MYBSTER AND DOUNREAY: STRATEGIC DEVELOPMENT PLAN

Our network serving communities across the Northeast Highlands

Draft for consultation

October 2025

Scottish & Southern Electricity Networks

1. EXECUTIVE SUMMARY

Scottish and Southern Electricity Networks (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) take the feedback we have received from stakeholders on their future energy needs from today out to 2050 and translate these requirements into strategic spatial plans of distribution network needs. This helps us transparently present our future conceptual plans and facilitate discussion with local authorities and other stakeholders. The overall methodology and how it fits into our wider strategic planning process is presented in the Strategic Development Plan Methodology. The focus area of this SDP is that supplied by Mybster and Dounreay supply area in the Northeast Highland area, shown below in **Figure 1.**

This report documents the stakeholder led plans that are driving net zero and growth in the local area, the resulting electricity demands, and the network needs arising from this for Mybster and Dounreay supply area. A significant amount of work has been triggered through the Distribution Network Option Assessment (DNOA) process.

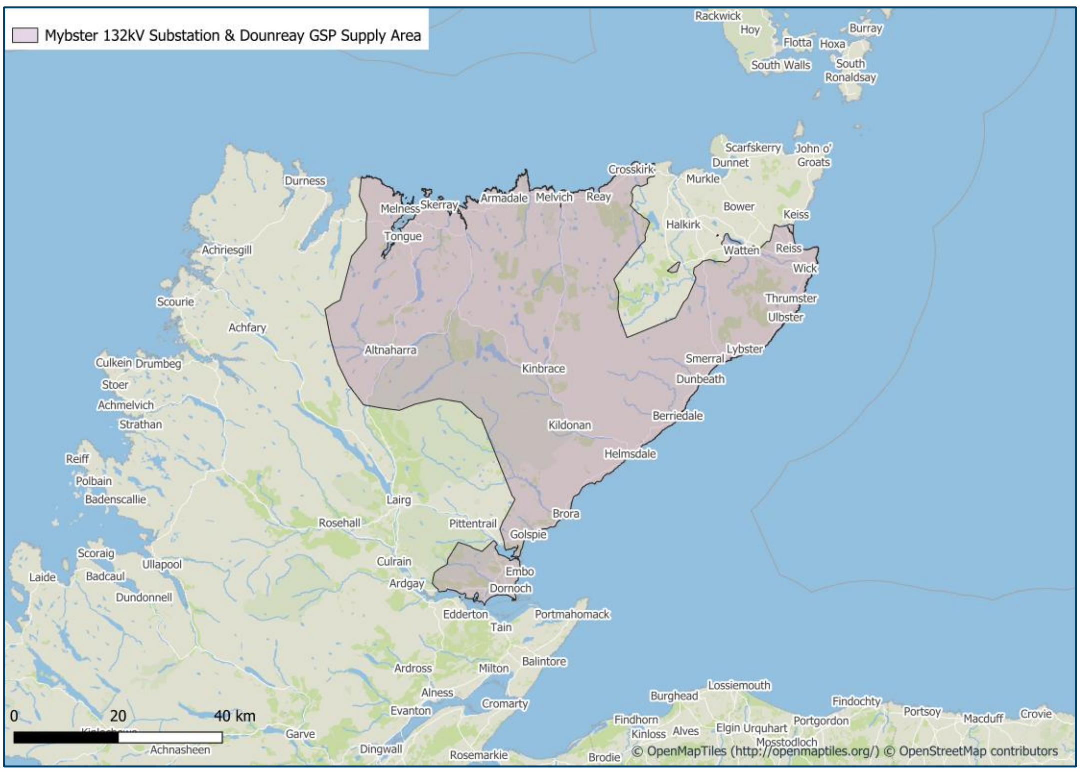

Figure 1 Area of focus for this SDP.

This SDP utilises the Distribution Future Energy Scenarios (DFES) to understand the pathways 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 ambitions in the area to provide a robust evidence base for load growth out to 2050 across the Mybster and Dounreay supply area. The Mybster and Dounreay supply area n provides power to several Grid Supply Points (GSPs) across the Scottish Highlands and islands. 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.

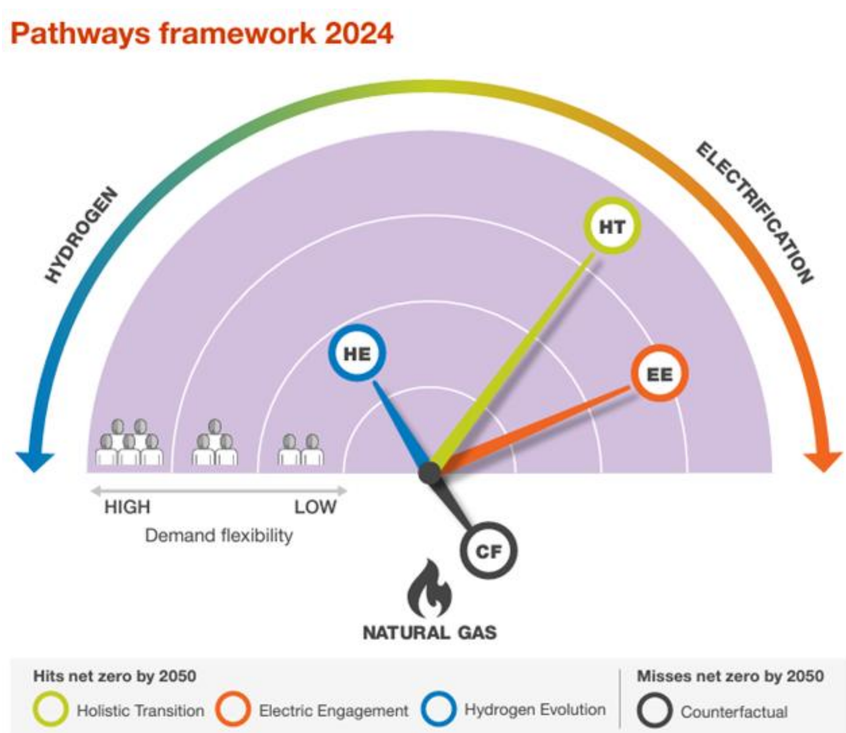

Figure 2: The FES Scenario framework (source: NESO).

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. We also model across the other scenarios to understand when these needs arise and what network capacity should be planned for in the event each scenario is realised.

The DNOA process provides more detailed optioneering for each of these system needs, 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.

Further information on the FES framework can be found in the DFES 2024 introductory report.

3. STAKEHOLDER ENGAGEMENT AND WHOLE SYSTEM CONSIDERATIONS

3.1. Local Authorities and Local Area Energy Planning

Mybster and Dounreay supply one local authority: the Highland Council on the Scottish mainland as shown in **Figure 3.** The Highland Council's development plans will significantly impact the potential future electricity load growth on SSEN's distribution network. As such, it is vital for SSEN to engage with these plans when carrying out strategic network investment.

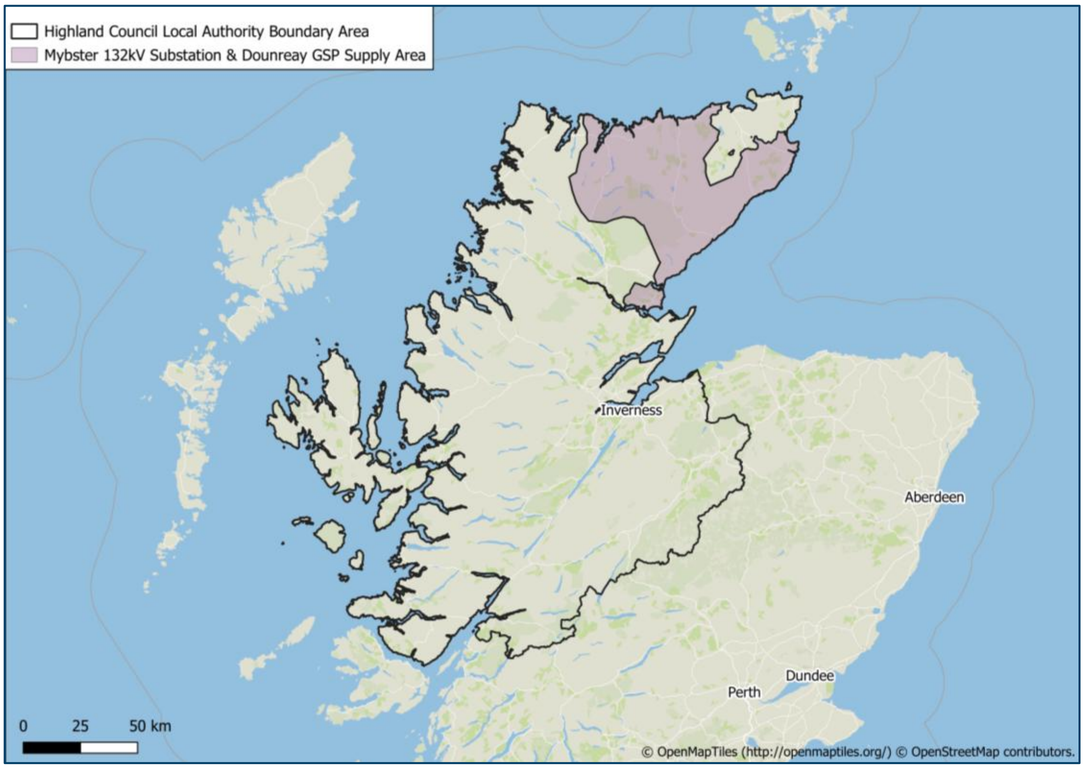

Figure 3 Mybster and Dounreay supply area and Highland Council local authority boundaries.

3.1.1. Highland Council

The Highland Council serves a third of the land area of Scotland, which includes some of the most remote and sparsely populated parts of the UK mainland. The total estimated population at mid-year 2023 for Highland Council was 236,330, which is the seventh highest population of the 32 local authorities in Scotland. The Highlands have seen significant population growth over the past 30 years by 13.9% between 2001 and 2021[1].

Highland Council has published their Net Zero Strategy[2] 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[3]. This is in line with

1 City_Region_Deal_Annual_Report_2024.pdf

2 Net Zero Strategy | Climate change | The Highland Council

3 Net Zero Strategy | Climate change | The Highland Council

the Scottish Government's national target. Areas of focus from this strategy that are of particular interest to SSEN include:

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

Highland Council has also published their Local Heat and Energy Efficiency Strategy (LHEES) and Delivery Plan[4] 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[5].

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

3.2. Whole System Considerations

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

3.2.1. Security of Supply

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

3.2.2. Transmission Interactions

There remains an open dialogue between SSEN Distribution and Transmission regarding the portfolio of works, and 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 Scottish Highlands area. Therefore, we will continue to engage with SSEN Transmission regarding the evolution of their plans for the Mybster and Dounreay supply area networks.

Mybster and Dounreay form part of the overall SSEN Transmission Strategy.

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

5 Electric Vehicle Infrastructure Fund | Transport Scotland

SSEN Transmission have studied and confirmed the need to reinforce the onshore transmission infrastructure between Spittal and Beauly. To enable these reinforcements, a new 400kV substation is required in Loch Buidhe and will connect to a new 400kV connection between Spittal and Beauly and the existing Loch Buidhe 275kV substation. The project currently stands in the project refinement stage, in which the forestry clearing and road improvements are being actioned.

3.3. Flexibility Considerations

SSEN procures Flexibility Services from owners, operators, or aggregators of Distributed Energy Resources (DERs) or Consumer Energy Resources (CERs), which can be generators, storage, or demand assets. These services are needed in areas of the network which have capacity constraints at particular times or under certain circumstances. SSEN purchases Flexibility Services from all types of providers (e.g. domestic or commercial). Information on the process for 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.[6,7]

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 most recently opening in mid-July 2025.[2]

To date we have not procured any flexibility services in the Mybster and Dounreay supply area, shown below in **Figure 4.**

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

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

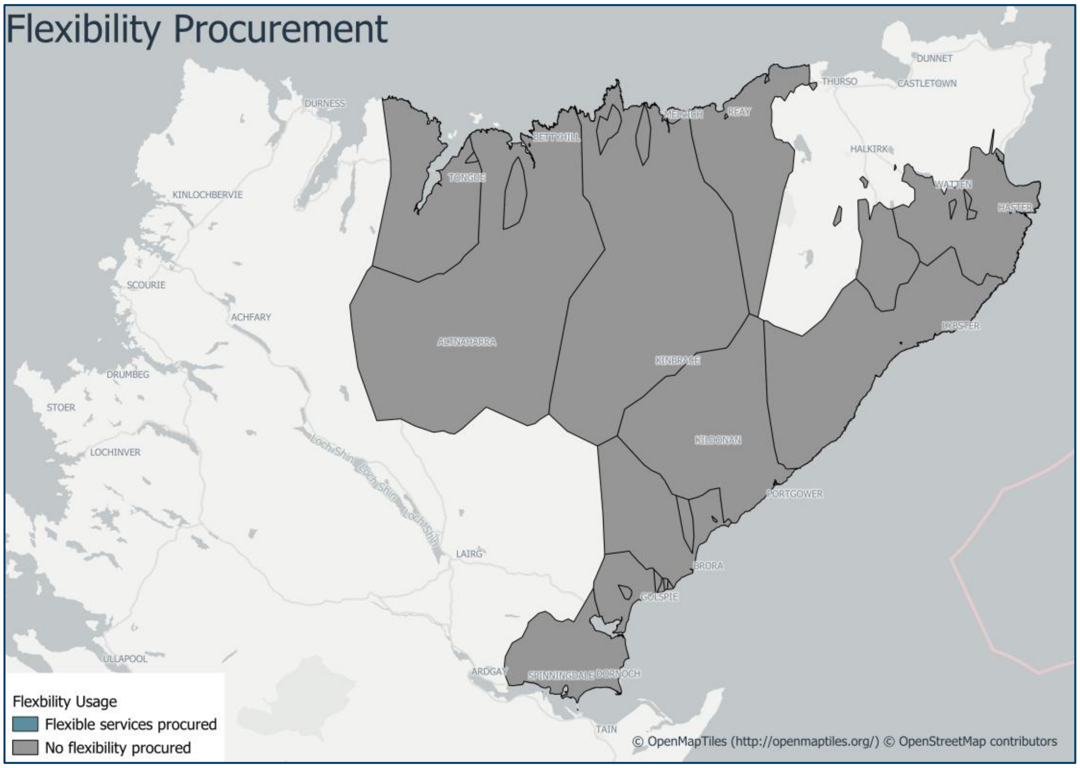

Figure 4 Flexibility procurement areas across Mybster and Dounreay supply area.

Load Managed Areas (LMAs)

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

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

GSP	% of RTS customers
Brora	19.98%
Dounreay	14.26%
Dunbeath	No LMA data available
Mybster	13.06%

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

4. EXISTING NETWORK INFRASTRUCTURE

4.1. Mybster and Dounreay supply area context

The Mybster and Dounreay network is made up of 33kV, 11kV, and LV circuits. It is a mix of rural and urban network spanning across the Scottish highland region. While much of the land is used for agricultural purposes, there is a mix of residential, commercial, and industrial land, which is located throughout the supply area. In total, Mybster and Dounreay supply approximately 15,620 customers with the breakdown for each Grid Supply Point shown in **Table 2** below. A further breakdown by Primary substation can be found in **Appendix B.**

GSP	Number of Customers Served	2024 Substation Maximum MVA (Winter)
Brora GSP	4,669	9.32
Dounreay GSP	1,823	8.17
Dunbeath GSP	1	N/A
Mybster GSP	6,608	10.56

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

4.2. Current Network Topology

The **Figure 5** below highlights the existing 33kV network topology fed from the Mybster and Dounreay supply area. The SSEN Transmission network supplies the distribution network at various Grid Supply Point (GSP) sites. It is then distributed to the 11 Primary substations via the 33kV distribution network.

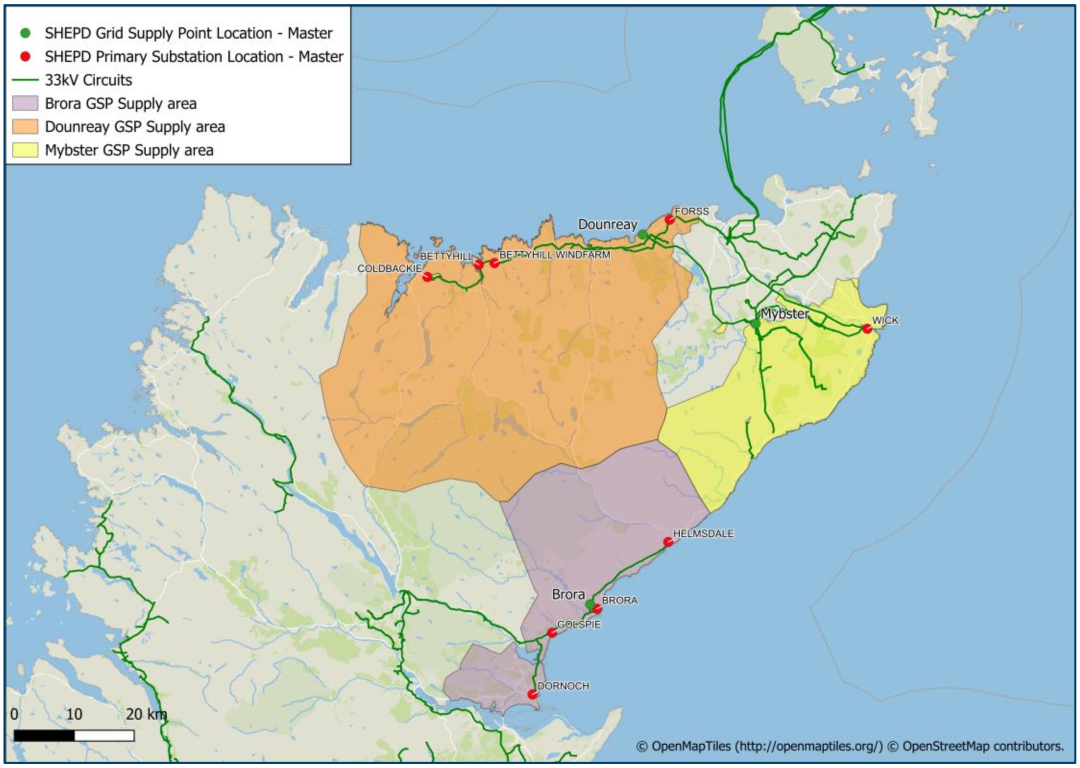

Figure 5 Current network topology of Mybster & Dounreay supply area - Geographic Information System (GIS) View.

4.3. Network Schematic

The network schematics in **Figures 6-8** (below) depict how the 33kV distribution network is projected to look by 2025. Note that the Dunbeath GSP is a single generation point, within the SDP area, and is therefore not represented below.

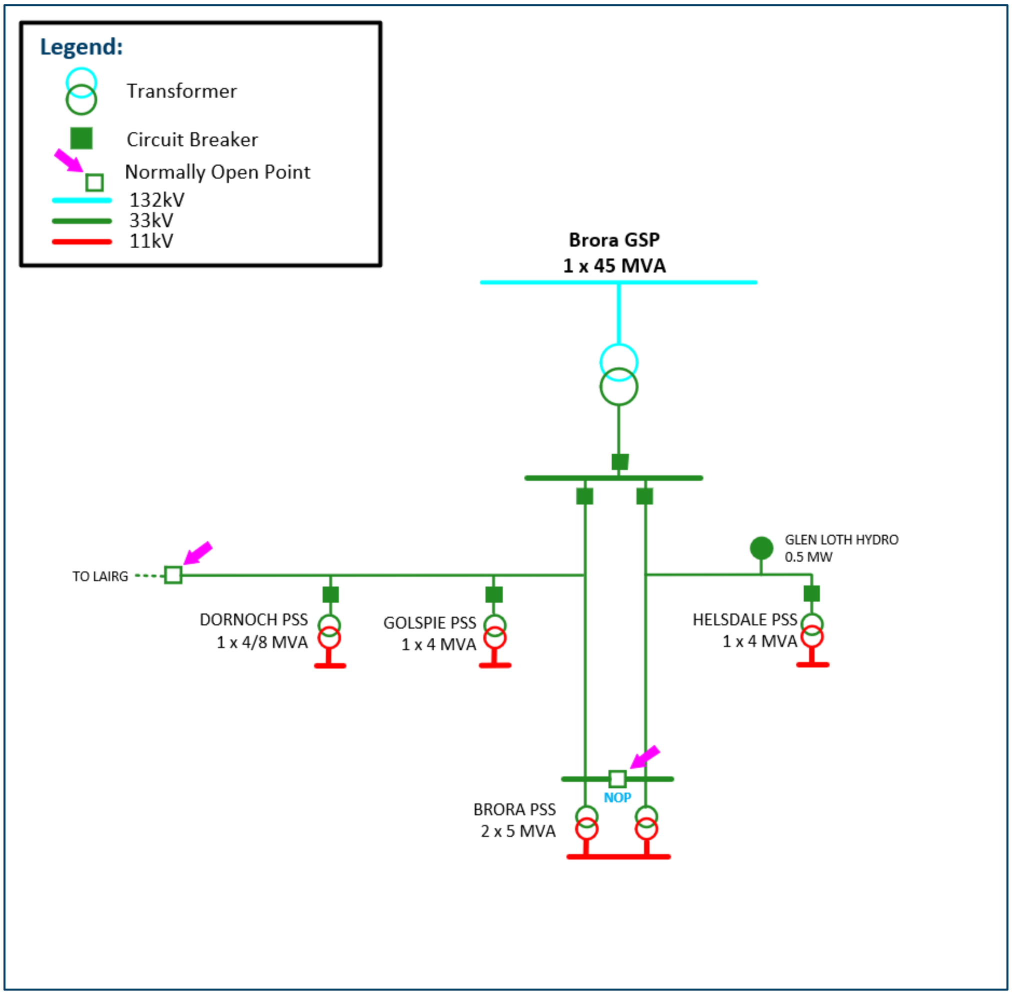

Figure 6 Brora 33kV network schematic.

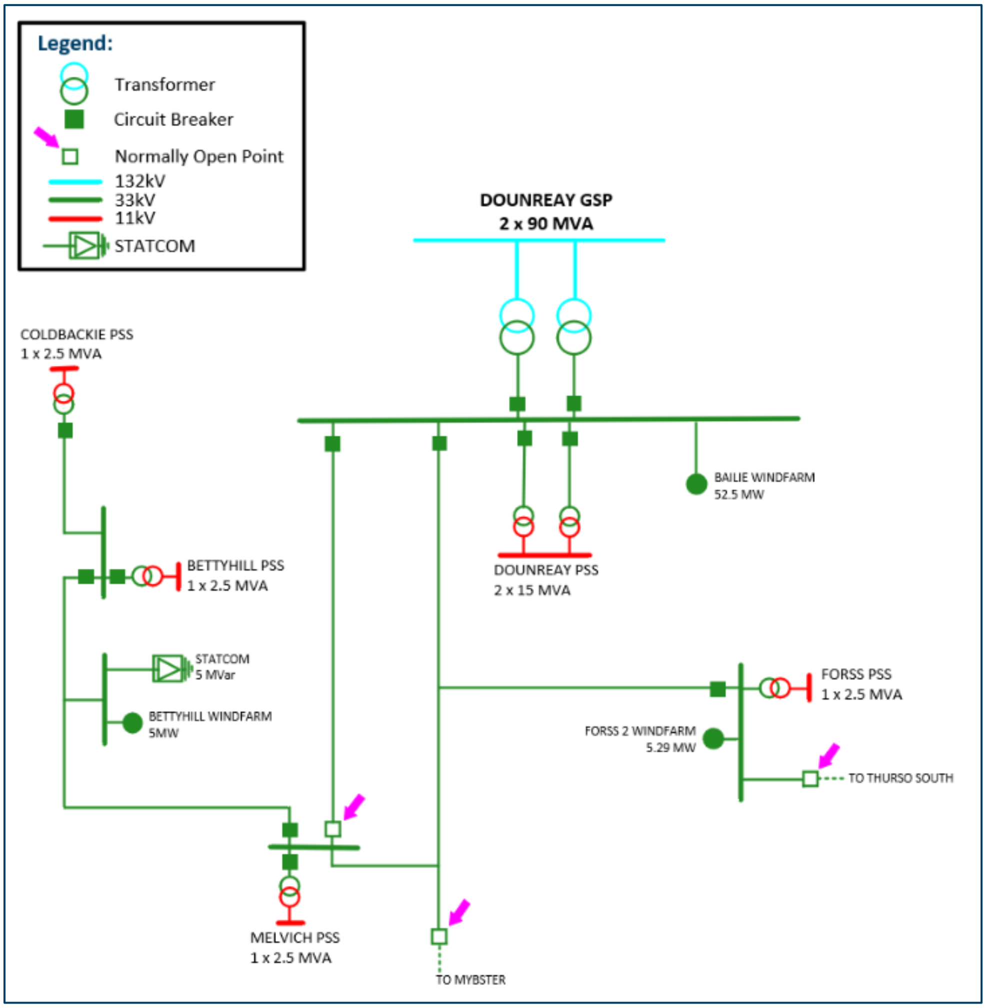

Figure 7 Dounreay 33kV network schematic.

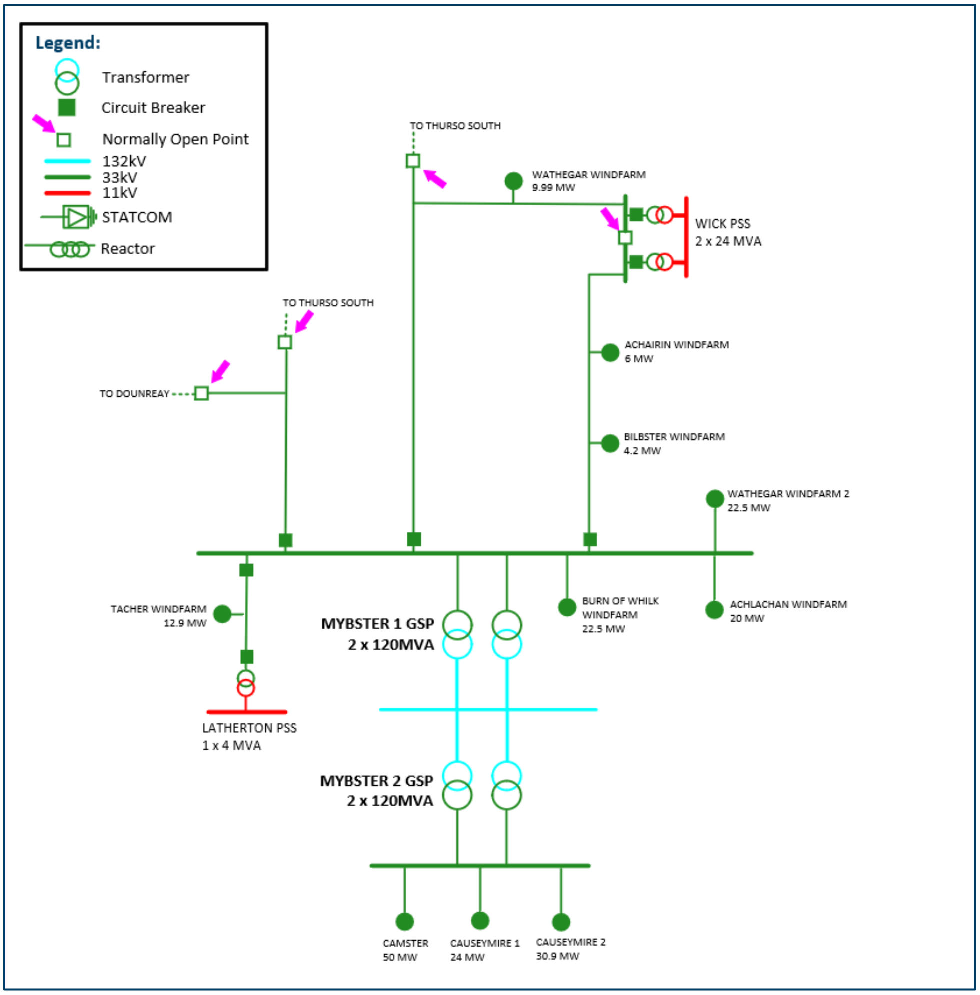

Figure 8 Mybster 1 & Mybster 2 33kV network schematic.

5. FUTURE ELECTRICITY LOAD IN MYBSTER AND DOUNREAY SUPPLY AREA

The following section details load growth across technologies included in the Distribution Future Energy Scenarios. 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 supply area highlighted in **Figure 1**.
- Where MW values are presented in this section, they represent total installed capacity. When conducting network studies these values are appropriately diversified to represent the coincident maximum demand of the entire system rather than the total sum of all demands.
- For projections specific to individual primary substations or local authorities, please refer to our online dashboard.

5.1. Generation and Storage

DFES Scenario	Renewable energy capacity (MW)				Electricity storage capacity (MW)			
	Baseline	**2030**	**2040**	**2050**	**Baseline**	**2030**	**2040**	**2050**
Holistic Transition	249	618	1033	1126	5	129	172	182
Electric Engagement		847	1027	1134		7	26	38
Hydrogen Evolution		392	595	700		7	19	32
Counterfactual		386	461	529		6	10	19

Table 3 Distribution generation capacity across Mybster and Dounreay supply area readings (MW).

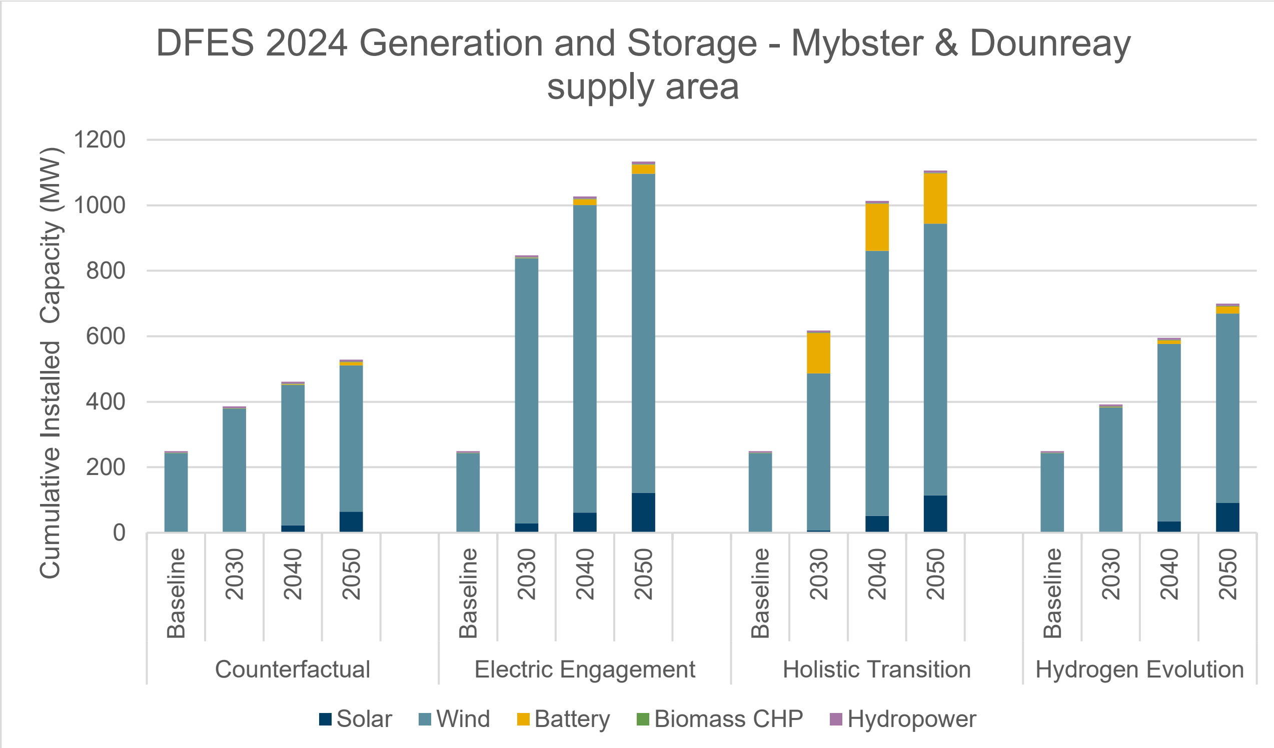

Figure 9 Projected cumulative distribution generation capacity across Mybster and Dounreay supply area (MW). *Source: SSEN DFES 2024*

5.2. Transport Electrification

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	118	2109	8379	8617	0	0	2	2
Electric Engagement		3586	8437	8624		0	2	2
Hydrogen Evolution		2060	8161	8370		0	3	3
Counterfactual		1634	6397	8232		0	2	3

Table 4 Transport EV charge point capacity across Mybster and Dounreay supply area

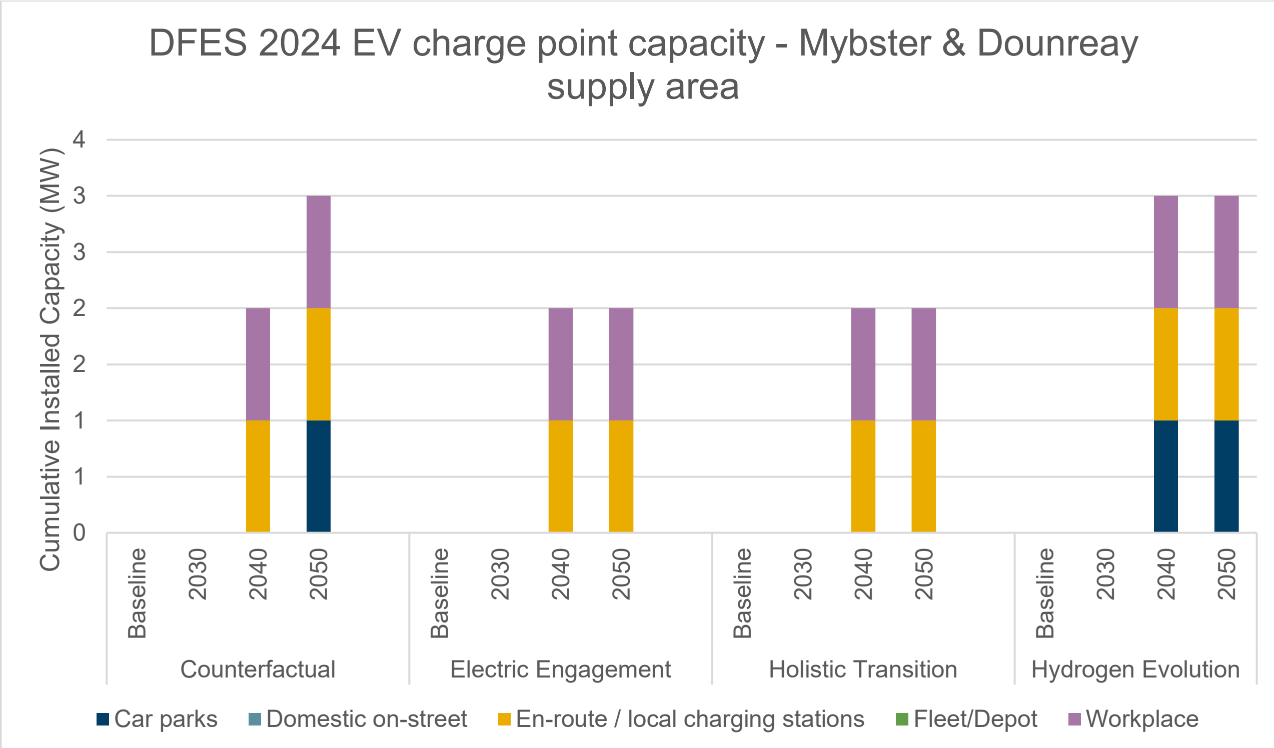

Figure 10 Projected EV charge point capacity across Mybster and Dounreay supply area. *Source: SSEN DFES 2024*

5.3. Electrification of Heat

DFES Scenario	Non-domestic heat pumps (m^2 of floorspace)				Domestic heat pumps (number of units)			
	Baseline	**2030**	**2040**	**2050**	**Baseline**	**2030**	**2040**	**2050**
Holistic Transition	0	35160	38421	38421	903	3898	8977	9988
Electric Engagement		32213	42993	42993		3779	9254	9736
Hydrogen Evolution		32213	42993	42993		2803	8564	9308
Counterfactual		17147	40422	45996		2082	4874	8363

Table 5 Number of heating/cooling technologies across Mybster and Dounreay supply area

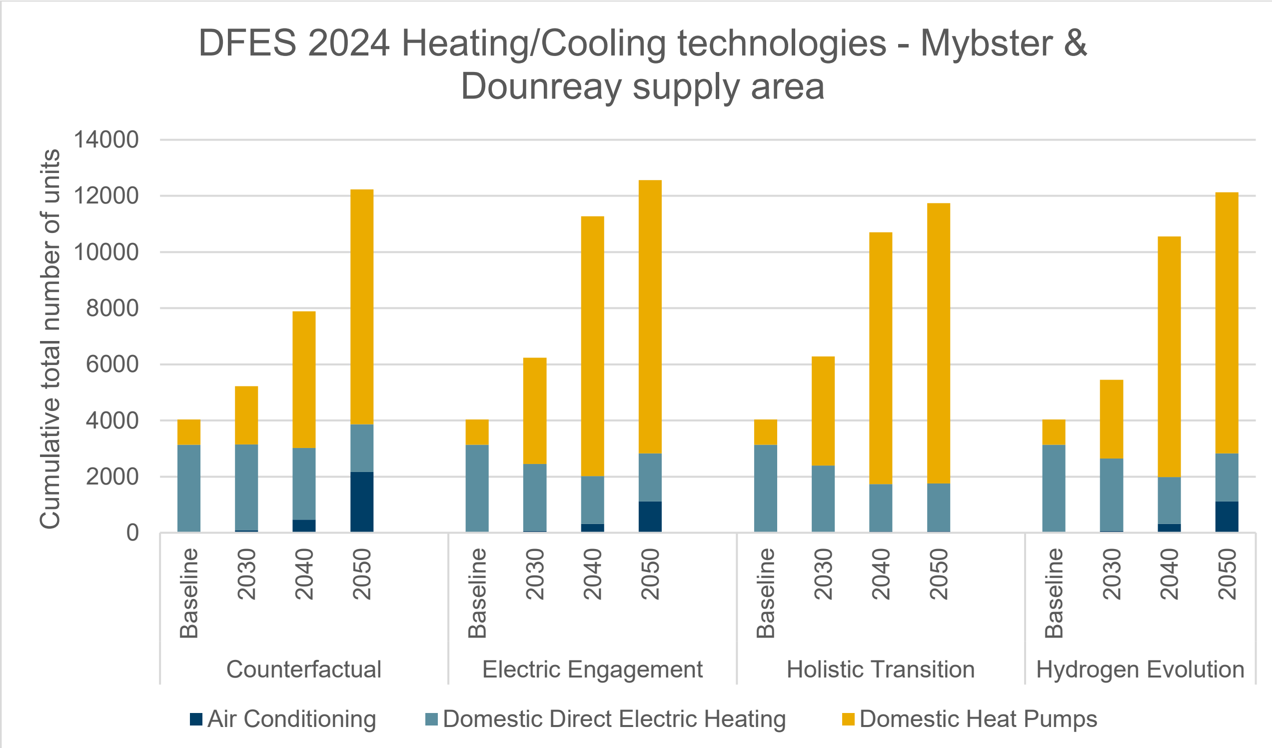

Figure 11 Projected number of heating/cooling technologies across Mybster and Dounreay supply area. *Source: SSEN DFES 2024*

5.4. New Building Developments

Through engagement with local authorities, we have developed an understanding of new development across our licence areas. This has allowed us to gauge an insight into future electricity demand for new developments ahead of a formal connection application. Below we investigate the non-domestic new developments across the study area for this SDP.

DFES Scenario	New domestic development (number of homes)			New non-domestic development (m^2)		
	2030	2040	2050	2030	2040	2050
Holistic Transition	155	421	526	73463	76724	76724
Electric Engagement	85	363	448	65943	76724	76724
Hydrogen Evolution	85	294	314	65943	76724	76724
Counterfactual	83	290	297	43290	70655	76724

Table 6 Non-domestic new development across Mybster and Dounreay supply area

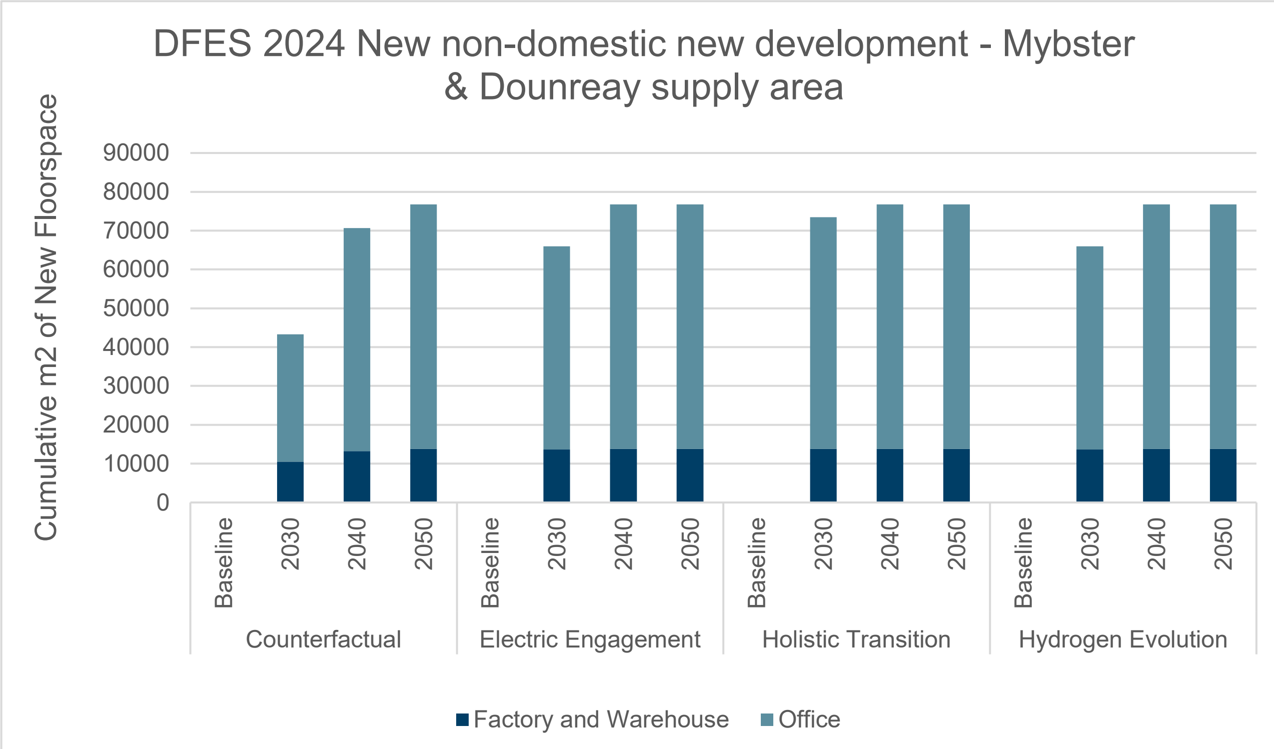

Figure 12 Non-domestic new development across Mybster and Dounreay supply area. *Source: SSEN DFES 2024*

5.5 Commercial and Industrial Electrification

The decarbonisation of industries specific to Northern Scotland and broader industries indicate there could be a range of potential electrification outcomes for the Mybster and Dounreay supply area. We have identified a number of industries below as areas of potential significant future industrial demand growth for the region.

Decarbonisation of the agricultural sector is an important consideration in this geographic area. SSEN leads the innovation project 'Future Agricultural Resilience Mapping' (FARM)[8] 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.

The Mybster and Dounreay supply area supplies a significant coastal area, including the port of Wick Harbour, is looking for new developments to support the offshore wind industry. The shipping sector is a new, large electricity customer, and the UK's target of achieving zero-emissions shipping by 2050 will lead to a substantial

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8 Future Agricultural Resilience Mapping FARM | SSEN Innovation

increase in the demand for electricity across the maritime industry. Whilst this is not accounted for fully in the DFES 2024 projections here, future insight from SSEN's SeaChange innovation project will provide high quality insights for this in future iterations.[9] This project involves building a 'Navigating Energy Transitions' (NET) tool, which will help ports to plot their most viable pathways for decarbonisation.

Further to the maritime industry, other large demand users connected to the distribution network include car manufacturing sites.

9 SeaChange, SSEN Innovation Project, 10/2024, SSEN's nature and shipping innovation projects win £1m in new development funding - SSEN

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 Mybster and Dounreay 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.

The published DNOA outcomes relevant to Mybster and Dounreay supply area included in **Appendix C**. The work included here is all work that has passed through the ID2 gate of our Distribution Governance and Investment Framework (DGIF), further information on this process is available in the DSO service statement 2025.[10] Summary of existing works shown below in **Table 7.**

ID	Substation	Description	Driver	Forecast completion	Resolves future strategic needs to 2050?
Mybster GSP					
1	Dornoch PSS 2	Due to site access constraints, the existing transformer cannot be upgraded and a second Dornoch PSS is therefore proposed. The 8MVA transformer will have 1 x incoming 33kV feed and 2 outgoing 11kV feeders.	DNOA Process - Load Related	2029	
2	Brora GSP	GSP switchboard replaced under a contracted generation job.	Customer Connection	2034	
Dounreay GSP					
3	Dounreay 8L5 33kV Feeder	Upgrade OHL from P5 to P64 by increasing conductor size from 70 mm² Cu to 150 mm² Cu to accommodate an embedded generation connection.	Customer Connection	2026	
5	Dounreay GSP	GSP switchboard replaced in a new switchroom building under a contracted generation job.	Customer Connection	2031	

10 DSO Service Statement 2025

6	Dounreay GSP 2	New GSP to be triggered by the BELLA/BEGA process for multiple contracted job as current GSP no longer has distribution options available.	Customer Connection	NA	
Mybster GSP					
7	Mybster GSP 2/4	New GSPs to be triggered by the BELLA/BEGA process for multiple contracted jobs as current GSPs no longer have distribution options available.	Customer Connection	NA	

Table 7 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 aim to provide capacity across the Mybster and Dounreay supply area for 2050 based on current projections.

6.1. Network Schematic (following completion of above works)

The network considered for long-term modelling is shown below in **Figures 13-14.**

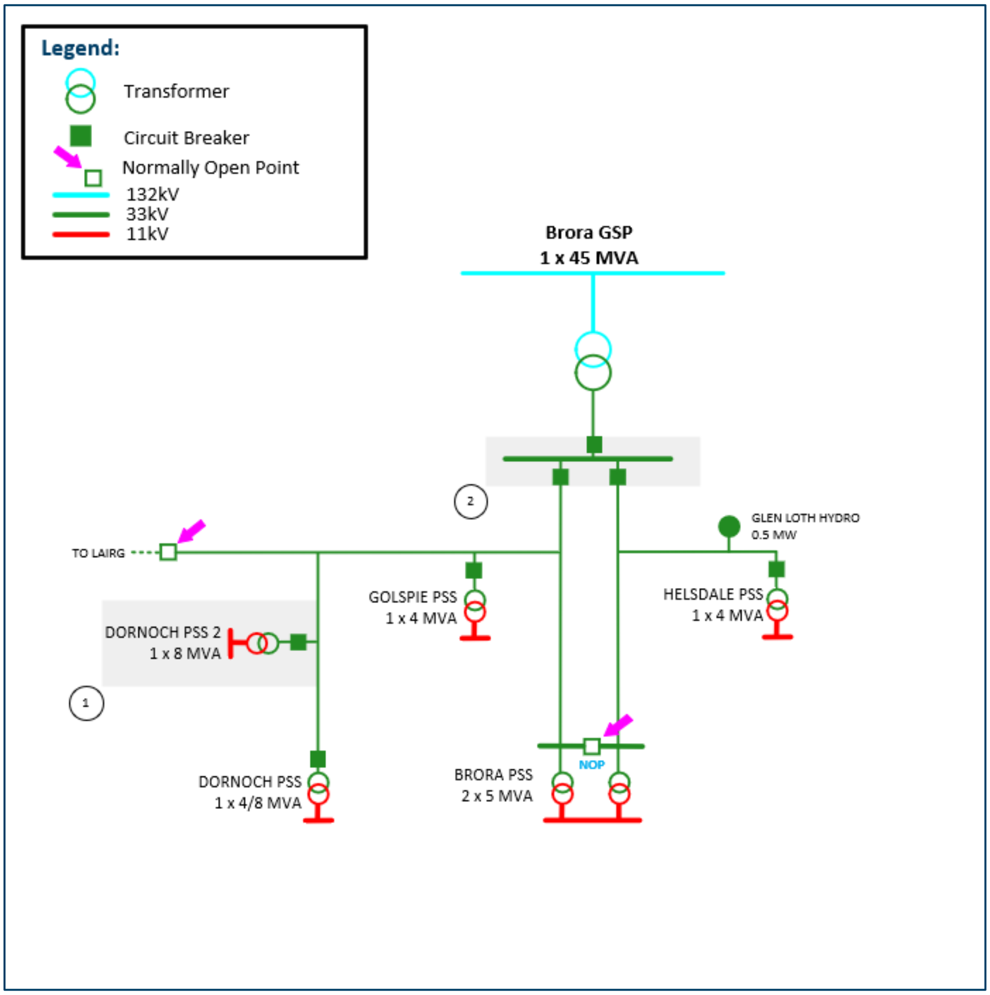

Figure 13 Brora GSP 33kV Network - Following completion of triggered works.

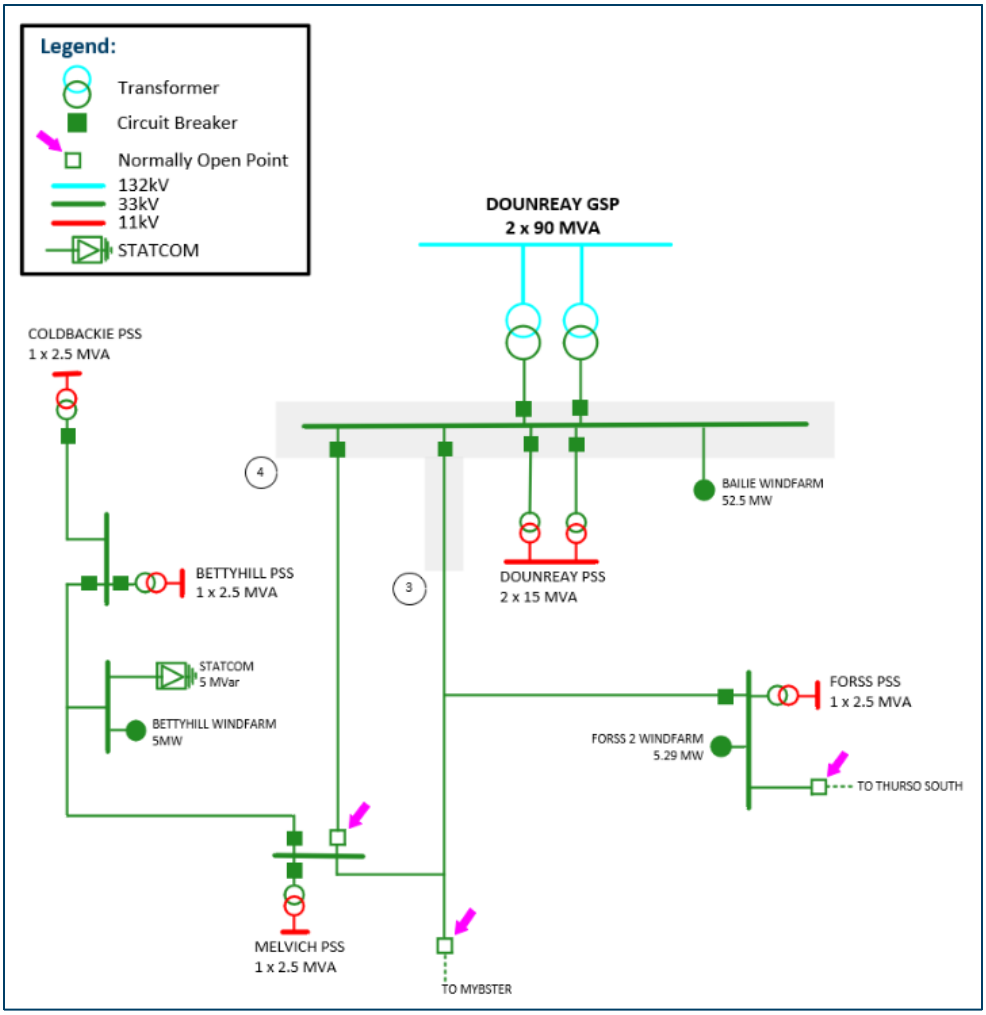

Figure 14 Dounreay GSP 33kV Network - Following completion of triggered works.

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7. SPATIAL PLANS OF FUTURE NEEDS

7.1. EHV/HV spatial plans

The EHV/HV spatial plan shown below in **Figure 15** shows the projected headroom or capacity shortfall due to demand increases at primary substations across the Mybster and Dounreay supply area. Darker shades indicate that there is a projected capacity shortfall whereas lighter blue shades indicate that there is headroom capacity based on current projections. EHV/HV spatial plans for the other DFES scenarios are presented in **Appendix D**

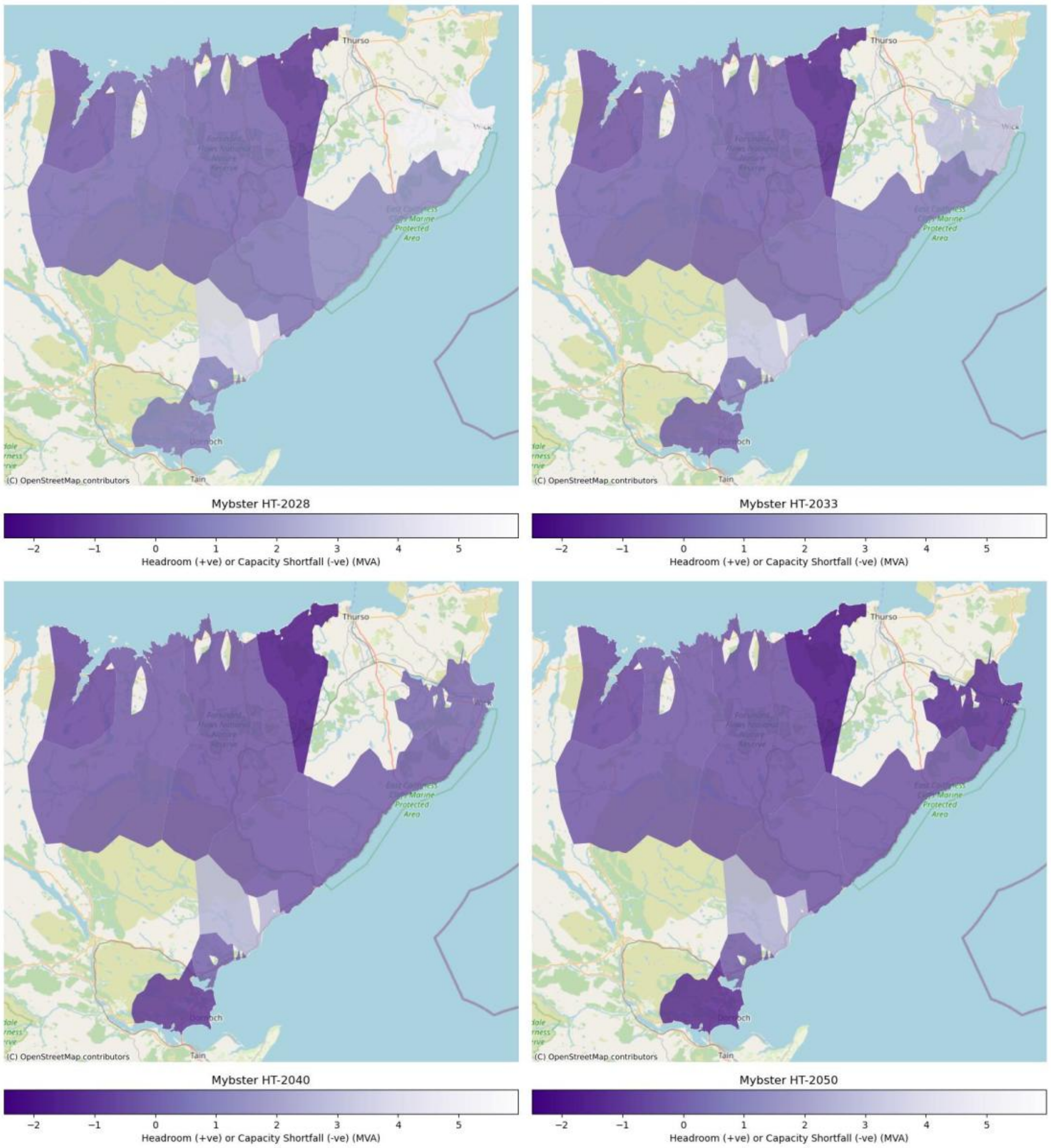

Figure 15 Mybster and Dounreay supply area - EHV/HV Spatial Plans – Holistic Transition

7.2. HV/LV spatial plans

The HV/LV spatial plans shown below in **Figure 16** show the point locations of secondary transformers supplied by Mybster and Dounreay. The points are colourised based on the projected percentage loading with red meaning higher percentage loading and green being lower percentage loading. The HV/LV spatial plans for the other DFES scenarios are available in **Appendix E.**

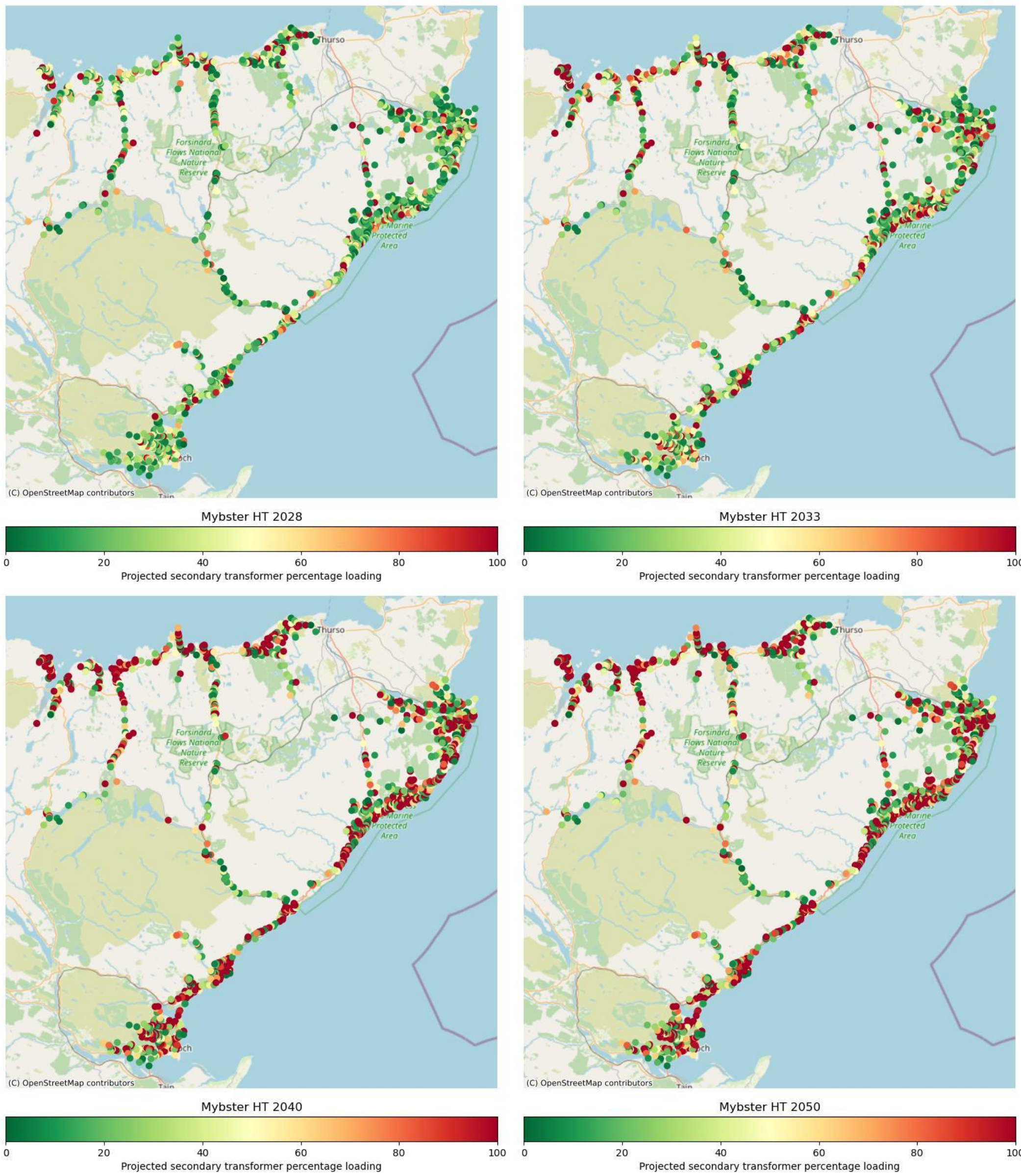

Figure 16 Mybster and Dounreay supply area - HV/LV Spatial Plans – Holistic Transition

8. SPECIFIC SYSTEM NEEDS AND OPTIONS TO RESOLVE

In this section we summarise the more specific needs arising from our future spatial plans. We also propose some initial options to meet these requirements. 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.

- 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 will recommend 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.

- 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.

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

8.1. Overall dependencies, risks, and mitigations

There are several overarching risks to the delivery of our strategic plan. Below we list these alongside proposed mitigating actions. We will work with stakeholders to develop these mitigating actions further.
Highlight the potential dependencies/risks and what we have done here or plan to do in order to mitigate these risks.

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 Mybster and Dounreay supply area.

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

Dependency: Growth of generation in the area may begin to cause reverse power flow on the network. It should be ensured that the assets currently on the network are able to handle the projected levels of reverse power flow and increased fault level.

Risks: Further reinforcement than identified here is required to enable connection of generation. Increasing fault levels leads to damaged distribution network assets.
Mitigation: We should further assess the near-term generation requirements to ensure that we are in a position to facilitate the Clean Power 2030 targets set by DESNZ. Consideration of future fault level to prevent the risk of damaged assets should be considered when designing future schemes.

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

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

8.2. Future EHV System Needs

The following tables details the 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 8,** 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 strategically to be considered alongside each other and any additional interactions between constraints referenced.

8.2.1. System needs to 2035

ID	Location of proposed intervention	HT Year	EE Year	HE Year	CF Year	Network State	Comments and potential options to resolve the system need
Brora GSP							
1	4L5 circuit to Golspie and Dornoch PSS.	2030	2029	2036	2039	Intact	Options to resolve the low voltage experienced by the circuit include: - Upgrading to a larger conductor (lower impedances and hence lower voltage drop). - Adding a new 33kV feed to isolate PSSs (currently all on one ring). - Procurement of flexibility services.

ID	Location of proposed intervention	HT Year	EE Year	HE Year	CF Year	Network State	Comments and potential options to resolve the system need
							- Loadshedding on the 11kV network (interconnection with Brora and Tain PSS)
Mybster GSP							
2	4L5 and 2L5 circuits to Wick PSS.	2033	2032	2035	2040	N-1 outage for 4L5 or 2L5.	Circuits experience low voltage: however, thermal issues present from 2039 under the HT scenario. Options to resolve include: - Upgrading to a larger conductor (higher thermal rating and lower impedance, hence lower voltage drop) - Procurement of flexibility services. - Loadshedding on the 11kV network (several interconnections with Hastigrow and Latheron PSS)

Table 8 - Summary of system needs identified in this strategy through to 2035 along with indicative solutions.

8.2.2. System needs to 2050

ID	Location of proposed intervention	HT Year	EE Year	HE Year	CF Year	Network State	Comments and potential options to resolve the system need
Dounreay GSP							
3	Forss PSS Transformer (Dounreay GSP)	2039	2038	2038	-	Intact	Options to resolve thermal constraint on the 2.5MVA transformer include: - Upgrade existing transformer. - Addition of a second transformer (farmland adjacent to the existing site, and existing ONAN transformer can be loaded to 130% under outages) - Procurement of flexibility services - Loadshedding on the 11kV network (interconnection with Ormlie PSS)

Table 9 - Summary of system needs identified in this strategy through to 2050 along with indicative solutions.

8.3. 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, and this section provides further context on this work for the Mybster and Dounreay supply area high voltage and low voltage network needs to 2050.

8.3.1. 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.[11]

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 Mybster and Dounreay supply area, 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 17** 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.

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

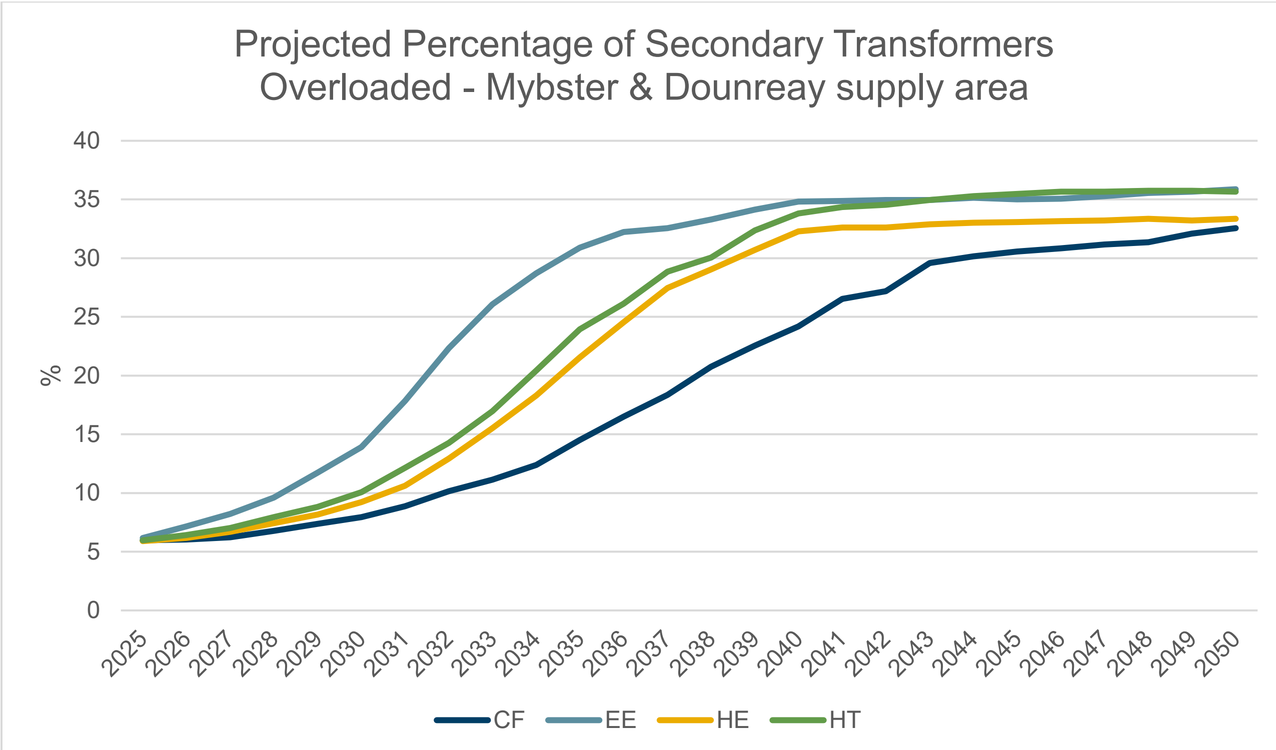

Figure 17 Mybster and Dounreay supply area Projected Secondary Transformer Loading. Source: SSEN Load Model

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 foresighting techniques, along with data analytics and expert validation could be used to identify and forecast consumers in vulnerable situations as we move toward net zero. The insights from the VFES enable SSEN to develop the network in a way that genuinely accounts for the levels of vulnerability their customers face in different locations.

One of the outputs from this innovation project was the report produced by the Smith Institute.[12] This work groups Lower layer Super Output Areas (LSOAs)[13] 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 10**.

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.
2 – High	Driven up by larger household sizes, reduced by lower elderly population levels.

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

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

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 10 VFES Groupings

To understand the vulnerability groupings across the Mybster and Dounreay supply area, we have visualised the LSOA categorisation for the study area. By overlaying secondary transformers that are projected to be overloaded by 2028 (under the Consumer Transformation scenario), we begin to understand the crossover between network capacity needs and areas categorised as high vulnerability through the VFES work. This is shown below in **Figure 17.**

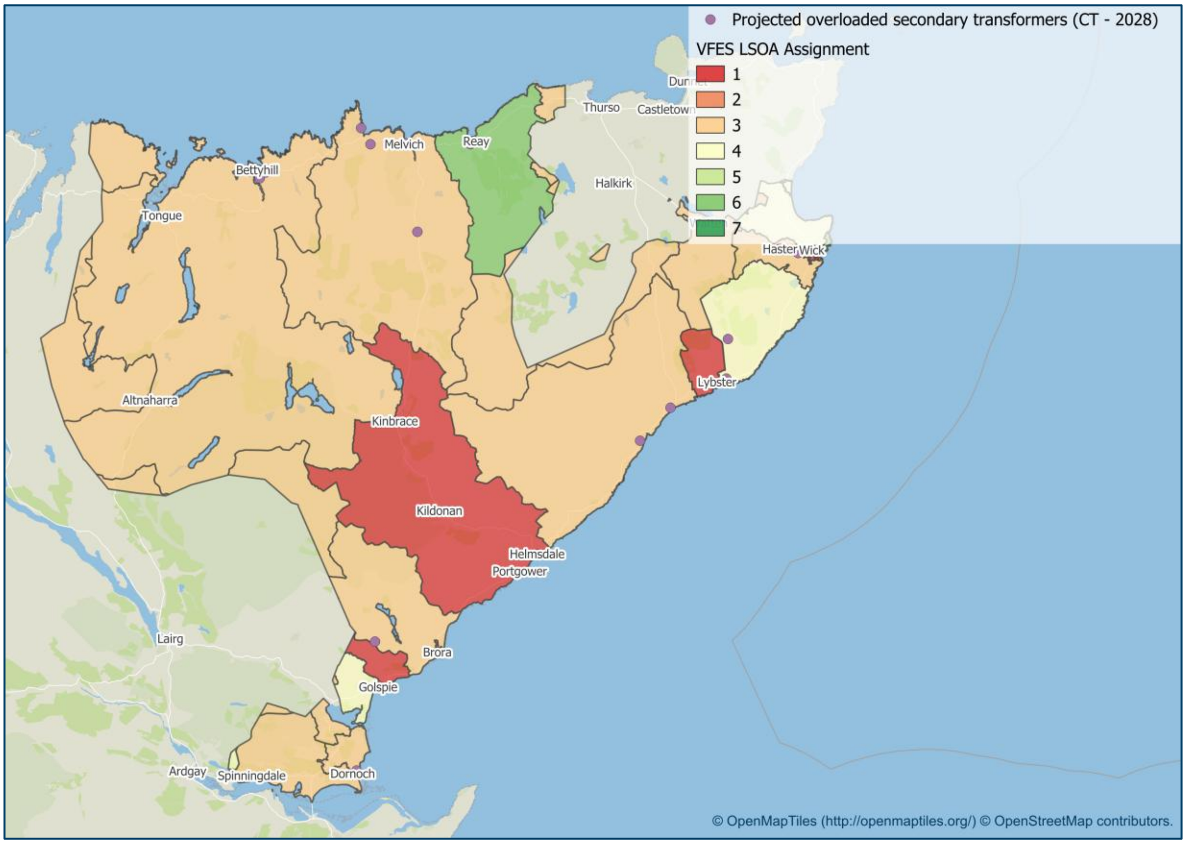

Figure 18 Mybster and Dounreay VFES Output with secondary transformer overlay.

The majority of the SDP area falls within group 3, indicating high levels of vulnerability. This high level of vulnerability is driven up by a larger elderly population, reduced by lower levels of disability and mental health benefit claimants. In the Brora and Mybster supply area there are several LSOAs that fall into the higher categories of vulnerability (groups 1, 2, and 3) as two LSOA areas falling into the group 1 – very high vulnerability, around Kildonan and Lybster. This very high vulnerability classification is driven up by higher levels of poor health and disability/mental health benefit claimants, reduced by smaller household sizes.

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

More vulnerable groups may have lower level of adoption of LCTs and therefore provide less ability to manage overloads through flexibility services. Further, they may point towards areas of social housing where there could be a 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.

8.3.2. Low Voltage Networks

Drivers for interventions in low voltage networks may be either capacity related or be driven by voltage requirements. We are progressing options to resolve both drivers. From a network perspective the solution typically involves upgrading the number of LV feeders to split/ balance the load and improve voltage or to install another substation at the remote end of the LV network to balance load and improve voltage. 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) and My Electric Avenue 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.

Capacity driven needs – Thermal constraints tend to materialise in the sections of cable leading to the substation (transformer) where multiple customer loads join together. We are modelling requirements out to 2050 leveraging low voltage monitoring and metering equipment combined with analytical techniques. This will demonstrate how the magnitude of the system need of the LV network across Mybster and Dounreay changes across scenarios and years out to 2050.

Voltage driven needs – Generally, connection of Low Carbon Technology and large loads such as heat pumps is limited by voltage constraints before thermal constraints when located more than around 150m from the local secondary transformer. Increased loading on our low voltage networks can reduce the voltages to consumer premises. This is a non-liner relationship and as such requires more complex analysis. We are currently undertaking analysis to better understand the extent of this future need.

Initial analysis indicates that across the study area, *3.18*% of low voltage feeders may need intervention by 2035 and *4.02*% by 2050 under the CT scenario as shown in Figure 25. 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.

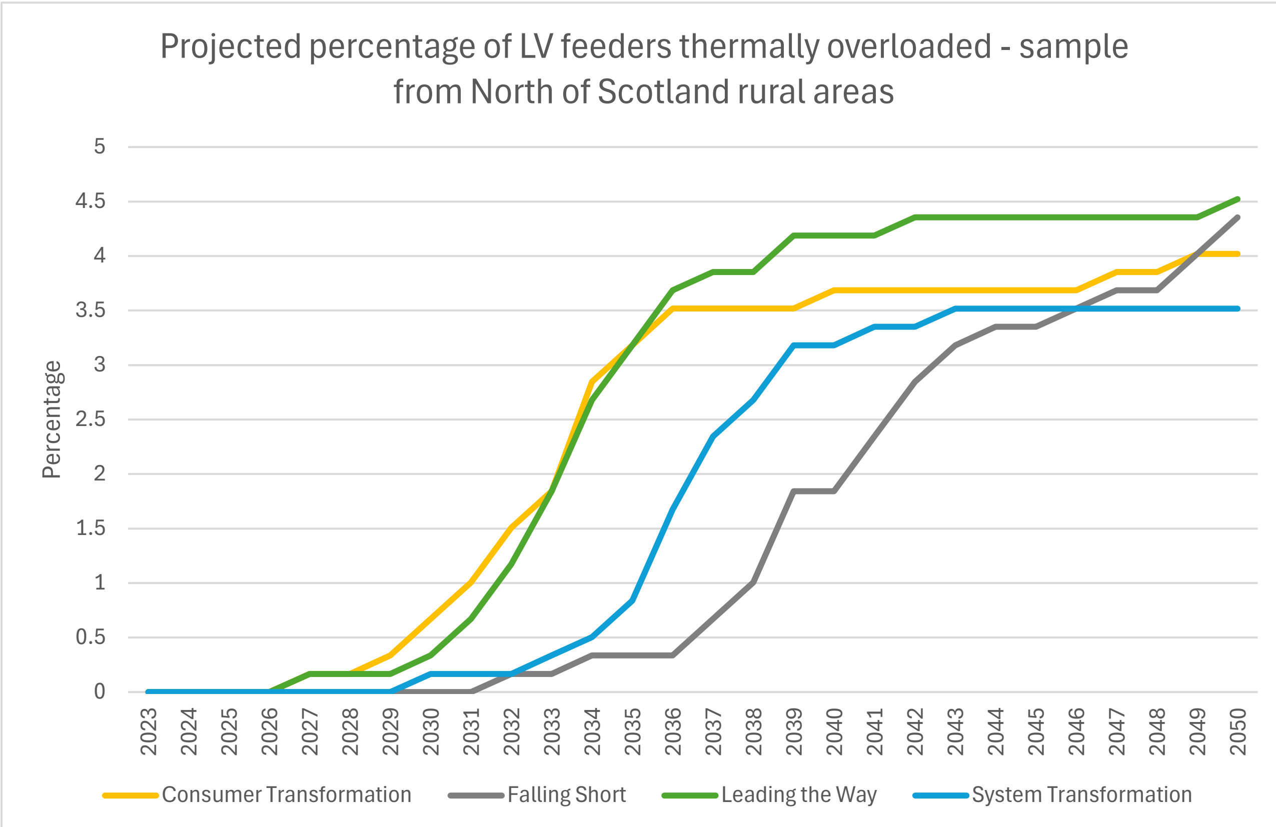

Figure 19 Percentage of LV feeders projected to be overloaded under Mybster and Dounreay supply area.

9. RECOMMENDATIONS

The review of stakeholder engagement and the SSEN 2024 DFES analysis provides a robust evidence base for load growth across Myster and Dounreay supply area in both the near and longer term. Drivers for load growth across the SDP focus area arise from multiple sectors and technologies. These drivers impact not only the EHV network but will drive system needs across all voltage levels.

The findings from this report have provided evidence for 4 key recommendations:

1) System needs that have been identified to arise in the near-term should be progressed through the DNOA process to develop a more in-depth solution. For this SDP, this includes:
    a) Thermal and voltage constraints on the 4L5 and 2L5 circuits to Wick PSS.
    b) Voltage constraints on the 4L5 circuit to Golspie and Dornoch PSS.

    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 a 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.

2) Considering the significant generation growth expected across Myster and Dounreay supply area, engagement with SSEN Transmission and NESO should be proactive, creating a long-term plan for the area which incorporates the outputs of CP2030 and connections reform. More detailed network studies should also be carried out to determine how growth in generation will impact the network, especially in summer minimum demand maximum generation conditions.

3) Understanding how rural decarbonisation could impact load on the network. Specifically, the electrification of ports in the area and how to capture those plans in load forecasts. It will also be important to understand how substations covered by security of supply derogations will be affected by increased demand.

4) 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 Myster and Dounreay 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.

Appendix A – 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

Table 11 Glossary

APPENDIX B – Primary Substation Customer Numbers

Grid Supply Point	Primary Substation	Number of Customers Served (approximate)	2024 Substation Maximum demand in MVA (Winter)
Brora	BRORA	1185	2.6
Brora	DORNOCH	1818	3.87
Brora	GOLSPIE	996	1.82
Brora	HELMSDALE	665	0.94
Dounreay	BETTYHILL	508	0.75
Dounreay	COLDBACKIE	393	1.09
Dounreay	DOUNREAY	20	4.53
Dounreay	FORSS	424	1.55
Dounreay	MELVICH	478	0.75
Dunbeath	NA	NA	NA
Mybster 1	LATHERON	1263	1.83
Mybster 1	WICK	5309	8.63

Table 12 PSS Customer Numbers.

APPENDIX C – DNOA OUTCOME REPORTS

Dornoch (Dornoch PSS)

DNOA Outcome Report
Related SDP: Mybster

DNOA outcome: Operational management followed by asset solution.

Scheme description

- The reinforcement of the Dornoch PSS will increase capacity in the Dornoch area. Postcode(s): IV24, IV25.
- Local authority: Highland Council
- Load related – substation thermal overload issues during network intact conditions due to forecasted demand growth.

Proposed option

- Asset Solution: Installation of an additional 1 x 8MVA primary substation approximately 1km from the original site.
- Flexibility was unable to be utilised due to forecasted insufficient flexible assets.
- This option addresses the forecasted demand growth at Dornoch PSS out to 2035.
- Capacity released: 1.96MVA

Indicative flexibility price (if available)

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

System need requirement

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

DNOA History

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

Estimated peak MW outside firm network capacity under each scenario

	25/26	26/27	27/28	28/29	29/30	30/31	31/32	32/33	33/34	34/35
CT	0.97	1.16	1.36	1.58	(1.87)	(2.05)	(2.14)	(2.22)	(2.30)	(2.40)
ST	0.84	0.96	1.07	1.17	(1.34)	(1.44)	(1.53)	(1.63)	(1.74)	(1.87)
LTW	1.09	1.27	1.48	1.72	(2.03)	(2.26)	(2.36)	(2.46)	(2.57)	(2.67)
FS	0.70	0.79	0.86	0.94	(1.04)	(1.13)	(1.21)	(1.30)	(1.40)	(1.50)

Constraint management timeline

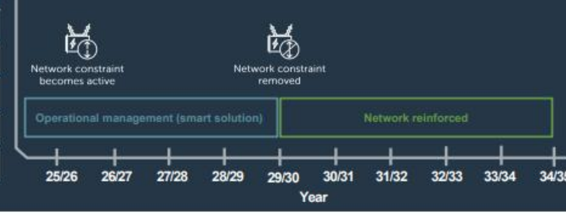

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Figure 20 Dornoch PSS DNOA Outcome

APPENDIX D – EHV/HV spatial plans for other DFES scenarios

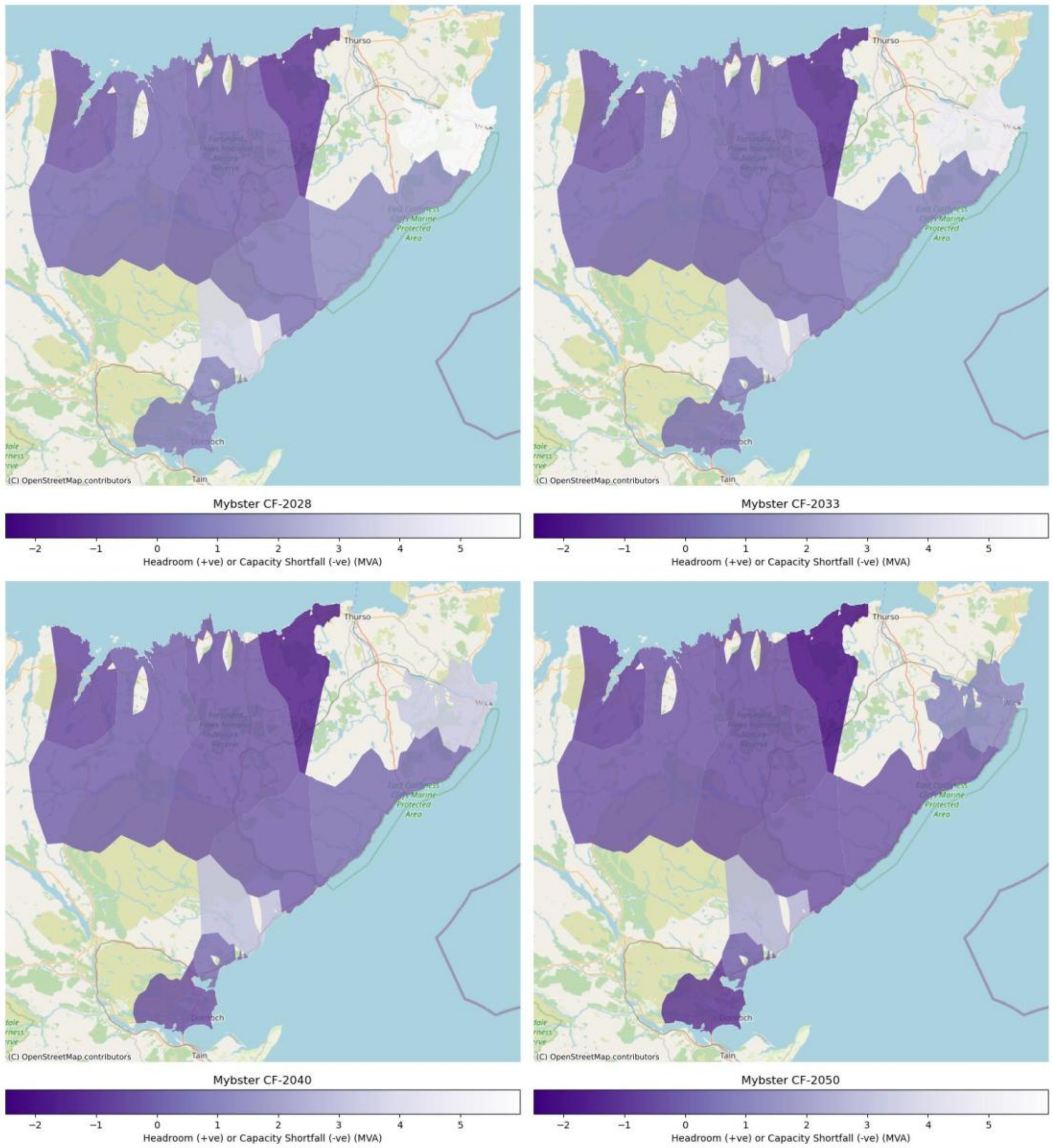

Figure 21 Mybster and Dounreay supply area - EHV/HV Spatial Plan – Counter Factual

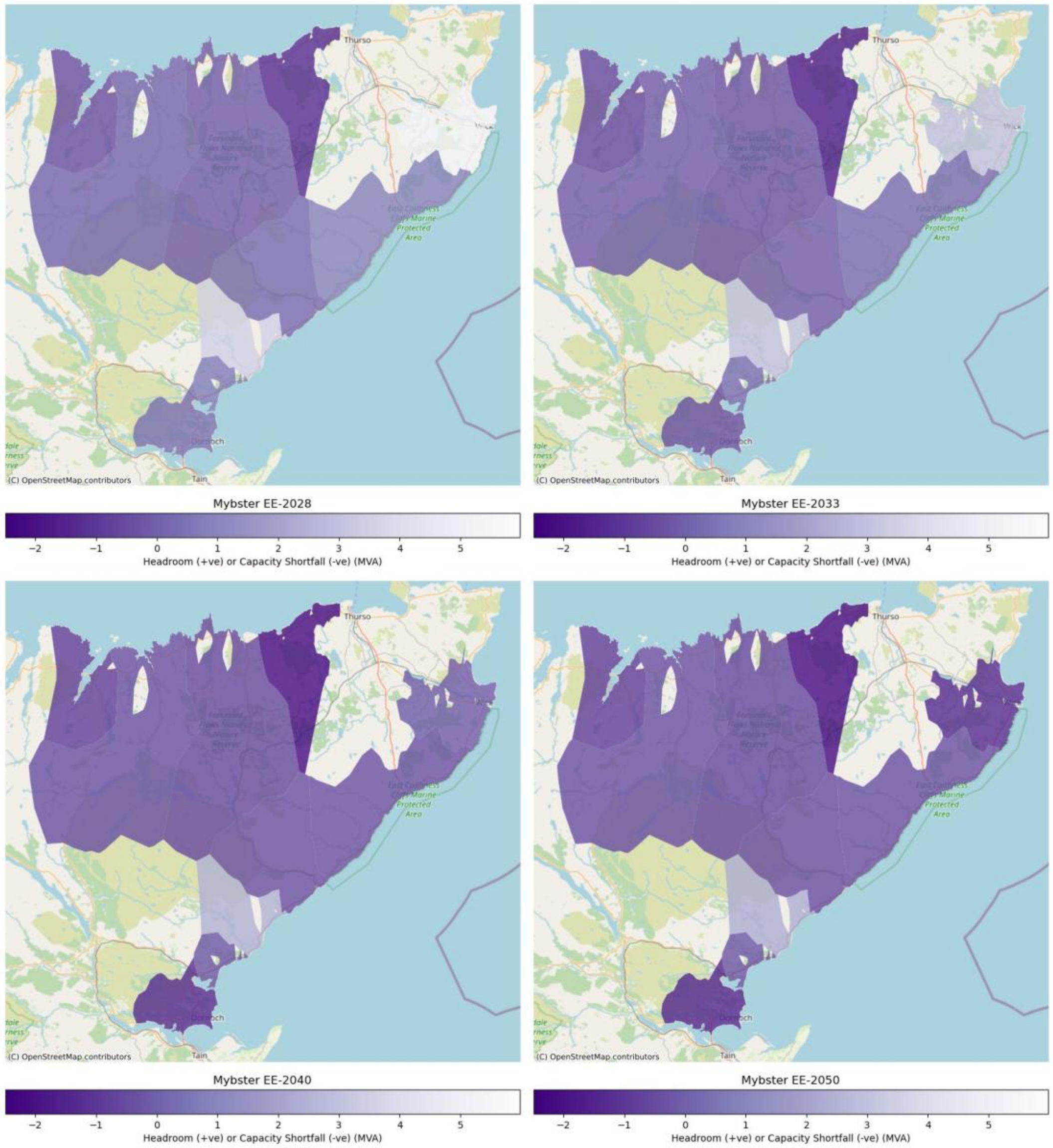

Figure 22 Mybster and Dounreay supply area - EHV/HV Spatial Plan – Electric Engagement

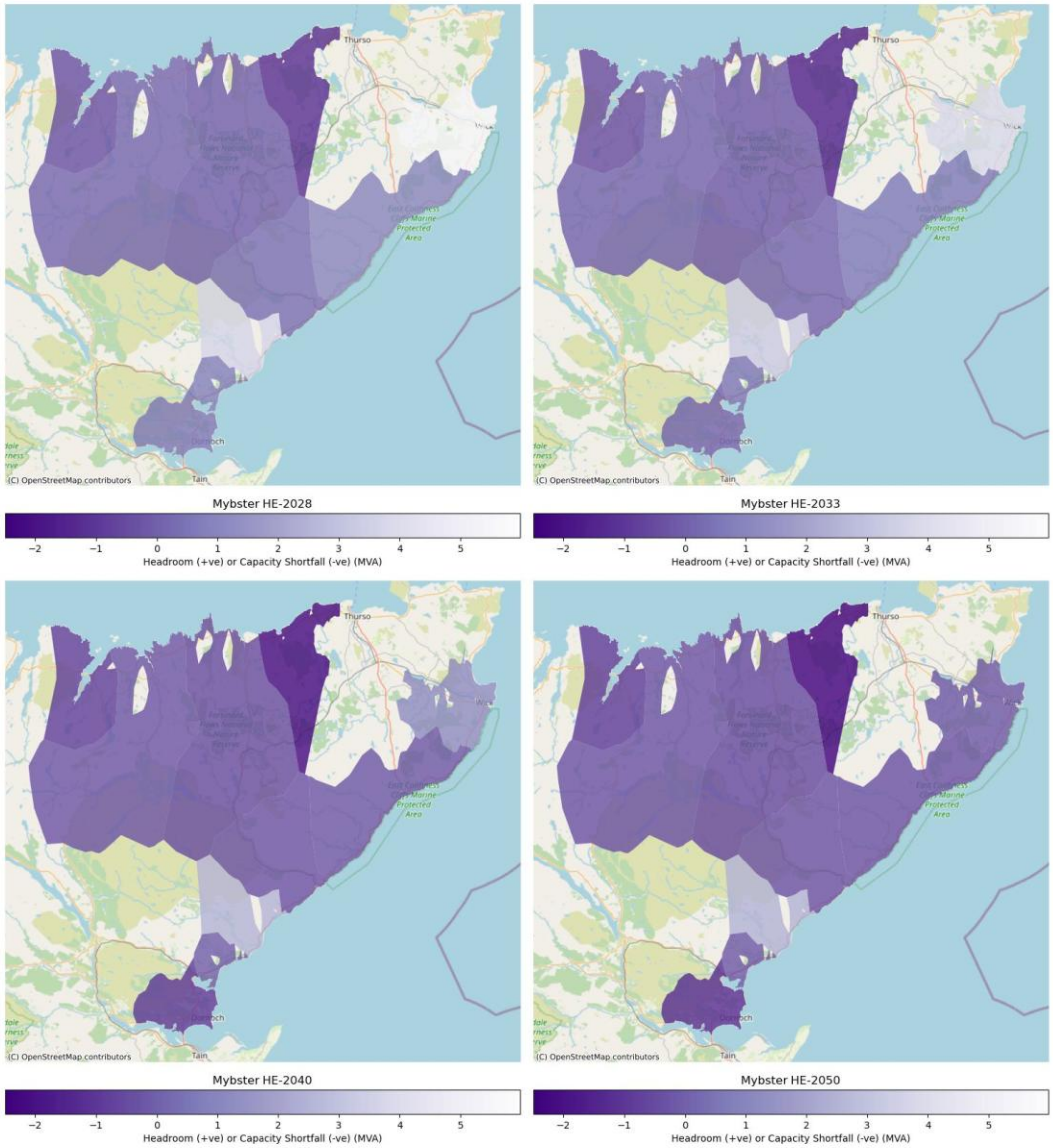

Figure 23 Mybster and Dounreay supply area - EHV/HV Spatial Plan – Hydrogen Evolution

APPENDIX E – HV/LV spatial plans for other DFES scenarios

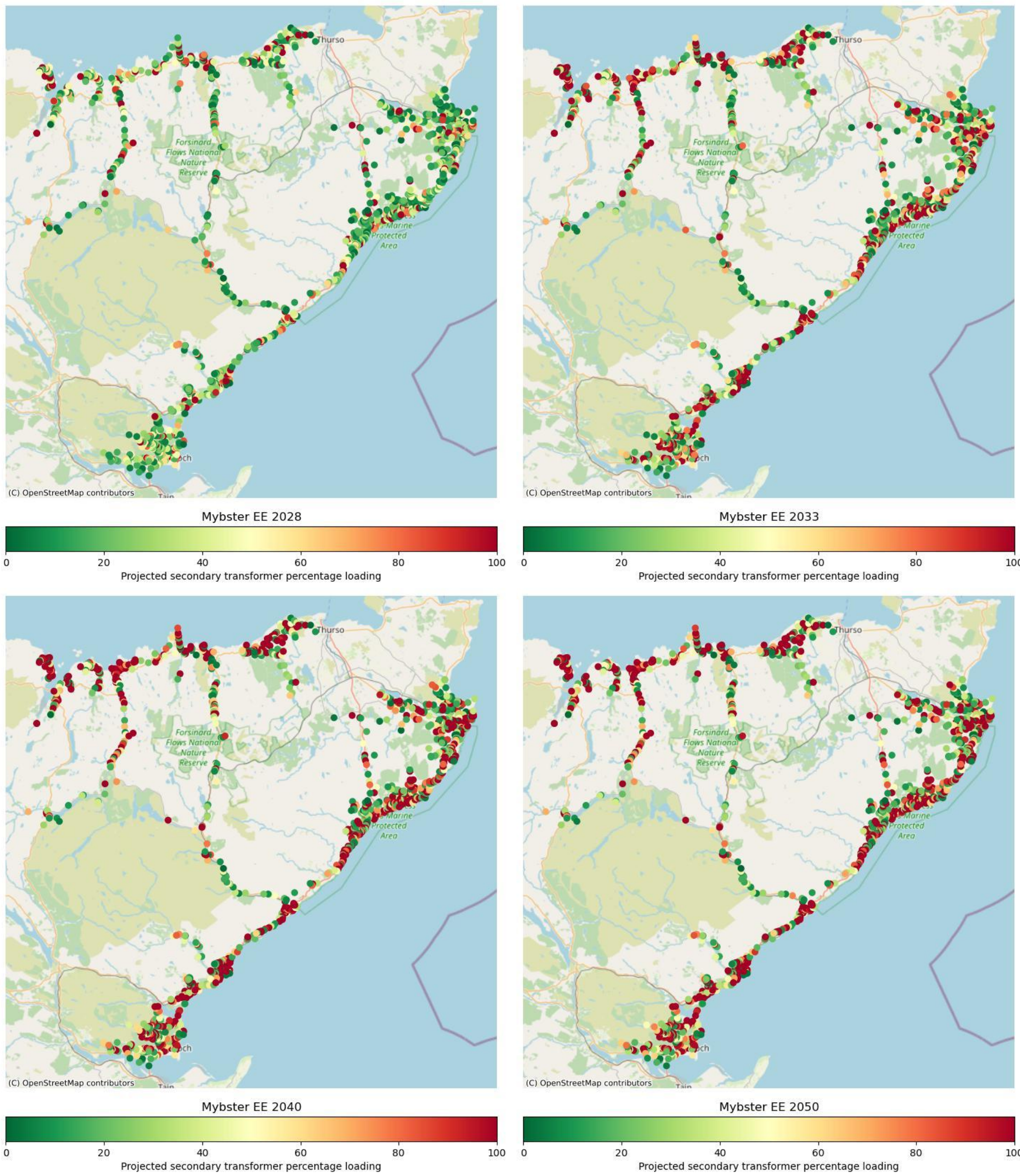

Figure 24 Mybster and Dounreay supply area - HV/LV Spatial Plan – Electric Engagement

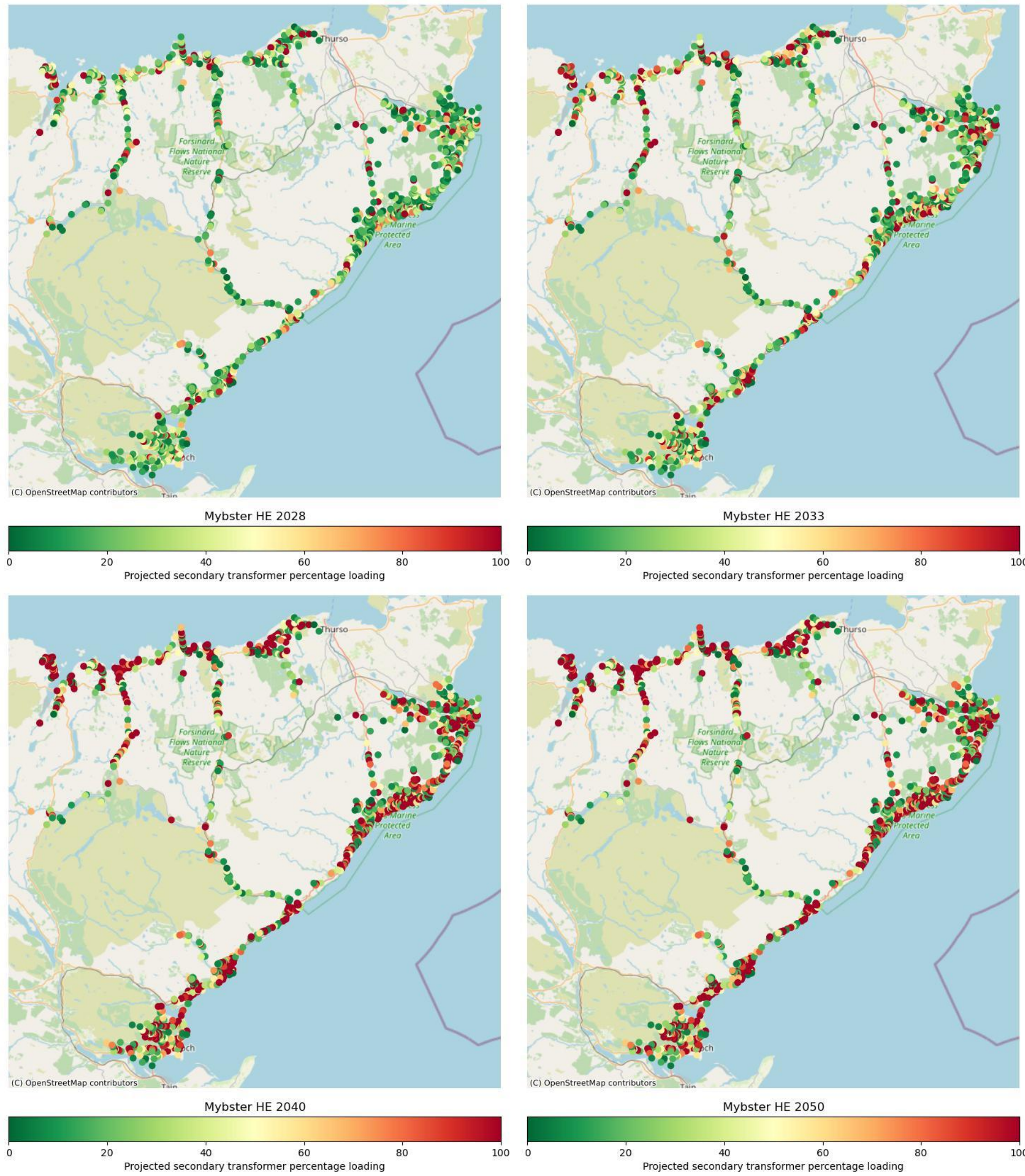

Figure 25 Mybster and Dounreay supply area - HV/LV Spatial Plan – Hydrogen Evolution

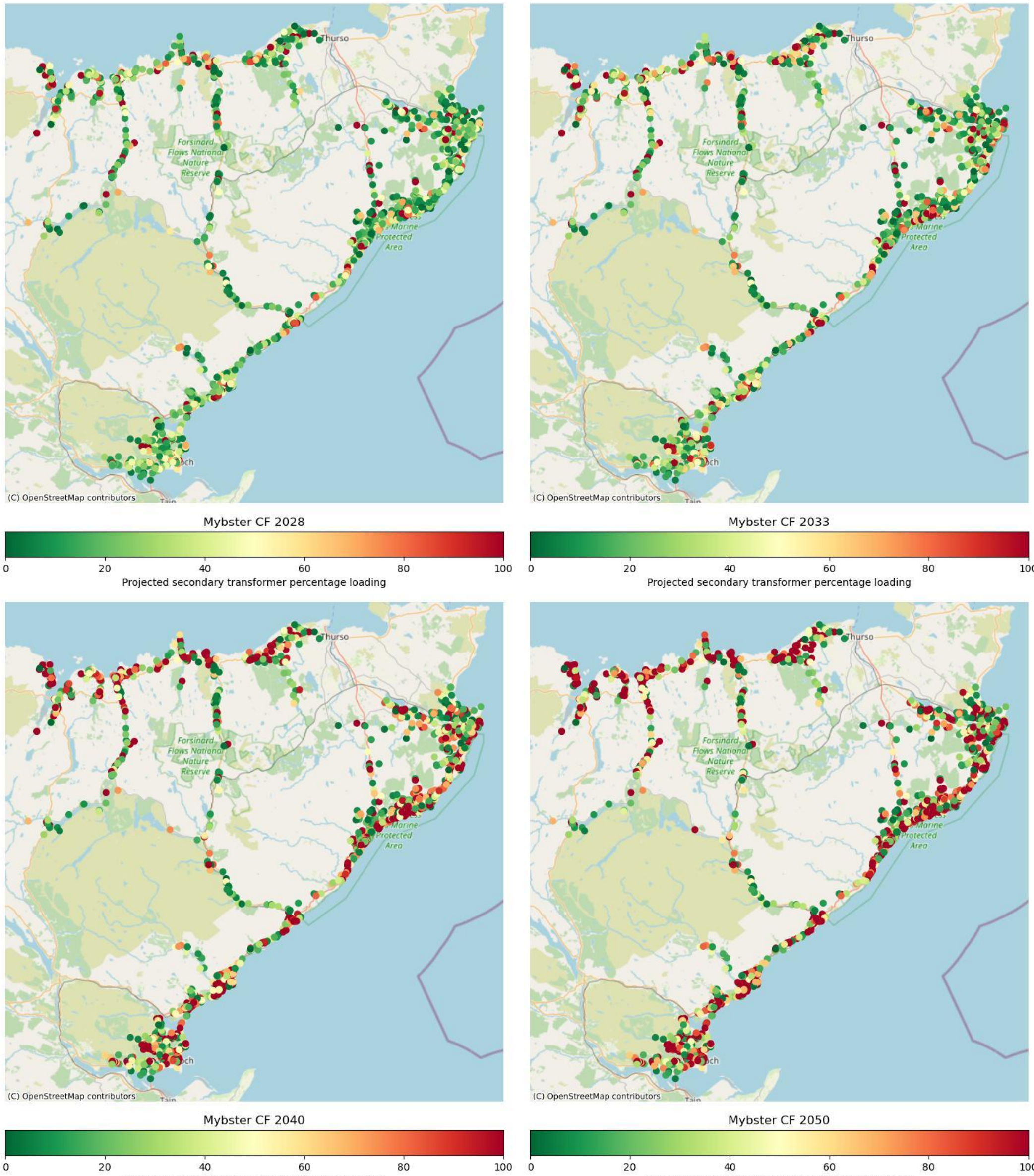

Figure 26 Mybster and Dounreay supply area - HV/LV Spatial Plan – Counter Factual

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