PETERHEAD 132KV SUPPLY AREA: STRATEGIC DEVELOPMENT PLAN

Our network serving communities across the North East Scottish Highland area

Draft for Consultation

October 2025

Scottish & Southern Electricity Networks

1. EXECUTIVE SUMMARY

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

Our Strategic Development Plans (SDPs) incorporate stakeholder feedback on future energy needs through to 2050 and translate these insights into strategic spatial plans for the future distribution network requirements. This enables us to transparently present our future conceptual plans and facilitate discussion with local authorities and other stakeholders. The overall methodology and how this fits into our wider strategic planning process is presented in the Strategic Development Plan Methodology (Strategic Development Plan Methodology - January 2025).

The focus area of this SDP is that supplied by Peterhead 132kV supply area in the northeastern Scotland area, as shown below. The scope of this report concentrates on the Grid Supply Points (GSPs) supplied via the Peterhead 132kV supply area.

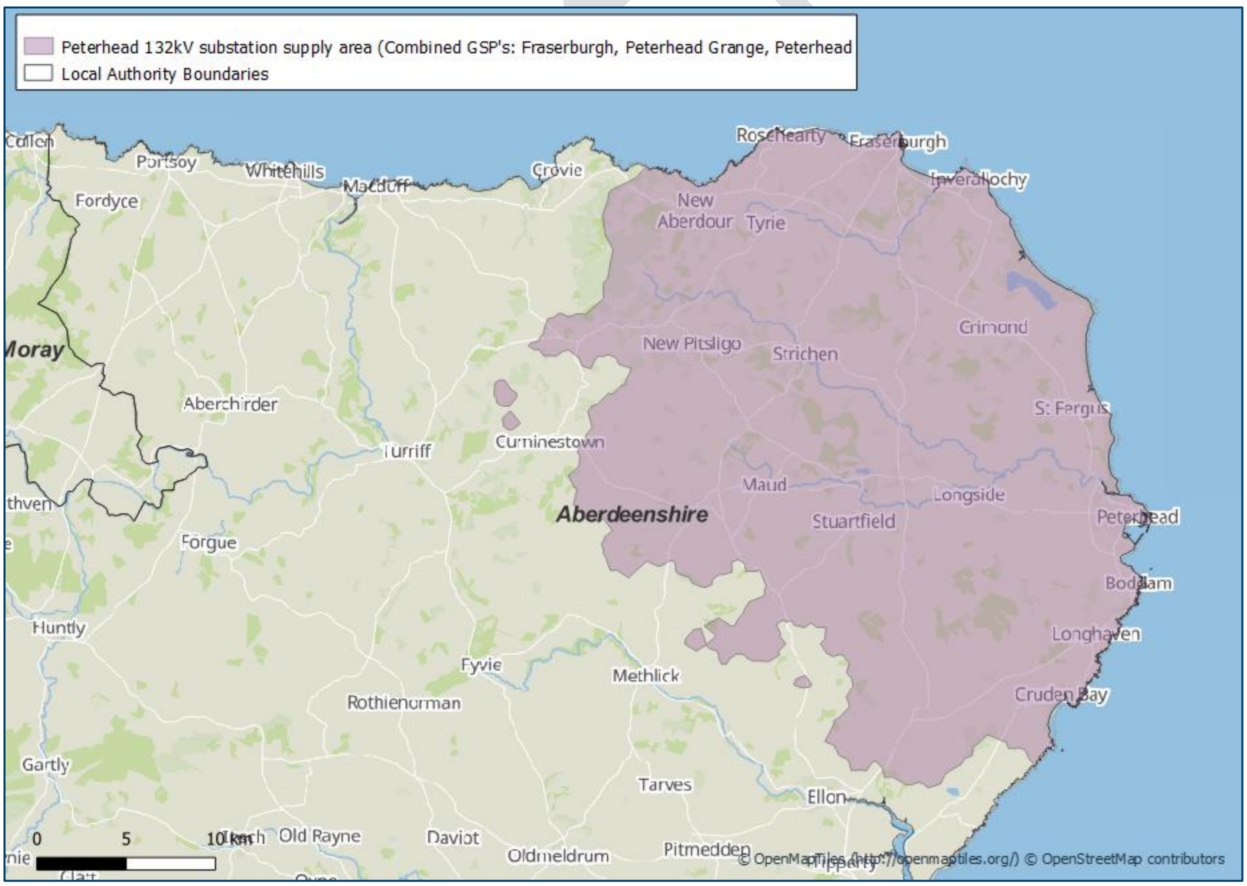


Figure 1: Area of focus for this SDP

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

To identify the future requirements of the electricity network, SSEN 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 summarized 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, is also considered in our forecasts to ensure that the projected load more accurately reflects what we expect to see in the future.

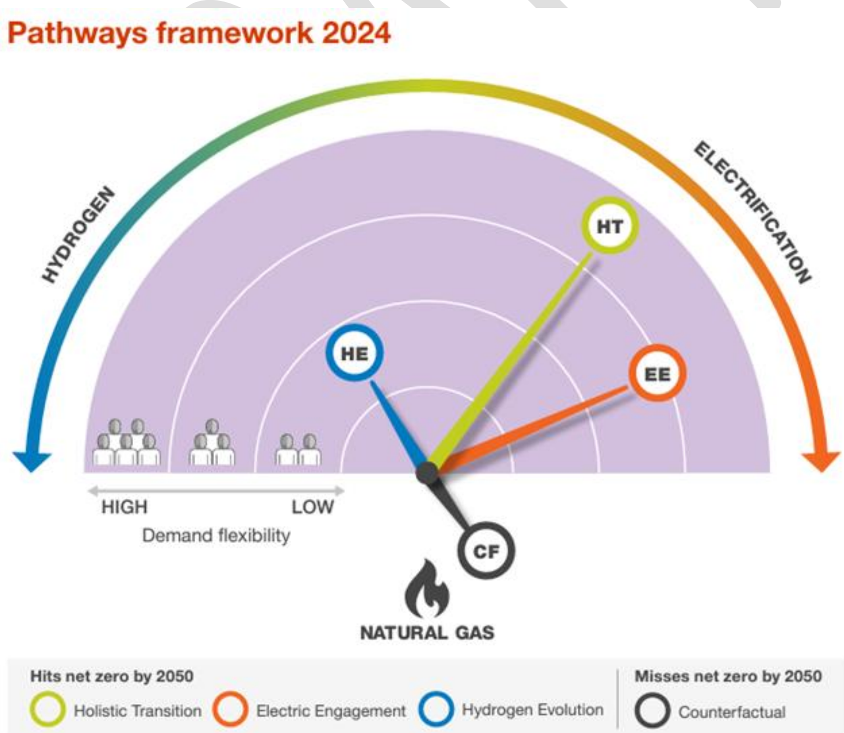


Figure 2: DFES 2024 Scenarios. Source ESO FES2023

1 Strategic Development Plan Methodology - January 2025

We have seen significant generation customer connection requests across the Peterhead 132kV supply area. Where this demand has not been captured in the DFES, we have considered this to ensure that the projected load more accurately reflects what we expect to see in the future.

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 and 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 will provide more detailed optioneering for each of these reinforcements, improving stakeholder visibility of the strategic planning process. Opportunities for the procurement of flexibility will also be highlighted in the DNOA to cultivate the flexibility markets.

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 Pathway Scenarios

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

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

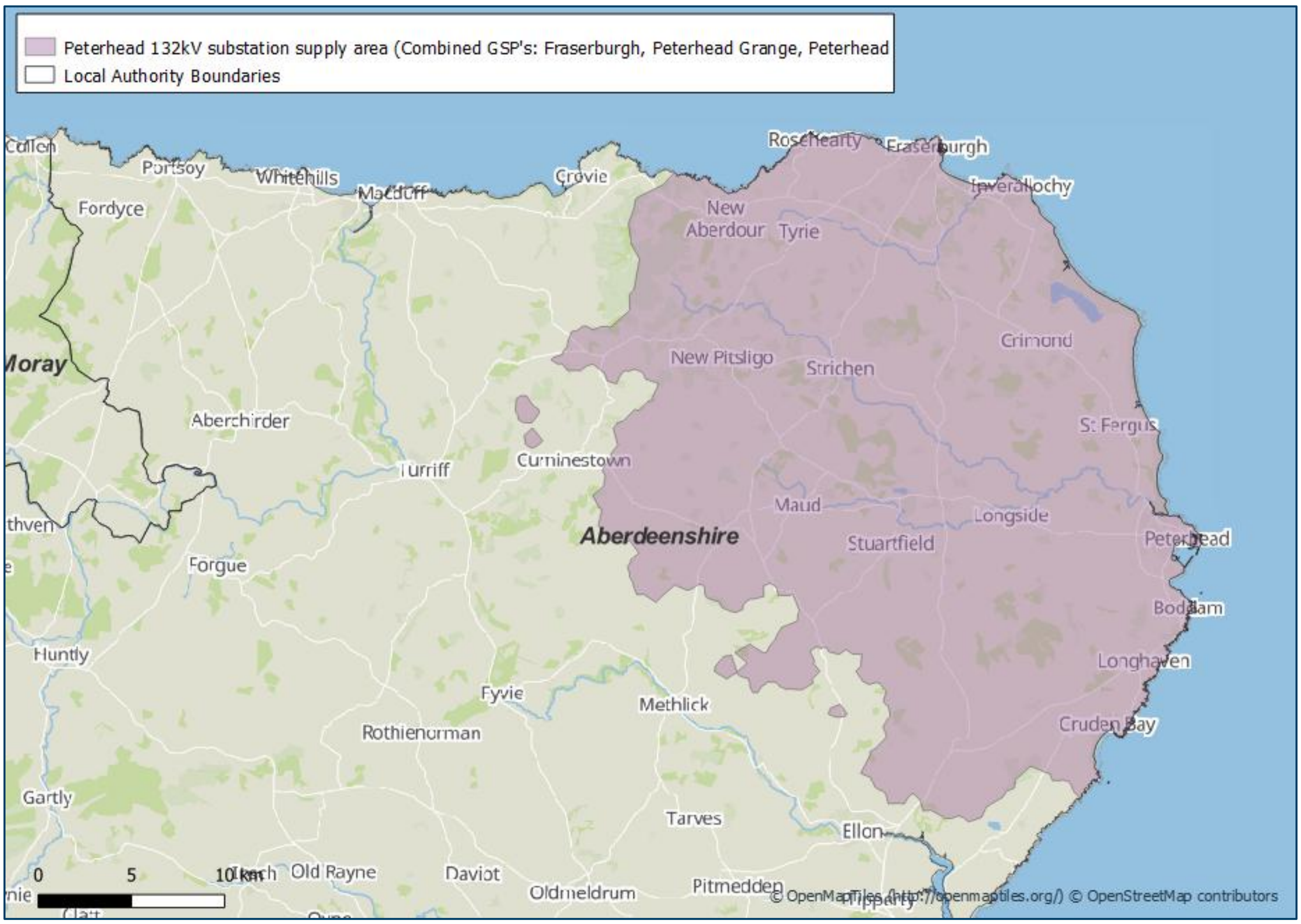


Figure 3: Aberdeenshire Council Local Authority Boundaries and Peterhead 132kV substation supply area

3.1.1. Aberdeenshire Council

Peterhead 132kV supply area supplies parts of Aberdeenshire Council. Aberdeenshire has an estimated population of 264,320[2] (0.2% increase from the year before), making it the 6th highest population out of all 32

2 Population statistics - Aberdeenshire Council

council areas in Scotland. Aberdeenshire Council aims to reach net zero by 2045, in line with Scotland's national target. Aberdeenshire Council has developed a 'Route Map to 2030 and Beyond' which sets out their plans to decarbonise 75% of its emissions by the end of 2030 and to net zero by 2045.

Aberdeenshire was the first local authority in Scotland to develop and approve a carbon budget in 2017/18. The carbon budget is set in February each year and is monitored throughout the year by the Sustainability Committee. The Council have committed to identifying funding opportunities to support decarbonisation[3]. In July 2024, it was announced that the Scottish Government will be providing over £7 million across Aberdeenshire Council, Aberdeen City, Moray Council, The Highland Council and Dundee City Council[4].

3.2. Whole System Considerations

We have worked closely with local stakeholders, customers, market participants, government bodies and SSEN Transmission to build upon our engagement prior to RIIO-ED2, in order to develop an enduring whole system solution to meet the future energy needs of the Peterhead 132kV supply area and to enable the region to support the transition to net zero through its extensive natural resource potential.

3.2.1. Transmission Interactions

SSEN Transmission is progressing a major programme of works in the central Scotland and Peterhead area to unlock renewable generation potential and enable the transition to net zero. The portfolio spans delivered, ongoing, and planned projects, with Peterhead positioned as a critical hub for multiple high-capacity offshore HVDC connections. These include two 2GW subsea links from Peterhead - Drax, and England, each jointly developed with National Grid where applicable. Alongside these, a new 400kV substation at Peterhead is being delivered to strengthen the local network and facilitate future connections.

Individually, the projects are at varying stages: the Peterhead–Drax HVDC link is in refinement and targeting completion by 2029; the Peterhead–England link is in development, and the new 400kV substation is approaching energisation this year. Together, these investments will significantly expand transmission capacity from northeast Scotland into England. Ongoing coordination between SSEN Distribution and Transmission will ensure whole-system alignment as further strategic plans for the central Highlands network take shape.

3.2.2. 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.

Substation Name	Site Type	% of RTS customers
Fraserburgh GSP	Grid Supply Point	11.1

3 Aberdeenshire's decarbonisation plans for 2030 and beyond - Aberdeenshire Council

4 Over £7 million to support electric vehicle infrastructure | Transport Scotland

Peterhead Grange GSP	Grid Supply Point	4.33
Strichen GSP	Grid Supply Point	12.5

Table 2: Number of LMA customers subject to RTS (2024)

3.3. Flexibility Considerations

SSEN procures Flexibility Services from owners, operators, or aggregators of Distributed Energy Resources (DERs) or Consumer Energy Resources (CERs), which can be generators, storage, or demand assets. These services are needed in areas of the network which have capacity constraints at particular times or under certain circumstances. SSEN purchases Flexibility Services from all types of providers (e.g. domestic or commercial). Information on the process of procurement and how to participate are published on the Flexibility Services website[5] 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].

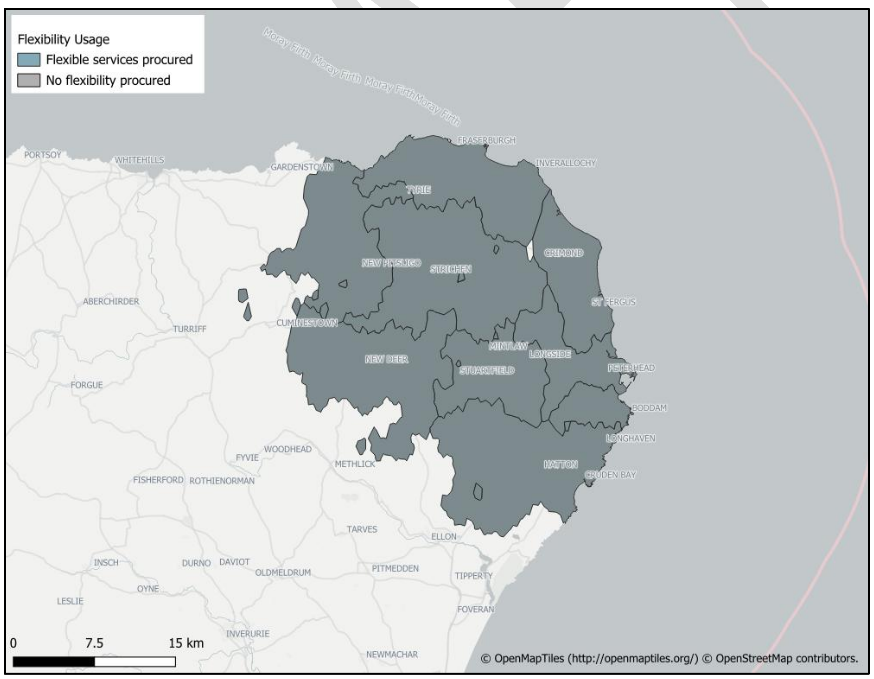


Figure 4: Flexibility Procurement Map

5 Flexibility Services - SSEN

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

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

No flexibility has been procured in the Peterhead 132kV supply area at the time of writing this SDP.

4. EXISTING NETWORK INFRASTRUCTURE

4.1. Peterhead 132kV Supply Area Context

The Peterhead 132kV supply area network is made up of 275kV, 132kV, 33kV, 11kV, and LV circuits. It is a mix of rural and urban network spanning across the Scottish highland region. While much of the land is used for agricultural purposes, there is a mix of residential, commercial, and industrial land, which is located throughout the supply area. In total, the Peterhead 132kV supply area supplies approximately 18,890 customers with the breakdown for each Grid Supply Point shown in **Table 2** below. A further breakdown by primary substation can be found in **Appendix A**.

Substation Name	Site Type	Number of Customers Served	2023/24 Substation Maximum MVA (Season)
Fraserburgh GSP	Grid Supply Point	8,558	15.74 (Winter)
Peterhead Grange GSP	Grid Supply Point	8,524	22.93 (Winter)
Strichen GSP	Grid Supply Point	1,708	13.31 (Winter)
	TOTAL	**18,890**	**51.98 (Winter)**

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

4.2. Current Network Topology

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

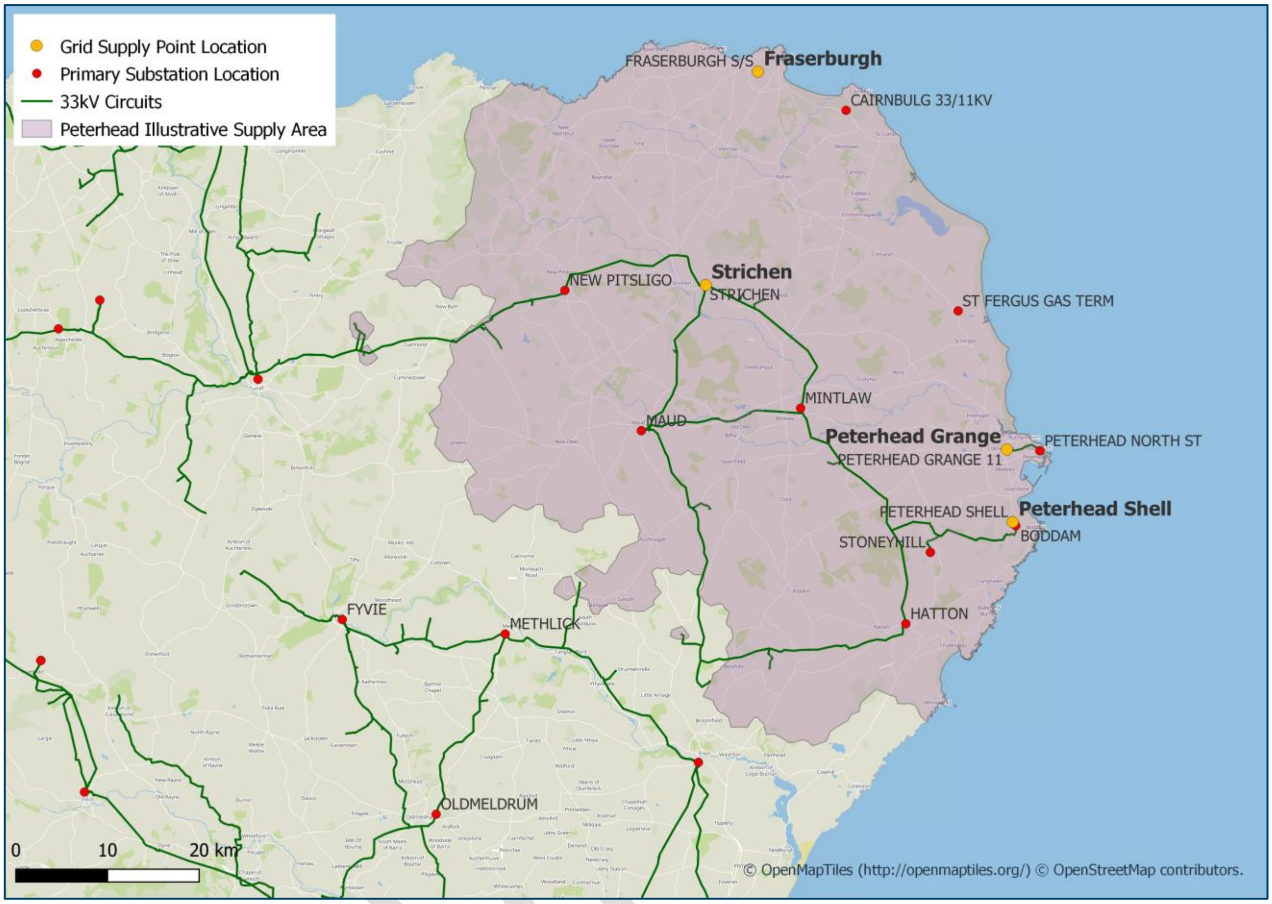


Figure 5: Peterhead 132/33kV network by GSP supply area

4.3. Network Schematic

The network schematics in **Figures 7 – 9** (below) depict the existing 33kV distribution network at Fraserburgh, Peterhead Grange and Strichen GSPs.

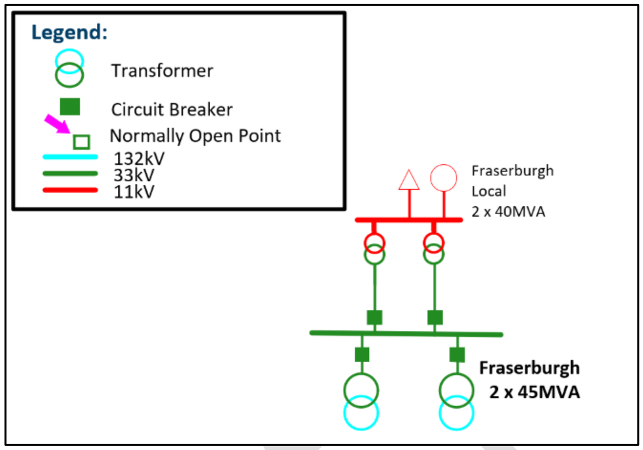


Figure 6: Existing Fraserburgh 33kV Network Schematic

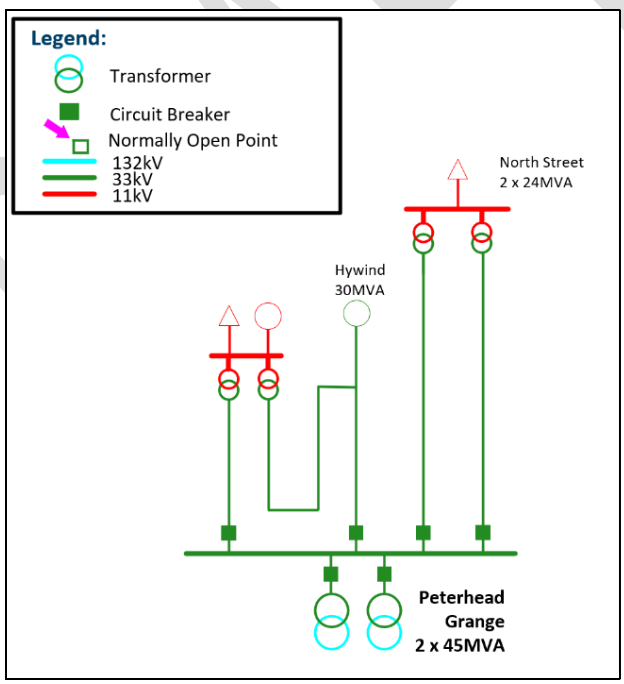


Figure 7: Existing Peterhead Grange 33kV Network Schematic

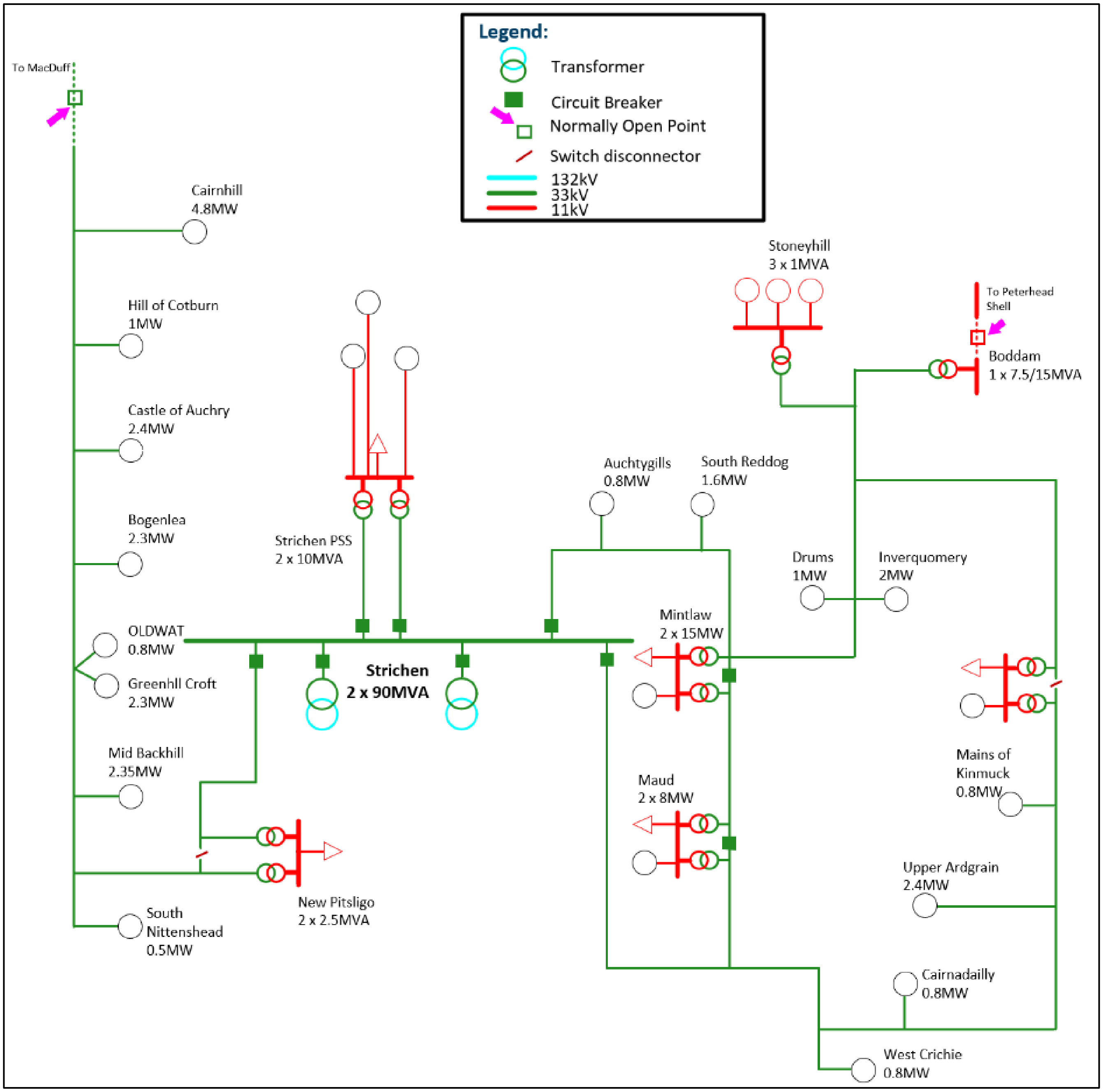


Figure 8: Existing Strichen 33kV Network Schematic

5. FUTURE ELECTRICITY FORECASTS FOR THE PETERHEAD 132KV SUPPLY AREA

The following section details load growth across the technologies projected 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 GSP supply area highlighted in Figure 3 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.[8]

5.1. Generation and Electricity Storage

DFES Scenario	Generation capacity (MW)				Electricity storage capacity (MW)			
	Baseline	2030	2040	2050	Baseline	2030	2040	2050
Holistic Transition	74MW	189 MW	377 MW	467 MW	0MW	260 MW	287 MW	300 MW
Electric Engagement		211 MW	386 MW	490 MW		204 MW	224 MW	240 MW
Hydrogen Evolution		184 MW	281 MW	374 MW		54 MW	59 MW	65 MW
Counterfactual		171 MW	219 MW	280 MW		150 MW	152 MW	161 MW

8 SSEN DFES Technology Projections - Microsoft Power BI

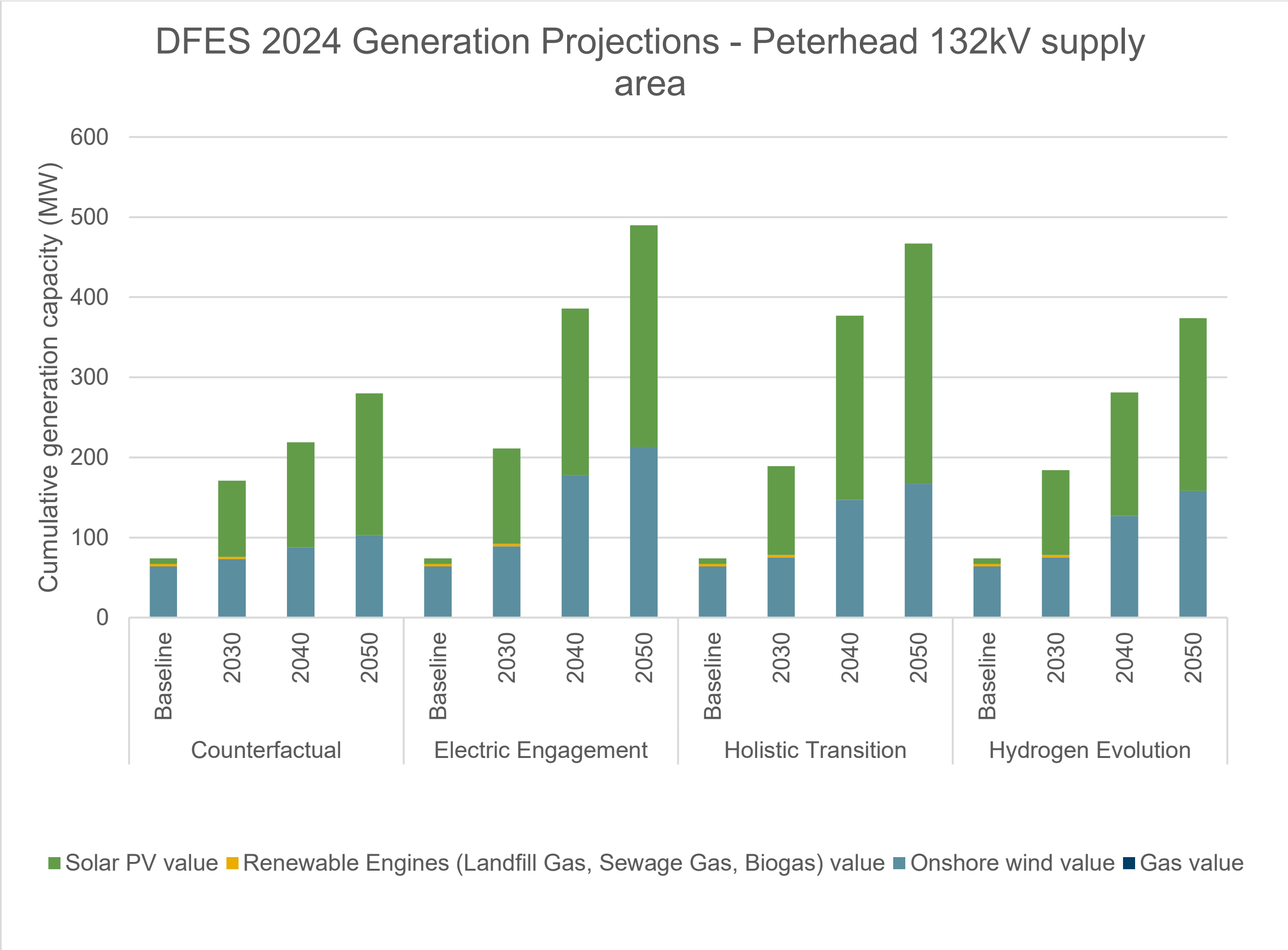


Figure 9: Projected cumulative distributed generation capacity across Peterhead 132kV Supply Area.
Source SSEN DFES 2024

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	576	5,839	22,208	22,832	0MW	3MW	25MW	28MW
Electric Engagement		9,632	22,294	22,785		5MW	25MW	26MW
Hydrogen Evolution		5,748	21,880	22,435		4MW	28MW	29MW
Counterfactual		4,631	17,277	22,145		0MW	18MW	30MW

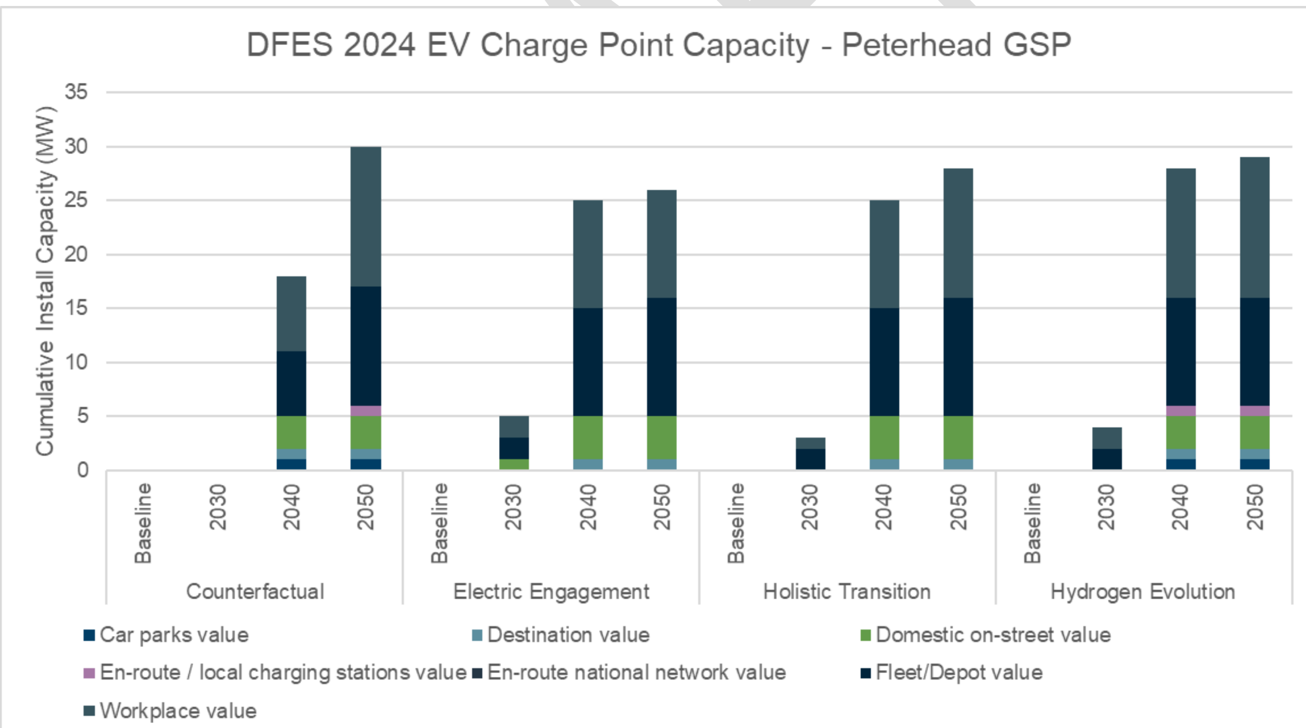


Figure 10: Projected cumulative EV Charge Point Capacity across Peterhead 132kV Supply Area.
Source SSEN DFES 2024

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	81,108	363,229	776,980	776,980	4,968	11,437	28,917	33,544
Electric Engagement		319,549	787,409	791,535		11,019	29,112	36,548
Hydrogen Evolution		323,994	800,745	809,316		8,943	24,248	33,773
Counterfactual		21,3324	605,695	714,935		7,521	15,472	31,298

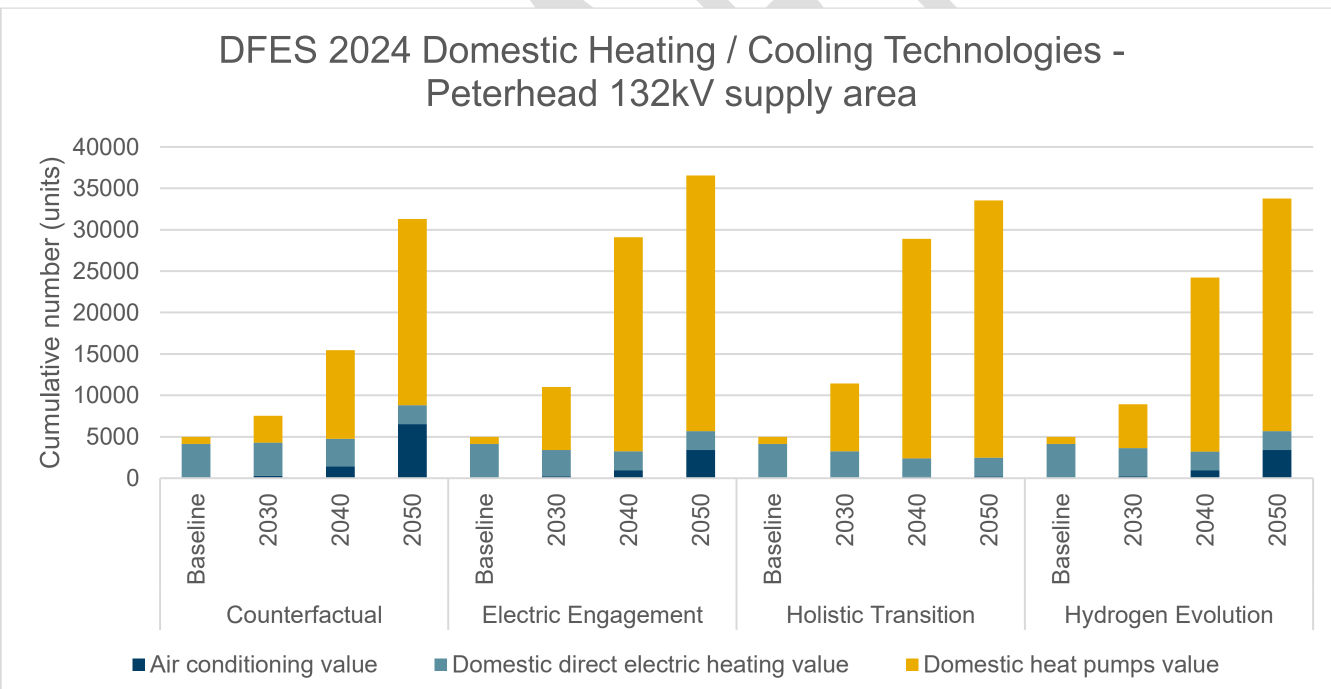


Figure 11: Projected cumulative Domestic Heating / Cooling Technologies across Peterhead 132kV Supply Area.
Source SSEN DFES 2024

5.4. New Building Development

Through engagement with local authorities, we have developed an understanding of new development across our license 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 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	1,435	4,065	5,225	369,814	776,290	776,290
Electric Engagement	1,354	3,964	5,161	314,084	776,290	776,290
Hydrogen Evolution	1,395	3,957	5,017	314,084	776,290	776,290
Counterfactual	1,193	3,738	4,935	205,719	659,988	776,290

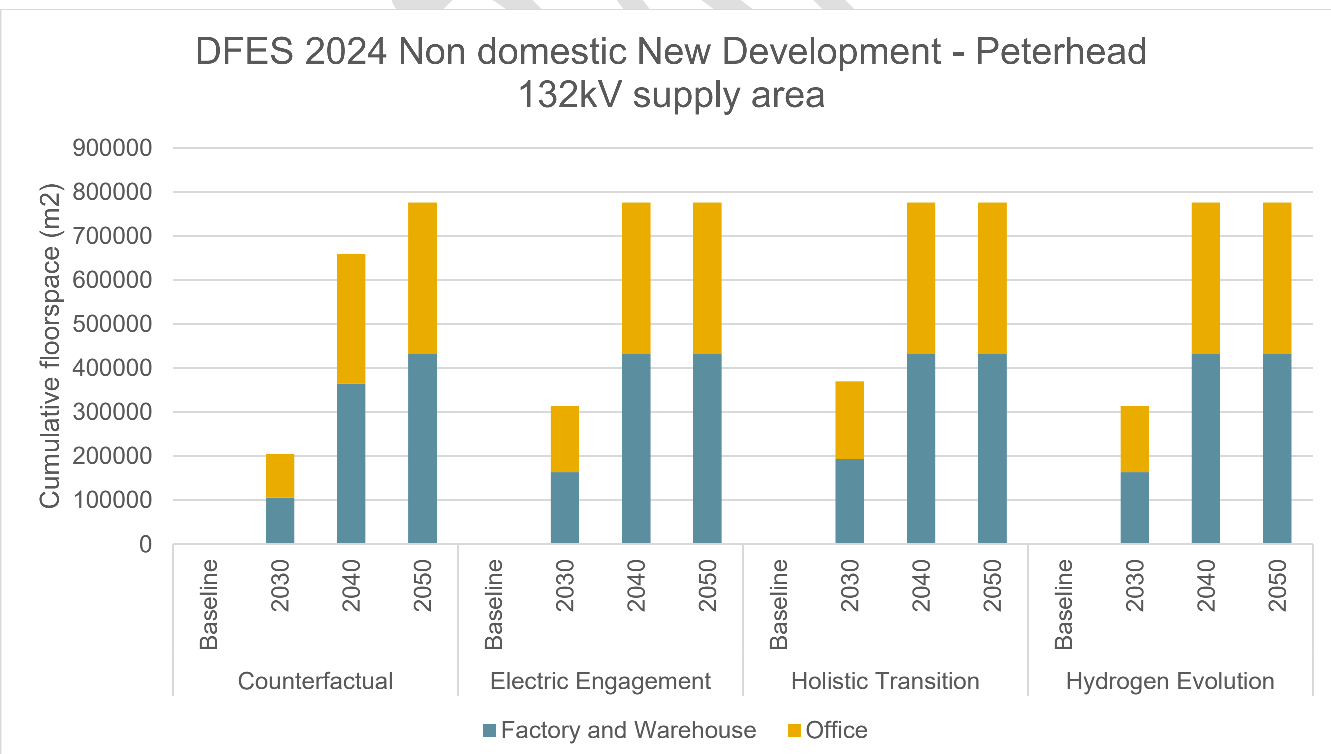


Figure 12 Projected cumulative New Development across Peterhead 132kV Supply Area.
Source SSEN DFES 2024

There are a number of industrial customers connected at the High Voltage level (11kV and 6.6kV) across Peterhead GSP. In addition to this, there are larger EHV connected customers with examples including water treatment works.

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 Peterhead 132kV supply area. We have identified agriculture and ports 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) 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.

As well as this, SSEN leads an innovation project aimed at better understanding the potential electricity demands arising from the maritime industry, so assets and network in the area can be sized appropriately. SSEN's SeaChange innovation project has been funded through the Strategic Innovation Fund.[9] This project involves building a 'Navigating Energy Transitions' (NET) tool, which will help ports to plot their most viable pathways for decarbonisation.

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 Peterhead 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 Peterhead 132kV supply area. A summary of existing works is shown in **Table 4** below and further information on the schemes which have recently been through our DNOA process can be found in **Appendix F**. The network considered for long-term modelling is shown below in Figure 14.

ID (Schematic Reference)	Substation	Description	Driver	Forecast completion	Fully resolves future strategic needs to 2050?
		Strichen GSP			
1	Strichen 33kV Circuit	Reinforce existing 33kV circuit with underground cable	Thermal overload and voltage issue	2029/30	
2	New Pitsligo PSS	Upgrade existing 2 x 2.5MVA TX to 6.25MVA	Thermal overload	2029/30	

Table 4: Works already triggered

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 Peterhead 132kV substation supply area for 2050.

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

The network considered for long-term modelling is shown below in Figure 14.

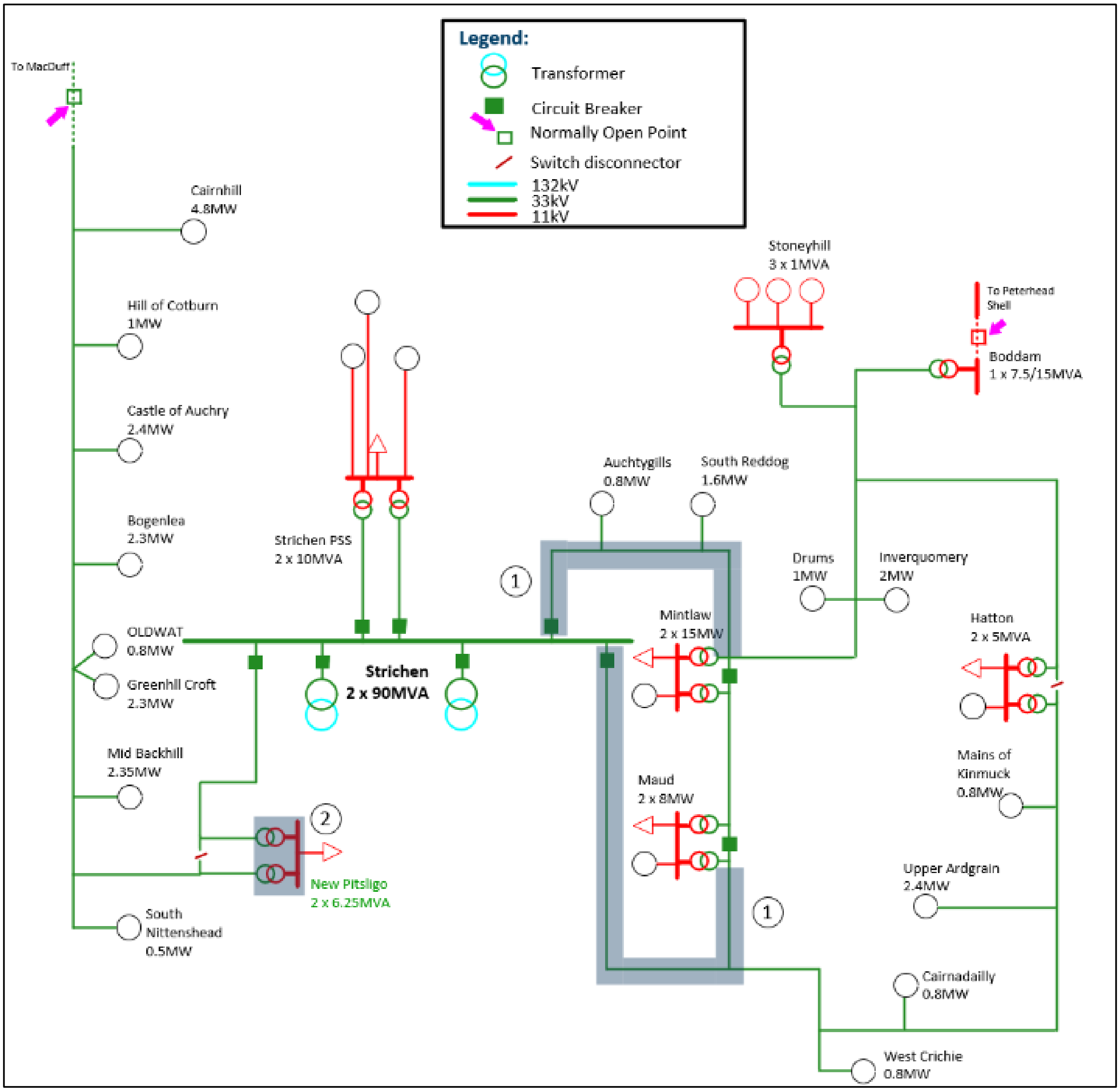


Figure 13: Future distribution network development around Strichen 132kV supply area

7. SPATIAL PLANS OF FUTURE NEEDS

7.1. Extra High Voltage/High Voltage Spatial Plans

The EHV/HV spatial plan shown below in **Figure 14** shows the projected headroom or capacity shortfall due to demand increases at primary substations across the Peterhead 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 pathways are presented in **Appendix C** and **Appendix D**. The values are taken from the Network Scenario Headroom report (NSHR), part of the Network Development plan (NDP)[10]. 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.

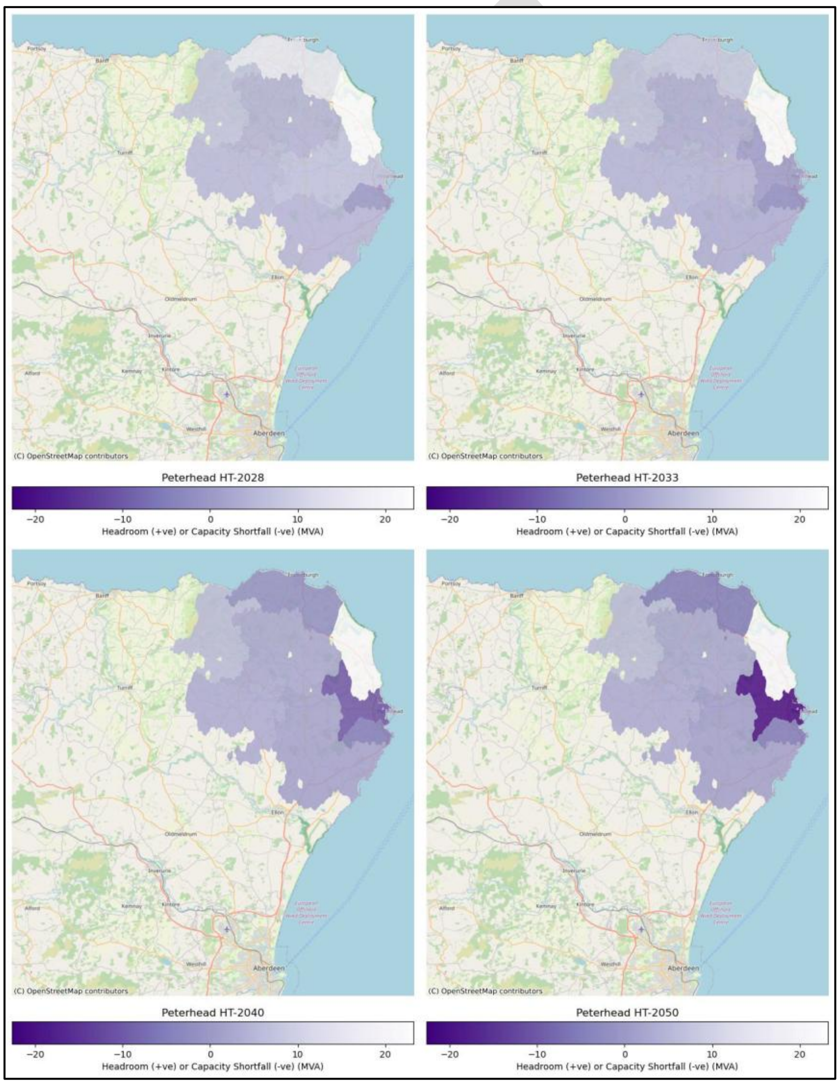


Figure 14: Peterhead 132kV supply area EHV network spatial plans for HT 2028, 2033, 2040, and 2050

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

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 15** and **Appendix D**. As shown in the legend, the points are coloured based on their percentage loading with green being low percentage loading, and darker reds indicate higher percentage loading (see legend for details on loading bands and colouring).

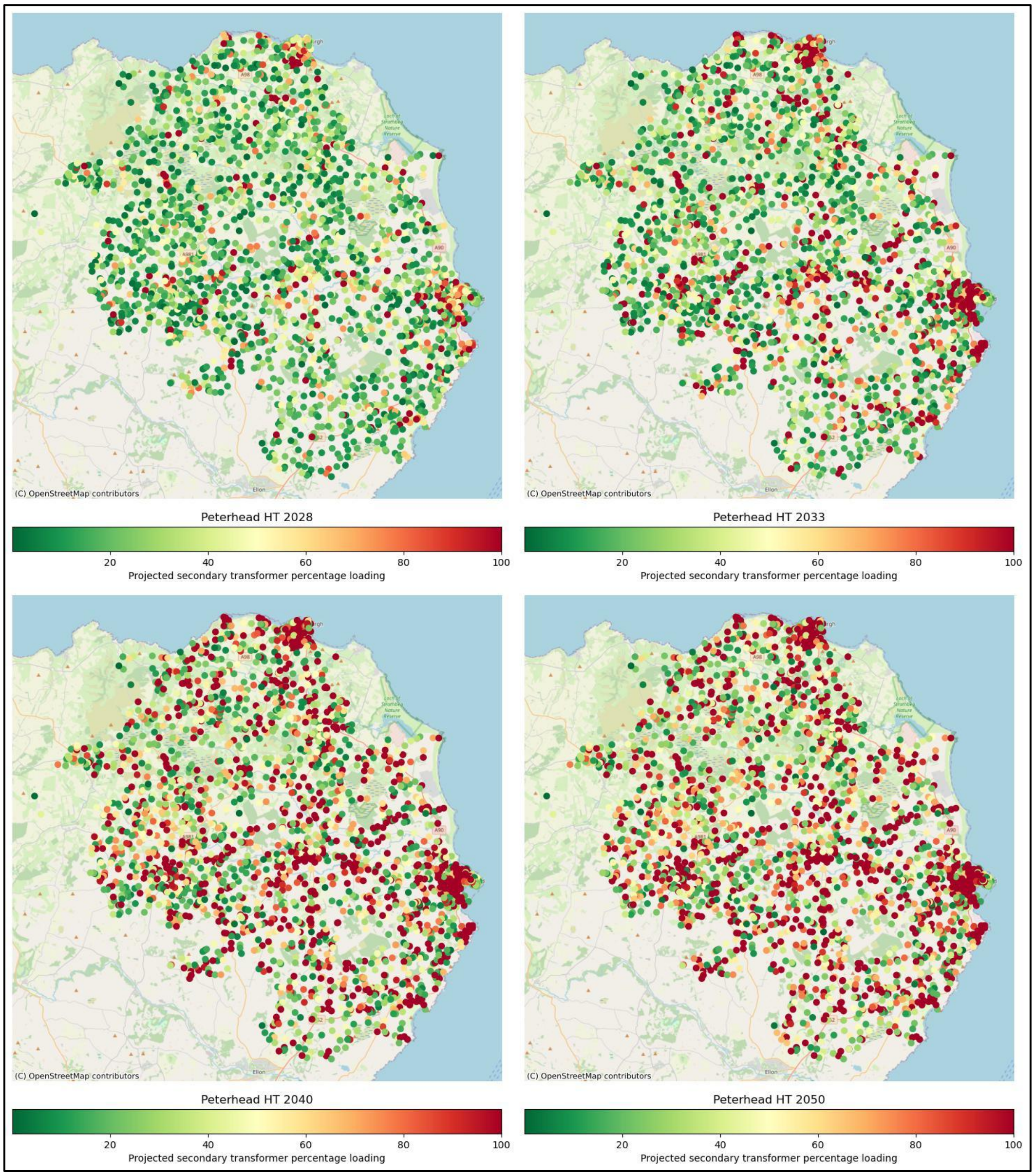


Figure 15: Peterhead 132kV supply area HV/LV HT spatial plans for HT 2028, 2033, 2040 and 2050

8. OPTIONS TO RESOLVE SPECIFIC SYSTEM NEEDS

In this section we summarise the specific needs arising from our future spatial plans. The outputs of the power system analysis in this section show where we may observe the need for further intervention on the distribution network. This could be through asset solutions or flexibility services including access products which may be used to enable connection of projects ahead of reinforcement delivery. We also propose some initial options to resolve the needs forecasted. If required during the next ten years, these will be further developed through the DNOA process.

The section consists of three sets of results:

- Future EHV system needs to 2035 – these needs are more certain and therefore we have more clearly defined options to meet the requirements and we recommend that these are progressed through the DNOA process. In all cases, we are proposing solutions that meet the projected requirements for 2050 and where appropriate, system needs arising beyond this period are considered to ensure a holistic solution. 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 opportunities 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: Connections reform process, which is taking place this year, is likely to change the number and composition of generation/storage projects currently in the connections queue.

Risks: The reinforcements currently planned, that have been triggered by generation connections, may not be necessary if the generation projects drop out of the connections queue.

Mitigation: Works triggered by generation projects that have a level of uncertainty have not been included in the works in the progress or the network modelling. This assumes these works will not release capacity so network can be planned for worst-case scenario in terms of these works going ahead. Network models will be rerun when there is more clarity.

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

Risks: Further reinforcement than identified here is required to enable connection of generation. Increasing fault levels leads to damaged distribution network assets.

Mitigation: We should further assess the near-term generation requirements to ensure that we are in a position to facilitate the Clean Power 2030 targets set by DESNZ. Consideration of future fault level to prevent the risk of damaged assets should be considered when designing future schemes.

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

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

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

8.2. 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 4 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
33kV Network							
	Peterhead Grange GSP	2034	2034	2035	2041	N-1 outage for 1T0 and 2T0	Transformers experience thermal constraints on 2 x 45MVA transformers. Option to resolve thermal constraint include: - Reinforce both existing assets to provide capacity out to 2050
	Strichen GSP	2029	2029	2030	2032	N – 1 outage of STRI – 3L5	Circuits experience thermal constraint on 7.892km of overhead lines rated 0.1in CU, 0.13km of 240mm Al. Option to resolve thermal constraint include: - Upgrade the OHL circuits between Auchtygill, South Reddog and towards Maud.
	Strichen GSP	2032	2032	2033	2036	N – 1 outage of STRI – 2L5	Circuits experience thermal constraint on 4.007km of 0.15eq ACSR overhead lines between Strichen GSP and Maud PSS, and 0.149km of 240mm Al. UG Cable. Option to resolve thermal constraint include: - Construction of new circuits from Strichen GSP to Mintlae PSS.
	Strichen GSP	2034	2032	2036	2037	N – 1 outage of STRI – 3L5 towards Maud	Circuits experience thermal constraints on 5.058km of 32mm CU OHL, 3.147km of 95mm Cu Underground cable, and 0.903km of 0.1in Cu UG cable. Options to resolve thermal constraints include: - Construction of new circuits from Strichen GSP to Maud PSS.
	Hatton PSS	2030	2030	2031	2033	N – 1 outage of STRI – 3L5 towards Maud	Transformers experience thermal constraints on the 5MVA x 2 transformers. Options to resolve thermal constraints include: - Reinforce both existing assets to provide capacity into the 2050s.

ID	Location of proposed intervention	HT Year	EE Year	HE Year	CF Year	Network State	Comments and potential options to resolve the system need
	Strichen PSS	2030	2030	2030	2030	N – 1 outage of STRI – Local	Transformers experience thermal constraints on the two 10MVA units. Options to resolve thermal constraints include: - Reinforce both existing assets to provide capacity into the 2050s.

Table 5: 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
33kV Network							
1	Fraserburgh PSS	2038	2038	2041	2048	N-1 outage for 3HO and 1HO	Transformers experience thermal constraints on the 2 x 40MVA transformers. Options to resolve thermal constraint include: - Reinforce both existing assets to provide capacity out to 2050 - Reinforcement considerations to be make closer to the identified date of overloading, proposing 5 years before forecasts are realised to ensure more accurate intervention.
2	Peterhead Grange PSS	2042	2043	2043	2048	N-1 outage of 2T0	Transformers experience thermal constraints on the 2 x 45MVA transformers. Options to resolve this thermal constraint could include: - Reinforce both existing assets to provide capacity out to 2050
3	Mintlaw PSS	2037	2037	2039	2043	N – 1 outage of STRI – 2L5 or N – 1 outage of 3L5	Transformers experience thermal constraints on the 2 x 15MVA transformers. Options to resolve this thermal constraint could include. - Reinforce both existing assets to provide capacity out to 2050

Table 6: 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. This section provides further context on the work for the Peterhead 132kV supply areas high voltage and low voltage network needs up 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 Peterhead 132kV 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.

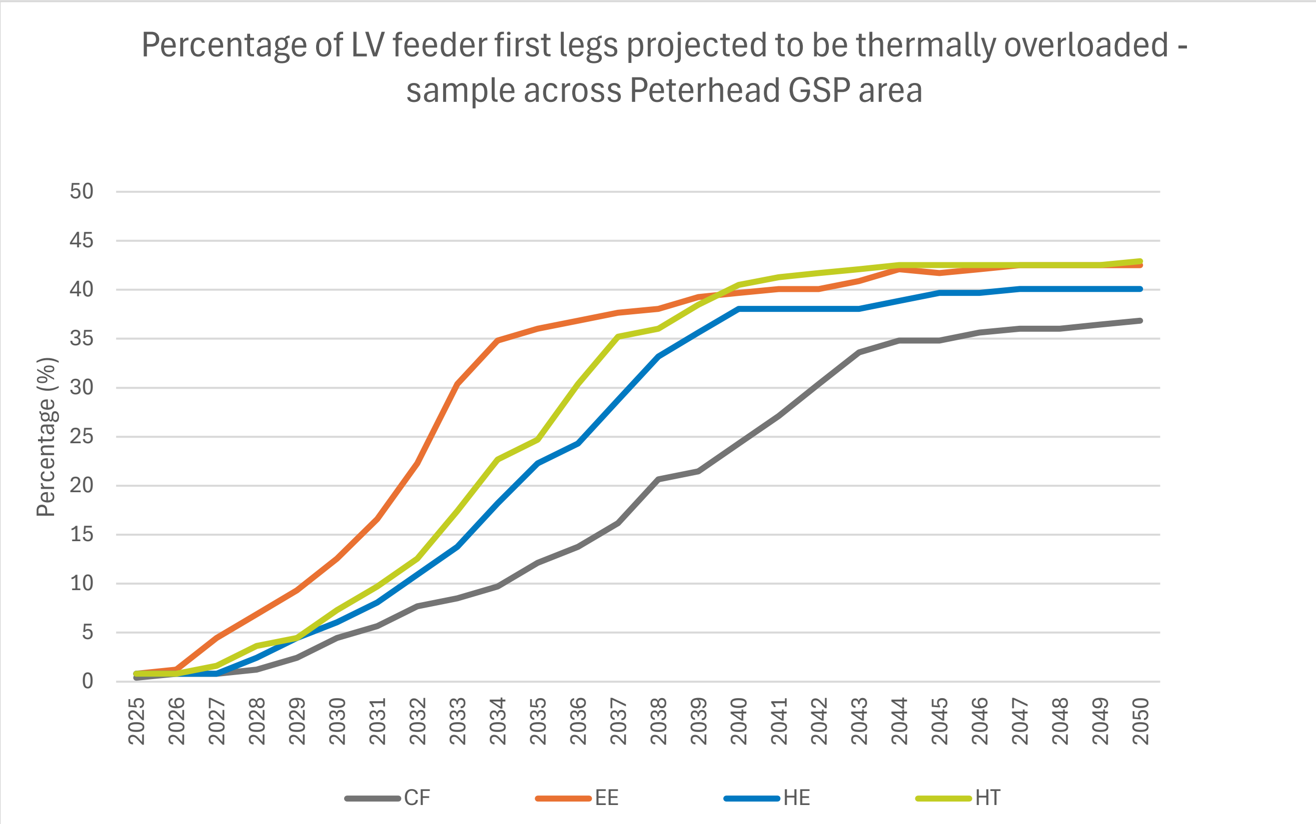


Figure 16: Peterhead 132kV supply area Projected Secondary Transformer Loading. Source: SSEN Load Model

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.[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 7.

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)

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.
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 7: VFES Groupings

To understand the vulnerability groupings across the Peterhead 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**), 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 18**.

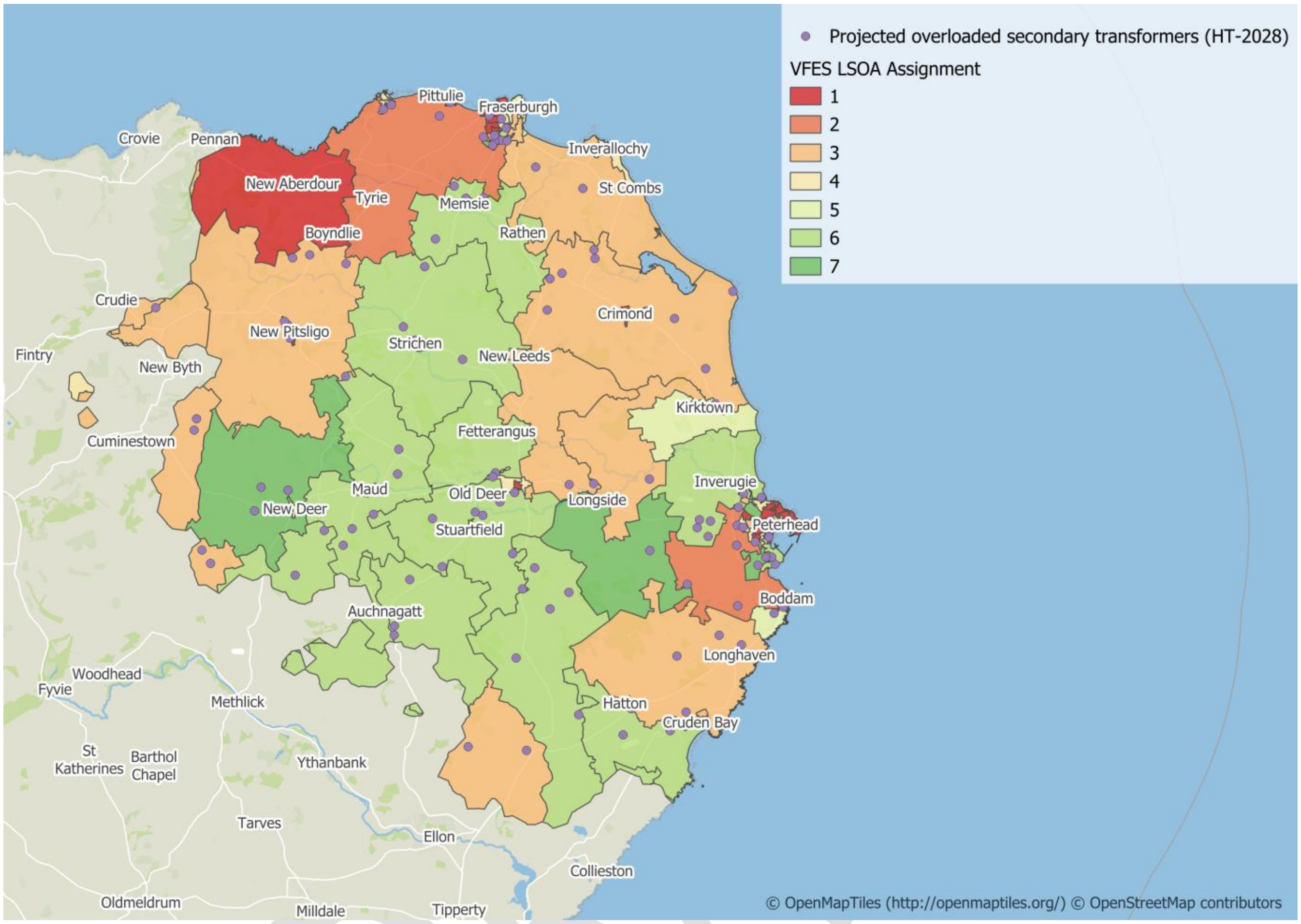


Figure 17: Peterhead 132kV supply area VFES Output with secondary transformer overlay

We can see that there is a distribution of areas that fall within group 3. Group 3 indicated that there is a relatively high levels of vulnerability. This level of vulnerability is driven up by a larger elderly population and reduced by lower levels of disability and mental health benefit claimants. In the Peterhead 132kV supply area there are several LSOAs that fall into the higher categories of vulnerability (groups 1 and 2). We also see some LSOA areas falling into the group 1 – very high vulnerability, around New Aberdour and within Peterhead. This very high vulnerability classification is driven up by higher levels of poor health and disability/mental health benefit claimants, but reduced by smaller household sizes.

By overlaying the point locations of secondary transformers projected to be overloaded (in 2028 under Holistic Transition), 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.

8.3.2. 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)[14] and My Electric Avenue[15] 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, *20.5*% of low voltage feeders may need intervention by 2035 and *30.8*% by 2050 under the Holistic Transition scenario as shown in **Figure 19**. 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.

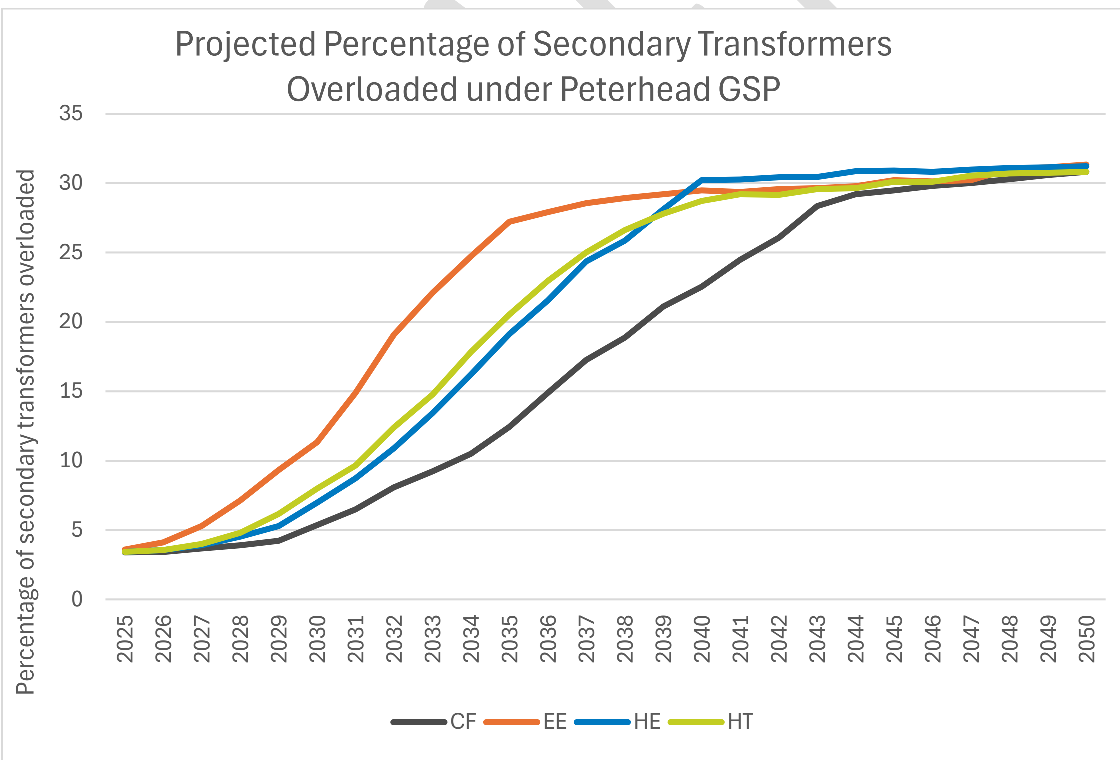


Figure 18: Percentage of LV feeders projected to be overloaded under Peterhead 132kV substation supply area

14 [Project LEO | SSEN Innovation]

15 [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 Peterhead 132kV supply area in both the near and longer term. Load growth across the north east Highlands region is driven by multiple sectors and technologies, impacting not only our EHV network but also driving system needs across all voltage levels.

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

1. System needs that have been identified at earlier timescales (ahead of 2035) should be studied in 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:
    a. Peterhead GSP 33kV transformers
    b. Strichen GSP 33kV transformers
    c. Strichen GSP 33kV circuits 3L5 (Strichen GSP – Maud PSS)
    d. Strichen GSP 33kV circuits 2L5 (Strichen GSP – Mintlaw PSS.)
    e. Hatton primary substation 33kV transformers
    f. Strichen primary substation 33kV transformers

2. 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.

3. 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.

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 Peterhead 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 PRIMARY SUBSTATION CUSTOMER NUMBERS BREAKDOWN

Grid Supply Point	Primary Substation	Number of Customers Served (approximate)	2025 Substation Maximum demand in MW (Winter)
Peterhead Grange	Peterhead Grange	8524	11.85
Peterhead Grange	Peterhead North St	2447	15.03
Fraserburgh	Fraserburgh	8658	17.57
Strichen	Hatton	2233	3.11
Strichen	Maud	1772	3.17
Strichen	Mintlaw	2900	6.26
Strichen	New Pitsligo	975	2.05
Strichen	Stoneyhill	3	2.10
Strichen	Strichen	1708	3.95

Appendix B EHV/HV spatial plans for other DFES scenarios

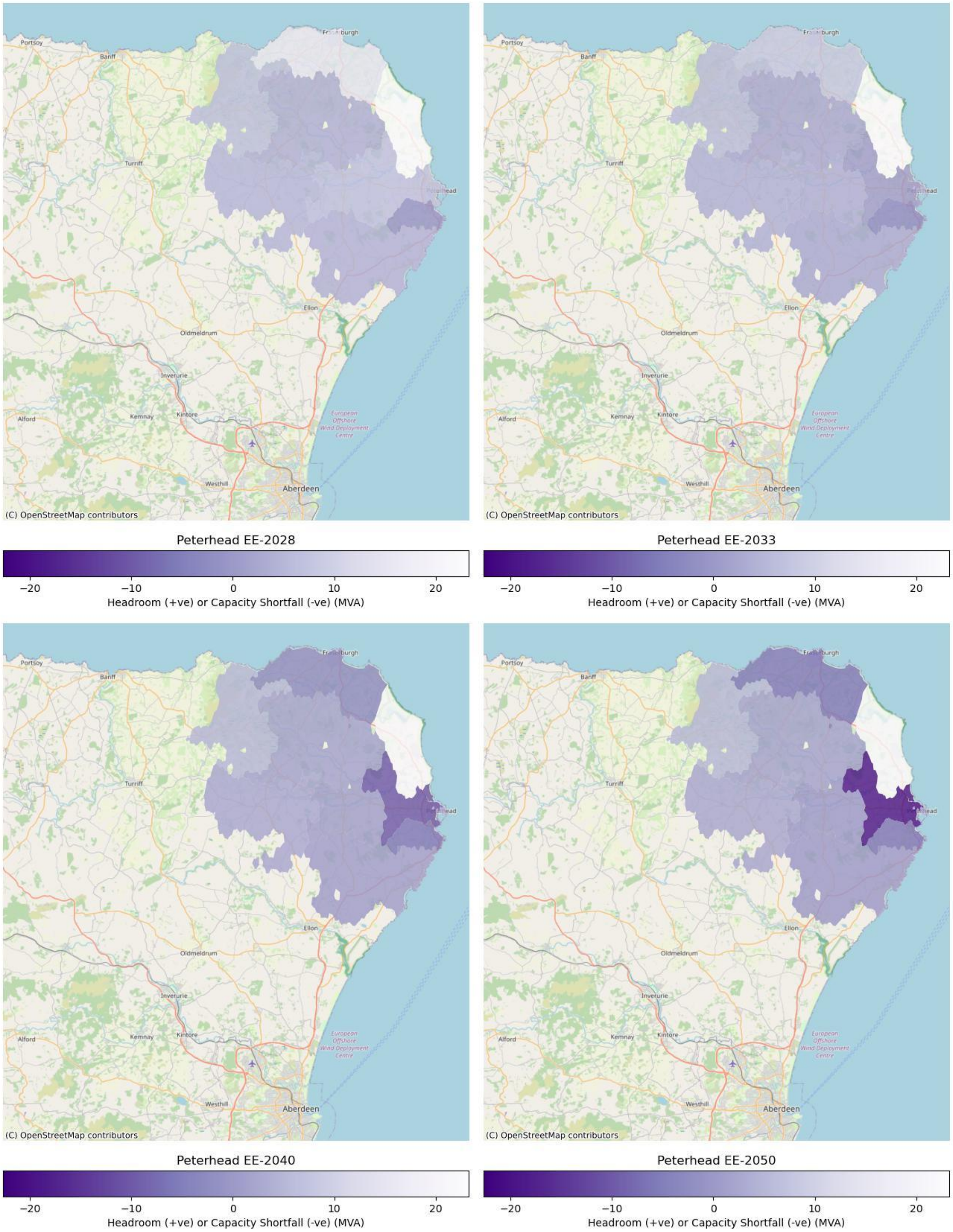


Figure 19: Peterhead 132kV supply area EHV network spatial plans for EE 2028, 2033, 2040, and 2050

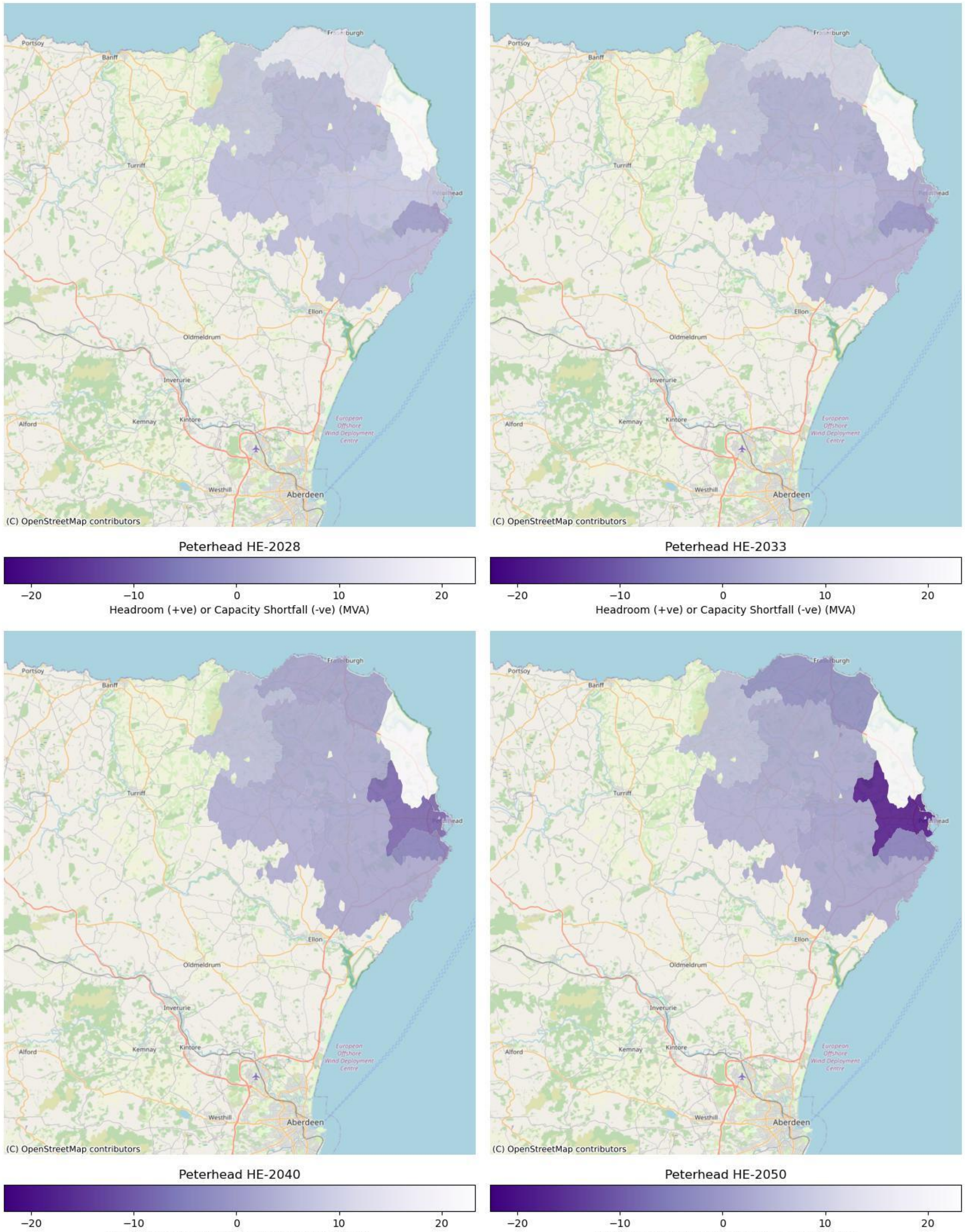


Figure 20: Peterhead 132kV supply area EHV network spatial plans for HE 2028, 2033, 2040, and 2050

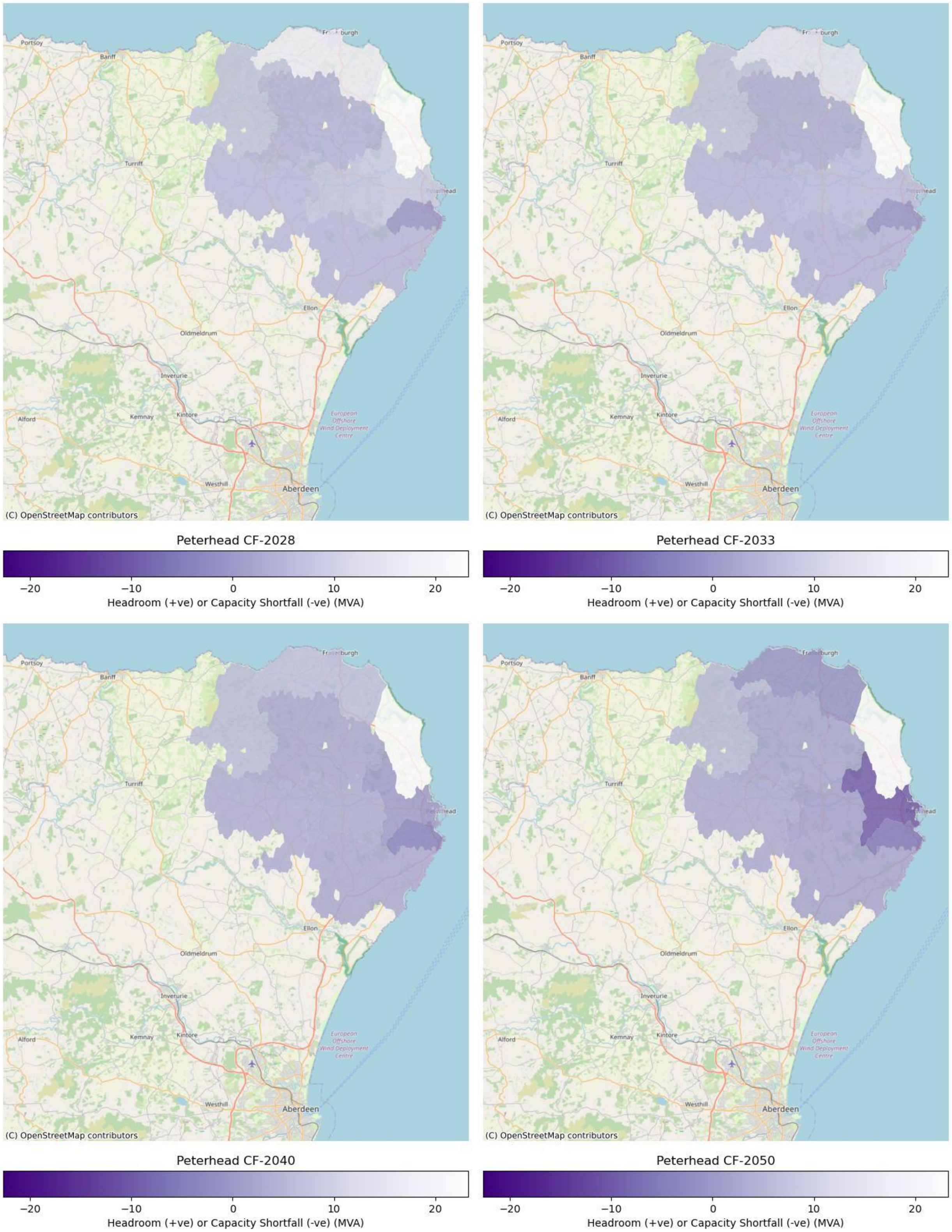


Figure 21: Peterhead 132kV supply area EHV network spatial plans for CF 2028, 2033, 2040, and 2050

Appendix C HV/LV spatial plans for other DFES scenarios

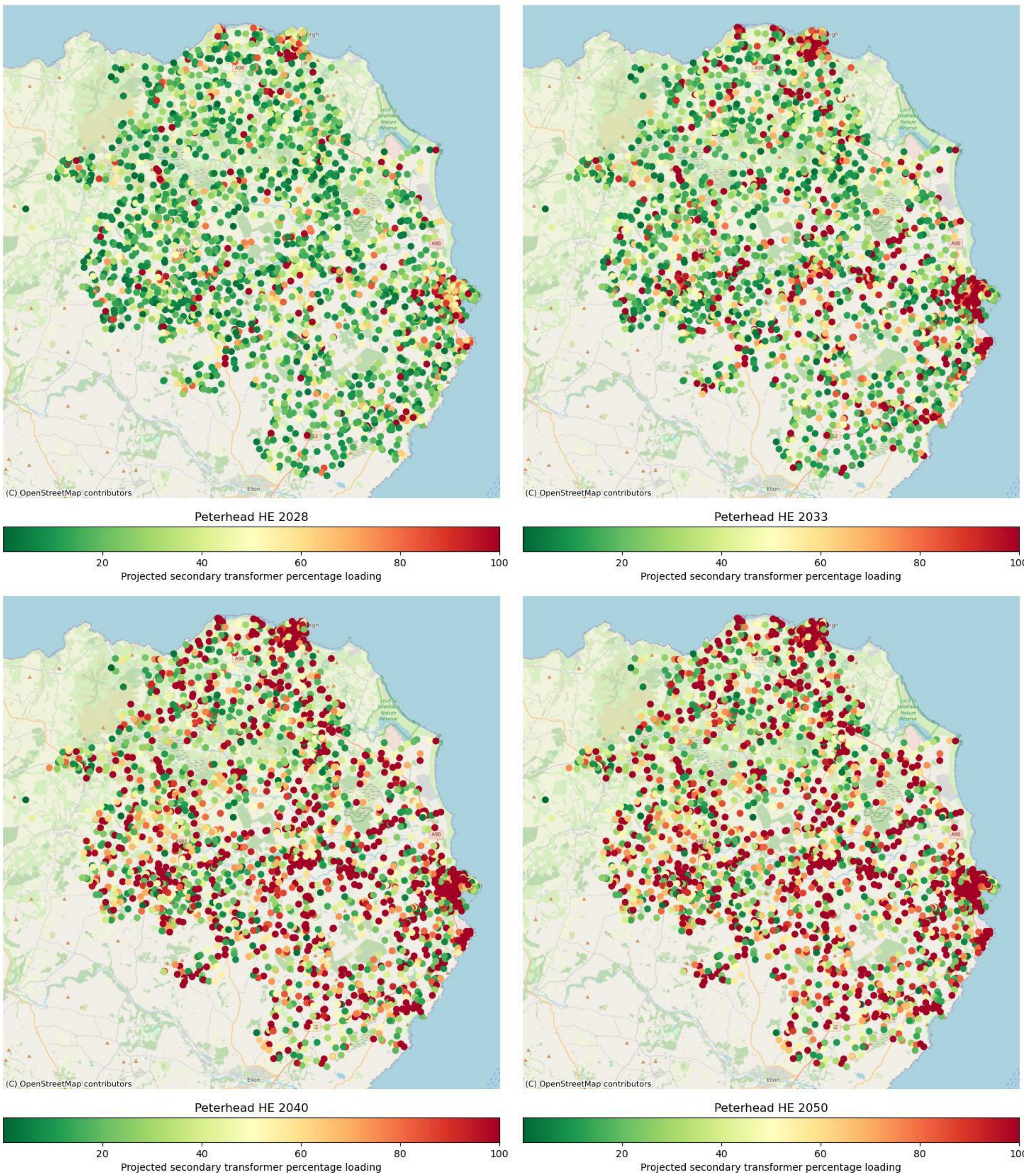


Figure 22: Peterhead 132kV supply area HV/LV HE spatial plans for 2028, 2033, 2040, and 2050

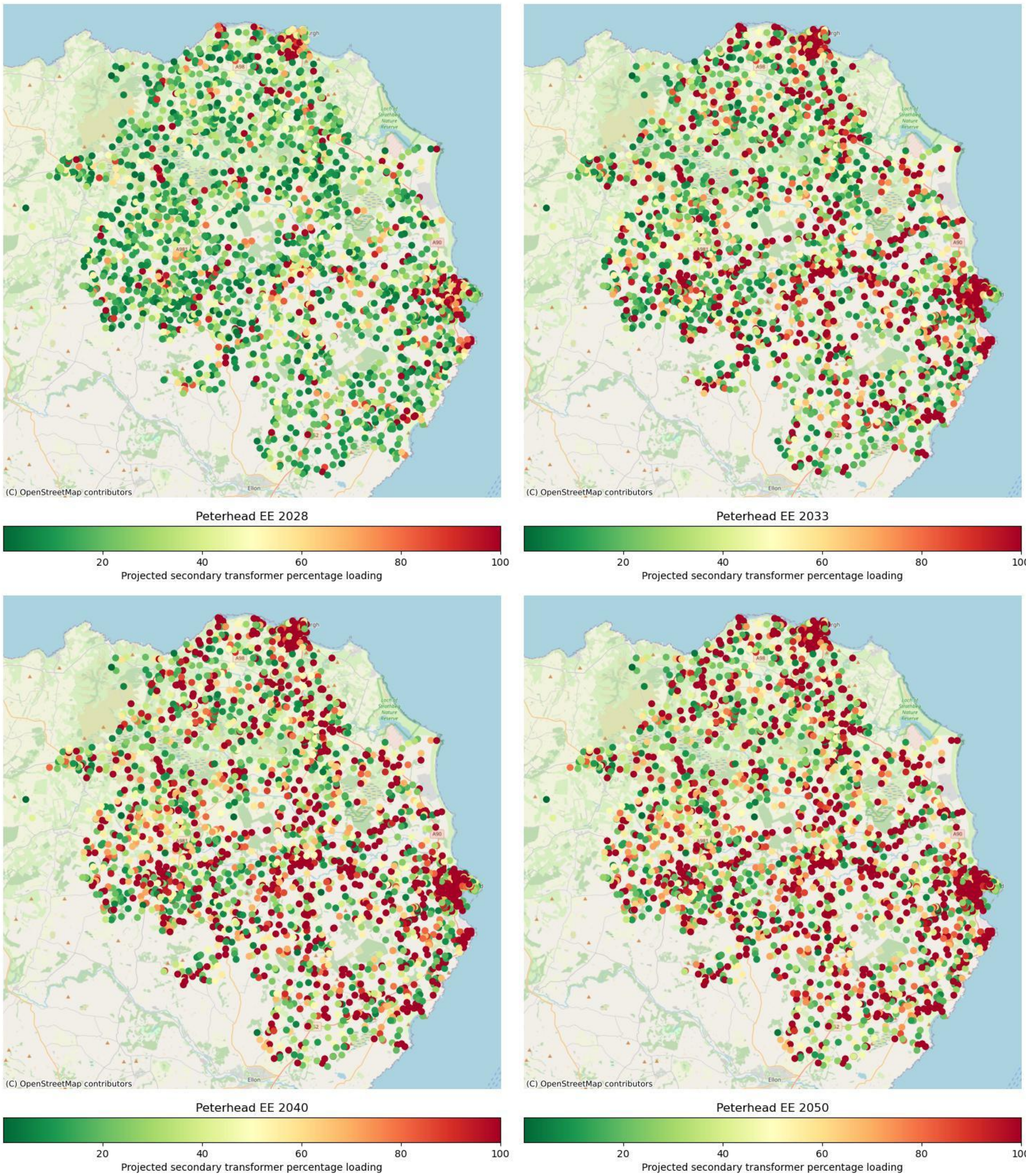


Figure 23: Peterhead 132kV supply area HV/LV EE spatial plans for 2028, 2033, 2040, and 2050

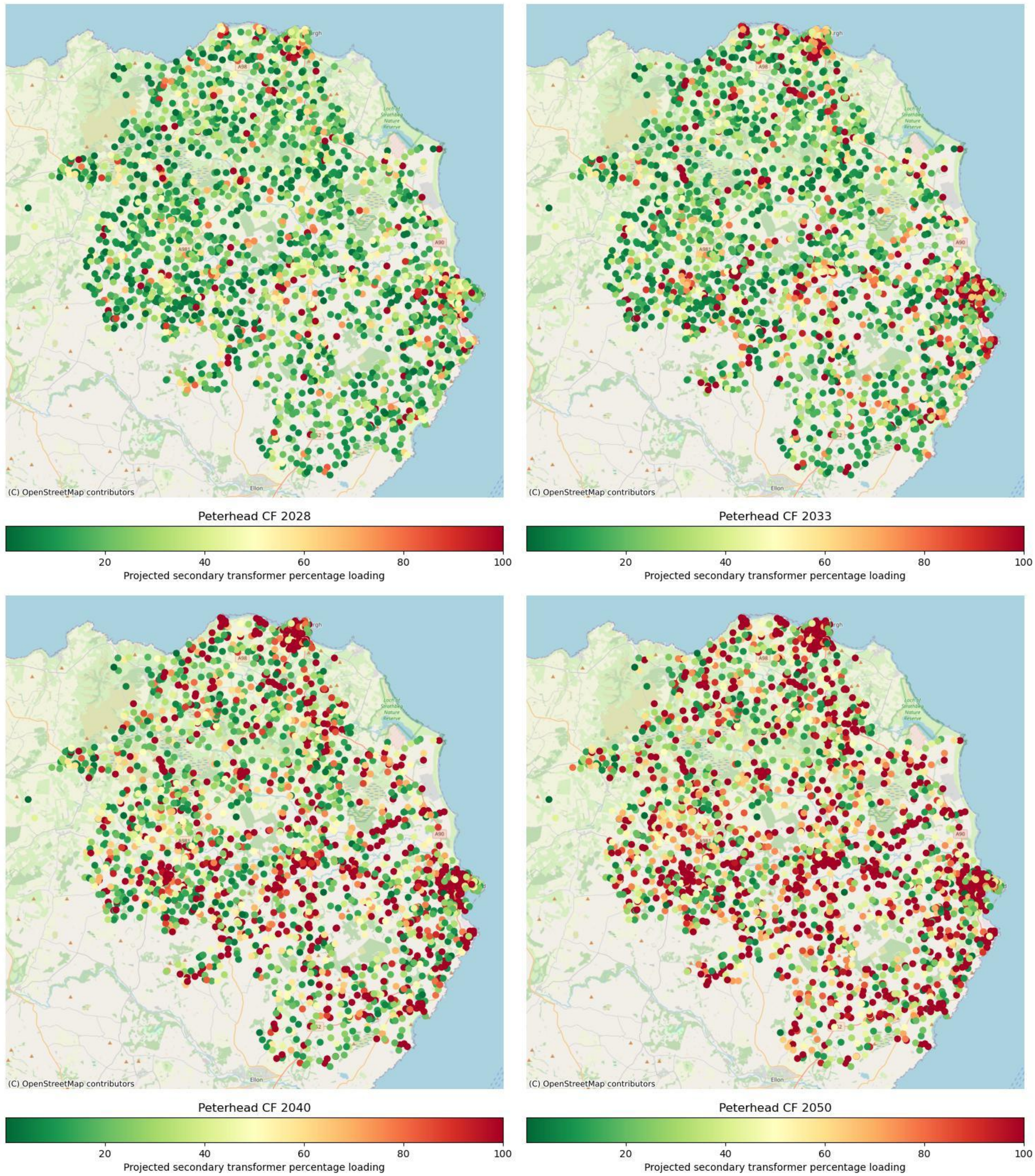


Figure 24: Peterhead 132kV supply area HV/LV CF spatial plans for 2028, 2033, 2040, and 2050

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

DNOA Outcome Report

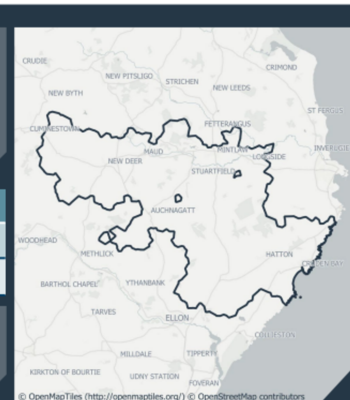
Northeast Aberdeenshire (Strichen 33kV Circuits)

Scheme description

- The reinforcement of Strichen 33kV circuits will increase capacity in the northeast Aberdeenshire area. Postcode(s): AB41, AB42, AB53.
- Local authority: Aberdeenshire Council
- Load related – thermal overload and voltage issues under FCO conditions due to forecasted demand growth.

Proposed option

- Smart/Asset Solution: Reinforcement of existing 33kV circuits with underground cable. Flexibility not utilised as this involves additional complexity to resolve voltage issues, becoming a more expensive solution.
- This option addresses the overloading issues on the Strichen 33kV circuits out to 2050. Resolves voltage issues in the near-term, further enhancements may be needed in the future to manage voltage requirements.
- Capacity released: 25.6MVA



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

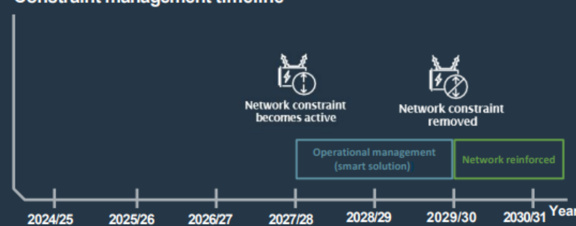
- Reinforcement delivery by the end of 2028/29.

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	-	-	-	0.75	1.89	- (3.23)	- (4.35)
ST	-	-	-	-	-	- (0.77)	- (1.46)
LTW	-	-	0.38	1.28	2.25	- (3.56)	- (4.86)
FS	-	-	-	-	-	-	- (0.07)

Constraint management timeline



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