KINTORE GRID SUPPLY POINT: STRATEGIC DEVELOPMENT PLAN

Final following consultation

July 2025

CONTENTS

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) incorporate the feedback we have received from stakeholders on their future energy needs up to 2050 and translates these insights into strategic spatial plans, which address the future distribution network needs. This helps 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[1].

This SDP focuses on the area supplied by the Kintore Grid Supply Point (GSP), which includes parts of Aberdeenshire.
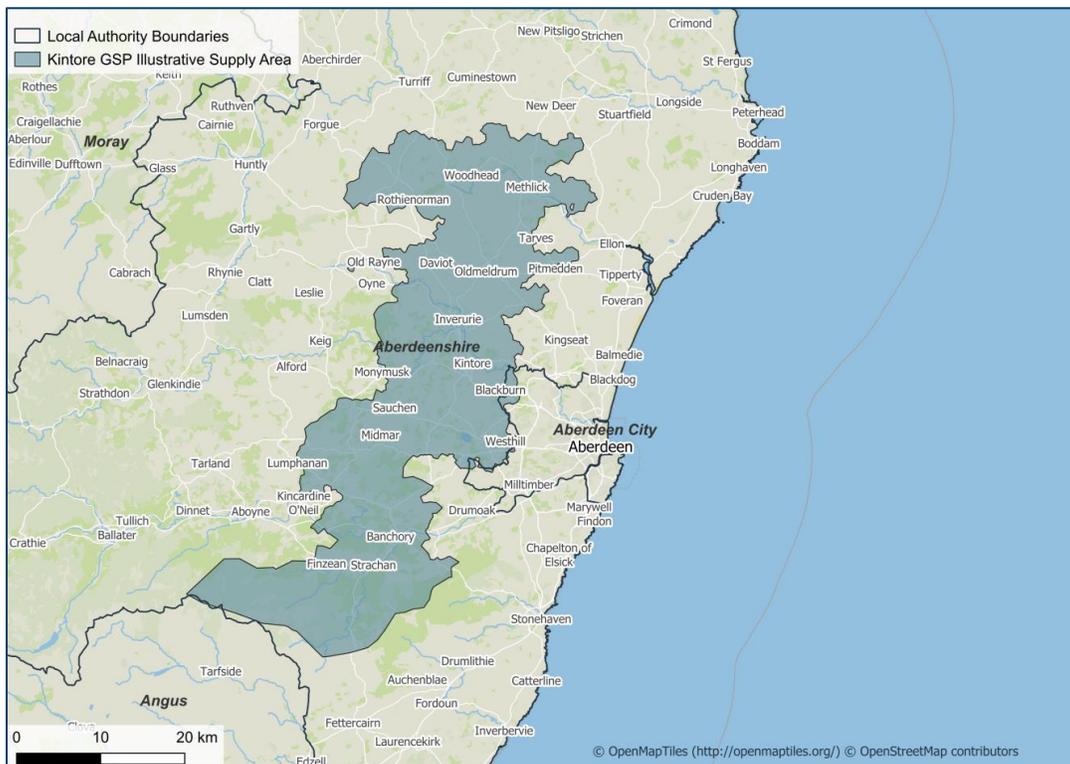
Figure 1: Kintore Grid Supply Point

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. In the case of the Kintore GSP, work has already been triggered through the Distribution Network Option Assessment (DNOA) process (see Appendix E). Much of this work has strategically been sized to support 2050 projected demands under the Consumer Transformation scenario from the Distribution Future Energy Scenarios (DFES).

As part of this report, we aim to identify further needs for the relevant network study area. In the case of the Kintore GSP, several additional network reinforcements were needed to provide capacity out to 2050. This will be reassessed on an annual basis to understand the network impact of updated forecasts.

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1 Strategic-development-plans---methodology-january-2025.pdf

2. INTRODUCTION

The goal 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 Kintore Grid Supply Point (GSP) area. A GSP is an interface point between the national transmission system and the distribution system, enabling SSEN Distribution to then take power to local homes and businesses within a geographic area. Figure 1 illustrates the area included within the scope of the Kintore Grid Supply Point (GSP).

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

We have highlighted where demand due to recent connection requests has not been captured in the DFES, which ensures that we are capturing where near-term connections requests may be driving system needs in addition to DFES scenarios.
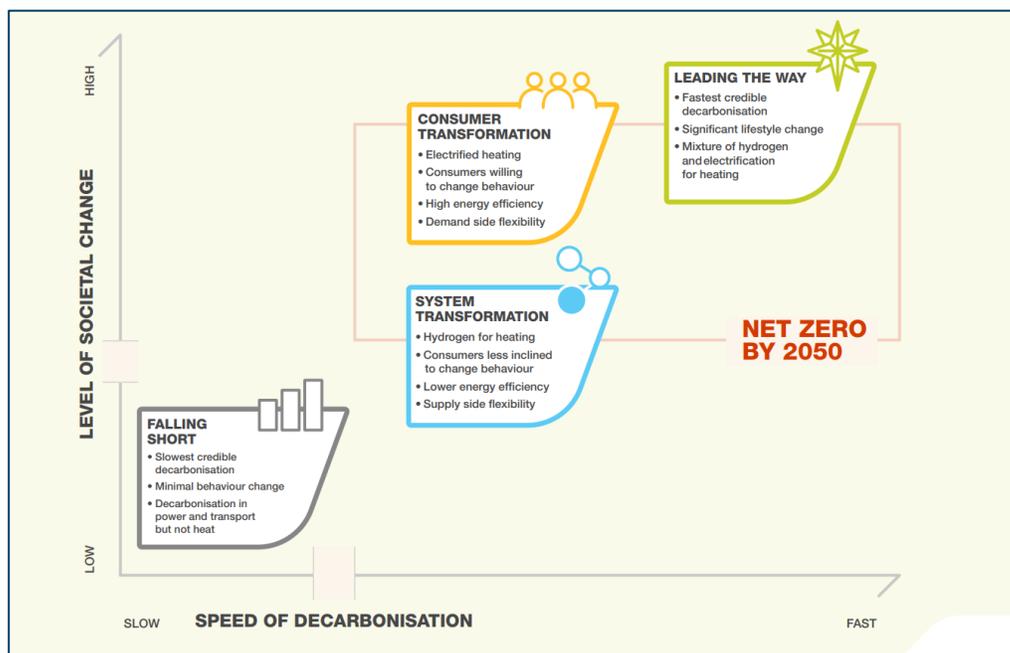
Figure 2: The four Future Energy Scenarios adopted for the DFES. *Source: ESO FES*

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 four scenarios, and the projected 2050 load. Here, system needs are identified through power system analysis using the Consumer Transformation scenario in alignment with evidence gathered in preparation of the SSEN

ED2 business plan. We also model across the other three scenarios to understand when these needs arise and what demand projections should be planned for in the event each of these scenarios 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 procurement of flexibility will also be highlighted in the DNOA, to cultivate the flexibility markets, and to align with SSEN's flexibility first approach.

3. STAKEHOLDER ENGAGEMENT AND WHOLE SYSTEM CONSIDERATIONS

3.1. Local Authorities and Local Area Energy Planning

The local authority that is supplied by Kintore GSP is Aberdeenshire Council, as shown by the local authority boundaries in Figure 3. The development plans for this local authority will have a significant impact on the potential future electricity load growth on SSEN's distribution network. As such, it is vital that SSEN continue to engage with these plans when carrying out strategic network investment.
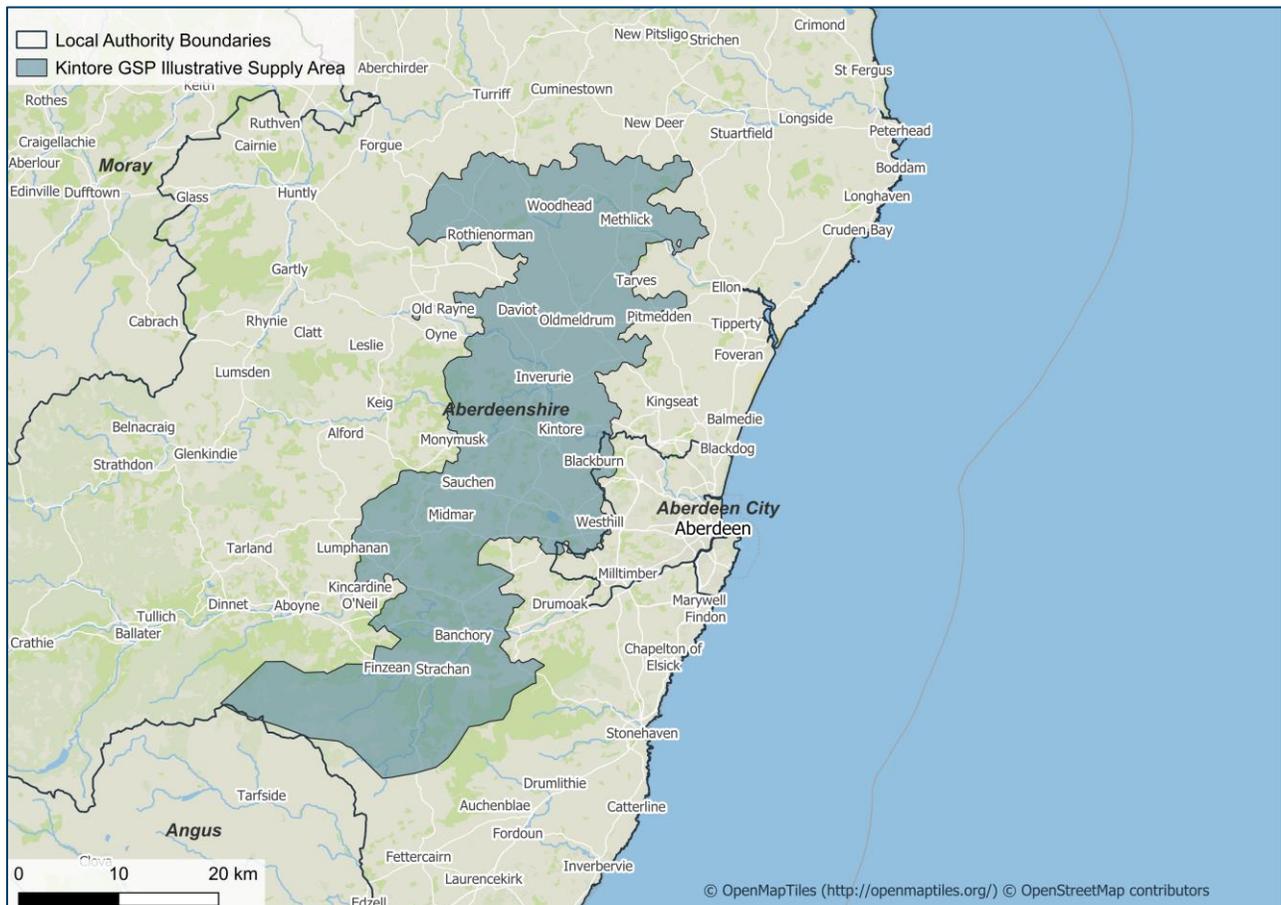
Figure 3: Kintore GSP Supply Area and Local Authority Boundaries

3.1.1. Aberdeenshire Council

In 2021, Aberdeenshire's population was 262,690, which is around 0.7% increase from 2020. Prior to 2021, the population had fallen for four consecutive years after a long period of rapid growth up until 2014/15[2]. Aberdeenshire is the fourth largest local authority area by land area in Scotland. The area is largely rural, with the largest towns being Peterhead, Inverurie, Fraserburgh, Westhill, Stonehaven and Ellon.

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2 Population statistics - Aberdeenshire Council

Aberdeenshire Council has a target of 75% reduction in emissions by 2030 (from its 2010 – 2011 baseline), and aims to reach net zero by 2045, in alignment with the Scottish Government's national target[3]. The Council published their Local Heat and Energy Efficiency Strategy (LHEES)[4] in July 2024 and are currently preparing their LHEES delivery plan. The LHEES sets out the Council's long-term plans for decarbonising heat in buildings and improving energy efficiency across the local authority area. The Council has also developed a 'Route Map to 2030 and Beyond'[5], which sets out the requirements and investment needed to reach the net zero by 2045 ambition. Local authorities in the North of Scotland, encompassing Aberdeen City, Aberdeenshire, Moray, and Highland Councils, have been awarded £6.86 million in grant funding from the £30 million Scottish Government Electric Vehicle Infrastructure Fund, effective from Spring 2025[6].

The Council continues to expand the electric vehicle charging network across the region and is assessing the feasibility for heat pumps, solar PV, and battery storage installations on council-owned buildings. Grants for Air Source Heat Pumps are available through March 2026 to residents across rural Aberdeenshire whose properties are oil- or LPG-heated[7]. Their 2023 Local Development Plan states that they would aim for having one electric vehicle charge point for every 25 employees in workplace parking sites[8]. Aberdeenshire Council has signed up and been boarded onto the SSEN's LENZA platform.

3.2.   Whole System Considerations

SSEN has strong working relationships with stakeholders across Aberdeenshire. We have met with Aberdeenshire Council to discuss local area energy planning and have engaged with Scottish Government's LHEES Forum, Community Energy Scotland, Transport Scotland, and the Scottish Futures Trust. This engagement has helped SSEN to stay informed about planning and development that will impact local communities' use of the network.

3.2.1. Transmission Interactions

SSEN regularly engage with Scottish and Southern Electricity Network Transmission (SSENT) to understand the interactions between the distribution and transmission networks in the area. Currently SSEN is working together with SSENT to release capacity at Kintore GSP, with works estimated for completion in 2026/27. This involves a phased development of a new substation operating at 400kV, with Phase 1 completed to tie in with the network of North Kintore in October 2023 and Phase 2 completed for the network south of Kintore, energising to 400kV operation in 2026.

A new GSP (Kintore 2) is under development in the Kintore area driven by the high volume of generation connections requests in the region. This has an estimated completion date of before 2035. Continuous engagement and Whole System planning will enable the optimal use of this development.

Additional projects in the area that are under way consist of the following schemes:
- A new 400kV substation within the vicinity of the existing Fiddes substation

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3 Carbon Budget 2024-25 Report.pdf

4 Local Heat and Energy Efficiency Strategy - Aberdeenshire Council

5 Climate change and sustainability - Aberdeenshire Council

6 Electric Vehicle Infrastructure Fund | Transport Scotland

7 Free Heat Pumps Aberdeen - Grants for Air Source Heat Pumps & Insulation

8 Report of Examination - dated 22 June 2022.doc

- A new 400kV substation within the vicinity of the existing Tealing substation
- A new 400kV connection between Kintore, Fiddes and Tealing
- An upgrade to the existing Alyth - Tealing 275kV Overhead Line
- An upgrade to the existing Tealing - Westfield 275kV Overhead Line (to the Scottish Power Transmission operational border)
- Connection of the upgraded Alyth - Tealing and Tealing - Westfield Overhead Lines into the proposed Tealing Substation.

Upgrading the grid to 400kV ensures that the transmission network remains resilient, providing a reliable supply of electricity to the region and beyond.

3.2.2. 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.[9,10]

SSEN regularly recruits new Flexibility Services providers and increases the procured Flexibility Services with the latest bidding round for long term requirements held in August 2024 and recruitment through the Mini-Competition process in October 2024.[2]

Historically there have been no flexible services used under Kintore GSP, but we are currently looking into areas of our network to see where this can be utilised.

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

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

4. EXISTING NETWORK INFRASTRUCTURE

4.1. Kintore Grid Supply Point Context

The distribution network is fed from Kintore GSP network consists of 33kV, 11kV, and LV circuits. It serves approximately 40,000 customers, covering a diverse mix of urban and rural areas across Aberdeenshire. The detailed breakdown of each primary substation included within the GSP is shown in Table 1.

Substation Name	Site Type	Number of Customers Served	2024 Substation Maximum MVA (Season)
BANCHORY	Primary substation	5,809	9.2 (Winter)
FYVIE	Primary substation	1,732	4.2 (Winter)
INVERURIE	Primary substation	8,843	12.7 (Winter)
KEMNAY	Primary substation	2,281	3.9 (Winter)
MIDMAR	Primary substation	1,505	2.7 (Winter)
OLDMELDRUM	Primary substation	2,790	4.8 (Winter)
PARK	Primary substation	1,120	2.1 (Winter)
SKENE	Primary substation	5,588	13.2 (Winter)
TORRYBURN	Primary substation	4,266	9.3 (Winter)

Table 1: Customer number breakdown and substation peak demand readings (2023)

4.2. Current Network Topology

Figure 4 depicts the current 33kV network topology for the Kintore GSP, including primary substation locations.
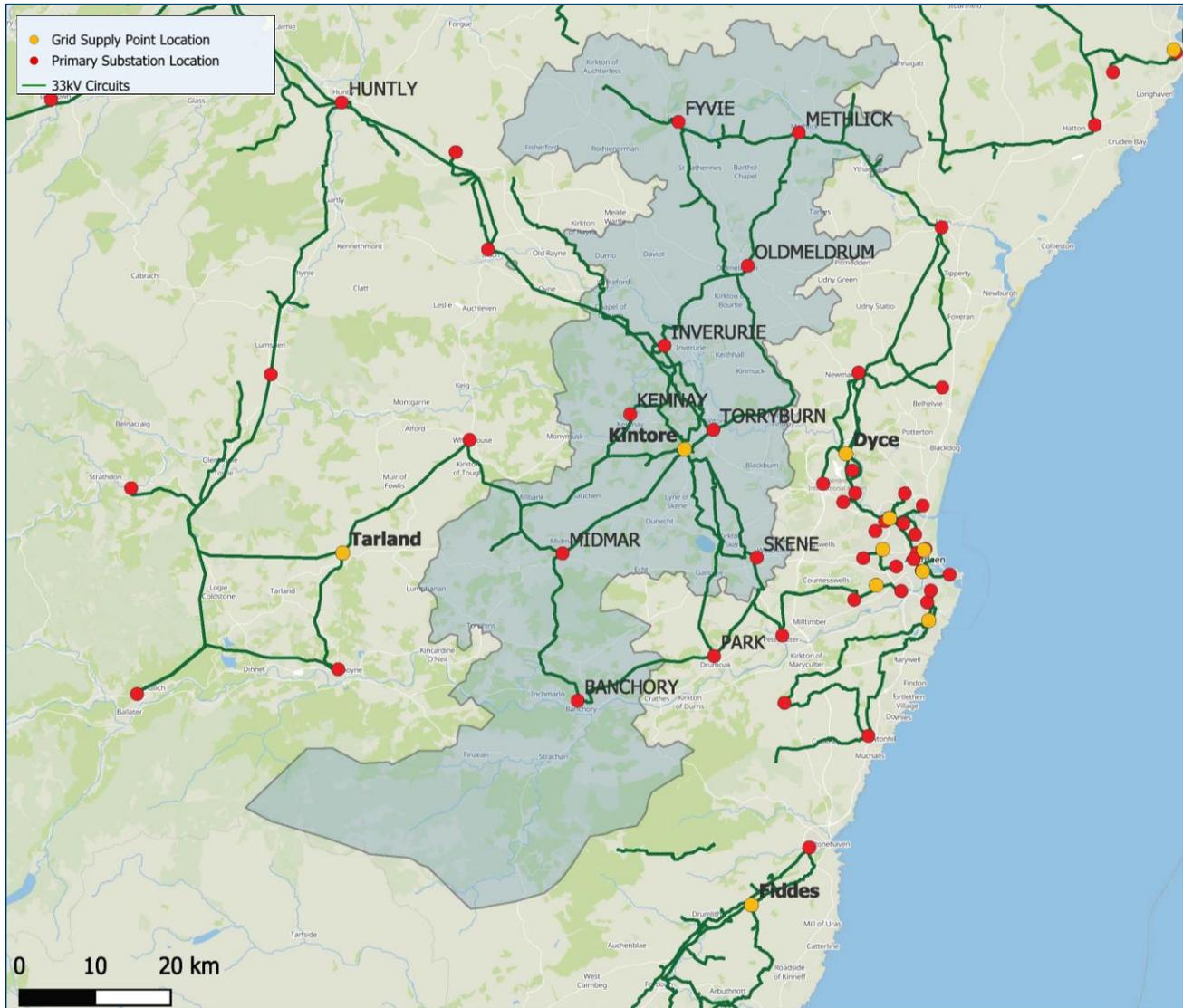

Figure 4: Kintore GSP Existing 33kV Network Topology Map

4.3. Current Network Schematic

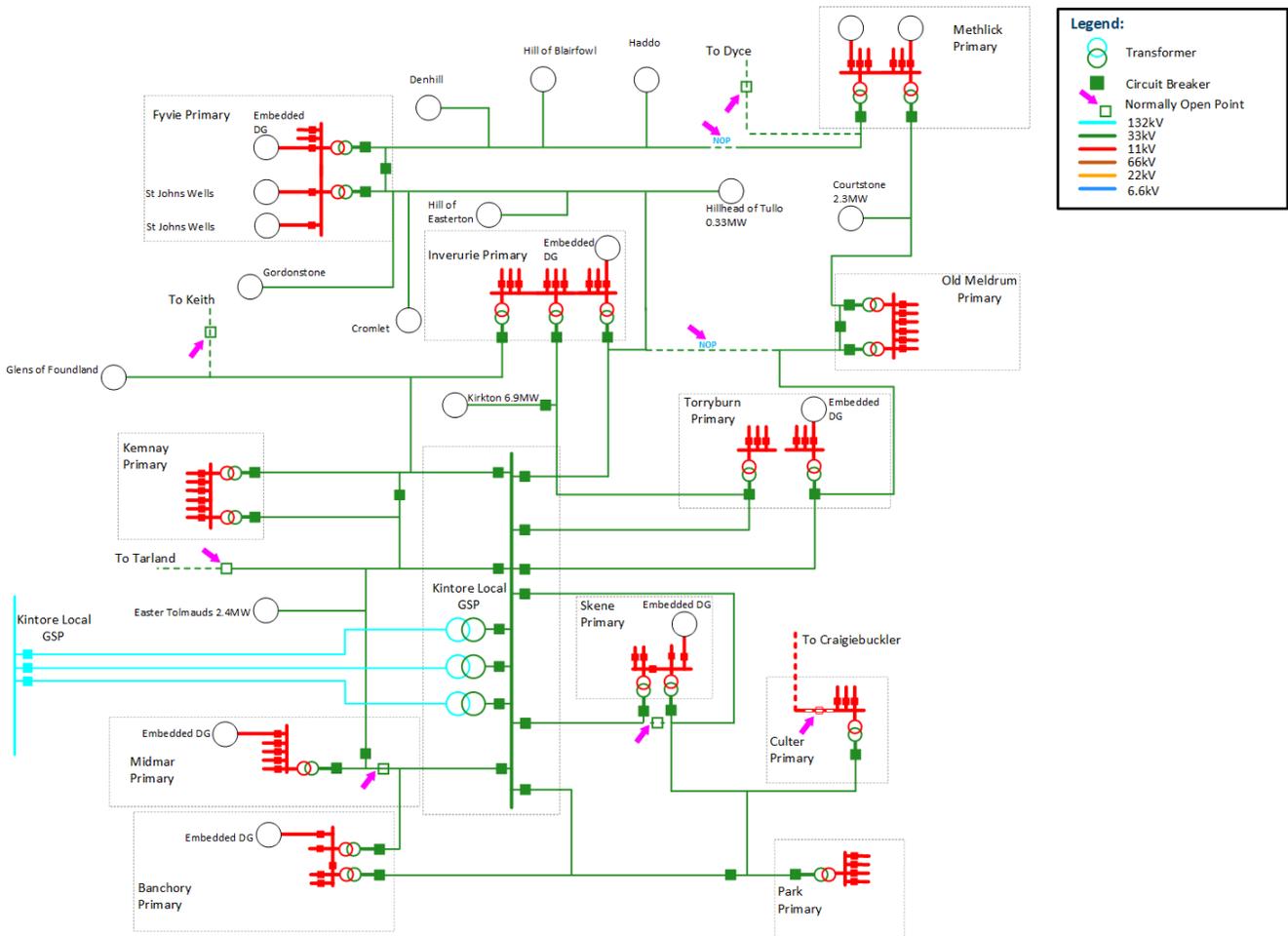The existing network at Kintore GSP is shown below in Figure 5.

Figure 5: Kintore GSP - Existing Network Schematic

5. FUTURE ELECTRICITY LOAD AT KINTORE GSP

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:

- These projections relate to the GSP supply area highlighted in Figure 1 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 represent the coincident maximum demand of the entire system rather than the total sum of all demands.

For future iterations of the DFES, additional work will be carried out to ensure that the demand projections are rationalised against any future LAEPs produced for the Kintore GSP area.

5.1. Distributed Energy Resource

In the Kintore GSP area, there are two main distributed energy resources (DER), onshore wind and solar. Due to Aberdeenshire having a consistent and strong wind resource (due to its location on the northeast coast of Scotland), there are a large number of onshore wind farms. The current installed capacity of these onshore wind farms and solar PV equated to 68.3MW, with installed capacity projected to reach 333.5MW by 2050.

5.1.1. Kintore GSP DFES Projections

5.1.1.1. Generation

The baseline value for solar PV is 8.3MW, onshore Wind is 60MW, gas is 0.24 and other generation is 0.02MW. Based on the DFES projections, under the Consumer Transformation scenario, distributed renewable generation across Kintore GSP will increase significantly from approximately 68.26MW in current connected baseline to 333MW by 2050, as shown in Figure 6. We can see decarbonisation of gas by the end of 2050, with onshore wind and solar PVs accounting for most of the distributed generation increase from 2025 onwards.
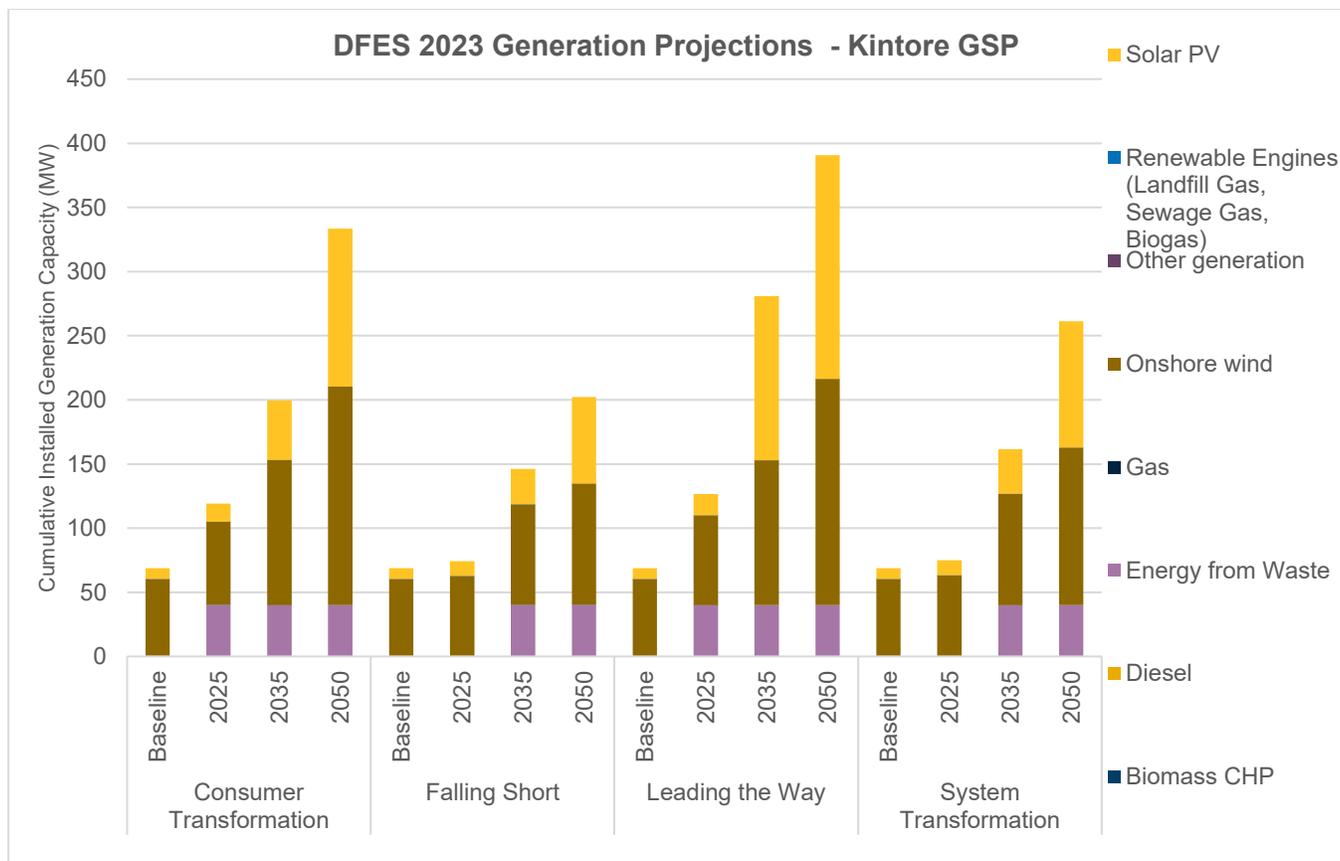
Figure 6: Projected Cumulative Distributed Generation Capacity Kintore GSP (MW). Source SSEN DFES 2023

5.1.1.2. Storage

While multiple storage technologies have their projected uptake modelled in the DFES, in the Kintore GSP supply area, we see a significant increase in the installation of domestic storage, co-location storage and high energy user storage. The domestic storage refers to those 1-15kW in scale, designed to enable households to increase the self-consumption of domestic solar PV, as well as acting as a backup power supply to households in more rural locations. A cumulative storage capacity of approximately 4.25MW is projected by 2050 under the Consumer Transformation scenario. The co-located generation refers to systems where battery storage is located with renewable generation, and this has a current storage capacity of 0MW, however, its projected to be 9.78MW under the Consumer Transformation scenario by 2050.

Standalone grid services refer to energy services provided by systems or technologies that operate independently of the main electrical grid. This currently has 0MW baseline, however, it is projected to be 325MW by 2050 under the Consumer Transformation scenario, as illustrated in Figure 7.

DFES 2023 Storage Projections - Kintore GSP

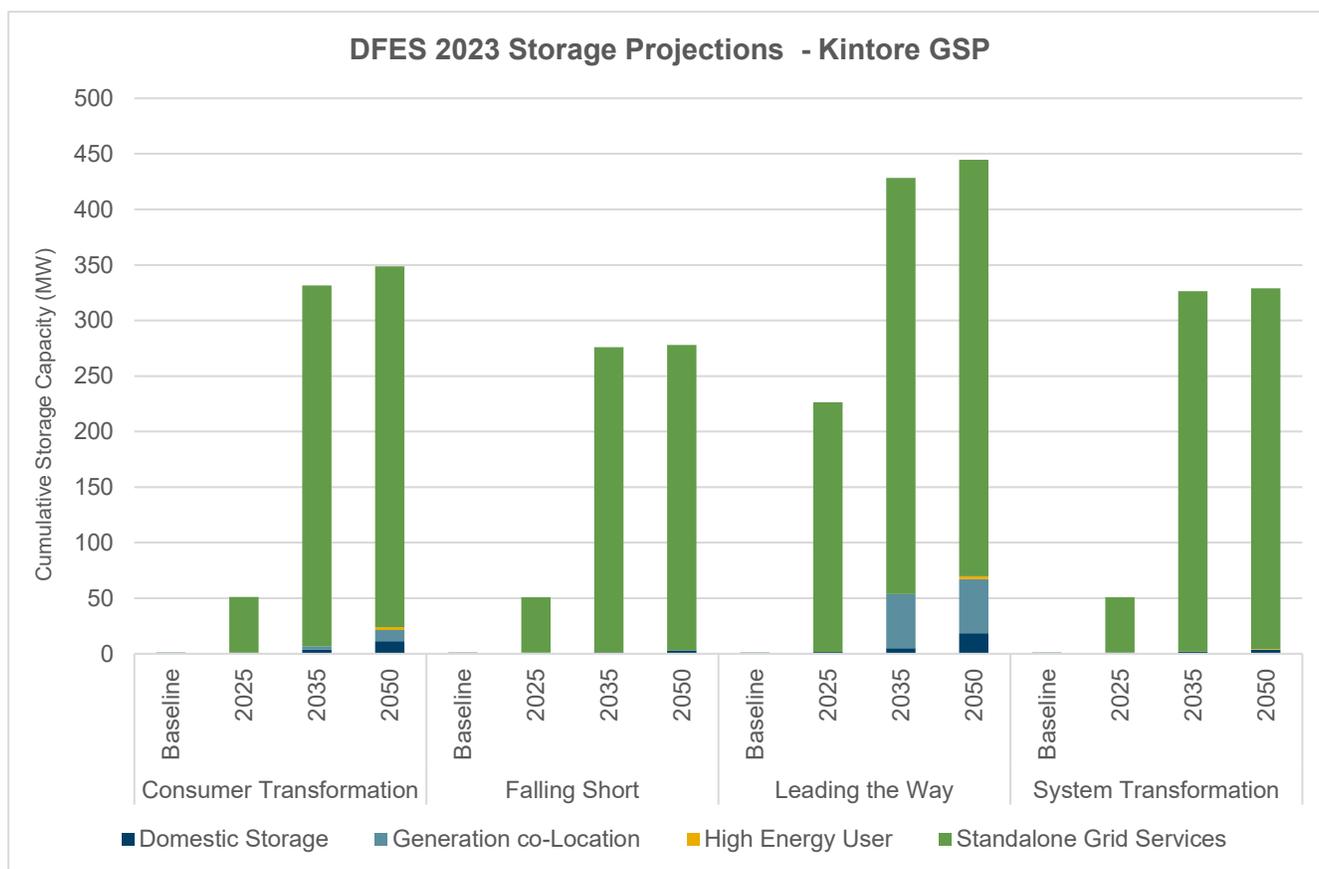**Figure 7: Projected Cumulative Storage Capacity Kintore GSP (MW). Source: SSEN DFES 2023**

5.2. Transport Electrification

Future electricity demand from transport could result from three different transport sectors that are on very different timelines. EV charging is likely to see rapid adoption to meet demand from residents and visitors. Aberdeenshire Council's net zero transport strategy forms park of its broader decarbonisation goals, which aim to reduce emissions and promote sustainable travel across the region by 2030 and beyond. A key focus is on encouraging active travel and reducing reliance on vehicles through various initiatives, such as enhancing cycling infrastructure, trailing peak-time road closures near schools, and developing the Integrated Travel Towns to promote sustainable transport options[11].

Aberdeenshire has targeted a 75% reduction in emissions by 2030, aligning with Scotland's national goal of achieving net zero by 2045. This plan involves not only transport but also improvements in council-operated buildings and fleet upgrades to hydrogen and electric vehicles.

These activities will have a direct impact of the uptake of EV infrastructure, which will be acknowledged and integrated into the DFES projections.

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11 Aberdeenshire Council Route Map 2030 and Beyond Update (moderngov.co.uk)

5.2.1. DFES Projections

According to SSEN's 2023 DFES analysis, there could be just over 38,600 (CT) EV cars registered in the Kintore GSP area by 2050. As the network operator, it is important for SSEN to understand the impact on network driven by the electricity demand of EVs. To do this we can use the projected EV charger capacity (MW) from SSEN's DFES analysis. The SSEN DFES forecasts indicate that the total connected EV charge point capacity in Kintore GSP, excluding off-street domestic chargers forecast data for CT scenario, indicates 28MW by 2035 increasing to 33MW by 2050.

The uptake of domestic off-street chargers follows a similar trend. By 2035, there could be as many as 23,488 (CT) domestic off-street chargers installed under Kintore GSP with this increasing to approximately 26,398 (CT) by 2050 as illustrated in Figure 8.
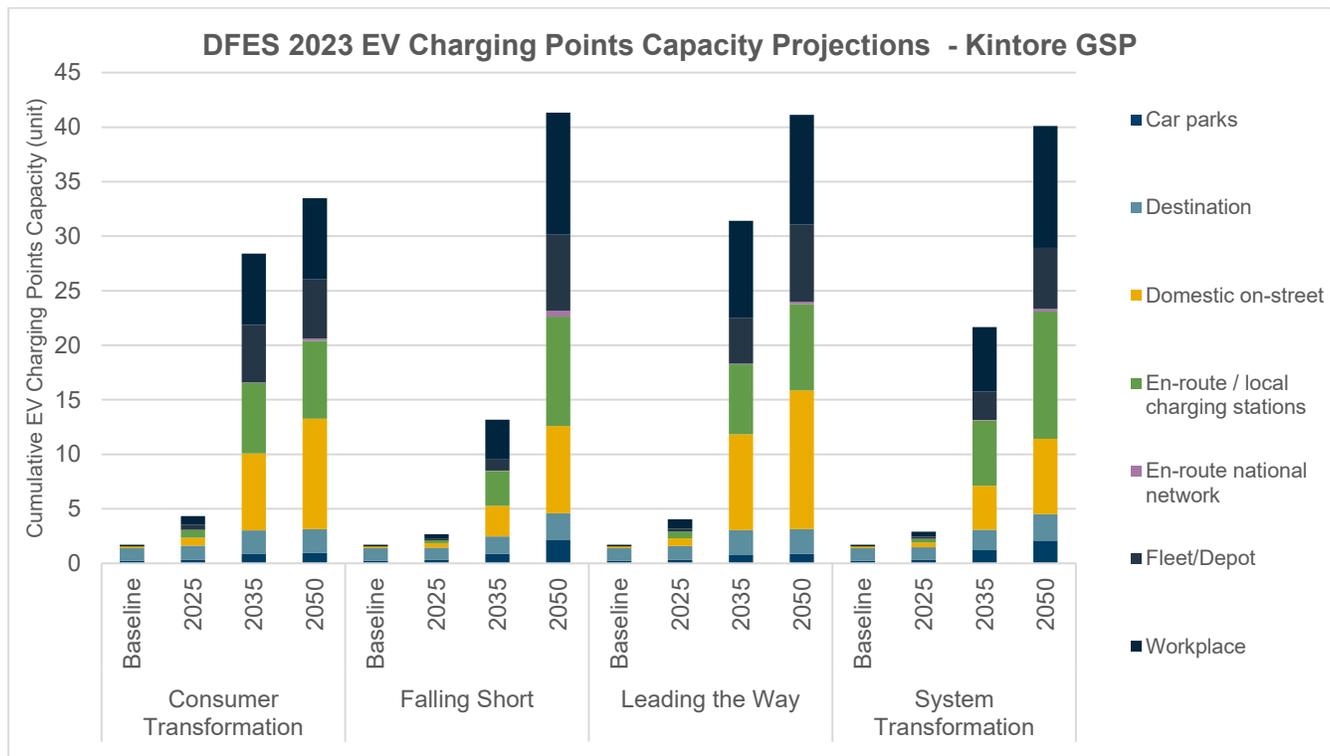
Figure 8: Projected Cumulative EV Charging Point Capacity Projections Kintore GSP. Source: SSEN DFES 2023

As the network operator, it is important for SSEN to understand the network facing demand of EVs. To do this we can use the projected EV charger capacity (MW) from SSEN's DFES analysis. The SSEN DFES project that the total connected EV charge point capacity under Kintore GSP, excluding off-street domestic chargers, could total 36MW by 2035 under the CT scenario, as shown in Figure 8. It is important to note that this value represents the total installed capacity and does not consider diversity. In our studies for future system needs, diversity is taken into consideration.

5.3. Electrification of heat

The decarbonisation of space heating technologies in homes and businesses will have a significant impact on the future energy system. Historically in Scotland, central heating is mainly attributable to mains gas and oil (80%) and to electric heating (11% including storage heaters)[12]. Government legislation, including the publication of local authorities' Local Heat and Energy Efficiency Strategies (LHEES)[13], and consumer behavior are just two of many factors that will impact the future electricity demand arising from space heating.

5.3.1. DFES Projections

The electrification of heat could create significant new electricity load in the Kintore GSP, with the adoption of heat pumps and next generation night storage. The air source heat pumps (domestic and non-domestic) and direct heater units could increase by up to 19,509 (CT) in 2035 steadily rising to 32,029 (CT) by 2050. This excludes air conditioning load which accounts for a total of 2292 units by 2050, as illustrated in Figure 9.
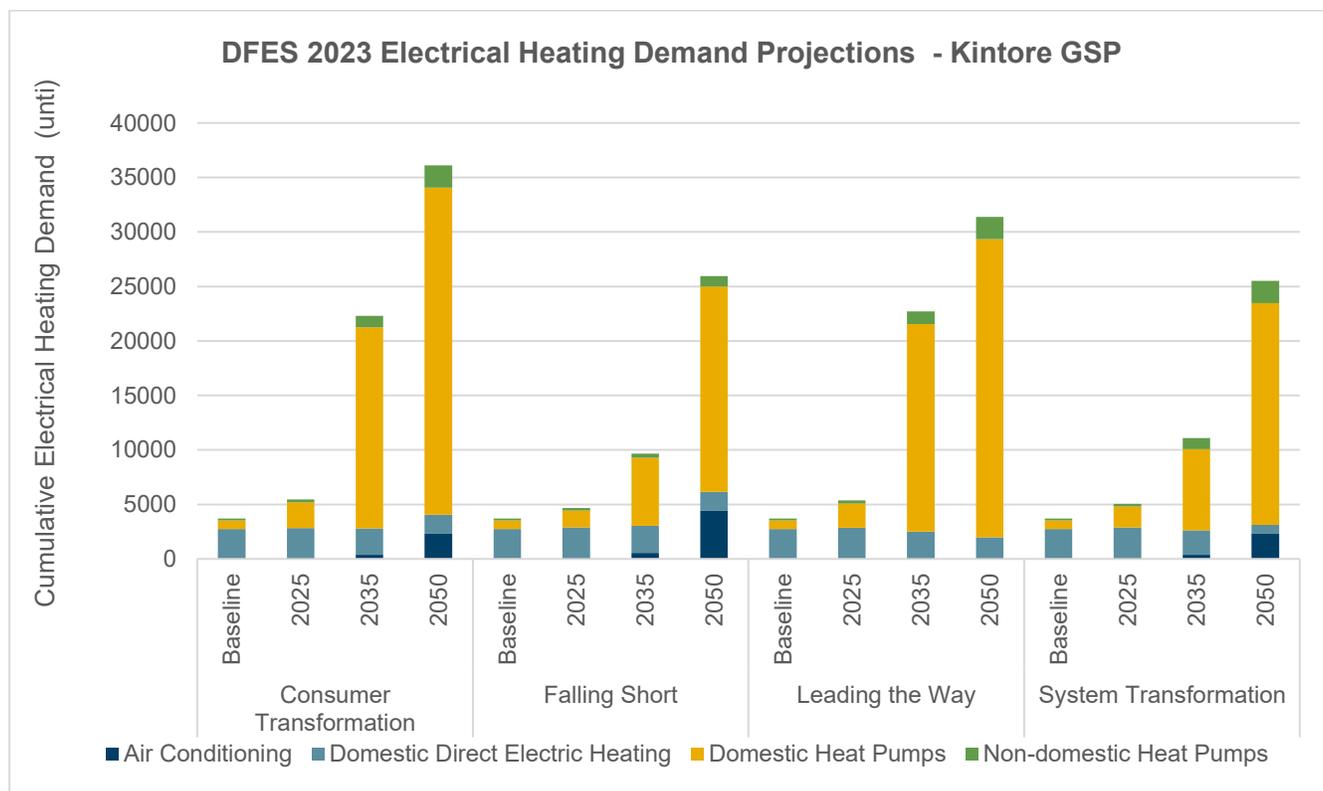
Figure 9: Projected Cumulative Electric Heating Demand Volumes Projections Kintore GSP (units). Source: SSEN DFES 2023

5.4. New building developments

A key stage in producing the DFES is engagement with local authorities. On an annual basis local authorities provide their current best view on new development plans to inform these projections. The results presented

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12 Scottish House Condition Survey: 2021.

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

here are the information shared by local authorities during the DFES 2023 development process. Where we do not have responses from local authorities these values are determined from published documents, for example adopted local plans.

5.4.1. DFES Projections

For Kintore GSP, the DFES forecasts include the cumulative floorspace of non-domestic new developments. Figure 10 shows that the two building classifications contributing to the largest floorspace growth are factory and warehouse developments (141,866 m^2 by 2050 in all scenarios), and new office space (77,381 m^2 by 2050 in all scenarios). The domestic cumulative number of homes is expected to rise from 4,181 in 2035 (CT and ST) to 5,012 in 2050 (CT and ST). The data is similar for the LW scenario with increase 4,315 in 2035 to 5,201 in 2050.

Figure 10: Projected Cumulative Non-domestic New Building Developments Kintore GSP (Floorspace m2). Source: SSEN DFES 2023

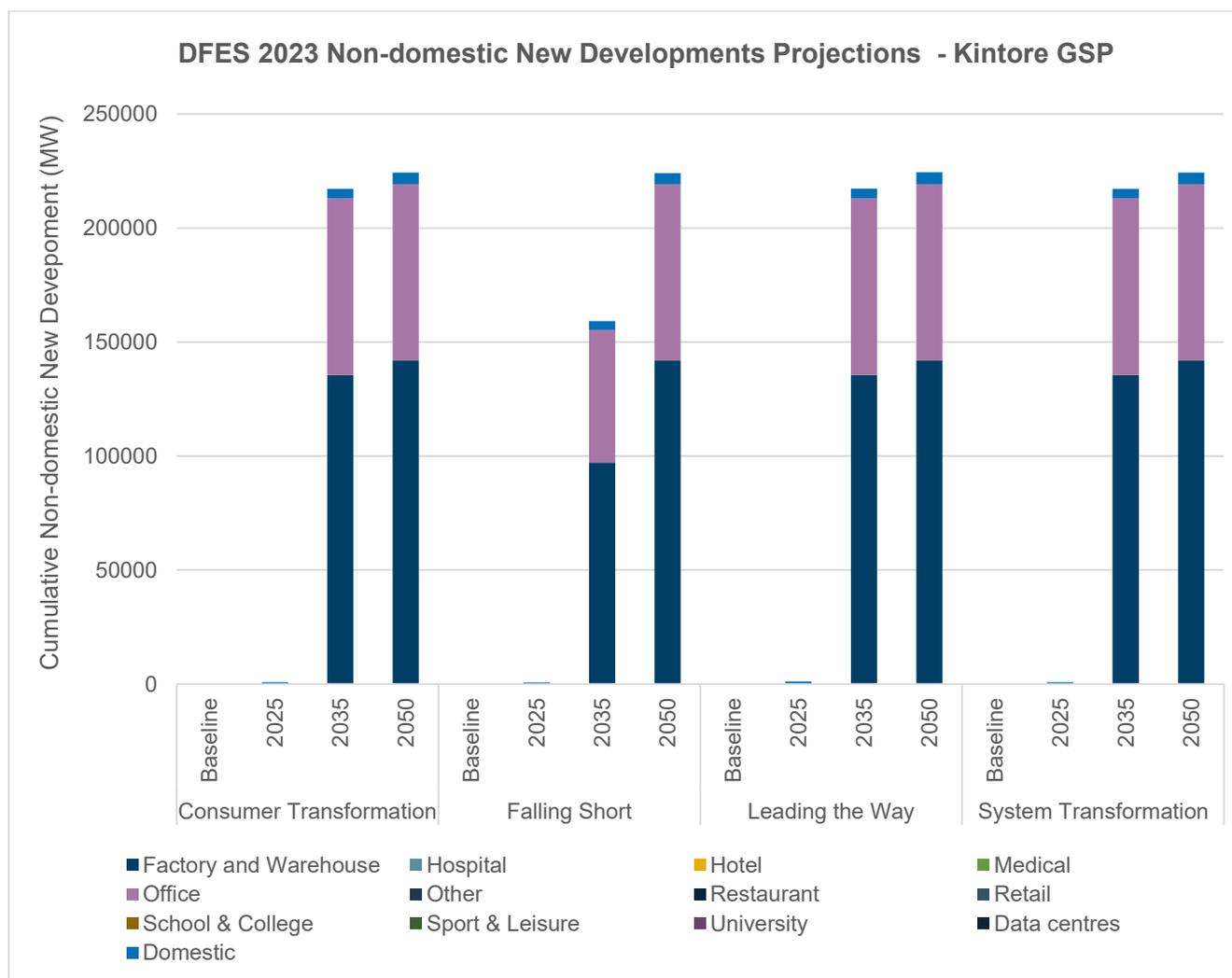## 5.5. Commercial and industrial electrification

5.5.1. Distilleries

Aberdeenshire is home to several distilleries, primarily focusing on whisky production. Some notable ones include, Glen Garioch Distillery, located in Oldmeldrum, which is one of Scotland's oldest distilleries, dating back to 1797 and The Royal Lochnagar Distillery, situated near Balmoral Castle. In addition to whisky, there are some newer gin distilleries emerging in Aberdeenshire, such as Deeside Distillery, which produces gin and craft spirit.

If distilleries seek to electrify, the demand capacity on the distribution network could become one of the largest sources of electricity demand in the region.

The distilling process has significant and constant high-temperature heat demand which is largely met by fossil fuel combustion at present. The wider whisky industry has made progress towards decarbonisation, with non-fossil fuels making up 20% of its energy use in 2018, up from only 3% in 2008[14]. Regen engagement with the Scotch Whisky Association (SWA) highlighted that their 2023-25 strategy includes commitments to achieving net zero emissions in their own operations by 2040[15]. A Ricardo report commissioned by the SWA in 2019 investigated how carbon reduction in the distillery industry could be achieved[16]. The Regen analysis provided qualitative information on the distilleries.

The timeframe of possible electricity load growth is heavily linked to the timeline of individual distilleries changing their energy sources. This timeline is currently difficult to quantify due to uncertainties around technology readiness.

5.6. Generation and Demand Forecast Summary

The data presented in sections 5.1-5.5 of this report is utilised in the development of profiled forecasts of demand and generation on our networks. These are shown in further detail in Appendices A and B whilst in this section we summarise this information.

5.6.1. Forecast Generation Installed Capacity of Kintore

Table 2 below summarises the cumulative forecast generation installed capacity from today to 2050 for Kintore GSP.

Substation	CT Scenario (in MW)			LW Scenario (in MW)		
	2025	2035	2050	2025	2035	2050
Kintore GSP	79.1	159.4	239.5	86.6	241.0	350.6

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14 Heriot Watt University, 2021. Distilleries need blend of green energy and storage for net zero.

15 Scotch Whisky Association, 2021. The Scotch Whisky Industry Sustainability Strategy.

16 Scotch Whisky Association (Ricardo), 2020. Scotch whisky pathway to net zero.

Substation	ST Scenario (in MW)			FS Scenario (in MW)		
	2025	2035	2050	2025	2035	2050
Kintore GSP	75.0	121.7	221.3	74.1	106.0	162.2

Table 2: Forecast Generation Installed Capacity for CT, LW, ST and FS scenarios in Kintore GSP

6. PROJECTS IN PROGRESS

6.1. Ongoing works in Kintore

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

There is an existing capital scheme to integrate the Kintore and Keith networks to the new Rothienorman GSP. The scheme has impact on the Kintore network, through transfer of Methlick and Fyvie primary substation demand to Rothienorman GSP. Additionally, several generators which are currently exporting via Kintore will be transferred to export via Rothienorman.

The network considered for long-term modelling is shown in Table 3. The summary of existing works are shown below. Refer to Appendix B for the schematic with the IDs outlined.

ID	Substation	Description	Driver	Forecast completion	Fully resolves future strategic needs to 2050?
1	Rothienorman GSP	Construction of a new GSP	Customer Connection/Primary Reinforcement	2023/24	✓
2	Rothienorman / Kintore GSP	Transfer of Glen of Foudland Generation from Kintore GSP to Rothienorman via a dedicated direct feed	Primary Reinforcement	2025/26	✓
3	Rothienorman / Kintore GSP	Transfer of Gordonstown Generation from Kintore to Rothienorman via a dedicated direct feed	Primary Reinforcement	2025/26	✓
4	Fyvie PSS	Integration of Fyvie from Kintore to Rothienorman GSP	Primary Reinforcement	2026/27	✓
5	Methlick	Integration of Methlick from Kintore to Rothienorman GSP	Primary Reinforcement	2026/27	✓
6	Midmar PSS	Reinforcement the existing 1 x 33/11kV transformer with 2 x 33/11kV transformer upgrades.	DNOA Process	2026/27	✓
7	Kintore GSP	Reinforcement of the 3 x 132/33kV transformers, consolidate into 2 x 132/33kV transformer	Asset Health	2025/26	✗

8	Oldmeldrum PSS	Reinforcement and upgrade of the two existing 33/11kV transformers.	DNOA Process	2029/30	
9	Banchory	Reinforcement of the two existing 33/11kV transformers.	DNOA Process	2028/29	
10	Skene PSS	Reinforcement of cable section with sufficient cable from Kintore GSP to Skene PSS	DNOA Process	2026/27	
11	Banchory PSS / Kintore GSP	Reinforce cable with 500Al cable from Banchory to Kintore GSP	DNOA Process	2028/29	
12	Rothienorman GSP / Kintore GSP	There will be 2 new NOPs between Rothienorman and Kintore under the new arrangement	Reinforcement	2028/29	

Table 3: Works already triggered through customer connections and the DNOA process

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

6.2. Network Schematic (following completion of above works)

The 33kV Network Schematic shown in Figure 11 highlights how the network will be configured once the works in Table 3 are completed.

Figure 11: Network Schematic following completion of triggered works
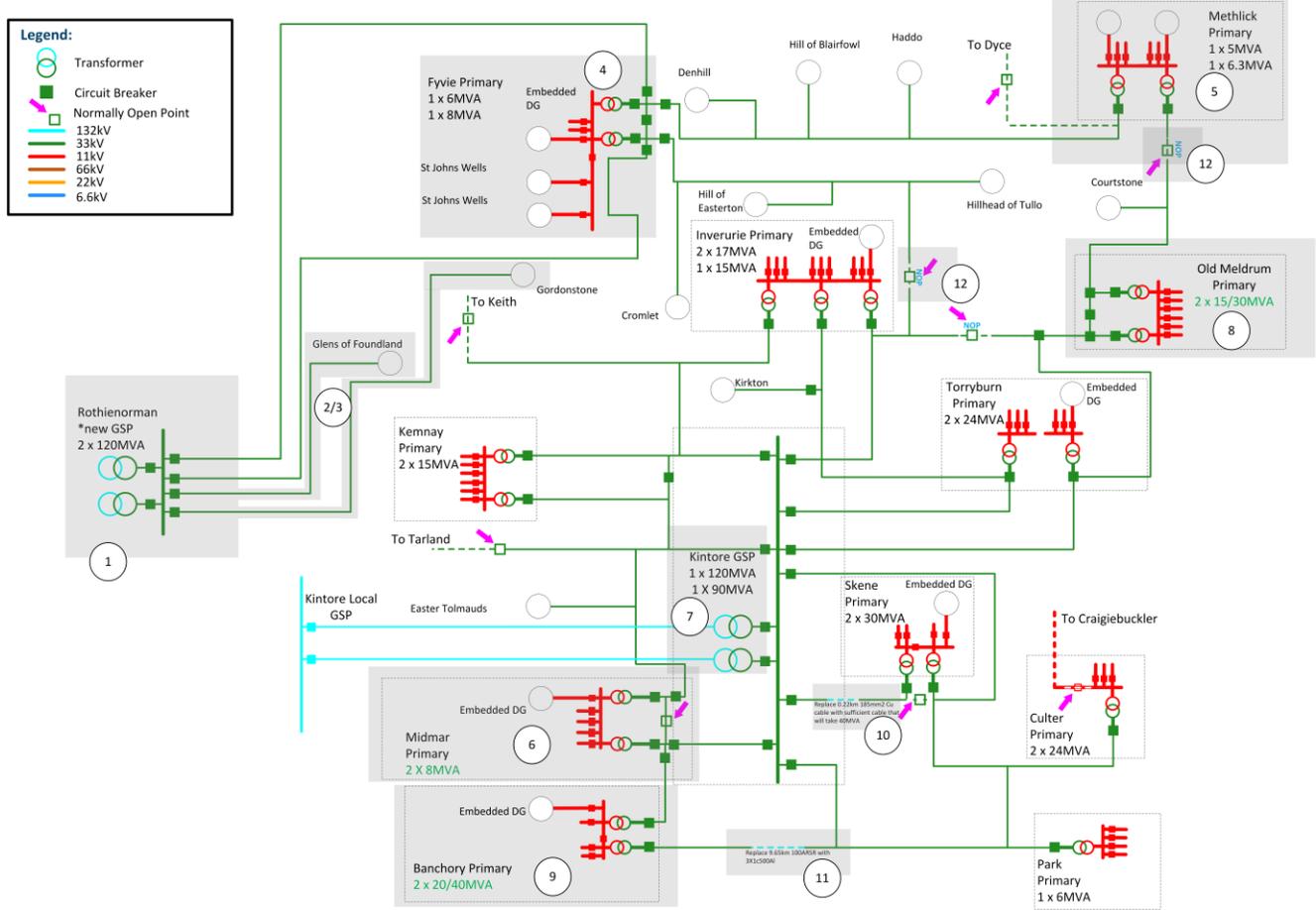
7. Spatial Plans of Future Needs

The previous section summarised Kintore GSP's forecast future demand and generation requirements. We have used this information to understand what this means for the local networks in the Aberdeenshire area. Initially this is developed through the creation of a spatial plan of future system needs.

We have created spatial plans at a primary substation level (33/11kV) and secondary substation level (11kV/LV). Snapshots are provided below for 2028, 2033, 2040, and 2050 enabling clear visualisation of future system needs beyond the network capacity following completion of triggered works. They are currently based on 2023 DFES Consumer Transformation forecasts.

7.1. Extra High Voltage / High Voltage spatial plans

Figure 12 shows the projected headroom or capacity shortfall across the illustrative primary substation supply areas. The values are taken from the Network Scenario Headroom report (NSHR), part of the Network Development plan (NDP). Negative values indicate a shortfall in capacity, positive values indicate headroom.

These are presented for each of the four DFES scenarios to understand how the projected availability of network capacity changes across each of these scenarios. It should be noted that the NSHR is produced annually and last published in May 2024, where work has been triggered between this date and the time of publication of this report, future capacity may not be reflected.
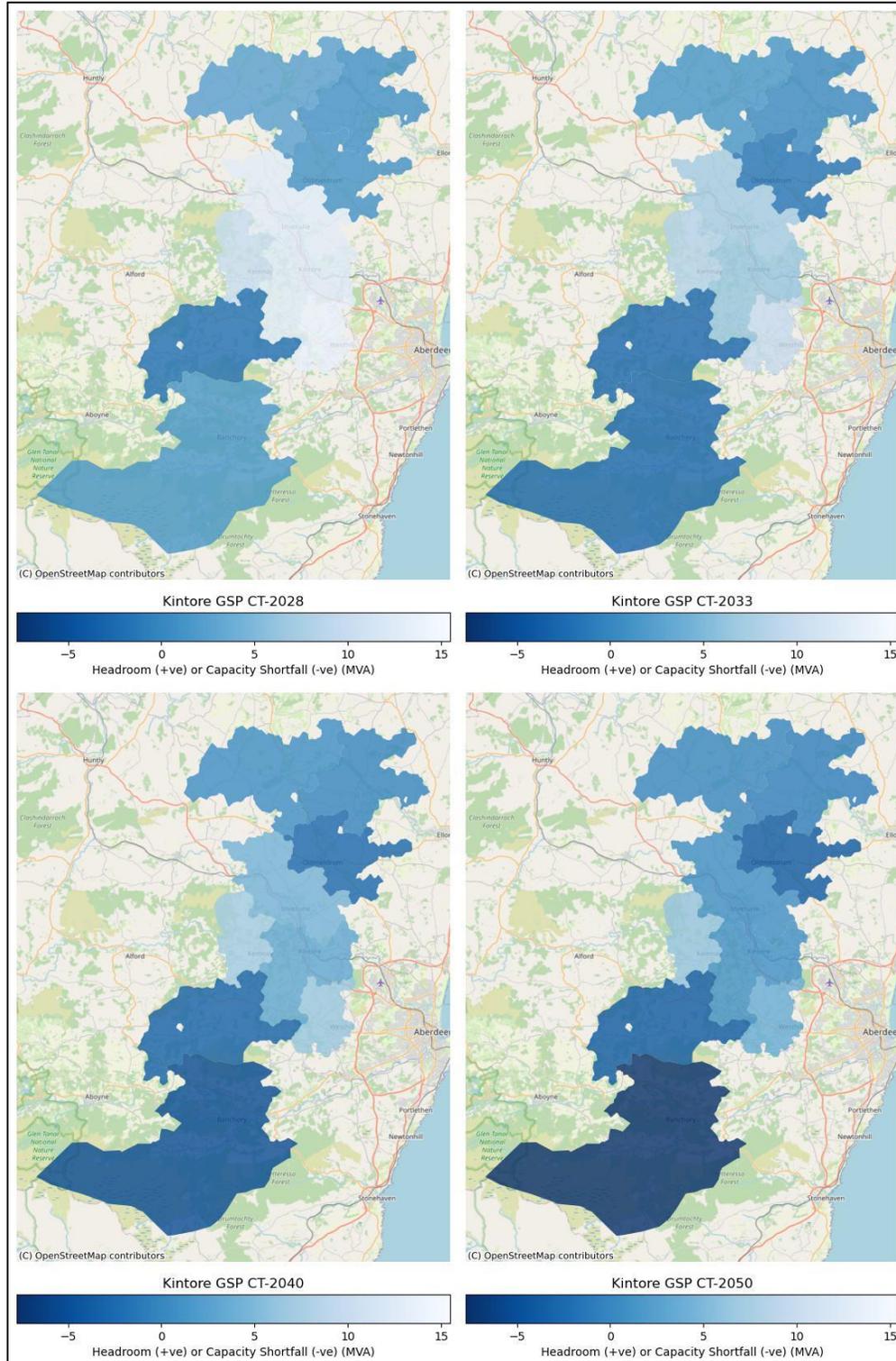
Figure 12: Kintore EHV network spatial plans for 2028, 2033, 2040, and 2050

7.2. High Voltage / Low Voltage spatial plans

To understand where load is growing at a lower granularity, we have used information from the SSEN load model that is produced by SSEN's Data and Analytics team. As shown in Figure 13, several secondary transformers are either approaching or exceeding 100% loading in the near term. This represents a near term risk that will need to be addressed.

There are areas of lower loaded secondary transformers, and it could be possible to shift load through LV load transfers as a short-term solution. This approach could help manage demand until the network is either reinforced or expanded with additional assets to accommodate growing demand. There is a requirement for additional capacity at the secondary substation level increase as we approach 2050.

Figure 13: Kintore HV/LV spatial plans for 2028, 2033, 2040, and 2050

8. SPECIFIC SYSTEM NEEDS AND OPTIONS TO RESOLVE

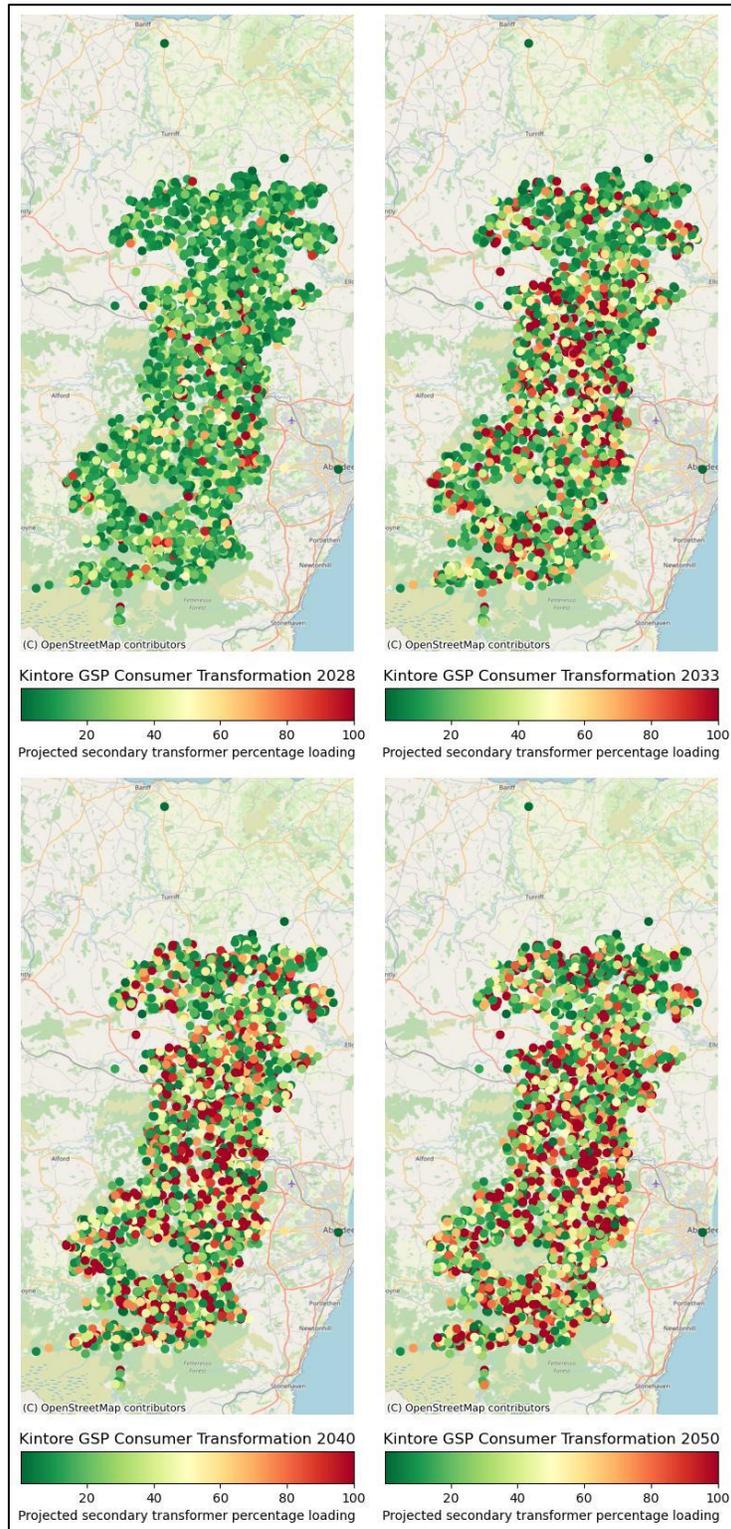In this section we summarise the more specific needs arising from our future spatial plans. We also propose some initial options to meet these requirements. These will be further developed through the DNOA process, where they will be considered alongside the potential for flexibility.
The section is 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 seven 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, risk and mitigations.

There are a number of overarching risks to the delivery of our strategic plans. Below we list them alongside proposed mitigation actions. We will work with stakeholders to develop these mitigating actions further.

Dependency: Works proposed here are dependent on Rothienorman absorbing the demand of Methlick and Fyvie primary substations which are currently connected to Kintore GSP, and by several generators which are currently exporting via Kintore being moved to export via Rothienorman. Works expected to be completed in 2026.
Risks: Works delay potential interventions downstream and/or do not provide flexibility of future investment.
Mitigation: Continue productive engagement with Asset Management to enable the detailed design and planning of Rothienorman GSP integration works.

Dependency: Works proposed here are dependent on delivery of the transmission scheme to replace the 2 x 60MVA transformers with a single 120MVA Grid Transformer by transmission, aimed to be delivered by 2026.
Risks: Risk of security of network for 2035
Mitigation: Continued engagement with SSEN Transmission to ensure delivery date of 2026

Dependency: Proposal of a new GSP, Kintore 2 being constructed
Risks: Limited availability of capacity and breakers for new connections
Mitigation: Work with SSEN Transmission to ensure the delivery of Kintore 2 GSP

8.2. Future EHV System Needs to 2035.

The following outputs of the power system analysis, as shown in Table 4, show where we may observe the need for further intervention on the distribution network. This could be through asset solutions or flexibility services. Whilst projects are in delivery access products may potentially be used to enable connection of projects ahead of reinforcement delivery. In some cases, the need has been projected to arise ahead of 2030, in these cases we will recommend that the projects enter more detailed study through the DNOA process.

Ref	Location of proposed intervention	CT Year	ST Year	LW Year	FS Year	Worst case asset loading (%)	Network State	Comment
(1)	Park PSS transformer	2032	2038	2032	2042	102.0	Intact condition, network experiences overloading on the Park PSS.	Park PSS experiences overloading of its sole transformer. Potential solutions to address the issue are: • Replace the existing transformer at Park PSS with a higher rating to address overloading. • Install an additional second transformer at the site. This will address overloading and enhance the security of supply at the site.
(2)	33kV Circuits towards Park PSS	2032	2040	2033	2044	105.0	N-1, outage of one of the lines from Kintore to Park and Banchory PSS, network is overloaded	The constraints on the network are due to the projected load growth on the primaries connected to the shared 33kV network. Potential solutions to address the issue are: • Install dedicated 33kV circuits to PSS's on the shared circuit to remove them from sharing the same circuits and reduce the demand on the shared circuits. • Reinforce by increasing the size of the 33kV network lines and cables. • Add additional shared 33kV circuits to be shared by the PSS's Reconfiguring the network will also address the low voltage issues at the primary substations in this area.

(3)	Inverurie PSS	2028	2033	2028	2031	100%	Intact condition, overloading of one of the 15MVA transformers at Inverurie PSS.	There are currently three transformers at Inverurie PSS, 2 x 17MVA and the overloaded transformer rated as 15MVA. Potential options to address the issue are: • Replace the existing transformers on site with two larger transformers with direct feeders to Kintore GSP • Replace the three transformers with three larger transformers and reinforce the shared 33kV network with larger 33kV overhead lines and underground cables. • Transfer some of the load from Inverurie PSS to other PSS's it is interconnected with
(4)	Kintore GSP to Torryburn PSS 33kV circuit	2031	2033	2031	2038	100	N-1, loss of one of the circuits from Kintore teeing Torryburn and Oldmeldrum PSS, results in the other circuit between Kintore GSP to Torryburn is overloaded, and low volts at Old Meldrum and an overloaded transformer at Inverurie	Potential options to address issues across all sites may be to: • Overlaying the affected sections of overloaded cable between the Kintore GSP and Torryburn. • Establishing dedicated 33kV overhead lines or underground cables to some of or specific PSS's which share this 33kV network. • Work with SSEN Transmission to establish whether new feeders should go to the newly proposed Kintore GSP
(5)	Skene PSS	2033	2038	2033	2041	130%	Intact condition, overload of both of the transformers, T1 and T2 at Skene PSS.	Potential options to address the issue are: • Replace both of the transformers at Skene with higher capacity units. • Add additional transformers to make Skene a 3 or 4 transformer site • Shift the load from Skene onto other PSS's it is interconnected with

Table 4: Summary of system needs identified in this strategy through to 2035 along with indicative solutions

8.3. Future EHV System Needs to 2050

Additional system needs have been identified in Table 5 that the DFES 2023 indicates may need addressing ahead of 2050. These have been identified through thermal power system analysis. There is significant uncertainty with forecasts in this period and works need to be considered alongside the strategies described in the previous section. As the likelihood of these demands being realised increases, the necessary mitigations through asset or flexible solutions should be implemented.

Table 5 below summarises the specific system needs that have been identified.

Ref	Location of proposed intervention	CT Year	ST Year	LTW Year	FS Year	Worst case asset loading (%)	Network State	Comment
(1)	Oldmeldrum PSS	2046	Post 2050	2047	Post 2050	N/A	Intact condition, network experiences low volts	The constraints on the network are due to the projected load growth by 2050. Potential options to address the issue are: • Install a STATCOM (Static Synchronous Compensator). However, this approach is not viable as a long-term solution is required • A more efficient intervention would involve establishing new dedicated circuits from Kintore GSP to Oldmeldrum, providing a future-proof resolution.
(2)	Torryburn PSS Transformers	2038	Post 2050	2038	Post 2050	102%	Intact condition, one cable from Kintore GSP to Torryburn experiences overloading and also overloading of T1 and T2 at Torryburn	The constraints on the network are due to the projected load growth by 2050. Potential options to address the issue are: • Replace both transformers at Torryburn with higher capacity units. • Add additional transformers to make Torryburn a 3 or 4 transformer site • Shift the load from Torryburn onto other PSS's it is interconnected with
(3)	Culter PSS	2039	Post 2050	2038	Post 2050	114%	N-1, outage of the 33kV circuit between Kintore GSP and Skene	An additional voltage issue was also forecast to appear by 2050 Potential option to address the issues are:

							PSS overloading of Culter PSS.	• Install a dedicated circuit from Kintore GSP or CraigieBuckler GSP to Culter PSS. • Install an additional third or 4th transformer at the site. The additional circuit may also address the low voltage issues at the primary substation and will increase its security of supply.
(4)	Banchory PSS	2050	Post 2050	2043	Post 2050	N/A	Intact condition, there are low volts at Banchory PSS.	The constraints on the network are due to the projected load growth by 2050. Potential options to address the issue are: • An interim solution would be to install a STATCOM to manage the low voltage. • A long-term solution may involve overlaying the existing cable from Kintore GSP. • Another solution would be to remove either Midmar PSS or Banchory PSS from the shared 33kV circuit and give either PSS's their own dedicated 33kV circuit. Considering the cable length, it may be more future-proof to install a dedicated feeder from Kintore GSP and remove the tee connection between Banchory and Park PSS which was recommended as one of the options for Park PSS in table 4.
(5)	Midmar PSS	2050	Post 2050	2047	Post 2050	N/A	Intact condition, low volts.	The constraints on the network are due to the projected load growth by 2050. Potential options to address the issue are: • Reinforce the current circuit arrangement to Midmar and upgrade the cables. • Another solution would be to remove either Midmar PSS or Banchory PSS from the shared 33kV circuit and give either PSS's their own dedicated 33kV circuit shown in the comment above.

Table 5: Future EHV system needs projected to arise between 2035 and 2050

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

Our HV/LV spatial plans reveal that while secondary network overloading is predominantly observed in areas with high population density, no consistent trends are apparent within these regions. We are therefore adopting a forecast volume-based planning approach. This section provides additional context regarding this approach, addressing the high voltage and low voltage network requirements for Kintore through to 2050.

8.4.1. High Voltage Networks

In addition to the EHV system needs outlined in the previous section, the growing integration of low carbon technologies (LCTs) into the distribution network is expected to drive increased demand on both the High Voltage (HV) and Low Voltage (LV) networks. To assess the impact of these technologies on the distribution network, we have utilised a load model developed by SSEN's Data and Analytics team.

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 views are then aggregated up the network hierarchy based on the combinations of customers associated with each asset. This view is supplemented by the DFES to highlight the projected impact of LCTs on the network.

For all of the primary substations supplied by Kintore GSP, the percentage of secondary substations where projected peak loading exceeds the nameplate rating of the secondary transformer was taken from the load model data. Figure 14 demonstrates how this percentage changes under each DFES scenario from now up 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.
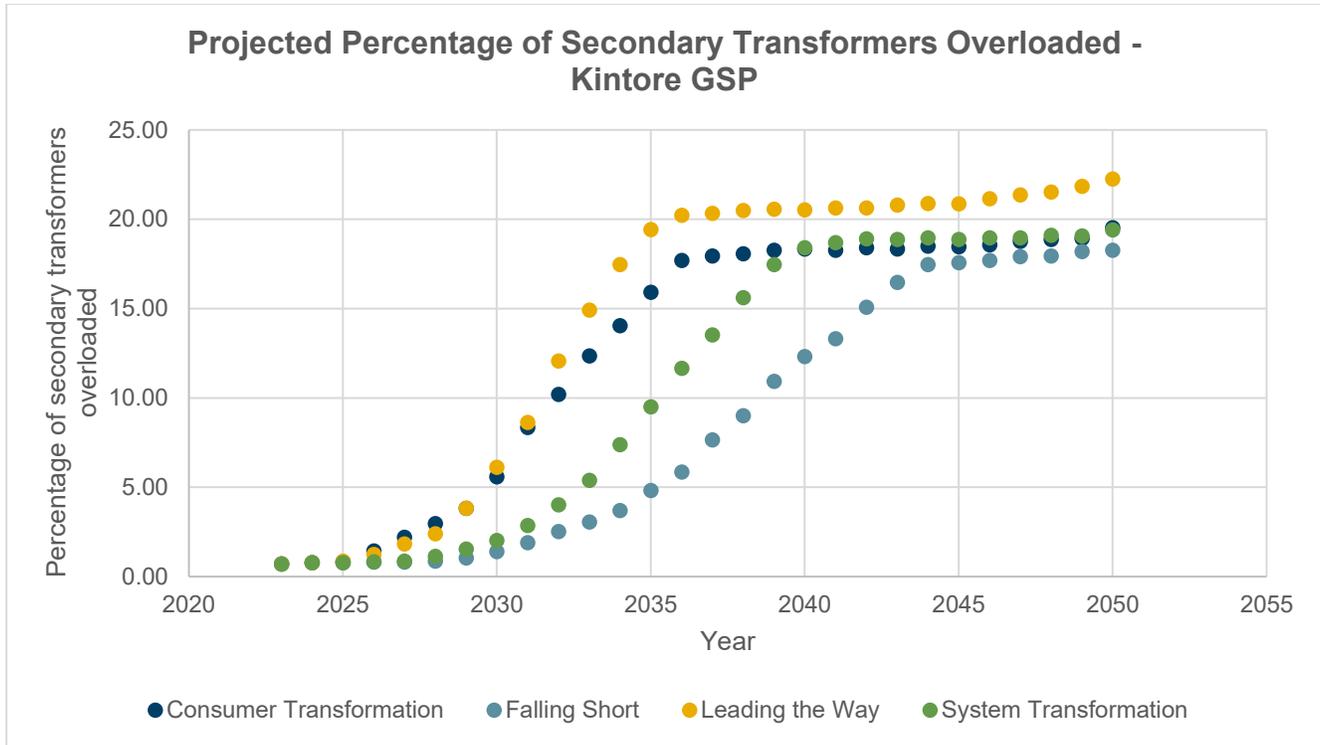
Figure 14: Kintore GSP Projected secondary transformer overloading. *Source: SSEN Lead Model*

Considering the Just Transition in HV development

SSEN are 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. Use of the outputs from the VFES enable SSEN to develop the network in a way that truly accounts for the levels of vulnerability their customers in different locations face.

One of the outputs from this innovation project was the report produced by the Smith Institute.[17] This work groups LSOAs[18] that share similar drivers of vulnerability. The groupings were informed by mathematical analysis of demographic data and of SSEN's priority service register, using machine learning to model the complex relationships that exist between the two. The resulting group numbers and descriptions are shown in Table 6.

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

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

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

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

Table 6: VFES Groupings

To understand the vulnerability groupings across the Kintore GSP, 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 15.
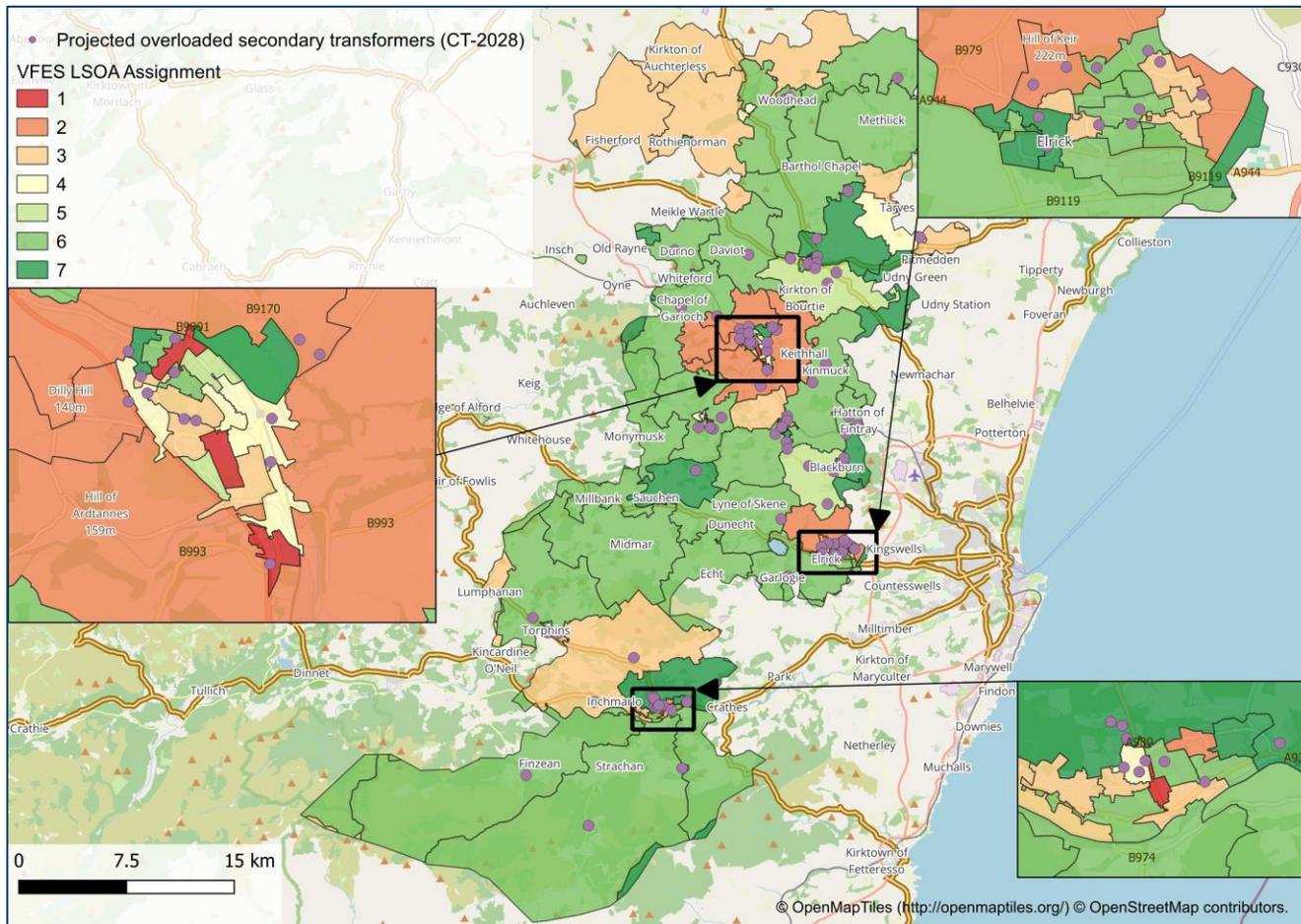
Figure 15: Kintore GSP VFES Outputs with secondary transformer overlay

The majority of the area falls within group 6 – lower levels of vulnerability. This low level of vulnerability is driven down by lower level of poor health and disability/mental health benefit claimants, increased by moderate elderly population levels and household sizes. However, in the GSP area there are several LSOAs that fall into the higher categories of vulnerability (groups 1, 2, and 3). We also see an LSOA area falling into the group 1 – very high vulnerability. This 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 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 disadvantaged by outages.

8.4.2. 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 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 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 Kintore GSP 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 18% of low voltage feeders may need intervention by 2035 and 22% by 2050 under the CT scenario as shown in Figure 16. The need is unlikely to be triggered until 2028 onwards. However, due to the timeline to grow workforce, with jointing skills taking typically 4 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.
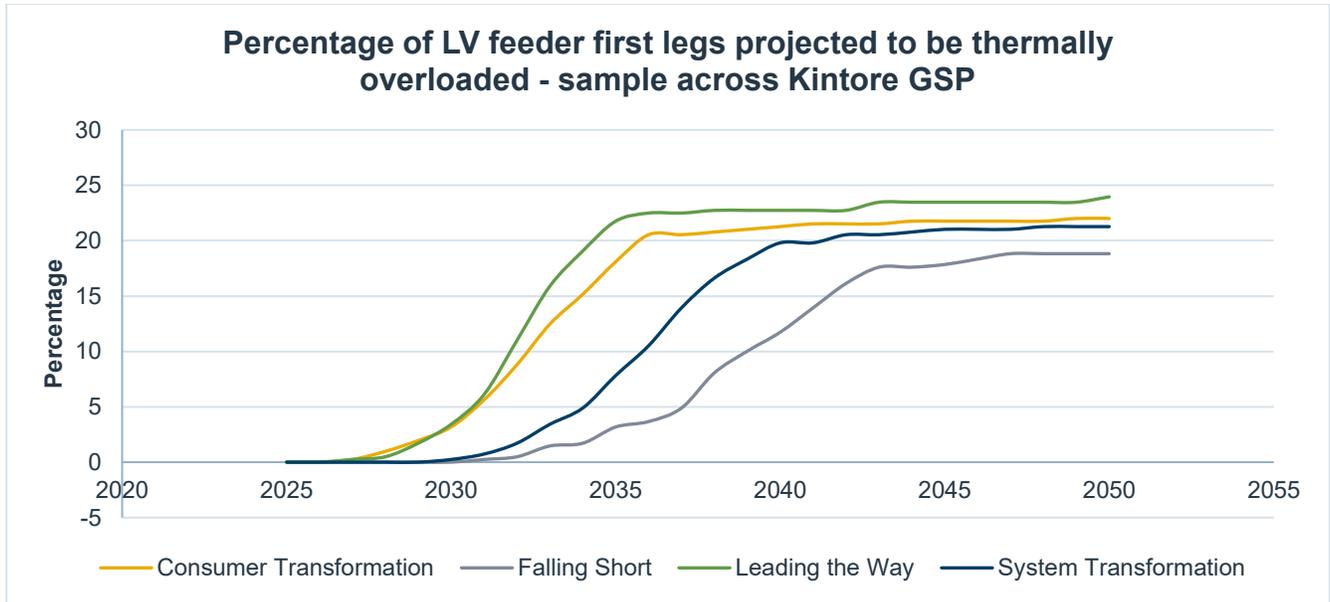
Percentage of LV feeder first legs projected to be thermally overloaded - sample across Kintore GSP

Legend: Consumer Transformation, Falling Short, Leading the Way, System Transformation

Figure 16: Percentage of LV feeder first legs projected to be overloaded that are supplied from Kintore GSP

9. RECOMMENDATIONS

The review of stakeholder engagement and the SSEN 2023 DFES analysis provides a robust evidence base for load growth across the Kintore GSP in both the near and longer term. Drivers for load growth across the Kintore GSP arise from multiple sectors and technologies, predominantly renewable generation. These drivers impact not only our EHV network but will drive system needs across all voltage levels. We have already had close engagement with multiple industrial energy users to understand how we can plan strategically to enable decarbonisation of industry across the study area.

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

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

1. Where we have identified work that is required in the near term (ahead of 2035), this should be progressed through the DNOA process. Through detailed studies we will understand the network requirements in more detail and progress these where appropriate. This includes the following system needs:

    a. Park Primary Transformer and 33kV circuits
    b. Inverurie Primary Transformers
    c. Kintore GSP to Torryburn Primary 33kV circuit
    d. Skene PSS Transformers

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.

2. Continue engagement with Scottish and Southern Electricity Network Transmission on the development of a new Kintore GSP and the reinforcement of the existing Kintore GSPs transformers to be able to ensure continued security of supply and whole systems thinking when developing this area. This can also provide an opportunity for rationalisation of circuits that can resolve thermal and low voltage issues on the local distribution networks.

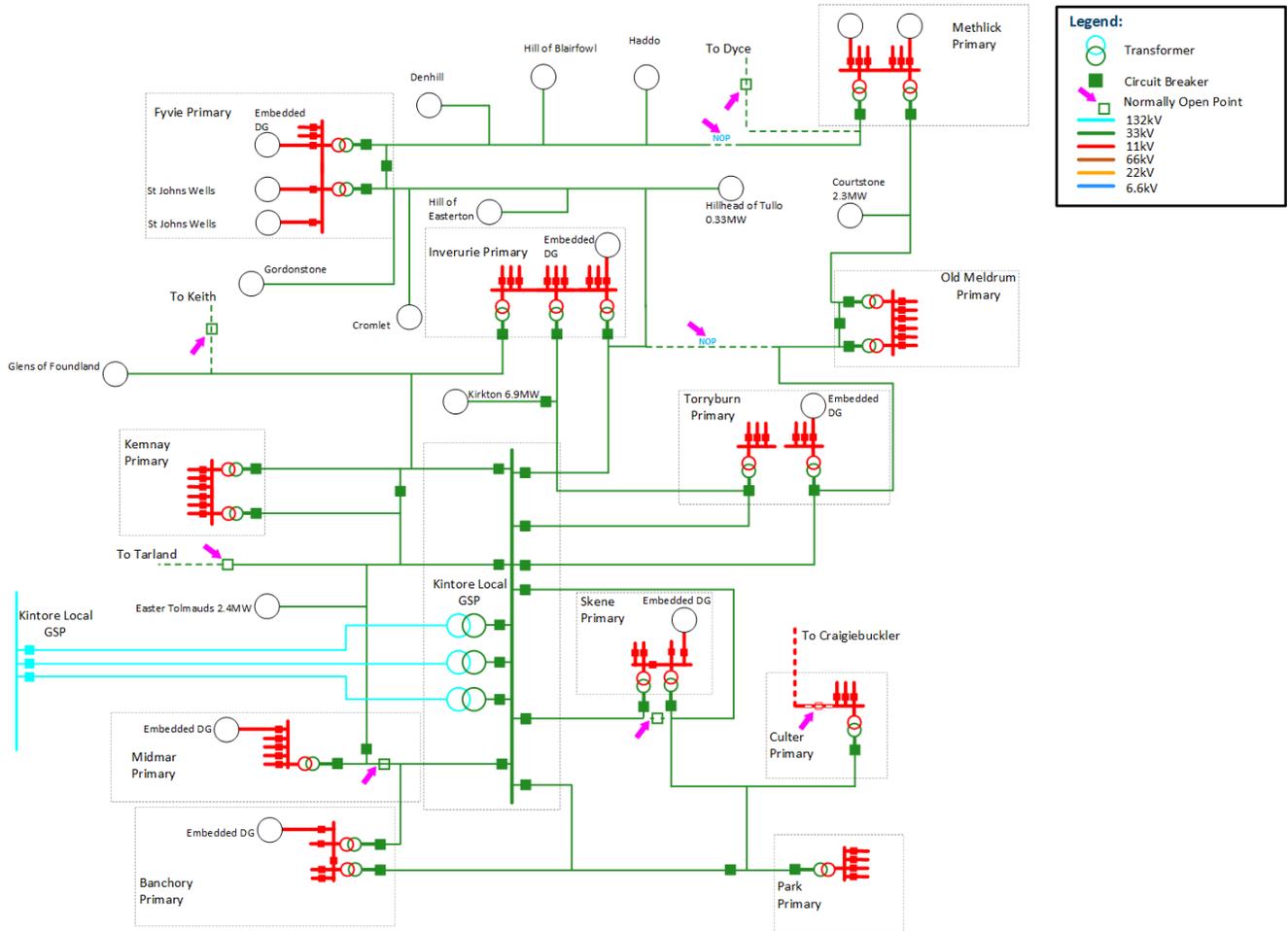# Appendix A   33kV existing network schematic

Figure 17: Kintore GSP - Existing Network Schematic

Appendix B   33kV works in progress network schematics

Appendix C   Additional EHV/HV Plans for other DFES Scenarios
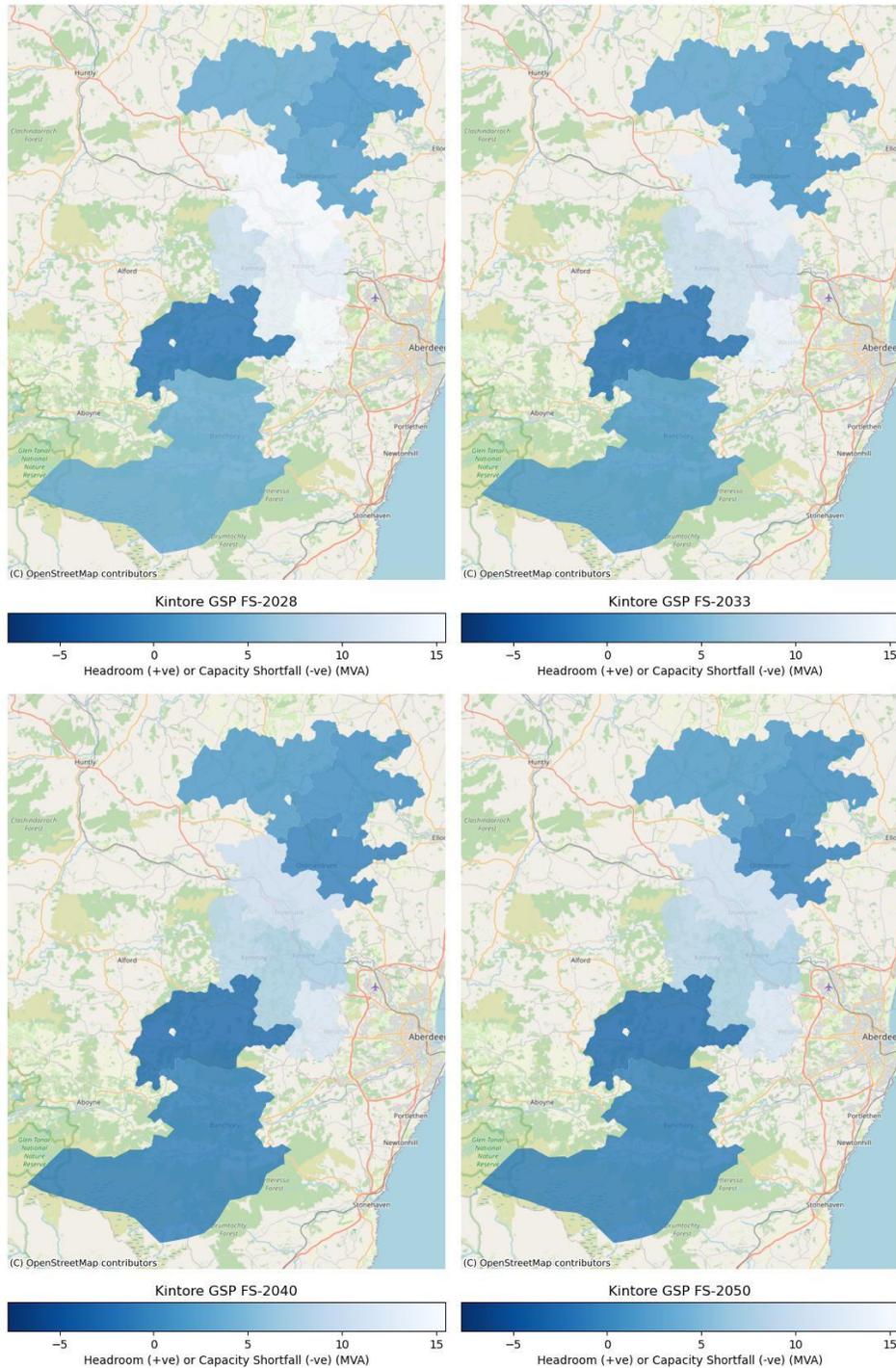

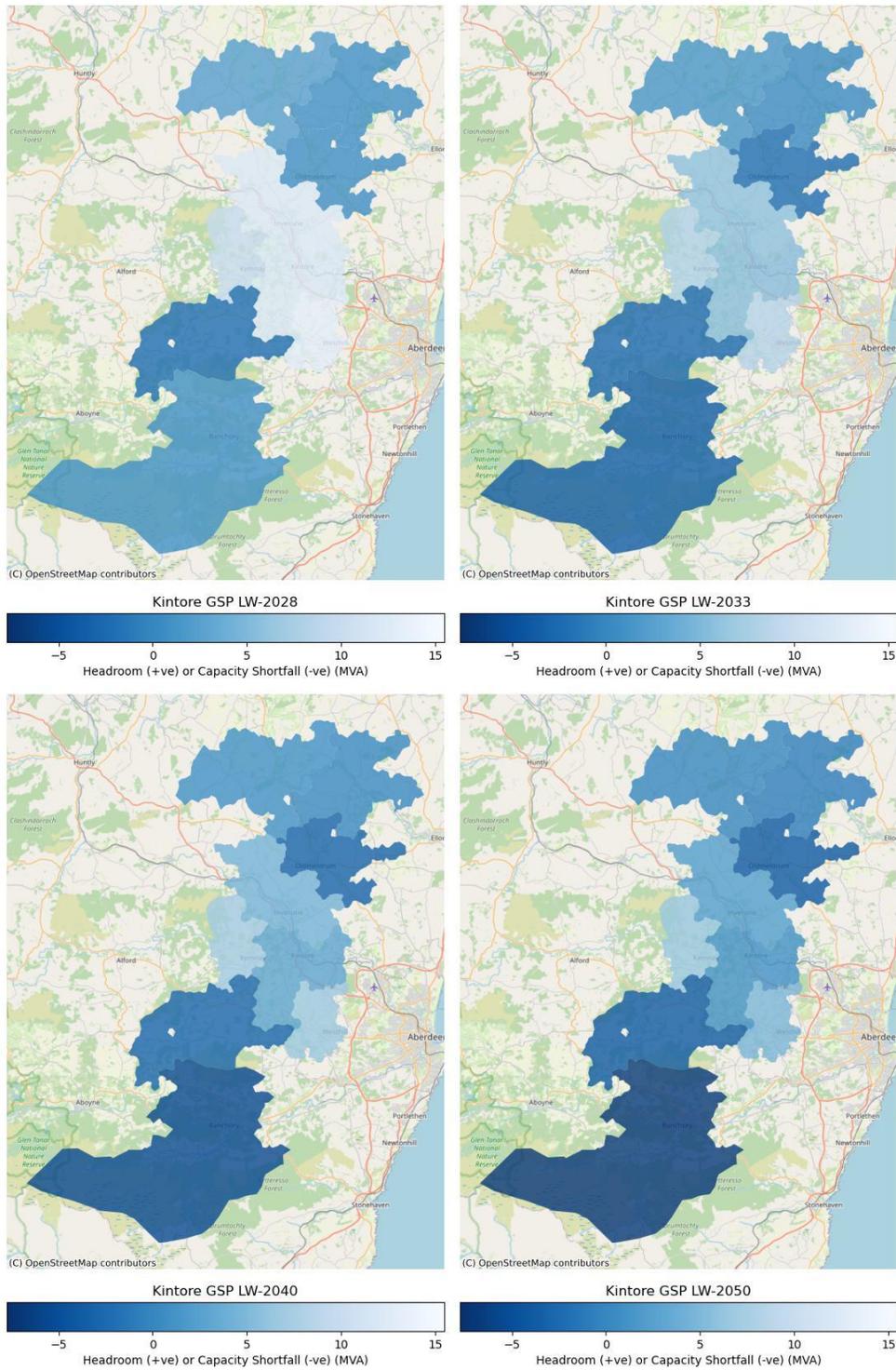**Figure 18: EHV/HV Spatial Plan - Falling Short**

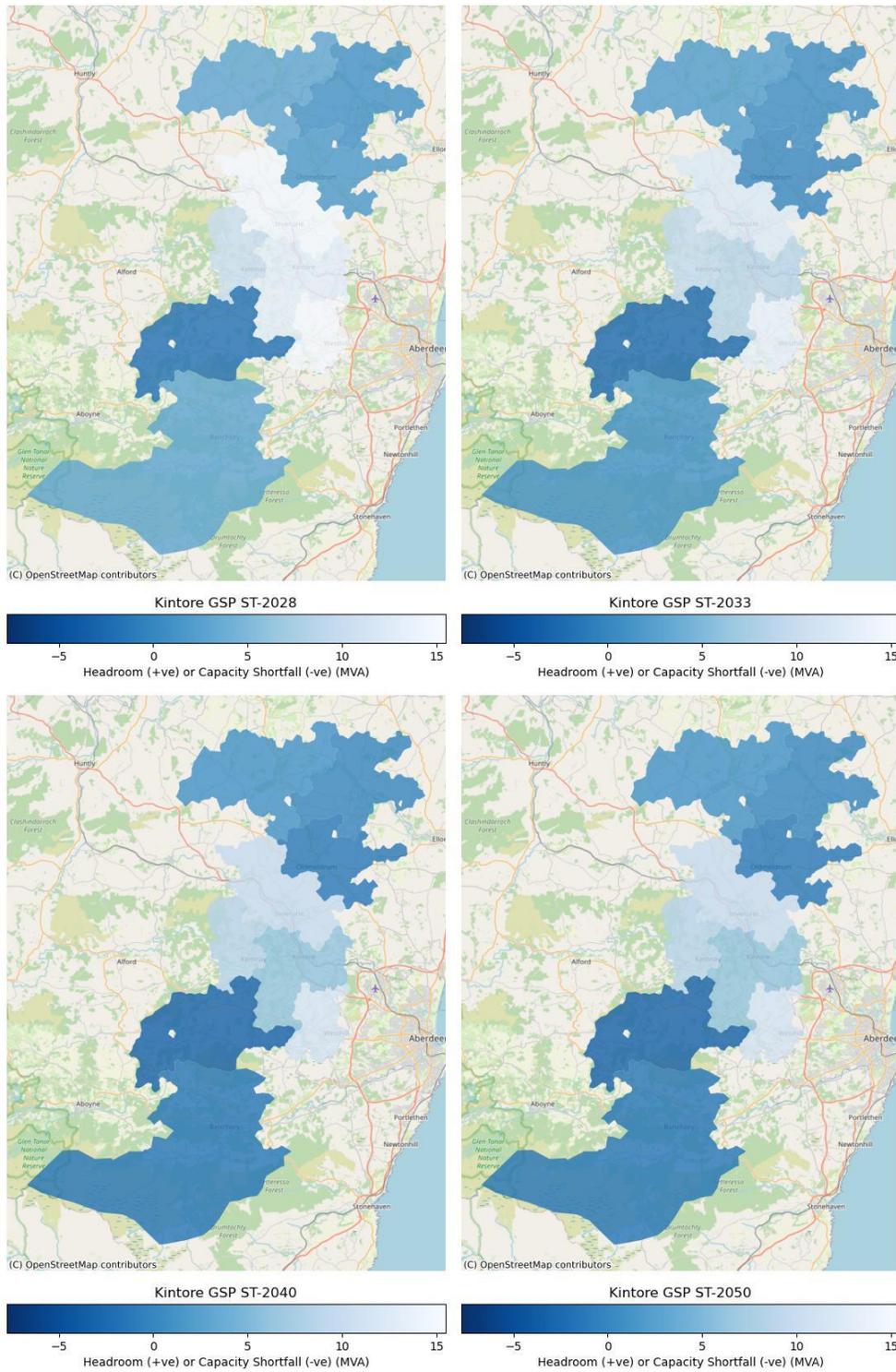**Figure 19: EHV/HV Spatial Plan - Leading the Way**

Figure 20: EHV/HV Spatial Plan - System Tranformation

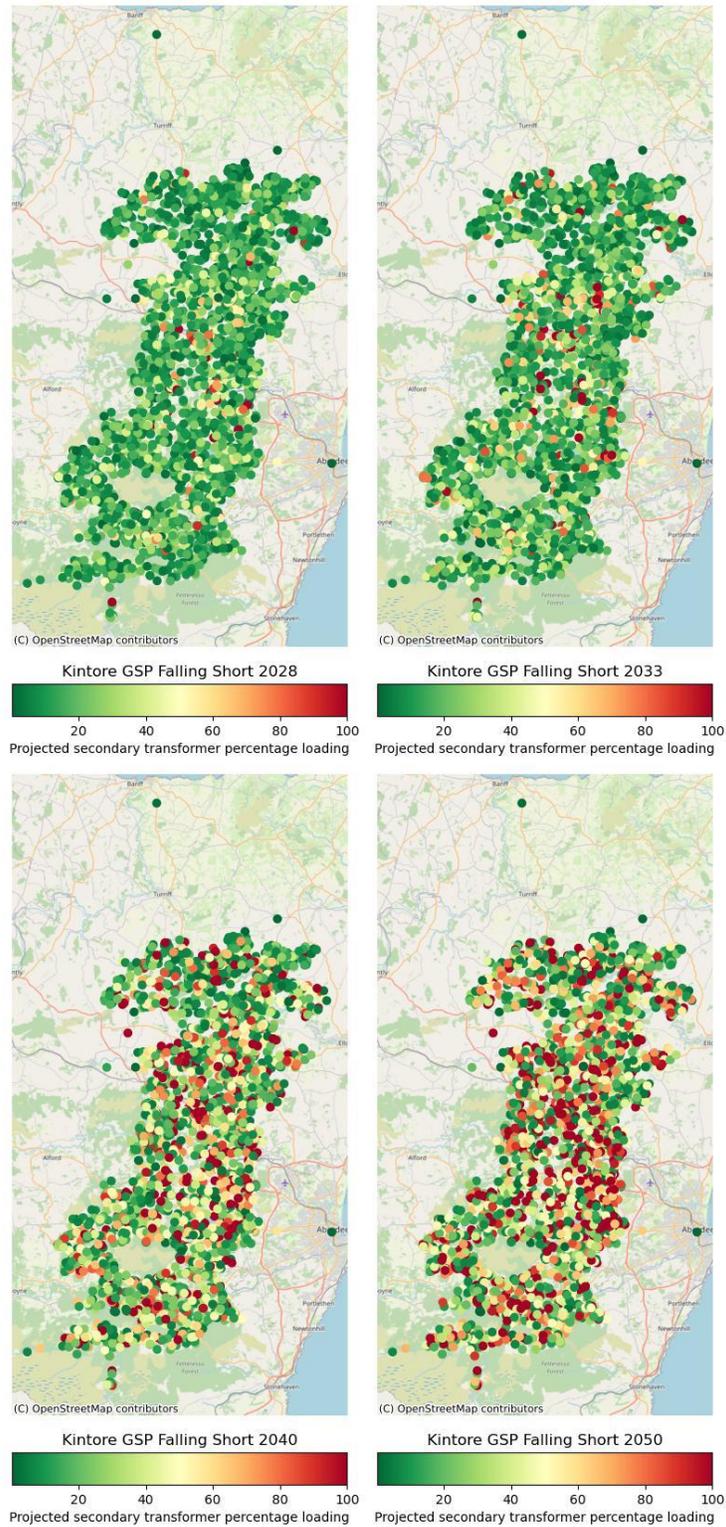# Appendix D   Additional HV/LV plans for other DFES scenarios

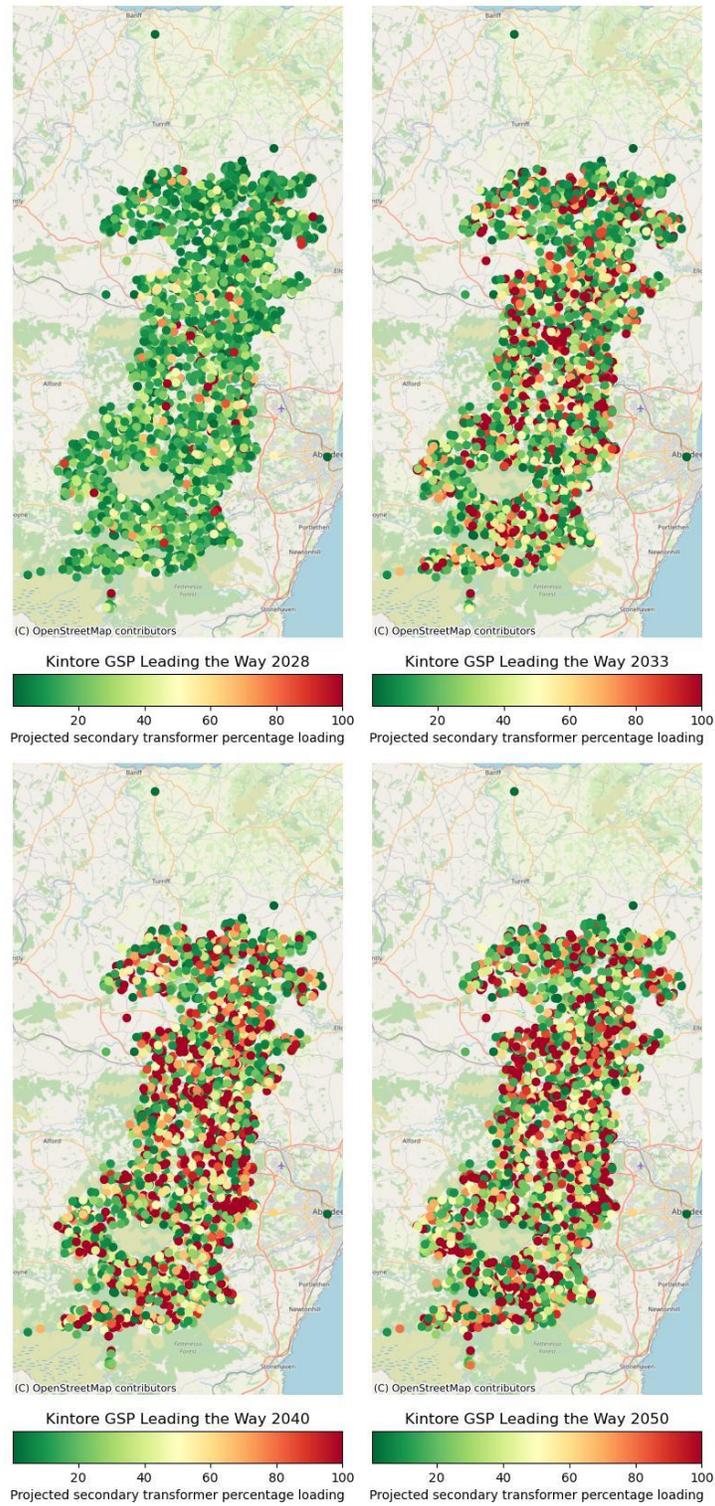**Figure 21: Kintore GSP - HV/LV Spatial Plan - Falling Short**

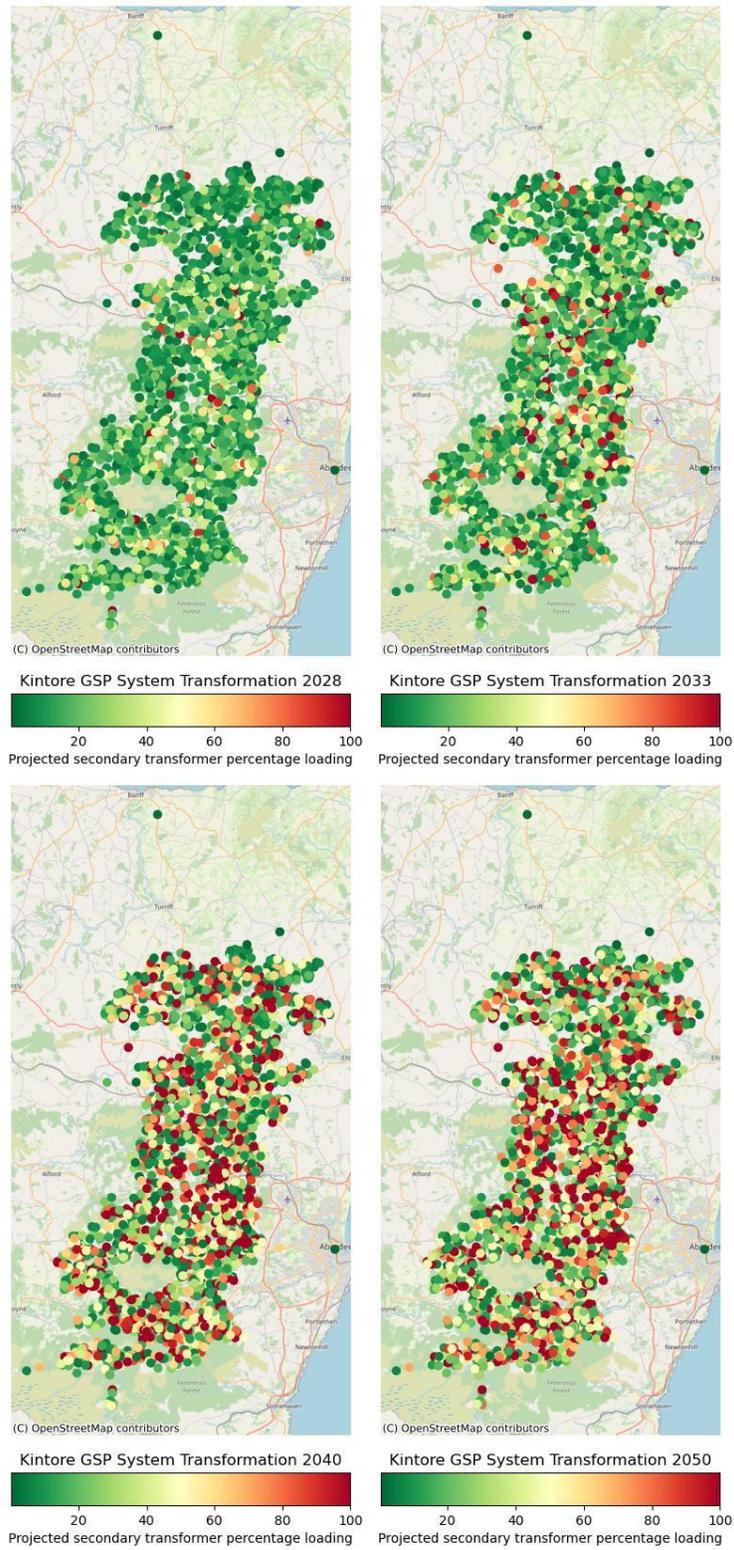**Figure 22: Kintore GSP - HV/LV Spatial Plan - Leading the Way**

Figure 23: Kintore GSP - HV/LV Spatial Plan - System Transformation

Appendix E   Relevant DNOA outcomes reports

DNOA Outcome Report

Banchory
(Banchory Primary/Circuits)

Scheme description
- The reinforcement of the Banchory PSS will increase capacity in the Banchory area. Postcode(s): AB30, AB31, AB39
- Local authority: Aberdeenshire Council
- Load related – substation and circuits thermal overload/voltage issues during network intact conditions due to forecasted demand growth.

Proposed option
- Flexibility/Asset Solution: Utilise flexibility for 3 years ahead of Banchory PSS transformer and circuit reinforcement.
- This option addresses the forecasted thermal overload and voltage issues at Banchory PSS out to 2050.
- Capacity released: 5.21MVA

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: £108/MW/h
- Utilisation price: £133/MWh

Reinforcement timeline
- Flexibility solution utilised from start of 2026/27 until end of 2028/29.
- Reinforcement delivery by end of 2028/29.

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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	-	-	0.05	0.83	1.65	- (2.41)	- (3.23)
ST	-	-	-	-	0.04	- (0.30)	- (0.63)
LTW	-	0.19	0.68	1.38	2.13	- (2.87)	- (3.79)
FS	-	-	-	-	-	- (0.05)	- (0.30)

Constraint management timeline

Network constraint becomes active

Network constraint removed

Flexibility Procurement | Flexibility utilisation | Network reinforced

2024/25 2025/26 2026/27 2027/28 2028/29 2029/30 2030/31 Year

Glossary

Acronym	Definition
AIS	Air Insulated Switchgear
ANM	Active Network Management
ARC	Advanced Research Computing
BAU	Business as Usual
BSP	Bulk Supply Point
CB	Circuit Breaker
CBA	Cost Benefit Analysis
CER	Consumer Energy Resources
CMZ	Constraint Managed Zone
CT	Consumer Transformation
DER	Distributed Energy Resources
DESNZ	Department for Energy Security and Net Zero
DFES	Distribution Future Energy Scenarios
DNO	Distribution Network Operator
DNOA	Distribution Network Options Assessment
DSO	Distribution System Operation
DSR	Demand Side Response
EHV	Extra High Voltage
EJP	Engineering Justification Paper
ER P2	Engineering Recommendation P2
NESO	National Energy System Operator
NGET	National Grid Electricity Transmission
ENA	Electricity Networks Association
EV	Electric Vehicle
FES	Future Energy Scenarios
FS	Falling Short

GIS	Gas Insulated Switchgear
GSPs	Grid Supply Point
GT	Grid Transformer
HV	High Voltage
kV	Kilovolt
LAEP	Local Area Energy Planning
LCT	Low Carbon Technology
LENZA	Local Energy Net Zero Accelerator
LEO	Local Energy Oxfordshire
LV	Low Voltage
LW	Leading the Way
OHL	Overhead Line
PSS	Primary Substation
PV	Photovoltaic
NSHR	Network Scenario Headroom Report (part of the Network Development Plan)
MW	Megawatt
MVA	Mega Volt Ampere
ODM	Operational Decision Making
RESOP	Regional Energy System Operation Planning
RIIO-ED1/2	Revenue = Incentives + Innovation + Outputs, Electricity Distribution 1 / 2 (regulatory price control periods)
SDP	Strategic Development Plan
SEPD	Southern Electric Power Distribution
SLC	Standard Licence Condition
SSEN	Scottish and Southern Electricity Network
ST	System Transformation
UKPN	UK Power Networks
UM	Uncertainty mechanism
VFES	Vulnerability Future Energy Scenarios

WSC	Worst Served Customers
ZCOP	Zero Carbon Oxfordshire Partnership

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