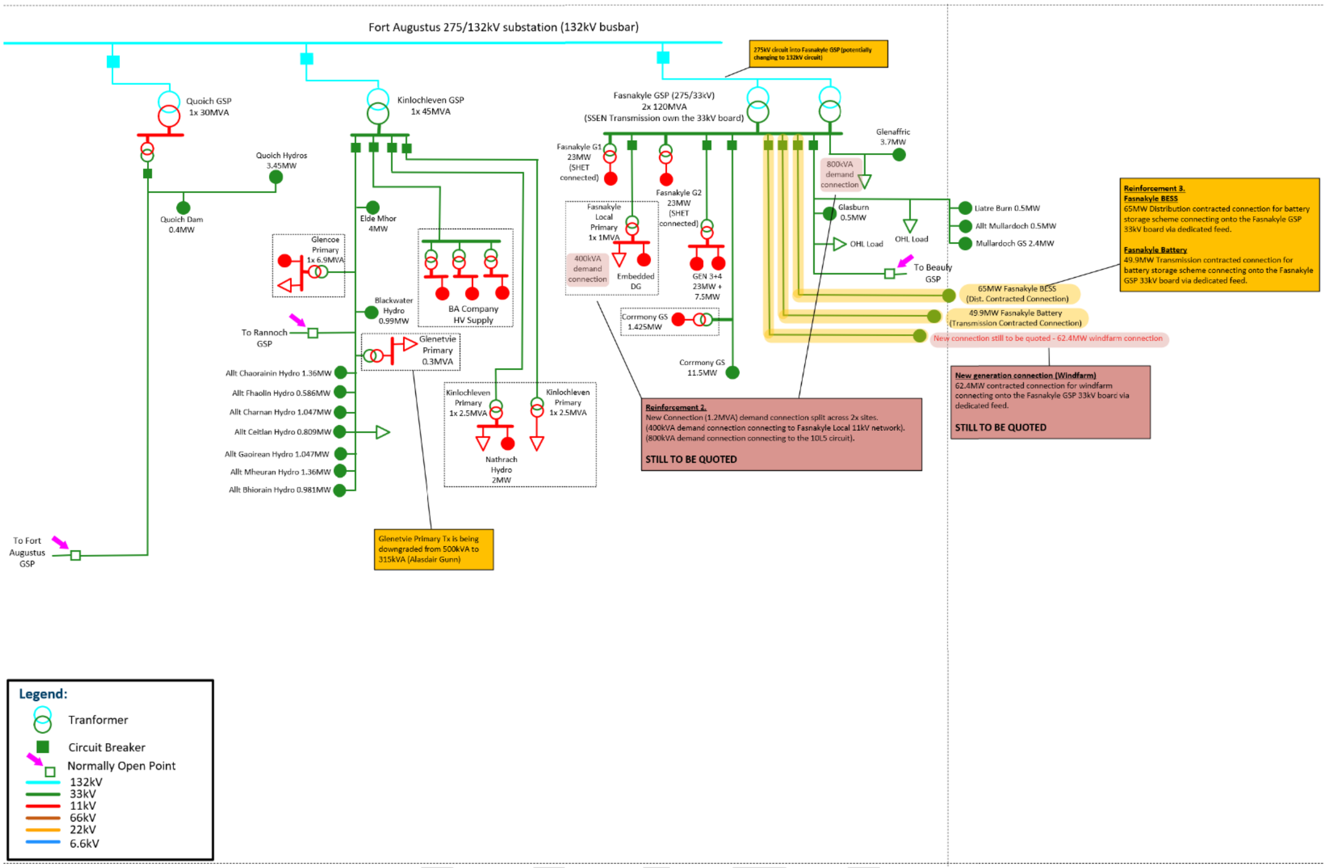


Figure 13 Future distribution network development around Fort Augustus 132kV supply area – Part 2

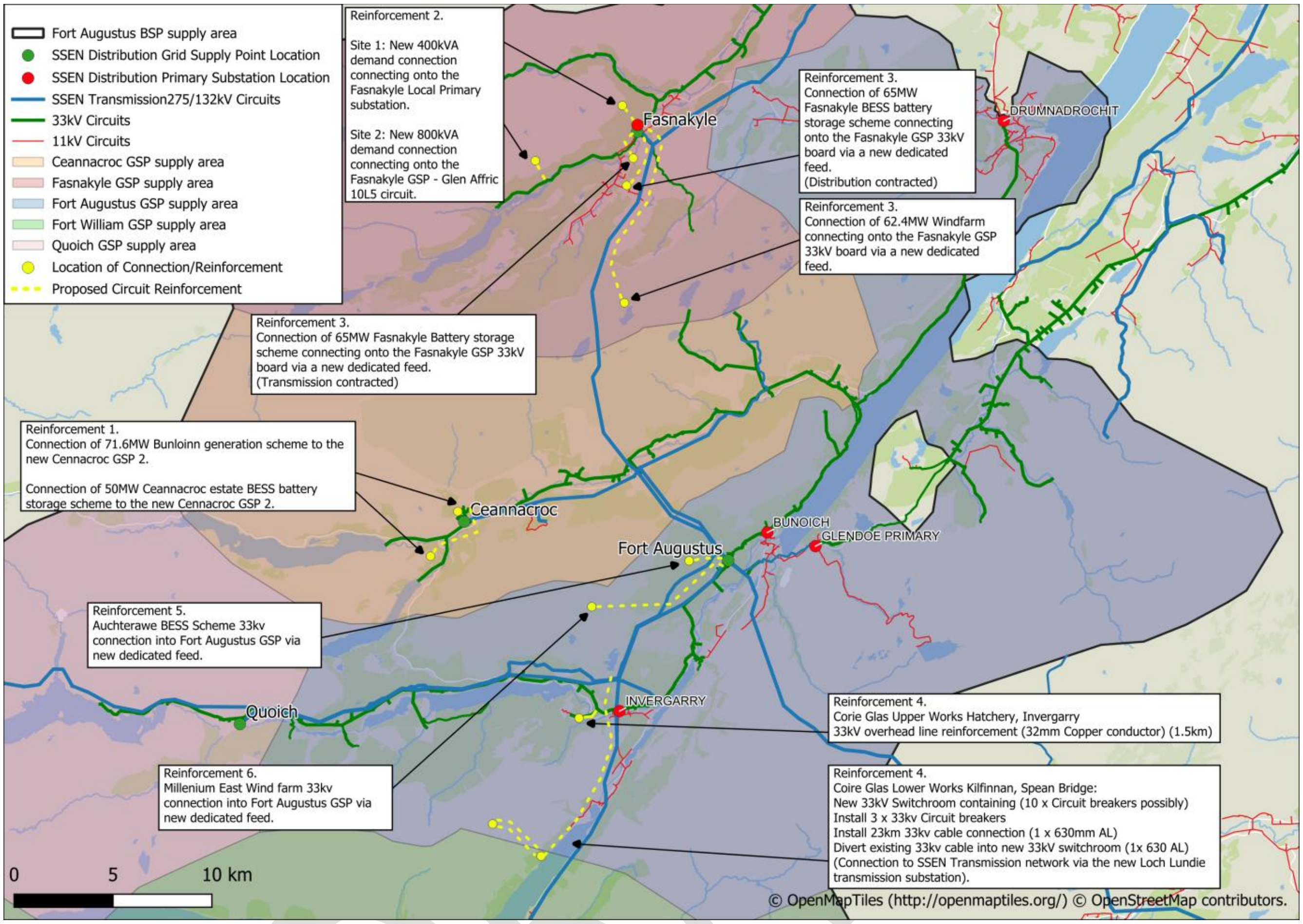


Figure 14 GIS View of Works in Progress and system needs annotated on Ceannacroc, Fasnakyle and Fort Augustus GSPs

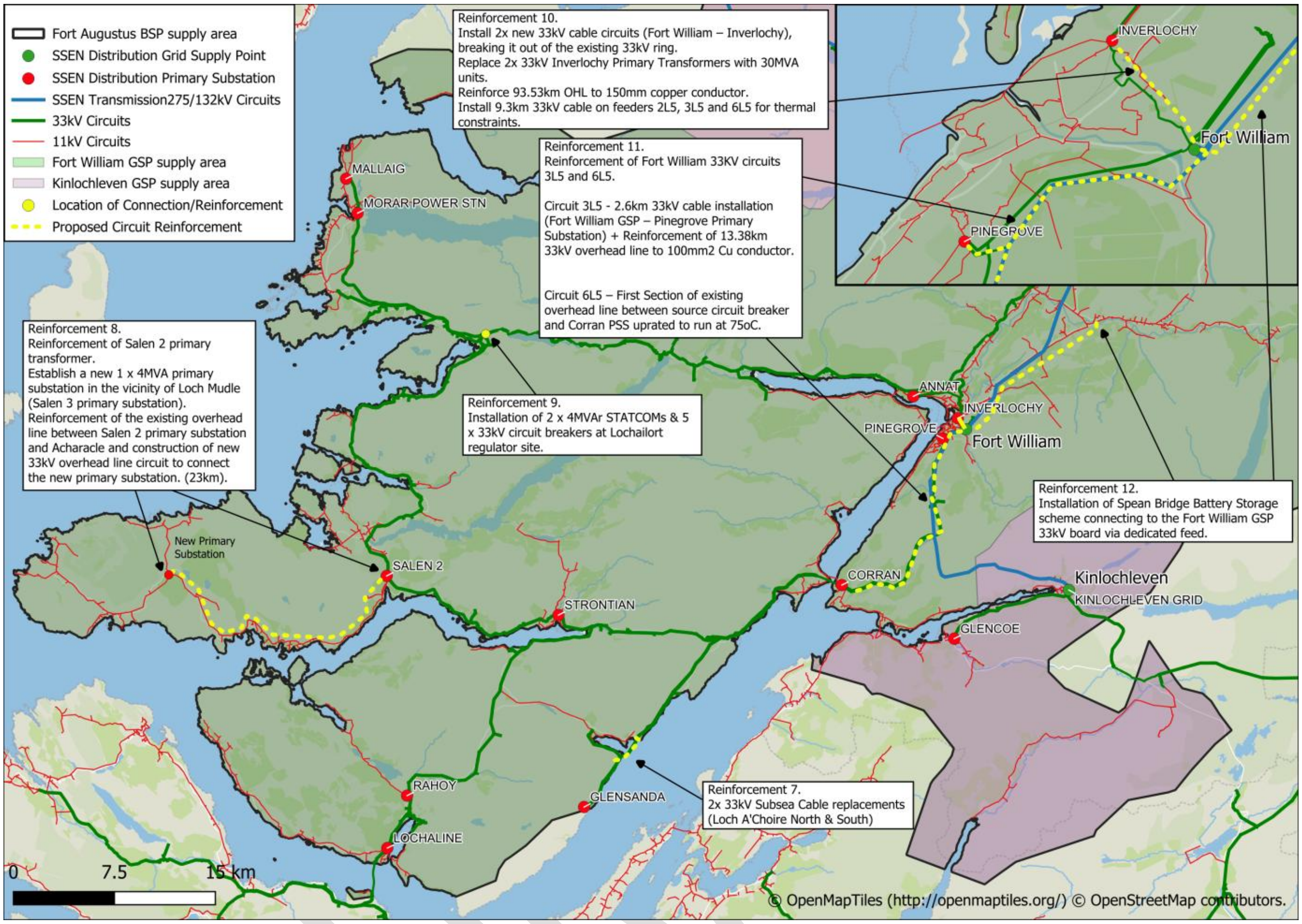


Figure 15 GIS View of Works in Progress and system needs annotated on Fort William GSP

7. SPATIAL PLANS OF FUTURE NEEDS

7.1. Extra High Voltage/High Voltage Spatial Plans

The EHV/HV spatial plan shown below in **Figure 16** shows the projected headroom or capacity shortfall due to demand increases at primary substations across the Fort Augustus 132kV supply area. Darker purple shades indicate that there is a projected capacity shortfall whereas lighter shades indicate that there is headroom capacity based on current projections. EHV/HV spatial plans for the other DFES scenarios are presented in **Appendix C** and **Appendix D**. The values are taken from the Network Scenario Headroom report (NSHR), part of the Network Development plan (NDP)[22]. It should be noted that the NSHR is produced annually and was last published in May 2025, where work has been triggered between this date and the time of publication of this report, future capacity may not be reflected.

22 SHEPD Network Development Report - Data Asset - SSEN Distribution Data Portal

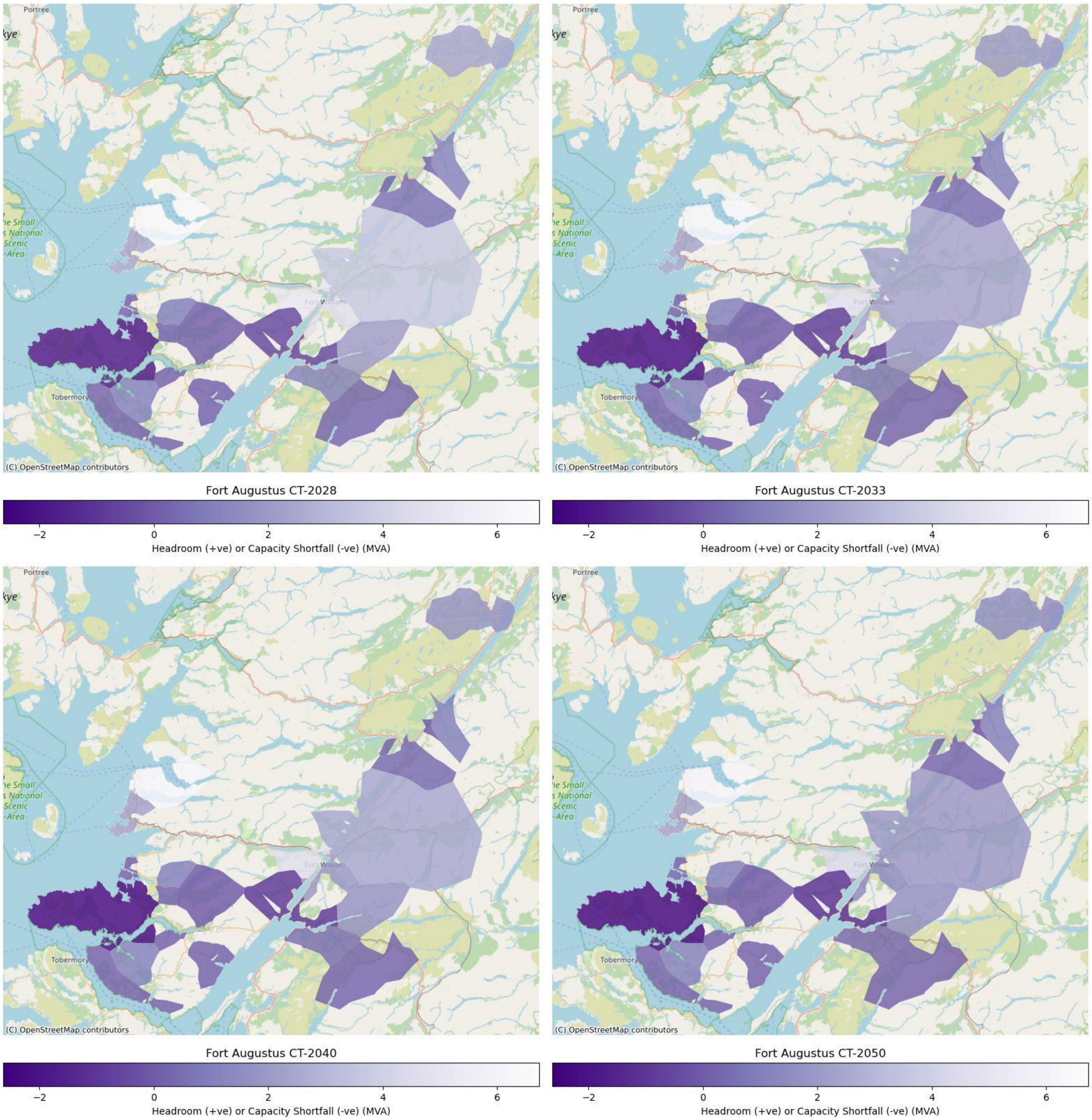


Figure 16 Fort Augustus 132kV supply area EHV network spatial plans for CT 2028, 2033, 2040, and 2050

7.2. Existing Network Constraints

There are a few existing network constraints within the Fort Augustus 132kV supply area, which are described below:

Fort Augustus 132kV supply area constraints:

With the growing demand on the Fort Augustus 132kV distribution network, coupled with the contracted load awaiting connection, the system requires reinforcement covered by the schemes recommended in Section **Error! Reference source not found.** for the RIIO-ED2 price control period. Beyond that, there will be need for further reinforcement works to address thermal constraints on the Fort William 33kV circuits and at Aberchalder, Corran, Fasnakyle Local, Inverlochy, and Wester Drummond primary substations, taking into consideration significant growth from onshore generation.

Voltage issues are becoming more prevalent on the EHV network under certain network loading/outage events, particularly in the south of the supply area affecting customers connected to Fort William GSP and to a lesser extent Fort Augustus GSP. The network reinforcement schemes, as described in Section 6, 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.

7.3. Extra High Voltage Specific System Generation Needs

The Fort Augustus 132kV supply area has significant renewable generation potential due to high wind levels, making the region suitable for onshore wind projects, as well as hydropower and solar generation schemes. There will be an increased level of generation connecting to both the transmission and distribution networks, with the onshore wind farm uptake in the region.

The increase in hydropower generation schemes and onshore wind farms in the area may drive the need for both distribution and transmission reinforcement. This may necessitate new 33kV circuits between existing substations and their relevant 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 the Fort William EHV network, specifically on the 33kV distribution circuits, to meet the projected increases in demand under system intact and N-1 conditions. Reinforcement works will also be required at primary substation level including Aberchalder, Corran, Fasnakyle Local, Inverlochy, and Wester Drummond primary substations, where the demand increases moderately up to 2050.

As the demand increases towards 2050, further voltage reinforcement works will also be required on all the existing Fort William 33kV circuits, as well as the 33kV circuit between Fort Augustus GSP and Drumnadrochit primary substation and at Ceannacroc GSP.

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 17** and **Appendix D**. 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).

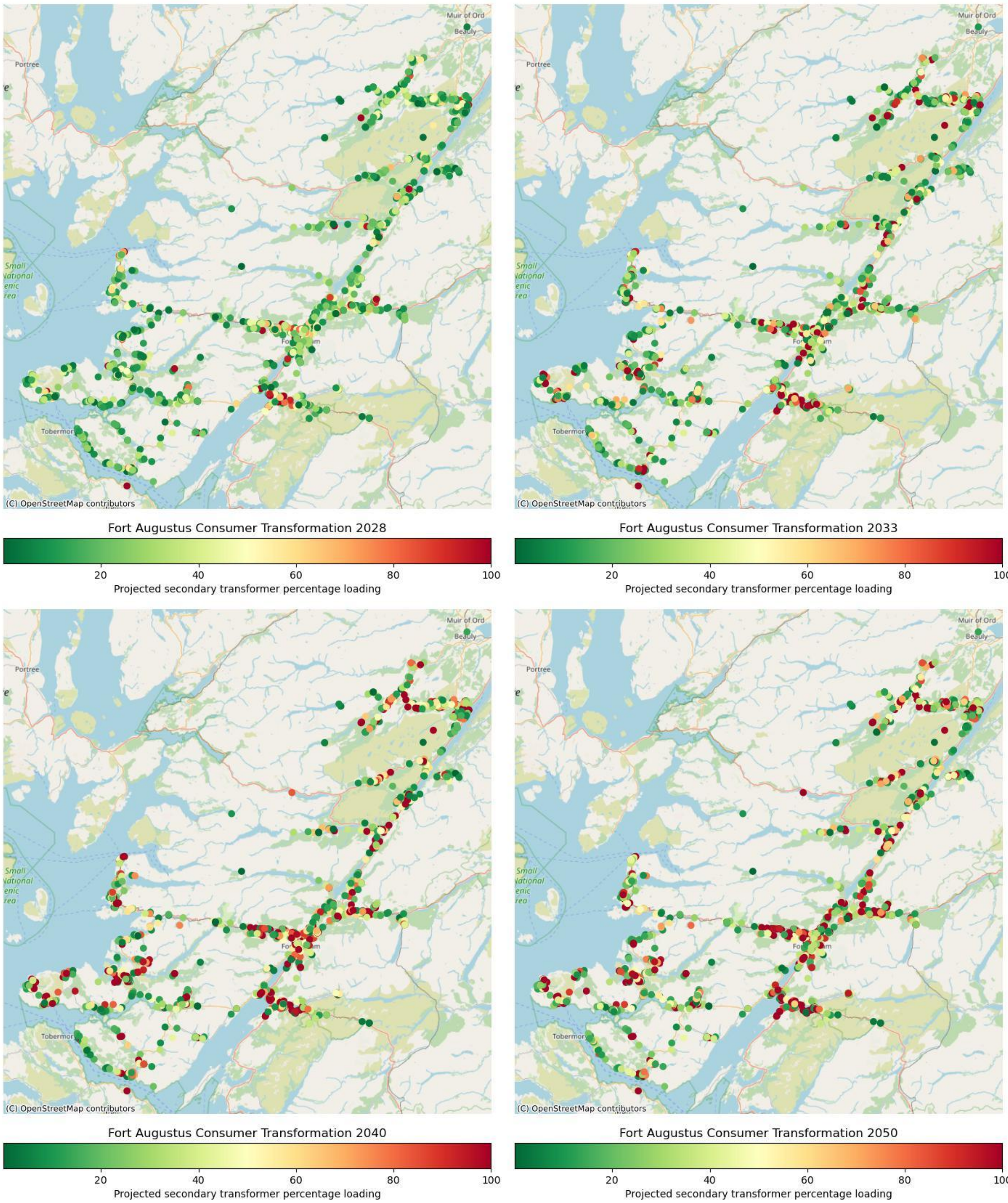


Figure 17 Fort Augustus 132kV supply area HV/LV CT spatial plans for 2028, 2033, 2040, and 2050

8. OPTIONS TO RESOLVE SPECIFIC SYSTEM NEEDS

The relevant spatial plans provide offer a strategic view of future system needs. We have reviewed these 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 are all accounted for.

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 process, where they will be considered alongside the potential for flexibility.

The section is split into three parts:

1. Future EHV system needs to 2035 – 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 a number of 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: Some of the works proposed here are dependent on the completion of works carried out by SSEN Transmission.
Risks: Works delay potential interventions downstream and/or do not provide flexibility of future investment.
Mitigation: Continue productive engagement with SSEN Transmission to enable planning and a better understanding of when capacity will be released in the Fort Augustus 132kV supply area.

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.

Dependency: Connections reform process, which is taking place this year, is likely to change the number and composition of generation/storage projects currently in the connections queue.
Risks: The reinforcements currently planned, that have been triggered by generation connections, may not be necessary if the generation projects drop out of the connections queue.
Mitigation: Works triggered by generation projects that have a level of uncertainty have not been included in the works in the progress or the network modelling. This assumes these works will not release capacity so network can be planned for worst-case scenario in terms of these works going ahead. Network models will be rerun when there is more clarity.

Dependency: Growth of generation in the area may begin to cause reverse power flow on the network. It should be ensured that the assets currently on the network are able to handle the projected levels of reverse power flow and increased fault level.
Risks: Further reinforcement than identified here is required to enable connection of generation. Increasing fault levels leads to damaged distribution network assets.
Mitigation: We should further assess the near-term generation requirements to ensure that we are in a position to facilitate the Clean Power 2030 targets set by DESNZ. Consideration of future fault level to prevent the risk of damaged assets should be considered when designing future schemes.

Dependency: The future works described in this section are only indicative and further detailed study through the DNOA will be required when delivery of the work needs to be initiated.
Risks: Changes in forecasts and/or practical considerations may result in changing the scope of the high-level solutions detailed here.
Mitigation: The purpose of this section is to highlight the long-term requirements based on current forecasts, annual update of the SDP and more detailed assessment in the DNOA will ensure proposed work that is passed from DSO to the asset owner is appropriate.

Dependency: SSEN has committed to removing Load Managed Areas (LMAs) during the ED2 and ED3 price control period.
Risks: Firstly, some of the smart meters being used to replace the radio tele switching may not be able to connect to the smart network. Secondly, participation in flexibility markets from previous LMA customers is not as high as expected.
Mitigation: Technical support is given for the installation of smart meters. Detailed network studies are undertaken for areas most impacted by the removal of LMAs to determine whether flexibility solutions or reinforcements will be required

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 2035.

The following table details the near-term to medium-term distribution network system needs that have been identified through power system analysis. While asset solutions are described in the table below it is important to note that the use of flexibility will be evaluated for all schemes to ensure the best possible solution is progressed. For the projects shown in Table 4 we recommend that these are progressed through the DNOA process so that there is sufficient time for solutions to be designed and delivered.

Location of proposed intervention	CT Year	ST Year	LW Year	FS Year	CT Worst case asset loading (%)	Network state	Comments
Fort William 33kV circuit 2L5 (Fort William – Arisaig via Annat and Mallaig)	Ahead of 2030	Ahead of 2030	Ahead of 2030	Ahead of 2030	-	Intact	Voltage constraint: • Voltage constraint under intact conditions. Low voltage at Lochailort 33kV regulator site. Potential options to resolve this constraint are: • Reinforcement of Fort William 33kV circuit 2L5. • Construction of additional 33kV circuit/s from Fort William GSP. • Additional voltage regulation assets or STATCOMs.
Fort William 33kV circuit 6L5 (Fort William GSP – Glensanda via Pinegrove)	Ahead of 2030	Ahead of 2030	Ahead of 2030	Ahead of 2030	-	Intact & N-1 outage of Fort William circuit 3L5 (Fort William GSP - Pinegrove – Corran – Glensanda)	Voltage Constraint: • Voltage constraint on Fort William circuit 6L5 under both intact and N-1 outage loss of Fort William circuit 3L5 (Fort William GSP - Glensanda via Pinegrove and Corran), including Glensanda subsea cable section. • Several voltage constraints are triggered on different sections of this circuit in different years from 2024/25 – 2043/44. • Future thermal overload of Fort William circuit 6L5 in 2031/32 (N-1). Awareness

							and consideration of future thermal constraint in 2031/32 should be factored into optioneering. Potential options to resolve this constraint are: • Reinforcement of Fort William 33kV circuit 6L5. • Install automated switching asset at 33kV NOP (e.g. replacement of ABSW with PMAR). • Reconfiguration of 33kV network feeding arrangements to transfer the load of Lochaline 33kV spur onto Taynuilt GSP under N-1 scenario. • Construction of additional 33kV circuit/s from Fort William GSP. • Break Pinegrove primary substation out of the 3L5 / 6L5 circuits and transfer onto 2x new dedicated 33kV circuits from Fort William GSP. • Additional voltage regulation assets or STATCOMs. • New GSP in the vicinity of Loch Shiel, followed by 33kV network reconfiguration and the transfer of some existing 6L5 / 3L5 load.
Fort William 33kV circuit 6L5 (Fort William GSP – Glensanda via Pinegrove)	2030 – 2035	2035 – 2040	2030 – 2035	2040 – 2045	115.3	N-1 of Loss of 3L5 circuit (Fort William GSP - Pinegrove - Corran - Glensanda)	Thermal Constraint: • Thermal overload of Fort William 33kV circuit 6L5 under N-1 outage loss of 3L5 circuit (Fort William GSP - Glensanda via Pinegrove and Corran). • Future thermal overload of Carnoch Regulator (2048/49). • Several voltage constraints are triggered on different sections of this circuit in

							different years from 2024/25 – 2043/44. Potential options to resolve this constraint are: • Reinforcement of Fort William 33kV circuit 6L5. • Reconfiguration of 33kV network feeding arrangements to transfer the load of Lochaline 33kV spur onto Taynuilt GSP under N-1 scenario. • Assess options for procuring flexibility services. • Break Pinegrove primary substation out of the 3L5 / 6L5 circuits and transfer onto 2x new dedicated 33kV circuits from Fort William GSP. • New GSP in the vicinity of Loch Shiel, followed by 33kV network reconfiguration and the transfer of some existing 6L5 / 3L5 load.
Fort Augustus 33kV circuit 2L5 (Fort Augustus GSP – Drumnadrochit Primary substation)	Ahead of 2030	Ahead of 2030	Ahead of 2030	2030 - 2035	-	Intact	Voltage constraint: • Voltage constraint under intact conditions Low voltage at Drumnadrochit Primary substation. Potential options to resolve this constraint are: • Installation of voltage regulating assets on Fort Augustus 33kV circuit 2L5. • Installation of a new 33kV circuit to Drumnadrochit PSS (potentially from Fasnakyle GSP) • Reinforcement to increase the OHL conductor size.

Table 4 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 5 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
Wester Drummond Primary Substation	2045 - 2050	2040 – 2045	2030 - 2035	-	105.9	Intact	Thermal Constraint: • Thermal overload of Wester Drummond Primary Transformer under intact conditions. Potential options to resolve this constraint are: • Reinforcement of existing Primary transformer. • Extension of existing 33kV circuit, installation of a new primary transformer site, followed by reconfiguration of 11kV feeding arrangements to split the existing loading between the two sites. • Assess options for procuring flexibility services.
Carnoch Regulator	2045 - 2050	2045 - 2050	2040 – 2045	-	102.3	N-1 of loss of Fort William 3L5 circuit (Fort William GSP – Glensanda via Pinegrove and Corran)	Thermal Constraint: • Thermal overload of Carnoch Regulator under N-1 outage loss of 3L5 circuit Fort William GSP – Glensanda via Pinegrove and Corran. • Several voltage constraints are triggered on different sections of this circuit in different years from 2024/25 – 2043/44. Potential options to resolve this constraint are: • Reinforcement of Carnoch regulator. • Installation of an additional 33kV feeder from Fort William GSP

							followed by the transfer of some existing 6L5 / 3L5 load onto the new circuit. • Break Pinegrove primary substation out of the 3L5 / 6L5 circuits and transfer onto 2x new dedicated 33kV circuits from Fort William GSP. • Reconfiguration of 33kV network feeding arrangements to transfer the load of Lochaline 33kV spur onto Taynuilt GSP under N-1 scenario. • Assess options for procuring flexibility services.
Inverlochy Primary Substation	2045 – 2050	-	2045 – 2050		100.8	N-1 loss of Lochaber smelter 33kV feeder 1 and N-1 outage loss of (Fort William GSP - Inverlochy - Bunnarkaig) Feeder 2	Thermal Constraint: • Thermal overload of Inverlochy 11kV bus-section circuit breakers under N-1 loss of Lochaber smelter feeder 1 and N-1 loss of Fort William – Inverlochy feeder) Potential options to resolve this constraint are: • Reinforcement of the existing 11kV assets and switchboard. • Reconfiguration of 11kV feeding arrangements to transfer some existing load onto Annat PSS or Pinegrove PSS. • Assess options for procuring flexibility services.
Aberchalder Primary Substation	-	-	2045 – 2050	-	-	Intact	Thermal Constraint: • Thermal overload of Aberchalder Primary Transformer under Intact conditions **(LW scenario only)** Potential options to resolve this constraint are: • Reinforcement of existing Primary transformer. • Extension of existing 33kV circuit, installation of a new primary transformer site, followed by

							reconfiguration of 11kV feeding arrangements to split the existing loading between the two sites. • Assess options for procuring flexibility services.
Corran Primary Substation	-	-	2045 – 2050	-	-	Intact	Thermal Constraint: • Thermal overload of Corran Primary Transformer under Intact conditions **(LW scenario only)** Potential options to resolve this constraint are: • Reinforcement of existing Primary transformer. • Installation of an additional Primary transformer. • Assess options for procuring flexibility services.
Fasnakyle local Primary Substation	-	-	2045 – 2050	-	-	Intact	Thermal Constraint: • Thermal overload of Fasnakyle Primary Transformer under Intact conditions **(LW scenario only)** Potential options to resolve this constraint are: • Reinforcement of existing Primary transformer. • Installation of an additional Primary transformer. • Assess options for procuring flexibility services.
Fort Augustus 33kV circuit 2L5	-	-	2045 – 2050		-	Intact	Voltage constraint: • Voltage constraint under intact conditions. Low voltage from Fort Augustus GSP - Drumnadrochit primary substation. **(LW scenario only)** Potential options to resolve this constraint are: • Installation of voltage regulating assets on Fort Augustus 33kV circuit 2L5.

							• Installation of a new 33kV circuit to Drumnadrochit PSS (potentially from Fasnakyle GSP) • Reinforcement to increase the OHL conductor size.

Table 5 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 Fort Augustus 132kV supply areas 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.[23]

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 the Fort Augustus 132kV substation, 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 18** 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.

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

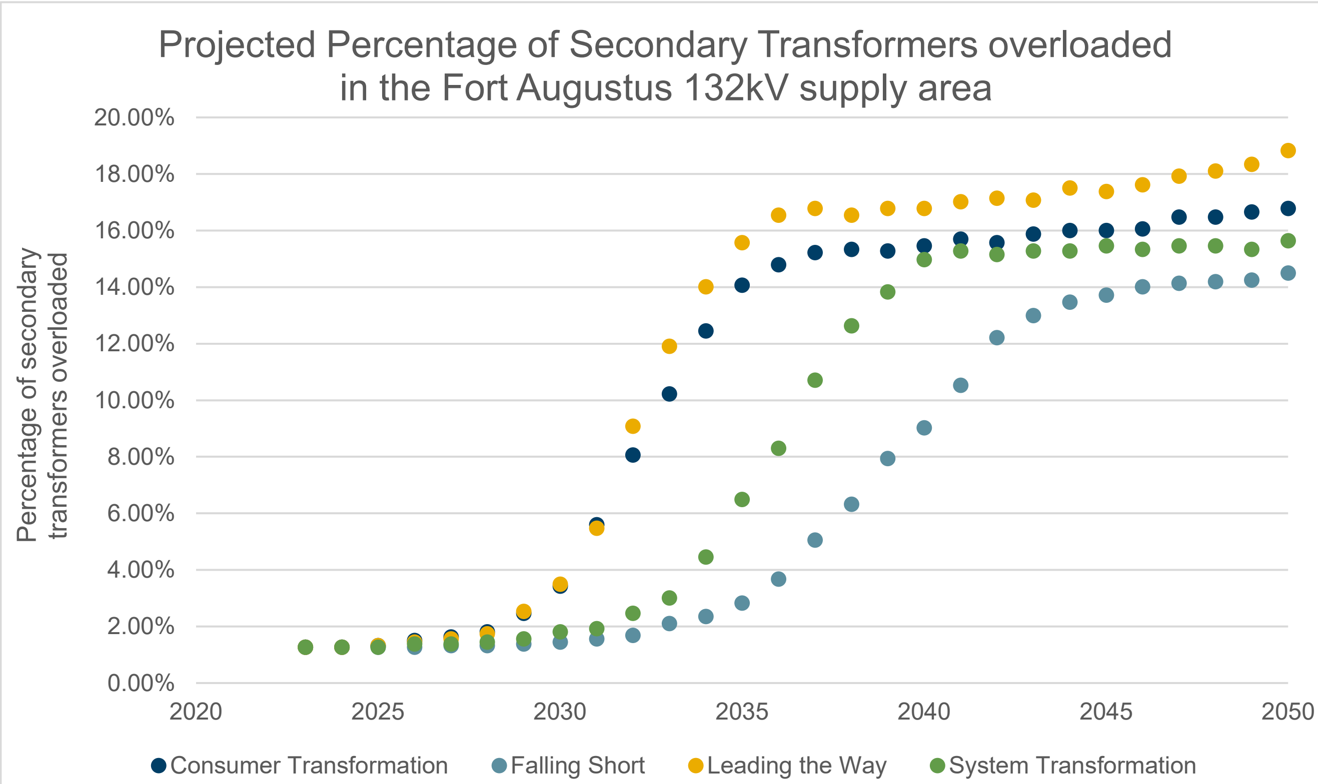


Figure 18 Fort Augustus 132kV supply area Projected Secondary Transformer Loading. Source: SSEN Load Model

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 fore sighting 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.[24] This work groups Lower layer Super Output Areas (LSOAs)[25] 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 6.

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.

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

25 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 6 VFES Groupings

To understand the vulnerability groupings across the Fort Augustus 132kV 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 19.**

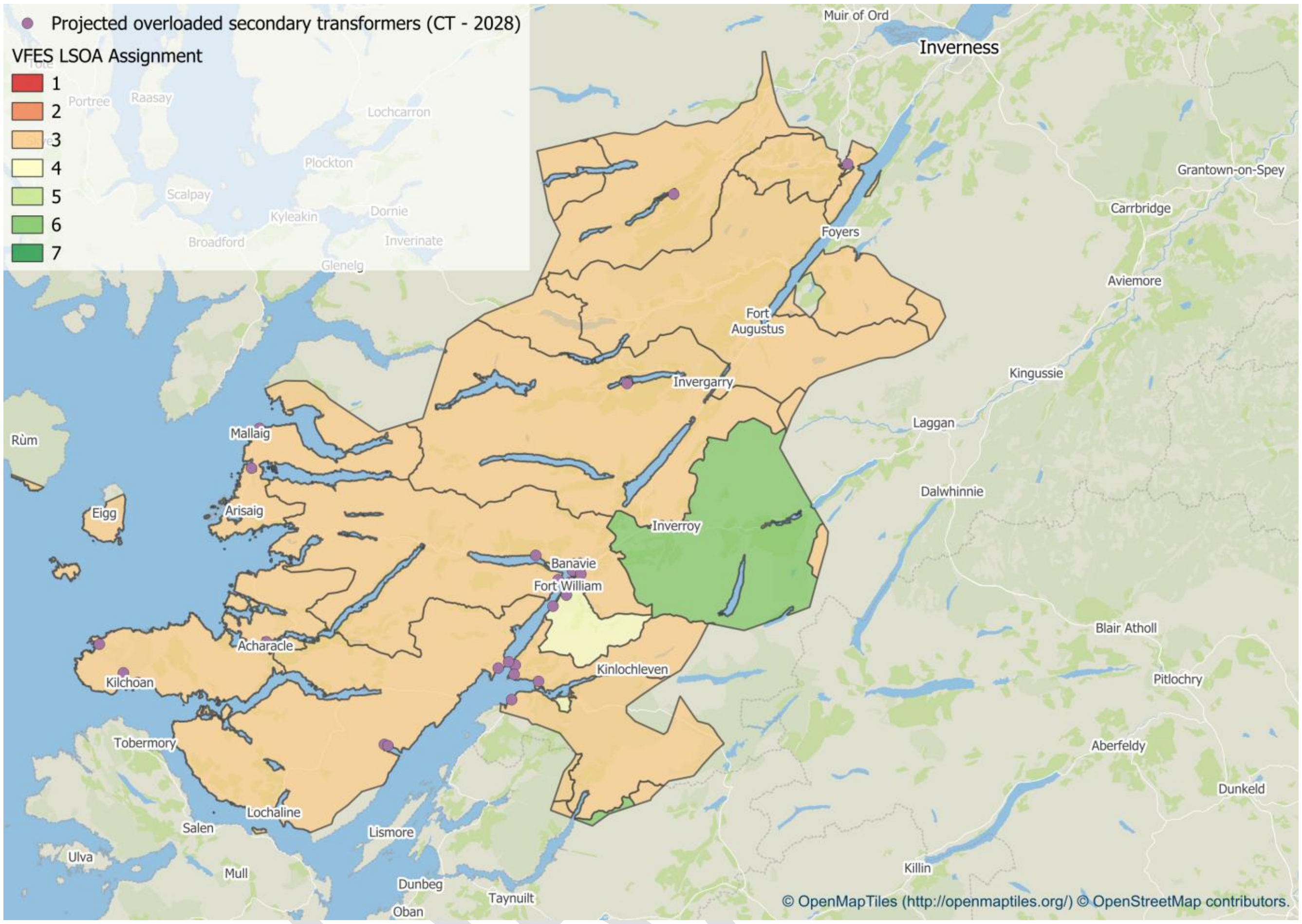


Figure 19 Fort Augustus 132kV supply area VFES Output with secondary transformer overlay.

We can see that most of the area falls within group 3, indicating relatively high levels of vulnerability. This level of vulnerability is driven up by a larger elderly population and reduced by lower levels of disability and mental health benefit claimants. In the Fort Augustus 132kV supply area there are several LSOAs that fall into the higher categories of vulnerability (groups 1, 2, and 3). We also see three LSOA areas falling into the group 1 – very high vulnerability, around Fort William and Kinlochleven. This very high vulnerability classification is driven up by higher levels of poor health and disability/mental health benefit claimants but 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 also 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 more sudden 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 of these 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)[26] and My Electric Avenue[27] 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 20**. 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.

26 Project LEO | SSEN Innovation

27 My Electric Avenue |

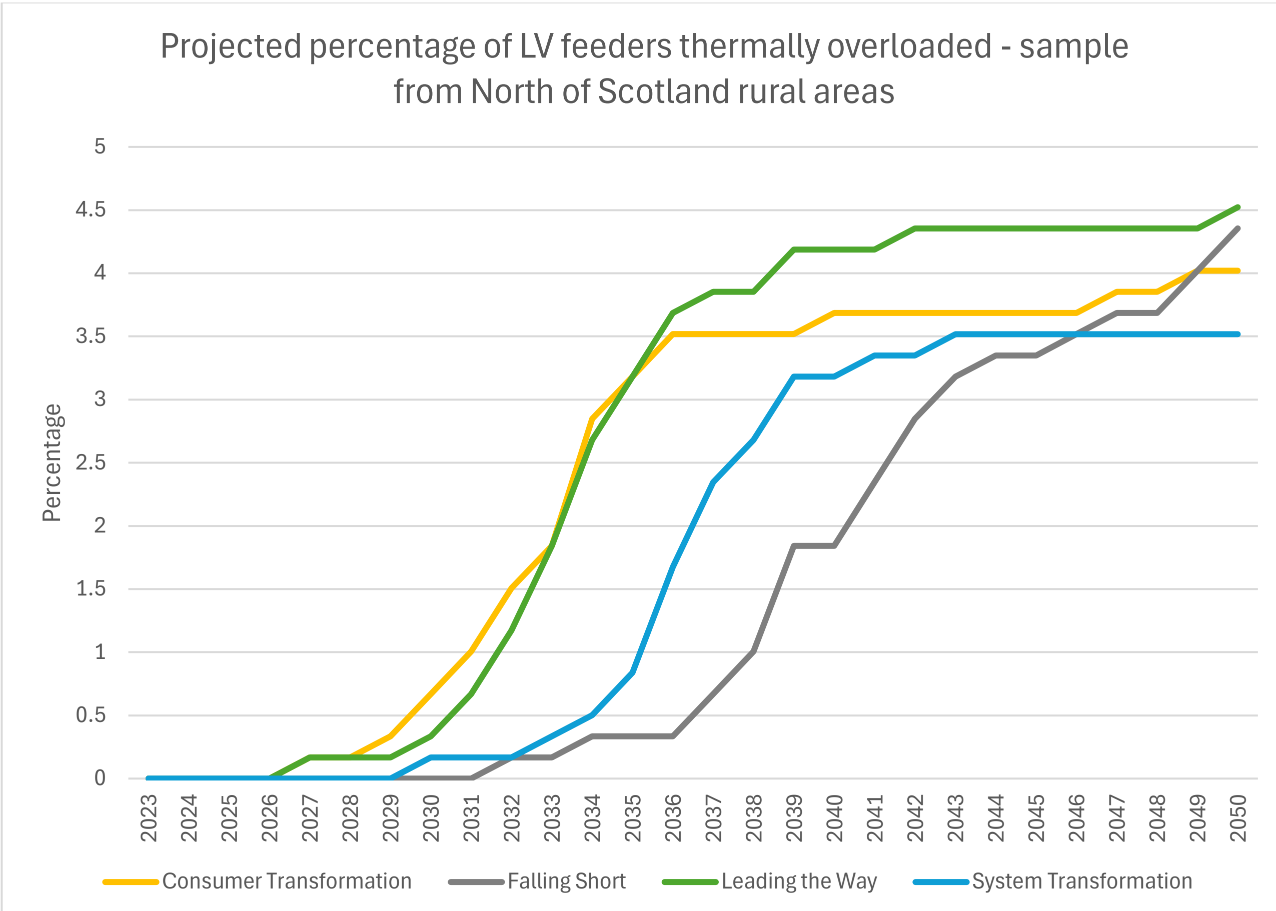


Figure 20 Percentage of LV feeders projected to be overloaded under Fort Augustus 132kV substation supply area.

9. RECOMMENDATIONS

The stakeholder engagement insights and the SSEN 2023 DFES analysis provides a robust evidence base for load growth across the Fort Augustus 132kV supply area in both the near and longer term. Load growth across the Central Highlands region is driven by multiple sectors and technologies, impacting not only our EHV network but also driving system needs across all voltage levels.

Across the Fort Augustus 132kV substation supply area, a variety of works have already been triggered, the latest of which has progressed through the DNOA process and published in a 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 seven key recommendations:

1. System needs that have been identified at earlier timescales (ahead of 2035) should be studied in more detail. Work in these timescales should be progressed for more detailed assessment through the DNOA process. This relates to the assets tabulated in section 8.2. For this SDP, this includes:
    - Fort William GSP 33kV circuits (2L5, 3L5 and 6L5)
    - Fort Augustus GSP 33kV circuit (2L5)

2. SSEN should continue to ensure a positive channel of communication remains open between SSEN Distribution, SSEN Transmission and NESO regarding the following:
    - The possibility/feasibility of establishing a new GSP located in the vicinity of Loch Shiel. This should be explored in further detail as a potential option to alleviate future forecasted constraints on the existing Fort William distribution network and increasing network resilience to the region.
    - The creation of a long-term plan for the area so that alongside the delivery of any future SSEN Transmission works highlighted in section 3.2.2., we can plan the distribution network in parallel. This will enable efficient capacity release at both Transmission and Distribution level and should incorporate the outputs of CP2030 and connections reform.
    - The development of policy to unlock the ability of local and community-based generation to connect.
    - Co-ordination between prospective ANM schemes and the impact of T-D limits at GSPs.

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.

4. Voltage constraints have been identified through the power system analysis network modelling results. Awareness and consideration of all future constraints will be critical in any further network studies and the successful optioneering of proposed interventions within the Fort Augustus 132kV substation supply area. Some circuits will have both thermal and voltage constraints. Detailed studies should be carried out to determine where reinforcements could resolve both constraints, creating the most cost-effective solution and ensuring network does not have to be 'touched twice'.

5. Understanding how rural decarbonisation could impact load on the network. Specifically, the electrification of distilleries and ports along the east coast of the Fort Augustus 132kV supply area and how to capture those plans in load forecasts. This should be done through further engagement in the SeaChange project. It will also be important to understand how substations covered by security of supply derogations will be affected by increased demand.

6. As the move away from LMAs develops, continued work should take place to understand the impact of households not participating in flexibility markets and the network reinforcements triggered by this. The move away from radio tele switching (RTS) to smart meters should also be supported if technical difficulties arise.

7. 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 Fort Augustus 132kV supply area, so this should be taken on 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.

PRIMARY SUBSTATION CUSTOMER NUMBERS BREAKDOWN

Ap

Grid Supply Point	Primary Substation	Number of Customers Served (approximate)	2023 Substation Maximum demand in MVA (Winter)
Ceannacroc GSP	CEANNACROC GRID	250	N/A
Fasnakyle GSP	FASNAKYLE GRID	107	N/A
Fasnakyle GSP	FASNAKYLE PRIMARY	244	0.36
Fort Augustus GSP	ABERCHALDER	20	0.03
Fort Augustus GSP	BUNOICH	267	0.17
Fort Augustus GSP	DRUMNADROCHIT	1,234	2.43
Fort Augustus GSP	FORT AUGUSTUS GRID	314	N/A
Fort Augustus GSP	GLEN LAOGH	5	0
Fort Augustus GSP	GLENDOE PRIMARY	342	1.15
Fort Augustus GSP	INVERGARRY	172	0.28
Fort Augustus GSP	WESTER DRUMMOND	13	0.02
Fort William GSP	ANNAT	1,332	2.4
Fort William GSP	ARISAIG	372	0.58
Fort William GSP	CORRAN	550	1.08
Fort William GSP	FISHNISH	2	0
Fort William GSP	FORT WILLIAM GRID	696	N/A
Fort William GSP	GLENUIG	28	0.06
Fort William GSP	INVERLOCHY	3,773	9.15
Fort William GSP	KINGAIRLOCH	29	0.07
Fort William GSP	KINLOCHMOIDART	26	0.05
Fort William GSP	LIDDESDALE	7	0.02
Fort William GSP	LOCHALINE	262	1.18
Fort William GSP	MALLAIG	675	1.22

Fort William GSP	PINEGROVE	2,382	5.14
Fort William GSP	POOR HOUSE	7	0.01
Fort William GSP	RAHOY	11	0.02
Fort William GSP	SALEN 2	842	2.41
Fort William GSP	SHONA BEAG	11	0.02
Fort William GSP	STRONTIAN	303	0.78
Kinlochleven GSP	GLENCOE	783	1.92
Kinlochleven GSP	GLENETIVE	4	0.05
Kinlochleven GSP	KINLOCHLEVEN	657	1.13
Quoich GSP	QUOICH PRIMARY	19	4.13

DFES 2024 Projections

NESO publishes the FES framework annually, and this is adopted for the DFES. The 2024 edition outlines three new pathways (Holistic Transition, Electric Engagement, and Hydrogen Evolution) that achieve net zero by 2050 against a counterfactual. The pathways framework is shown below in **Figure 21**.

Appendix B

The following charts show the latest DFES 2024 projections similar to those in section 5 with the updated pathways.

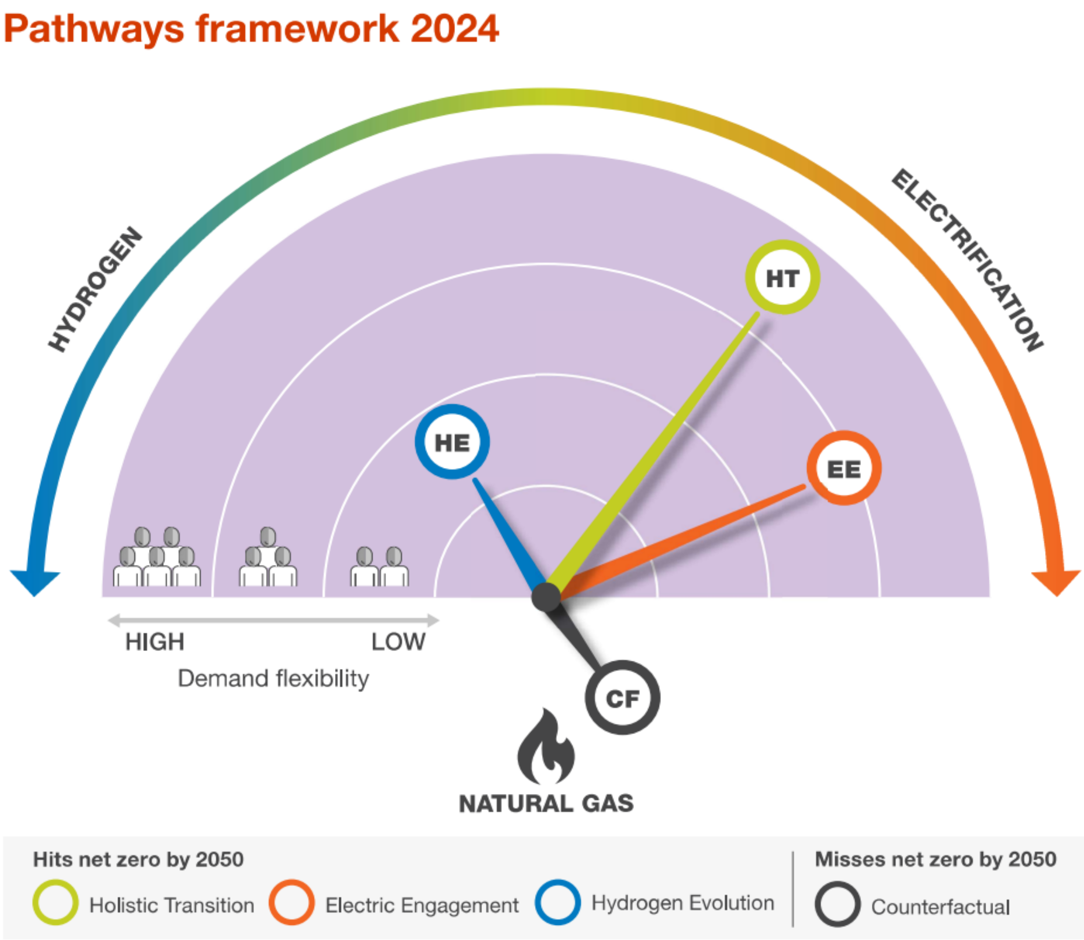


Figure 21 The FES 2024 scenario framework (source: NESO)

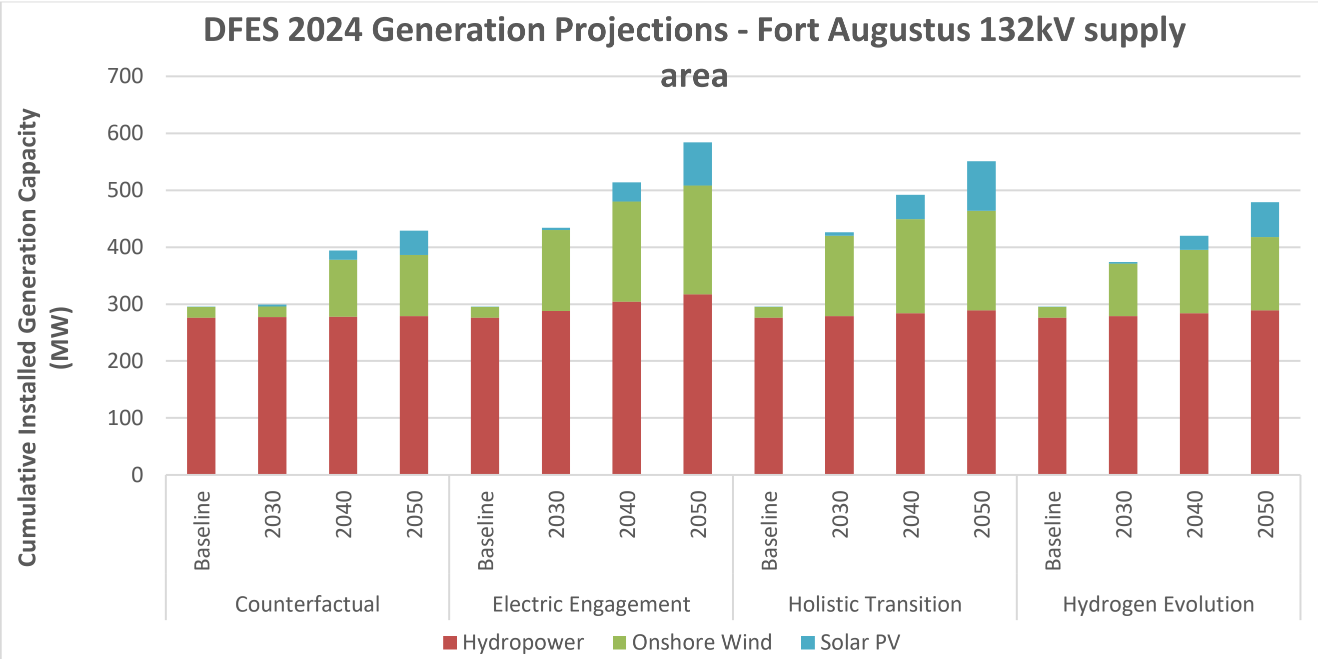


Figure 22 Projected Cumulative Distributed Generation Capacity for Fort Augustus 132kV supply area (MW). Source: SSEN DFES 2024

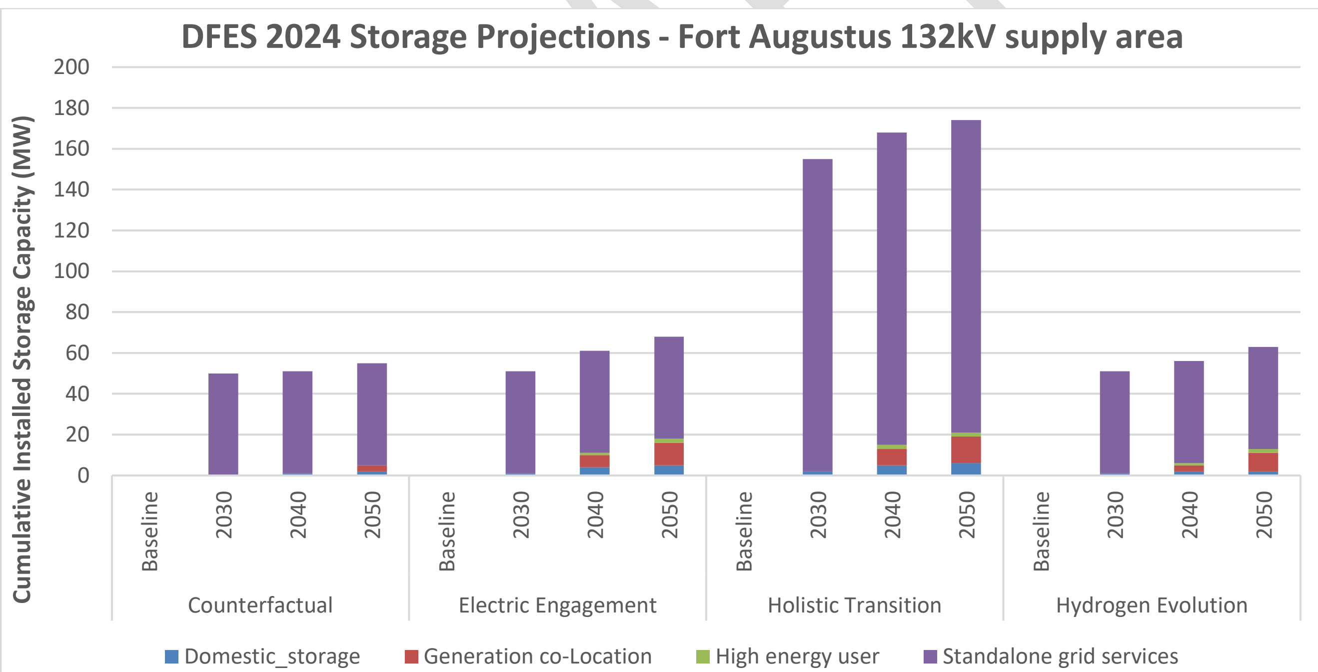


Figure 23 Projected Cumulative Storage Capacity for Fort Augustus 132kV supply area (MW). Source: SSEN DFES 2024

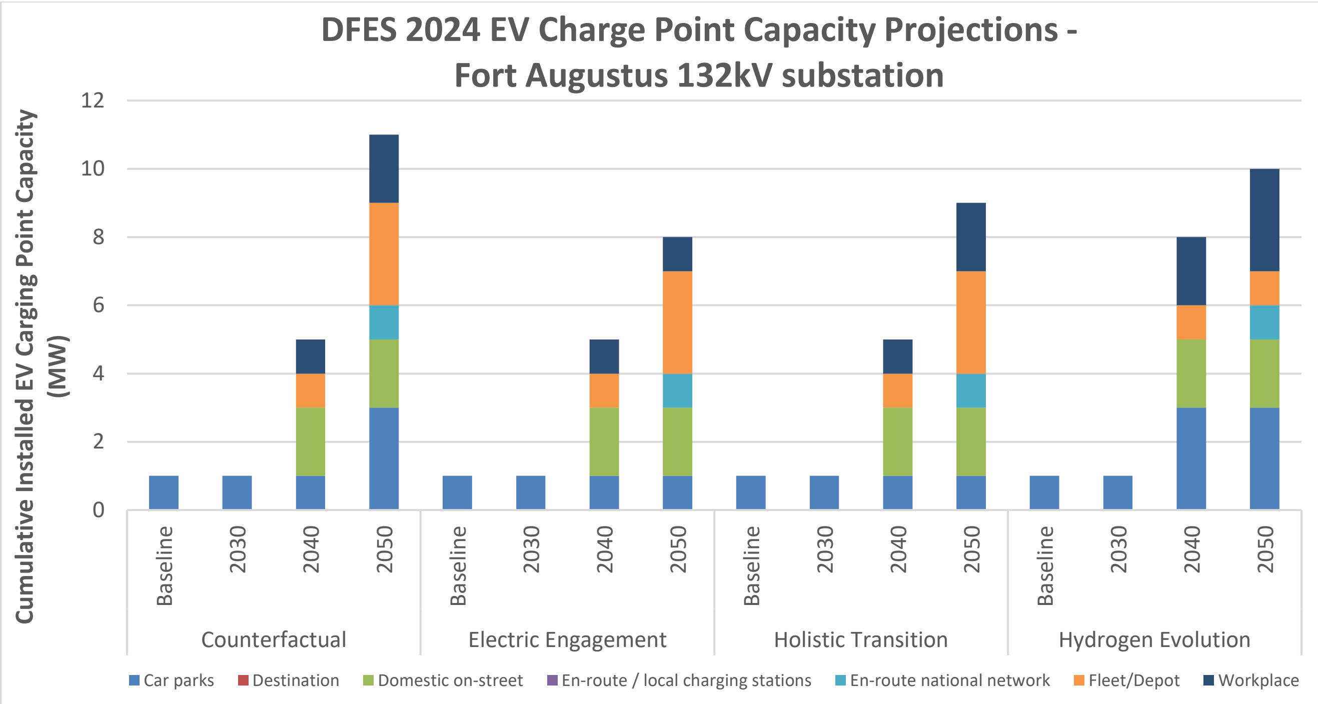


Figure 24 Projected Cumulative EV Charging Point Capacity Projections for Fort Augustus 132kV supply area (MW). Source: SSEN DFES 2024

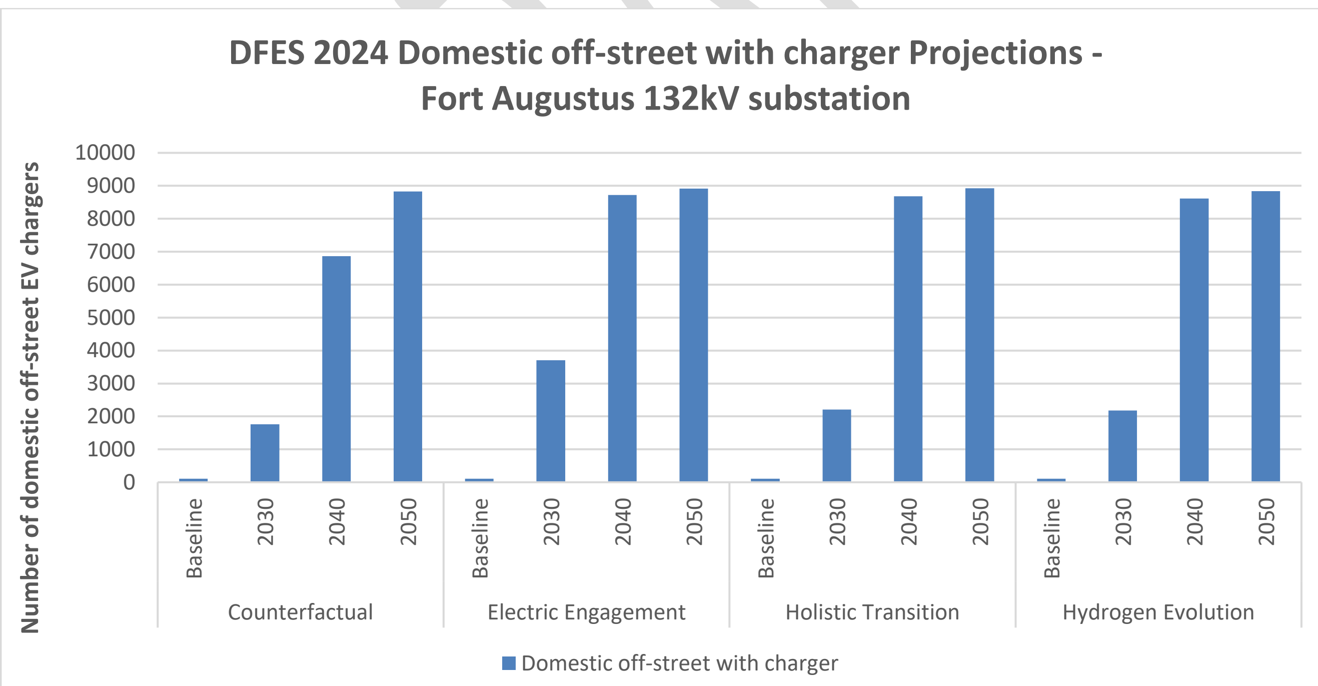


Figure 25 Projected Count of Domestic off-street with charger Projections for Fort Augustus 132kV supply area (MW). Source: SSEN DFES 2024

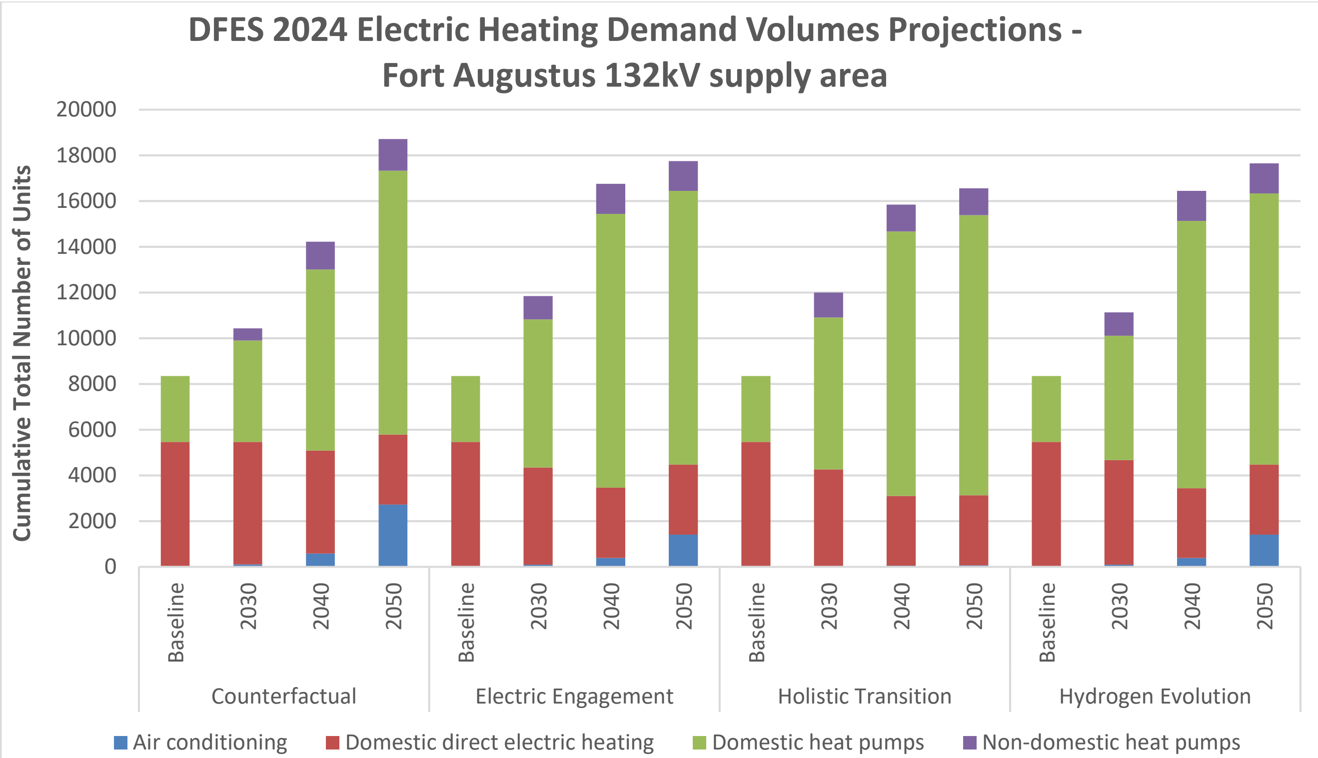


Figure 26 Projected Cumulative Electric Heating Demand Volumes Projections for Fort Augustus 132kV supply area (units). Source: SSEN DFES 2024

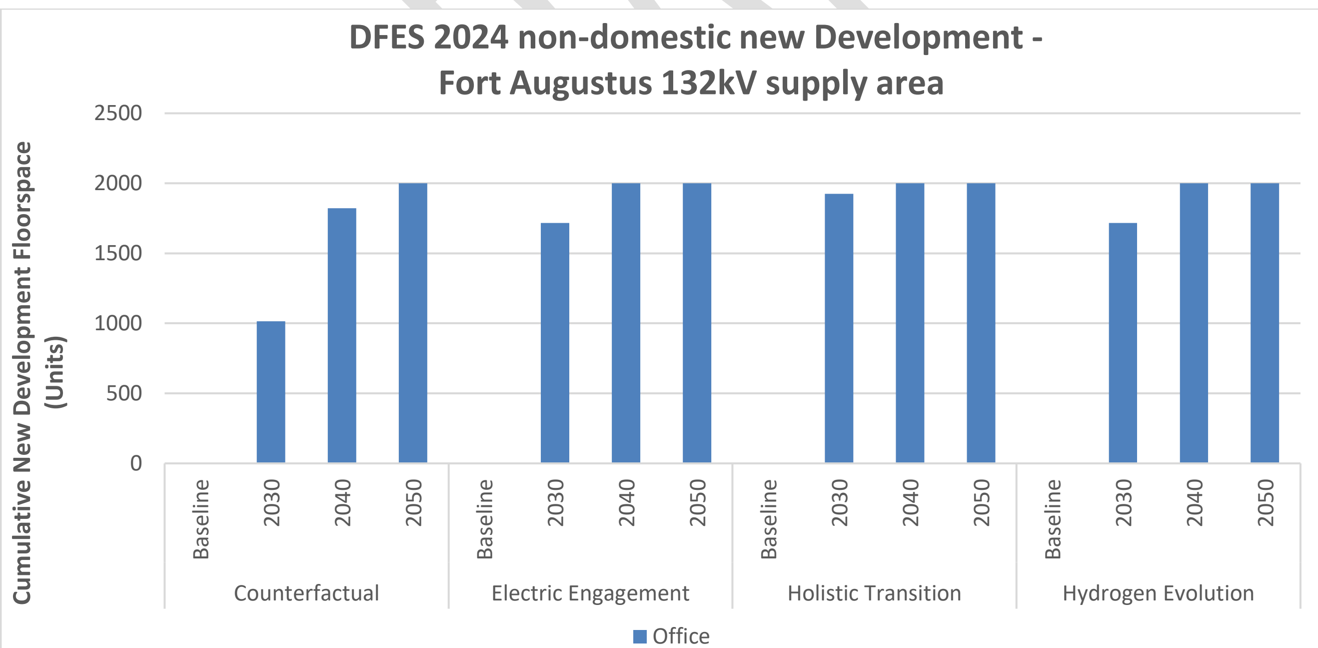


Figure 27 Projected Cumulative Non-Domestic New Developments for Fort Augustus 132kV supply area (m^2).

Source: SSEN DFES 2024

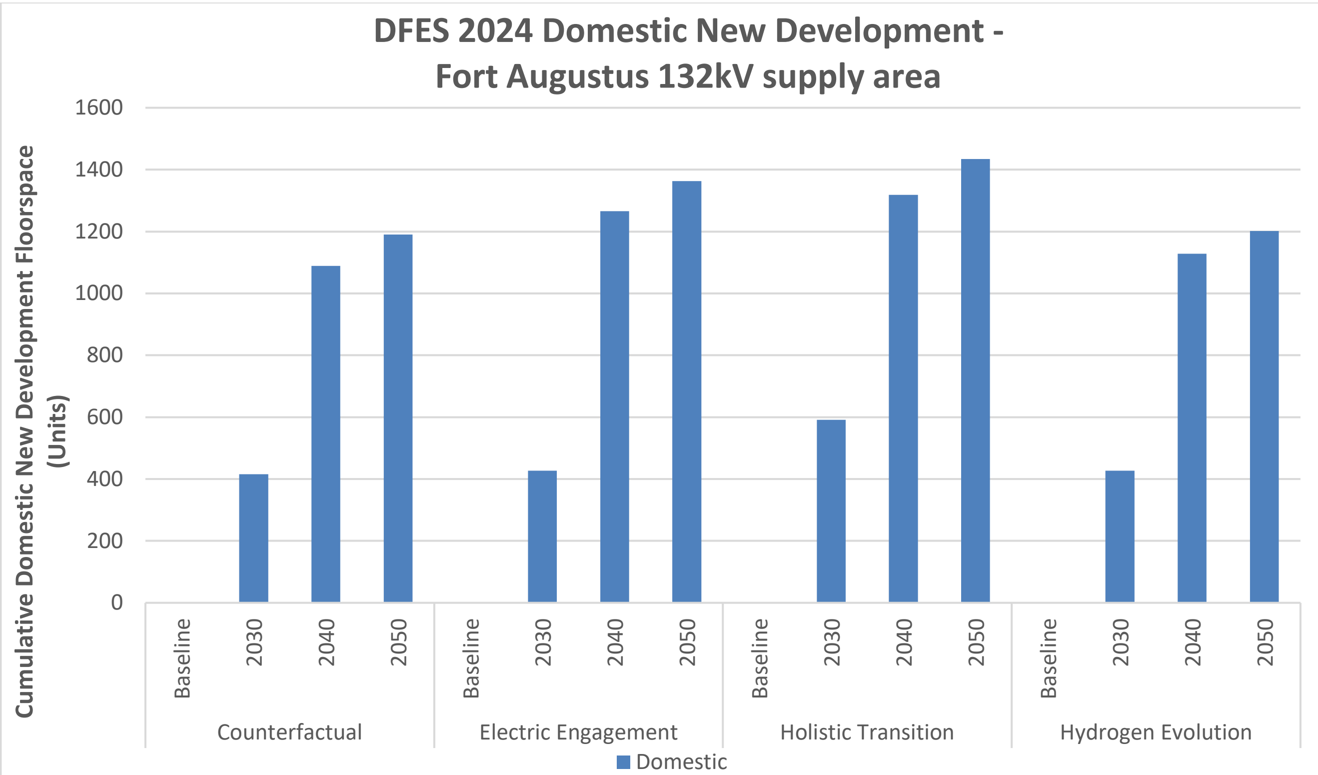


Figure 28 Projected Cumulative Domestic New Developments for Fort Augustus 132kV supply area (Units).

Source: SSEN DFES 2024

EHV/HV spatial plans for other DFES scenarios

Ap

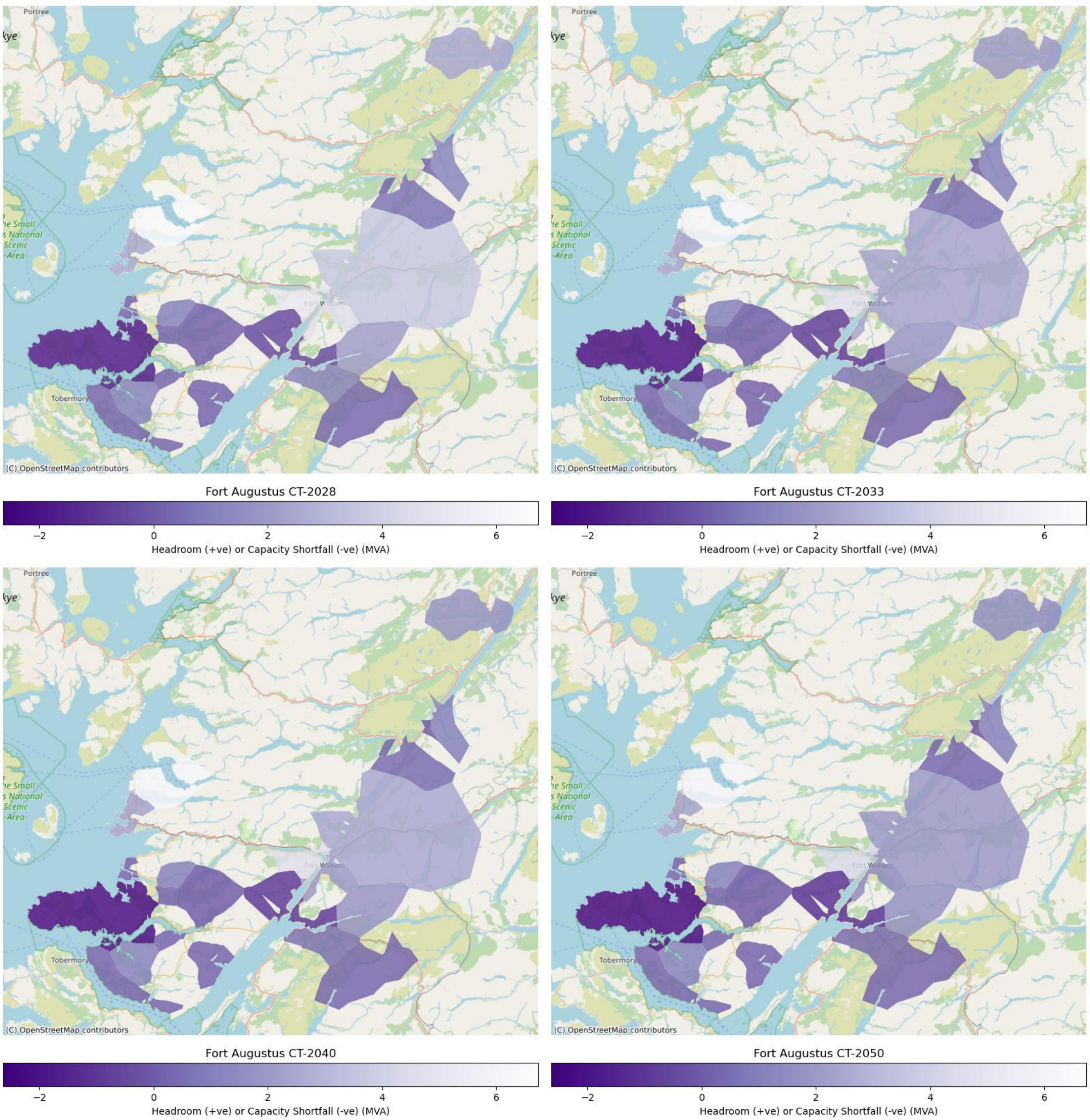


Figure 29 Fort Augustus 132kV substation EHV network spatial plans for CT 2028, 2033, 2040, and 2050

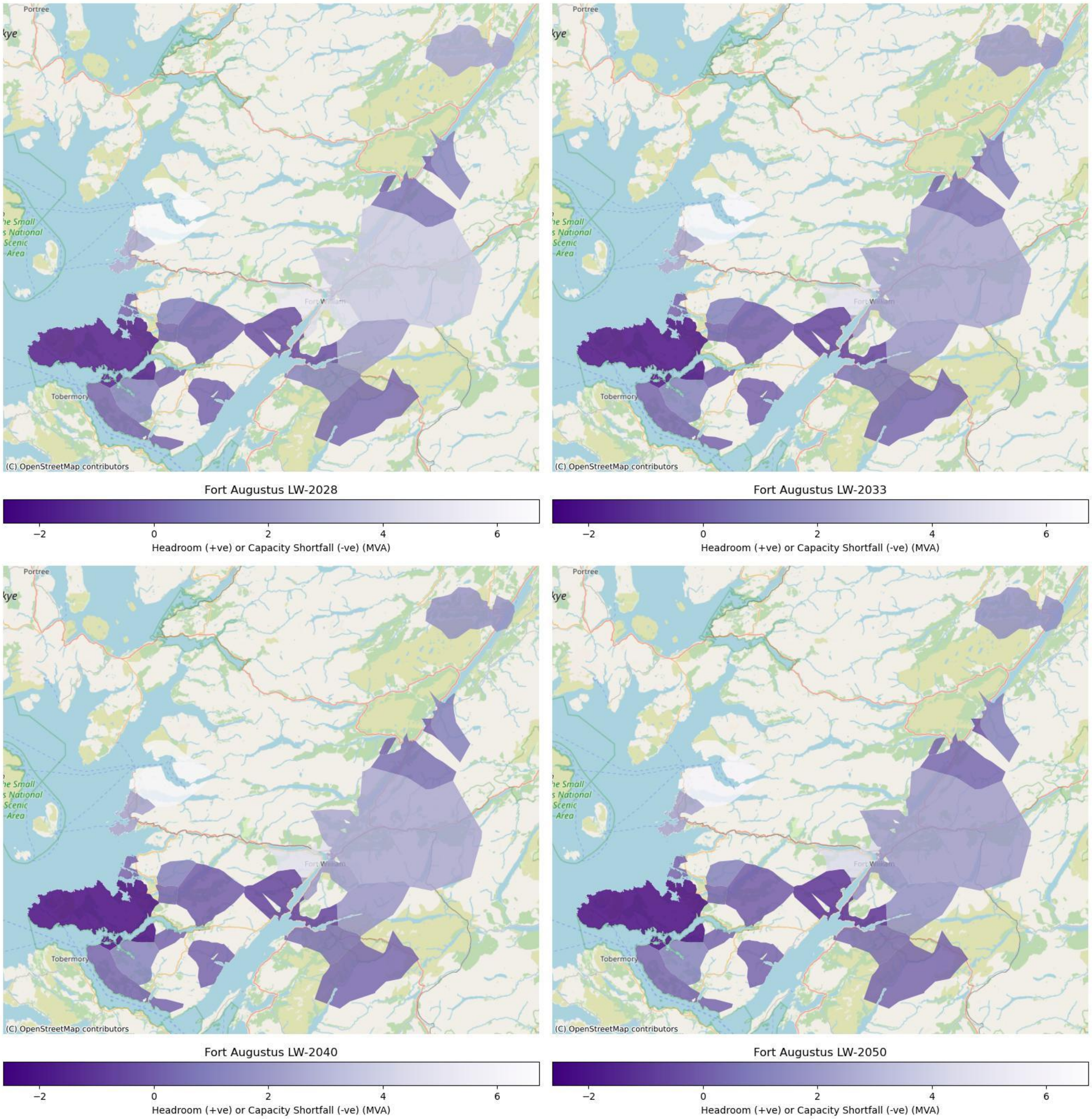


Figure 30 Fort Augustus 132kV substation EHV network spatial plans for LW 2028, 2033, 2040, and 2050

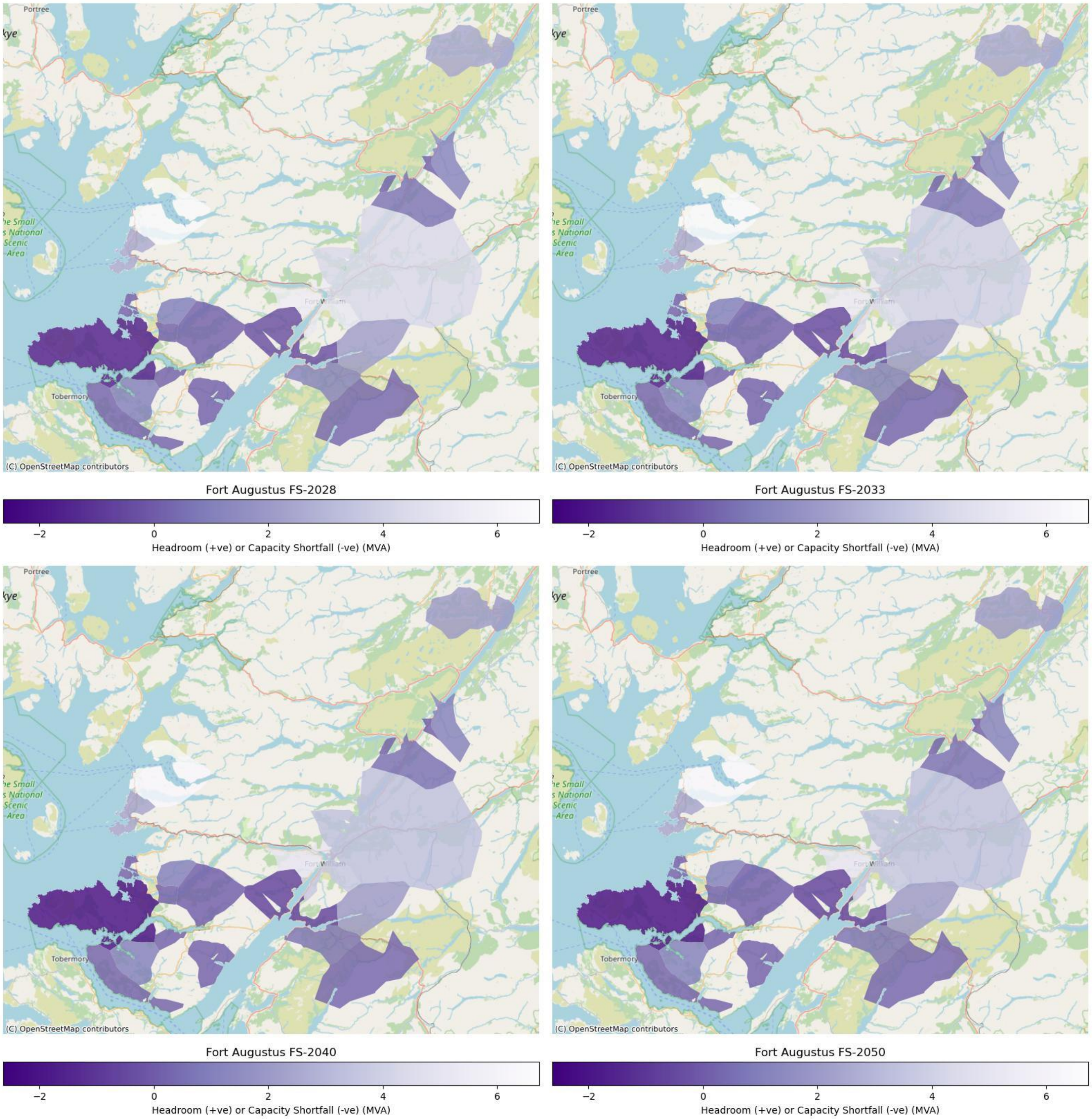


Figure 31 Fort Augustus 132kV substation EHV network spatial plans for FS 2028, 2033, 2040, and 2050

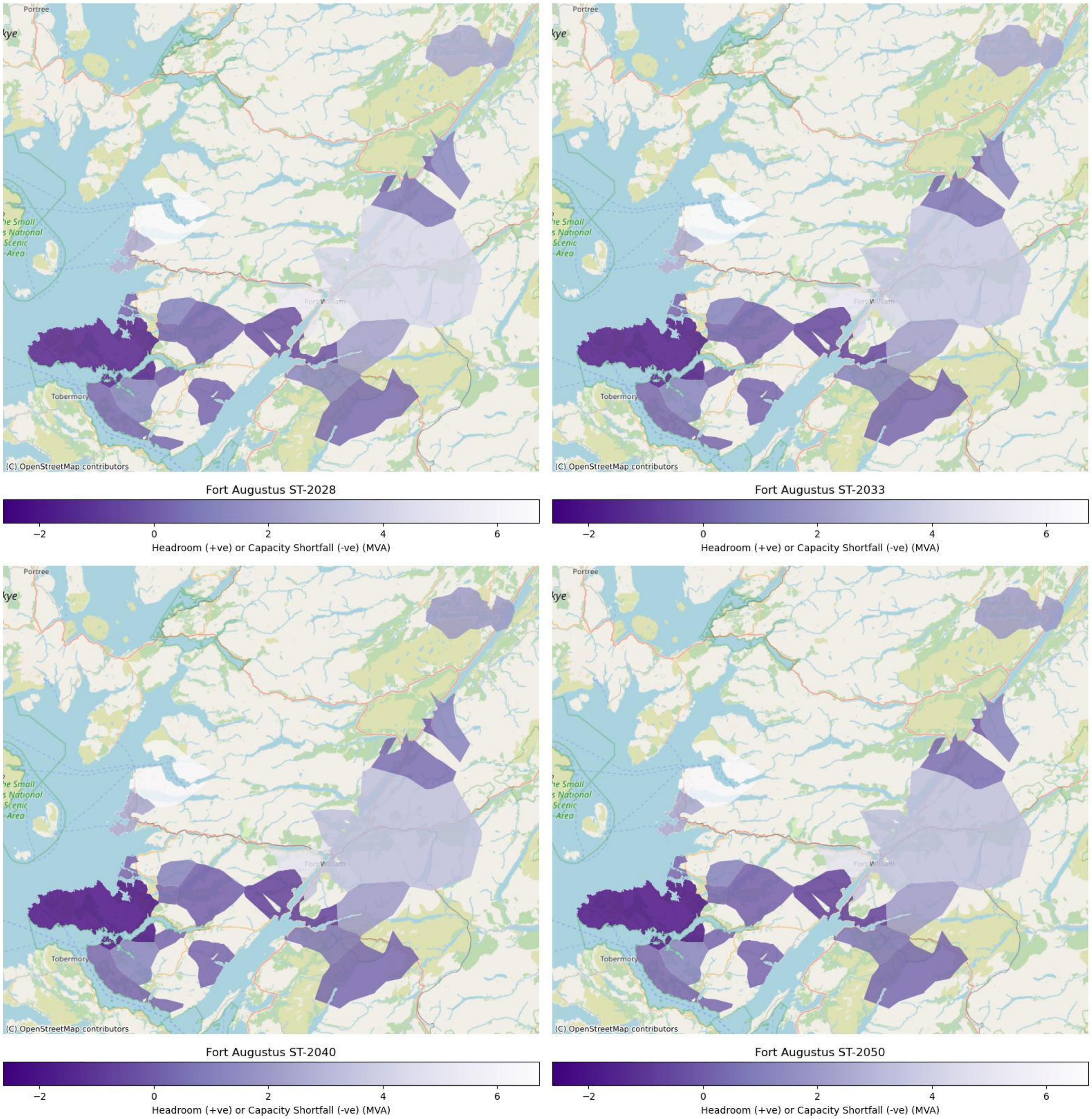


Figure 32 Fort Augustus 132kV substation EHV spatial plans for ST 2028, 2033, 2040, and 2050

HV/LV spatial plans for other DFES scenarios

Ap

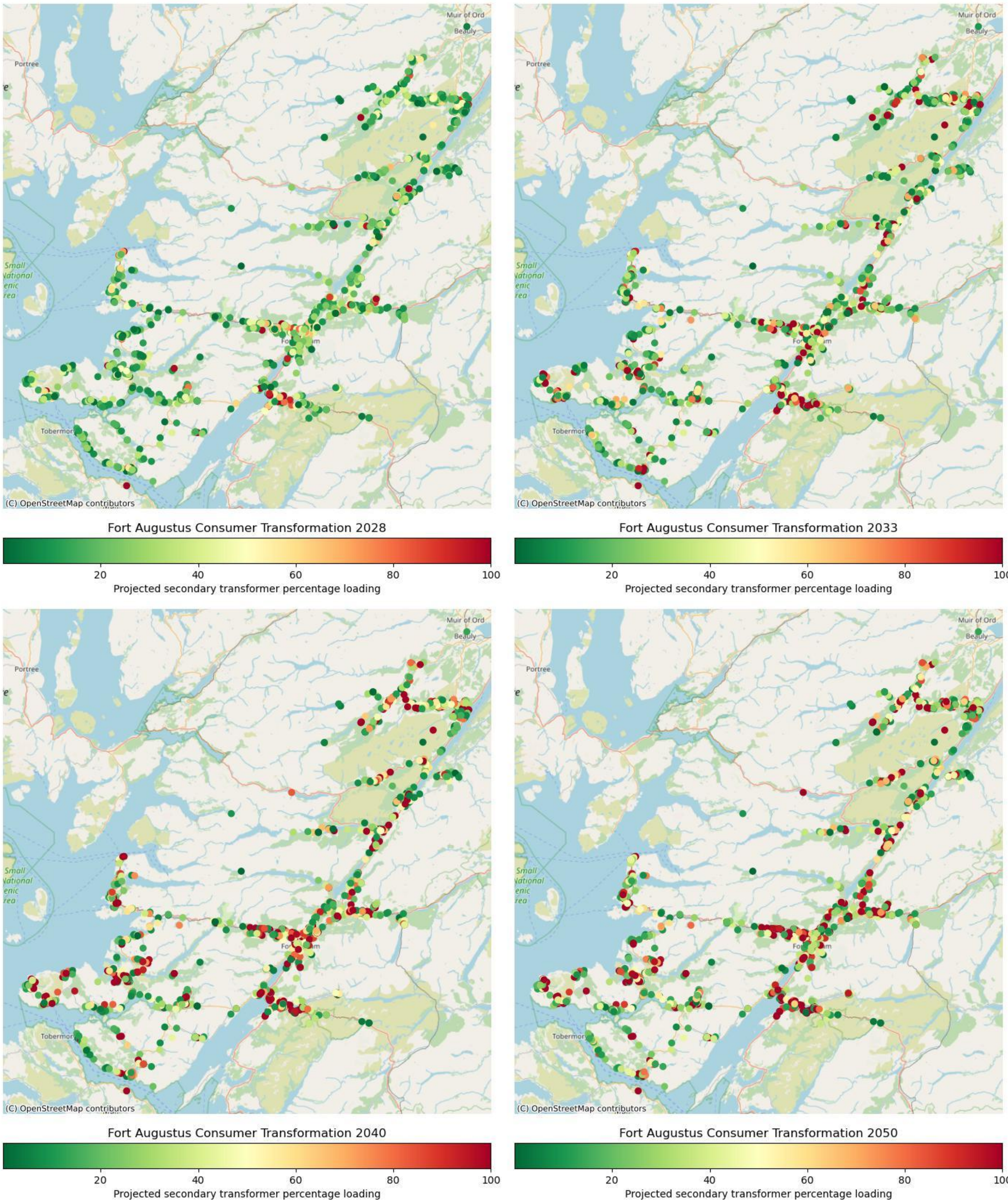


Figure 33 Fort Augustus 132kV substation HV/LV CT spatial plans for 2028, 2033, 2040, and 2050

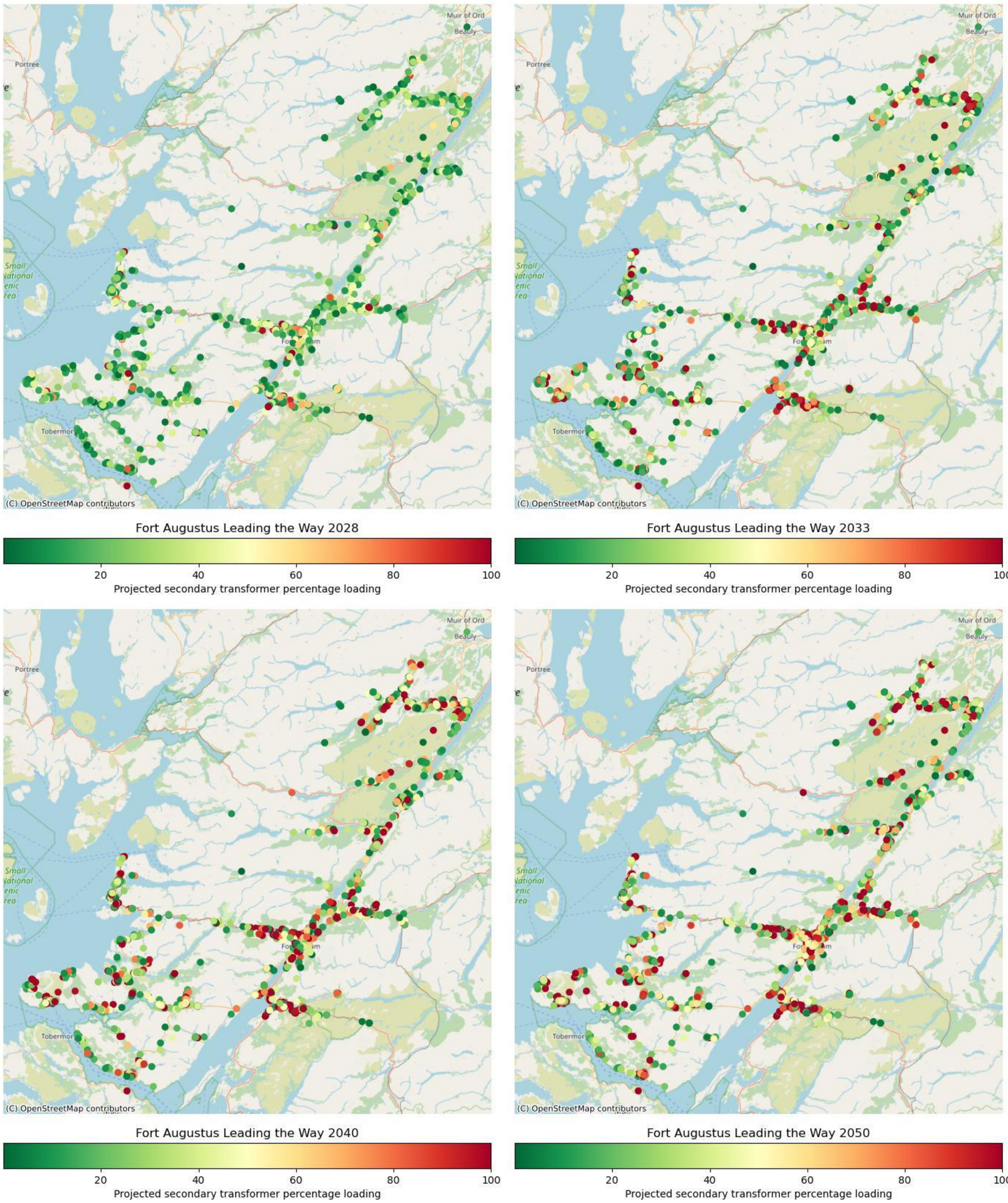


Figure 34 Fort Augustus 132kV substation HV/LV LW spatial plans for 2028, 2033, 2040, and 2050

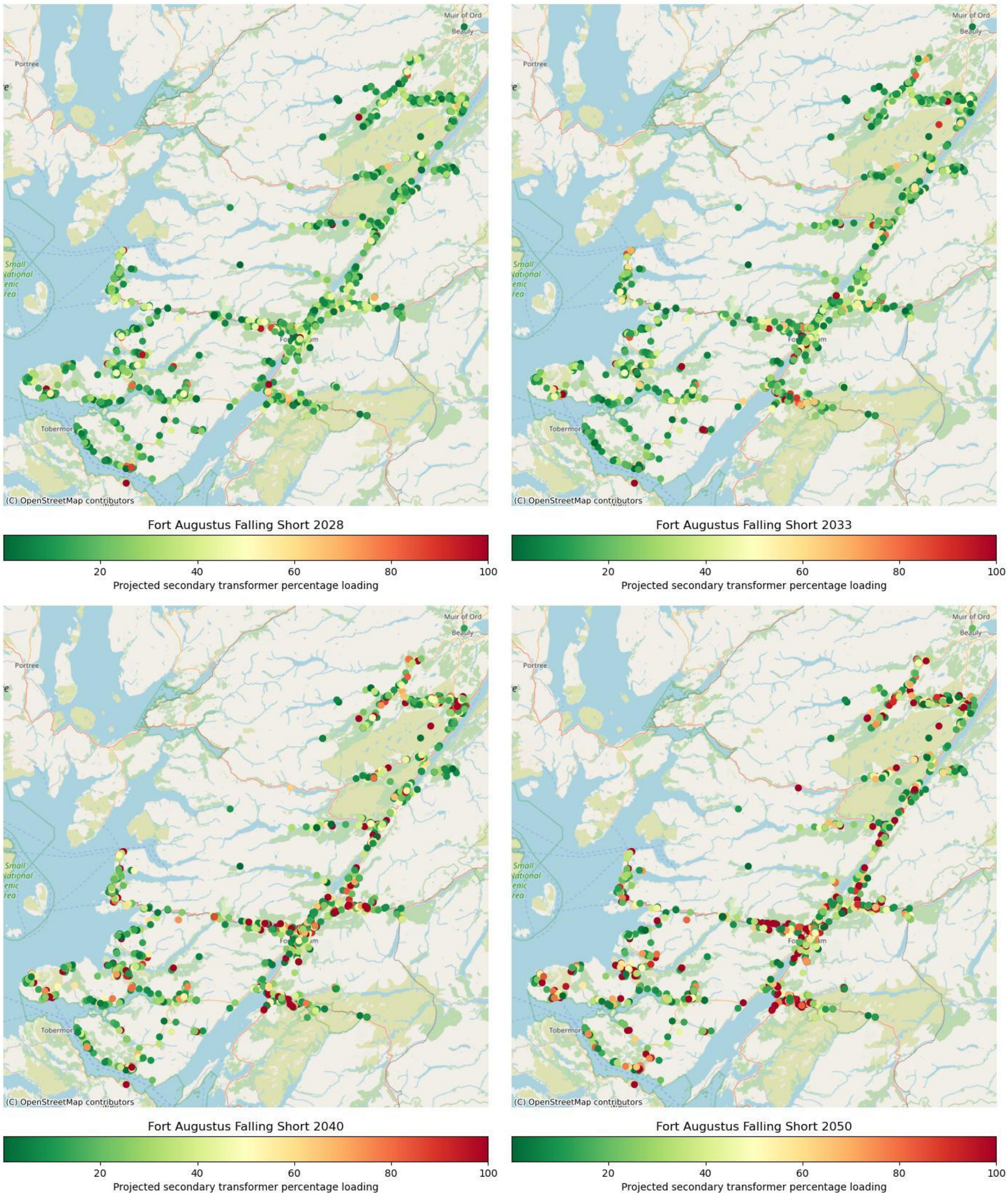


Figure 35 Fort Augustus 132kV substation HV/LV FS spatial plans for 2028, 2033, 2040, and 2050

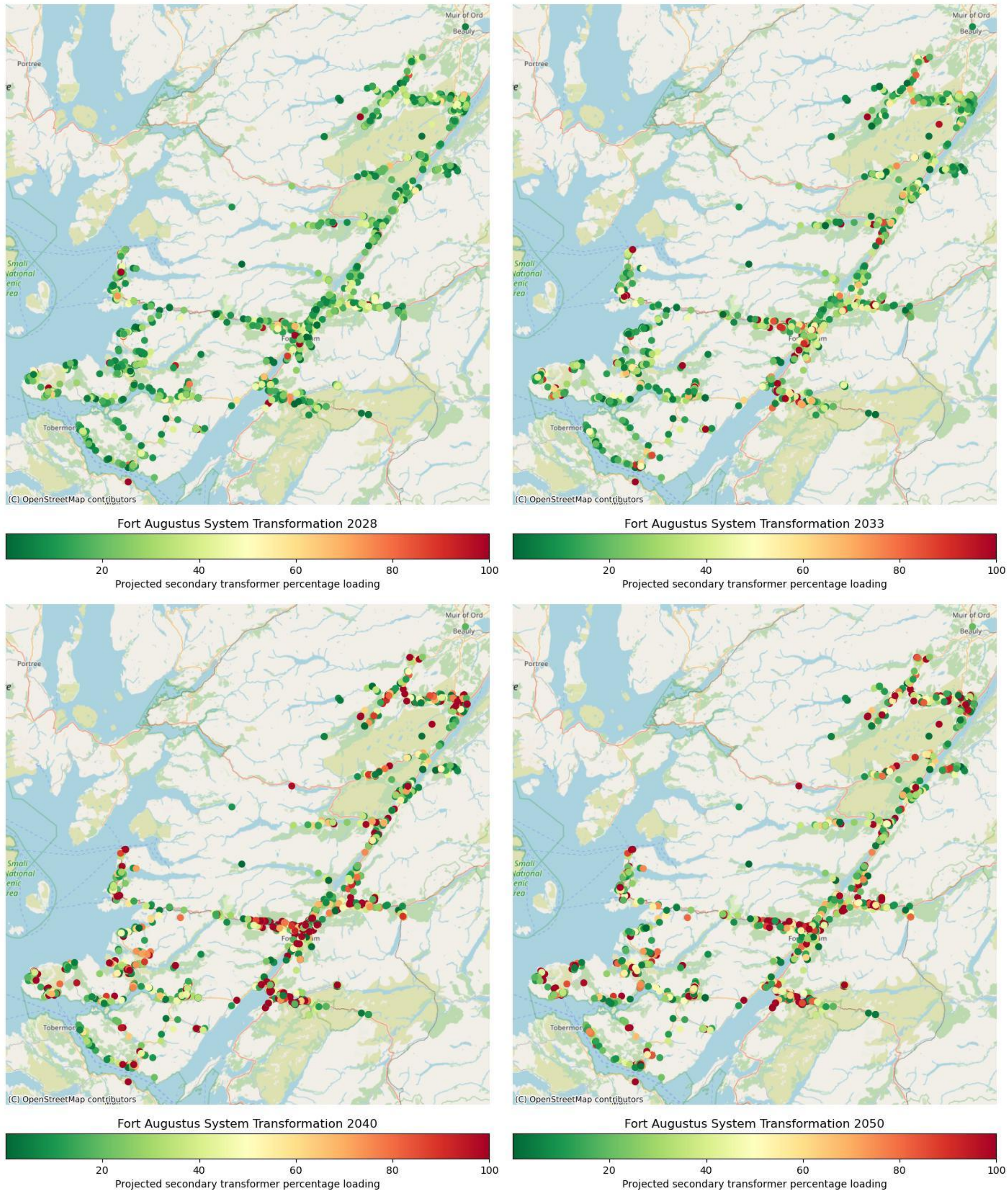


Figure 36 Fort Augustus 132kV substation HV/LV ST spatial plans for 2028, 2033, 2040, and 2050

Appendix E

Glossary

ACRONYM	DEFINITION
ANM	Active Network Management
BAU	Business as Usual
BSP	Bulk Supply Point
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

DNOA OUTCOME REPORTS

This annex shows the published DNOA Outcome Reports which are relevant to the Fort Augustus 132kV supply area.

Ap

Ardnamurchan (Salen 2 PSS)

DNOA Outcome Report
Related SDP: Inverarnan

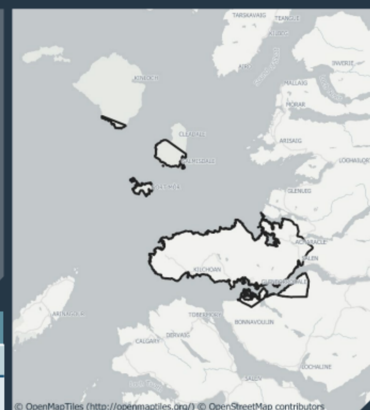
DNOA outcome: Operational management followed by asset solution.

Scheme description

- The reinforcement of the Salen 2 PSS will increase capacity in the Ardnamurchan peninsula area. Postcode(s): PH36.
- Local authority: Highland Council
- Load related – substation thermal overload issues during network intact conditions, with additional increased resilience requirements due to forecasted demand growth.

Proposed option

- Smart/Asset Solution: Reinforcement of 33/11kV transformer at Salen PSS, and installation of a new primary substation near Loch Mudle.
- Flexibility was unable to be utilised due to network resilience requirements.
- This option addresses the forecasted thermal overload at Salen 2 PSS out to 2050.
- Capacity released: 0.65MVA



Indicative flexibility price (if available)

Availability price: £ N/A /MW/h Utilisation price : £ N/A /MWh

System need requirement

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

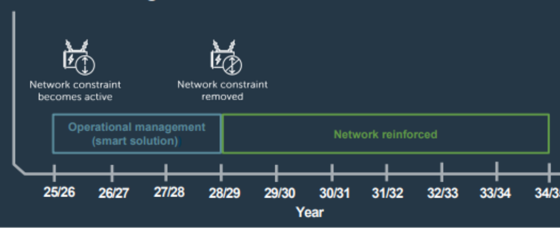
DNOA History

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

Estimated peak MW outside firm network capacity under each scenario

	25/26	26/27	27/28	28/29	29/30	30/31	31/32	32/33	33/34	34/35
CT	0.43	0.53	0.63	(0.73)	(0.73)	(0.83)	(0.93)	(0.93)	(1.03)	(1.03)
ST	0.43	0.43	0.43	(0.43)	(0.53)	(0.53)	(0.63)	(0.63)	(0.73)	(0.73)
LTW	0.53	0.53	0.63	(0.63)	(0.73)	(0.83)	(0.93)	(0.93)	(1.03)	(1.13)
FS	0.33	0.43	0.43	(0.43)	(0.43)	(0.53)	(0.53)	(0.53)	(0.63)	(0.63)

Constraint management timeline



10 | Scottish and Southern Electricity Networks Distribution | **DNOA Outcomes Report May 2025 – Ref 0525-03**

CONTACT

whole.system.distribution@sse.com

Scottish & Southern Electricity Networks