ERROCHTY 132KV SUPPLY AREA: STRATEGIC DEVELOPMENT PLAN

Our network serving communities across Perthshire and central Scotland.

Draft for consultation

October 2025

Scottish & Southern Electricity Networks

1. EXECUTIVE SUMMARY

SSEN is taking a strategic approach in 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 Abernethy, Braco West, Burghmuir, Coupar Angus, Killin, Rannoch, St Fillans and Tummel Bridge Grid Supply Points (GSPs) that make up the Errochty 132kV supply area. These GSPs predominantly supply customers located in the in the Perthshire, Stirlingshire and central Scotland area, as shown below.

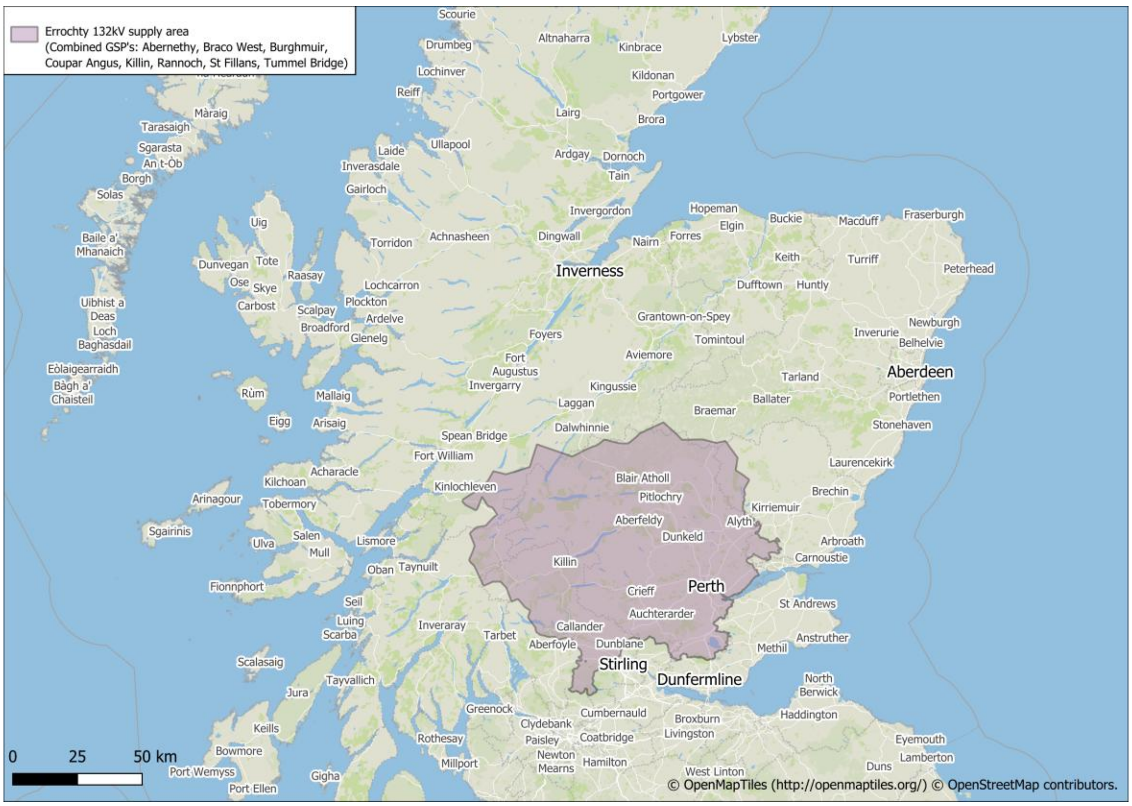

Figure 1 Area of focus for this SDP

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 central Scotland 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 align with stakeholder perspectives in the area to provide a robust evidence base for load growth out to 2050 across the Abernethy, Braco West, Burghmuir, Coupar Angus, Killin, Rannoch, St Fillans and Tummel Bridge Grid Supply Points (GSPs) that make up the Errochty 132kV supply area. A GSP is an interface point with the national transmission system where SSEN Distribution then takes power to local homes and businesses within a geographic area. Context for the area this represents is shown above in **Figure 1**.

To identify the future requirements of the electricity network, SSEN commissions 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 incorporating 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 different scenarios as we move towards the national 2050 net zero target. These scenarios are summarised in **Figure 2**. SSEN uses Holistic Transition as the central case scenario, reviewing this position annually. Any more recent unforeseen demand changes, for example customer connection requests, are also considered in our forecasts to ensure that the projected load more accurately reflects what we expect to see in the future.

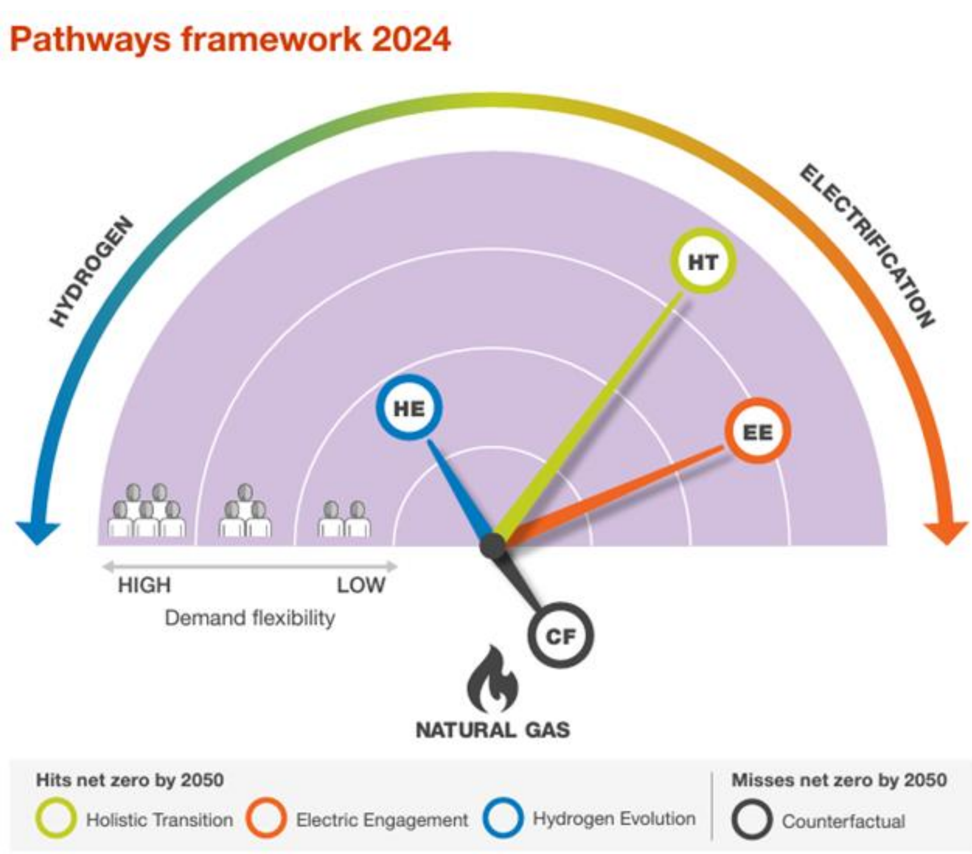

Figure 2: The FES Scenario framework (source: NESO)

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 highlighting the year the need is identified under each of the scenarios, and the projected 2050 load. System needs are identified through power system analysis using the Holistic Transition Pathway scenario, in alignment with evidence gathered in preparation for the SSEN ED2 business plan. We also model across the other scenarios to understand when these needs arise and what demand projections should be planned for in the event each scenario is realised.

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

New Pathway	Previous Scenario	Focus
Holistic Transition	**Leading the Way**	Balanced innovation: hydrogen + electrification with high ambition.
Electric Engagement	**Consumer Transformation**	Strong consumer engagement driving electrification.
Hydrogen Evolution	**System Transformation**	Infrastructure-led, hydrogen-heavy solutions for challenging sectors.
Counterfactual	**Falling Short**	Limited progress and continued reliance on fossil fuels.

Table 1 DFES Transition from Scenarios to Pathways

3. STAKEHOLDER ENGAGEMENT AND WHOLE SYSTEM CONSIDERATIONS

3.1. Local Authorities and Local Area Energy Planning

The electrical network covered by this SDP supplies Perth and Kinross Council and Stirling Council, while also supplying smaller parts of Aberdeenshire Council, Angus Council, Argyll and Bute Council, Clackmannanshire Council and The Highland Council. This report focuses on the area shown in **Figure 3** below.

The local authority 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.

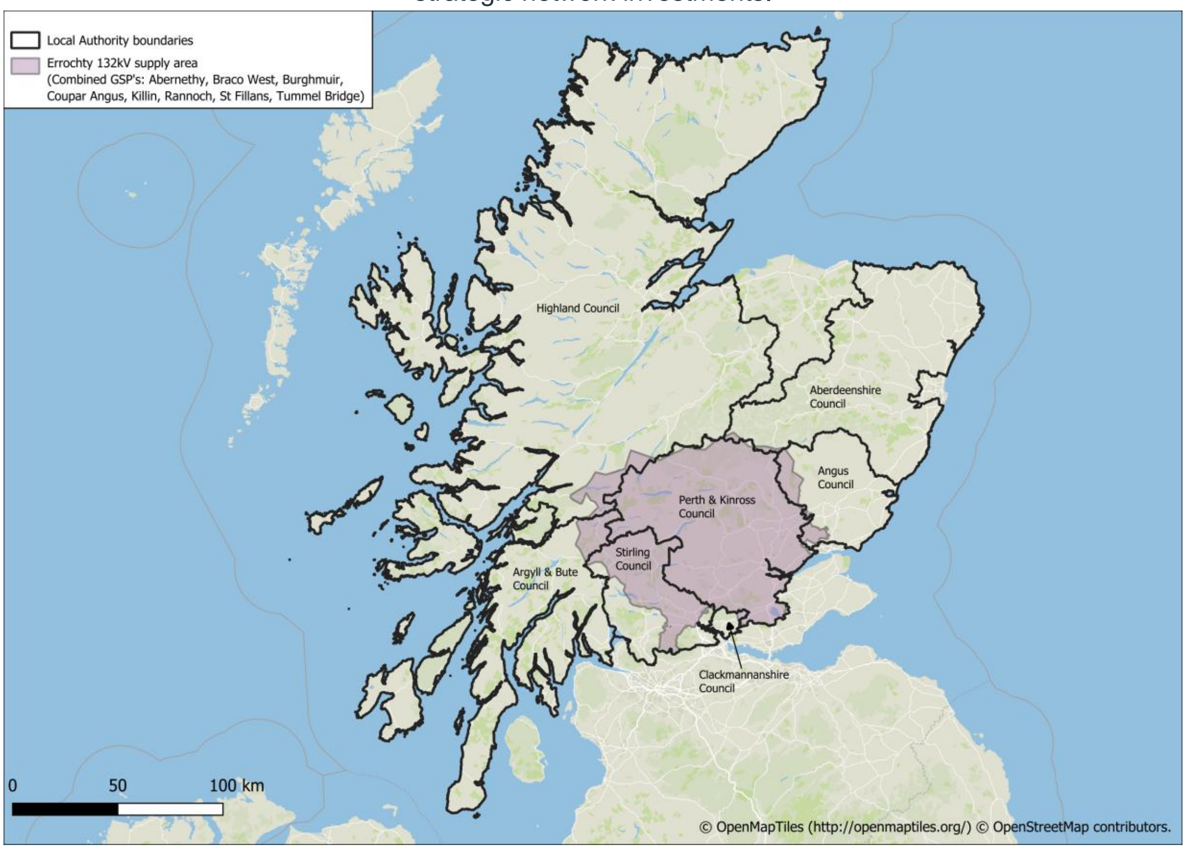

Figure 3 Errochty 132kV supply area and Local Authority Boundaries

3.1.1. Perth And Kinross Council

Perth and Kinross is a largely rural area with predominately off gas grid properties. It is the 5th largest unitary authority in Scotland, covering an area of 5,285km[1]. The total population in Perth and Kinross was estimated to be 150,953 in the 2022 Census[2], with the largest city being Perth.

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1 Local Development Plan 3 2027.pdf

2 Population and the Census - Perth & Kinross Council

In 2021, Perth and Kinross Council (PKC) published their Climate Change Strategy and Action Plan, which sets out how the area will transition to net zero carbon emissions by 2025, or sooner. Following this, the Council published their Local Area Energy Plan (LAEP) and Local Heat and Energy Efficiency Strategy (LHEES) plans, which will form part of the overall decarbonisation strategy for the area. PKC is one of two local authorities in Scotland that have created a LAEP to date, the plan includes recommendations for achieving the 2045 target whilst taking a whole systems approach.

SSEN have a collaborative working relationship with Perth and Kinross Council and there are future plans for the Council to submit their future demand projections via SSEN's LENZA[3] platform.

3.1.2. Stirling and Clackmannanshire Council

Stirling Council recorded an estimated population of 92,530 in the 2022 Census, with Stirling being its largest city. Two Distribution Network Operators (DNOs) manage the area's electricity supply: SSEN Distribution and Scottish Power Energy Networks (SPEN). Stirling itself falls within SPEN's licence area, while SSEN predominantly serves the region's more rural areas.

Clackmannanshire Council is the second smallest local authority in Scotland, covering roughly 159km^{2}. The population for the area is estimated to be 51,940, making it the smallest council by population in Scotland. The main settlement is Alloa, with a population of 20,750[4].

Clackmannanshire Council and Stirling Council have developed a Regional Energy Masterplan, which was approved by both councils in December 2023. They are both aiming to achieve net zero by 2045. The masterplan outlines strategies for enhancing energy efficiency, optimising heat management, increasing renewable energy generation, and sequestering residual emissions to reach net zero. Additionally, the plan fulfils the statutory requirements of the Local Heat and Energy Efficiency Strategies (LHEES). Clackmannanshire Council have also developed their Climate Change Strategy, which sets out how they plan to reach net zero.

3.1.3. 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[5].

Highland Council has published their Net Zero Strategy[6] 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[7]. 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:

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3 LENZA - SSEN

4 Clackmannanshire Facts and Figures

5 City_Region_Deal_Annual_Report_2024.pdf

6 Net Zero Strategy | Climate change | The Highland Council

7 Net Zero Strategy | Climate change | The Highland Council

- 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[8] 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[9].

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.

3.1.4. Argyll & Bute Council

The 2022 Census enumerated the population of Argyll and Bute at 86,000. The National Records of Scotland (NRS) more recent mid-year estimates calculated Argyll and Bute's population to be 87,920 (NRS' 2022 based Mid-Year Estimates)[10]. Argyll and Bute council has the 27th highest population out of all 32 council areas in Scotland and covers the second-largest administrative area of any Scottish council, making up almost 9% of the country's land mass. It has the fourth sparsest population of the 32 Scottish local authorities, with an average population density of 13 persons per hectare. The area has a diverse and vibrant economy, driven primarily by tourism, aquaculture, forestry, distilleries, and renewable energy.

Argyll and Bute Council has committed to become a Net Zero organisation by 2045 in alignment with national targets. In their 2022-2025 Decarbonisation Plan, the Council states that they endeavour to install more solar PV on council buildings, identify further opportunities for renewable energy sourcing, and produce an Electric Vehicle Infrastructure Strategy. The Council is expanding the electric vehicle charge point network via funding secured from Scottish Government. This may involve installing higher voltage connections for rapid charging in towns, villages, and ferry departure points, which are often rural locations. Through March 2026, residents in rural areas can take advantage of ECO Grants to install heat pumps and insulation in their homes.

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

9 Electric Vehicle Infrastructure Fund | Transport Scotland

10 Argyll-bute.gov.uk, May 2024, Population: Where We Live.

3.1.5. Angus Council

Angus, on Scotland's East coast, has both rural and urban areas. Its main towns include Arbroath, Brechin, Carnoustie, Forfar, Kirriemuir, Monifieth, and Montrose. According to the 2022 Census, Angus has an estimated population of 114,660.

In September 2022, Angus Council approved the Transition to Net Zero Action Plan (2022-2030) to meet the Scottish Government's interim emissions reduction target of 75% by 2030 and achieve Net Zero by 2045. The council also developed LHEES Strategy and Delivery plans to explore energy efficiency and heat decarbonisation options for the area.

3.1.6. Aberdeenshire Council

In 2021, Aberdeenshire's population was 262,690, which is around 0.7% increase from 2020. Prior to 2021, the population had fallen for four consecutive years after a long period of rapid growth up until 2014/15. Aberdeenshire is the fourth largest local authority area by land area in Scotland. The area is largely rural, with the largest towns being Peterhead, Inverurie, Fraserburgh, Westhill, Stonehaven and Ellon. Aberdeenshire Council has a target of 75% reduction in emissions by 2030 (from its 2010 – 2011 baseline), and aims to reach net zero by 2045, in alignment with the Scottish Government's national target. The Council published their Local Heat and Energy Efficiency Strategy (LHEES) in July 2024 and are currently preparing their LHEES delivery plan. The LHEES sets out the Council's long-term plans for decarbonising heat in buildings and improving energy efficiency across the local authority area. The Council has also developed a 'Route Map to 2030 and Beyond', which sets out the requirements and investment needed to reach the net zero by 2045 ambition. The North of Scotland, encompassing Aberdeen City, Aberdeenshire, Moray, and Highland Councils, have been awarded £6.86 million in grant funding from the £30 million Scottish Government Electric Vehicle Infrastructure Fund, effective from Spring 2025.

The Council continues to expand the electric vehicle charging network across the region and is assessing the feasibility for heat pumps, solar PV, and battery storage installations on council-owned buildings. Grants for Air Source Heat Pumps are available through March 2026 to residents across rural Aberdeenshire whose properties are oil or LPG heated. Their 2023 Local Development Plan states that they aim to have one electric vehicle charge point for every 25 employees in workplace parking sites. Aberdeenshire Council has signed up and been boarded onto the SSEN's LENZA platform.

3.2. Whole System Considerations

SSEN has strong working relationships with stakeholders across the Errochty 132kV supply area. We have met with several council representatives to discuss local area energy planning and have engaged with Scottish Government's LHEES Forum, Community Energy Scotland, Transport Scotland, and the Scottish Futures Trust. This engagement has helped SSEN to stay informed about planning and development that will impact local communities' use of the network. Both Councils have been onboarded to SSEN's LENZA platform.

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 with SSEN having committed to removing LMAs during ED2 and ED3.

The percentage of customers subject to LMA rulings are outlined in **Table 2** below.

Substation Name	Site Type	% of RTS customers
Abernethy GSP	Grid Supply Point	10.97%
Braco West GSP	Grid Supply Point	12.47%
Burghmuir GSP	Grid Supply Point	14.97%
Coupar Angus GSP	Grid Supply Point	12.13%
Killin GSP	Grid Supply Point	22.73%
Rannoch GSP	Grid Supply Point	20.18%
St Fillans	Grid Supply Point	12.78%
Tummel Bridge GSP	Grid Supply Point	16.47%

Table 2 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 Scotland area and the Errochty 132kV supply area there are a number of contracted generation connections due to connect to the transmission network. To facilitate this, SSEN Transmission currently have a strong presence in the central Scotland area, 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 four projects that are relevant to the Errochty 132kV switching station:

- Beauly – Denny 400kV Upgrade[11]
- Cambushinnie 400kV Substation[12]
- Errochty Grid Supply Point[13]
- Lochay 132/11kV Transformer Replacement[14]

11 Beauly Denny 400kV Upgrade - SSEN Transmission

12 Cambushinnie 400kV Substation - SSEN Transmission

13 Errochty GSP - SSEN Transmission

14 Lochay 132/11kV Transformer Replacement - SSEN Transmission

Beauly – Denny 400kV Upgrade

In order 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 for the Beauly – Denny Second Circuit 400kV Upgrade Project and new 400kV substations at Braco West and Fasnakyle. The project includes the following elements:

- A new 400kV substation at Braco West, known as Cambushinnie
- A new 400kV substation at Fasnakyle (near Beauly), known as Bingally
- Modifications or extensions to other substations along the route, including Fort Augustus, Errochty, Kinardochy and Tummel
- Connections to existing substations will also be required as part of the upgrade

Cambushinnie 400kV Substation

The proposed Cambushinnie 400kV substation is located immediately west of the existing Braco West 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. This project is currently in early development and as such any projected completion timeline is yet to be confirmed.

Errochty Grid Supply Point

A new Errochty GSP is to be built that will provide a 33kV connection point to accommodate generation and demand currently served by Tummel Bridge GSP. This follows the requested capacity increase for Tummel Bridge Hydro Power station.

The scope of this project includes the creation of a new 132/33kV Errochty GSP, followed by the transfer of the existing Tummel GSP Network to the new Errochty GSP. This involves diverting the five 33kV circuits from the existing Tummel 33kV switchboard to a new 33kV switchboard at Errochty GSP. One further circuit will need to be established to serve Tummel primary substation, which will be disconnected from the existing 4H0 33kV circuit, which currently feeds Tummel Power Station.

Lochay 132/11kV Transformer Replacement

The two 25MVA 132/11kV grid transformers at Lochay Power Station have reached the end of their operational lives and are due to be replaced.

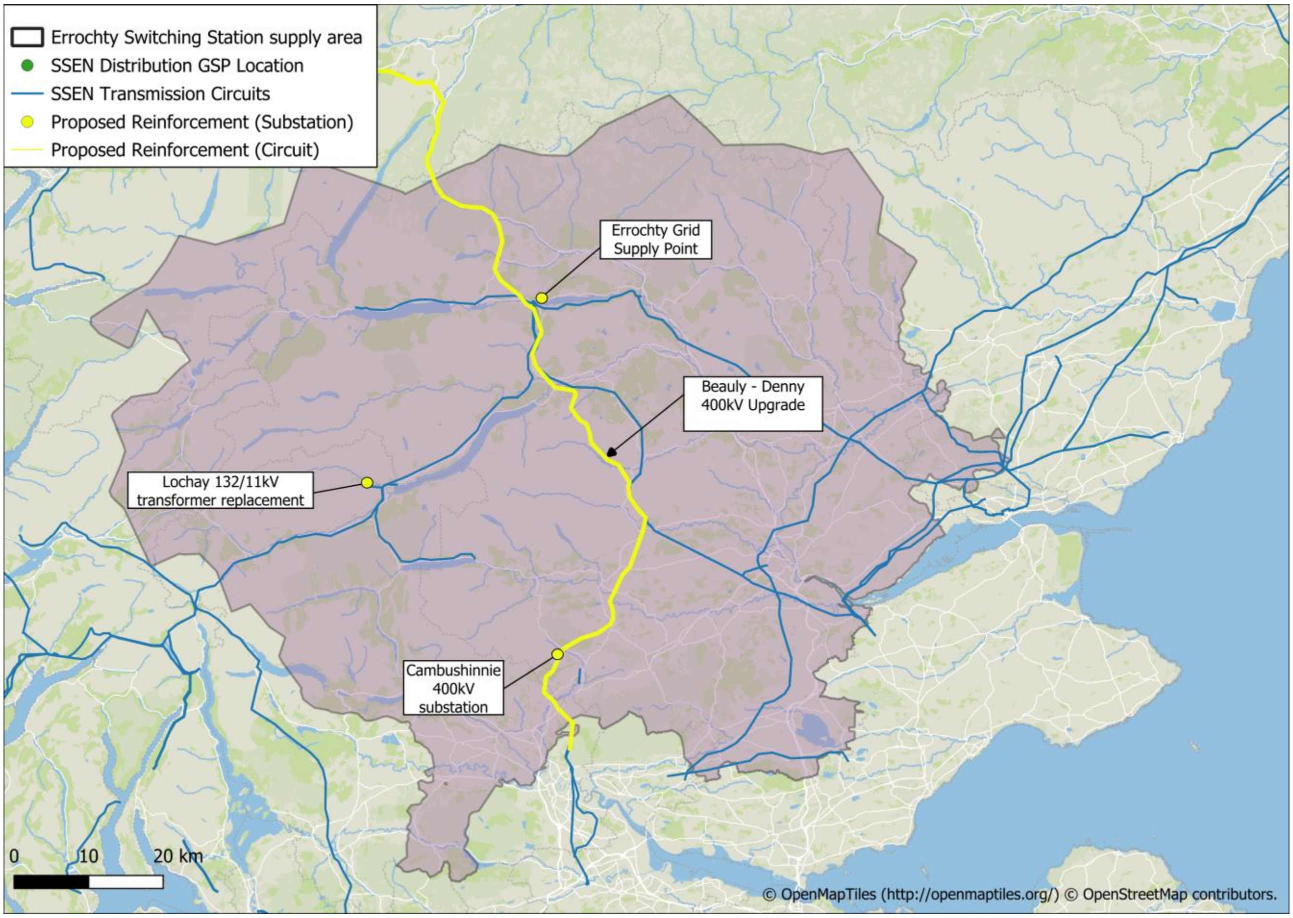


Figure 4 Transmission Infrastructure planned within the Errochty 132kV supply area.

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 a number of 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. Ongoing Area developments

New Grid Supply Points (GSPs)

We are aware of a number of potential new GSPs being developed for generation connections within the Errochty 132kV supply area. We will monitor the progress of these with SSEN Transmission as Connections Reform develops.

3.4. 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.[15,16]

SSEN regularly recruits new flexibility services providers and increases the procured flexibility services with the latest bidding round for long term requirements held in May 2025 and recruitment through the Mini-Competition process in Mid-July 2025.

Areas across the Errochty 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 for managing the deferral of reinforcement.

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

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

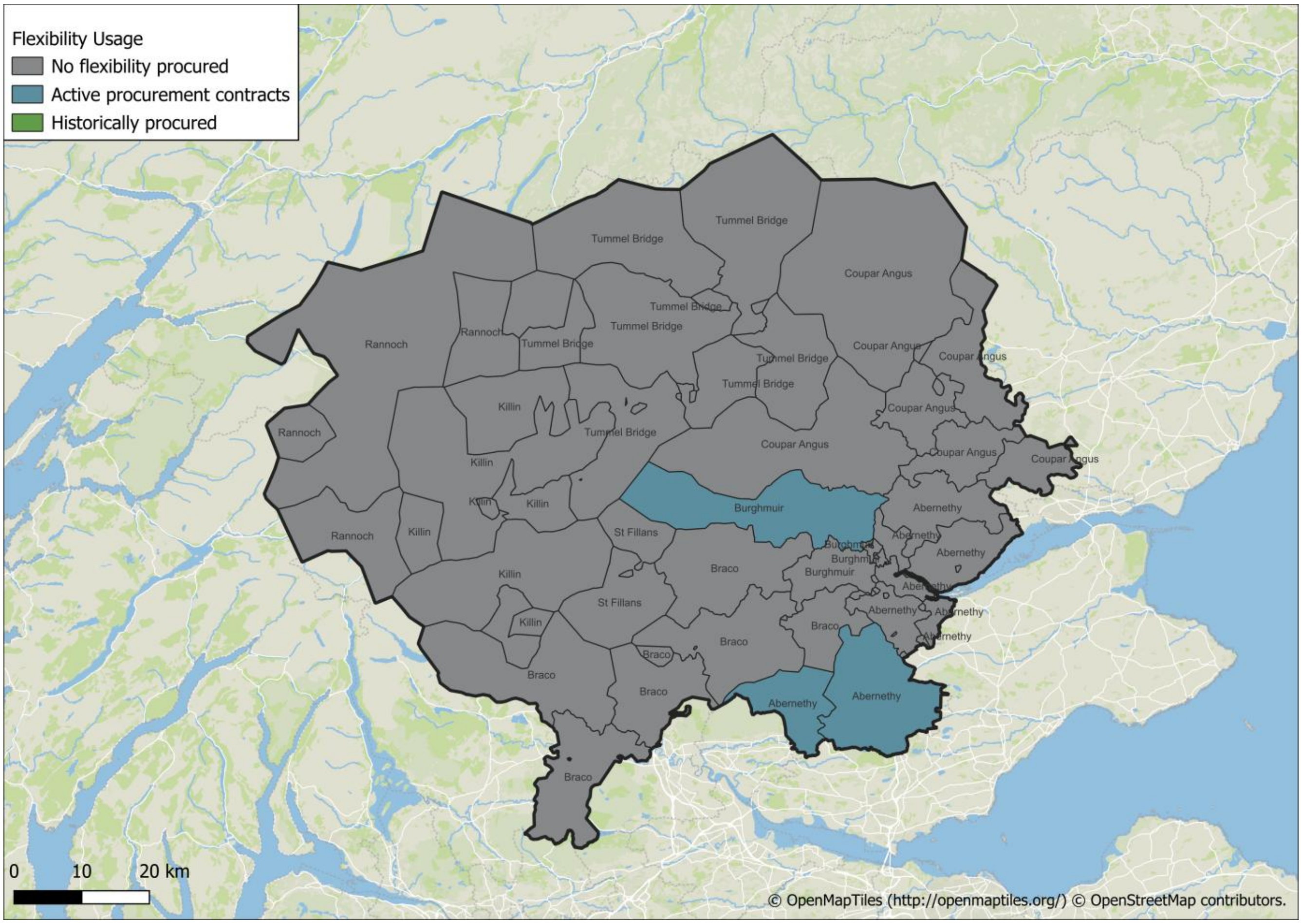


Figure 5 Flexibility procurement areas across Errochty 132kV supply area

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 are currently no active ANM schemes in operation within the Errochty 132kV supply area. Any future requirement to introduce ANM to the transmission or distribution network should be thoroughly assessed with engagement between SSEN Distribution, SSEN Transmission & the National Energy System Operator (NESO).

4. EXISTING NETWORK INFRASTRUCTURE

4.1. Errochty 132kV Supply Area Context

The Errochty 132kV supply area network is made up of 33kV, 11kV, and LV circuits. It is a mix of rural and urban network spanning across the central Scotland 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 Errochty 132kV switching station supplies approximately 94,000 customers with the breakdown for each Grid Supply Point shown in **Table 3** below. Values include appropriate output from distribution connected BESS. 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)
Abernethy GSP	Grid Supply Point	22,935	57.89 (Winter)
Braco West GSP	Grid Supply Point	20,575	39.44 (Winter)
Burghmuir GSP	Grid Supply Point	24,177	41.00 (Winter)
Coupar Angus GSP	Grid Supply Point	16,107	55.16 (Winter)
Killin GSP	Grid Supply Point	1,783	5.73 (Winter)
Rannoch GSP	Grid Supply Point	506	45.42 (Winter)
St Fillans GSP	Grid Supply Point	1,386	15.11 (Winter)
Tummel Bridge GSP	Grid Supply Point	6,836	113.50 (Winter)
TOTAL		94,305	273.25 (Winter)

Table 3 Customer number breakdown and substation peak demand readings (2024)

4.2. Current Network Topology

The **Figure 6** below highlights the existing 33kV network topology in the Errochty 132kV supply area. The SSEN Transmission network supplies the distribution network at eight Grid Supply Point (GSP) sites. It is then distributed to the 49 primary substations via the 33kV distribution network.

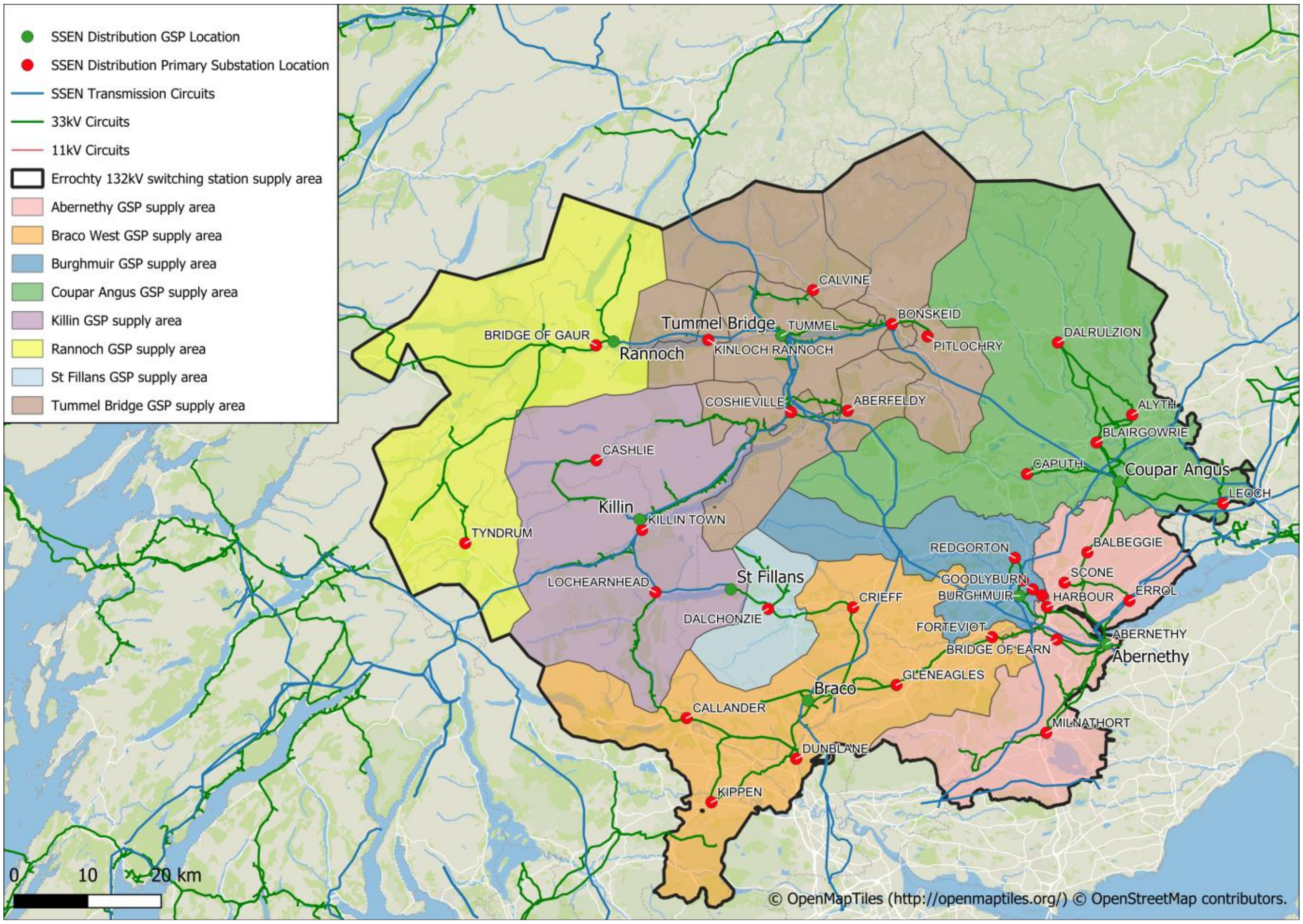


Figure 6 Errochty 132/33kV network by GSP supply area- Geographic Information System (GIS) View

4.3. Network Schematic

The network schematics in **Figures 7-14** (below) depict the existing 33kV distribution network at Abernethy, Braco West, Burghmuir, Coupar Angus, Killin, Rannoch, St Fillans and Tummel Bridge GSPs.

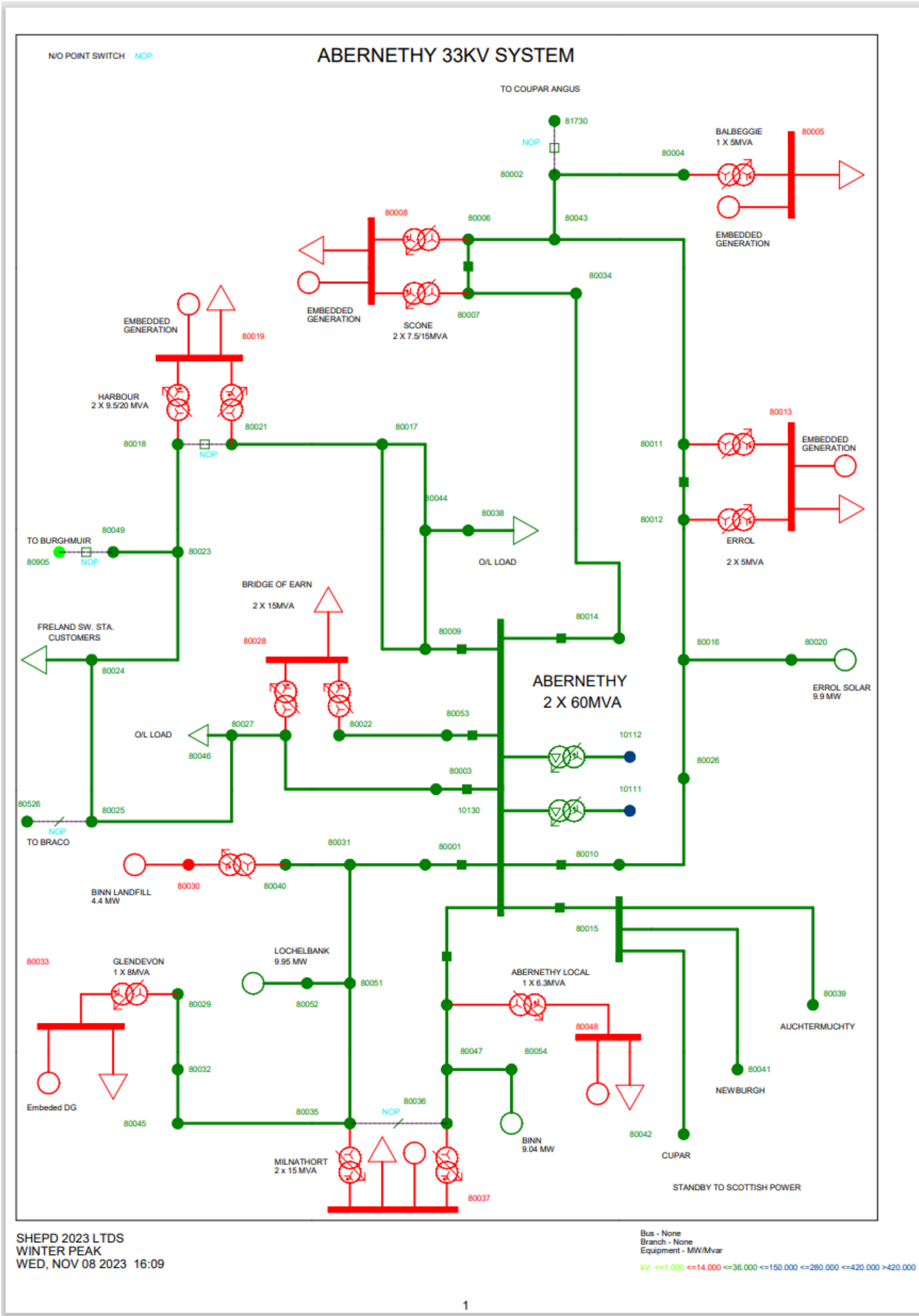


Figure 7 Existing Abernethy 33kV network schematic

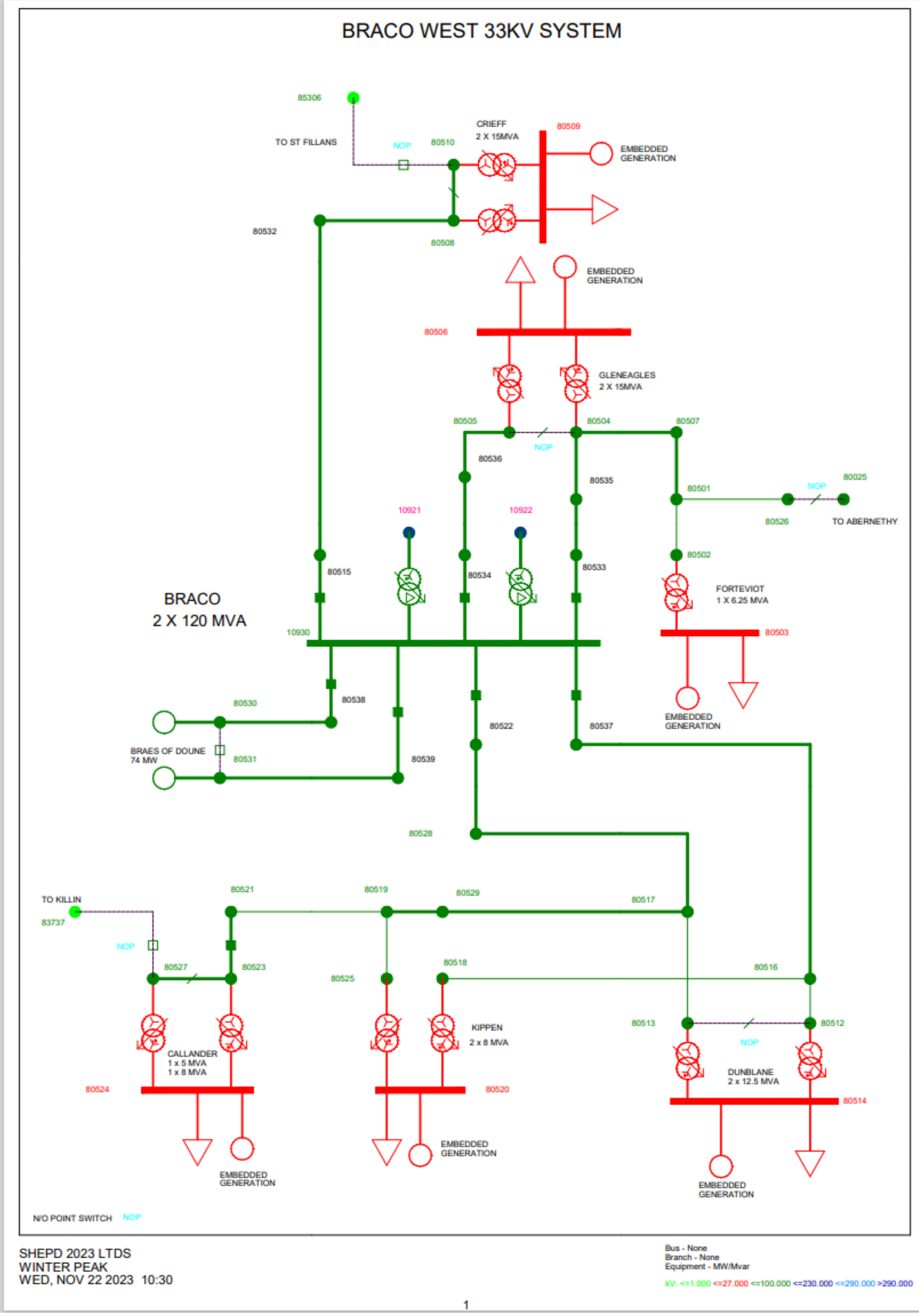


Figure 8 Existing Braco West 33kV network schematic

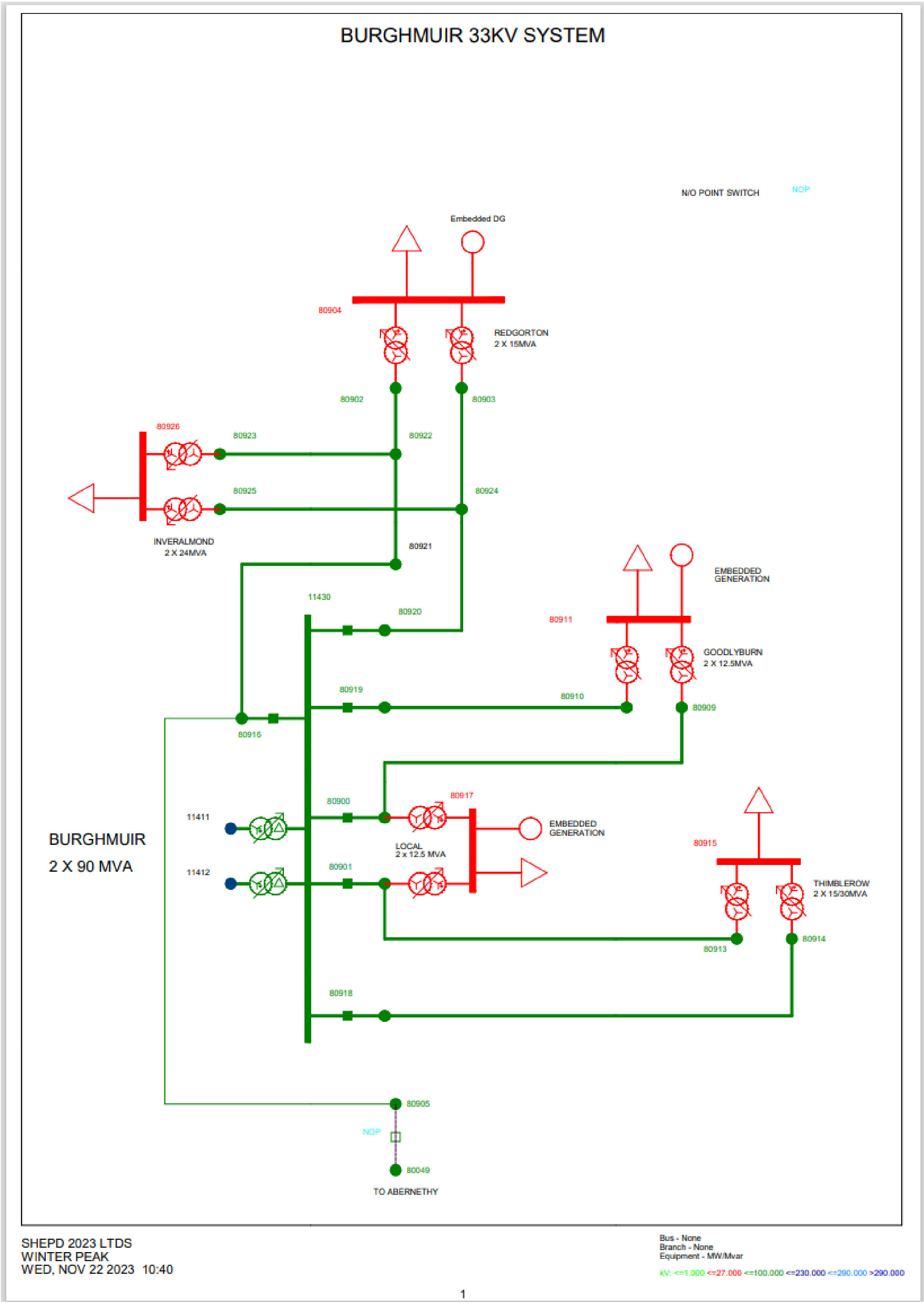


Figure 9 Existing Burghmuir 33kV network schematic

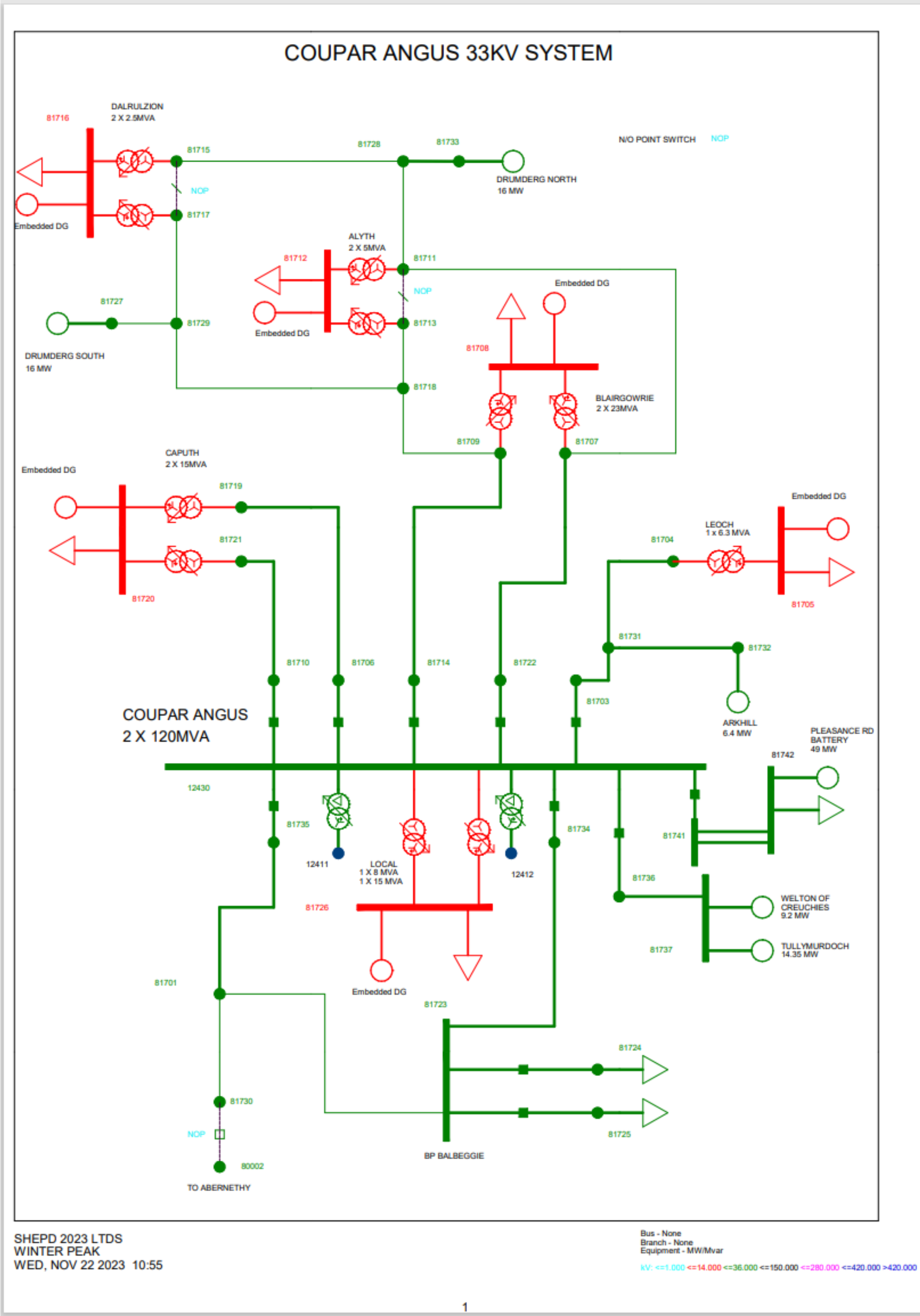


Figure 10 Existing Coupar Angus 33kV network schematic

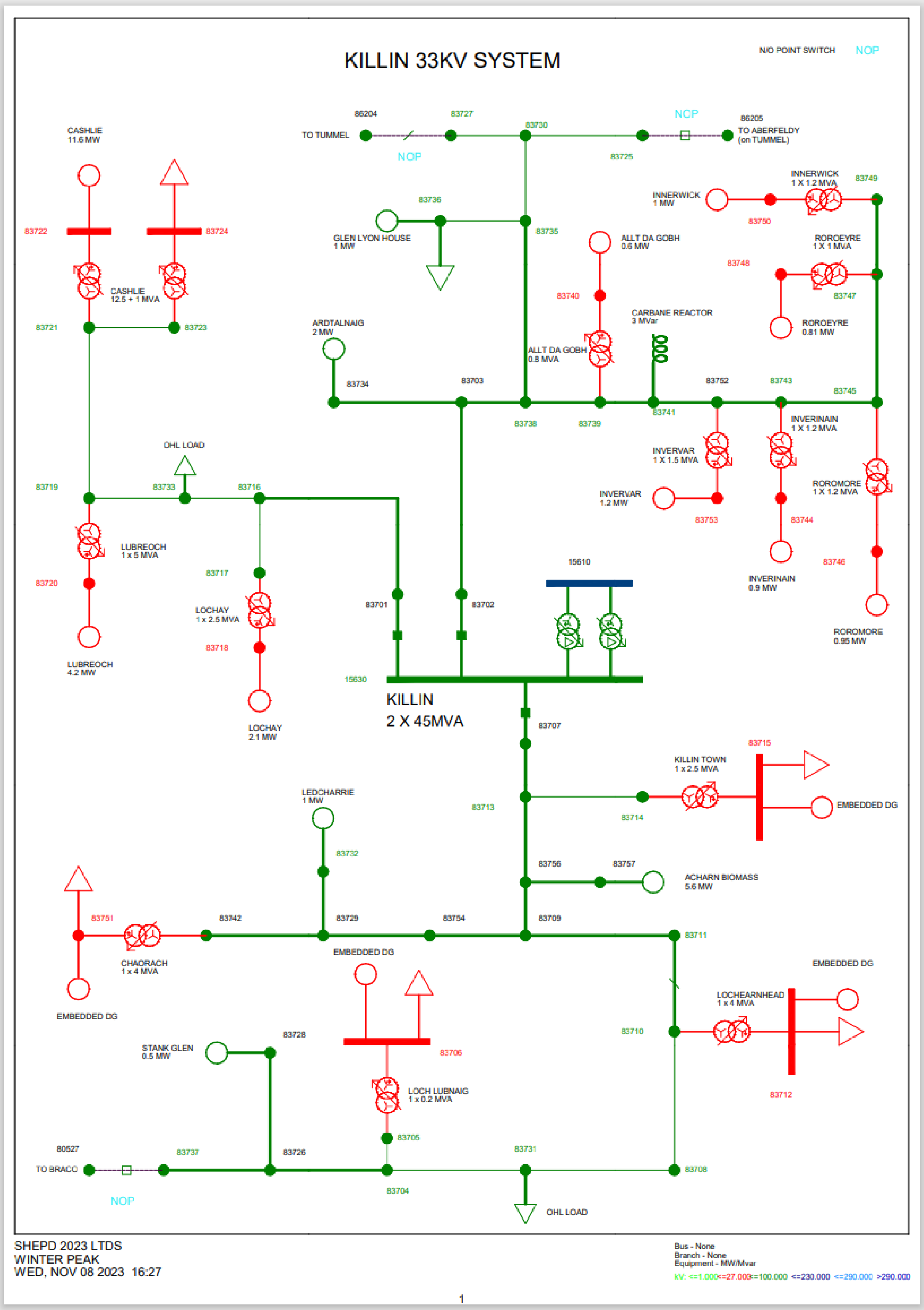


Figure 11 Existing Killin 33kV network schematic

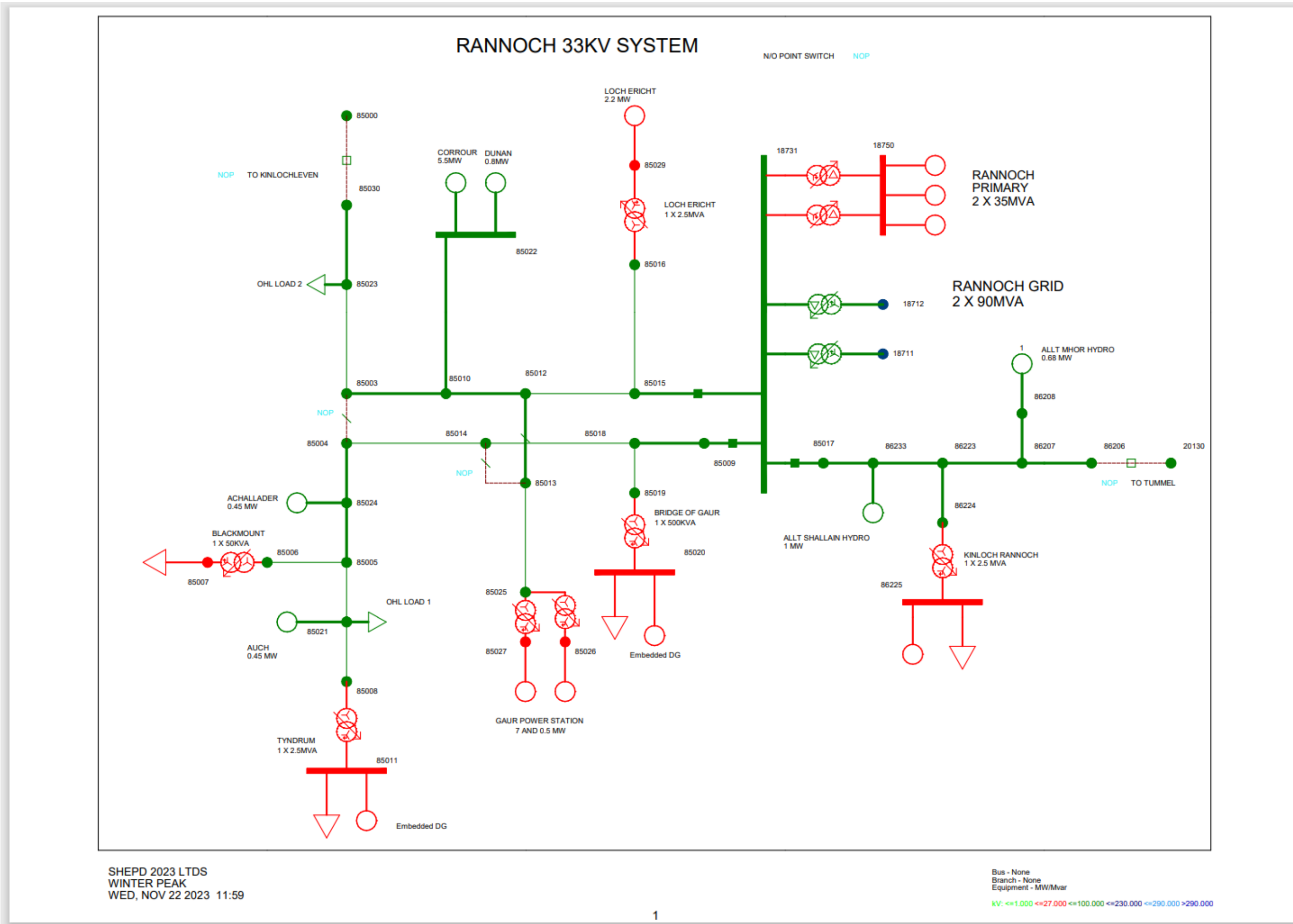


Figure 12 Existing Rannoch 33kV network schematic

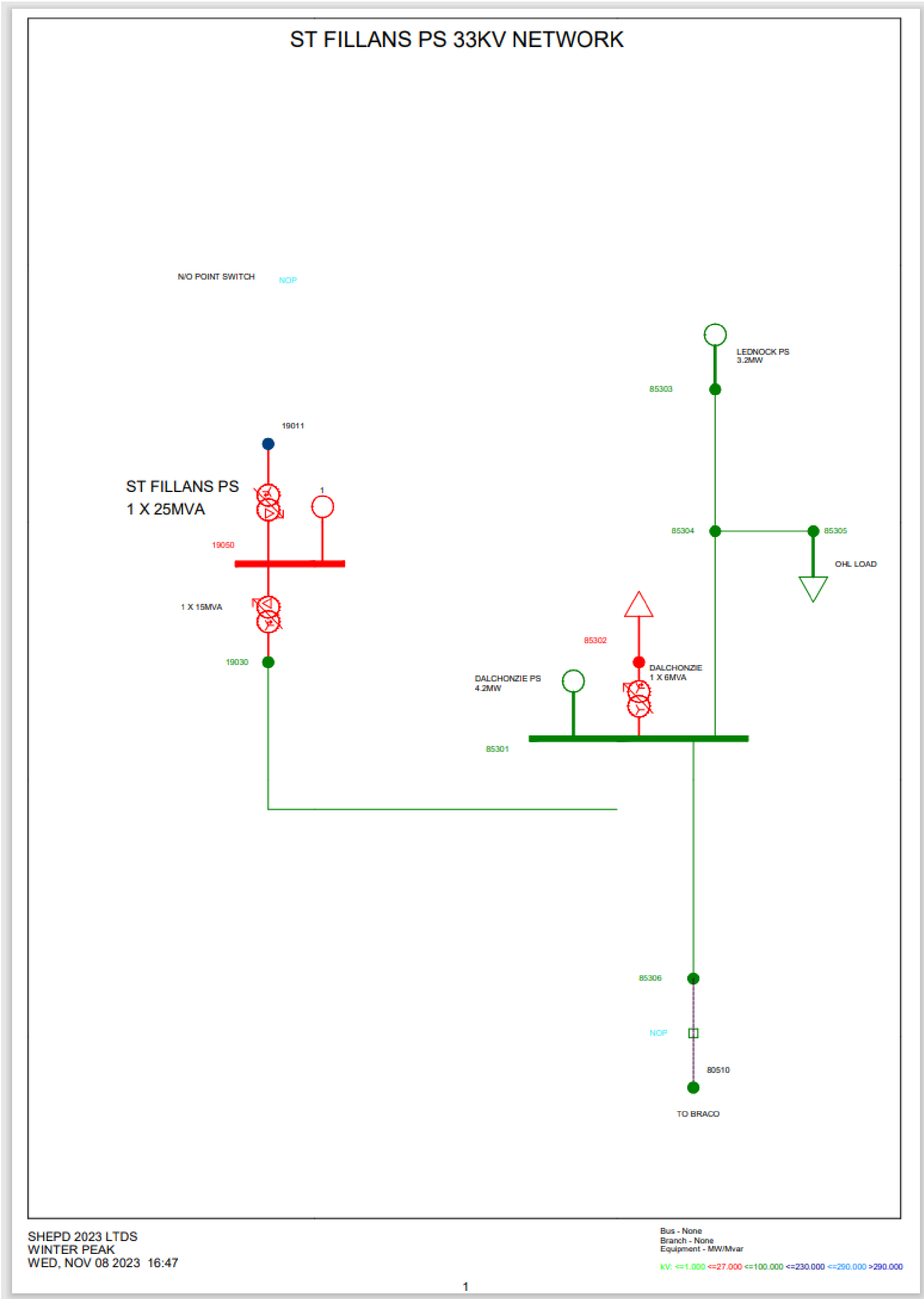


Figure 13 Existing St Fillans 33kV network schematic

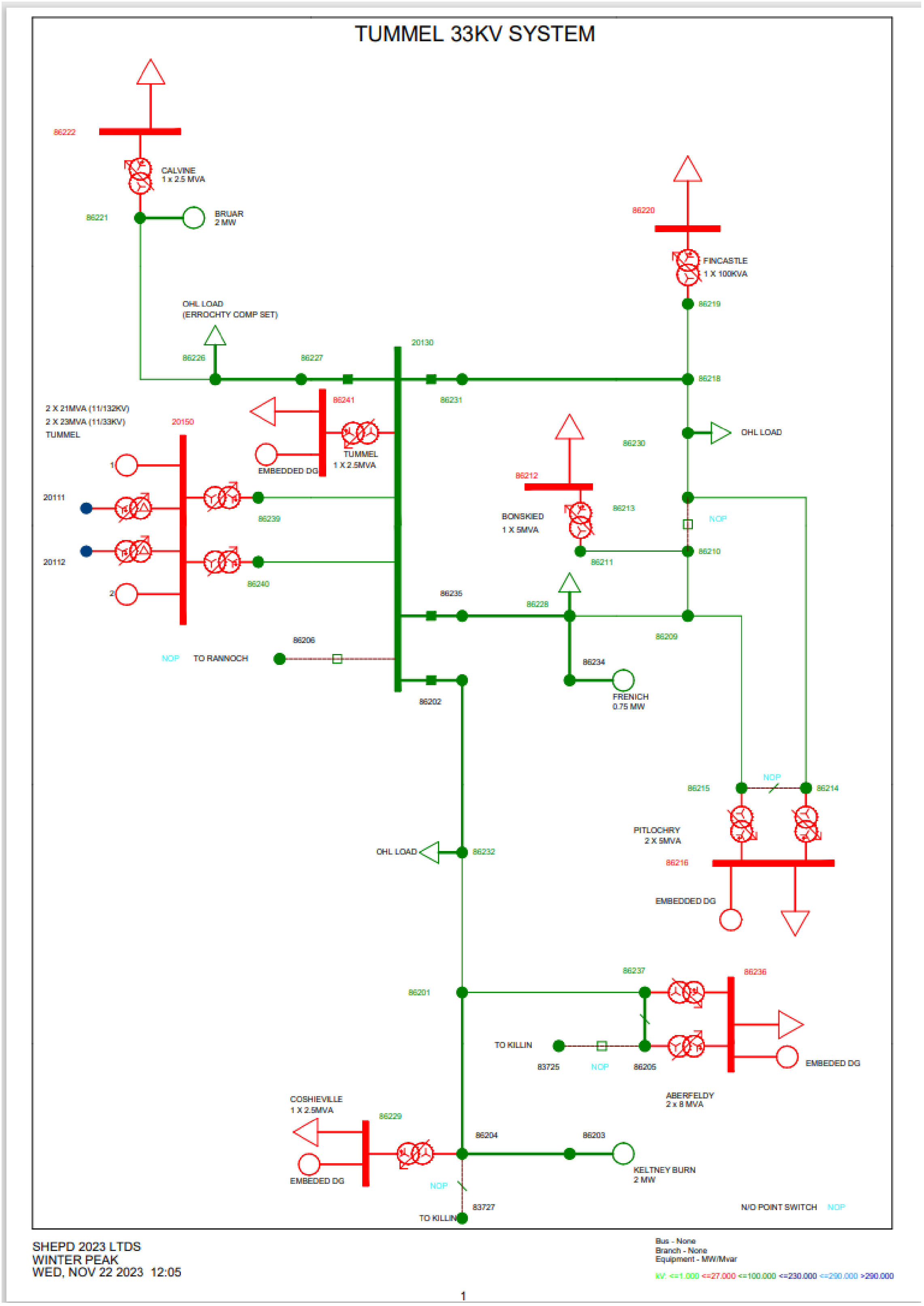


Figure 14 Existing Tummel 33kV network schematic

5. FUTURE ELECTRICITY FORECASTS IN ERROCHTY 132KV SUPPLY AREA

The following section details load growth across the technologies projected in the Distribution Future Energy Scenarios (DFES). There are important notes on the values presented here:

- This SDP and the analysis conducted has been completed ahead of any changes arising from Clean Power 2030.
- These projections relate to the 132kV supply area highlighted in **Figure 6** and are not directly aligned to a particular local authority.
- Where MW values are presented in this section, they represent **total installed capacity.** When conducting network studies these values are appropriately diversified to reflect the likely peak demand experienced on the network. Diversifying load values accounts for the fact that not all demand load connected to the network peaks at the same time and so provides a more realistic total expected peak power.
- For projections specific to individual primary substations or local authorities, please refer to our online dashboard.[17]

5.1. Generation and Electricity Storage

The totals presented in this section relate to generation and storage projects connected to the local distribution networks rather than those connected directly the transmission network.

DFES Scenario	Generation capacity (MW)				Electricity storage capacity (MW)			
	Baseline	2030	2040	2050	Baseline	2030	2040	2050
Holistic Transition	379MW	715MW	1,392MW	1,755MW	99MW	674MW	822MW	868MW
Electric Engagement		834MW	1,295MW	1,679MW		515MW	639MW	696MW
Hydrogen Evolution		607MW	971MW	1,352MW		427MW	529MW	571MW
Counterfactual		505MW	692MW	914MW		423MW	485MW	513MW

Table 4 Distribution Connected Generation and Electricity Storage projections in Errochty 132kV supply area. Source: SSEN DFES 2024

17 SSEN DFES Technology Projections - Microsoft Power BI

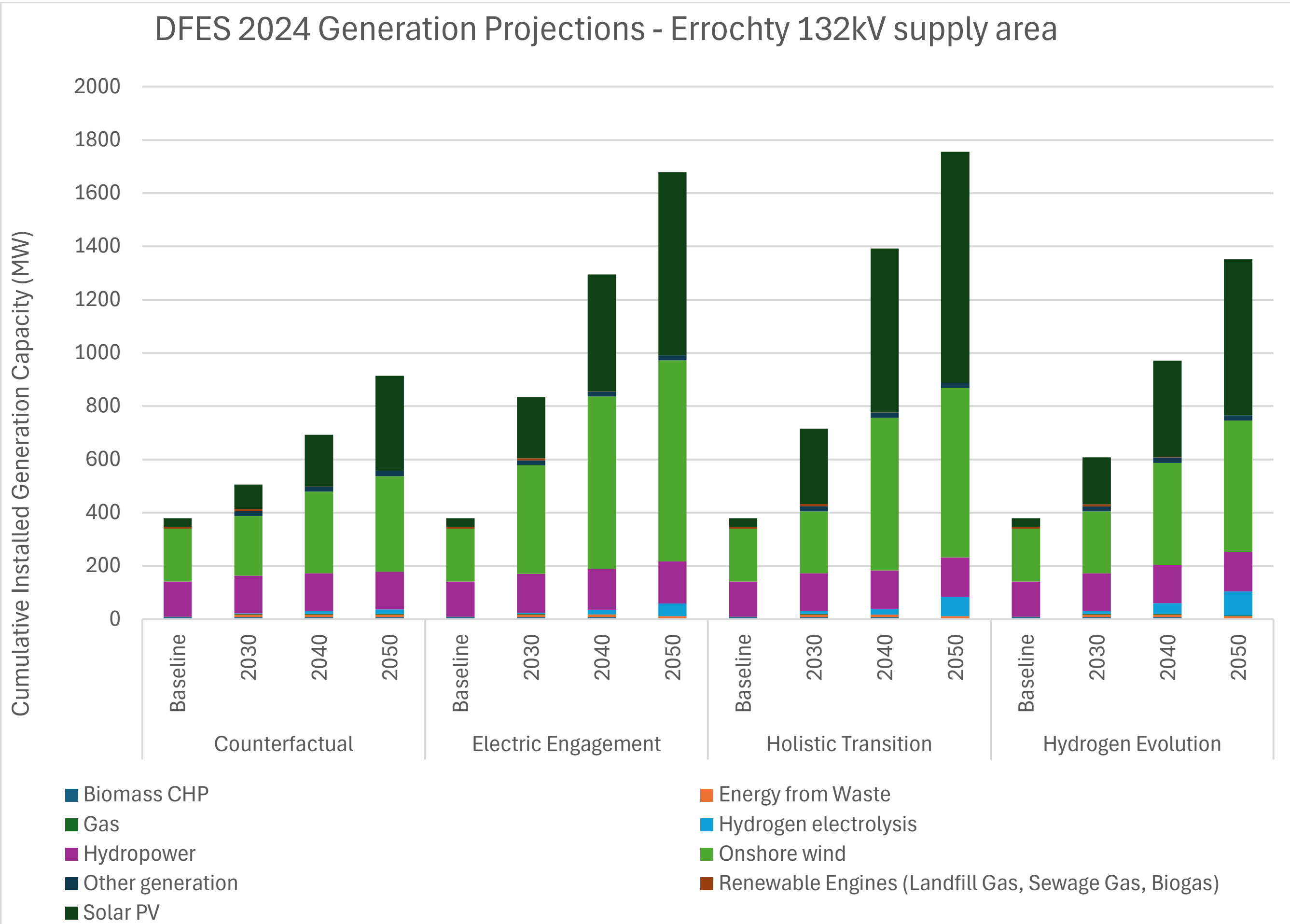


Figure 15 Projected Cumulative Distributed Generation Capacity Errochty 132kV supply area (MW). Source: SSEN DFES 2024

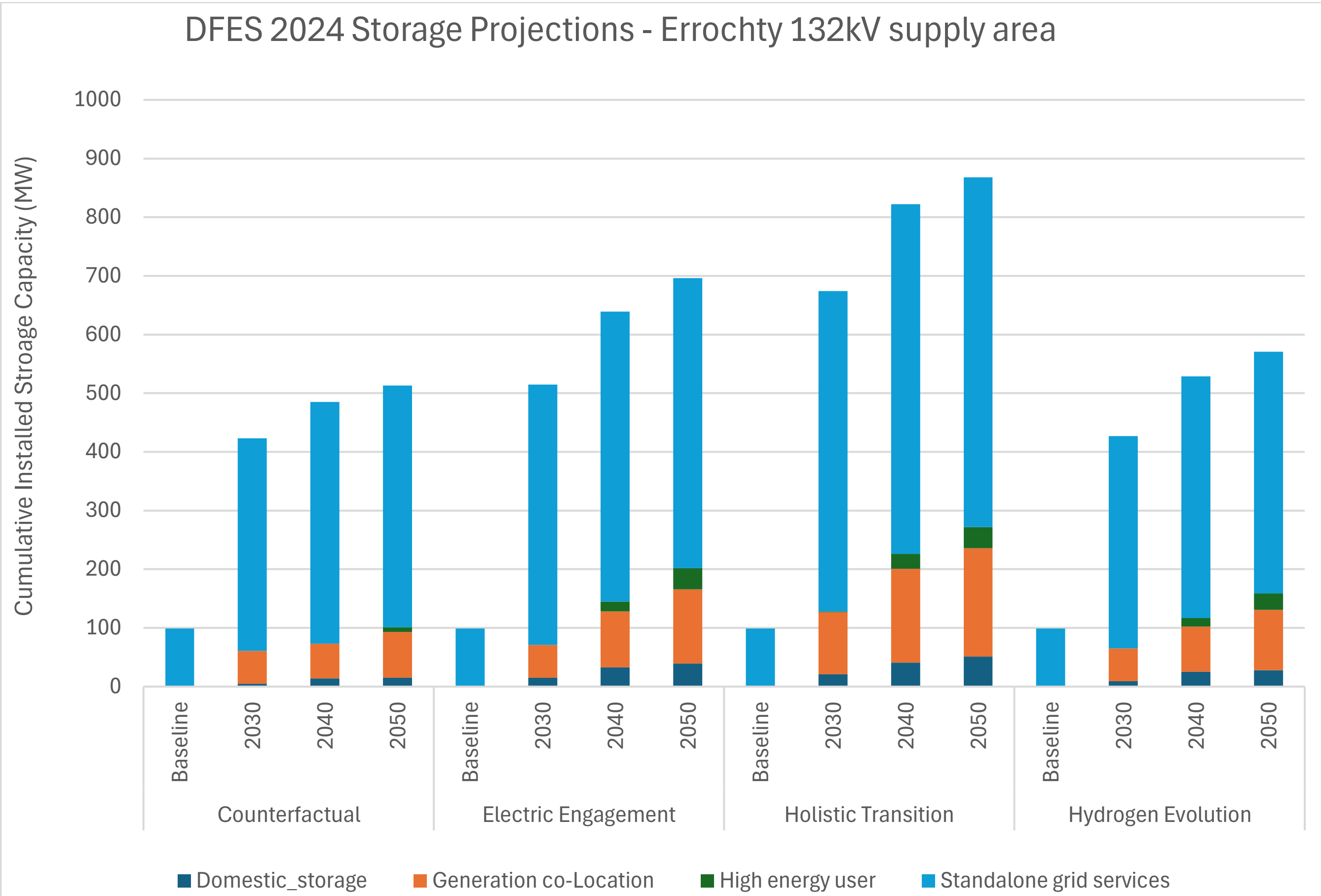


Figure 16 Projected Cumulative Storage Capacity Errochty 132kV supply area (MW). Source: SSEN DFES 2024

5.2. Electric Vehicle Charging

DFES Scenario	Domestic EV chargers – off-street (number of units)				Non-domestic EV chargers & domestic on-street EV chargers (MW)			
	Baseline	**2030**	**2040**	**2050**	**Baseline**	**2030**	**2040**	**2050**
Holistic Transition	1,405	15,560	58,861	60,527	4MW	22MW	110MW	132MW
Electric Engagement		25,347	58,830	60,128		41MW	132MW	155MW
Hydrogen Evolution		15,478	58,864	60,353		30MW	136MW	150MW
Counterfactual		12,668	47,292	60,589		16MW	81MW	145MW

Table 5 Electric vehicle charging projections in Errochty 132kV supply area. Source: SSEN DFES 2024

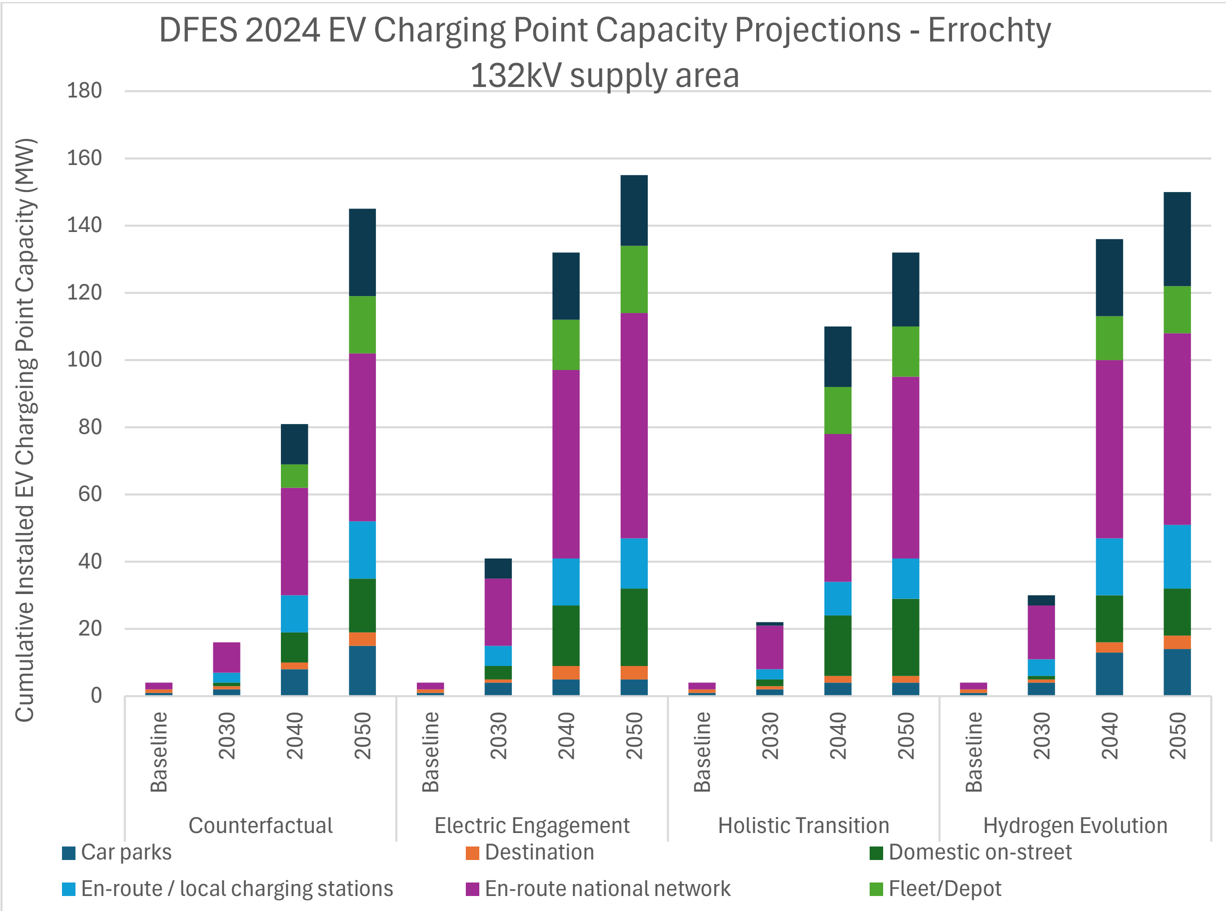


Figure 17 Projected Cumulative EV Charging Point Capacity Projections Errochty 132kV supply area (MW). Source: SSEN DFES 2024

5.3. Electrification of heat

DFES Scenario	Non-domestic heat pumps and resistive electric heating (m² of floorspace)				Domestic heat pumps (number of units)			
	Baseline	2030	2040	2050	Baseline	2030	2040	2050
Holistic Transition	1,806,164	5,678,180	10,481,048	10,951,500	3,706	25,636	69,423	77,845
Electric Engagement		5,159,786	10,723,612	11,279,726		24,703	68,699	75,582
Hydrogen Evolution		5,180,920	10,219,611	10,570,761		17,758	56,436	70,650
Counterfactual		3,715,090	8,086,234	9,460,085		10,873	29,674	60,594

Table 6 Electrification of heat projections in Errochty 132kV supply area. Source: SSEN DFES 2024

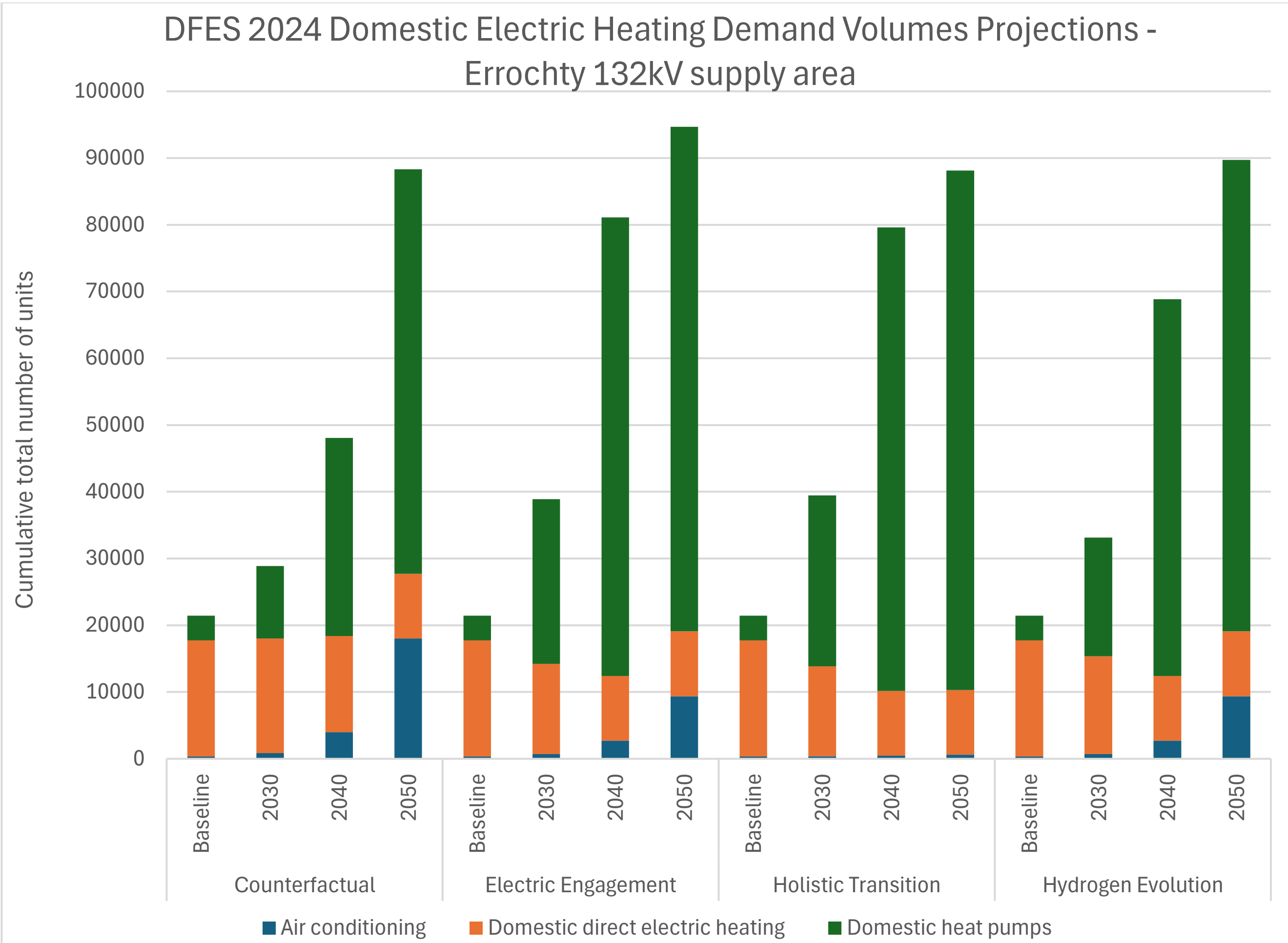


Figure 18 Projected Cumulative Electric Heating Demand Volumes Projections Errochty 132kV supply area (units). Source: SSEN DFES 2024

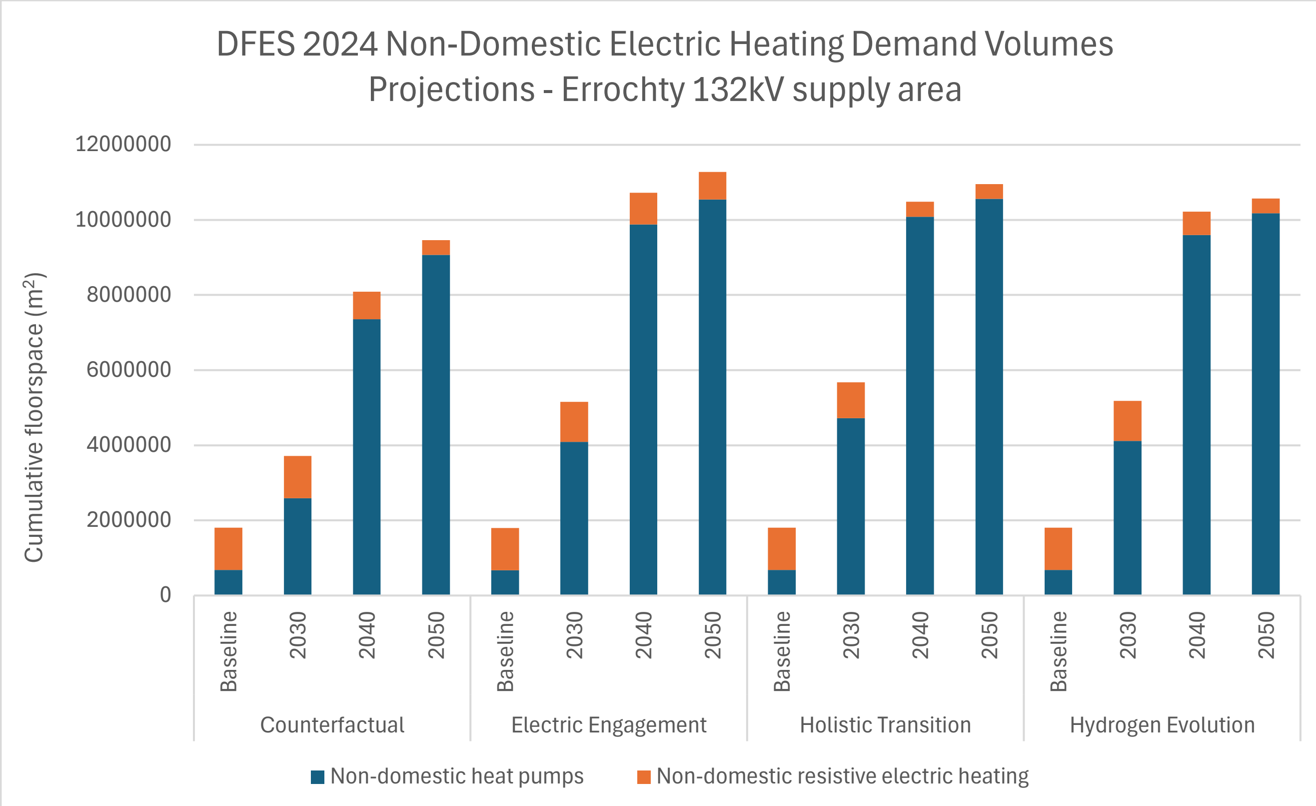


Figure 19 Projected Cumulative Non-Domestic Electric Heating Demand Volumes Projections Errochty 132kV supply area (Floorspace m²). Source: SSEN DFES 2024

5.4. New building developments

DFES Scenario	New domestic development (number of homes)			New non-domestic development (m²)		
	2030	2040	2050	2030	2040	2050
Holistic Transition	6,063	13,939	17,807	426,889m²	826,035m²	826,035m²
Electric Engagement	5,712	13,403	17,231	373,914m²	826,035m²	826,035m²
Hydrogen Evolution	5,909	13,621	17,200	373,914m²	826,035m²	826,035m²
Counterfactual	4,998	12,948	16,787	225,858m²	696,102m²	826,035m²

Table 7 New building development projections in Errochty 132kV supply area. Source: SSEN DFES 2024

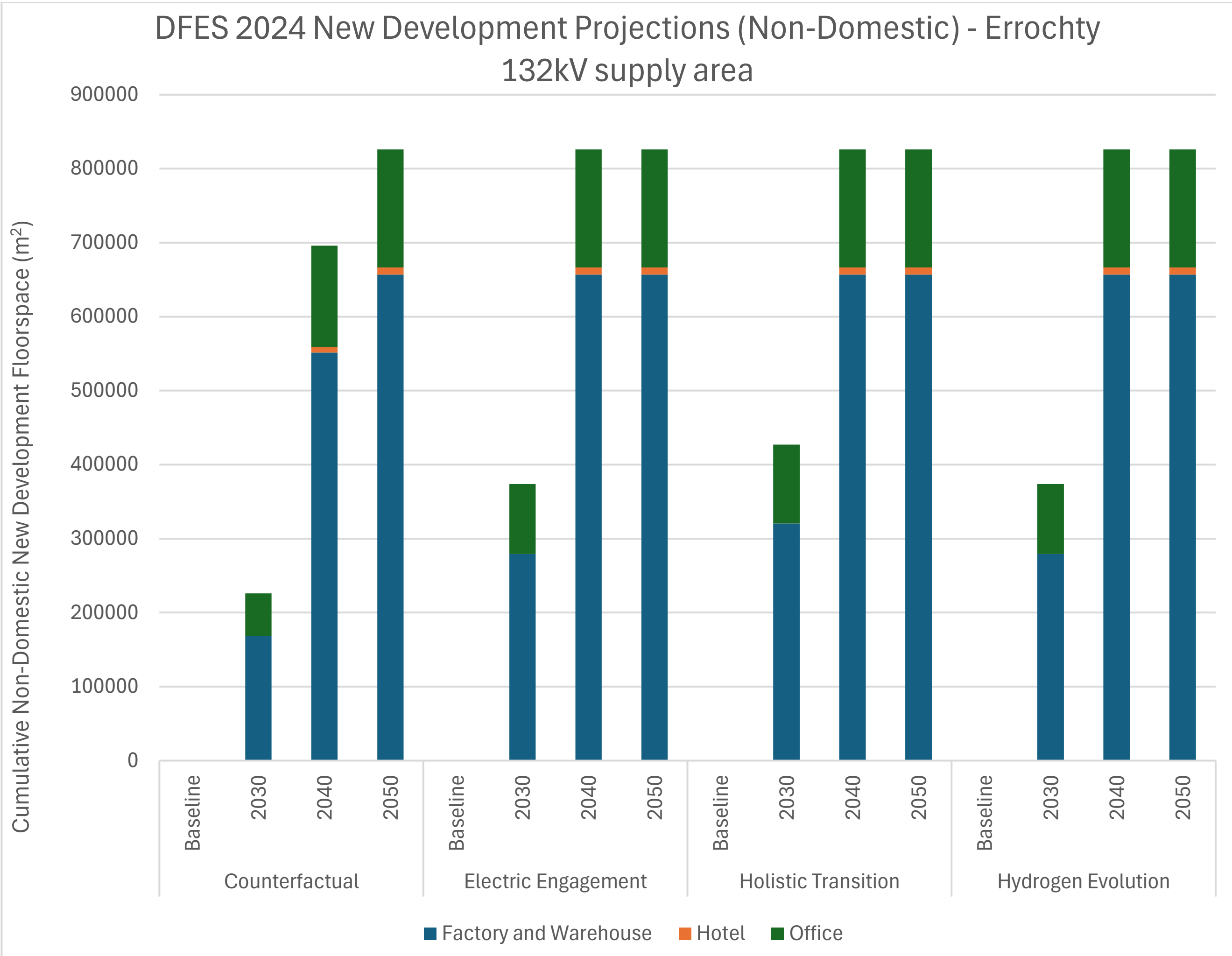


Figure 20 Projected Cumulative Non-Domestic New Development floorspace Errochty 132kV supply area (m^2). Source: SSEN DFES 2024

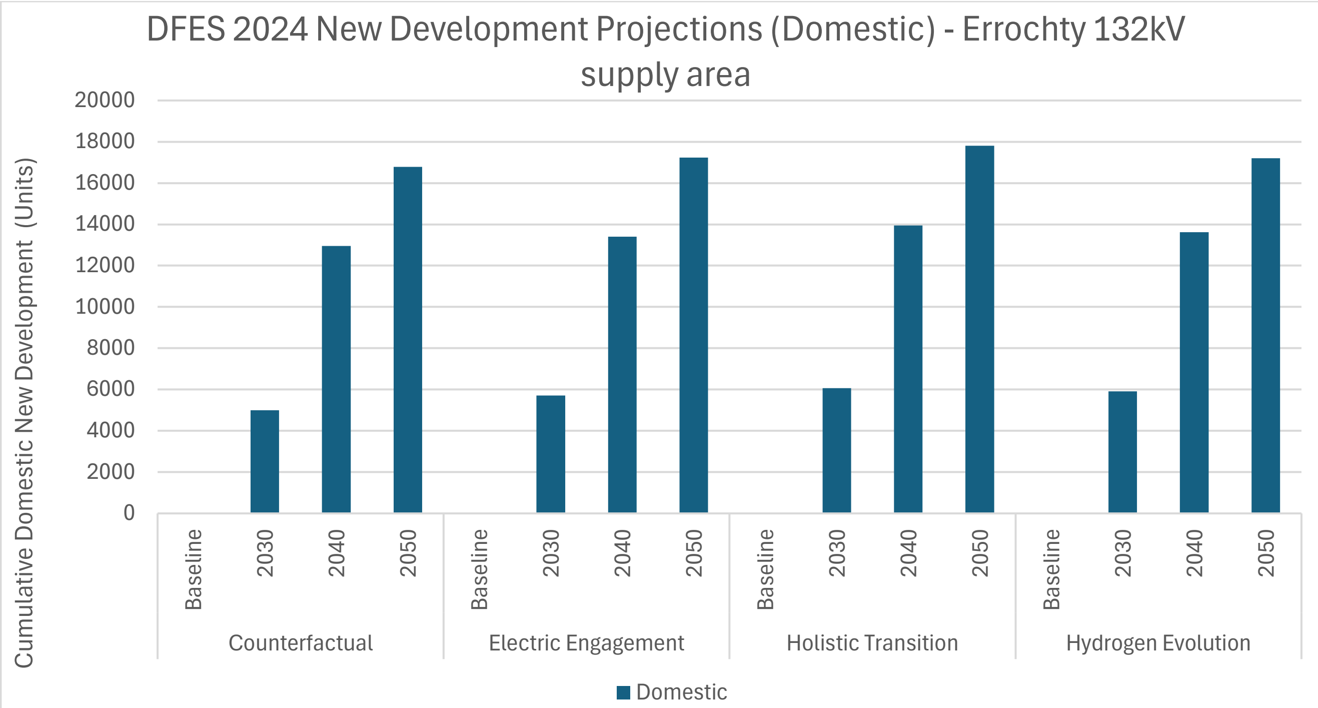


Figure 21 Projected Cumulative Domestic New Developments Errochty 132kV supply area (Units). Source: SSEN DFES 2024

5.5. Commercial and industrial electrification

The decarbonisation of industries specific to Northern Scotland (i.e. whisky distilleries) and broader industries (e.g. agriculture and other commercial businesses) indicate there could be a range of potential electrification outcomes for the Errochty 132kV switching station supply area. We have identified distilleries and agriculture 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 Errochty 132kV supply area is relatively small with eight 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 Errochty 132kV switching station supply area are:

- Aberargie Distillery
- Aberfeldy Distillery
- Blair Athol Distillery
- Deanston Distillery
- Edradour Distillery
- Stratheran Distillery
- The Glenturret Distillery
- Tullibardine Distillery

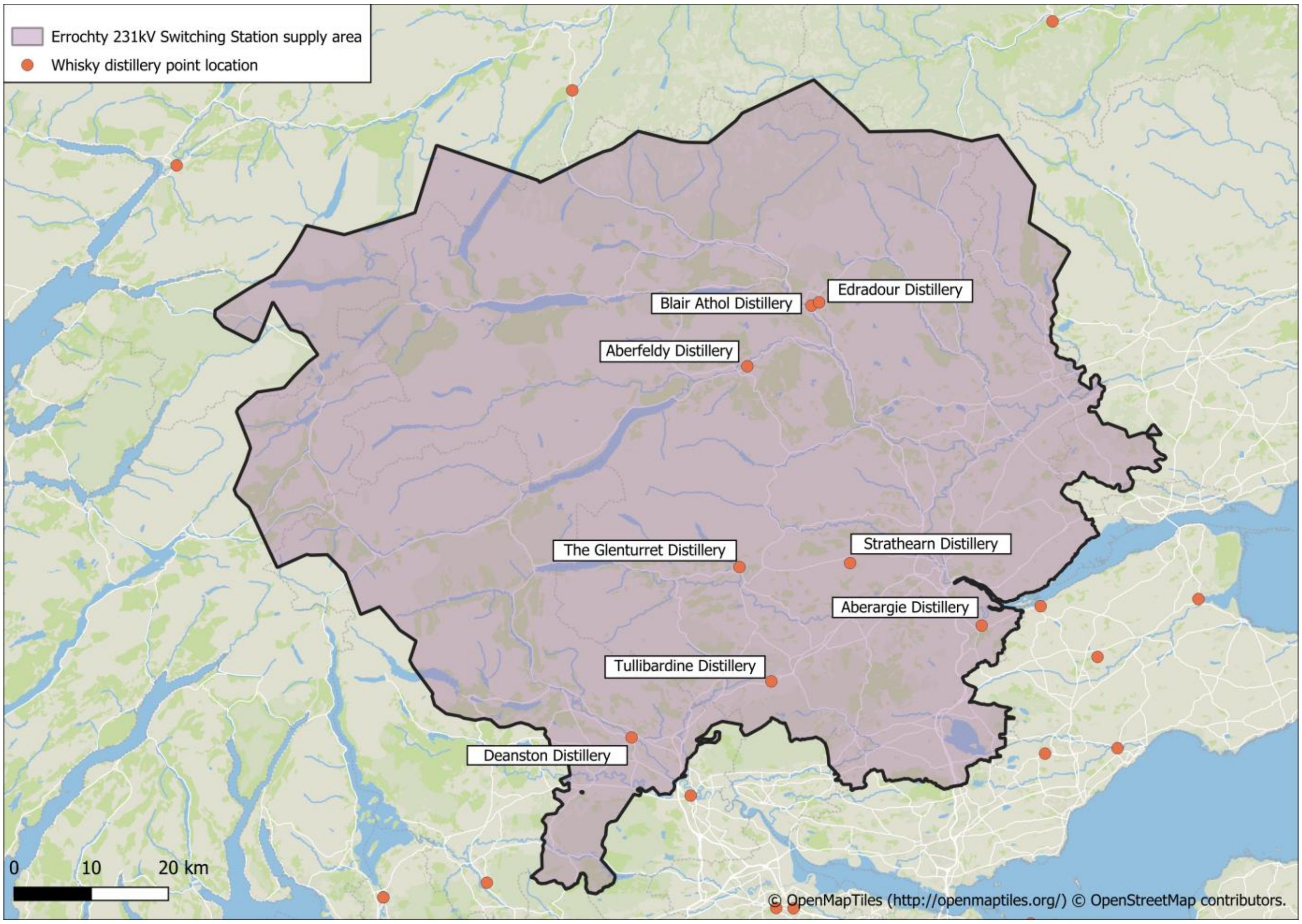


Figure 22 Errochty 132kV supply area registered whisky distillery location map

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)[18] 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.

18 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 Errochty 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 Errochty 132kV supply area. A summary of existing works is shown in **Table 8** below and further information on the schemes which have recently been through our DNOA process can be found in **Appendix E**. The network considered for long-term modelling is shown below in **Figures 23-30** Figure .

ID (Schematic Reference)	Substation	Description	Driver	Forecast completion	Fully resolves future strategic needs to 2050?
Abernethy GSP					
1	Abernethy GSP – Milnathort primary substation	***Abernethy GSP & Milnathort Primary*** • Replacement of the 2x existing Milnathort 15MVA primary transformers with 20/40MVA units. • Installation of two new 33kV cable circuits from Abernethy GSP 33kV board to a new 8 panel 33kV board installed at Milnathort PSS, consisting of 8x new 33kV Circuit Breakers. • Installation of new 11kV switchboard at Milnathort PSS. • Installation of new 33kV OHL circuit (approx. 1km) and creation of a new suitable NOP consisting of a pole mounted circuit breaker (PMCB) and air-break switch disconnector (ABSD). • Installation of two Shunt reactors at Abernethy GSP on the two new 33kV cable circuits to Milnathort PSS.	*DNOA process*	*2029*	
2	Abernethy GSP	***Contracted connection & OHL reinforcement*** • Reinforcement of OHL conductor to 150mm2 CU from Abernethy GSP to Binn wind farm. • Contracted connection for additional capacity at Binn WF. • Binn Eco Park 9.9MW contracted connection.	*Customer Connection*	*2029*	
3	Abernethy GSP – Tealing GSP	***ASTI Dips Phase 1 Abernethy to Tealing*** • Installation of 25x 33kV cable dips (including 18x 33kV poles replacements). Cumulative total of 3.89km of 33kV underground cable to be installed at various locations between Abernethy and Tealing GSPs. • 30x 11kV pole replacements and a cumulative total of 4.33km of 11kV underground cable to be installed	*Customer Connection*	*2026*	

		at various locations between Abernethy and Tealing GSPs. • 4x sets of 11kV overhead line fuses (3x sets for replacement & 1x new set) • Removal of 1x Pole Mounted Circuit Breaker (PMCB).			
4	Balbeggie primary substation	***Balbeggie T1 Transformer Replacement*** • Replacement of existing 5MVA Primary Transformer with new 15MVA Transformer at Balbeggie primary substation.	*Asset Replacement*	*2026*	
5	Abernethy GSP	***Abernethy GSP 33kV Busbar Replacement*** • Replacement of the existing tubular Aluminium busbar with a copper busbar of the same dimensions (51x3mm) at Abernethy GSP, which will increase the rating from 470A to 1250A. The increase in capacity achieved removes the potential for thermal overloads and provides enough headroom to facilitate the connection of the 2x contracted BESS schemes as per their proposed connection agreements.	*Primary Reinforcement*	*2025 (recently completed)*	
6	Scone and Errol PSS's	***Scone and Errol primary substations 11kV switchboard replacements*** • Replacement of 8x 11kV circuit breakers & EHV batteries at Scone PSS. • Replacement of the 11kV switchboard at Errol PSS.	*Asset Replacement*	*2026*	
7	Abernethy GSP or Abernethy 2 GSP	***Contracted BESS Connections*** Customer connection of 2x Battery storage schemes: • BESS Scheme 1 30MW • BESS Scheme 2 19MW	*Customer connection*	*TBC*	
Braco West GSP					
8	Braco West GSP – Callander PSS	***Braco West / Callander 33kV STATCOM - Braco Grid GSP*** • Installation of a new 7x panel 33kV indoor switchboard. • Removal of the existing 33kV outdoor circuit breakers. • Installation of 2x 4MVAr STATCOMs and 33kV cabled connections for STATCOMs at Callander PSS (0.02km). • Reinforce part of the Braco 4L5 33kV overhead line circuit to 150mm2 CU conductor (13.1km Conductor + 164 poles)	*Primary Reinforcement*	*2026*	
9	Creiff PSS	***Crieff Primary Substation T1, T2 & 11kV switchboard replacement*** • Replacement of both existing 15MVA 33kV primary transformers with 24MVA units. • Replacement of 33kV outdoor switchgear with a new 5 panel indoor 33kV switchboard. • Installation of a new 9 panel 11kV indoor switchboard.	*Asset Replacement*	*2027*	

10	Braco West GSP – Dunblane PSS	**Network Improvement / Dunblane Tee to Dunblane Primary 33kV OHL Improvement Dunblane Area** • The removal of 33kV overhead line dual circuit section to Dunblane PSS	*Primary Reinforcement*	*2025*	
11	Gleneagles PSS	**Gleneagles primary substation reinforcement** • Replacement of existing 2x 15MVA primary transformers with 2x 30MVA units.	*Primary Reinforcement*	*2028*	
Burghmuir GSP					
12	Burghmuir GSP – Inveralmond and Redgorton PSS's	**Burghmuir 33kV Circuit Reinforcement** • Reinforcement of 7.5km 33kV underground cable between Burghmuir GSP – Inveralmond PSS. • 6.35km 33kV OHL conductor reinforcement + 96 pole replacements between Inveralmond PSS – Redgorton PSS. • Installation of a new 7 panel 33kV switchboard at Inveralmond PSS.	*Primary Reinforcement*	*2027*	
Coupar Angus GSP					
13	Coupar Angus PSS	**Coupar Angus 11kV Switchboard & T2 Replacement** • Replacement of existing 8MVA primary transformer with 15MVA unit. • Replacement of 7 panel 11kV switchboard.	*Asset Replacement*	*2026*	
Killin GSP					
14	Lochay PSS	**Lochay 33/3.3kV Transformer Lochay Power Station** • Replacement of existing 2.5MVA T3 Primary Transformer with a 5MVA unit. • New 3 panel 33kV switchboard. • New single circuit breaker 11kV Switchboard (run at 3.3kV) • Install new 33kV cable section to extend existing circuit to the new transformer location (0.3km). • Install new 11kV cable section (run at 3.3kV) to extend existing circuit to the new transformer location (0.3km). • Replacement of 4x 33kV poles. • Install a new 33kV Air-break switch on pole 311. • Install 1x new 33kV/LV 200kVA pole mounted auxiliary transformer for Lochay power station.	*Asset Replacement*	*2028*	
15	Lochearnhead PSS	**Lochearnhead 33/11kV Transformer Replacement** • Replacement of the existing 4MVA primary transformer with a 6.3MVA unit.	*Asset Replacement*	*2025*	
Rannoch GSP					

16	Bridge of Gaur PSS	***Bridge of Gaur Primary Substation Transformer Replacement*** • Replacement of existing 1MVA 33kV primary transformer with a higher rated unit (MVA rating TBC by Investment management). • Installation of 1x new 33kV circuit breaker. • Replacement of 1x 11kV Pole mounted circuit breaker (PMCB). • 11kV/LV alteration works outside PSS.	*Asset Replacement*	*2030*	
		Tummel Bridge GSP			
17	Tummel Bridge GSP and New Errochty GSP	***Errochty/ Tummel Bridge Works Integration works*** • Creation of a new Errochty GSP comprising of: • 2x 90MVA grid transformers. • 11 panel indoor 33kV switch room (Including 1x 33kV bus section circuit breaker and 1x circuit breaker to facilitate connection of the proposed Taymouth PSS (triggered under new connection EZZ672) - A backfeed will be provided via 33kV interconnection from Killin GSP. • Diversion of the 5x existing 33kV circuits from Tummel Bridge GSP to the new Errochty GSP. • Install a new 33kV circuit from the new Errochty GSP -Tummel Primary, which will be disconnected from the existing 4H0 33kV circuit currently feeding Tummel Power Station.	*DNOA process*	*2026*	
18	Calvine PSS	***Calvine Primary Transformer - Tummel Bridge Grid*** • Replacement of the existing 2.5MVA Calvine primary transformer with a 6.3MVA unit. • Installation of one new 33kV circuit breaker. • Removal of the existing 33kV pole mounted circuit breaker (PMCB) within Calvine primary substation. • Installation of a new 3 panel 11kV switchboard.	*Primary Reinforcement*	*2029*	
19	Coshieville PSS	***Coshieville Primary Transformer - Tummel Bridge Grid*** • Replacement of the existing 2.5MVA Coshieville primary transformer with a 6.3MVA unit. • Replacement of 1x 33kV circuit breaker. • Replacement of 2x 33kV pole mounted circuit breakers (PMCB).	*DNOA process*	*2027*	
20	Bonskeid PSS	***Bonskeid T1 Transformer Replacement*** • Replacement of the existing 5MVA Bonskeid primary transformer with a 6.3MVA unit.	*Asset Replacement*	*2025*	
21	Errochty GSP 8L5 – Killin GSP 4L5 circuits	***New Taymouth Primary substation*** Construction of a new primary substation (Taymouth PSS) comprising of: • 2x 7.5/15MVA primary transformers. • New 33kV switchboard. • New 11kV switchboard. • Connection to the new Errochty GSP 33kV board via new dedicated 33kV circuit (8L5). • Connection/backfeed to Killin GSP (4L5) via new teed 33kV circuit from pole 35.	*Customer Connection*	*2027*	

		• Installation of 4MVAr STATCOM on Killin 4L5 incoming side at Taymouth PSS. • Decommissioning of Carbane Reactor 3MVAr on Killin 33kV circuit 4L5) Part of Tummel Bridge / Errochty GSP integration works. A backfeed will be provided via 33kV interconnection from Killin GSP).				

Table 8 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 Errochty 132kV 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 **Figures 23-30**Figure .

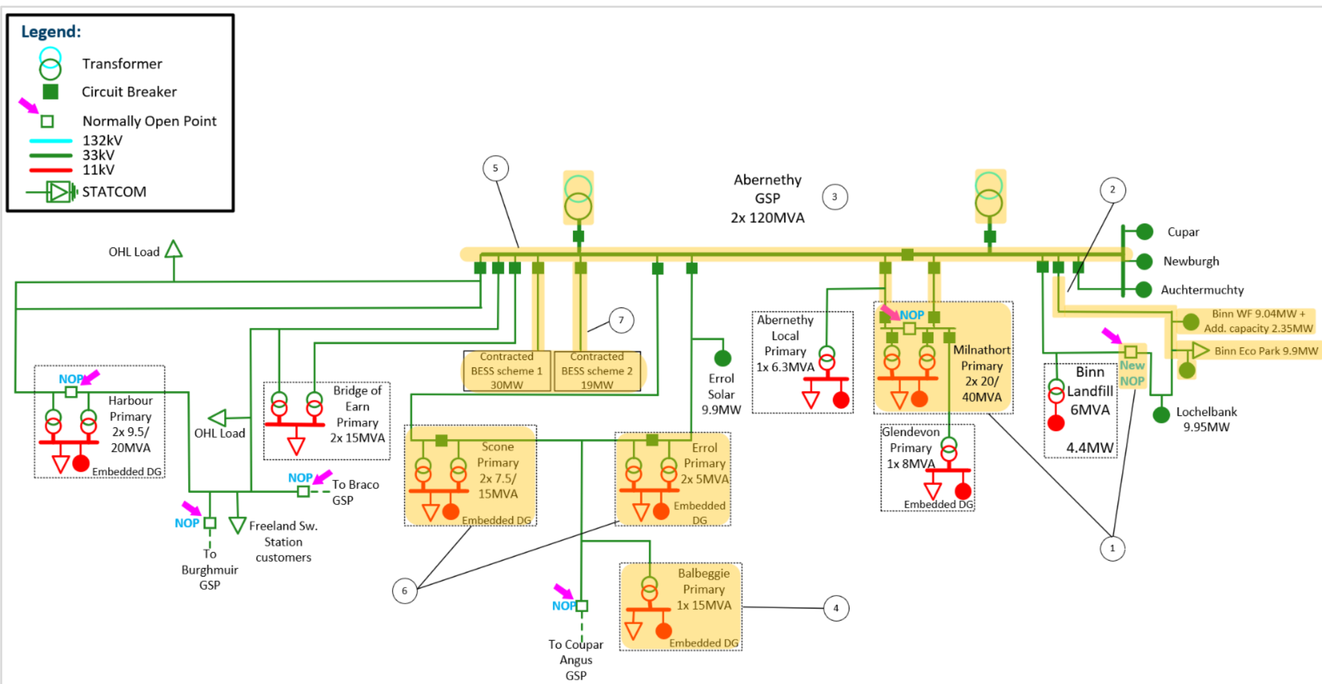


Figure 23 Future Network Development around Abernethy GSP

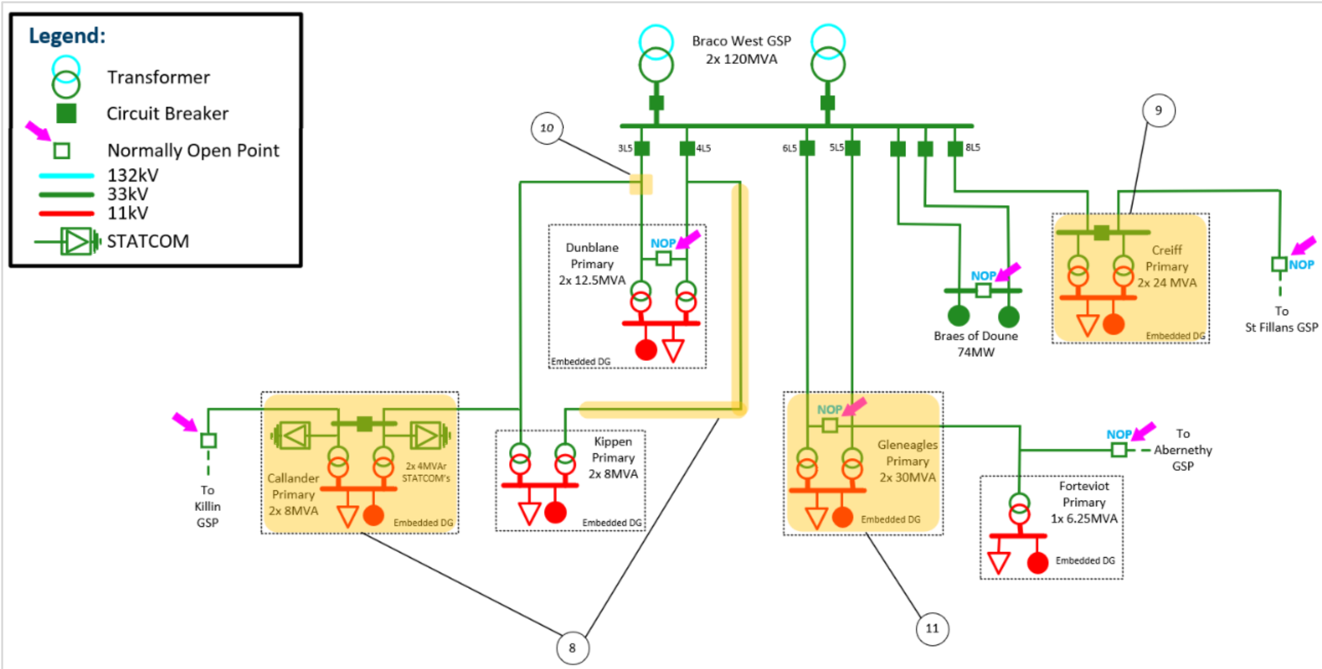


Figure 24 Future Network Development around Braco West GSP

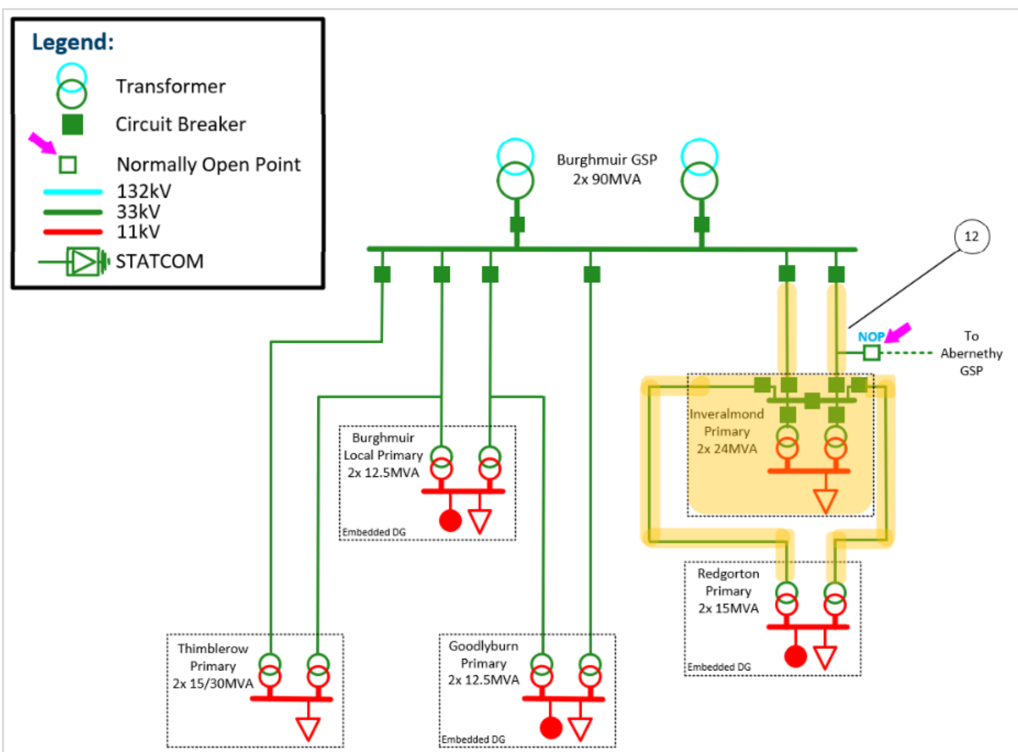


Figure 25 Future Network Development around Burghmuir GSP

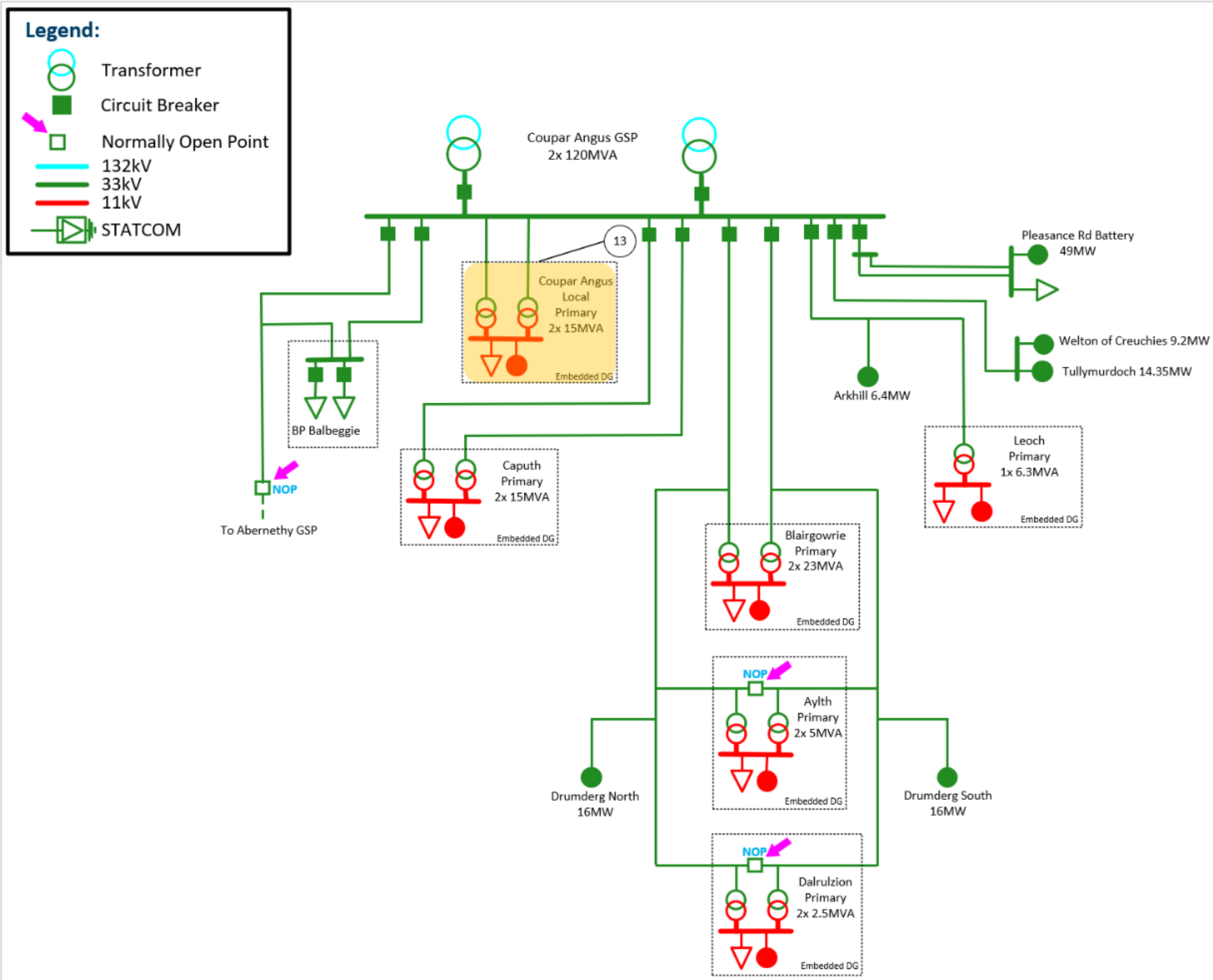


Figure 26 Future Network Development around Coupar Angus GSP

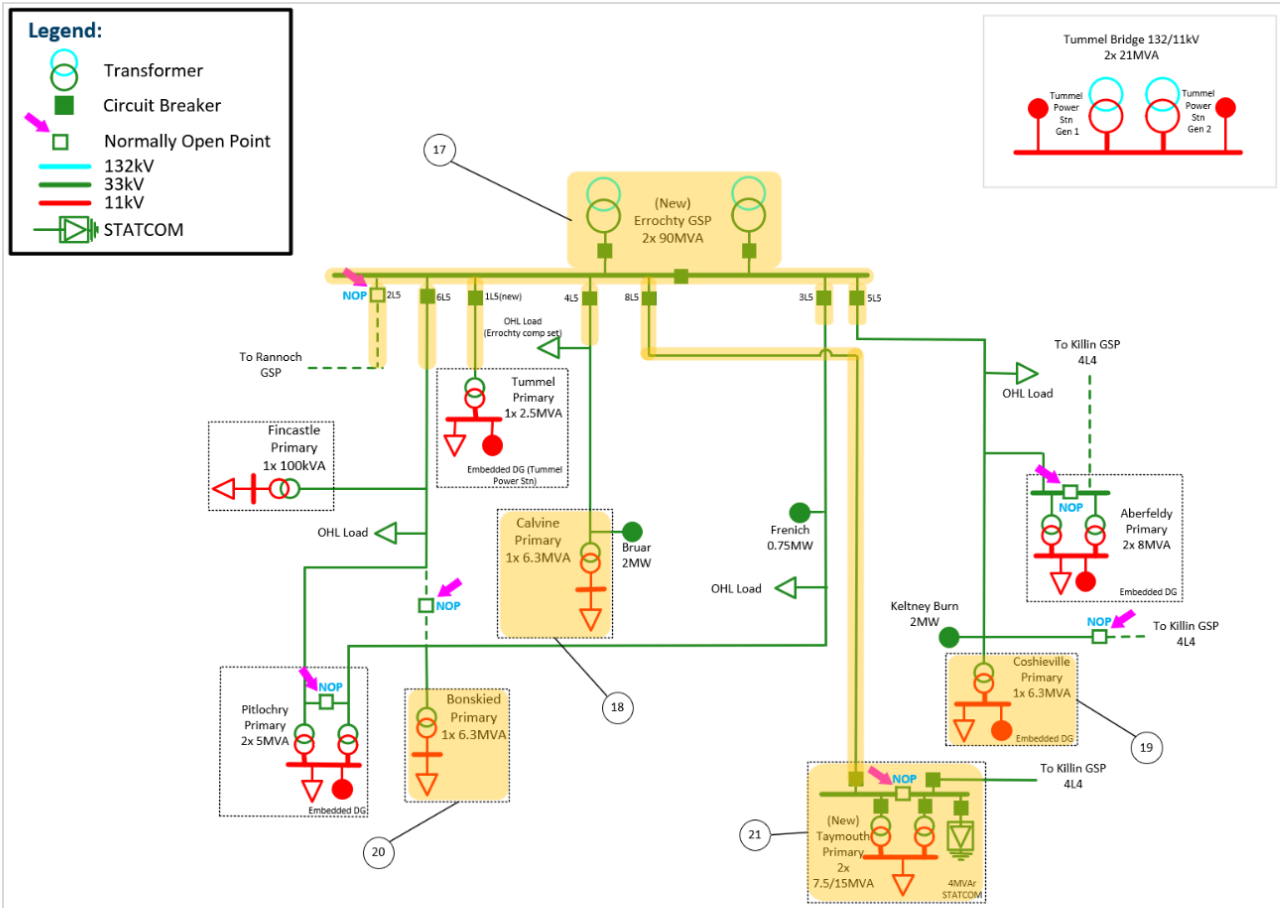


Figure 27 Future Network Development around the Tummel Bridge & (New) Errochty GSP

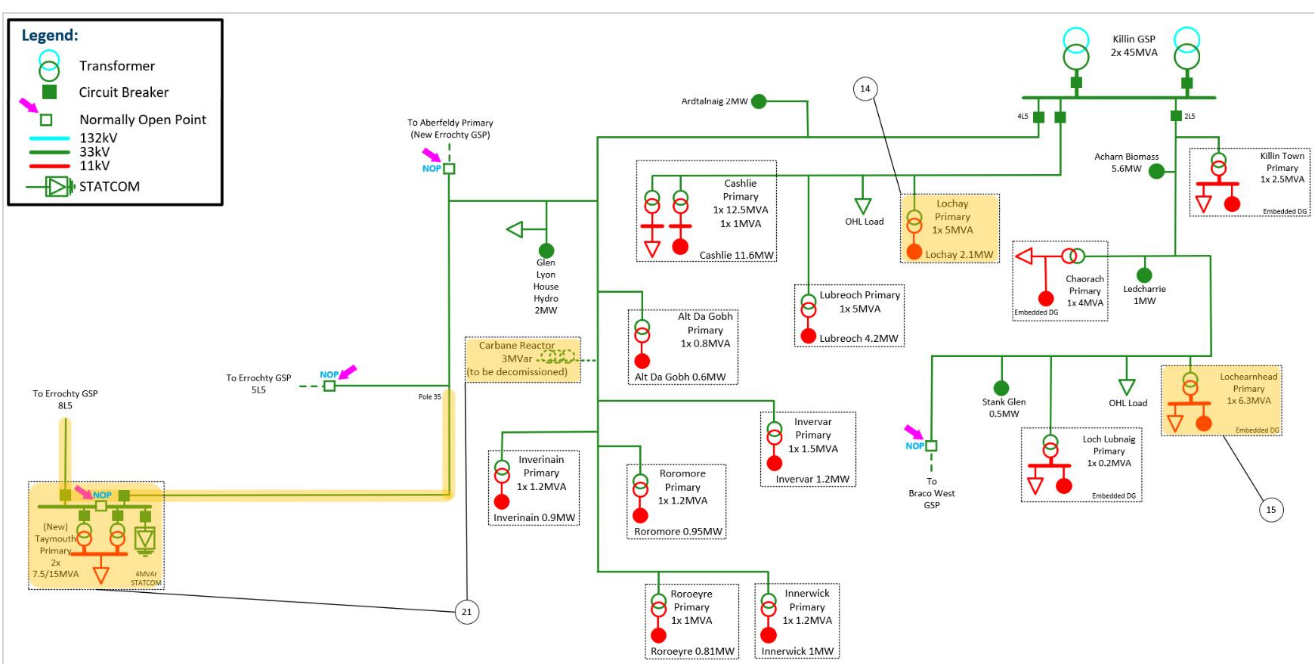


Figure 28 Future Network Development around Killin GSP

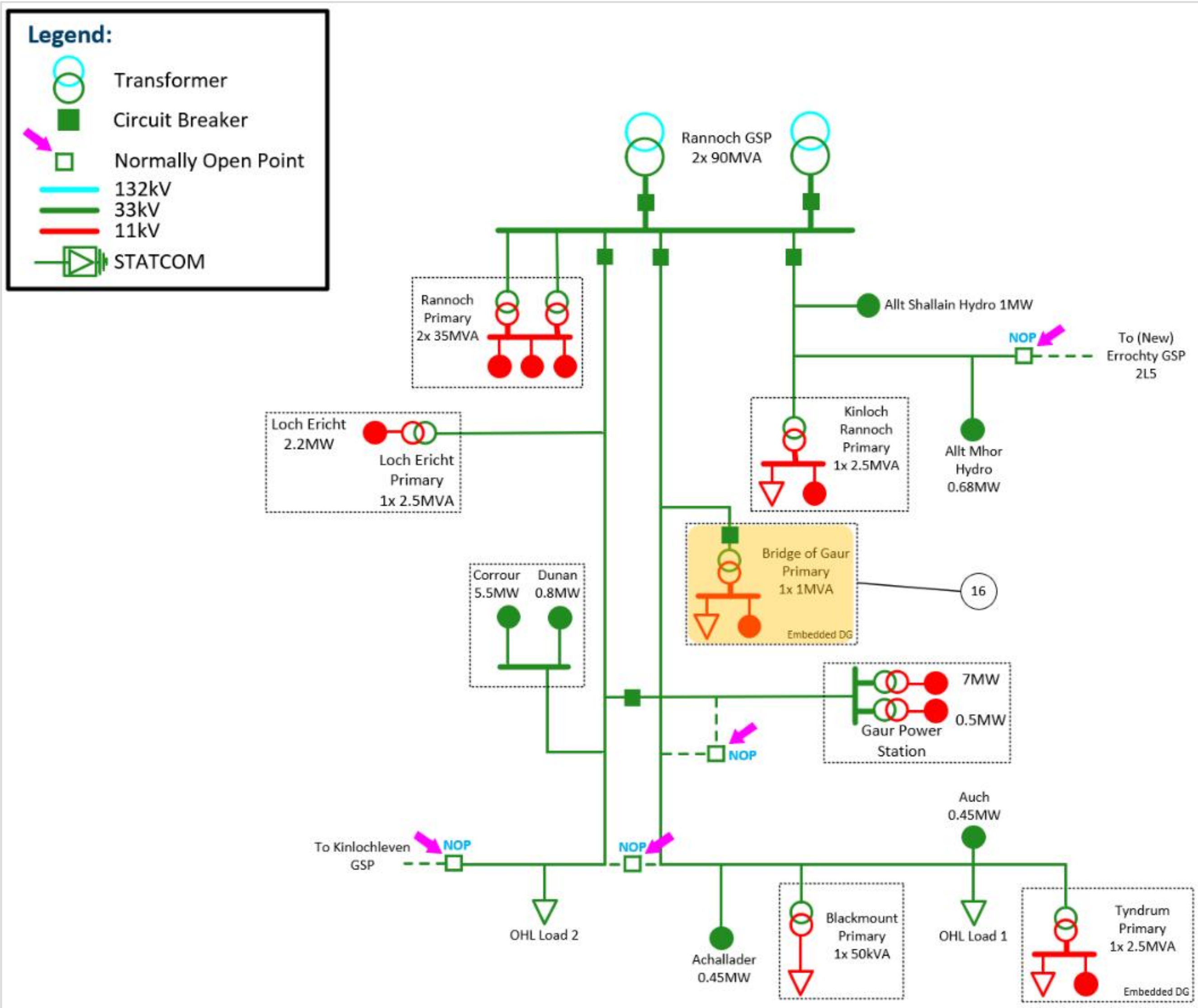


Figure 29 Future Network Development around Rannoch GSP

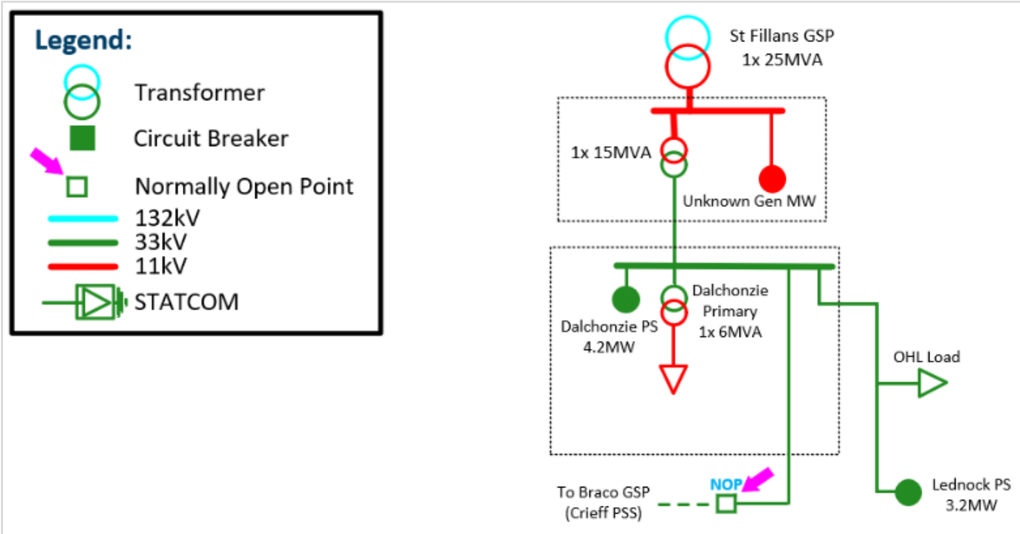


Figure 30 Future Network Development around St Fillans GSP

7. SPATIAL PLANS OF FUTURE NEEDS

7.1. Extra High Voltage/High Voltage Spatial Plans

The EHV/HV spatial plan shown below in **Figure 31** shows the projected headroom or capacity shortfall due to demand increases at primary substations across the Errochty 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 B** and **Appendix C**. The values are taken from the Network Scenario Headroom report (NSHR), part of the Network Development plan (NDP). 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.

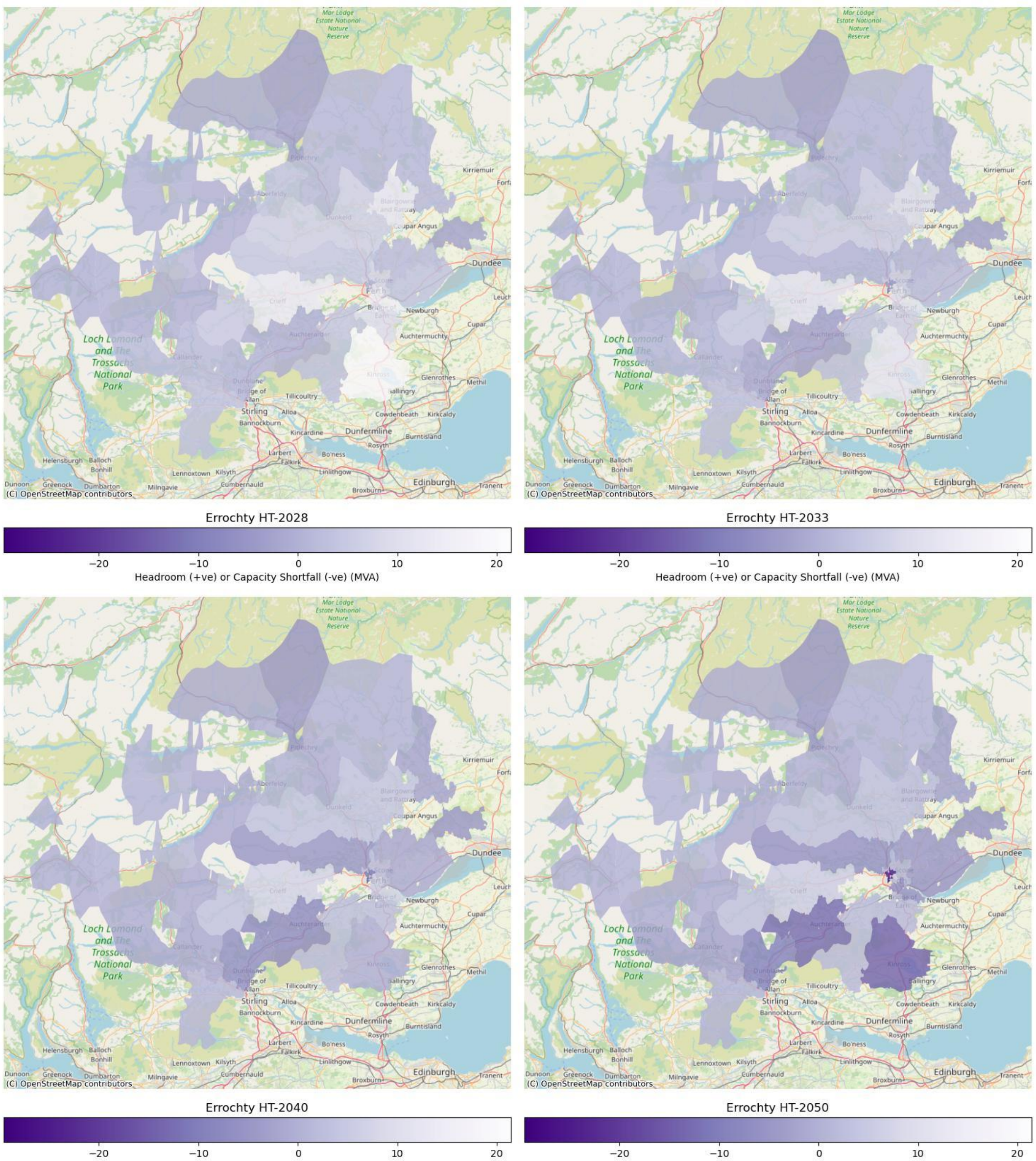


Figure 31 Errochty 132kV supply area EHV HT spatial plans for 2028, 2033, 2040, and 2050.

7.2. 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 32** and **Appendix C**. 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).

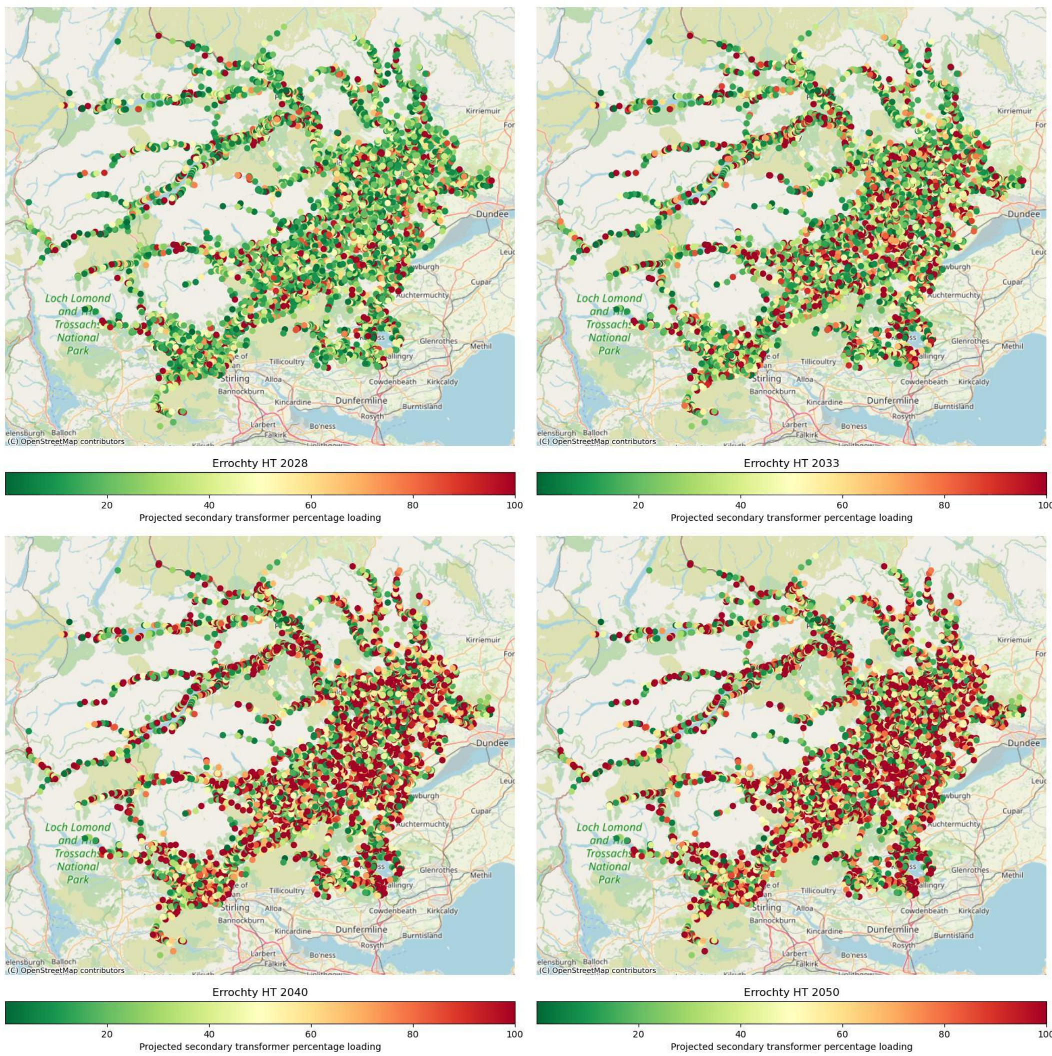


Figure 33 Errochty 132kV supply area HV/LV HT spatial plans for 2028, 2033, 2040, and 2050.

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 2024 DFES alongside other information including known connection applications. Initial needs have been identified using the DFES Holistic Transition 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 ten 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 Errochty 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: Participation in flexibility markets is not as high as expected or the rollout of smart meters to replace radio tele switching is slower than expected.
Mitigation: Detailed network studies are undertaken for areas most impacted by the removal of LMAs to determine whether reinforcements will be required.

Dependency: Procurement of new land and consents across the supply area is likely to be necessary.
Risks: Long lead timescales in terms of land consents, procurement and the challenge of finding suitable sites/routes.
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 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 9** we recommend that these are progressed through the DNOA process so that there is sufficient time for solutions to be designed and delivered. The interactions between possible options have been considered to identify potential synergies and efficiencies. As such, constraints have been grouped to be considered alongside each other and any additional interactions between constraints referenced.

Location of proposed intervention	EE Year	HE Year	HT Year	CF Year	CEE Worst case asset loading (%)	Network state	Comments
				Abernethy GSP			
Abernethy 33kV 4L5 & 5L5 ring circuit (Abernethy GSP - Scone, Balbeggie, Errol PSS)	2031	2031	2031	2034	242.2	N-1 outage of Abernethy GSP - Scone circuit. (ABNE.CON_2) N-1 outage of Abernethy GSP - Errol circuit. (ABNE.CON_1) Intact (2044).	Thermal Constraint: • Thermal overload of 33kV 4L5 / 5L5 ring circuit (Abernethy – Scone, Balbeggie, Errol) under N-1 conditions. Voltage Constraint: • Low voltage constraint from 2034 onwards under N-1 conditions. • Future thermal overloads of Balbeggie/Scone primary transformers. Potential options to resolve this constraint are: • Reinforcement of existing Abernethy 4L5 / 5L5 33kV ring circuit. • Reconfigure the 33kV ring circuit to establish a new NOP and transfer Balbeggie PSS onto Coupar Angus GSP. • Build new dedicated 33kV circuits to Scone/Balbeggie PSS to split up the existing 33kV ring circuit. • New GSP in the Dunkeld vicinity and new 33kV circuits to interconnect with Abernethy 4L5 & 5L5. • Installation of voltage compensation assets.

Errol PSS (2x 33kV Transformers)	2032	2032	2031	2036	292.6	N-1 outage of Errol primary transformer 2. (ABNE.CON_1) N-1 outage of Errol primary transformer 1. (ABNE.CON_8) N-1 outage of Abernethy GSP - Scone circuit. (ABNE.CON_2) Intact (2046).	Thermal Constraint: • Thermal overload of Errol Primary Transformer 1 under N-1 conditions. Potential options to resolve this constraint are: • Reinforcement of existing primary transformers. • Assess options for transfer of some 11kV load onto adjacent interconnected primary substations. • Establish a new primary substation and transfer some 11kV load from the existing Errol PSS. • Assess options for procuring flexibility services.
Braco West GSP							
Braco West 33kV circuit 8L5 (Braco GSP - Crieff PSS)	2030	2032	2031	2035	155.8	N-1 outage of St Fillans GSP (SFIL.CON_1) N-1 outage of Crieff primary transformer 2. (BRAC.CON_7 (2034)) Intact (2035).	Thermal Constraint: • Thermal overload of 33kV circuit 8L5 (Braco – Crieff) under N-1 conditions. Voltage Constraint: • Low voltage from 2032 onwards under intact and N-1 conditions. Potential options to resolve this constraint are: • Reinforcement of existing Braco West 33kV circuit 8L5. • Build a new dedicated 33kV circuit to Crieff PSS. • Install additional 132kV circuit to St Fillans GSP, followed by installation of additional 132/11kV and 33/11kV transformers at St Fillans GSP to remove the need for N-1 backfeed from Braco West 8L5 circuit. The existing 8L5 backfeed then becomes N-2 contingency. • Installation of voltage compensation assets.
Callander PSS (2x 33kV Transformers)	2031	2033	2033	2037	381.2	N-1 outage of Braco 3L5 circuit. (BRAC.CON_5) N-1 outage of Braco 4L5 circuit. (BRAC.CON_4_2027_PH004222)	Thermal Constraint: • Thermal overload of Callander primary transformer 2 under N-1 conditions, which is related to the N-1 voltage problem. Voltage Constraint: • Low voltage from 2033 onwards under N-1 conditions.

						N-1 outage of Callander primary transformer 2. (BRAC.CON_6)	Potential options to resolve this constraint are: • Reinforcement of existing primary transformer. • Assess options for transfer of some 11kV load onto adjacent interconnected primary substations. • Establish a new primary substation and transfer some 11kV load from the existing Callander PSS. • Build a new GSP in the Callander vicinity. • Assess options for procuring flexibility services.
Dunblane PSS (2x 33kV Transformers)	2031	2033	2032	2037	205.7	N-1 outage of Braco 3L5 circuit. (BRAC.CON_5) N-1 outage of Braco 4L5 circuit. (BRAC.CON_4_2027_PH004222)	Thermal Constraint: • Thermal overload of Dunblane primary transformers under N-1 conditions. Voltage Constraint: • Low voltage from 2050 onwards under N-1 conditions. Potential options to resolve this constraint are: • Reinforcement of existing primary transformer. • Assess options for transfer of some 11kV load onto adjacent interconnected primary substations. • Establish a new primary substation and transfer some 11kV load from the existing Dunblane PSS. • New GSP in the Callander vicinity. • Assess options for procuring flexibility services.
Braco West 33kV circuit 3L5 (Braco GSP - Dunblane, Kippen PSS's) (Callander Circuit)	2031	2033	2031	2035	196	N-1 outage of Braco 4L5 circuit. (BRAC.CON_4_2027_PH004222) N-1 outage of Killin 2L5 circuit. (KIIN.CON_1) BRAC.CON_6 Intact (2036)	Thermal Constraint: • Thermal overload of 33kV circuit 3L5 (Braco – Dunblane, Kippen) under N-1 conditions, which is related to the N-1 voltage problem. Voltage Constraint: • Low voltage from 2031 onwards under N-1 conditions. Potential options to resolve this constraint are: • Reinforcement of existing Braco West 33kV 3L5 & Killin 2L5 circuits. • New GSP in the Callander vicinity.

							• Assess options for procuring flexibility services.
Braco West 33kV circuit 5L5 (Braco GSP - Gleneagles PSS, Teed to Forteviot PSS)	2032	2032	2031	2036	215.2	N-1 outage of Braco 6L5 circuit. (BRAC.CON_2) N-1 outage of Braco 5L5 circuit. BRAC.CON_3	Thermal Constraint: • Thermal overload of 33kV circuit 5L5 (Braco – Gleneagles, Forteviot) under N-1 and intact conditions, which is related to the N-1 voltage problem. Voltage Constraint: • Low voltage from 2027 onwards under N-1 conditions. Potential options to resolve this constraint are: • Reinforcement of existing Braco West 33kV 5L5 circuit. • Installation of new direct 33kV circuit (Braco GSP – Gleneagles) • Installation of voltage compensation assets. • Assess options for procuring flexibility services.
Braco West 33kV circuit 6L5 (Braco GSP - Gleneagles PSS)	2034	2034	2033	2039	174.5	N-1 outage of Braco 5L5 circuit. BRAC.CON_3	Thermal Constraint: Thermal overload of 33kV circuit 3L5 (Braco – Gleneagles) under N-1 conditions, which is related to the N-1 voltage problem. Voltage Constraint: • Low voltage from 2027 onwards under N-1 and intact conditions Potential options to resolve this constraint are: • Reinforcement of existing Braco West 33kV 6L5 circuit. • Installation of voltage compensation assets. • Assess options for procuring flexibility services.
Braco West 33kV circuit 4L5 (Braco GSP - Dunblane PSS)	2034	2037	2034	2041	141.8	N-1 outage of Braco 3L5 circuit. (BRAC.CON_5)	Thermal Constraint: • Thermal overload of 33kV circuit 4L5 (Braco – Dunblane) under N-1 conditions, which is related to the N-1 voltage problem. Voltage Constraint: • Low voltage from 2036 onwards under N-1 and intact conditions. conditions. Potential options to resolve this constraint are: • Reinforcement of existing Braco West 33kV 4L5 circuit.

							• Installation of voltage compensation assets. • New GSP in the Callander vicinity. • Assess options for procuring flexibility services.
Burghmuir GSP							
Goodlyburn PSS (33kV Transformer 2)	2030	2029	2029	2032	278.1	N-1 outage of Goodylburn primary transformer 1 circuit. (BUMU.CON_3) Future: Intact (2043). Various N-1 scenarios.	Thermal Constraint: • Thermal overload of Goodlyburn Primary Transformer 2 under N-1 conditions. • Future thermal constraints by 2043 under Intact and various N-1 outage conditions. Potential options to resolve this constraint are: • Reinforcement of existing primary transformer. • Assess options for transfer of some 11kV load onto adjacent interconnected primary substations. • Establish a new primary substation and transfer some 11kV load from the existing Goodlyburn PSS. • Assess options for procuring flexibility services.
Redgorton PSS (33kV Transformer 1)	2035	2036	2035	2039	135	N-1 outage of Burghmuir 1L5 circuit.	Thermal Constraint: • Thermal overload of Redgorton primary transformer 1 under N-1 conditions. Potential options to resolve this constraint are: • Reinforcement of existing primary transformer. • Assess options for transfer of some 11kV load onto adjacent interconnected primary substations. • Establish a new primary substation and transfer some 11kV load from the existing Redgorton PSS. • Assess options for procuring flexibility services.
Coupar Angus GSP							
Dalrulzion PSS (2x 33kV Transformers)	2028	2029	2029	2030	160.8	N-1 outage of Coupar Angus 1L5 circuit. (COUA.CON_5) N-1 outage of Coupar Angus 2L5 circuit. (COUA.CON_6)	Thermal Constraint: • Thermal overload of Dalrulzion primary transformers under N-1 conditions. Voltage Constraint:

							• Low voltage from 2034 onwards under N-1 and intact conditions. conditions. Potential options to resolve this constraint are: • Reinforcement of existing primary transformer. • Assess options for transfer of some 11kV load onto adjacent interconnected PSS's. • Establish a new primary substation and transfer some 11kV load from the existing Dalrulzion PSS. • New GSP in the Dalrulzion/Bankfoot/Dunkeld vicinity and new 33kV circuits to interconnect with Coupar Angus 1L5 & 2L5. • Assess options for procuring flexibility services.
Alyth PSS (2x 33kV Transformers)	2030	2031	2030	2033	217.8	N-1 outage of Coupar Angus 1L5 circuit. (COUA.CON_5) N-1 outage of Coupar Angus 2L5 circuit. (COUA.CON_6)	Thermal Constraint: • Thermal overload of Alyth primary transformers under N-1 conditions. Voltage Constraint: • Low voltage from 2034 onwards under N-1 and intact conditions. conditions. Potential options to resolve this constraint are: • Reinforcement of existing primary transformer. • Assess options for transfer of some 11kV load onto adjacent interconnected primary substations. • Establish a new primary substation and transfer some 11kV load from the existing Alyth PSS. • New GSP in the Dalrulzion/Bankfoot/Dunkeld vicinity and new 33kV circuits to interconnect with Coupar Angus 1L5 & 2L5. • Assess options for procuring flexibility services.
Coupar Angus 33kV circuit 2L5 (Coupar Angus - Blairgowrie PSS)	2032	2034	2032	2038	184.7	N-1 outage of Coupar Angus 1L5 circuit. (COUA.CON_5)	Thermal Constraint: • Thermal overload of 33kV circuit 2L5 (Coupar Angus – Blairgowrie) under N-1 conditions. Voltage Constraint:

							• Low voltage from 2034 onwards under N-1 and intact conditions. Potential options to resolve this constraint are: • Reinforcement of existing Coupar Angus 33kV 2L5 circuit. • Install 2x new dedicated 33kV circuits to Blairgowrie PSS to remove it from the existing 33kV ring. • New GSP in the Dalrulzion/Bankfoot/Dunkeld vicinity and new 33kV circuits to interconnect with Coupar Angus 1L5 & 2L5. • Installation of voltage compensation assets. • Assess options for procuring flexibility services.
Coupar Angus 33kV circuit 1L5 (Coupar Angus - Blairgowrie PSS)	2034	2036	2034	2042	151.6	N-1 outage of Coupar Angus 2L5 circuit. (COUA.CON_6)	Thermal Constraint: • Thermal overload of 33kV circuit 1L5 (Coupar Angus – Blairgowrie) under N-1 conditions. Voltage Constraint: • Low voltage from 2034 onwards under N-1 and intact conditions. Potential options to resolve this constraint are: • Reinforcement of existing Coupar Angus 33kV 2L5 circuit. • Install 2x new dedicated 33kV circuits to Blairgowrie PSS to remove it from the existing 33kV ring. • New GSP in the Dalrulzion/Bankfoot/Dunkeld vicinity and new 33kV circuits to interconnect with Coupar Angus 1L5 & 2L5. • Installation of voltage compensation assets. • Assess options for procuring flexibility services.
Killin GSP							
Killin 33kV circuit 2L5 (Killin - Killin Town, Lochearnhead, Lubnaig PSS)	2027 2031	2027 2033	2027 2033	2025 2037	226.6	N-1 outage of Braco 3L5 circuit. (BRAC.CON_5) N-1 outage of Killin 2L5 circuit. (KIIN.CON_1)	Voltage Constraint: • Low voltage from 2027 onwards under N-1 conditions. Thermal Constraint: • Future thermal overload of 33kV circuit 2L5 (Killin – Killin Town, Lochearnhead, Lubnaig) under N-1 conditions from 2033, which is

							related to the N-1 voltage problem. Potential options to resolve this constraint are: • Reinforcement of existing Braco West 33kV 3L5 & Killin 2L5 circuits. • New GSP in Callander vicinity with interconnection to Braco West 3L5 & Killin 2L5. • Installation of voltage compensation assets. • Assess options for procuring flexibility services.
Rannoch GSP							
Blackmount PSS (33kV Transformer)	2027	2029	2029	2030	139.6	Intact & N-1 outage of Rannoch 3L5 circuit. (RANN.CON_2)	Thermal Constraint: • Thermal overload of Blackmount primary transformer under N-1 conditions. Potential options to resolve this constraint are: • Reinforcement of existing primary transformer (Pole-mounted). • Assess options for procuring flexibility services.
Tummel Bridge GSP (New Errochty GSP)							
Pitlochry PSS (2x 33kV Transformers)	2032	2034	2033	2037	158.3	N-1 outage of Errochty 3L5 circuit. (TUMB.CON_3) N-1 outage of Errochty 6L5 circuit. (TUMB.CON_4_2026_PH004382)	Thermal Constraint: • Thermal overload of Pitlochry primary transformers under N-1 conditions. Potential options to resolve this constraint are: • Reinforcement of existing primary transformer. • Assess options for transfer of some 11kV load onto adjacent interconnected primary substations. • Establish a new primary substation and transfer some 11kV load from the existing Pitlochry PSS. • Assess options for procuring flexibility services.
Tummel Bridge 33kV circuit 5L5 (Tummel Bridge - Coshieville, Aberfeldy PSS)	2025	2025	2025	2025	-	N-1 outage of Errochty 5L5 circuit. TUMB.CON_2 TUMB.CON_2_2025_SLD Update Intact (2036)	Voltage Constraint: • Potential low voltage from 2025 onwards under N-1 conditions, and under intact conditions from 2036. Potential options to resolve this constraint are:

							• Reinforcement of existing Tummel Bridge/Errochty 5L5 33kV circuit. • Installation of voltage compensation assets. • Installation of additional 33kV circuits from Tummel Bridge/Errochty GSP – Aberfeldy PSS and/or establish a new 33kV interconnecting circuit between Tummel Bridge 33kV ring circuit 3L5/6L5. • New GSP in the Dunkeld vicinity and new 33kV circuits to interconnect with Errochty 3L5, 5L5 & 6L5.

Table 9 Future EHV system needs projected to arise ahead of 2035.

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

Additional system needs identified in the DFES 2024 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 10 below summarises the specific system needs we have identified.

Location of proposed intervention	EE Year	HE Year	HT Year	CF Year	EE Worst case asset loading (%)	Network state	Comments
Abernethy GSP							
Milnathort PSS (2x 33kV Transformers)	2039	2038	2040	2049	118.3	N-1 outage of Abernethy 1L5 circuit (ABNE.CON_4_2028_PH004442) N-1 outage of Abernethy 5L5 (ABNE.CON_5)	Thermal Constraint: • Thermal overload of Milnathort Primary transformers under N-1 conditions. Potential options to resolve this constraint are: • Reinforcement of existing primary transformer. • Assess options for transfer of some 11kV load onto adjacent interconnected primary substations. • Establish a new primary substation and transfer some 11kV load from the existing Milnathort PSS. • Assess options for procuring flexibility services.

Harbour PSS (2x 33kV Transformers)	2040	2038	2038	2049	168	N-1 outage of Abernethy 9L5 circuit. (ABNE.CON_3) N-1 outage of Abernethy 2L5 circuit (ABNE.CON_7)	Thermal Constraint: • Thermal overload of Harbour primary transformers under N-1 conditions. • Future circuit thermal overload from 2043. Potential options to resolve this constraint are: • Reinforcement of existing primary transformer. • Assess options for transfer of some 11kV load onto adjacent interconnected primary substations. • Establish a new primary substation and transfer some 11kV load from the existing Harbour PSS. • Assess options for procuring flexibility services.
Abernethy 33kV circuit 2L5 (Abernethy GSP - Bridge of Earn PSS - Harbour PSS)	2042	2038	2040	-	153.4	N-1 outage of Abernethy 9L5 circuit. (ABNE.CON_3)	Thermal Constraint: • Thermal overload of 33kV circuit 2L5 (Abernethy – Bridge of Earn, Harbour) under N-1 conditions. Voltage Constraint: • Future low voltage constraint from 2049 onwards. Potential options to resolve this constraint are: • Reinforcement of existing Abernethy 33kV 2L5 circuit. • Installation of new 33kV circuits. • New GSP in the Callander vicinity. • Assess options for procuring flexibility services.
Abernethy 33kV circuit 9L5 (Abernethy GSP - Harbour PSS)	2043	2039	2042	-	135.2	N-1 outage of Abernethy 2L5 circuit (ABNE.CON_7)	Thermal Constraint: • Thermal overload of 33kV circuit 9L5 (Abernethy – Harbour) under N-1 conditions. Potential options to resolve this constraint are: • Reinforcement of existing Abernethy 33kV 2L5 circuit. • Installation of new 33kV circuits. • New GSP in the Perth vicinity. • Assess options for procuring flexibility services.
New Abernethy GSP - Milnathort PSS dedicated 33kV circuit 1	2043	2043	2046	-	102.8	N-1 outage of Abernethy – Milnathort 33kV circuit 2 (ABNE.CON_5)	Thermal Constraint: • Thermal overload of New Abernethy GSP - Milnathort PSS dedicated 33kV circuit 1 under N-1 conditions.

							Potential options to resolve this constraint are: • Further reinforcement of the new 33kV circuit currently in delivery. • Installation of additional 33kV circuits to Milnathort PSS. • New GSP in the Milnathort vicinity. Followed by creation of a new PSS to accommodate future demand growth.
New Abernethy GSP - Milnathort PSS dedicated 33kV circuit 2	2046	2044	2048	-	128.3	N-1 outage of Abernethy - Milnathort 33kV circuit 1 (ABNE.CON_4_2028_PH004442)	Thermal Constraint: • Thermal overload of New Abernethy GSP - Milnathort PSS dedicated 33kV circuit 2 under N-1 conditions. Potential options to resolve this constraint are: • Further reinforcement of the new 33kV circuit currently in delivery. • Installation of additional 33kV circuits to Milnathort PSS. • New GSP in the Milnathort vicinity. Followed by creation of a new PSS to accommodate future demand growth.
Scone PSS (33kV Transformers)	-	-	2045	-	-	N-1 outage of Abernethy GSP - Scone circuit. (ABNE.CON_2)	Thermal Constraint: • Thermal overload of Scone primary transformers under N-1 conditions. Potential options to resolve this constraint are: • Reinforcement of existing primary transformers. • Assess options for transfer of some 11kV load onto adjacent interconnected primary substations. • Establish a new primary substation and transfer some 11kV load from the existing Scone PSS. • Assess options for procuring flexibility services.
Braco GSP							
Kippen PSS (33kV Transformer 2)	2038	2040	2039	2045	123	N-1 outage of Braco 4L5 circuit. (BRAC.CON_4_2027_PH004222)	Thermal Constraint: • Thermal overload of Kippen primary transformer 2 under N-1 conditions. Potential options to resolve this constraint are: • Reinforcement of existing primary transformer.

							• Assess options for transfer of some 11kV load onto adjacent interconnected primary substations. • Establish a new primary substation and transfer some 11kV load from the existing Kippen PSS. • Assess options for procuring flexibility services.
Kippen PSS (33kV Transformer 1)	2041	2042	2042	2049	107	N-1 outage of Braco 3L5 circuit. (BRAC.CON_5)	Thermal Constraint: • Thermal overload of Kippen primary transformer 1 under N-1 conditions. Potential options to resolve this constraint are: • Reinforcement of existing primary transformer. • Assess options for transfer of some 11kV load onto adjacent interconnected primary substations. • Establish a new primary substation and transfer some 11kV load from the existing Kippen PSS. • Assess options for procuring flexibility services.
Forteviot PSS (33kV Transformer)	2043	2044	2042	-	111.5	N-1 outage of Braco 6L5 circuit. (BRAC.CON_2)	Thermal Constraint: • Thermal overload of Forteviot Primary transformer under N-1 conditions. Potential options to resolve this constraint are: • Reinforcement of existing primary transformer. • Installation of an additional primary transformer at Forteviot PSS and a new 33kV circuit from Braco West/Burghmuir/Abernethy GSP – Forteviot PSS. • Assess options for transfer of some 11kV load onto any interconnected primary substations. • Establish a new Primary substation and transfer some 11kV load from the existing Forteviot PSS. • Assess options for procuring flexibility services.
Gleneagles PSS (33kV Transformer 1)	2043	2042	2042	-	127.6	N-1 outage of Braco 6L5 circuit. (BRAC.CON_2)	Thermal Constraint: • Thermal overload of Gleneagles primary transformer 1 under N-1 conditions.

							Potential options to resolve this constraint are: • Reinforcement of existing primary transformer. • Installation of additional 33kV circuits to Gleneagles PSS. • Assess options for transfer of some 11kV load onto adjacent interconnected primary substations. • Establish a new primary substation and transfer some 11kV load from the existing Gleneagles PSS. • Assess options for procuring flexibility services.
Gleneagles PSS (33kV Transformer 2)	2049	2046	2046	-	127.6	N-1 outage of Braco 5L5 circuit. (BRAC.CON_3_2027_EQH841)	Thermal Constraint: • Thermal overload of Gleneagles primary transformer 2 under N-1 conditions. Potential options to resolve this constraint are: • Reinforcement of existing primary transformer. • Installation of additional 33kV circuits to Gleneagles PSS. • Assess options for transfer of some 11kV load onto adjacent interconnected primary substations. • Establish a new primary substation and transfer some 11kV load from the existing Gleneagles PSS. • Assess options for procuring flexibility services.

Burghmuir GSP							
Redgorton PSS (33kV Transformer 2)	2037	2036	2035	2039	136.5	N-1 outage of Burghmuir 2L5 circuit. (BUMU.CON_1)	Thermal Constraint: • Thermal overload of Redgorton primary transformer 2 under N-1 conditions. Potential options to resolve this constraint are: • Reinforcement of existing primary transformer. • Installation of additional 33kV circuits to Redgorton PSS. • Assess options for transfer of some 11kV load onto adjacent interconnected primary substations. • Establish a new primary substation and transfer some 11kV load from the existing Redgorton PSS. • New GSP in the Dunkeld vicinity and new 33kV circuits to interconnect with Burghmuir 1L5 & 2L5. • Assess options for procuring flexibility services.
Burghmuir GSP - Burghmuir PSS 33kV circuit 6L5 EWC952_CABLE2	2041	2042	2049	-	118.6	Intact	Thermal Constraint: • Thermal overload of 33kV circuit 6L5 (Burghmuir GSP – Burghmuir PSS) under Intact conditions. Potential options to resolve this constraint are: • Further reinforcement of the new 33kV circuit currently in delivery. • Install additional 33kV circuits to Burghmuir PSS. • Assess options for procuring flexibility services.
Burghmuir GSP - Goodlyburn PSS 33kV circuit 4L5	2042	2038	2040	-	136.3	N-1 outage of Burghmuir 3L5 circuit. (BUMU.CON_3)	Thermal Constraint: • Thermal overload of 33kV circuit 4L5 (Burghmuir – Goodlyburn) under N-1 conditions. Potential options to resolve this constraint are: • Reinforcement of existing Burghmuir 33kV 4L5 circuit. • Install additional 33kV circuits to Thimblerow PSS. • Assess options for procuring flexibility services.
Burghmuir PSS (33kV Transformer 2) NEW non-CER 30MVA	2042	2043	-	-	115.5	Intact	Thermal Constraint: • Thermal overload of Burghmuir primary transformer 2 under Intact conditions.

							Potential options to resolve this constraint are: • Further reinforcement of new Burghmuir primary transformer currently in delivery. • Assess options for procuring flexibility services.
Burghmuir GSP 33kV circuit 3L5 (Burghmuir PSS) EWC952_CABLE1	2043	2043	-	-	118.2	Intact	Thermal Constraint: • Thermal overload of 33kV circuit 3L5 (Burghmuir GSP – Burghmuir PSS) under Intact conditions. Potential options to resolve this constraint are: • Further reinforcement of the new 33kV circuit currently in delivery. • Install additional 33kV circuits to Burghmuir PSS. • Assess options for procuring flexibility services.
Coupar Angus GSP							
Blairgowrie PSS (2x 33kV Transformers)	2043	-	2042	-	111.3	N-1 outage of Coupar Angus 1L5 circuit. (COUA.CON_5) N-1 outage of Coupar Angus 2L5 circuit. (COUA.CON_6)	Thermal Constraint: • Thermal overload of Blairgowrie primary transformer 1 under N-1 conditions, which is related to the N-1 voltage problem. Potential options to resolve this constraint are: • Reinforcement of existing primary transformers. • New GSP in the Dunkeld vicinity and new 33kV circuits to interconnect with Coupar Angus 1L5 & 2L5. • Assess options for procuring flexibility services.
Leoch PSS (33kV Transformer)	2044	-	2044	-	103.1	Intact	Thermal Constraint: • Thermal overload of Leoch primary transformer under Intact conditions. Potential options to resolve this constraint are: • Reinforcement of existing primary transformer. • Installation of an additional primary transformer at Leoch PSS. • Assess options for transfer of some 11kV load onto adjacent interconnected PSS's. • Establish a new primary substation and transfer some

							11kV load from the existing Leoch PSS. • Assess options for procuring flexibility services.
Killin GSP							
Killin 33kV circuit 4L5 (Killin - Alt Na Gobh, Inverar, Inverinain, Roromore, Roroeyre, Innerwick, Taymouth PSS)	2036	2039	2036	2045	-	N-1 outage of Errochty 5L5 circuit. (TUMB.CON_2_2025_ SLD Update)	Voltage Constraint: • Low voltage from 2036 onwards under N-1 conditions. Potential options to resolve this constraint are: • Reinforcement of existing Killin 4L5 and Tummel Bridge/Errochty 5L5 circuit. • Extension of Killin 33kV circuit 1L5 to interconnect with Killin 4L5 between Cashlie and Innerwick PSS's. • New GSP in the Dunkeld vicinity and new 33kV circuits to interconnect with Killin 4L5 & Tummel Bridge/Errochty 5L5 circuits. • Installation of voltage compensation assets.
Tummel Bridge GSP (New Errochty GSP)							
Fincastle PSS (33kV Transformer)	2036	2041	2038	2048	109.8	N-1 outage of Tummel Bridge 3L5 circuit. (TUMB.CON_3) Intact (2039)	Thermal Constraint: • Thermal overload of Fincastle primary transformer under N-1 conditions. Potential options to resolve this constraint are: • Reinforcement of existing primary transformer. • Installation of an additional primary transformer at Fincastle PSS. • Assess options for transfer of some 11kV load onto adjacent interconnected PSS's. • Establish a new primary substation and transfer some 11kV load from the existing Fincastle PSS. • Assess options for procuring flexibility services.
Aberfeldy PSS (2x 33kV Transformers)	2037	2040	2037	2048	120.7	N-1 outage of Errochty 5L5 circuit. (TUMB.CON_2) N-1 outage of Aberfeldy primary transformer 1 (TUMB.CON_5)	Thermal Constraint: • Thermal overload of Aberfeldy primary transformer 1 under N-1 conditions. Potential options to resolve this constraint are:

							• Reinforcement of existing primary transformers. • Assess options for transfer of some 11kV load onto adjacent interconnected PSS's. • Establish a new primary substation and transfer some 11kV load from the existing Aberfeldy PSS. • New GSP in the Dunkeld vicinity and new 33kV circuits to interconnect with Errochty 3L5, 5L5 & 6L5. • Assess options for procuring flexibility services.
Tummel Bridge 33kV circuit 3L5 (Tummel Bridge - Pitlochry, Bonskeid PSS)	2038	2040	2040	2046	-	Intact N-1 outage of Tummel Bridge 3L5 circuit. (TUMB.CON_3)	Voltage Constraint: • Low voltage from 2040 onwards under Intact and N-1 conditions. Potential options to resolve this constraint are: • Reinforcement of existing Tummel Bridge/Errochty 3L5/6L5 33kV ring circuit. • New GSP in the Dunkeld vicinity and new 33kV circuits to interconnect with Killin 4L5 & Tummel Bridge/Errochty 5L5 circuits. • Installation of voltage compensation assets.
Tummel Bridge 33kV ring circuit 3L5/6L5 (Tummel Bridge - Pitlochry, Bonskeid, Fincastle, Tummel Bridge PSS)	2038	2040	2040	2046	-	Intact	Voltage Constraint: • Low voltage from 2040 onwards under Intact conditions. Potential options to resolve this constraint are: • Reinforcement of existing Tummel Bridge/Errochty 3L5/6L5 33kV ring circuit. • New GSP in the Dunkeld vicinity and new 33kV circuits to interconnect with Killin 4L5 & Tummel Bridge/Errochty 5L5 circuits. • Installation of voltage compensation assets.
Tummel Bridge 33kV circuit 6L5 (Tummel Bridge - Pitlochry, Bonskeid PSS PSS)	2045	-	2045	-	-	N-1 outage of Tummel Bridge 3L5 circuit. (TUMB.CON_3)	Voltage Constraint: • Low voltage from 2045 onwards under N-1 conditions. Potential options to resolve this constraint are: • Reinforcement of existing Tummel Bridge/Errochty 3L5/6L5 33kV ring circuit.

							• New GSP in the Dunkeld vicinity and new 33kV circuits to interconnect with Killin 4L5 & Tummel Bridge/Errochty 5L5 circuits. • Installation of voltage compensation assets.

Table 10 Options to resolve system needs between 2035-2050

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 Errochty 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.[19]

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 Errochty 132kV switching station, 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 34** 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.

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

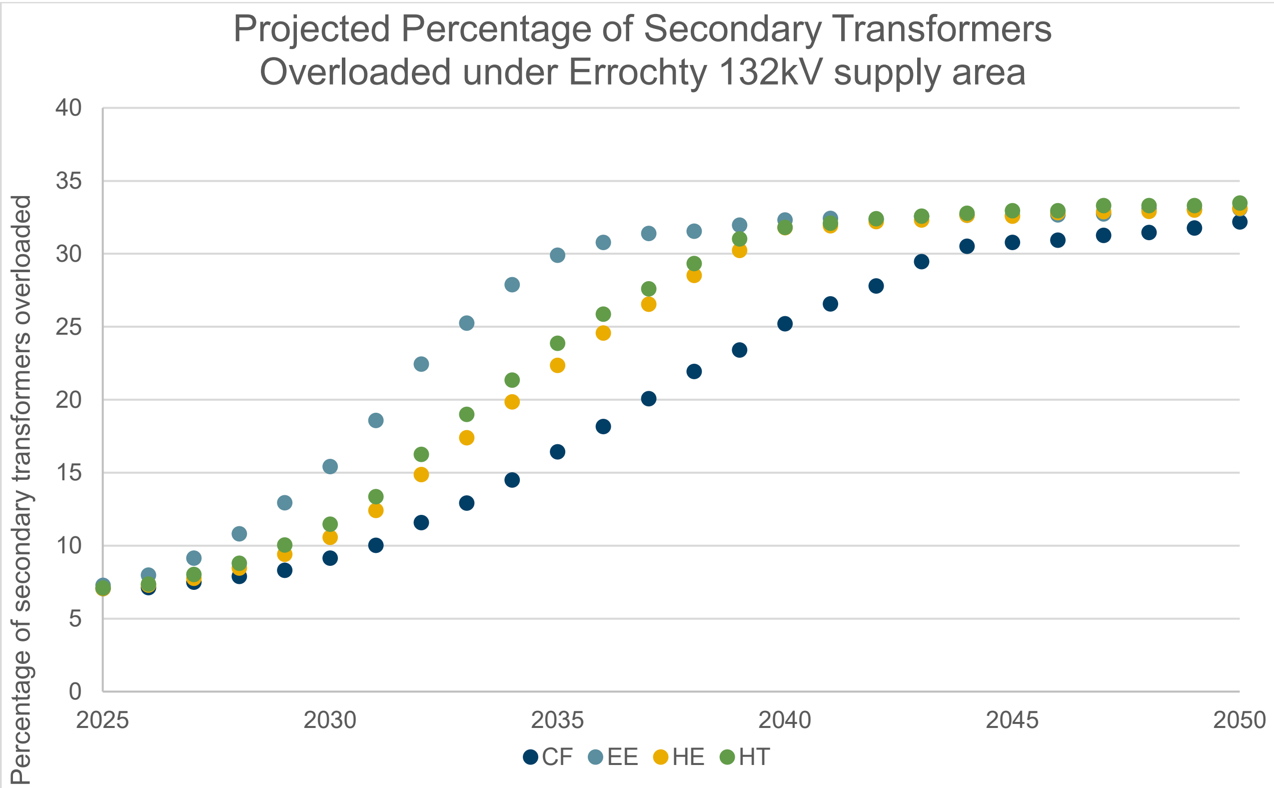


Figure 34 Errochty 132kV supply area Projected Secondary Transformer Loading. Source: SSEN Load Model

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.[20] This work groups Lower layer Super Output Areas (LSOAs)[21] 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 11**.

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.

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

21 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 11 VFES Groupings

To understand the vulnerability groupings across the Errochty 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 Holistic Transition pathway), 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 35.**

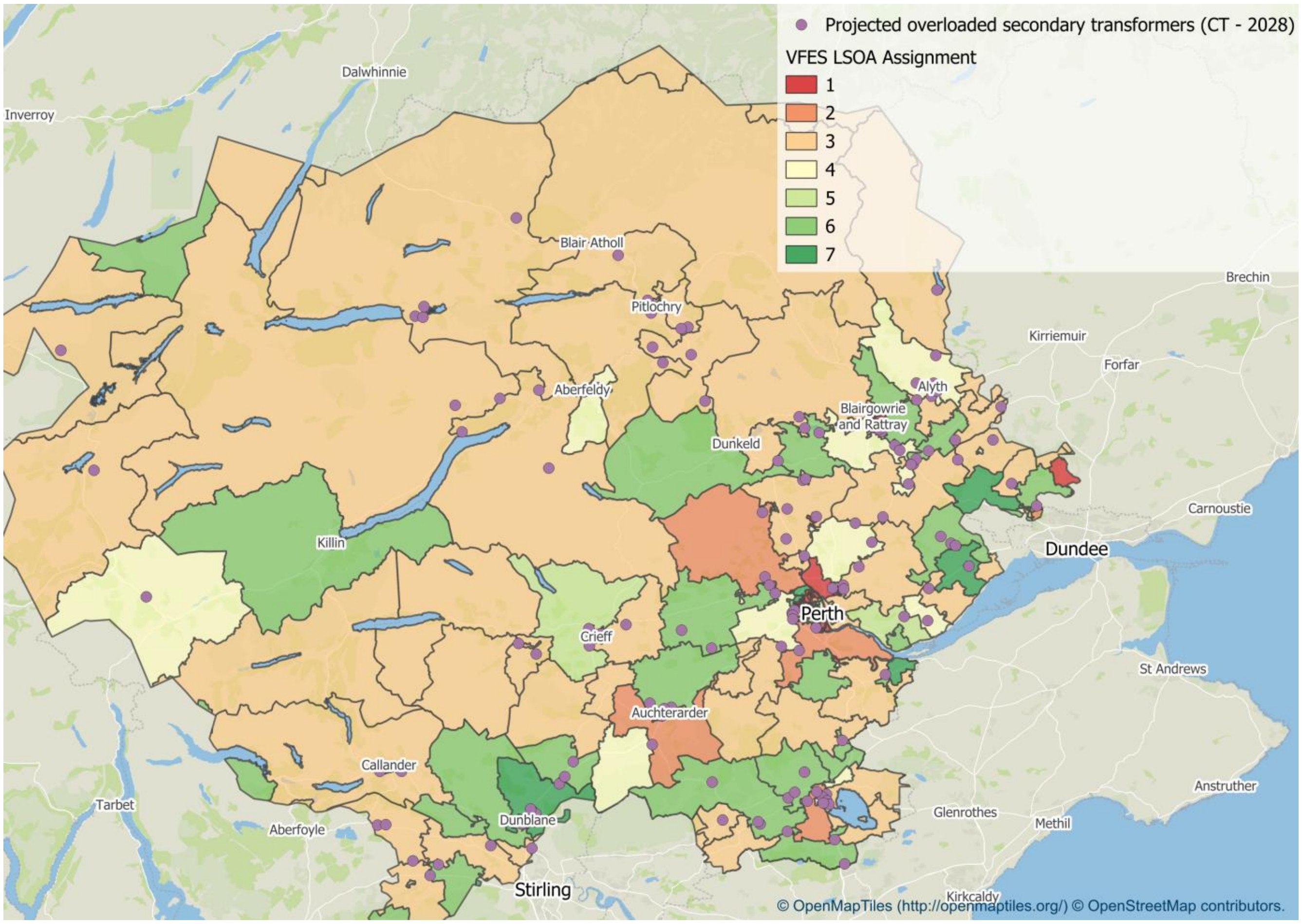


Figure 35 Errochty 132kV supply area VFES Output with secondary transformer overlay.

We can see that the majority of the area falls within group 3, indicating higher levels of vulnerability. This is driven up by a larger elderly population. In the Errochty 132kV supply area there are several LSOAs that fall into the higher categories of vulnerability (groups 1, 2, and 3). We also see several LSOA area's falling into the group 1 – very high vulnerability, around Blairgowrie, Creiff, Dunblane and Perth. 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 Holistic Transition pathway), 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)[22] and My Electric Avenue[23] 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, *14.17*% of low voltage feeders may need intervention by 2035 and *25.1*% by 2050 under the CT scenario as shown in **Figure 36**. 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.

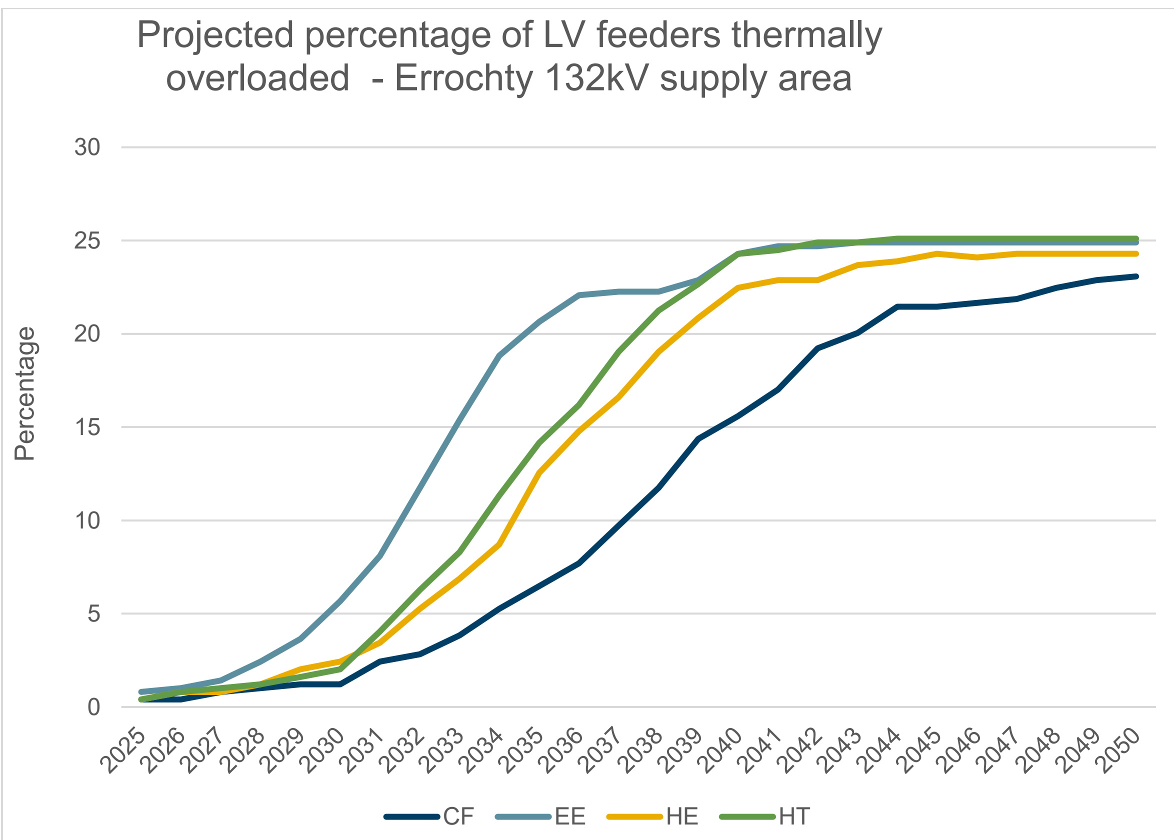


Figure 36 Percentage of LV feeders projected to be overloaded under Errochty 132kV supply area.

22 Project LEO | SSEN Innovation

23 My Electric Avenue |

9. RECOMMENDATIONS

The stakeholder engagement insights and the SSEN 2024 DFES analysis provides a robust evidence base for load growth across the Errochty 132kV supply area in both the near and longer term. Load growth across the central Scotland 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 Errochty 132kV supply area, 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 6 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:
   - Abernethy 33kV 4L5 & 5L5 ring circuit (Abernethy GSP - Scone, Balbeggie, Errol PSS)
   - Errol PSS (2x 33kV Transformers)
   - Braco West 33kV circuit 8L5 (Braco GSP - Crieff PSS)
   - Callander PSS (2x 33kV Transformers)
   - Dunblane PSS (2x 33kV Transformers)
   - Braco West 33kV circuit 3L5 (Braco GSP - Dunblane, Kippen, PSS) (Callander Circuit)
   - Braco West 33kV circuit 5L5 (Braco GSP - Gleneagles PSS, Teed to Forteviot PSS)
   - Braco West 33kV circuit 6L5 (Braco GSP - Gleneagles PSS)
   - Braco West 33kV circuit 4L5 (Braco GSP - Dunblane PSS)
   - Goodlyburn PSS (33kV Transformer 2)
   - Redgorton PSS (33kV Transformer 1)
   - Dalrulzion PSS (2x 33kV Transformers)
   - Alyth PSS (2x 33kV Transformers)
   - Coupar Angus 33kV circuit 2L5 (Coupar Angus - Blairgowrie PSS)
   - Coupar Angus 33kV circuit 1L5 (Coupar Angus - Blairgowrie PSS)
   - Killin 33kV circuit 2L5 (Killin - Killin Town, Lochearnhead, Lubnaig PSS)
   - Blackmount PSS (33kV Transformer)
   - Pitlochry PSS (2x 33kV Transformers)
   - Tummel Bridge 33kV circuit 5L5 (Tummel Bridge - Coshieville, Aberfeldy PSS)

2. SSEN should ensure an open channel of communication is present between SSEN Distribution, SSEN Transmission and NESO regarding the following:
   - The possibility/feasibility of establishing new GSP's located in the vicinity of Dalrulzion/Dunkeld/Bankfoot. This should be explored in further detail as a potential option to alleviate future forecasted constraints on the existing Abernethy, Burghmuir, Coupar Angus, Killin, Tummel Bridge/Errochty distribution networks and increasing network resilience within 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 Abernethy, Braco West, Coupar Angus, Killin, St Fillans and Tummel Bridge/Errochty Grid Supply Point areas. 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. 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.

6. 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 Errochty 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.

Appendix A FURTHER DETAIL ON EXISTING NETWORK INFRASTRUCTURE – PRIMARY SUBSTATIONS

Substation Name	Site Type	Number of Customers Served (approximate)	2023/24 Substation Maximum demand in MVA (Season)
Abernethy GSP			
ABERNETHY	Primary Substation	663	1.02 (Winter)
ABERNETHY GRID	Primary Substation	27	N/A
BALBEGGIE	Primary Substation	1,940	2.95 (Winter)
BRIDGE OF EARN	Primary Substation	2,056	1.57 (Winter)
ERROL	Primary Substation	2,567	3.42 (Winter)
GLENDEVON	Primary Substation	793	0.73 (Winter)
HARBOUR	Primary Substation	4,623	6.02(Winter)
MILNATHORT	Primary Substation	6,259	8.46 (Winter)
SCONE	Primary Substation	4,007	2.47 (Winter)
Braco West GSP			
BRACO WEST GRID	Primary Substation	50	N/A
CALLANDER	Primary Substation	2,603	3.90 (Winter)
CRIEFF	Primary Substation	5,346	7.12 (Winter)
DUNBLANE	Primary Substation	5,261	7.85 (Winter)
FORTEVIOT	Primary Substation	1,080	1.46 (Winter)
GLENEAGLES	Primary Substation	4,276	10.09 (Winter)
KIPPEN	Primary Substation	1,959	4.18 (Winter)
Burghmuir GSP			
BURGHMUIR	Primary Substation	6,017	8.33 (Winter)
BURGHMUIR GRID	Primary Substation	7	N/A
GOODLYBURN	Primary Substation	6,325	8.00 (Winter)
INVERALMOND	Primary Substation	155	5.30 (Winter)

REDGORTON	Primary Substation	3,633	5.89 (Winter)
THIMBLEROW	Primary Substation	8,040	14.05 (Winter)
Coupar Angus GSP			
ALYTH	Primary Substation	2,233	2.43 (Winter)
BLAIRGOWRIE	Primary Substation	5,640	6.29 (Winter)
CAPUTH	Primary Substation	3,049	4.96 (Winter)
COUPAR ANGUS	Primary Substation	2,463	4.40 (Winter)
COUPAR ANGUS GRID	Primary Substation	8	N/A
DALRULZION	Primary Substation	819	2.06 (Winter)
LEOCH	Primary Substation	1,895	2.50 (Winter)
Killin GSP			
ARDCHYLE	Primary Substation	6	N/A
CASHLIE	Primary Substation	74	0.08 (Winter)
CHAORACH	Primary Substation	31	0.93 (Winter)
KILLIN GRID	Primary Substation	498	N/A
KILLIN TOWN	Primary Substation	545	0.59 (Winter)
LOCHEARNHEAD	Primary Substation	621	0.73 (Winter)
LUBNAIG	Primary Substation	8	0.01 (Winter)
Rannoch GSP			
BLACKMOUNT	Primary Substation	14	0.01 (Winter)
BRIDGE OF GAUR	Primary Substation	119	0.12 (Winter)
KINLOCH RANNOCH	Primary Substation	247	0.09 (Winter)
TYNDRUM	Primary Substation	251	0.64 (Winter)
St Fillans GSP			
DALCHONZIE	Primary Substation	1,351	1.15(Winter)
ST FILLANS PS	Primary Substation	35	N/A
Tummel Bridge GSP			
ABERFELDY	Primary Substation	1,918	3.64 (Winter)

BONSKEID	Primary Substation	1,051	0.24 (Winter)
CALVINE	Primary Substation	313	1.46(Winter)
COSHIEVILLE	Primary Substation	872	2.15 (Winter)
FINCASTLE	Primary Substation	27	0.03 (Winter)
PITLOCHRY	Primary Substation	2,101	4.29(Winter)
TUMMEL BRIDGE GRID	Primary Substation	307	1.38 (Winter)

Appendix B COMBINED EHV SPATIAL PLAN (HEADROOM) FORECASTS FOR ALL DFES 2024 BACKGROUNDS

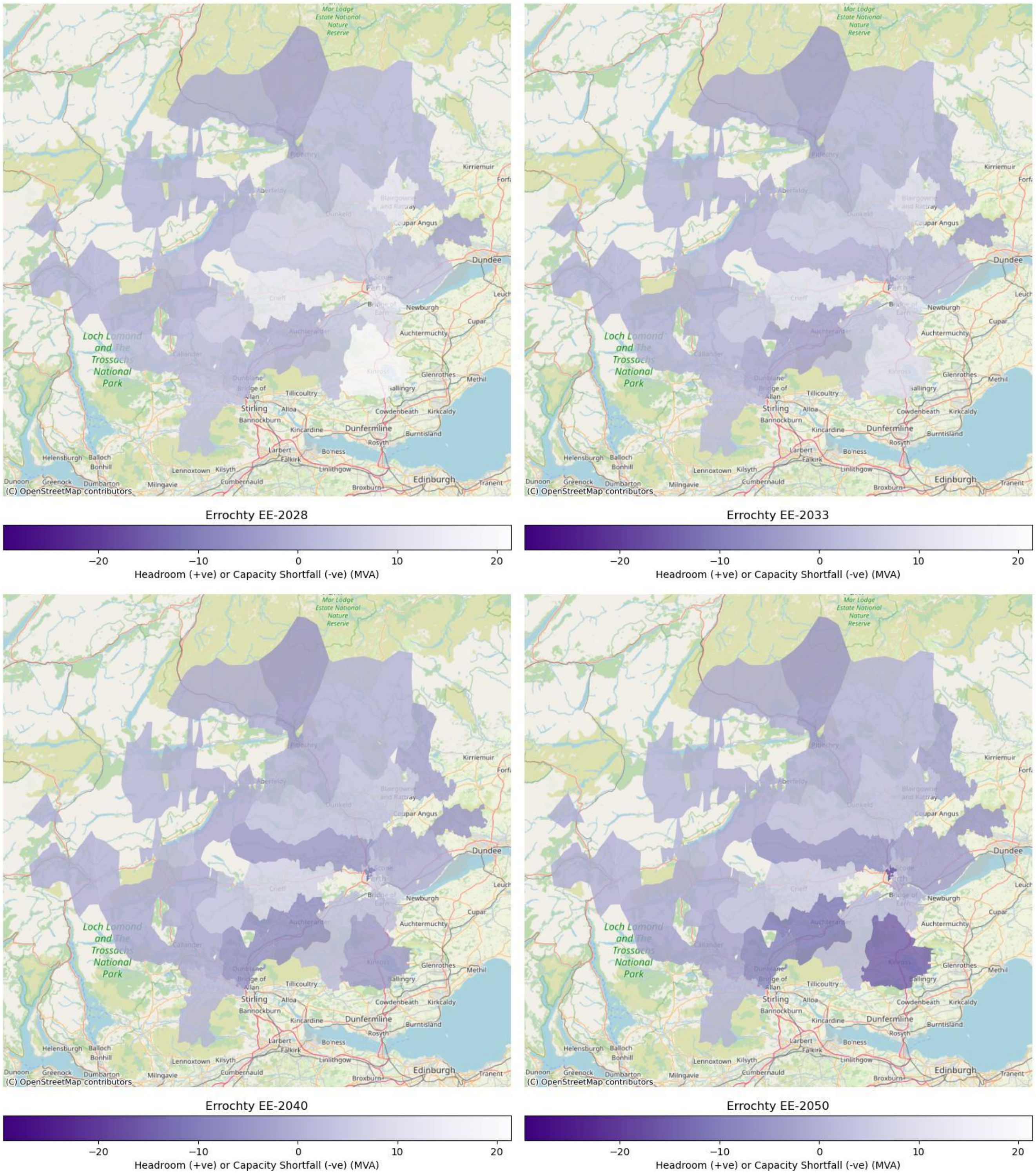


Figure 37 Errochty 132kV supply area EHV EE spatial plans for 2028, 2033, 2040, and 2050.

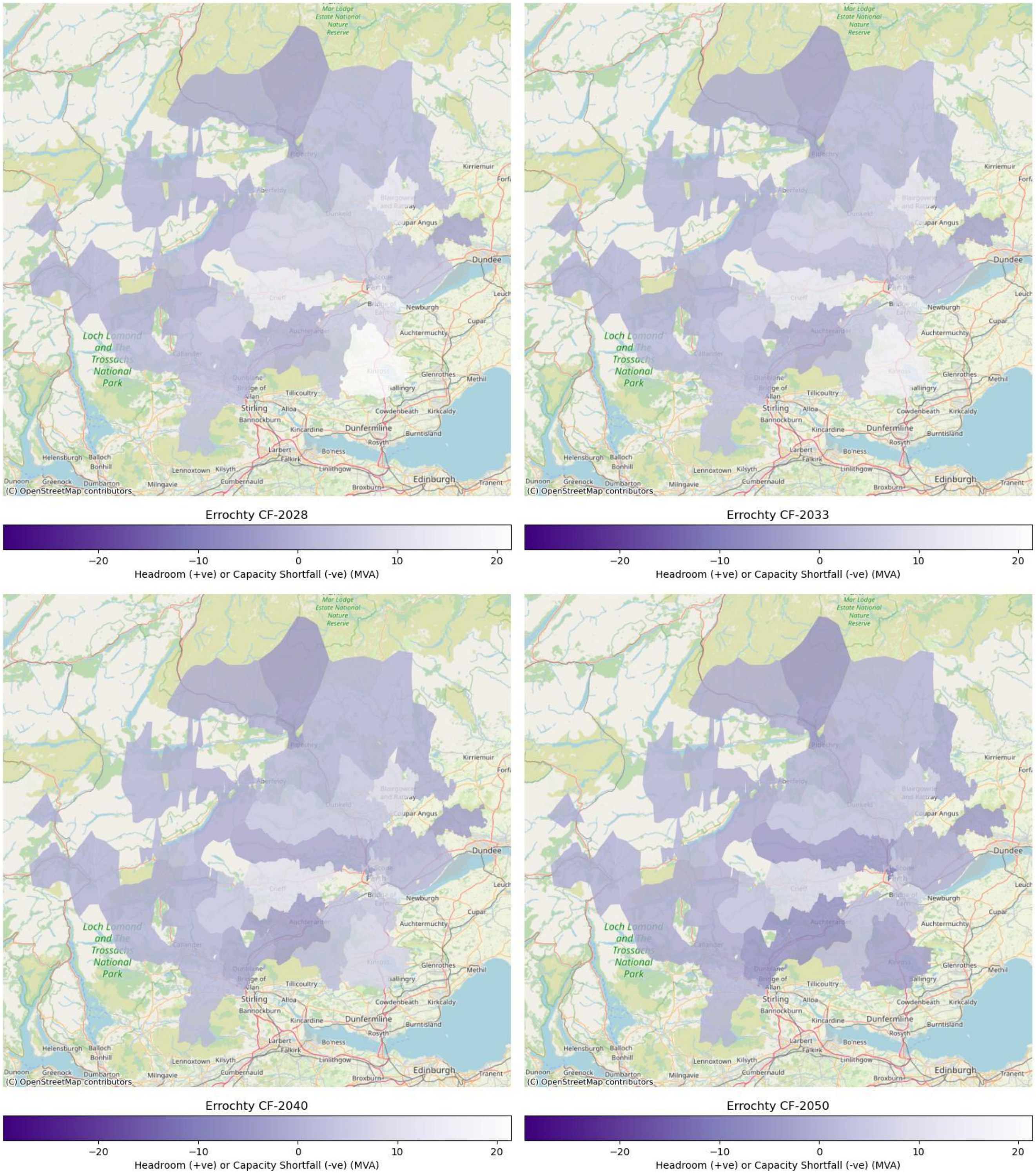


Figure 38 Errochty 132kV supply area EHV CF spatial plans for 2028, 2033, 2040, and 2050.

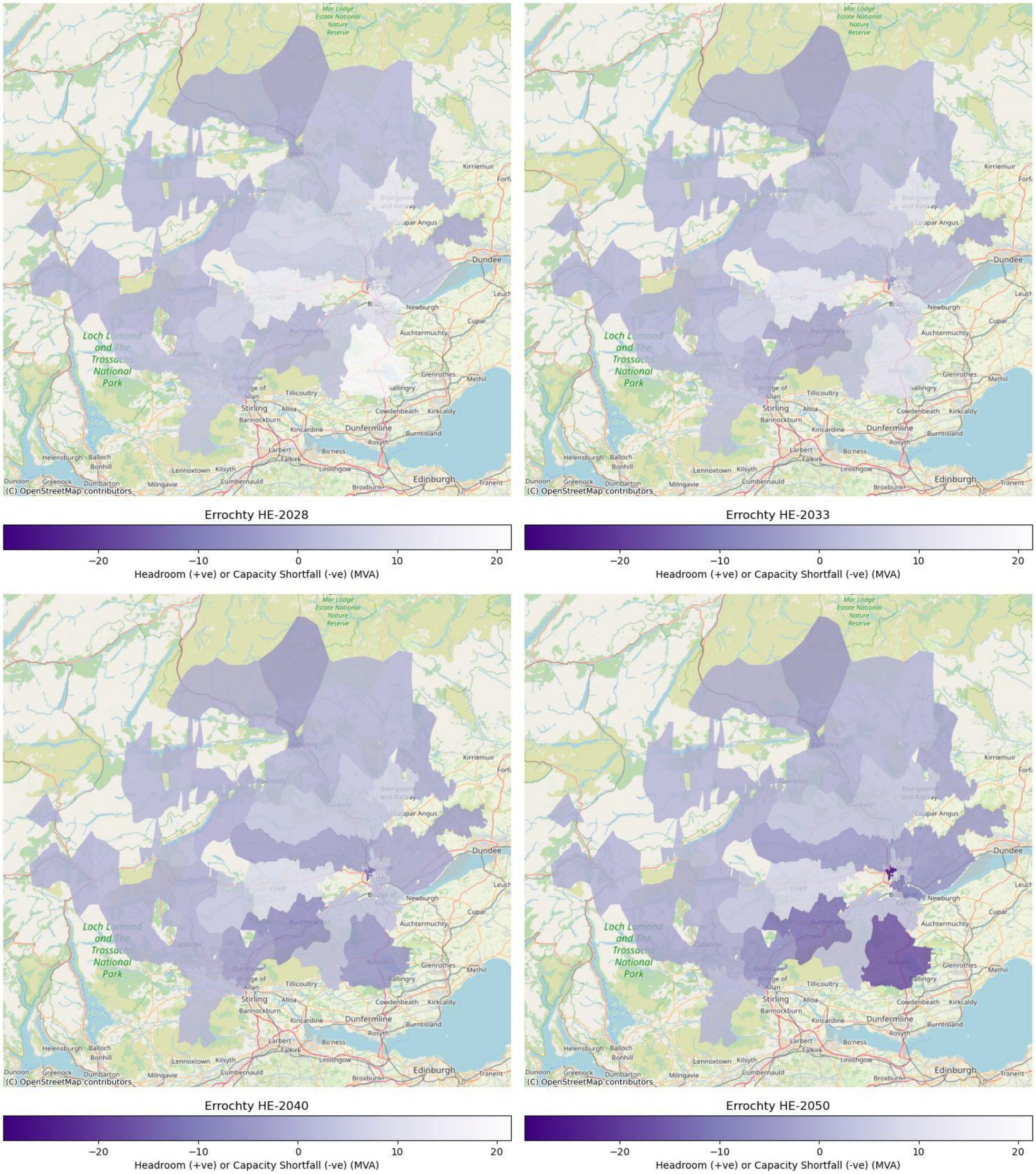


Figure 39 Errochty 132kV supply area EHV HE spatial plans for 2028, 2033, 2040, and 2050.

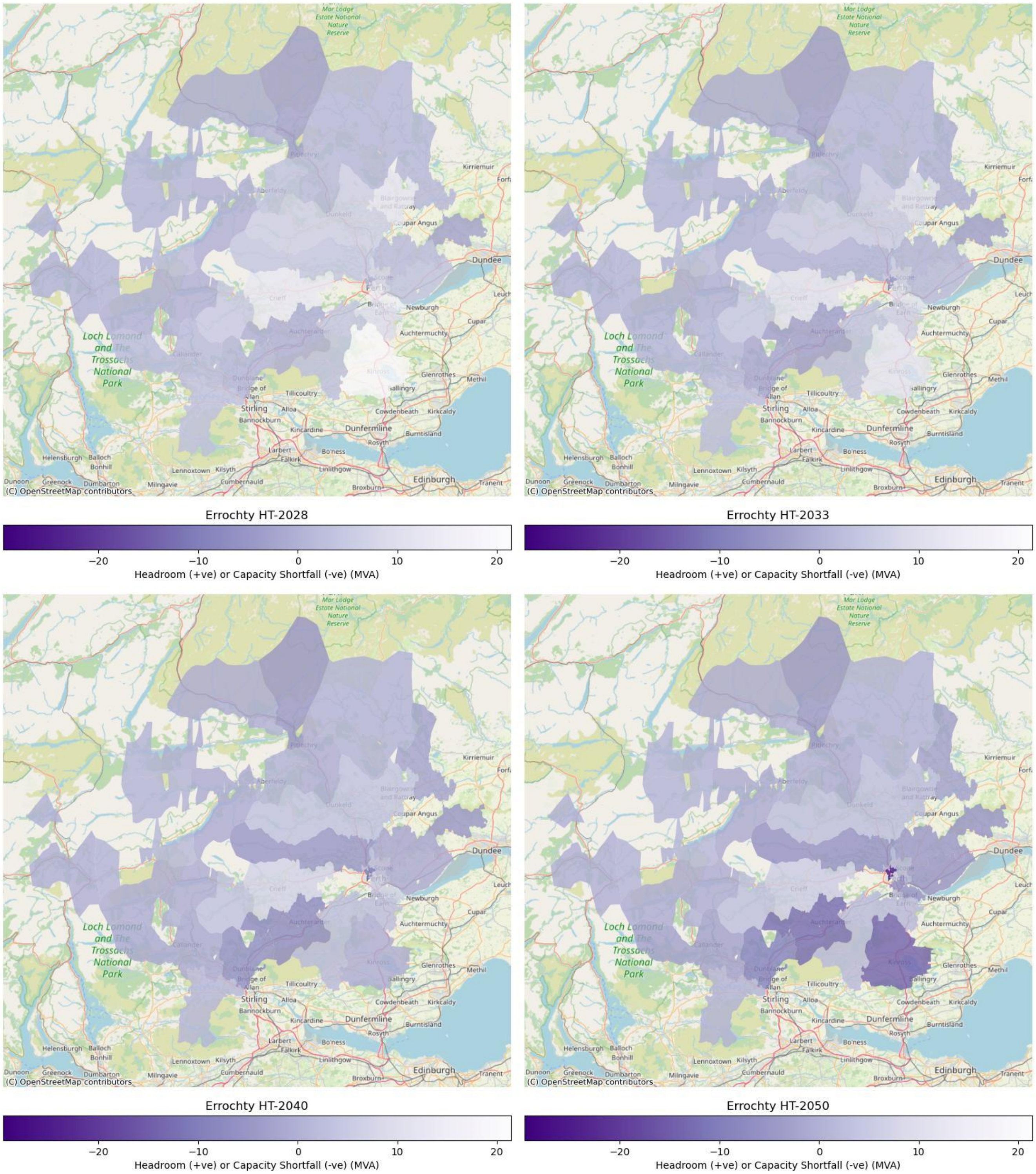


Figure 40 Errochty 132kV supply area EHV HT spatial plans for 2028, 2033, 2040, and 2050.

Appendix C COMBINED HV/LV SPATIAL PLAN FORECASTS FOR ALL DFES 2024 BACKGROUNDS

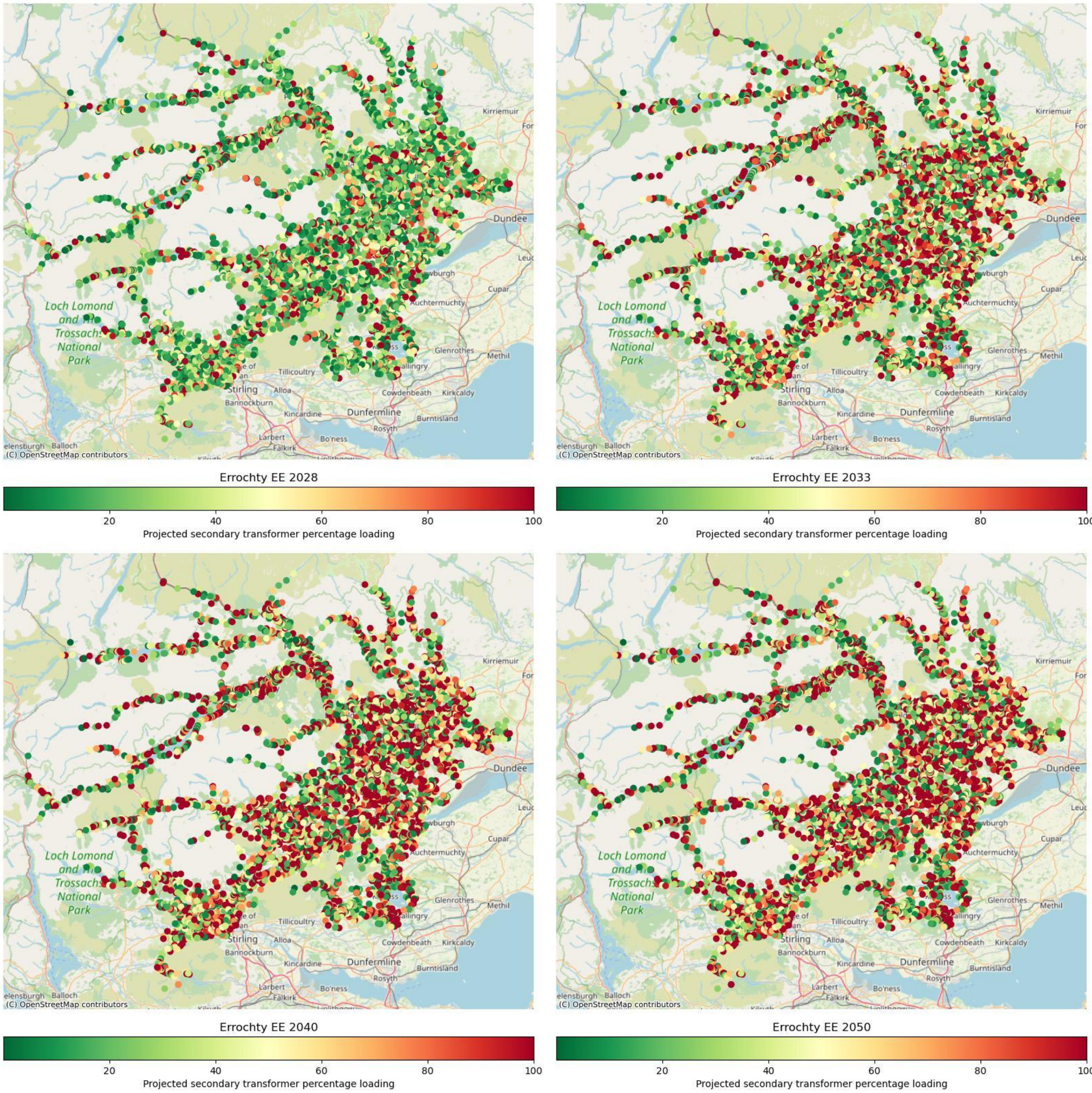


Figure 41 Errochty 132kV switching station HV/LV EE spatial plans for 2028, 2033, 2040, and 2050.

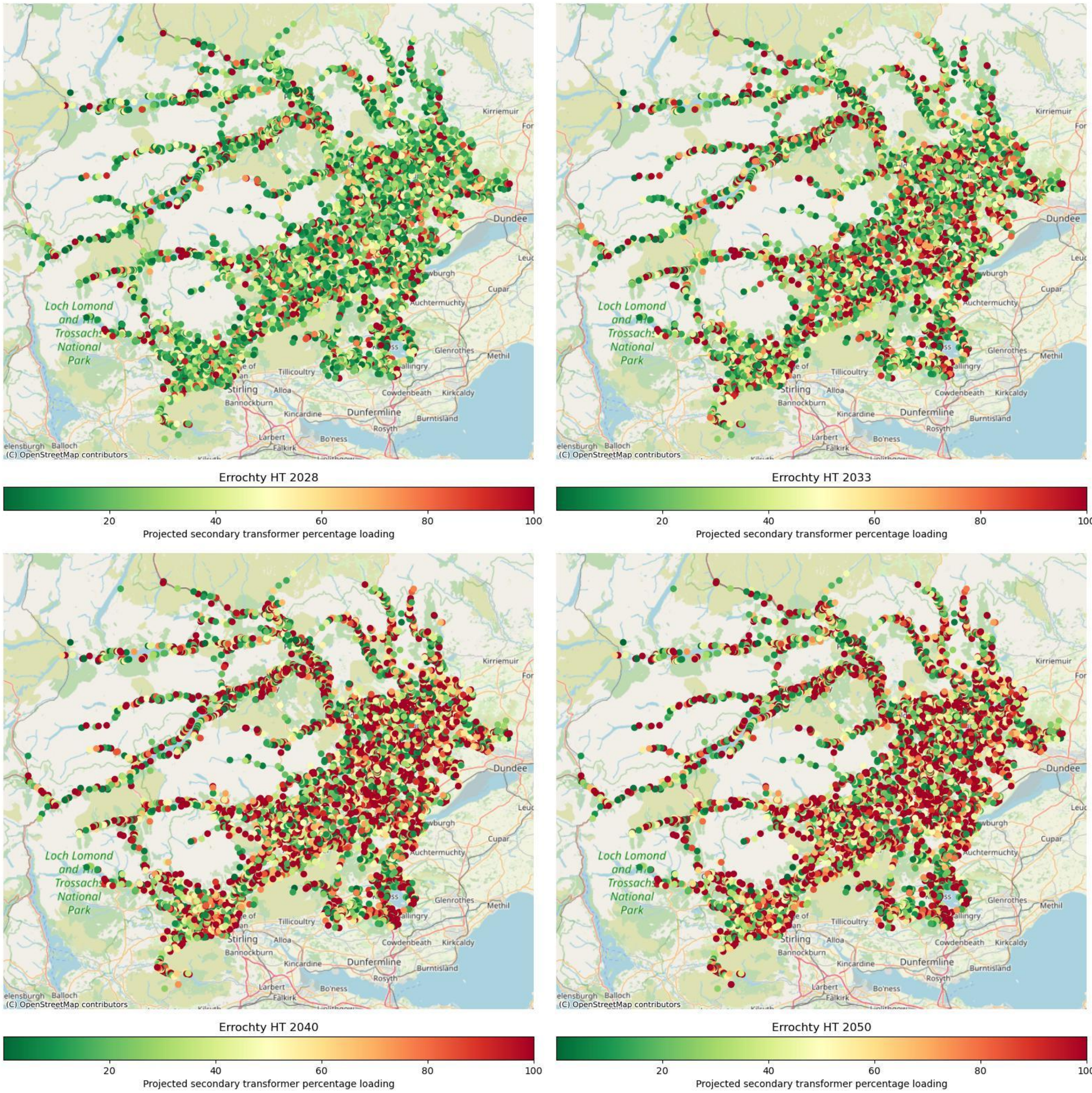


Figure 42 Errochty 132kV switching station HV/LV HT spatial plans for 2028, 2033, 2040, and 2050.

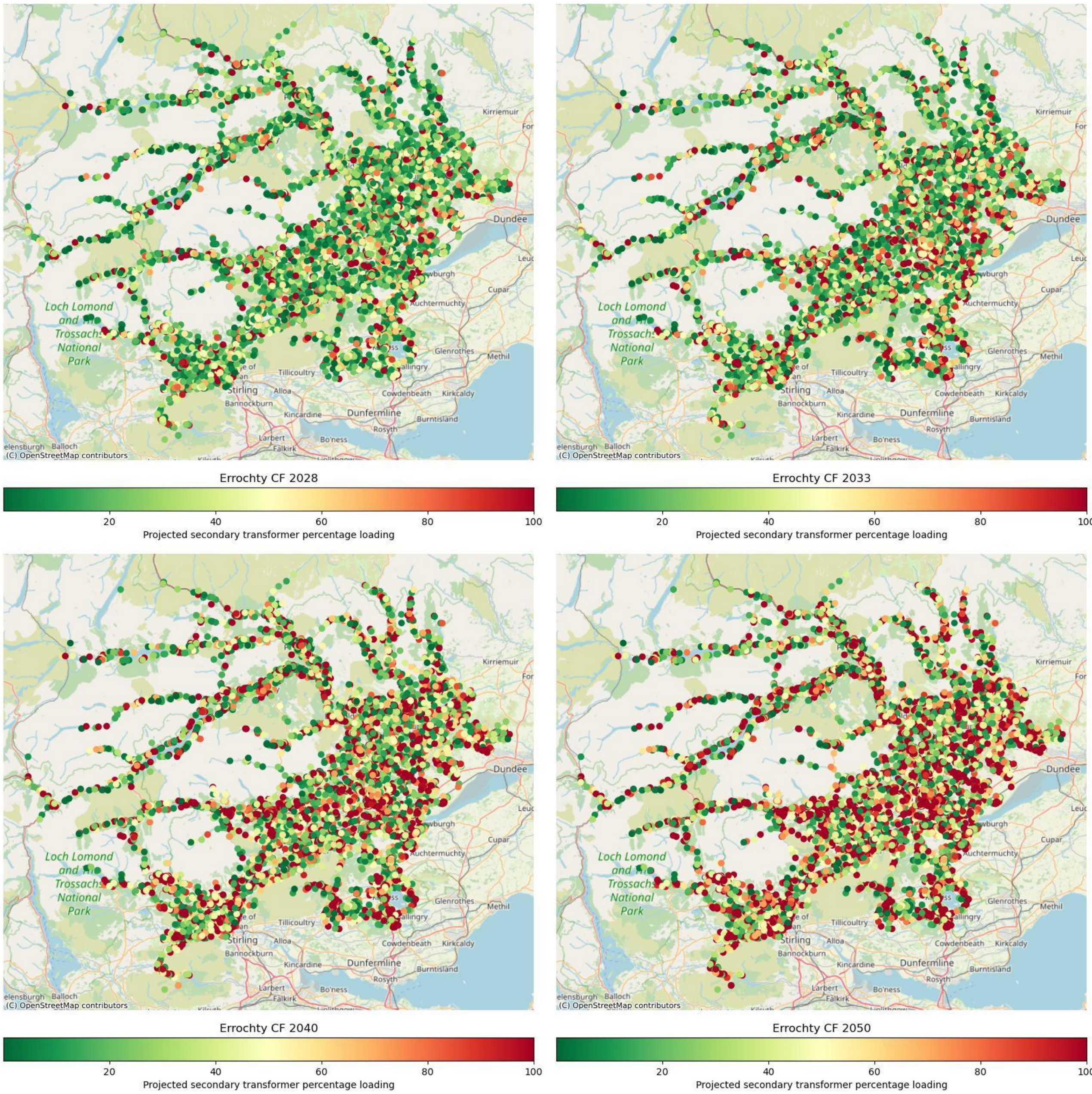


Figure 43 Errochty 132kV switching station HV/LV CF spatial plans for 2028, 2033, 2040, and 2050.

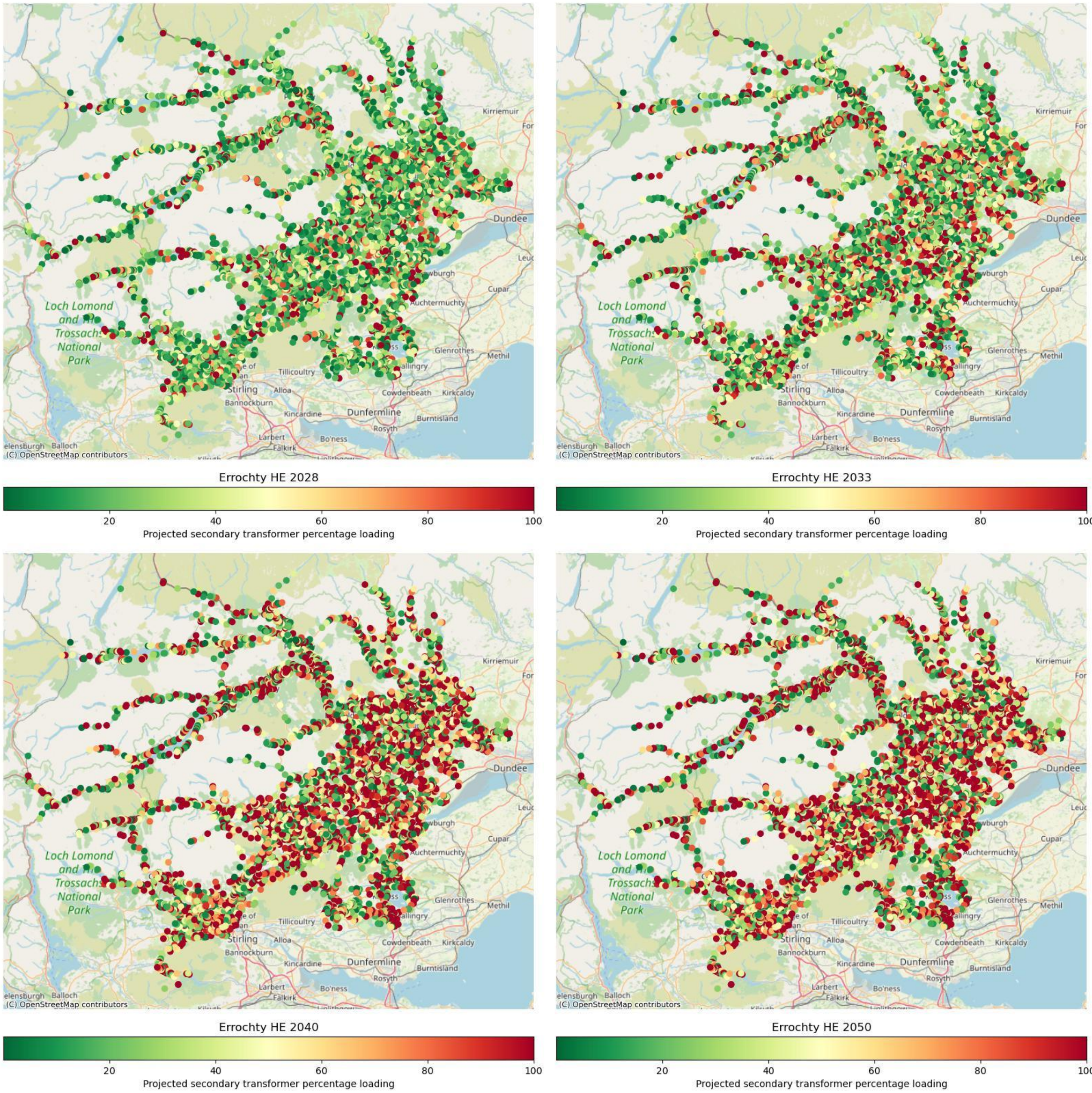


Figure 44 Errochty 132kV switching station HV/LV HE spatial plans for 2028, 2033, 2040, and 2050.

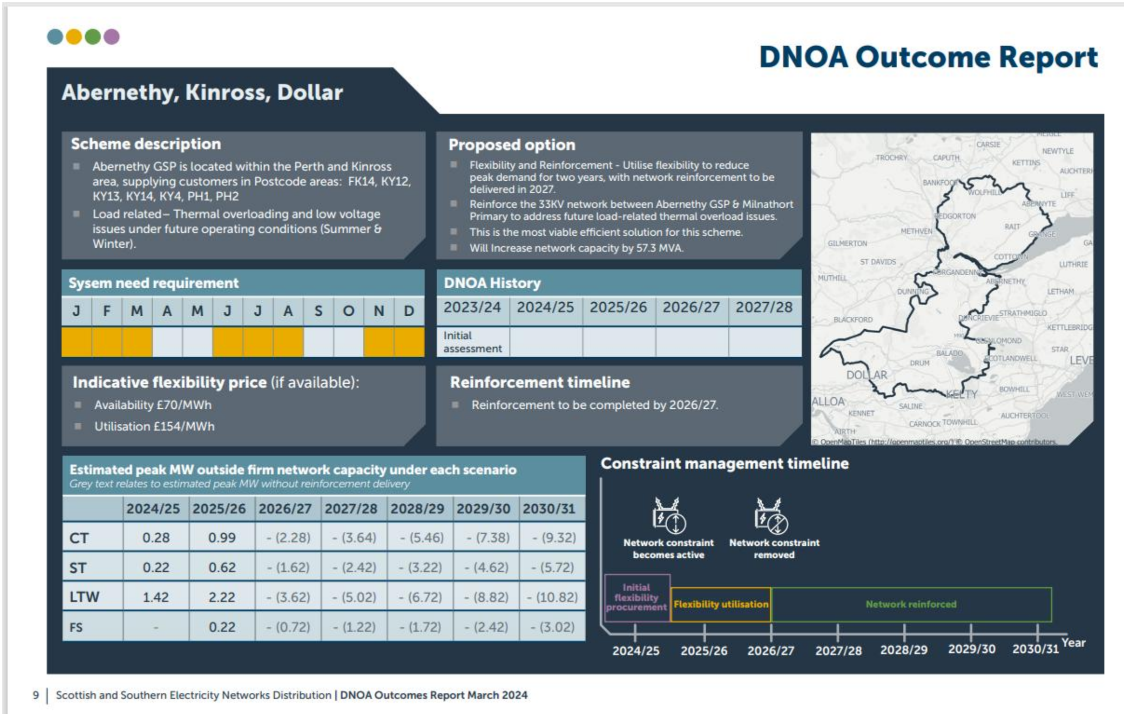
Appendix D GLOSSARY

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

Appendix E DNOA OUTCOME REPORTS

This appendiex shows the published DNOA Outcome Reports which are relevant to the Errochty 132kV supply area.



DNOA Outcome Report

Abernethy, Kinross, Dollar

Scheme description

- Abernethy GSP is located within the Perth and Kinross area, supplying customers in Postcode areas: FK14, KY12, KY13, KY14, KY4, PH1, PH2
- Load related– Thermal overloading and low voltage issues under future operating conditions (Summer & Winter).

Proposed option

- Flexibility and Reinforcement - Utilise flexibility to reduce peak demand for two years, with network reinforcement to be delivered in 2027.
- Reinforce the 33KV network between Abernethy GSP & Milnathort Primary to address future load-related thermal overload issues.
- This is the most viable efficient solution for this scheme.
- Will Increase network capacity by 57.3 MVA.

Sysem need requirement

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

DNOA History

2023/24	2024/25	2025/26	2026/27	2027/28
Initial assessment				

Indicative flexibility price (if available):

- Availability £70/MWh
- Utilisation £154/MWh

Reinforcement timeline

- Reinforcement to be completed by 2026/27.

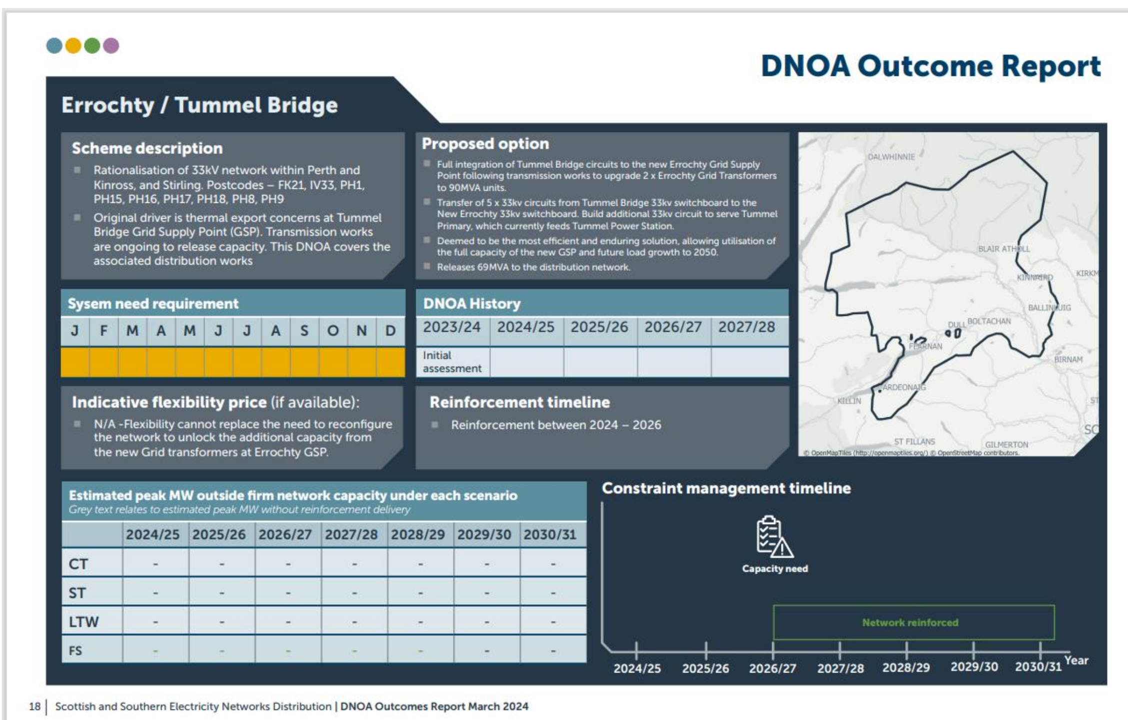
Estimated peak MW outside firm network capacity under each scenario
Grey text relates to estimated peak MW without reinforcement delivery

	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31
CT	0.28	0.99	- (2.28)	- (3.64)	- (5.46)	- (7.38)	- (9.32)
ST	0.22	0.62	- (1.62)	- (2.42)	- (3.22)	- (4.62)	- (5.72)
LTW	1.42	2.22	- (3.62)	- (5.02)	- (6.72)	- (8.82)	- (10.82)
FS	-	0.22	- (0.72)	- (1.22)	- (1.72)	- (2.42)	- (3.02)

Constraint management timeline

9 | Scottish and Southern Electricity Networks Distribution | DNOA Outcomes Report March 2024

Figure 45 DNOA Outcome Report for Abernethy, Kinross, Dollar (Abernethy GSP) (March 2024)



DNOA Outcome Report

Errochty / Tummel Bridge

Scheme description

- Rationalisation of 33kV network within Perth and Kinross, and Stirling. Postcodes – FK21, IV33, PH1, PH15, PH16, PH17, PH18, PH8, PH9
- Original driver is thermal export concerns at Tummel Bridge Grid Supply Point (GSP). Transmission works are ongoing to release capacity. This DNOA covers the associated distribution works

Proposed option

- Full integration of Tummel Bridge circuits to the new Errochty Grid Supply Point following transmission works to upgrade 2 x Errochty Grid Transformers to 90MVA units.
- Transfer of 5 x 33kv circuits from Tummel Bridge 33kv switchboard to the New Errochty 33kv switchboard. Build additional 33kv circuit to serve Tummel Primary, which currently feeds Tummel Power Station.
- Deemed to be the most efficient and enduring solution, allowing utilisation of the full capacity of the new GSP and future load growth to 2050.
- Releases 69MVA to the distribution network.

Sysem need requirement

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

DNOA History

2023/24	2024/25	2025/26	2026/27	2027/28
Initial assessment				

Indicative flexibility price (if available):

- N/A -Flexibility cannot replace the need to reconfigure the network to unlock the additional capacity from the new Grid transformers at Errochty GSP.

Reinforcement timeline

- Reinforcement between 2024 – 2026

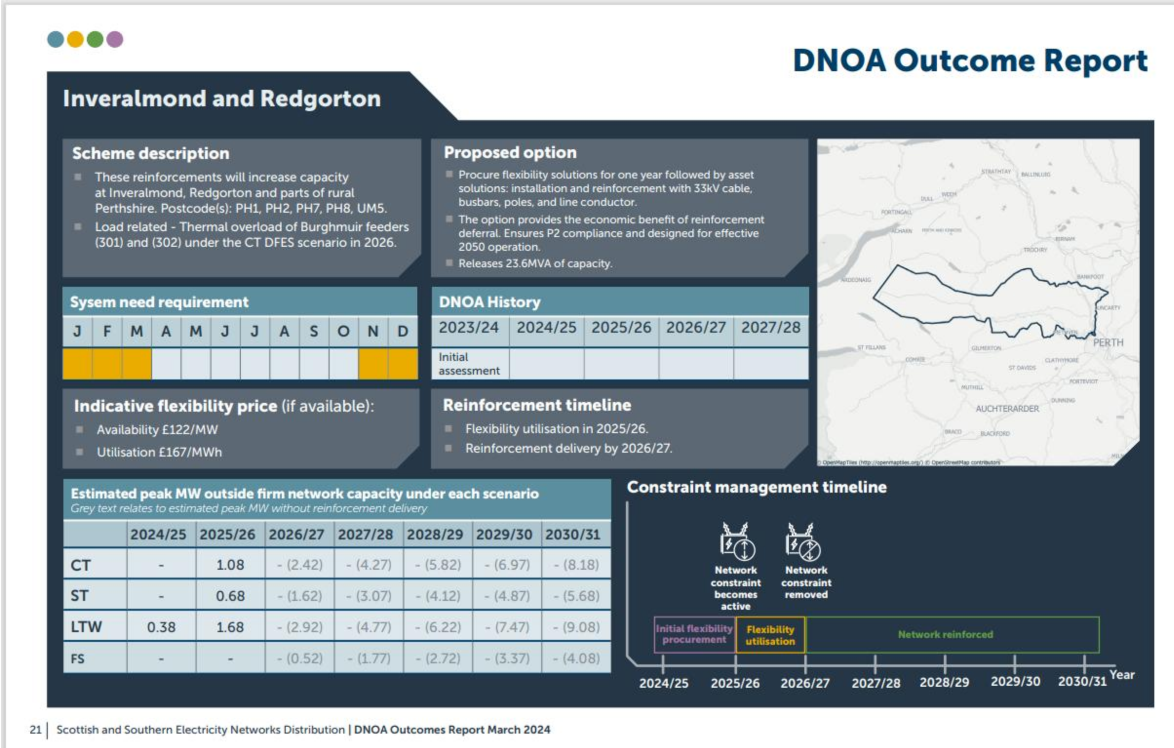
Estimated peak MW outside firm network capacity under each scenario
Grey text relates to estimated peak MW without reinforcement delivery

	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31
CT	-	-	-	-	-	-	-
ST	-	-	-	-	-	-	-
LTW	-	-	-	-	-	-	-
FS	-	-	-	-	-	-	-

Constraint management timeline

18 | Scottish and Southern Electricity Networks Distribution | DNOA Outcomes Report March 2024

Figure 46 DNOA Outcome Report for Errochty/Tummel Bridge (March 2024)



DNOA Outcome Report

Inveralmond and Redgorton

Scheme description

- These reinforcements will increase capacity at Inveralmond, Redgorton and parts of rural Perthshire. Postcode(s): PH1, PH2, PH7, PH8, UM5.
- Load related - Thermal overload of Burghmuir feeders (301) and (302) under the CT DFES scenario in 2026.

Proposed option

- Procure flexibility solutions for one year followed by asset solutions: installation and reinforcement with 33kV cable, busbars, poles, and line conductor.
- The option provides the economic benefit of reinforcement deferral. Ensures P2 compliance and designed for effective 2050 operation.
- Releases 23.6MVA of capacity.

Sysem need requirement

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

DNOA History

2023/24	2024/25	2025/26	2026/27	2027/28
Initial assessment				

Indicative flexibility price (if available):

- Availability £122/MW
- Utilisation £167/MWh

Reinforcement timeline

- Flexibility utilisation in 2025/26.
- Reinforcement delivery by 2026/27.

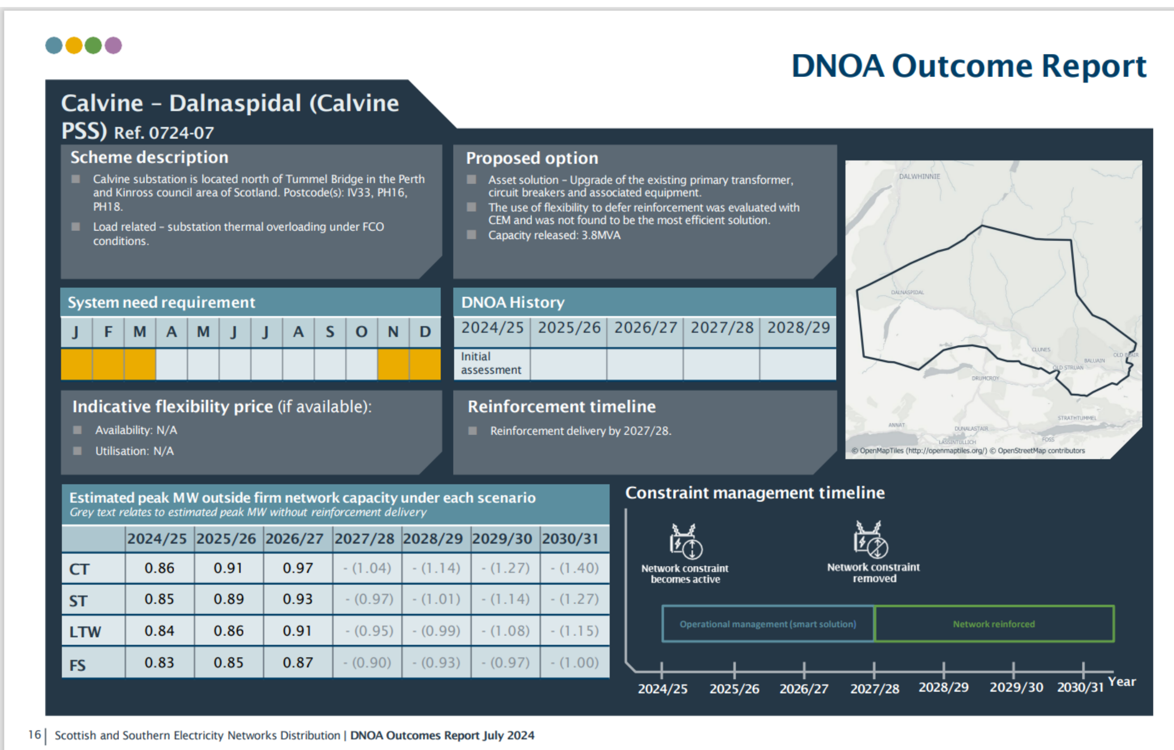
Estimated peak MW outside firm network capacity under each scenario
Grey text relates to estimated peak MW without reinforcement delivery

	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31
CT	-	1.08	- (2.42)	- (4.27)	- (5.82)	- (6.97)	- (8.18)
ST	-	0.68	- (1.62)	- (3.07)	- (4.12)	- (4.87)	- (5.68)
LTW	0.38	1.68	- (2.92)	- (4.77)	- (6.22)	- (7.47)	- (9.08)
FS	-	-	- (0.52)	- (1.77)	- (2.72)	- (3.37)	- (4.08)

Constraint management timeline

21 | Scottish and Southern Electricity Networks Distribution | DNOA Outcomes Report March 2024

Figure 47 DNOA Outcome Report for Inveralmond and Redgorton (Burghmuir GSP) (March 2024)



DNOA Outcome Report

Calvine – Dalnaspidal (Calvine PSS) Ref. 0724-07

Scheme description

- Calvine substation is located north of Tummel Bridge in the Perth and Kinross council area of Scotland. Postcode(s): IV33, PH16, PH18.
- Load related – substation thermal overloading under FCO conditions.

Proposed option

- Asset solution – Upgrade of the existing primary transformer, circuit breakers and associated equipment.
- The use of flexibility to defer reinforcement was evaluated with CEM and was not found to be the most efficient solution.
- Capacity released: 3.8MVA

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 delivery by 2027/28.

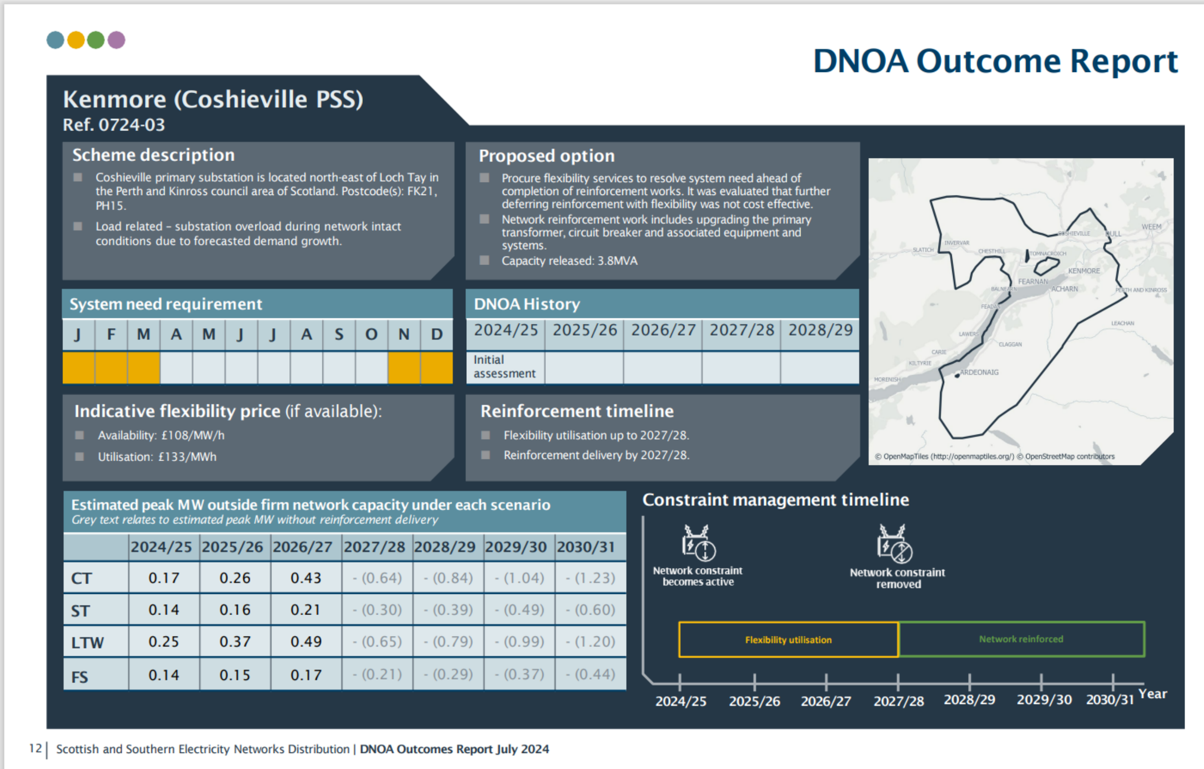
Estimated peak MW outside firm network capacity under each scenario
Grey text relates to estimated peak MW without reinforcement delivery

	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31
CT	0.86	0.91	0.97	- (1.04)	- (1.14)	- (1.27)	- (1.40)
ST	0.85	0.89	0.93	- (0.97)	- (1.01)	- (1.14)	- (1.27)
LTW	0.84	0.86	0.91	- (0.95)	- (0.99)	- (1.08)	- (1.15)
FS	0.83	0.85	0.87	- (0.90)	- (0.93)	- (0.97)	- (1.00)

Constraint management timeline

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

Figure 48 DNOA Outcome Report for Calvine - Dalnaspidal (Calvine Primary) (July 2024)



DNOA Outcome Report

Kenmore (Coshieville PSS)

Ref. 0724-03

Scheme description

- Coshieville primary substation is located north-east of Loch Tay in the Perth and Kinross council area of Scotland. Postcode(s): FK21, PH15.
- Load related – substation overload during network intact conditions due to forecasted demand growth.

Proposed option

- Procure flexibility services to resolve system need ahead of completion of reinforcement works. It was evaluated that further deferring reinforcement with flexibility was not cost effective.
- Network reinforcement work includes upgrading the primary transformer, circuit breaker and associated equipment and systems.
- Capacity released: 3.8MVA

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: £108/MW/h
- Utilisation: £133/MWh

Reinforcement timeline

- Flexibility utilisation up to 2027/28.
- Reinforcement delivery by 2027/28.

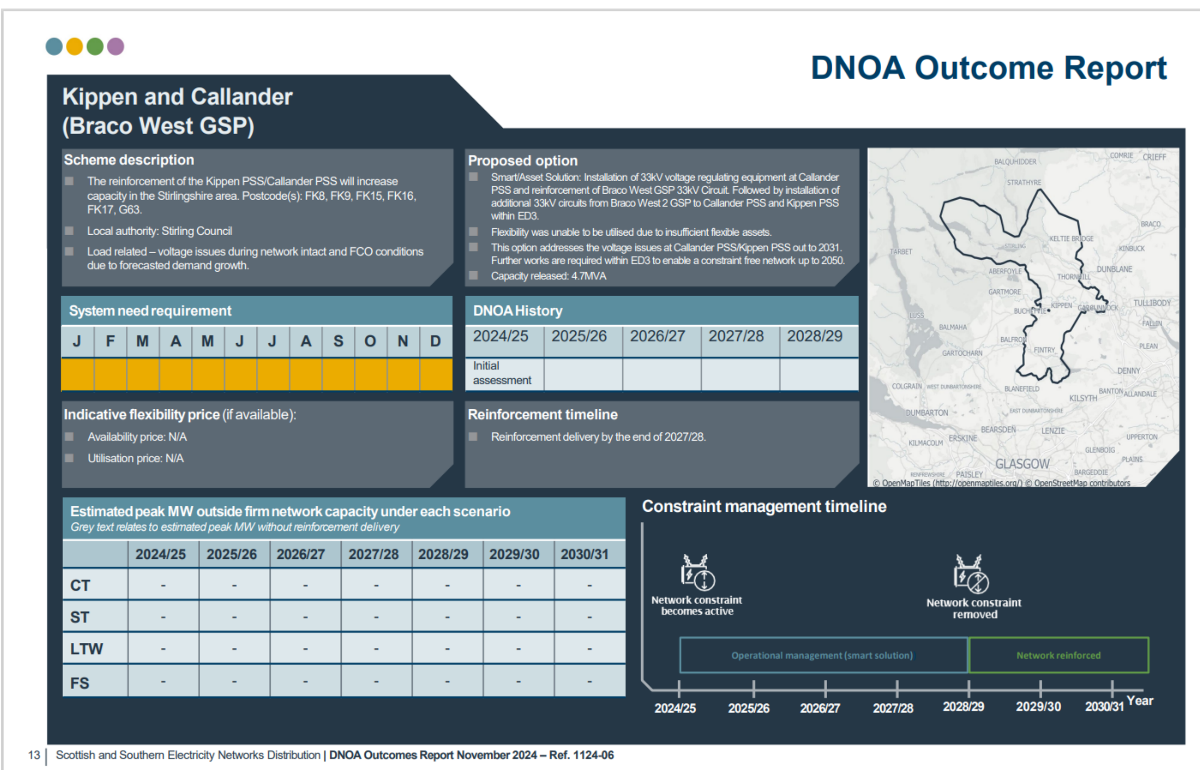
Estimated peak MW outside firm network capacity under each scenario

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	0.17	0.26	0.43	- (0.64)	- (0.84)	- (1.04)	- (1.23)
ST	0.14	0.16	0.21	- (0.30)	- (0.39)	- (0.49)	- (0.60)
LTW	0.25	0.37	0.49	- (0.65)	- (0.79)	- (0.99)	- (1.20)
FS	0.14	0.15	0.17	- (0.21)	- (0.29)	- (0.37)	- (0.44)

Constraint management timeline

Figure 49 DNOA Outcome Report for Kenmore (Coshieville Primary) (July 2024)



DNOA Outcome Report

Kippen and Callander (Braco West GSP)

Scheme description

- The reinforcement of the Kippen PSS/Callander PSS will increase capacity in the Stirlingshire area. Postcode(s): FK8, FK9, FK15, FK16, FK17, G63.
- Local authority: Stirling Council
- Load related – voltage issues during network intact and FCO conditions due to forecasted demand growth.

Proposed option

- Smart/Asset Solution: Installation of 33kV voltage regulating equipment at Callander PSS and reinforcement of Braco West GSP 33kV Circuit. Followed by installation of additional 33kV circuits from Braco West 2 GSP to Callander PSS and Kippen PSS within ED3.
- Flexibility was unable to be utilised due to insufficient flexible assets.
- This option addresses the voltage issues at Callander PSS/Kippen PSS out to 2031. Further works are required within ED3 to enable a constraint free network up to 2050.
- Capacity released: 4.7MVA

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 price: N/A
- Utilisation price: N/A

Reinforcement timeline

- Reinforcement delivery by the end of 2027/28.

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	-	-	-	-	-	-	-
ST	-	-	-	-	-	-	-
LTW	-	-	-	-	-	-	-
FS	-	-	-	-	-	-	-

Constraint management timeline

Figure 50 DNOA Outcome Report for Kippen and Callander (Braco West GSP) (November 2024)

CONTACT

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