LOVEDEAN GRID SUPPLY POINT: STRATEGIC DEVELOPMENT PLAN

Our network serving communities across the South Coast (Portsmouth, Havant, Fareham, and Chichester)

(Final following consultation)

July 2025

Scottish & Southern Electricity Networks

CONTENTS

1. EXECUTIVE SUMMARY

SSEN is taking a strategic approach in the development of its distribution networks. This will help to enable the net zero transition at a local level to the homes, businesses, and communities we serve. Our Strategic Development Plans (SDPs) take the feedback we have received from stakeholders on their future energy needs to 2050 and translate these requirements into strategic spatial plans of the future distribution network needs. This helps us transparently present our future conceptual plans and facilitate discussion with local authorities and other stakeholders. The overall methodology and how it fits into our wider strategic planning process is presented in the Strategic Development Plan Methodology (Strategic Development Plan Methodology - January 2025).

The focus area of this SDP is that supplied by Lovedean Grid Supply Point (GSP) on the South coast, shown below.

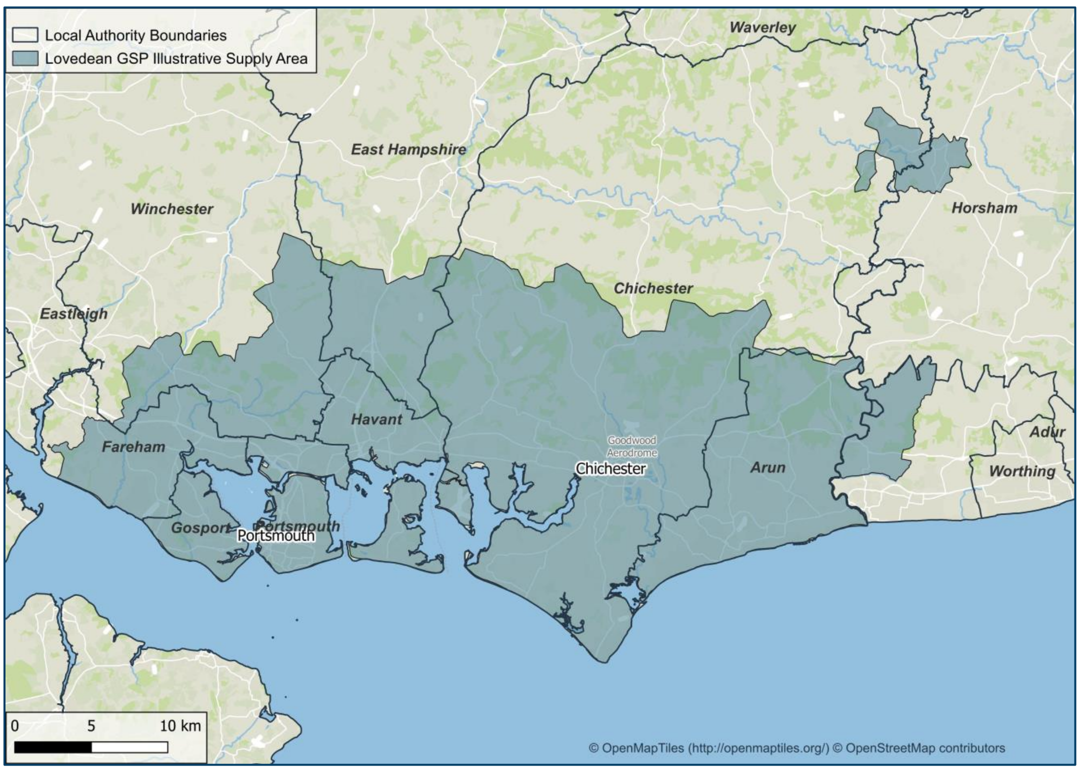

Figure 1 Area of focus for this SDP.

This report documents the stakeholder led plans that are driving net zero and growth in the local area, the resulting electricity demands, and the network needs arising from this. Plans from Arun, Chichester, East Hampshire, Havant, Portsmouth, Gosport, Winchester, Fareham, Hampshire County Council, West Sussex County Council and Horsham have been considered in preparation of this plan. A significant amount of 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 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 Lovedean Grid Supply Point (GSP) 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. Context for the area this represents is shown above in Figure 1.

To identify the future requirements of the electricity network, SSEN commission Regen to produce the annual Distribution Future Energy Scenarios (DFES). The DFES analysis is based on the National Energy System Operator (NESO) Future Energy Scenarios (FES) while accounting for more granular stakeholder insights from agencies such as local authorities and new demand and generation connection applications. The DFES provides a forward-looking view of how demand and generation may evolve under four different scenarios as we move towards the national 2050 net zero target. These scenarios are summarised in Figure 2. This SDP has been informed by the analysis undertaken as part of the DFES 2023. SSEN currently use Consumer Transformation as the central case scenario following stakeholder feedback during the RIIO-ED2 development process. This position is reviewed annually.

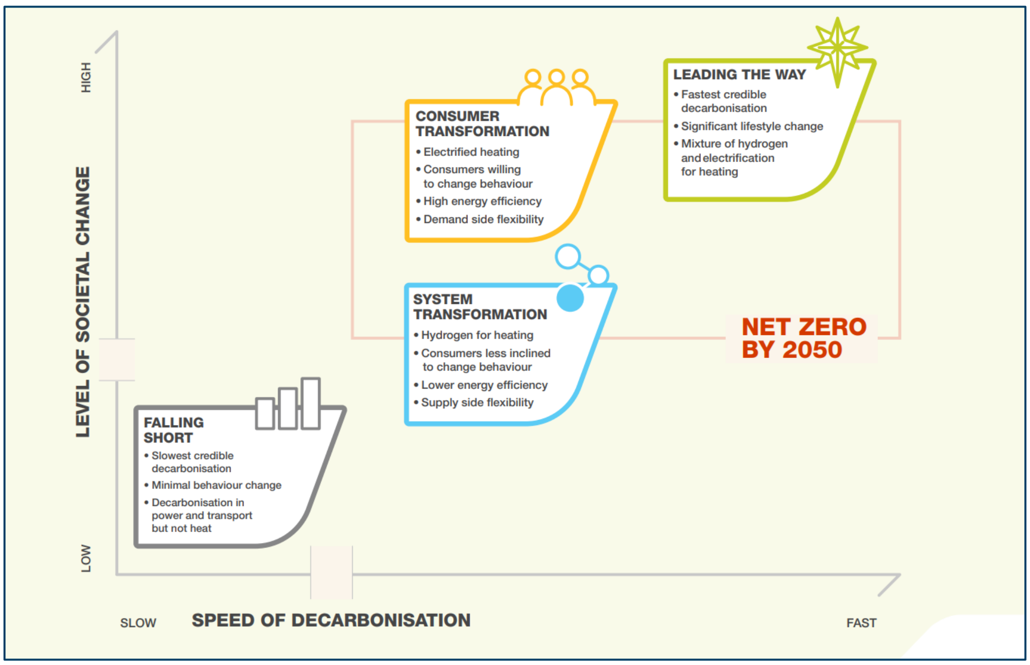

Figure 2 The 4 Future Energy Scenarios adopted for the DFES. *Source: ESO FES*

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 strategy.

3. STAKEHOLDER ENGAGEMENT AND WHOLE SYSTEM CONSIDERATIONS

3.1. Local Authorities and Local Area Energy Planning

The main local authorities that are supplied by Lovedean GSP are Arun, Chichester, Fareham, Gosport, Havant, Winchester, East Hampshire, Horsham, Portsmouth, Hampshire County Council and West Sussex County Council as shown in Figure 3. The development plans for these local authorities will have a significant impact on the potential future electricity load growth on SSEN's distribution network. As such, it is vital for SSEN to engage with these plans when carrying out strategic network investment.

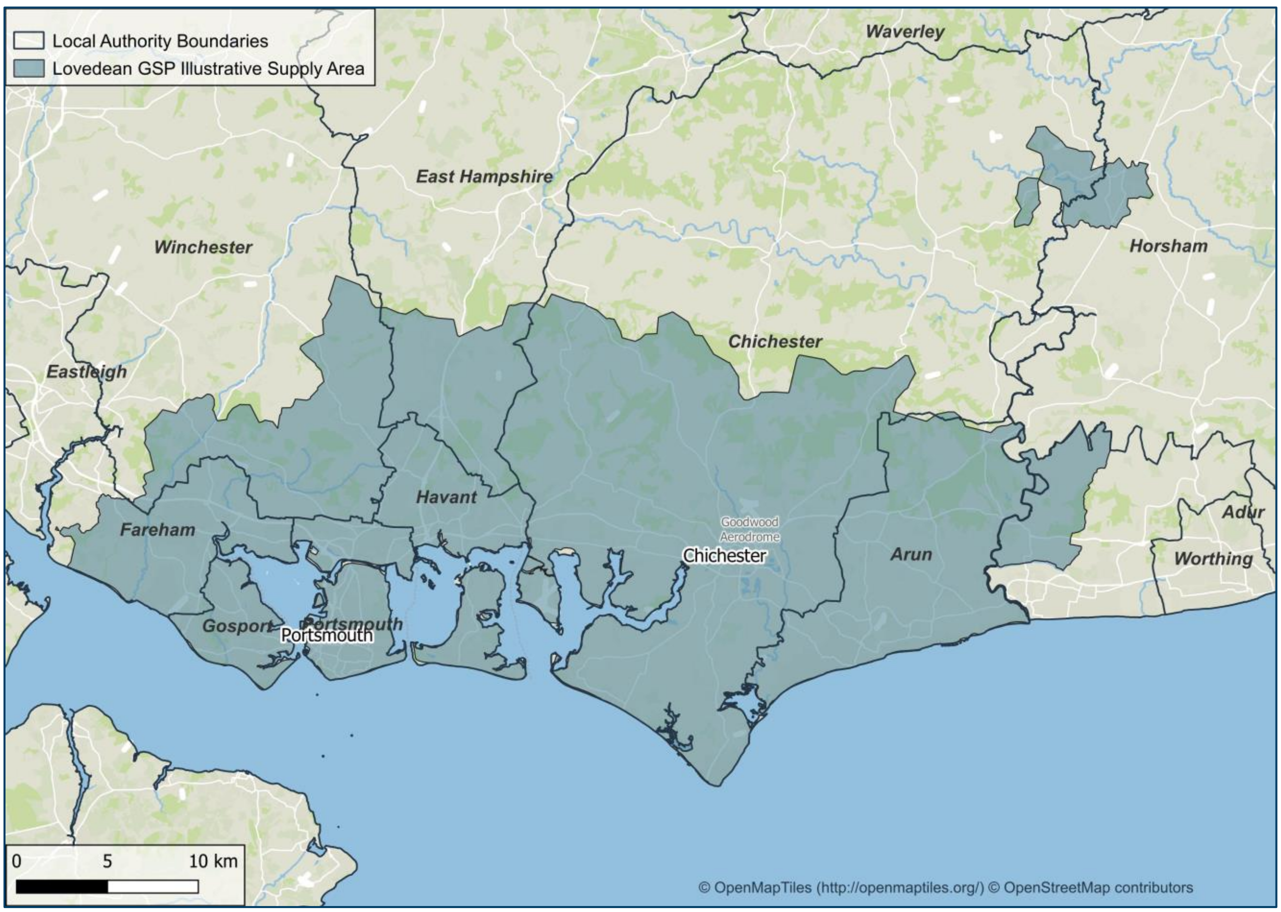

Figure 3 Lovedean GSP Supply Area and Local Authority Boundaries

3.1.1. Arun

Arun District Council has a net zero commitment for 2030 for its own business across all scopes, supported by a Carbon Neutral Strategy and Climate Action and Sustainability~~Biodiversity~~ Work Plan.

The Council has been and continues to roll out solar PV and batteries on assets including its Civic Centre and Leisure Centre and is reviewing the possibility of solar carports on their own car parks. ~~They are exploring the~~

~~feasibility of a heat network in the west of the district and are undertaking building audits to increase efficiency and shifting heating to heat pump where feasible.~~

In collaboration with the County Council and Connected Kerb, the Council is looking at implementing on-street EV charge points in addition to charge points in car parks.

3.1.2. Chichester

Chichester District Council has aimed to reduce emissions 10% year-on-year from 2018 to 2025, which will result in almost halving total emissions. Their local plan has been through examination, and they are planning for the electrification of their waste fleet and the infrastructure to support it at the depot. They are keen to develop heat networks, particularly the ring around the historic core, and are looking to electrify some of their rural estates who don't currently have a connection to the gas network.

3.1.3. Fareham

Fareham Borough Council has committed to being carbon neutral by 2030 for scope 1 (emissions from sources that an organisation owns or controls directly) and 2 (emissions that an organisation causes indirectly and come from where the energy it purchases and uses is produced) emissions. In terms of their own emissions, they are investigating opportunities to improve the energy efficiency of their buildings, running a bio-fuel trial for their garden waste collection vehicles, exploring opportunities to convert their vehicle fleet to ultra-low emission, including electrification.

More broadly, the council plans to install EV charge points in car parks, funding carbon reduction measures in their community centres, signposting residents to retrofit funding and exploring the feasibility of potential options for a solar farm.

3.1.4. Gosport

Gosport Borough Council has a climate change strategy that aspires for both the council and the borough to reach net-zero emissions by 2050 supported by an action plan. The council has already installed 30 charging points in 7 Council-owned car parks and the local plan has a policy requirement for an EV charge point for each new dwelling and a charge point for every five non-residential parking spaces. The Council has a rolling programme of work to keep Council houses up to date and aspires that in the future this will include the installation of low carbon technologies.

3.1.5. Havant

Havant Borough Council has a Climate Change and Environment Strategy that runs to 2026, committing the Council to net zero by 2050.

In support of this, the Council works in partnership with the Solar Together scheme and has undertaken a Heat Network Feasibility Study.

3.1.6. Portsmouth

Portsmouth City Council has a Climate Change Strategy that commits them to making the Council's operations net zero across all scopes by 2030 and to support efforts to make the city net zero by 2030. In support of this, the Council plans to develop a local area energy plan (LAEP).

The Council has a clean air zone and is rolling out on street electric vehicle charging, including 320 new charge points across 2025. The local plan encourages the use of heat networks in schemes of over 250 dwellings.

The Council supports the roll out of the Green Homes Grant Local Authority Delivery (GHG-LAD) and Home Upgrade Grant (HUG) schemes to retrofit domestic properties.

3.1.7. Winchester

Winchester City Council aims for the district to be carbon neutral by 2030, and to make the Council's own corporate estate net zero by the end of 2024. It has a Carbon Neutrality Action Plan that sets out a number of interventions to reduce carbon emissions.

Transport interventions include working with local businesses and procurement teams to decarbonize freight fleets and investing in EV charge points to decarbonize private cars. The EV strategy proposes locations for 46 charge points in council car parks, and so far, 35 have been installed. The Council has also recently launched its first electric waste vehicle. Instavolt is also launching the UK's largest rapid-only EV charging Super Hub off the A34 in Winchester in March 2025. It will be powered by on-site PV and energy storage.

To decarbonize buildings, the Council is rolling out several interventions for retrofit across domestic, commercial and industrial properties. Several measures have already been completed across the Council's own estate including the installing of solar PV, and there is an emerging programme of work to encourage businesses in the district to install solar PV and heat pumps.

A future action is to explore the feasibility of developing a hydrogen generating plant as a source of renewable fuel and to divert waste from land fill.

The Council has also committed to developing a local area energy plan (LAEP) as a priority action. Part of this will include the development of a renewable energy generation plan. The Carbon Neutrality Action Plan sets an objective to develop an additional 203MW of renewable energy across the Winchester district.

3.1.8. East Hampshire

East Hampshire District Council aims for the Council's emissions to be net zero by 2035 and for the district to be net zero by 2050, and is supported by the recently adopted strategy.

The Council has already rolled out five electric vehicle charge points in the borough and has committed to developing an EV strategy as part of the net climate and environment strategy delivery plan. This is likely to look at centralised locations like car parks for deployment.

Building decarbonisation is focused on the emerging local plan requiring the operational energy of new dwellings to be net zero. In terms of retrofit, the Council is working with communities to encourage eligible residents to apply for grants and operates a COSY loans scheme for those not eligible.

A Renewable and Low Carbon Study was carried out to assess the potential for further renewable generation across the district, which will inform the emerging local plan for potential sites for development.

3.1.9. Horsham

Horsham District Council aims for Council operations to be carbon neutral by 2030 and the wider district by 2050. This is supported by a Climate Action Strategy.

In collaboration with the County Council and Connected Kerb, the Council is looking at implementing on-street EV charge points in addition to charge points in car parks. The Council is also exploring the opportunity for a hydrogen refuelling station in the district.

The Council has partnered with Community Energy Horsham to roll out solar PV on its buildings and they offer Green LEAP Small Business Grants.

3.1.10. Hampshire County Council

Hampshire County Council has two targets: to be carbon neutral by 2050 and to build resilience to a two-degree rise in temperatures. The Council has published a strategy, action plan and strategic framework for action to achieve its carbon neutral aims and details numerous steps it has planned to electrify various sectors of the local economy.

In its strategic framework, the Council lays out plans to develop and roll out an electric vehicle strategy across the county and development of an electric vehicle charge point strategy is underway, supported by the LEVI (Local Electric Vehicle Infrastructure) fund. In terms of its own estates, the Council aims to transition to fossil-fuel-free heating and install solar PV on depot buildings and retrofit programme for privately owned residential properties has been identified and the Solar Together programme for group buying solar PV and battery storage has already taken place.

The Council intends to work with partners to balance renewable energy generation and demand, building self-sufficient communities throughout the county. A county-wide local area energy plan is to be developed and SSEN will be working closely with the Council and its partners during this process.

3.1.11. West Sussex County Council

West Sussex County Council aims to be a net zero council by 2030 and has an adopted strategy and Climate Action Adaptation Plan, which commits the Council to developing a local area energy plan (LAEP). Supporting this is the Council's Energy Strategy.

The Council already owns and operates two solar farms and has installed solar panels on 80 schools across the county. The Council is continuing to roll out solar PV and battery installations across schools and its own estate and is developing a large-scale energy storage facility. For residents, the Council continues to partner with Solar Together.

The Council has an Electric Vehicle Strategy, that ensures there is sufficient charging infrastructure in place to support the vehicles predicted to be reliant on public infrastructure to charge, and that for charging points on County Council land or highway are providing renewable energy.

3.2. Whole System Considerations

3.2.1. Specific whole system considerations

As shown in Figure 1, Lovedean GSP supplies a significant coastal area including Portsmouth Harbour. The Shipping sector is a new, large electricity customer, and the UK's target of achieving zero-emissions shipping by 2050 will lead to a substantial increase in the demand for electricity across the maritime industry. Whilst this is not accounted for fully in the DFES 2023 projections here, future insight from SSEN's SeaChange innovation project will provide high quality insights for this in future iterations.[1] This will also support the ambition in the Portsmouth City council Climate Change Strategy to provide the relevant infrastructure at Portsmouth International Port and other council owned maritime facilities to enable the decarbonisation of shipping.[2] Further to the maritime industry, other large demand users connected to the distribution network include car manufacturing sites.

3.2.2. Transmission interactions

National Grid Electricity Transmission (NGET) has no plans for direct works at Lovedean GSP within RIIO-T3 timescales (transmission business plan period for 2026-2031) but has a longer-term ambition to potentially replace the existing transmission substation. We will continue to work with NGET to ensure our plans are coordinated in the long term. There are three generators that are registered as embedded (distribution connected) balancing mechanism units within the GSP.

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

2 Portsmouth City Council Climate Change Strategy 2023 Version 2

3.2.3. Flexibility Considerations

Flexibility services

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.[3,4]

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.[3]

Areas across Lovedean GSP where flexibility has been procured is shown below in Figure 4. This map shows all Flexibility Services procured, which covers requirements beyond those identified for managing the deferral of reinforcement.

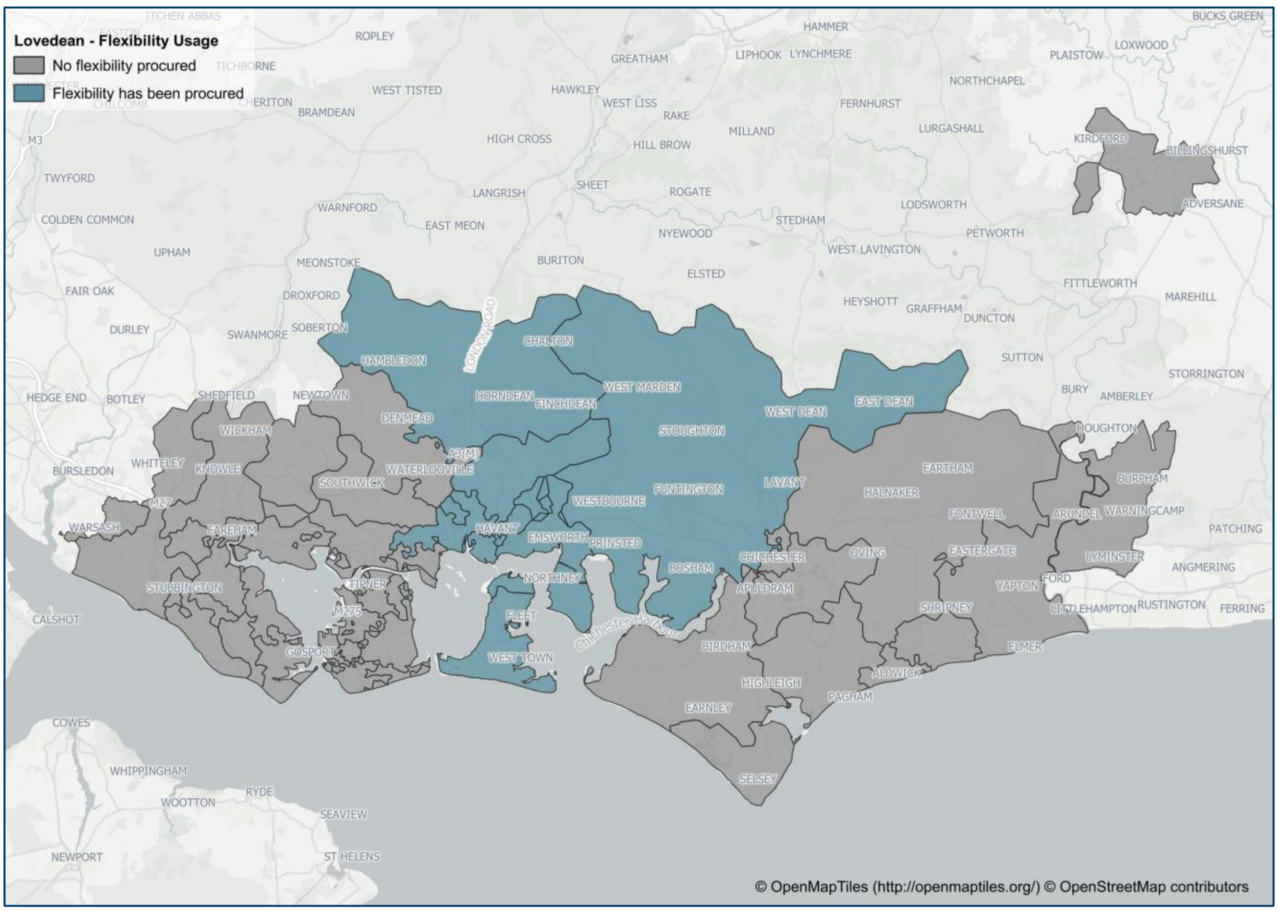

Figure 4 Flexibility procurement across Lovedean GSP.

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

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

4. EXISTING NETWORK INFRASTRUCTURE

4.1. Lovedean Grid Supply Point Context

The Lovedean GSP network is made up of 132kV, 33kV, 11kV, and LV circuits. It has both areas of urban and rural network, covering densely populated areas such as Portsmouth, Gosport, and Chichester, but also a large rural area along the South coast. In total the GSP serves approximately 350,000 customers. Table 1 shows the values for the GSP and Bulk Supply Points (BSPs) for information on primary substations please see Appendix A. The peak maximum demand refers to the peak at each individual substation which may not be at a coincident time as the others (meaning we would not expect the values for each BSP to sum to that at the GSP).

Substation Name	Site Type	Number of Customers Served (approximate)	2023/24 Substation Maximum demand in MVA (Season)
Lovedean	Grid Supply Point	351,000	536 (Winter)
Chichester & Hunston	Bulk Supply Point	94,000	148 (Winter)
Portsmouth	Bulk Supply Point	52,000	91 (Winter)
Havant	Bulk Supply Point	57,000	74 (Winter)
Wymering	Bulk Supply Point	51,000	89 (Winter)
Fort Widley	Bulk Supply Point	19,000	38 (Winter)
Fareham (T1A & T2A)	Bulk Supply Point	46,000	78 (Winter)
Fareham (T1B & T2B)	Bulk Supply Point	28,000	32 (Winter)

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

4.2. Current Network Topology

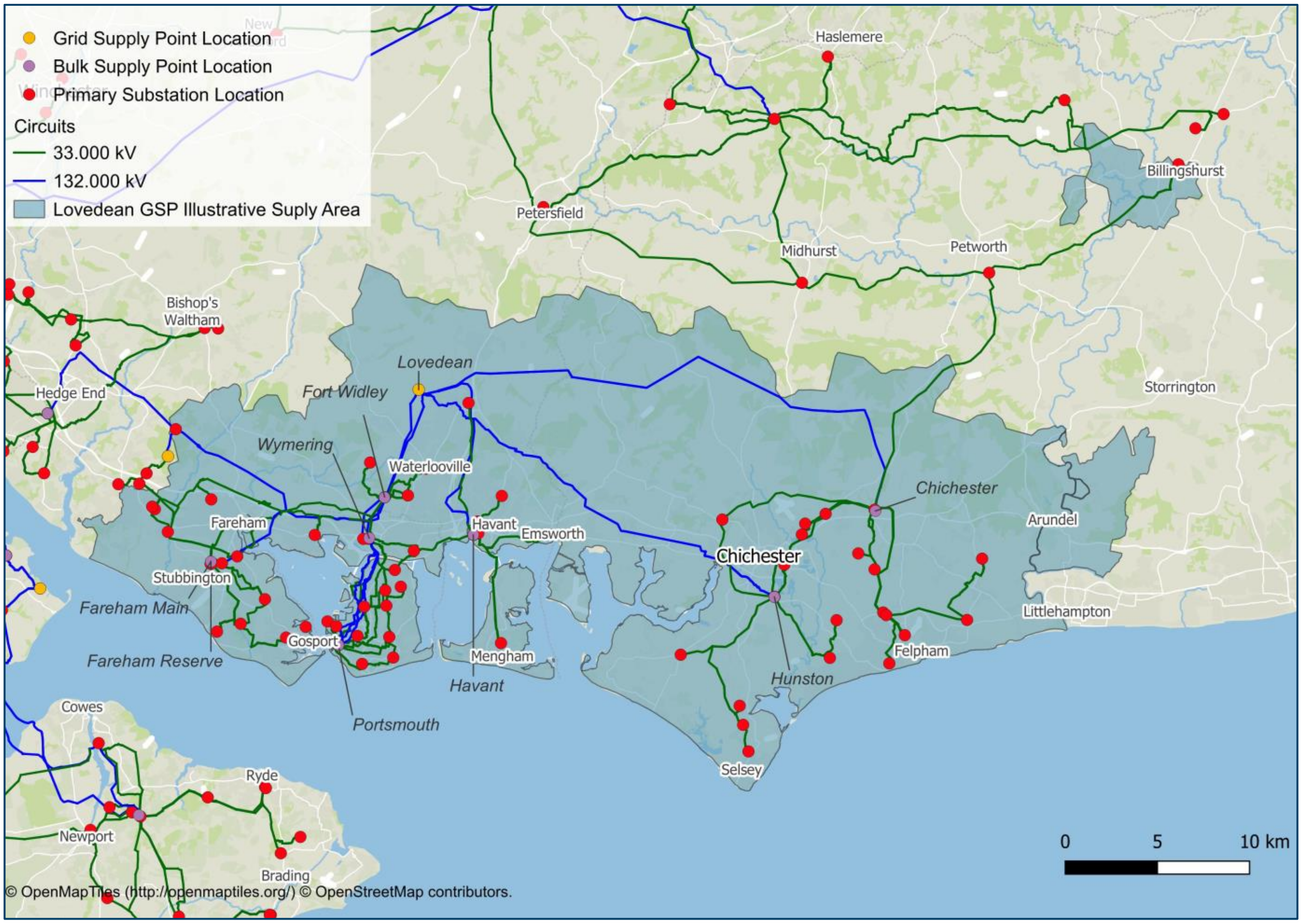

Figure 5 Geographic Information System view of Lovedean electricity network.

4.3. Current Network Schematic

The existing 132kV network at Lovedean GSP is shown below in Figure 6, network schematics for the 33kV network are shown in appendix B.

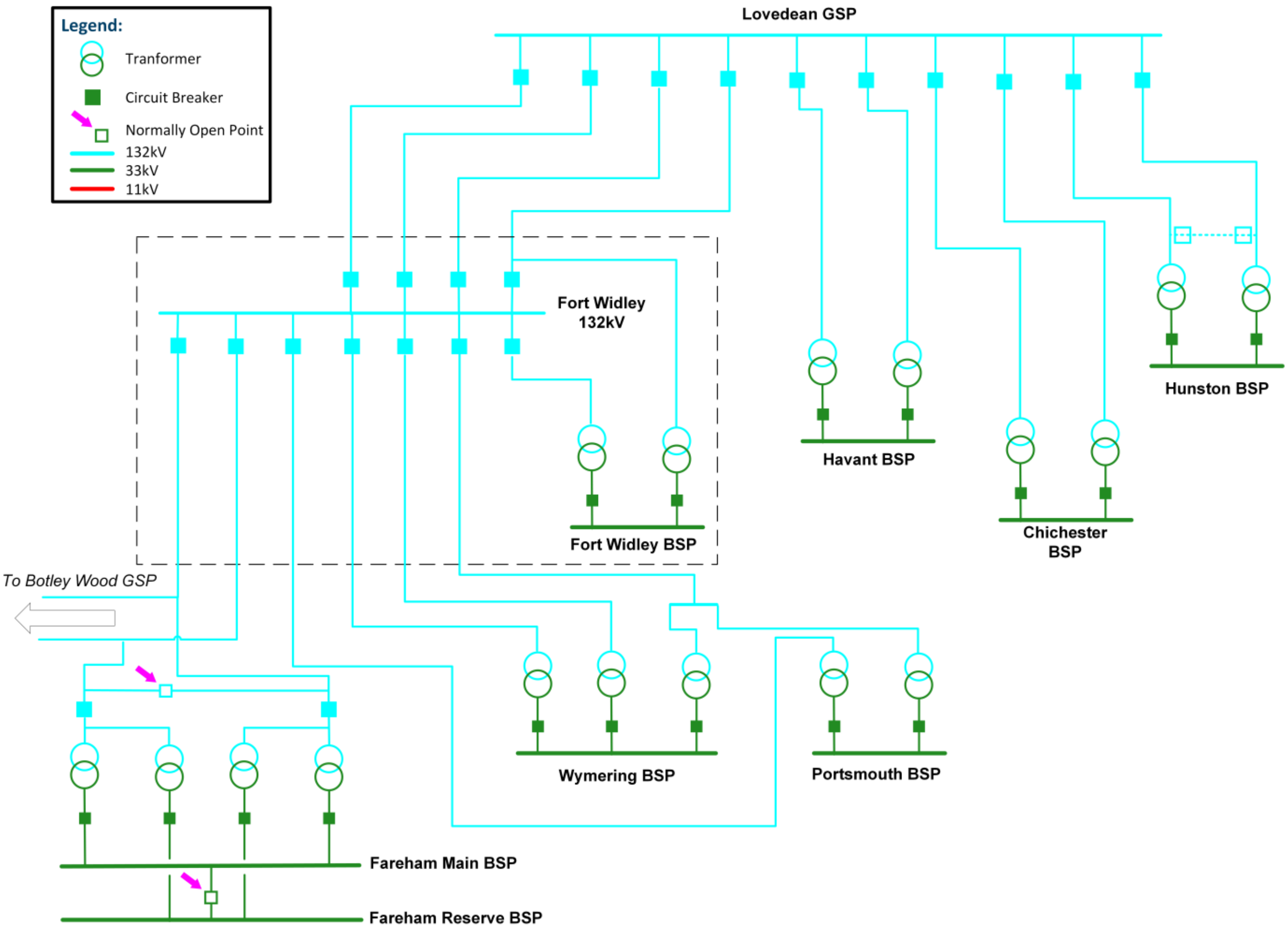

Figure 6 Existing 132kV network supplied by Lovedean GSP

5. FUTURE ELECTRICITY LOAD AT LOVEDEAN GSP

The following section details load growth across the technologies projected in the Distribution Future Energy Scenarios 2023[5]. There are important notes on the values presented here:

- 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 estimate the coincident maximum demand of the entire system rather than the total sum of all demands. This accounts for the fact that not all demand load connected to the network peaks at the same time.

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

5.1. Distributed Energy Resource

5.1.1. DFES Projections

Generation

The Lovedean GSP supply area covers an area across the South coast including large urban areas but also more rural areas slightly inland. Due to the high solar irradiance relative to the rest of the UK, it is a suitable area for installation of solar PV. The DFES 2023 generation projections reflect this with an installed capacity of almost 800MW projected under the Consumer Transformation scenario ahead of 2050. This is split across small to medium sized arrays (installed capacity <1MW) and larger generation sites (installed capacity >=1MW). There is a larger penetration of rooftop arrays in the more built-up areas while the larger scale sites are in more rural areas where there is sufficient available land to develop.

5 SSEN Distribution Future Energy Scenarios 2023

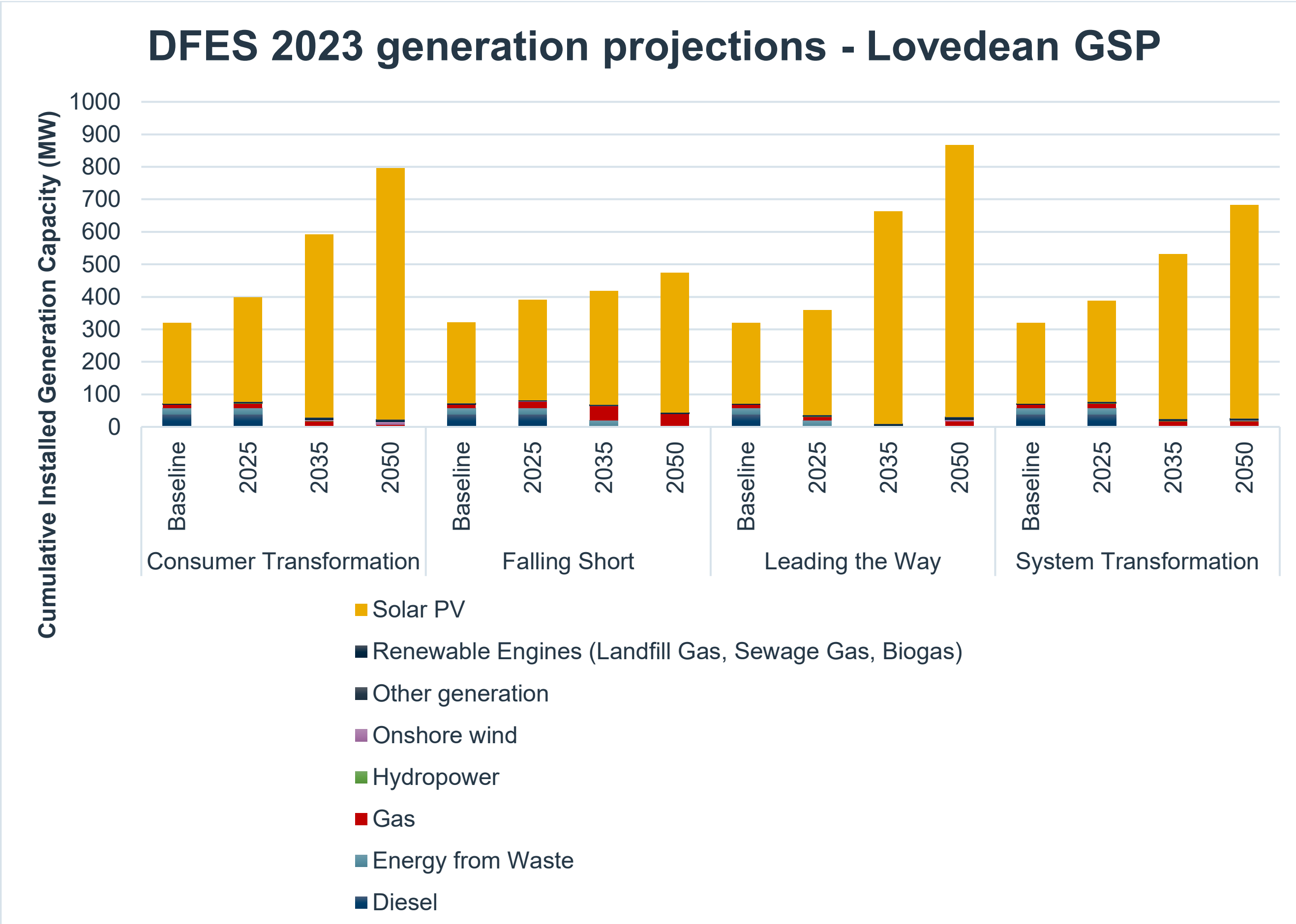

Figure 7 Projected cumulative distributed generation capacity Lovedean GSP (MW). *Source: SSEN DFES 2023*

Storage

The DFES also projects a significant amount of installed storage capacity ahead of 2050. Domestic battery storage could equate to 98MW of installed storage capacity by 2050. As seen with solar PV both small- and large-scale projects are projected, standalone batteries offering grid services are projected to exceed 100MW of installed capacity.

5.2. Transport Electrification

As explored in section 3.1, multiple of the local authorities in the study area have EV strategies in place. This stakeholder ambition is then reflected in the DFES projections to allow us to understand the network impact. It is important to note that any electrification of other transport vectors will likely also have a network impact. In the Lovedean GSP supply area this is notable as it is a coastal area so may see significant electricity demand increases through decarbonisation of marine transport.

SSEN are investigating this further through the SeaChange project, which is currently in the Alpha phase of the Strategic Innovation Fund (SIF). The project will develop a tool to understand potential maritime energy demands and considerations for optimised network planning. Then develop business models to facilitate the transition and consider the regulatory considerations for critical national infrastructure.

5.2.1. DFES Projections

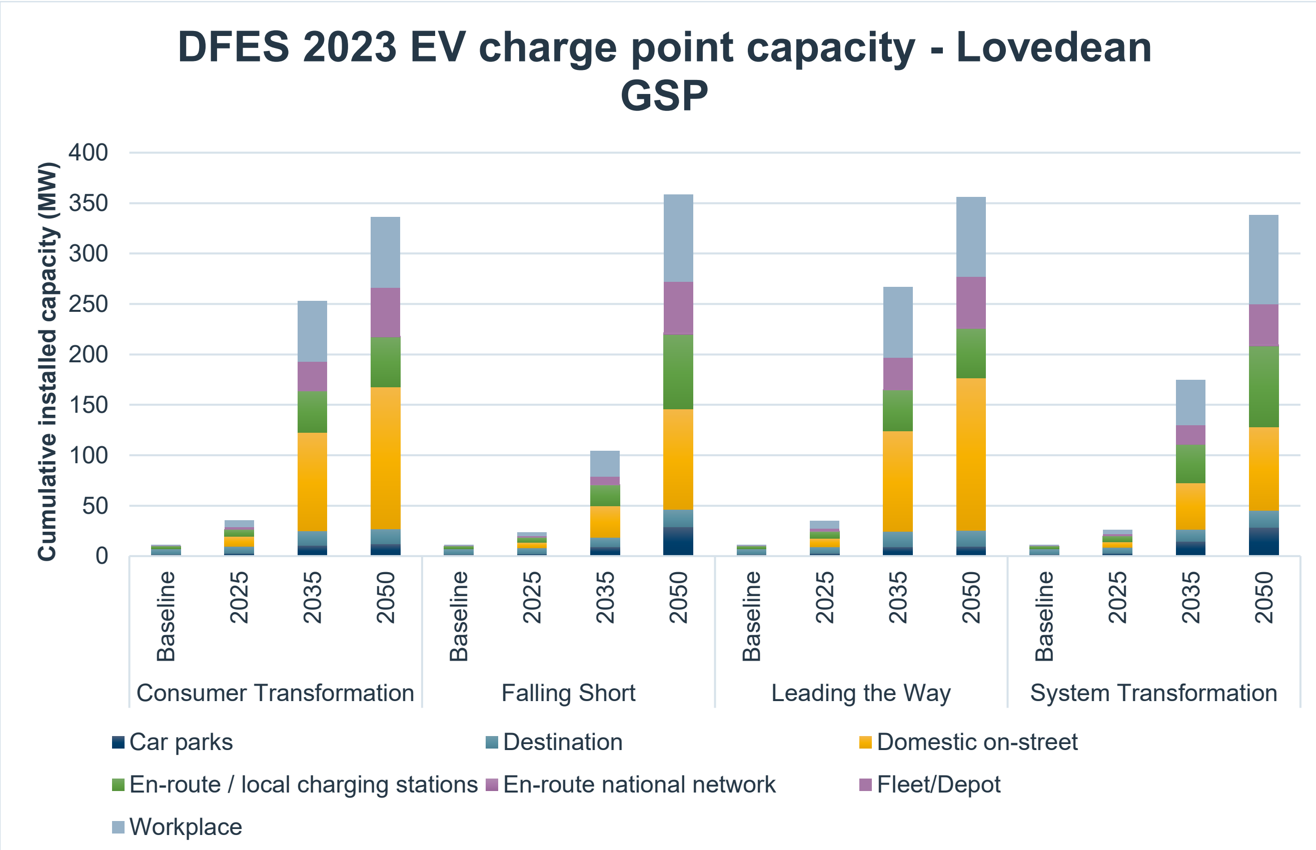

Figure 8 Projected EV charge point capacity across Lovedean GSP. *Source: SSEN DFES 2023*

As shown above in Figure 8, a range of different EV charger types are projected across the area with Workplace, En-route national network, En-route / local charging stations, and Domestic on-street chargers being the largest contributors. While the uptake rate differs across the four scenarios the 2050 total installed capacity is similar which reflects the higher degree of confidence that electrification of road transport will drive significant requirements of the electricity network.

Almost 1 million electric vehicles are projected to be located within the Lovedean GSP supply area by 2050 (DFES 2023 Consumer Transformation scenario).

5.3. Electrification of heat

The route to heat decarbonisation is currently more uncertain than for road transport, and a range of vectors/technologies may contribute. Scenario based modelling in the DFES uses a range of credible decarbonisation scenarios to capture this uncertainty. This uncertainty will likely be reduced following the decision from DESNZ on the role of hydrogen for heating in 2026.[6]

6 Decarbonising home heating - Committee of Public Accounts

5.3.1. DFES Projections

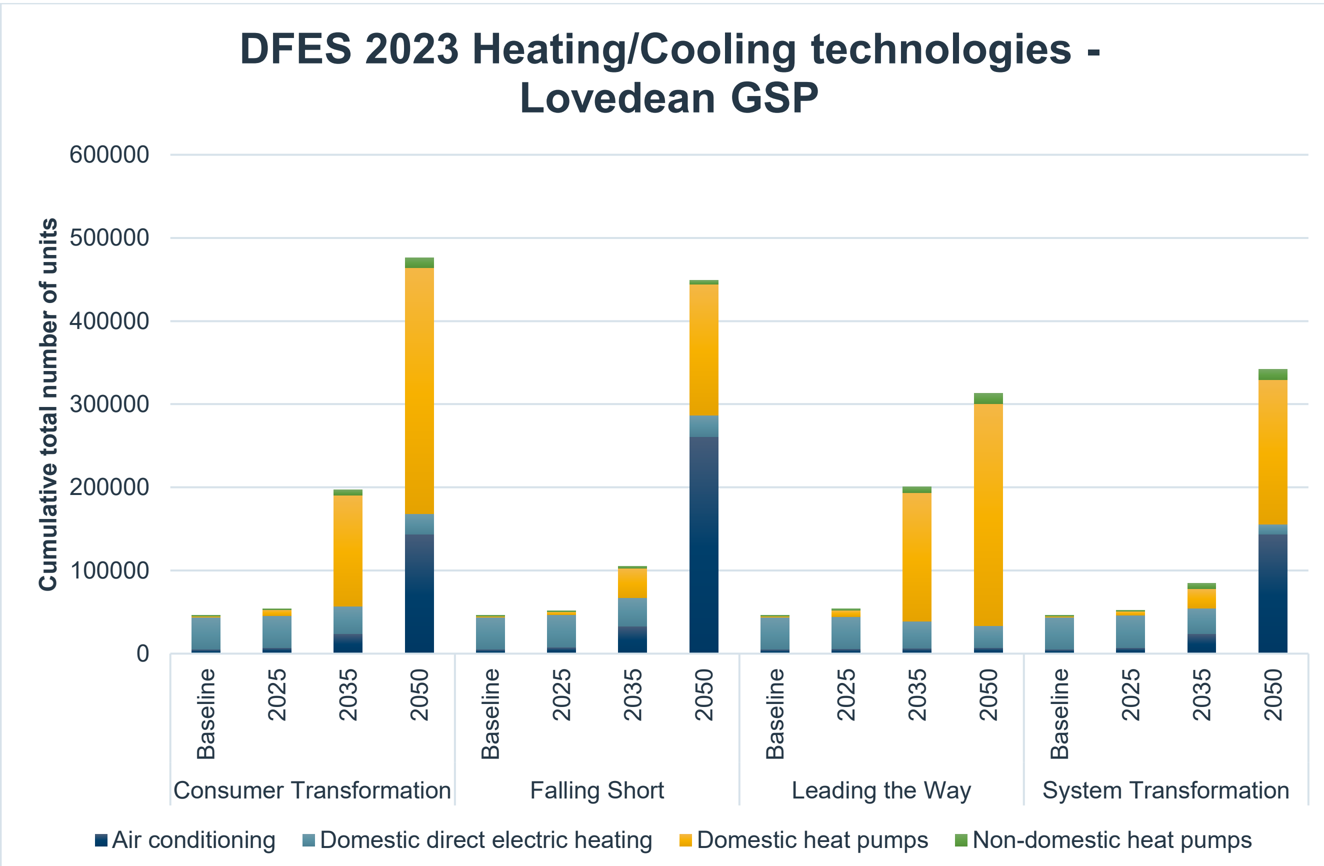

Figure 9 Projected number of heating/cooling technologies across Lovedean GSP. *Source: SSEN DFES 2023*

The DFES 2023 projects a significant increase in the number of heating/cooling units across all four scenarios. There is a dramatic increase in the number of domestic heat pumps rising from 1,487 units in the baseline to almost 300,000 units in 2050 (Consumer Transformation scenario). A dramatic increase in the number of air conditioning units is also projected under some of the scenarios, while the impact of air conditioning will not be coincident with heating technologies, it should be studied to understand the impact on summer peak demands. Warmer average temperatures along the South coast relative to the rest of the UK result in a higher uptake of AC than for other regions, especially comparing to the SHEPD licence area.

5.4. New building developments

A key stage in producing the DFES is engagement with Local Authorities. On an annual basis local authorities are requested to provide their current best view on new development plans to inform these projections. The results presented here are the information shared by local authorities during the DFES 2023 update 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

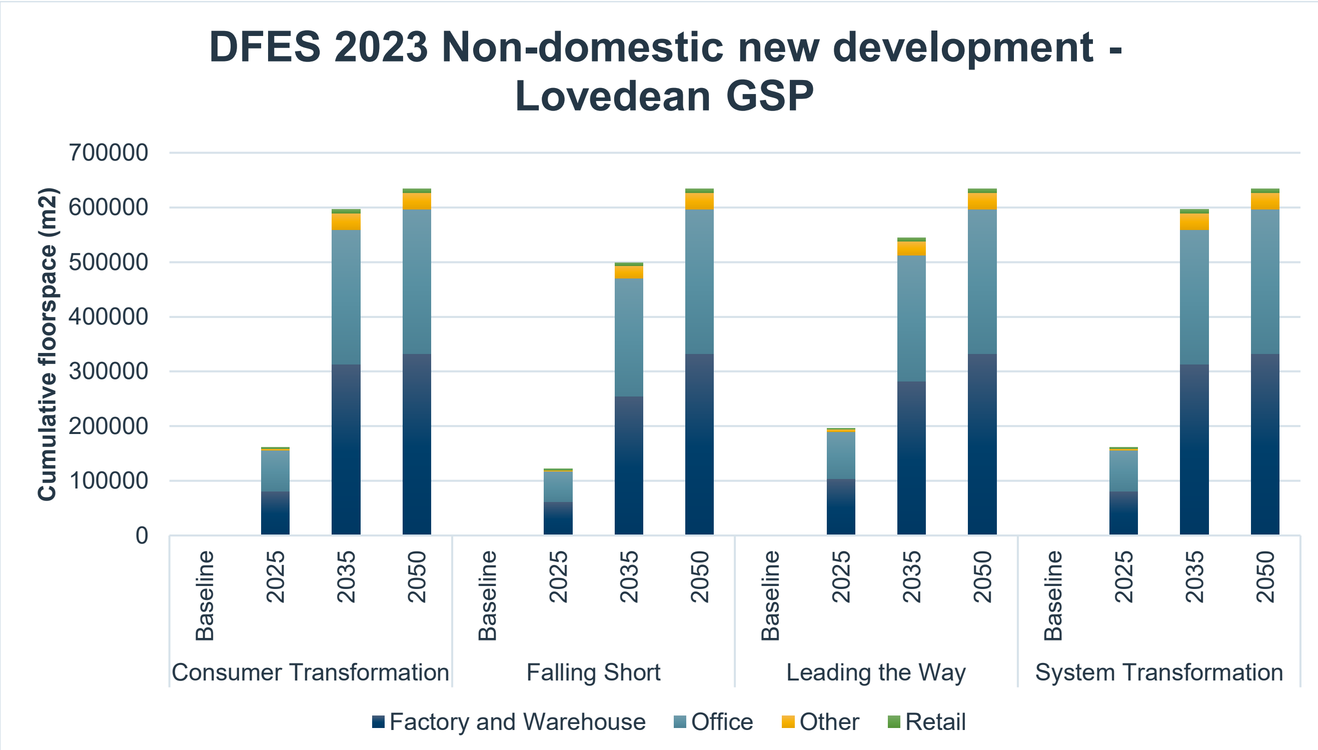

Figure 10 Projected non-domestic new development across Lovedean GSP. *Source: SSEN DFES 2023*

The relevant local authorities have informed us of multiple new developments across the area, with the two largest types being factory and warehouse floorspace, and office floorspace. Of this new floorspace, we are not currently aware of any that is more significantly energy intensive than our current modelling process assumes. Understanding the electricity demand of these new developments enables proactive strategic investment that aims to release capacity ahead of time. This should reduce lengthy connection wait times and support net zero ambitions and growth of the local economy.

As well as non-domestic new development the DFES 2023 also captures between 53,000 and 66,000 new homes in the area ahead of 2050. It should be noted that recent changes to the National Planning Policy Framework may result in significant changes to the targeted number of new homes[7], this will be captured in future iterations of the DFES and SDPs.

5.5. Commercial and industrial electrification

Outside of the DFES process, SSEN currently has a limited visibility of large scale new commercial and industrial electrification through bilateral discussions and connection applications.

It is important to note the importance of the maritime industry in the area of study for this report. Understanding of the potential electricity demands arising from the maritime industry will be key to appropriate sizing of assets and network development in the area. SSEN's SeaChange innovation project has been funded through the Strategic Innovation Fund.[8] This project involves building a 'Navigating Energy Transitions' (NET) tool, which will

7 National Planning Policy Framework - GOV.UK

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

help ports to plot their most viable pathways for decarbonisation. This tool will then give network operators like SSEN visibility of the predicted electrical load arising from ports. These insights will improve the quality of demand forecasting for subsequent DNOAs and SDPs for Lovedean GSP.

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 Lovedean 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. The drivers listed in the below table are predominantly where a customer connection application has driven the work or whether investment proposals developed through our DNOA process is driving the reinforcement work. The work included here is all work that has passed through the ID2 gate of our Distribution Governance and Investment Framework (DGIF), further information on this process is available in the DSO service statement 2025.[9] Summary of existing works is tabulated below:

ID (Schematic Reference)	Substation	Description	Driver	Forecast completion	Fully resolves strategic needs to 2050?
1	Chichester BSP	Reinforcement of the lower rated existing 132/33kV transformer at Chichester BSP.	Customer connection	2025	
2	Chichester BSP	Reinforcement of four 33kV Circuit Breakers (CBs) at Chichester BSP.	Customer connection	2025	
3	Hoeford PSS – North Fareham PSS	Reinforcement of 33kV circuit sections between Hoeford PSS and North Fareham PSS.	Customer connection	2025	
4	Birdham PSS	Installation of two new CBs at Hunston BSP. New 33kV dual circuit from Hunston BSP to Birdham PSS.	DNOA process	2026	

9 DSO Service Statement 2025

5	Hilsea PSS	Fault level reinforcement on 33kV bar at Hilsea PSS.	Customer connection	2026	-
6	Chichester BSP	New 132kV board at Chichester BSP and addition of a third 132/33kV transformer (run normally open). Install 33kV board at Bognor Bridge and transfer Market PSS to Chichester BSP.	Customer connection	2026	
7	Lovedean GSP	Reinforcement of 132kV circuits from Lovedean GSP to Chichester BSP. Havant BSP 33kV CB reinforcement.	Customer connection	2026	
8	Fareham BSP	Reinforcement of the lower rated existing 132/33kV transformer on Fareham BSP reserve bar.	Customer connection	2026	
9	Hunston BSP	Reinforcement of 33kV circuit between Hunston BSP and Rose Green PSS.	Customer connection	2026	
10	Wymering BSP – Hilsea PSS	Reinforcement of 33kV circuit sections between Wymering BSP and Hilsea PSS	Customer connection	2026	
11	Selsey PSS	Installation of a new 33kV indoor busbar at Selsey PSS. New 33kV dual circuit to be laid from	DNOA process	2027	

		Hunston BSP to Selsey PSS. New 33kV single circuits from Selsey PSS to Ferry Farm Selsey PV and from Selsey PSS to Sidlesham farm PV.			
12	Ashling Road PSS	Replace the two existing 33/11kV transformers with new units. New 33kV circuit from Hunston BSP to Ashling Road PSS, requires a new CB at Hunston BSP.	Primary reinforcement	2027	
13	Chichester PSS	Replace the two existing 33/11kV transformers with new units.	DNOA process	2028	
14	South Berstead PSS	Replace the two existing 33/11kV transformers with new units.	DNOA process	2028	
15	North Fareham PSS	Transfer North Fareham PSS to Botley Wood BSP (supplied by Botley Wood GSP). New 33kV circuits required.	DNOA process	2028	
16	Fort Widley BSP	Reinforcement of 132kV circuits from Fort Widley to Fareham tee. Reinforcement of the four 132kV circuits from Lovedean GSP to Fort Widley.	Customer connection	2028	

17	Horndean PSS	New 33kV and 11kV switchgear. Installation of a third 33/11kV transformer.	DNOA process	2029	
18	Fort Widley BSP	Replace existing 132/33kV transformers with two new units.	DNOA process	2029	
19	Horndean / Waterlooville 33kV network	Reinforcement of Fort Widley 33kV CBs and addition of two new 33kV CBs. New 33kV circuit from Fort Widley BSP to Horndean PSS. Replacement of 33kV and 11kV switchgear at Horndean PSS. Network rearrangement.	DNOA process	2029	
20	Lovedean GSP	New 132kV indoor switch room and double busbar to accommodate 28 CBs.	DNOA process	2029	
21	Emsworth PSS	Build a new PSS for relocation of Emsworth. Install two ne 33/11kV transformers at the site. New 11kV switch room and transfer 11kV feeders to the new PSS. New 33kV dual circuit to connect PSS to the existing 33kV network.	DNOA process	2029	

22	North Fareham PSS	Replace the two existing 33/11kV transformers with new units. Replace 11kV switchgear.	Customer connection	2029	
23	Hoeford PSS	Install a new 33kV board at the site and use a cable link to connect to the existing board. Installation of one additional 33/11kV transformer.	DNOA process	2030	
24	Bilsham PSS	Install new 33kV board and switch room. Installation of one additional 33/11kV transformer.	DNOA process	2030	
25	Birdham PSS	Replace the two existing 33/11kV transformers with new units.	DNOA process	2030	
26	Brockhurst PSS	New 33kV circuit from Fareham BSP to Brockhurst PSS. Installation of one additional 33/11kV transformer.	DNOA process	2031	
27	Titchfield PSS	Replace existing 33kV switchgear and replace existing board with indoor busbar system. Replace existing 33/11kV transformers with new units.	DNOA process	2031	
28	Chalcraft Lane PSS	Construction of a new PSS to accommodate load growth at South	DNOA process	2031	

		Berstead PSS. Install two 33/11kV transformers and lay new circuit from Shripney switching station to the new site.			
29	Fareham BSP	Existing 33kV busbar replaced with new 33kV indoor double busbar.	DNOA process	2031	
30	Portsmouth BSP	New 132kV circuit from Fort Widley 132kV switching station to Portsmouth BSP. New 132/33kV transformer at Portsmouth BSP.	DNOA process	2031	
31	Wymering BSP	Wymering BSP transferred to be directly fed from Lovedean GSP. Requires three new 132kV circuits and three new 132kV CBs at Lovedean GSP.	DNOA process	2031	

Table 2 Works already triggered through customer connections and the DNOA process.

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

Alongside these asset solutions being deployed, flexibility solutions are also being used to release additional capacity. This includes the installation of an Active Network Management (ANM) system at Chichester BSP. Active Network Management systems continually monitor all the constraints on an area of the network, in real-time, and allocates the maximum amount of capacity available to customers in that area based on the date their connection was accepted.

6.1. Network Schematic (following completion of above works)

The network schematic below in Figure 11 shows the 132kV network with changes highlighted and referenced to the table above, for the 33kV network future schematics, see appendix C.

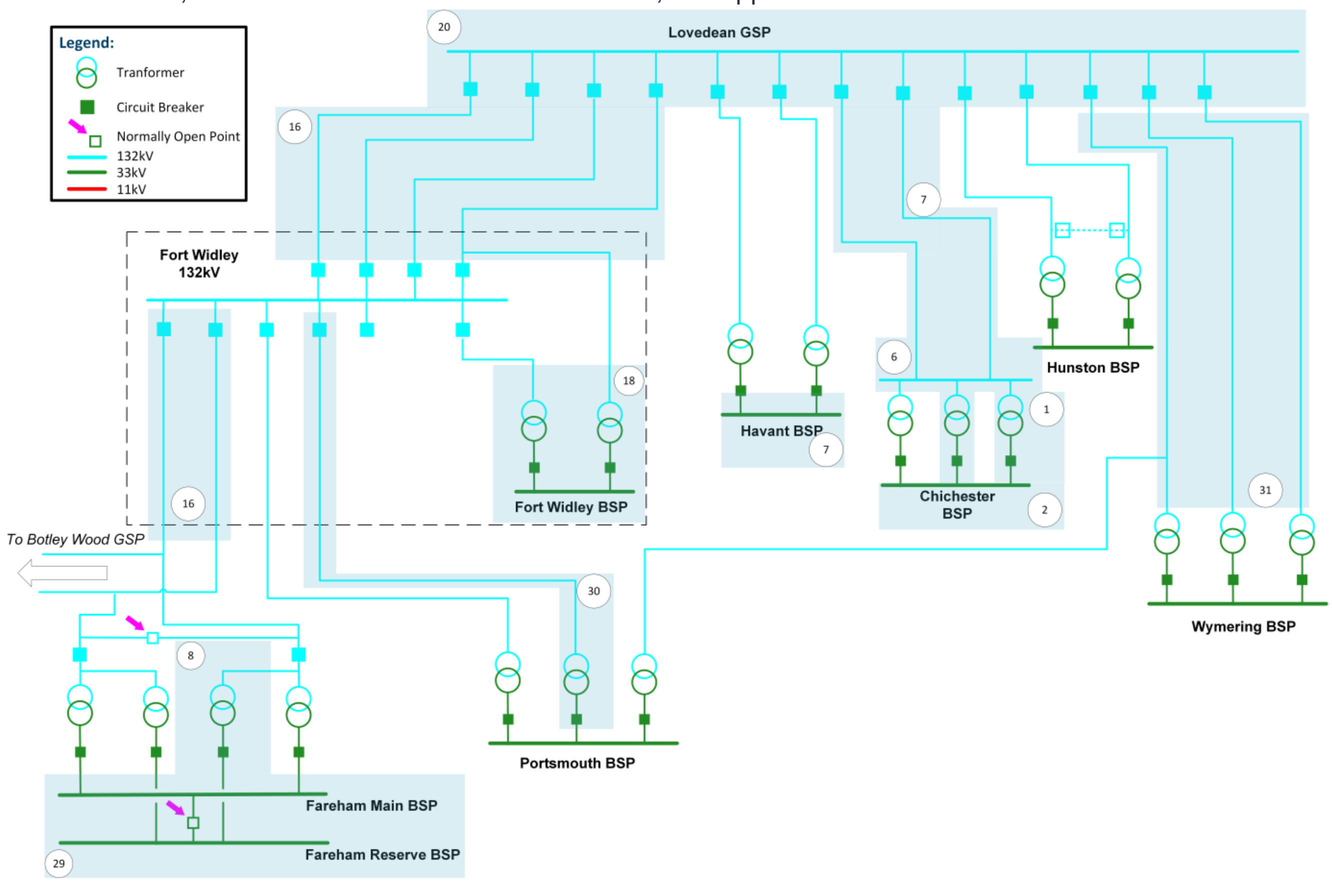

Figure 11 132kV Network schematic following completion of triggered works.

7. SPATIAL PLAN OF FUTURE NEEDS

7.1. Extra High Voltage / High Voltage spatial plans

The EHV/HV spatial plan shown below in Figure 12 shows the projected headroom or capacity shortfall due to demand increases at primary substations across the Lovedean SDP study area. Darker blue shades indicate that there is a projected capacity shortfall whereas lighter blue shades indicate that there is headroom capacity based on current projections. EHV/HV spatial plans for the other DFES scenarios are presented in appendix D. 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.

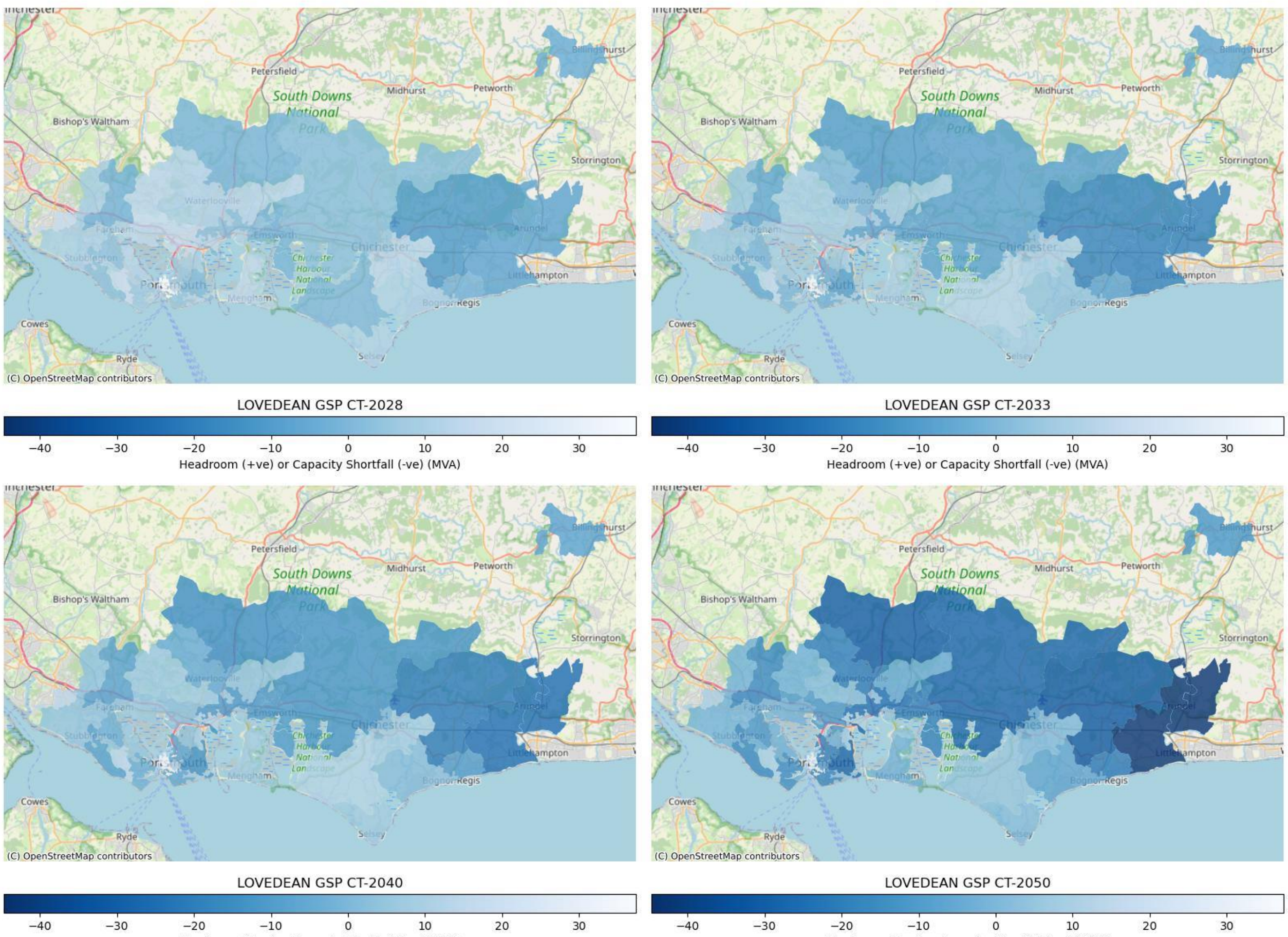

Figure 12 Lovedean GSP - EHV/HV Spatial Plans - Consumer Transformation

7.2. HV/LV spatial plans

The HV/LV spatial plans shown below in Figure 13 show the point locations of secondary transformers supplied by Lovedean GSP. The points are colourised based on the projected percentage loading with red meaning higher percentage loading and green being lower percentage loading. The HV/LV spatial plans for the other DFES scenarios are available in appendix E.

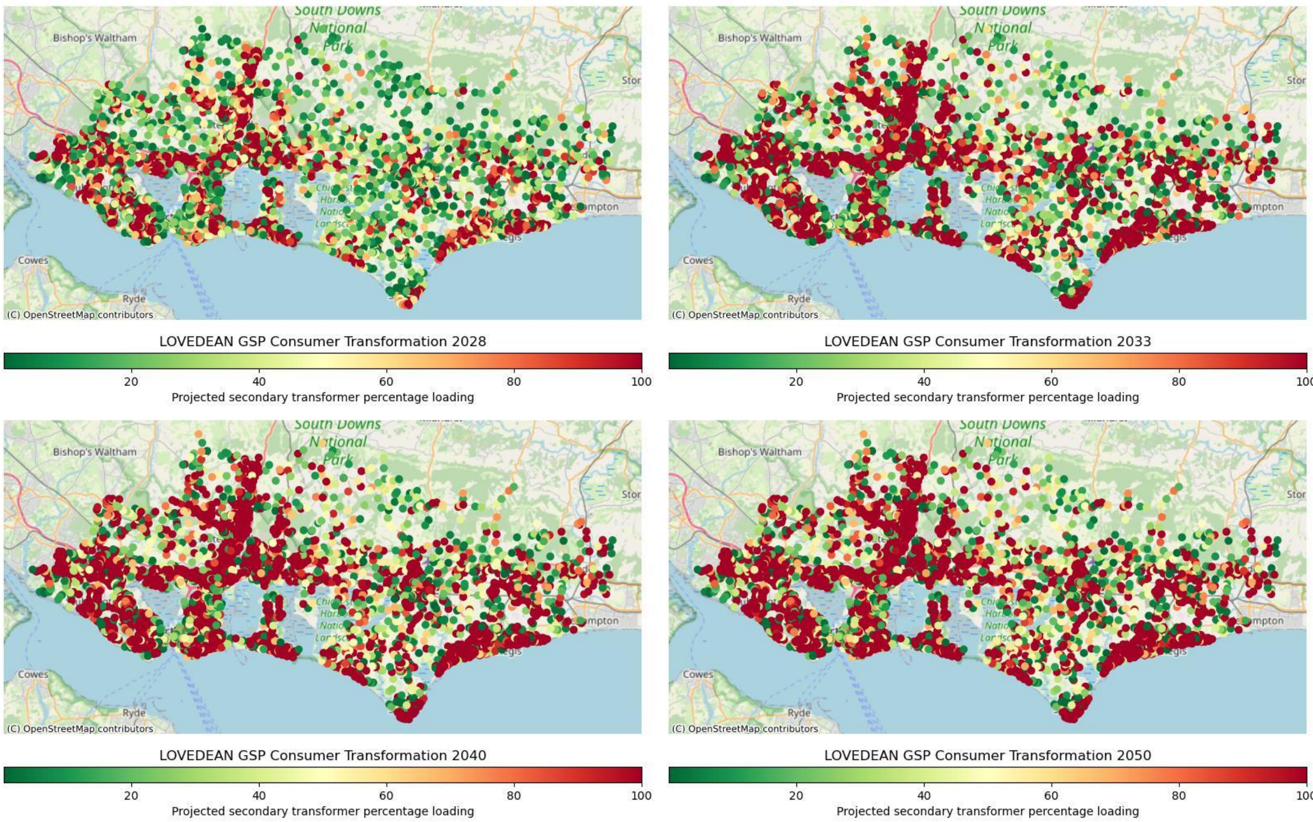

Figure 13 Lovedean GSP - HV/LV Spatial Plans - Consumer Transformation

8. SPECIFIC SYSTEM NEEDS AND OPTIONS TO RESOLVE

8.1.1. Overall dependencies, risks, and mitigations

There are a number of 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: Delivery of the reinforcement work highlighted in the works in progress section (section 6) will be required to enable both capacity in the near-term but also to enable the proposed future options in this system needs section.

Risks: Capacity is not released in the near-term. Additional space at the GSP and BSP sites to facilitate new circuit breaker bays is an important consideration.

Mitigation: Existing reinforcement schemes consider this, for example the 132kV indoor busbar proposed at Lovedean GSP allows for board extension in the future which will facilitate new 132kV circuit terminations in the future and resolves space constraints at the site. Proposed work should approach space constraints at sites and ensure that proposed work is enabling future network development.

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: Significant reinforcement work is projected to be required across densely populated areas such as Portsea Island, there may be associated delivery considerations.

Risks: Delivery of work may result in some disruption in the local area.

Mitigation: Early scoping of all work requirements driven by load out to 2050 has been identified through this work. This allows us to develop a suitable programme to complete the work with minimal disruption to local residents.

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.

8.2. Future generation requirements of the EHV network.

There is an increasing amount of distribution connected generation projected to connect as we approach 2050. This has the potential to result in a significant shift on the power flows observed on the network. While there will be specific system needs across the network fed by Lovedean GSP, here we look at the projected net power flows in 2030 and 2050. This is considering a minimum demand day, and peak generation which is projected to be summer due to the increased penetration of solar PV in the area. This analysis has been completed ahead of any changes to the generation queue arising from Clean Power 2030.

Figure 14 below shows net load profile in 2030 for a minimum demand day with peak generation. We can see the lowest net demand is at half hour 28 (14:00) which is driven by generation (mostly Solar PV) peaking at this time.

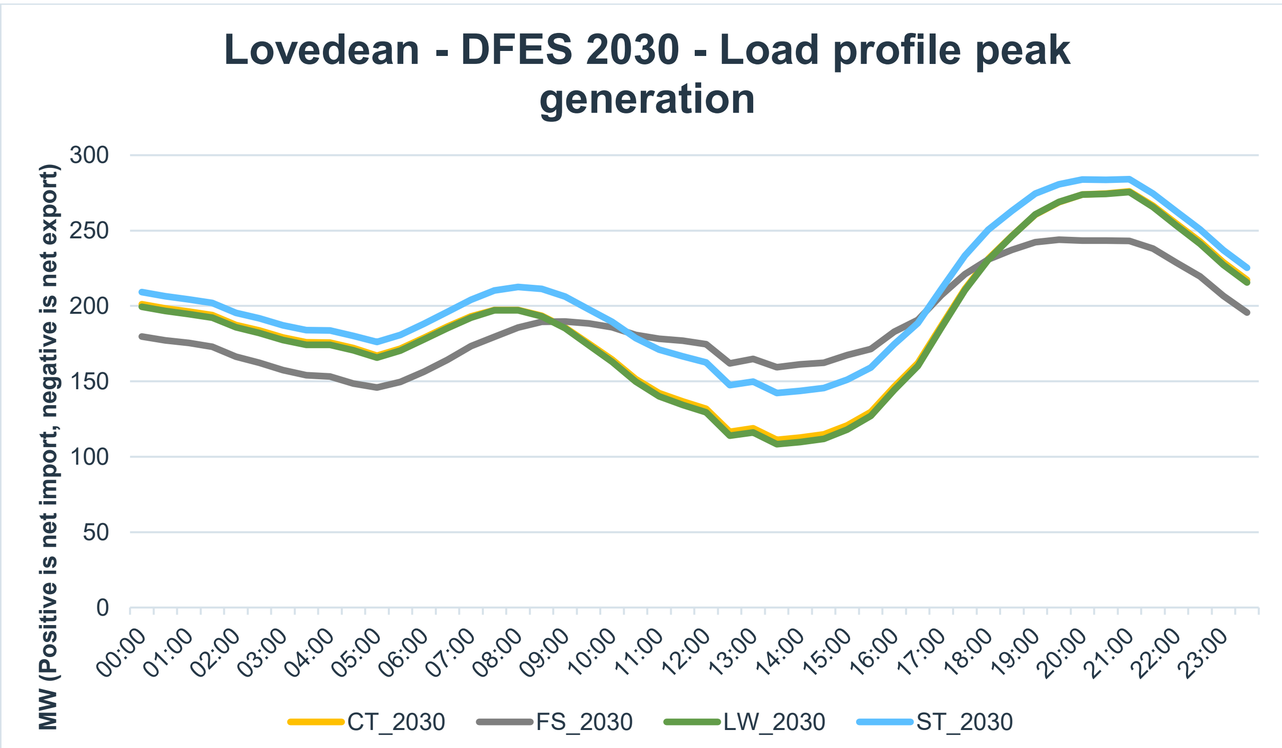

Figure 14 Lovedean GSP 2030 projected net daily load profile

There are several key factors that should be noted here:

- This is when considering the load profile from the day that showed the minimum demand point in the year 2022/23.
- The profile is static and doesn't consider any use of flexibility or the impact of energy storage systems that may be used to flatten the impact of peaks and troughs in a daily load profile.
- There is an inherent uncertainty with projections on this time horizon and this is intended to provide context rather than demonstrate an actual forecasted daily profile.
- These show the projected view at the GSP, at other points across the system the balance of demand and generation maybe different and this will require more specific intervention.

Figure 15 shows the minimum net daily load profile in 2050; we can see the lowest value is again at half hour 28 (14:00) but in this case the amount of generation exceeds the amount of demand in the system meaning that there is a large projected net export at Lovedean GSP.

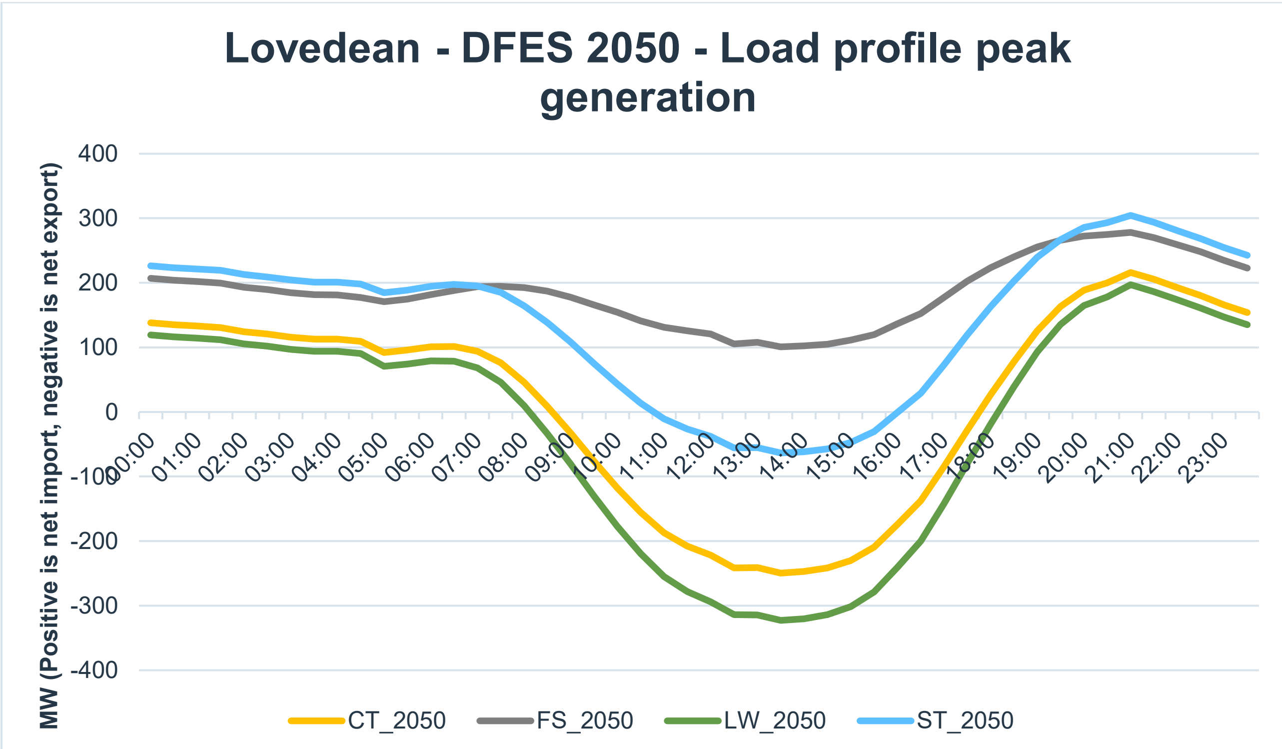

Figure 15 Lovedean GSP 2050 projected net daily load profile

While specific power system analysis including fault level studies has not been carried out for these scenarios here, it should be noted that further work maybe required on the distribution network to enable connection of this generation. Traditional reinforcement is not the only option, with mature access products (described in Our Flexibility Roadmap[10]) now able to help manage peak generation across different parts of the system.

8.3. Future EHV System Needs to 2035.

The following table details the near-term to medium-term distribution network system needs that have been identified through power system analysis. While asset solutions are described in the table below it is important to note that the use of flexibility will be evaluated for all schemes to ensure the best possible solution is progressed. For the projects shown in Table 3 we recommend that these are progressed through the DNOA process so that there is sufficient time for solutions to be designed and delivered.

Location of proposed intervention	CT Year	ST Year	LW Year	FS Year	CT loading of asset in year requiring intervention (%)	Network State (see glossary)	Proposed option(s) to resolve
Chichester BSP to Shripney switching station 33kV circuits.	2030 – 2035	2030 – 2035	2030 – 2035	2030 – 2035	100	N-1	Various 33kV circuit sections between Chichester BSP and Shripney switching station are projected to be overloaded under N-1 conditions. High-level options to resolve could be:

10 SSEN - Our Flexibility Roadmap

Location of proposed intervention	CT Year	ST Year	LW Year	FS Year	CT loading of asset in year requiring intervention (%)	Network State (see glossary)	Proposed option(s) to resolve
							• De-load Shripney by transferring a primary substation to Chichester BSP – short-term solution. • Construction of new circuits from Chichester BSP to Shripney PSS. • Upgrading Shripney with a 132kV supply and establishing as a new BSP – provides long term solution and can support load developing at neighbouring Chichester and Hunston BSPs. This is likely the preferred long-term option to resolve this constraint.
Meyrick Road 33/11kV transformer	2030 – 2035	2036 – 2040	2030 – 2035	2036 – 2040	104	N-1	The two existing 33/11kV transformers have different ratings. Both are overloaded in this timeframe, but the lower rated transformer is overloaded slightly earlier than the other. High-level options to resolve could include: • Reinforcement of both existing assets would provide capacity into the 2040s but may require further intervention if current forecasts are realised. • A longer-term strategy would be to reinforce the lower rated existing transformer to match the higher rated unit (15/30MVA), later a third transformer would need to be added to the site which would then provide sufficient capacity to 2050. An additional circuit will be required to facilitate addition of a third transformer (included in this table later).
Fareham Reserve to Rowner Park (via Brockhurst) 33kV circuit.	2030 – 2035	2030 – 2035	2030 – 2035	2036 – 2040	105	N-1	Potential option to resolve could be the direct connection of Zetland Road PSS to Fareham BSP to reduce peak demand on the assets – this would require approximately 8km of 33kV dual circuit. Further reinforcement of 33kV circuit sections from Fareham BSP to Rowner Park PSS and Lee-on-Solent

Location of proposed intervention	CT Year	ST Year	LW Year	FS Year	CT loading of asset in year requiring intervention (%)	Network State (see glossary)	Proposed option(s) to resolve
							PSS may be required to provide sufficient capacity in 2050.
Gamble Road PSS 33/11kV transformers.	2030 – 2035	2036 – 2040	2030 – 2035	2036 – 2040	107	N-1	The in-service 33/11kV transformer at Gamble Road PSS is projected to be overloaded under an N-1 condition. It should be noted that there are other Primary substations in the area that are also projected to experience capacity shortfalls in similar timeframes (for example, College Park), complementary solutions should be deployed. High-level options to resolve could include: • Reinforcement of existing assets to higher rated units (would require further intervention ahead of 2040). • Addition of a third transformer at the site - subject to space constraints (procurement of neighbouring land appears unlikely from a desk-based review). • Construction of a new primary substation to provide additional capacity in the area – land availability should be considered with potential connection to Wymering BSP or Portsmouth BSP. This will help ease projected capacity shortfalls across the area. Note circuit work required in a later year (dependent on solution deployed).
Zetland Road PSS 33/11kV transformers.	2030 – 2035	2036 – 2040	2030 – 2035	2036 – 2040	103	N-1	The in-service 33/11kV transformer at Zetland Road PSS is projected to be overloaded under an N-1 condition, high-level options to resolve could include: • Reinforcement of the existing assets could provide sufficient capacity until the mid-2040s, where additional capacity may be required if forecasts are realised. • Addition of a third transformer at the site maybe viable however, further 33kV network reinforcement will likely be required to facilitate this –

Location of proposed intervention	CT Year	ST Year	LW Year	FS Year	CT loading of asset in year requiring intervention (%)	Network State (see glossary)	Proposed option(s) to resolve
							this is detailed later. Further study may be required to consider implication on fault level.
Havant BSP to Meyrick Road PSS 33kV circuit.	2030 – 2035	2036 – 2040	2030 – 2035	2036 – 2040	109	N-1	The circuits supplying Meyrick Road from Havant BSP are projected to be overloaded under an N-1 condition, high-level options to resolve could include: • To enable the addition of a third 33/11kV transformer at Meyrick Road PSS (detailed earlier) a third 33kV circuit should be built to provide sufficient capacity at Meyrick Road PSS out to 2050.
Wymering BSP to Gamble Road 33kV circuit.	2030 – 2035	2036 – 2040	2030 – 2035	2036 – 2040	101	N-1	The 33kV circuits from Wymering BSP to Gamble Road PSS are projected to be overloaded under an N-1 condition, the solution deployed here should complement that described for the transformer reinforcement: • Reinforcement of existing 33kV circuits. • Construction of a third 33kV circuit to the existing Gamble Road sites. • Construction of new 33kV circuits to a new primary sites from the BSP best suited from a geographical and load perspective.
Fratton Park PSS 33/11kV transformers.	2030 – 2035	2036 – 2040	2030 – 2035	2041 – 2050	105	N-1	Projected overloading of Fratton Park 33/11kV transformers could be resolved through: • Load transfers through the HV network to Eastney PSS (projected to have spare capacity out to 2050) and continue to monitor load growth to defer reinforcement at Fratton Park PSS. • Reinforcement of the existing assets at the site to higher rated units (also requires circuit overlay in a later year). • Addition of a third transformer at the site – from a desktop study it seems

Location of proposed intervention	CT Year	ST Year	LW Year	FS Year	CT loading of asset in year requiring intervention (%)	Network State (see glossary)	Proposed option(s) to resolve
							there maybe space within the existing compound. This option would require a third circuit from Portsmouth BSP which would resolve the circuit constraint projected at a later date.
Lee-On-Solent PSS 33/11kV transformers.	2030 – 2035	2036 – 2040	2030 – 2035	2036 – 2040	108	N-1	Projected overloading of Lee-On-Solent 33/11kV transformers will need to be addressed, considerations to address this should include: • HV load transfers to neighbouring primary substations are unlikely to be a resolution due to the geography of the area. • From a desktop study the site appears to have sufficient space for expansion. In this case installation of 20/40MVA transformers to replace the existing assets is viable until 2050. Reinforcement of circuits in later year should ensure that they are sufficiently rated to allow full capacity of any new transformers installed to be fully utilised.
Portchester PSS 33/11kV transformers.	2030 – 2035	2036 – 2040	2030 – 2035	2041 – 2050	101	N-1	Projected overloading of Portchester 33/11kV transformers will need to be addressed, considerations to address this should include: • Reinforcement of existing assets. • Due to load growth both at Porchester PSS and Wymering PSS there is projected to be a capacity shortfall in the area. To resolve this, the potential for construction of a new primary should be investigated.
Selsey PSS 33/11kV transformers.	2030 – 2035	–	2030 – 2035	–	104	N-1	To resolve the network constraint on the 33/11kV transformers at Selsey PSS it is recommended to install a third 7.5/15MVA transformer at the primary substation. This would provide sufficient capacity at Selsey PSS until 2050 under current projections.

Location of proposed intervention	CT Year	ST Year	LW Year	FS Year	CT loading of asset in year requiring intervention (%)	Network State (see glossary)	Proposed option(s) to resolve
Portsmouth BSP to Fratton Park PSS 33kV circuit.	2030 – 2035	2036 – 2040	2030 – 2035	2041 – 2050	101	N-1	As highlighted earlier, 33kV supply circuits to Fratton Park PSS are projected to be overloaded shortly after the transformers. To resolve this reinforcement options could be: • Overlay of existing circuits (approximately 4km of dual 33kV underground circuit). • Addition of a third circuit from Portsmouth BSP to Fratton Park PSS – in a more detailed study the deliverability of this should be considered due to the densely populated area that a new cable route would likely follow.
33kV circuit to Lee-On-Solent PSS (tee off the Fareham reserve bar to Rowner Park 33kV circuit).	2030 – 2035	2041 – 2050	2030 – 2035	2041 – 2050	100	N-1	Reinforce the existing 33kV circuit from Lee-On-Solent tee to Lee-On-Solent PSS to a higher rated conductor (up to 2.6km requiring reinforcement in total). If transformer reinforcement is progressed as introduced earlier, circuits should have a minimum rating of at least 40MVA.
Lovedean GSP to Chichester BSP 132kV circuit.	2030 – 2035	2036 – 2040	2030 – 2035	2041 – 2050	103	N-1	Proposed reinforcement to resolve this constraint includes: • Development of Shripney BSP with a 132kV supply from Chichester BSP and Hunston BSP, with some of the load of the primary substations connected under Shripney now fed via a 132kV circuit from Hunston BSP the Chichester BSP circuits are slightly de-loaded. • Reinforcement of the underground cable segments of the Lovedean – Chichester dual 132kV circuit (approximately 2.3km) will increase firm capacity and maintain security of supply compliance.
Ashling Road PSS 33/11kV transformers.	2030 – 2035	2036 – 2040	2030 – 2035	2041 – 2050	101	N-1	Reinforcement of the two existing 33/11kV transformers to 20/40MVA units is proposed. Current forecasts

Location of proposed intervention	CT Year	ST Year	LW Year	FS Year	CT loading of asset in year requiring intervention (%)	Network State (see glossary)	Proposed option(s) to resolve
							show that this may not be sufficient until 2050. Construction of a new primary substation is proposed to relieve this future constraint at Ashling Road and provide sufficient capacity across the area for future development.
Havant BSP to Gable Head PSS 33kV circuit.	2030 – 2035	2041 – 2050	2030 – 2035	2041 – 2050	100	N-1	The existing 33kV circuits from Havant BSP to Gable Head PSS are approximately 6km and contain both overhead line and underground cable sections. The transformers at Gable Head PSS are not projected to require intervention until after 2040. Potential resolution: • As this primary substation is currently supplied by short lengths of subsea cable, SSEN Distribution's Island Resilience Policy applies. At this site this means N-2 support is required. As a result, reinforcement of the existing circuits and addition of a third circuit is likely to be required. The policy requirement here should be investigated in more detail before a solution is finalised. • As the only primary substation on Hayling Island, there is only a small capacity available for load transfer on the HV network.
Portsmouth BSP to Brandon Road PSS 33kV circuit.	2030 – 2035	–	2030 – 2035	2041 – 2050	102	N-1	The 33kV network from Portsmouth BSP to Brandon Road PSS also provides some on the capacity for Eastney PSS under normal running arrangements which adds some complexity to the reinforcement options when considering the projected 2050 requirements of the network. One option to resolve could be: • Join existing higher rated Portsmouth BSP to Brandon Road 33kV circuit with the existing Brandon Road PSS to Eastney PSS circuit so that this no longer

Location of proposed intervention	CT Year	ST Year	LW Year	FS Year	CT loading of asset in year requiring intervention (%)	Network State (see glossary)	Proposed option(s) to resolve
							supplies Brandon Road PSS and only passes through the site. • Overlay the remaining existing 33kV circuit from Portsmouth BSP to Brandon Road PSS (up to 2.6km) • Addition of new Portsmouth BSP to Brandon Road 33kV circuit.
Fareham Reserve 132/33kV transformer.	2030 – 2035	2041 – 2050	2030 – 2035	2041 – 2050	100	N-1	Resolution would be to implement a new 132kV indoor double busbar at Fareham BSP which will allow for three in-service transformers under N-1 conditions whereas currently it is only possible to have two remaining in-service. This arrangement will also allow for an additional 132kV circuit from Fort Widley to Fareham BSP which will resolve a constraint highlighted here to arise in the 2040s under the current arrangement. Due to the long-term uncertainty of these forecasts load growth should continue to be monitored with further work proposed if required.
Brandon Road PSS 33/11kV transformers.	2030 – 2035	–	2030 – 2035	–	105	N-1	If the proposed option to resolve the Portsmouth BSP – Brandon Road PSS 33kV circuit constraint is progressed it will enable two 20/40MVA transformers to replace the existing units, resolving this projected transformer constraint.
Chichester PSS 33/11kV transformers.	2030 – 2035	–	2030 – 2035	–	101	N-1	Currently triggered work provides capacity at Chichester PSS until approximately 2035. At this point further intervention will be required, several options should be considered for example: • Addition of a third 33/11kV transformer at the site, requiring a new 33kV CB at Chichester BSP 33kV busbar and a circuit to the new primary transformer (cost of new circuit will be low as the primary transformers and BSP are located at the same site).

Location of proposed intervention	CT Year	ST Year	LW Year	FS Year	CT loading of asset in year requiring intervention (%)	Network State (see glossary)	Proposed option(s) to resolve
							• HV load transfers to neighbouring primary substations that have been reinforced or to the newly proposed Chalcraft Lane PSS that is soon to be under construction.
College Park PSS 33/11kV transformers.	2030 – 2035	–	2030 – 2035	2041 – 2050	119	N-1	The in-service 33/11kV transformer at College Park PSS is projected to be overloaded under an N-1 condition. It should be noted that there are other Primary substations in the area that are also projected to experience capacity shortfalls in similar timeframes (for example, Gamble Road), complementary solutions should be deployed. High-level options to resolve could include: • Reinforcement of existing assets to higher rated units to 30MVA units would resolve the constraint at this site until 2050. • Construction of a new primary substation to provide additional capacity in the area – land availability should be considered with potential connection to Wymering BSP or Portsmouth BSP. This will help ease projected capacity shortfalls not just at this site but at neighbouring primaries through HV load transfers to the new primary substation.
Purbrook PSS 33/11kV transformers.	2030 – 2035	2041 – 2050	2030 – 2035	2041 – 2050	102	N-1	Reinforcement of the 33/11kV transformers at Purbrook PSS with higher rated units will provide sufficient capacity to 2050. Further work to relieve the circuit constraint projected to arise at a later date is visited in a later section. As a longer-term solution, it may be beneficial to expand this site further to satisfy projected demands at Waterlooville and Horndean PSS. Transfers through the HV network would then allow load to be transferred between these primary substations.

Location of proposed intervention	CT Year	ST Year	LW Year	FS Year	CT loading of asset in year requiring intervention (%)	Network State (see glossary)	Proposed option(s) to resolve
							Alternatively, a new primary substation should be developed with new circuits to Fort Widley BSP.
Wymering PSS 33/11kV transformers.	2030 – 2035	2036 – 2040	2030 – 2035	2041 – 2050	125	N-1	Further reinforcement of the assets at Wymering PSS is unlikely to provide sufficient capacity at out to 2050 as higher rated units are not currently in use at the 33/11kV voltage level. As stated under the Portchester 33/11kV transformer reinforcement a new primary substation in the area would be a suitable solution to mitigate constraints at both neighbouring primary substations by transferring load through the HV network to the new site.
Wymering BSP to Portchester PSS 33kV circuit.	2030 – 2035	–	2030 – 2035	2041 – 2050	117	N-1	If the option of a new primary substation in the area is progressed, transferring some of the future projected load at Portchester PSS to a new site will relieve this 33kV circuit constraint.
Havant BSP 132/33kV transformer.	2030 – 2035	2041 – 2050	2030 – 2035	2041 – 2050	106	N-1	To resolve the projected constraint at Havant BSP, a third 132/33kV transformer should be installed at the site – this will also require a third 132kV circuit from Lovedean to Havant to enable installation of a third transformer.

Table 3 Summary of system needs identified in this strategy through to 2035 along with indicative solutions.

8.4. Future EHV System Needs to 2040.

Table 4 details work that has been identified through power system analysis but are currently projected to arise between 2036 and 2040. The requirement for these works should continue to be monitored as the longer-term forecast has a higher degree of uncertainty associated. The annual update process for the SDPs will continue to analyse these requirements.

Location of proposed intervention	CT Year	ST Year	LW Year	FS Year	CT Worst case asset loading (%)	Network State	Proposed option(s) to resolve
Shripney switching station to Bilsham PSS 33kV circuit.	2036 – 2040	2036 – 2040	2036 – 2040	2036 – 2040	104	N-1	Addition of a third 33kV circuit from Shripney to Bilsham PSS (approximately 4.6km) is recommended as the future work

Location of proposed intervention	CT Year	ST Year	LW Year	FS Year	CT Worst case asset loading (%)	Network State	Proposed option(s) to resolve
							to ensure there is sufficient capacity at the site to 2050.
Chichester BSP 132/33kV transformer.	2036 – 2040	2041 – 2050	2030 – 2035	2041 – 2050	106	N-1	Development of Shripney as a BSP introduced earlier would help resolve this constraint. The primary substations currently fed from Shripney switching station (and Chichester BSP) will now be fed by Shripney BSP, this will de-load the Chichester BSP transformers and resolving the constraint observed here.
Waterlooville PSS 33/11kV transformers	2036 – 2040	2041 – 2050	2030 – 2035	2041 – 2050	102	N-1	Waterlooville PSS already has three 33/11kV transformers installed so further reinforcement or expansion of this site may not be beneficial. As detailed under Purbrook PSS 33/11kV transformer intervention detailed in the previous section, expansion of Purbrook PSS and load transfer through the HV network or construction of a new primary substation in the area should be progressed.
Hunston BSP 132/33kV transformer.	2036 – 2040	2041 – 2050	2036 – 2040	2041 – 2050	100	N-1	Development of Shripney as a BSP introduced earlier alongside the transfer of Rose Green PSS to the new BSP will reduce the load at Hunston BSP and defer this required intervention into the 2040s. At this point further reinforcement maybe required, for example the installation of a third 132/33kV transformer.
Purbrook PSS to Waterlooville PSS 33kV circuit, Fort Widley BSP to Waterlooville PSS 33kV circuit, and Havant BSP to Waterlooville 33kV circuit.	2036 – 2040	2041 – 2050	2030 – 2035	2041 – 2050	105	N-1	The 33kV circuits from the Purbrook tee to Waterlooville PSS are projected to be overloaded, as is the Havant BSP to Waterlooville PSS 33kV circuit. The solution deployed here should be complementary to those for transformer reinforcements at each site. A long-term solution would be to create separate supplies for each PSS. To do this the first step could be to reinforce the section of circuit from the Purbrook tee to Waterlooville PSS. The tee from these circuits towards Purbrook PSS should be severed. New circuits should then be

Location of proposed intervention	CT Year	ST Year	LW Year	FS Year	CT Worst case asset loading (%)	Network State	Proposed option(s) to resolve
							constructed from Fort Widley BSP to the tee point (approximately 0.3km of dual circuit) that supplies Purbrook PSS. This would then result in Purbrook and Waterlooville primary substations having independent 33kV circuits from Fort Widley BSP. Allows further development at Purbrook through a construction of a third circuit from Fort Widley BSP to Purbrook PSS if required in the future. The 33kV circuit from Havant BSP to Waterlooville PSS is also projected to be overloaded ahead of 2050. This circuit is approximately 14.3km so reinforcement would be costly. It may be possible to construct a new 33kV circuit from Fort Widley BSP to Waterlooville PSS (approximately 3.5km) but this is dependent on the availability of new 33kV circuit breakers at Fort Widley BSP.
Lovedean GSP to Havant BSP 132kV circuit.	2036 – 2040	–	2036 – 2040	–	103	N-1	As mentioned earlier, to enable the installation of a third transformer at Havant BSP a third 132kV circuit from Lovedean GSP to Havant BSP will be required. This will resolve this constraint.
Rose Green PSS 33/11kV transformers.	2036 – 2040	–	2036 – 2040	–	104	N-1	Reinforcement of the 33/11kV transformers at Rose Green PSS to higher rated units will resolve the constraint highlighted here. Reinforcement to 20/40MVA units will leave some headroom in 2050 based on current projections which could relieve system needs at neighbouring primary substations in the future.
Fareham reserve to West End PSS 33kV circuit.	2036 – 2040	2041 – 2050	2036 – 2040	2041 – 2050	100	N-1	Reinforcement of the existing 33kV dual circuit (approximately 2.6km) will resolve this constraint and provide sufficient capacity at West End primary substation until 2050 based on current projections.
Fort Widley BSP to Purbrook PSS 33kV circuit.	2036 – 2040	–	2036 – 2040	–	101	N-1	The solution above referring to the 33kV circuits from Fort Widley towards Waterlooville would also resolve this constraint as the load of Waterlooville PSS is no longer on the sections projected to be

Location of proposed intervention	CT Year	ST Year	LW Year	FS Year	CT Worst case asset loading (%)	Network State	Proposed option(s) to resolve
							overloaded from Fort Widley BSP to Purbrook PSS.
Fareham main BSP 132/33kV transformer.	2036 – 2040	–	2036 – 2040	–	101	N-1	Potential resolution would be to implement a new 132kV indoor double busbar at Fareham BSP which will allow for three in-service transformers under N-1 conditions whereas currently it is only possible to have two remaining in-service. This arrangement will also allow for an additional 132kV circuit from Fort Widley to Fareham BSP which will resolve a constraint highlighted here to arise in the 2040s under the current arrangement. Due to the long-term uncertainty of these forecasts load growth should continue to be monitored with further work proposed if required.
Fareham reserve to Lee-On Solent PSS 33kV circuit.	2036 – 2040	–	2036 – 2040	–	102	N-1	An earlier proposed intervention moved Zetland Road to have independent 33kV circuits from Fareham BSP. This will reduce the peak demand on these circuits so will likely defer this reinforcement to a later year. The requirement for reinforcement should continue to be assessed so that the reinforcement work can be triggered if forecasts develop.
Fort Widley to Fareham BSP 132kV circuit.	2036 – 2040	–	2036 – 2040	–	101	N-1	To resolve this system need, it is suggested that a third 132kV circuit from Fort Widley to Fareham BSP is added. This is beneficial for N-1 and N-2 reasons and provides capacity past 2050 based on current projections.
Leigh Park PSS 33/11kV transformers.	2036 – 2040	–	2036 – 2040	–	102	N-1	To resolve the projected constraint at Leigh Park, reinforcement of the two existing 33/11kV transformers to 20/40MVA rated units will provide sufficient capacity until beyond 2050.
Rowner Park PSS to Zetland Road PSS 33kV circuit.	2036 – 2040	–	2036 – 2040	–	102	N-1	An earlier proposed intervention moved Zetland Road to have independent 33kV circuits from Fareham BSP. This will mean there is no longer a requirement for reinforcement of the 33kV circuits from Rowner Park PSS to Zetland Road PSS.

Table 4 Summary of system needs identified in this strategy from 2036 to 2040 along with indicative solutions.

8.5. Future EHV System Needs to 2050.

Table 5 details the long-term system needs identified through power system analysis. Due to the uncertainty associated with these projection timelines, no action of these schemes is proposed now however, it is useful to understand the pipeline of work required under current forecasts.

Location of proposed intervention	CT Year	ST Year	LW Year	FS Year	CT Worst case asset loading (%)	Network State	Proposed option(s) to resolve
Gable Head PSS 33/11kV transformer.	2041 – 2050	–	2041 – 2050	–	101	N-1	Reinforcement of the existing 33/11kV transformers will be required. Reinforcement to 30MVA rated units will give sufficient capacity until the late 2040s or 20/40MVA rated units will give sufficient capacity until after 2050. As this is a longer-term need it can be reassessed at a later date to determine the best solution.
Lovedean GSP to Hunston BSP 132kV circuit,	2041 – 2050	–	2041 – 2050	–	101	N-1	Reinforcement could be possible through overlay of the existing 132kV circuits to higher rated assets. Alternatively, a third 132kV circuit could be added from Lovedean GSP to Hunston BSP which would be beneficial under an N-2 scenario.
Hunston PSS 33/11kV transformer.	2041 – 2050	2041 – 2050	2036 – 2040	–	101	N-1	Reinforcement of the two existing 33/11kV transformers to higher rated 20/40MVA units would resolve this system need.
West End PSS 33/11kV transformer.	2041 – 2050	–	2041 – 2050	2041 – 2050	101	N-1	Reinforcement of the two existing 33/11kV transformers to higher rated 20/40MVA units would resolve this system need.
Havant BSP to Leigh Park PSS 33kV circuit.	2041 – 2050	–	2041 – 2050	–	100	N-1	Overlay of the existing 33kV underground cables would be appropriate to provide additional capacity to enable 2050 demands.

Table 5 Summary of system needs identified in this strategy from 2041 to 2050 along with indicative solutions.

8.6. Future requirements of the High Voltage and Low Voltage Networks

Our HV/LV spatial plans have shown that there is no clear pattern to future demands on these lower voltage networks. We are therefore planning on a forecast volume basis, and this section provides further context on this work for both the Lovedean GSP high voltage and low voltage network needs to 2050.

8.6.1. High Voltage Networks

As well as the EHV system needs identified in the previous section, increased penetration 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 here we have used the load model that is 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 views 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 the 39 primary substations supplied by Lovedean 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 16 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.

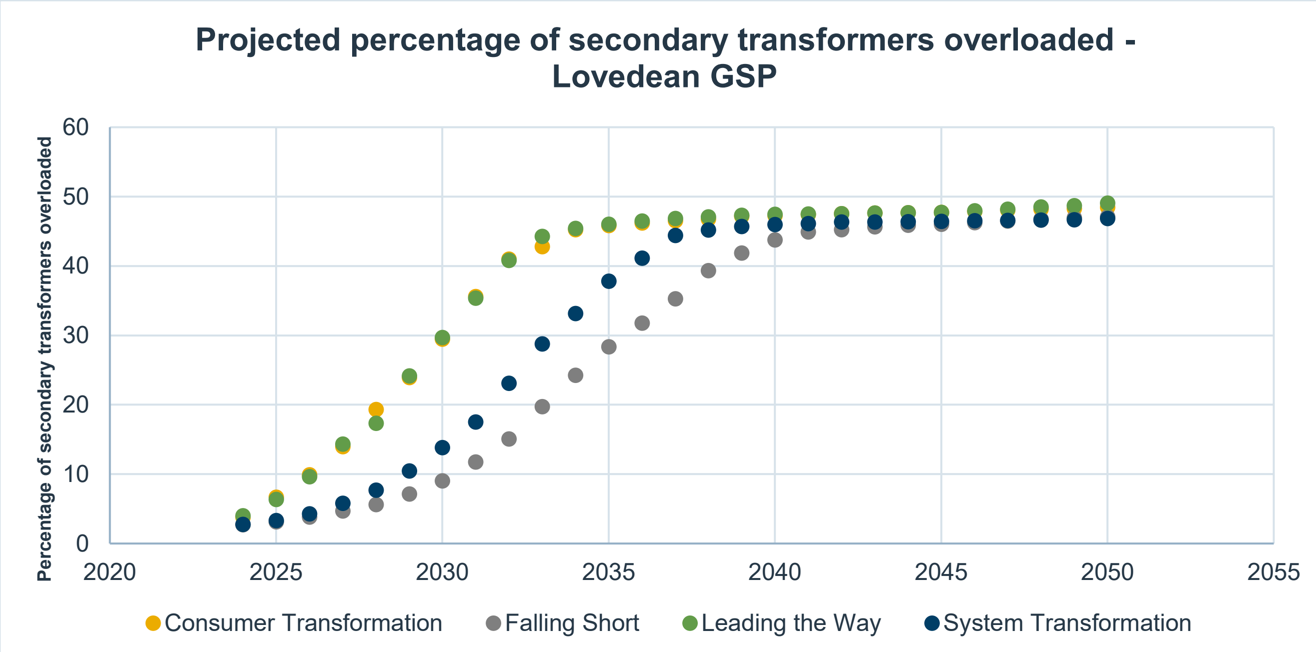

Figure 16 Lovedean GSP Projected secondary transformer loading. *Source: SSEN Load Model*

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 our customers in different locations face.

One of the outputs from this innovation project was the report produced by the Smith Institute.[12] This work groups 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 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.
3 – High	Driven up by larger elderly population levels, reduced by lower levels of disability and mental health benefit claimants.

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)

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

As shown in Figure 17, all the VFES groupings defined in the table above are present across the area supplied by Lovedean GSP. There are also areas that the VFES has identified as very high vulnerability that are also served by several secondary transformers that are projected to be overloaded by 2028 under the Consumer Transformation scenario. Proactive reinforcement of these assets will ensure that those in the area are less likely to be left behind in the energy transition while also improving the resilience of the network in these areas.

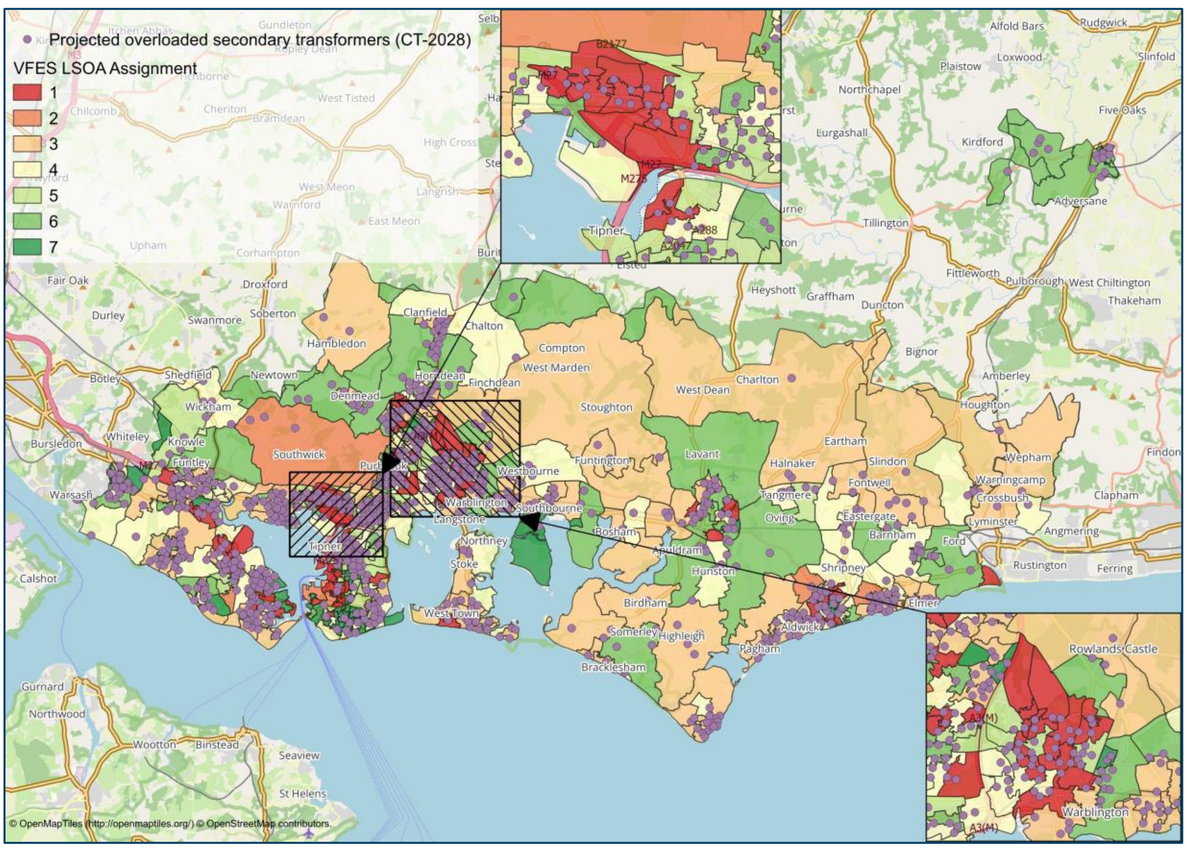

Figure 17 Lovedean GSP area VFES output with secondary transformer overlay.

8.6.2. 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. 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 Lovedean 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 18. 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.

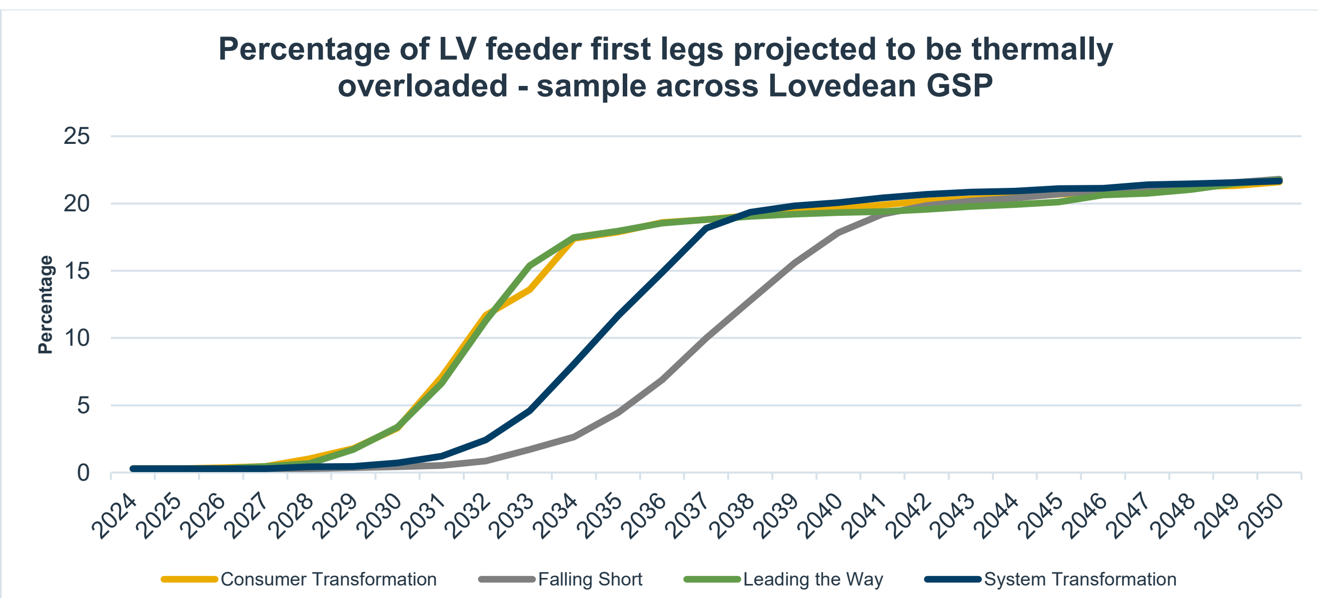

Figure 18 Percentage of LV feeders projected to be overloaded under Lovedean GSP

9. RECOMMENDATIONS

The review of stakeholder engagement and the SSEN 2023 DFES analysis provides a robust evidence base for load growth across Lovedean GSP group in both the near and longer term. Drivers for load growth across Lovedean GSP arise from multiple sectors and technologies. These drivers impact not only our EHV network but will drive system needs across all voltage levels.

Across Lovedean GSP group, a significant volume of work at both 132kV and 33kV has already been triggered through the DNOA process and published in DNOA Outcomes Reports. This delivers a significant amount of additional capacity in the area over the next decade. 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 4 key recommendations:

1. System needs that have been identified at earlier timescales (2030-2035) should be studied in more detail. Where estimated delivery timescales for this work are more than five years, work should be progressed for more detailed assessment through the DNOA process. This relates to the assets tabulated in section 8.2.

2. Considering the some of the dense urban areas that Lovedean GSP supplies, for example Portsea Island, further investigation of the HV and LV network requirements. Efficient solutions will help ensure minimal disruption in these areas where a significant amount of street work will impact a large number of customers.

3. The high solar irradiance of the south coast means it is well suited to Solar PV (and often co-located battery storage), SSEN should investigate the Clean Power 2030 targets to ensure that sufficient capacity is available to facilitate the DESNZ CP2030 targets.

4. The existing DFES process uses ‘technology building blocks’ to develop demand projections. In the DFES 2023, electrification of the maritime industry was not considered. The SeaChange innovation project led by SSEN will provide additional insight in this area. Due to the geography of the Lovedean SDP and significant ports in the supply area, insights from SeaChange should inform schemes in the DNOA process and future iterations of this SDP.

Actioning these recommendations will allow SSEN to develop a network that supports local net zero ambitions and enables growth in the local economy. By doing so, this will ultimately contribute to net zero targets at a national level.

Appendix A Further detail on existing network infrastructure – Primary Substations

Substation Name	Site Type	Number of Customers Served (approximate)	2023 Substation Maximum MVA (Season)
ARGYLE ROAD	Primary Substation	10500	14.97
ASHLING ROAD	Primary Substation	14700	22.14
BILLINGSHURST	Primary Substation	4600	6.37
BILSHAM	Primary Substation	9400	23.06
BIRDHAM	Primary Substation	6700	9.80
BRANDON ROAD	Primary Substation	16100	15.27
BROCKHAMPTON	Primary Substation	2900	13.91
BROCKHURST	Primary Substation	9500	15.83
CHICHESTER	Primary Substation	9800	20.18
COLLEGE PARK	Primary Substation	8100	8.95
EASTNEY	Primary Substation	6400	7.00
EMSWORTH	Primary Substation	7400	8.95
FARLINGTON	Primary Substation	2900	7.06
FRATTON PARK	Primary Substation	18100	21.01
GABLE HEAD	Primary Substation	9300	10.47
GAMBLE ROAD	Primary Substation	15800	17.99
GREETHAM STREET	Primary Substation	5100	11.99
HILSEA	Primary Substation	800	12.44
HOEFORD	Primary Substation	8000	13.08
HORNDEAN	Primary Substation	15500	17.53
HUNSTON	Primary Substation	5000	12.81
LEE-ON-SOLENT	Primary Substation	8700	9.85
LEIGH PARK	Primary Substation	10300	14.19

MARKET	Primary Substation	8600	12.54
MEYRICK ROAD	Primary Substation	12500	15.10
NORTH FAREHAM	Primary Substation	8700	10.79
PLESSY TITCHFIELD	Primary Substation	5500	16.69
PORTCHESTER	Primary Substation	10400	13.41
PORTSMOUTH	Primary Substation	6400	12.05
PURBROOK	Primary Substation	5100	6.16
ROSE GREEN	Primary Substation	7700	10.96
ROWNER PARK	Primary Substation	5900	7.92
SELSEY	Primary Substation	6200	7.95
SOUTH BERSTEAD	Primary Substation	11700	14.37
TITCHFIELD	Primary Substation	6400	7.80
WATERLOOVILLE	Primary Substation	14700	18.99
WEST END	Primary Substation	8900	11.54
WYMERING	Primary Substation	13000	28.56
ZETLAND ROAD	Primary Substation	14300	15.10

Appendix B Existing network schematics (33kV network)

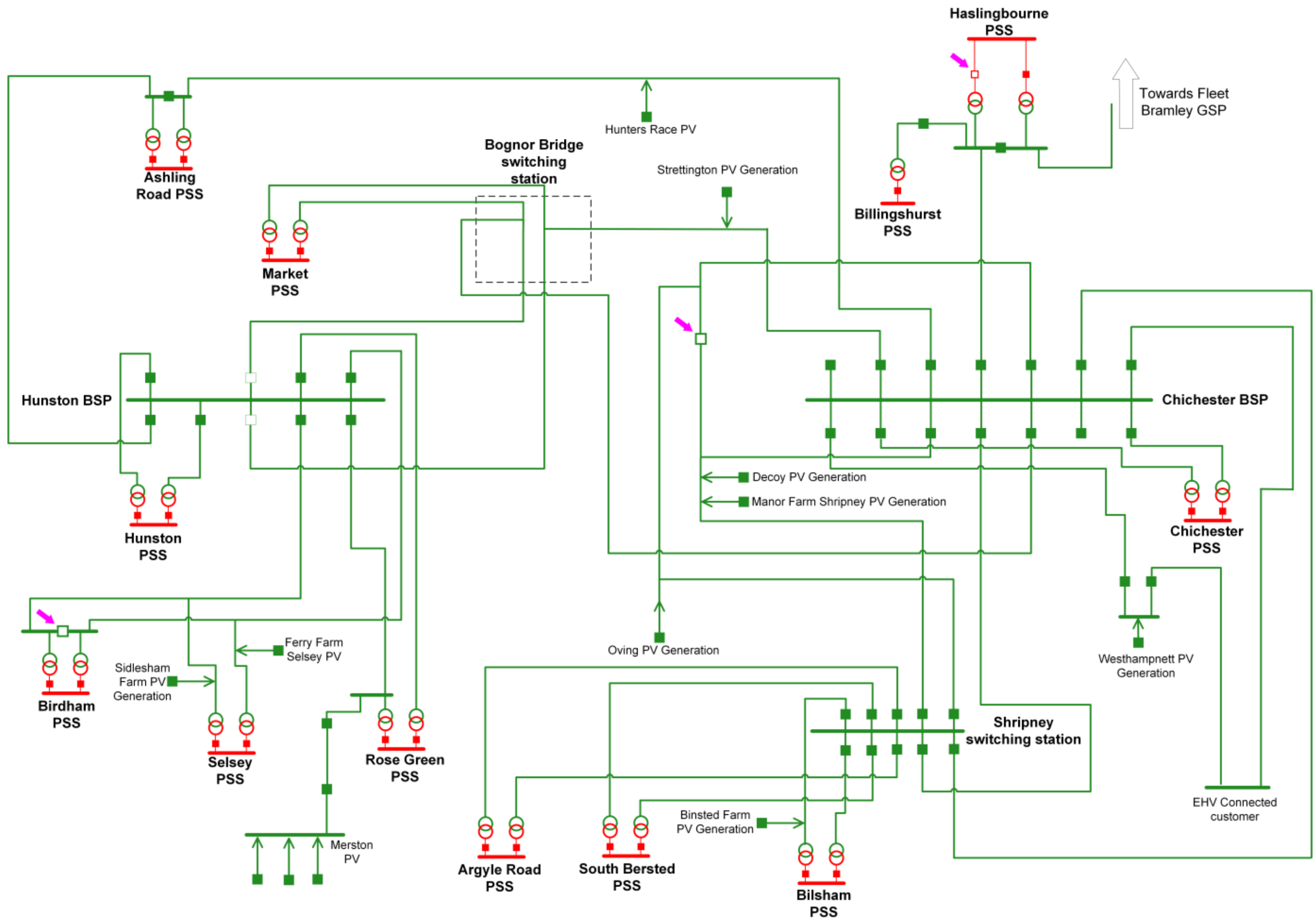

Figure 19 Chichester & Hunston BSPs 33kV network.

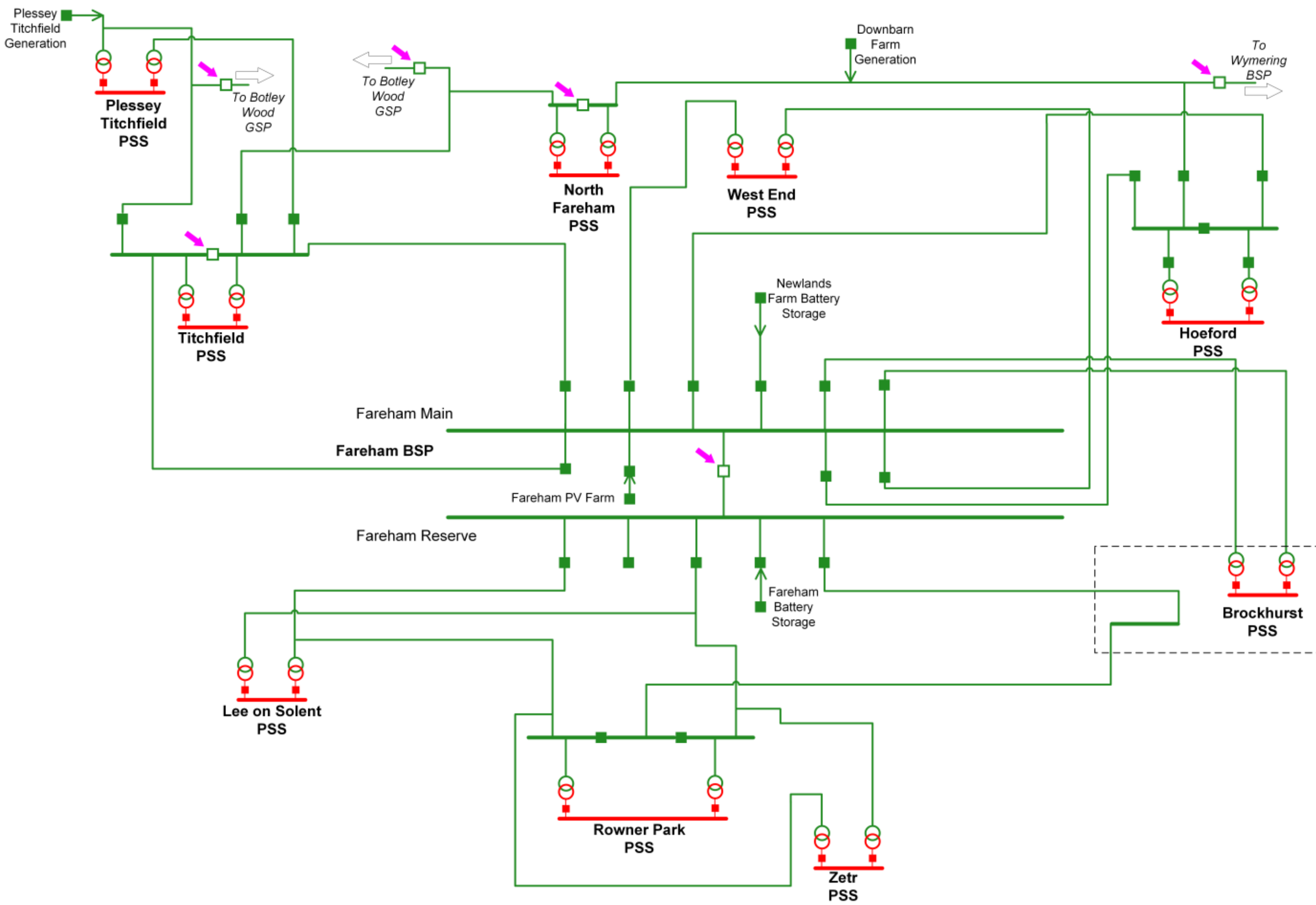

Figure 20 Fareham BSP 33kV network.

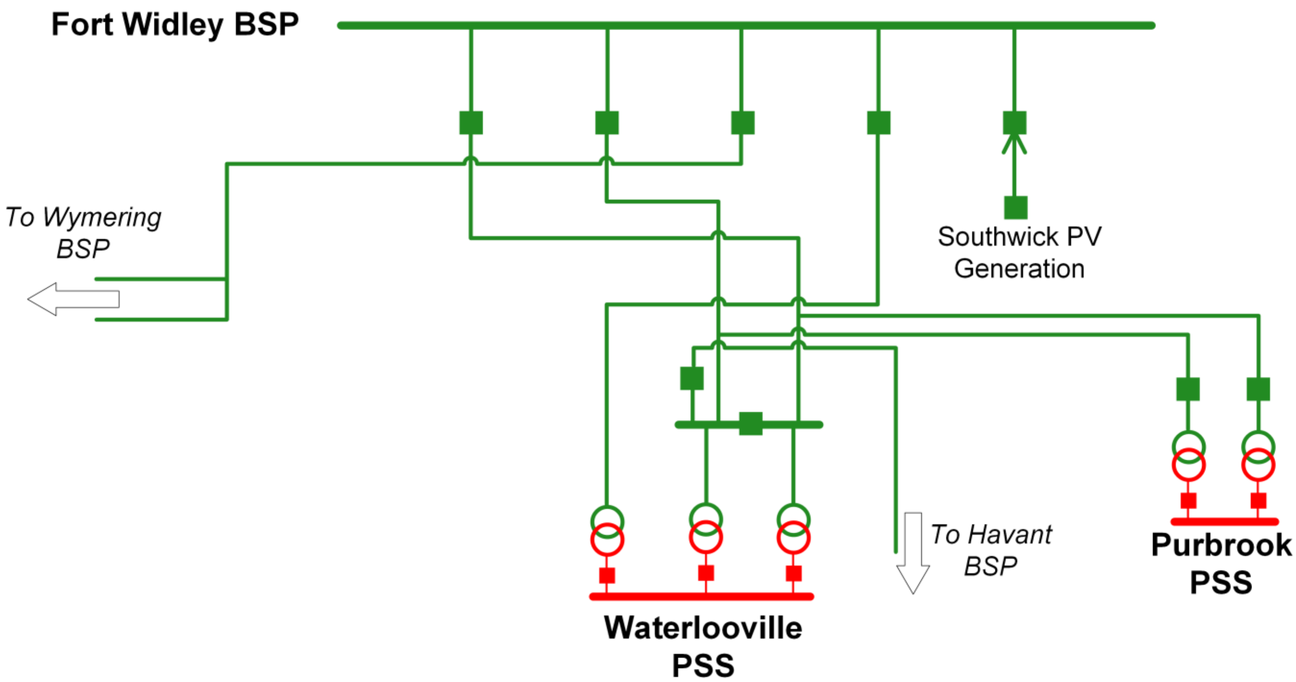

Figure 21 Fort Widley BSP 33kV network.

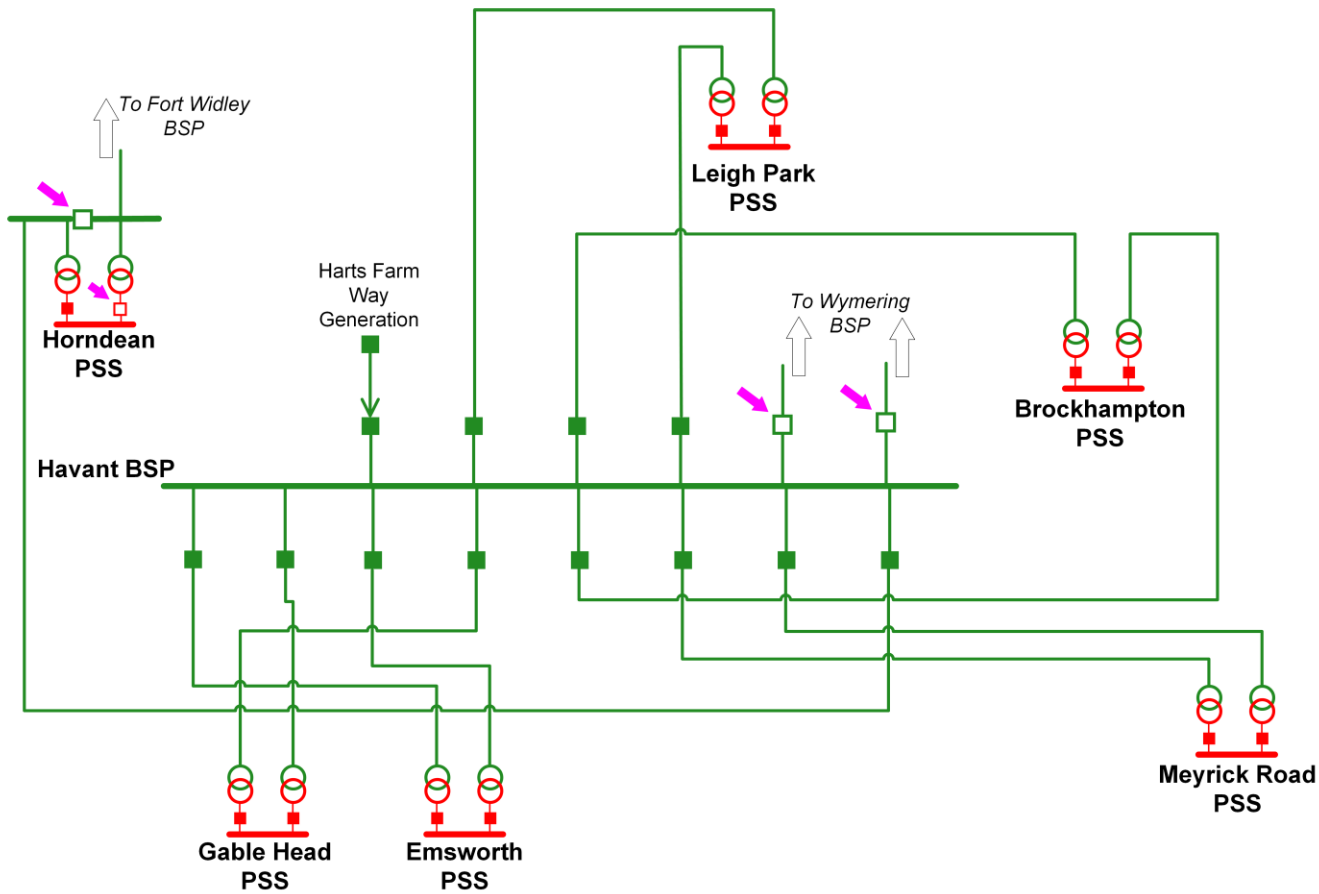

Figure 22 Havant BSP 33kV network.

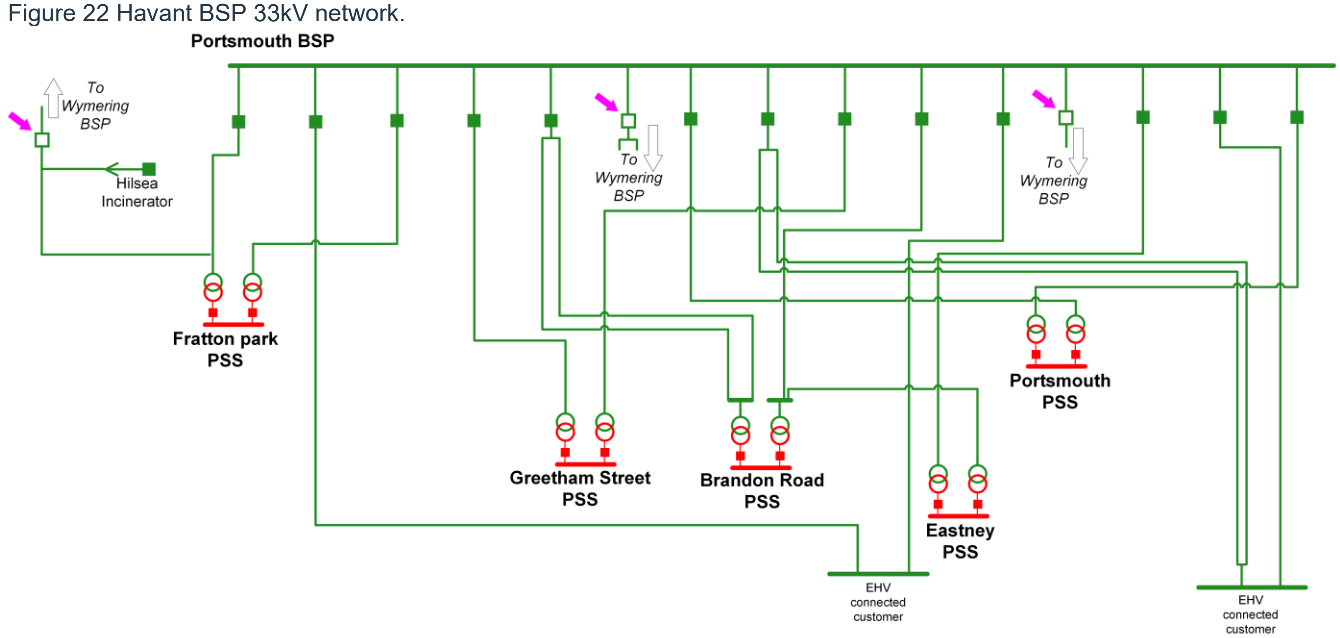

Figure 23 Portsmouth BSP 33kV network.

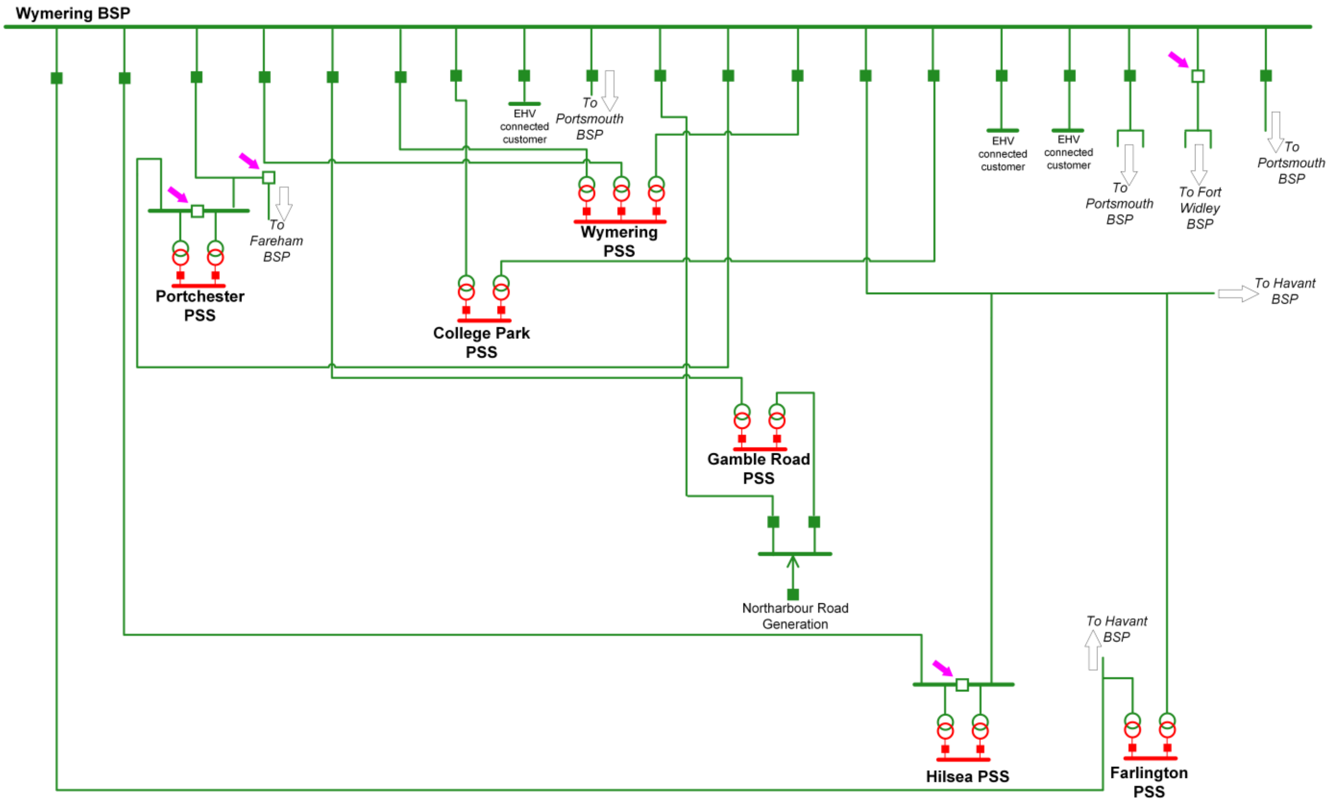

Figure 24 Wymering BSP 33kV network.

Appendix C Future network schematics following completion of triggered works (33kV network)

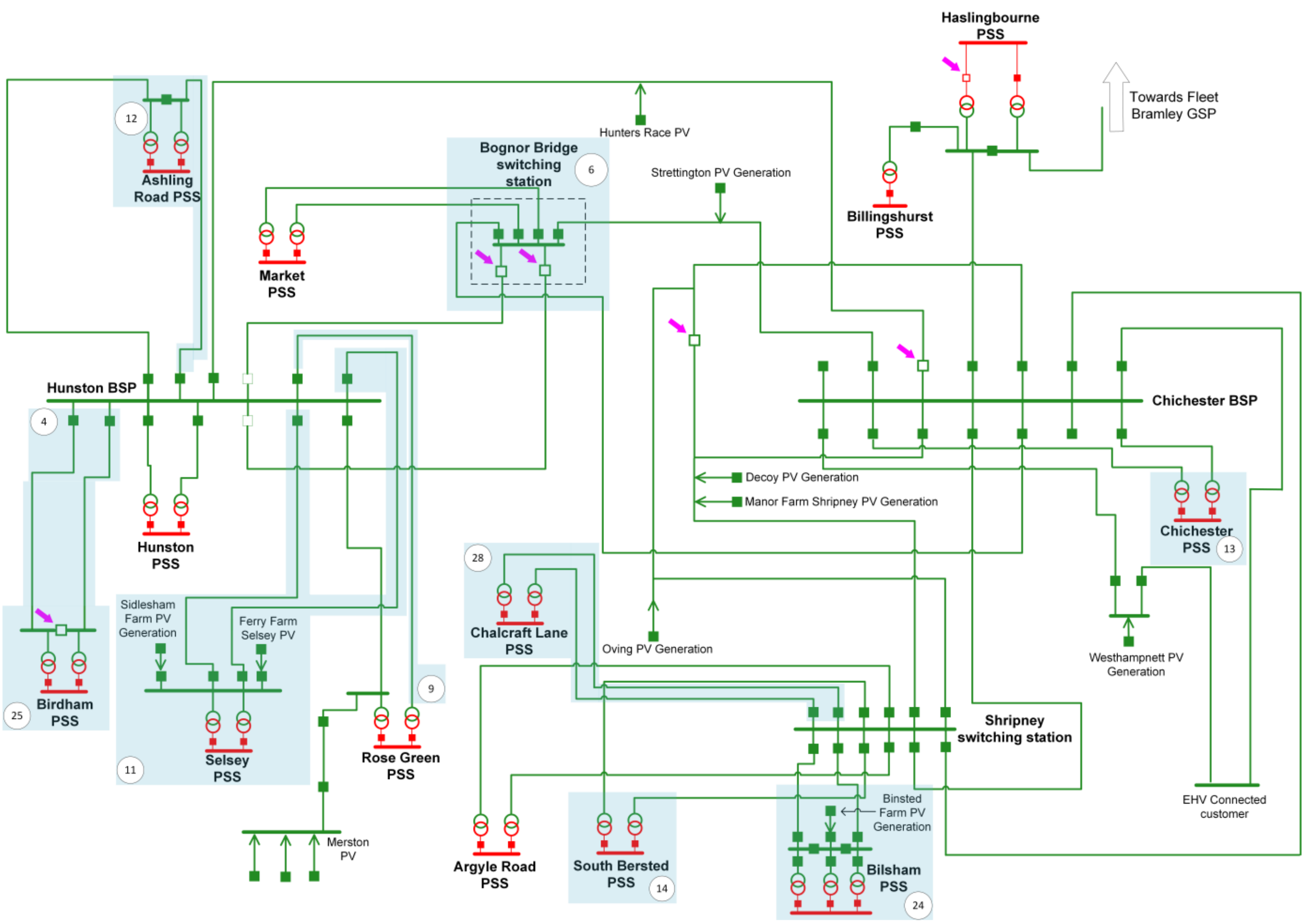

Figure 25 Chichester and Hunston BSPs - future 33kV network.

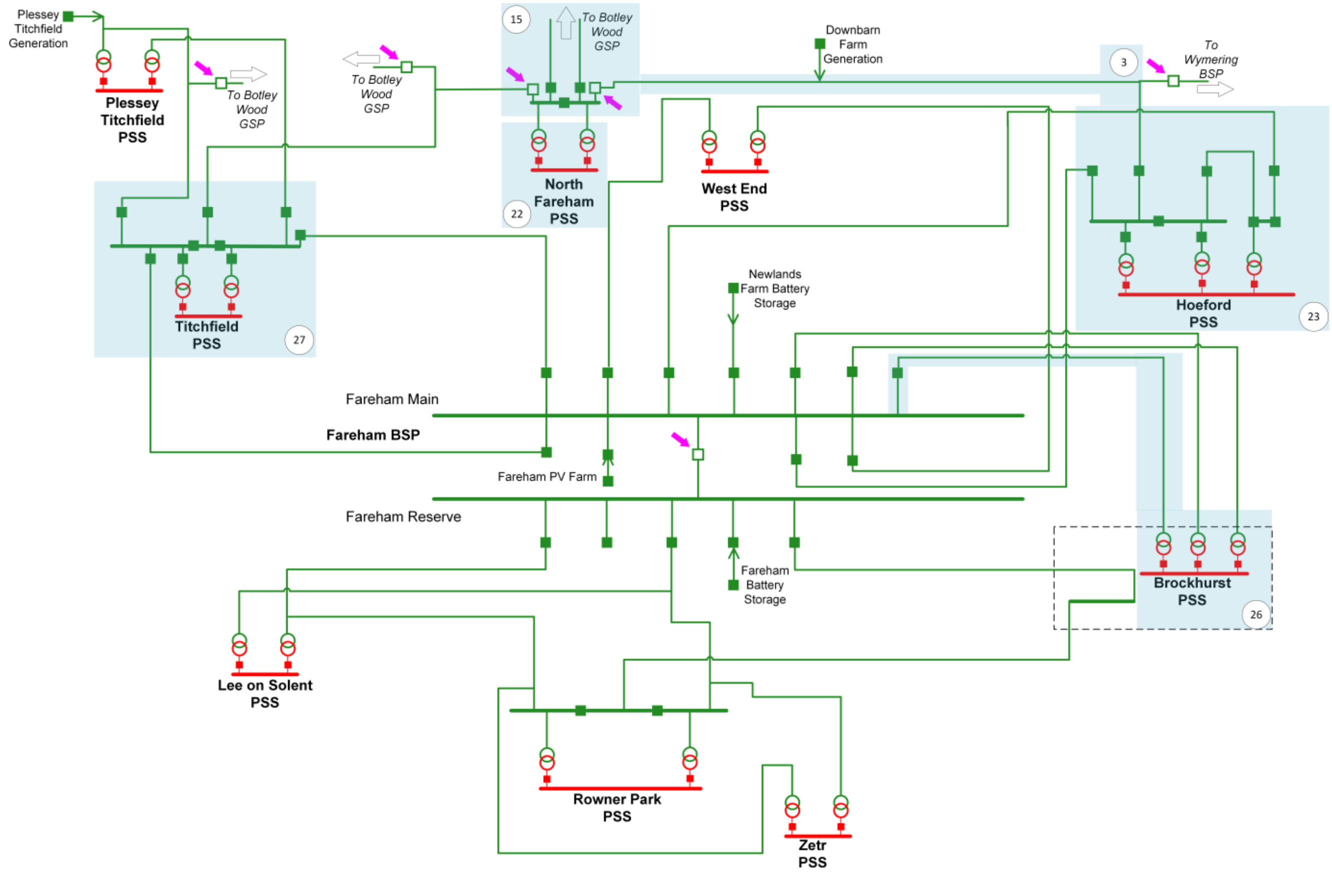

Figure 26 Fareham BSP - future 33kV network.

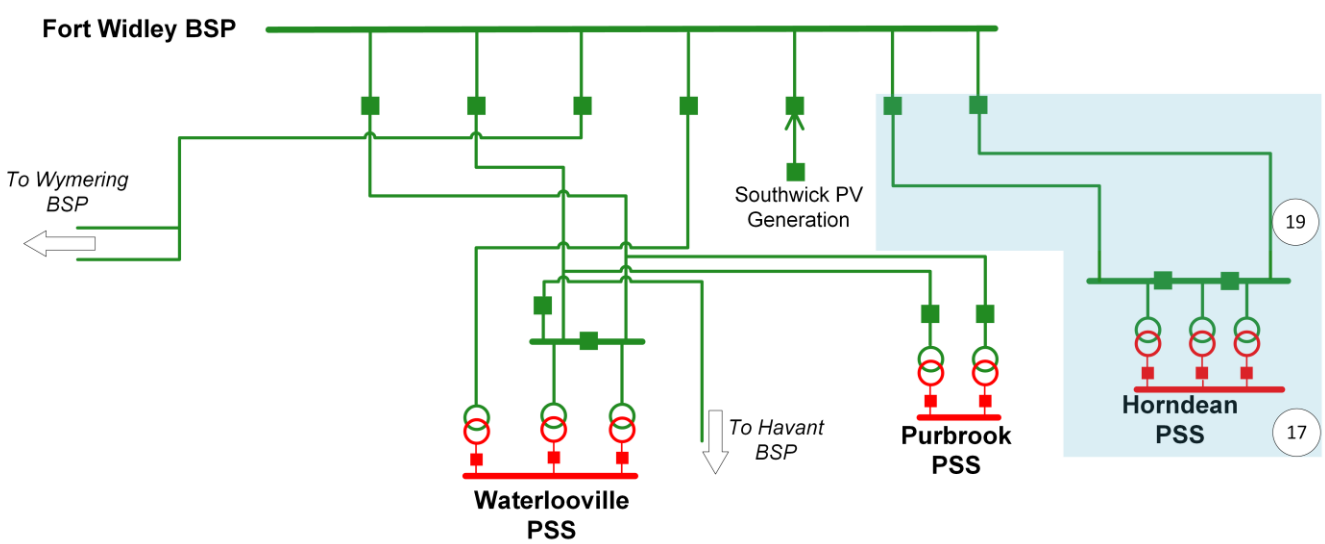

Figure 27 Fort Widley BSP - future 33kV network.

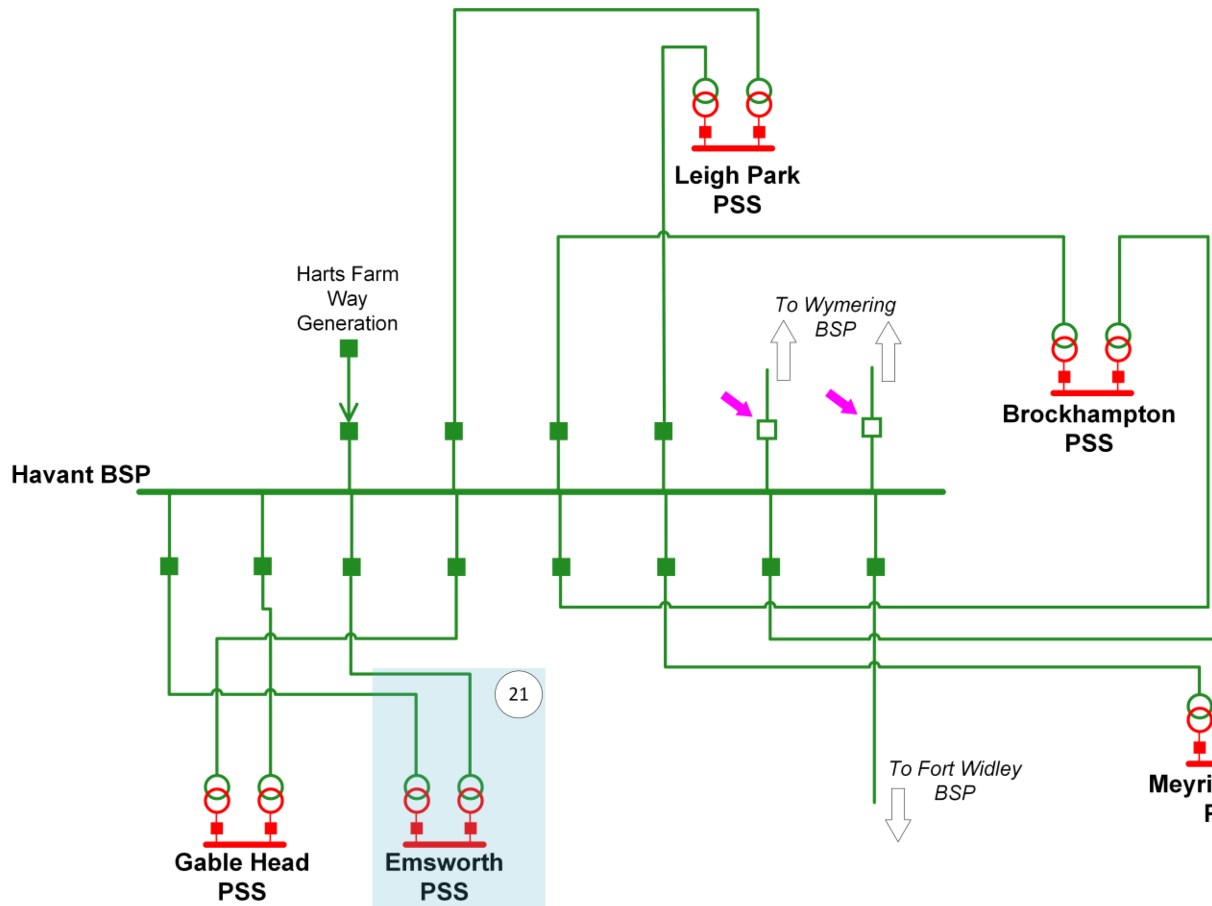

Figure 28 Havant BSP - future 33kV network.

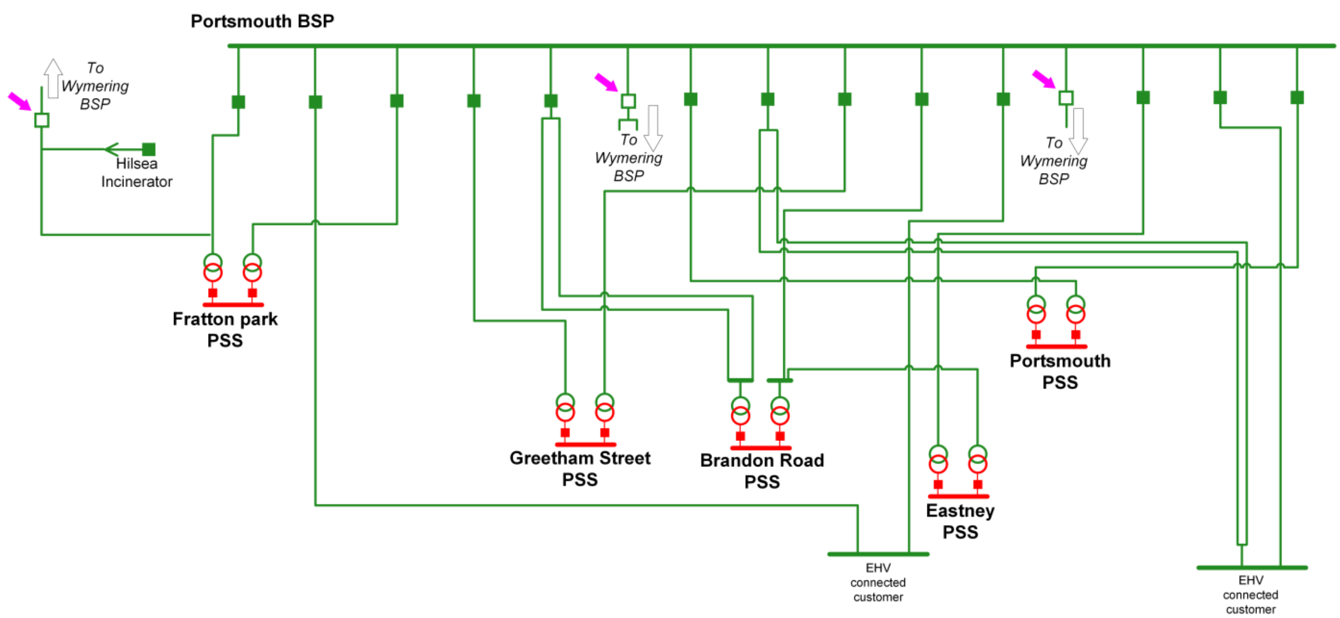

Figure 29 Portsmouth BSP - future 33kV network.

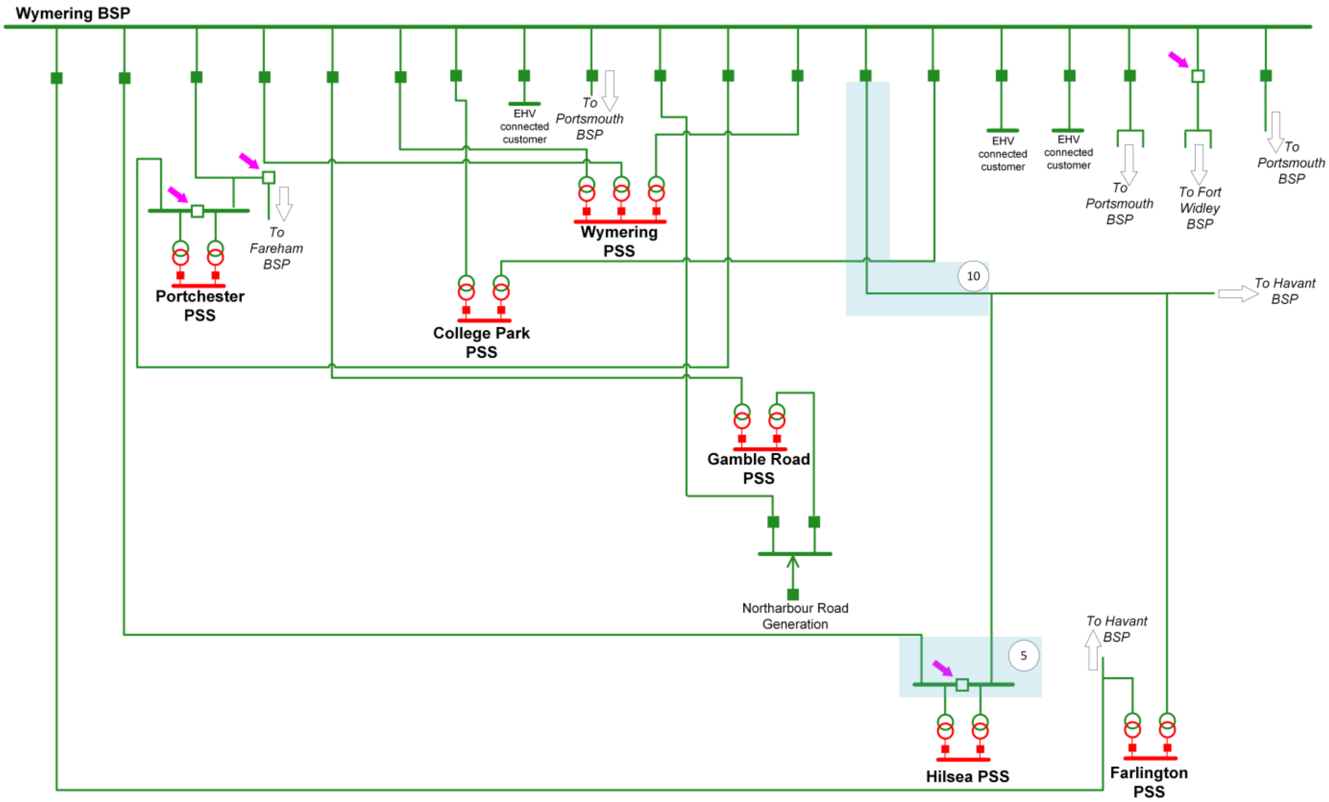

Figure 30 Wymering BSP - future 33kV network.

Appendix D EHV/HV spatial plans for other DFES scenarios

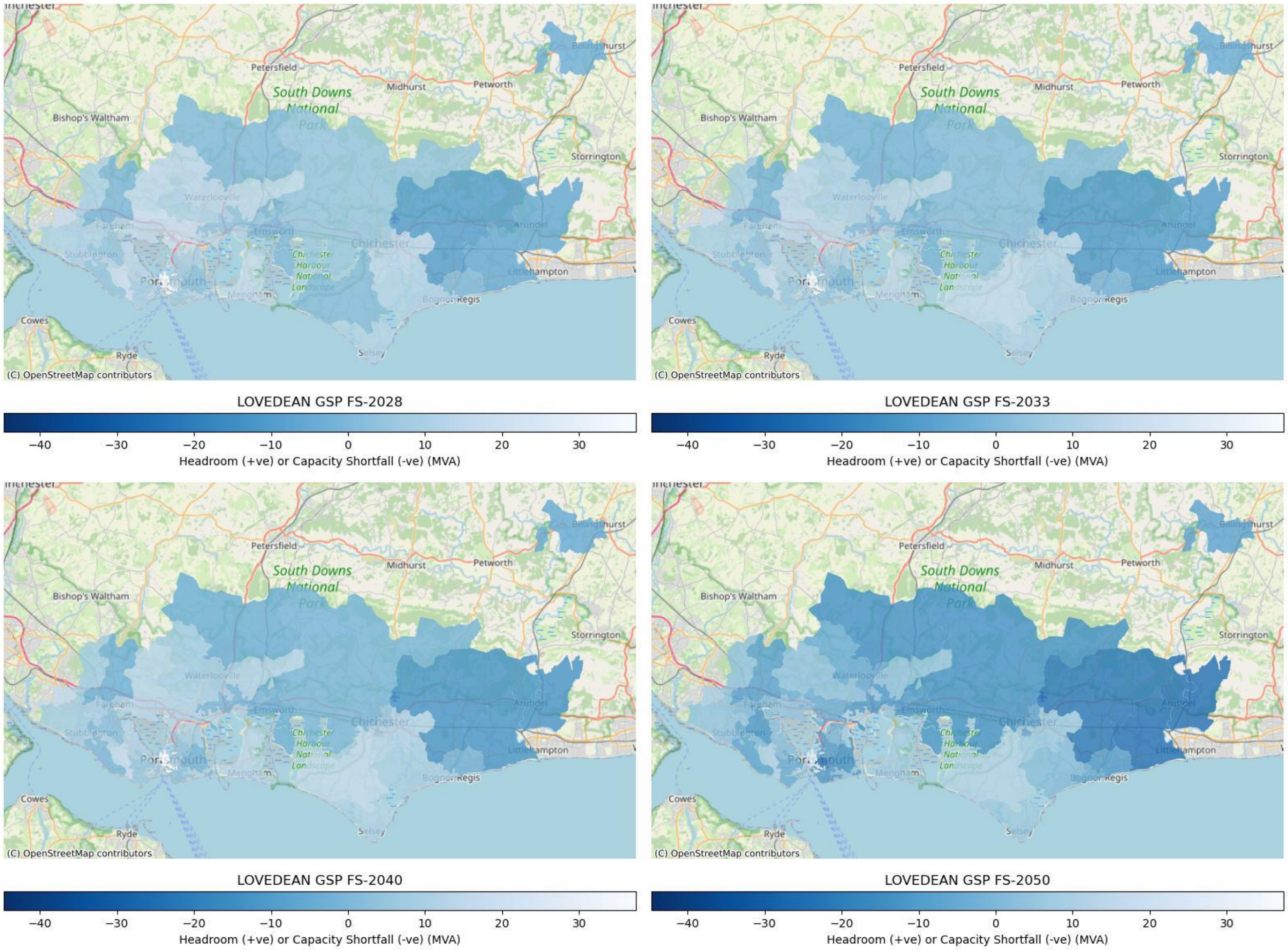

Figure 31 Lovedean GSP - EHV/HV Spatial Plan - Falling Short

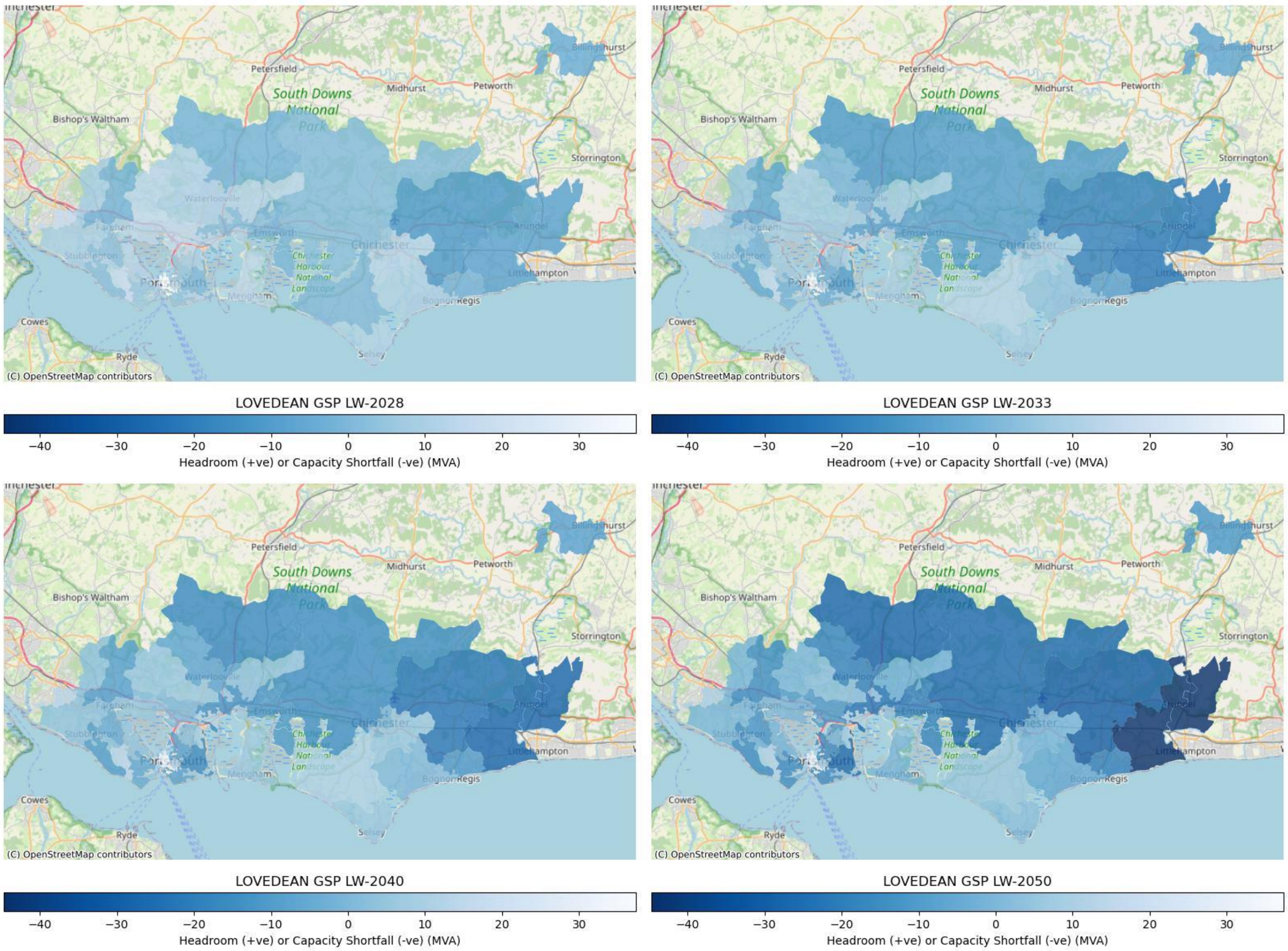

Figure 32 Lovedean GSP - EHV/HV Spatial Plan - Leading the Way

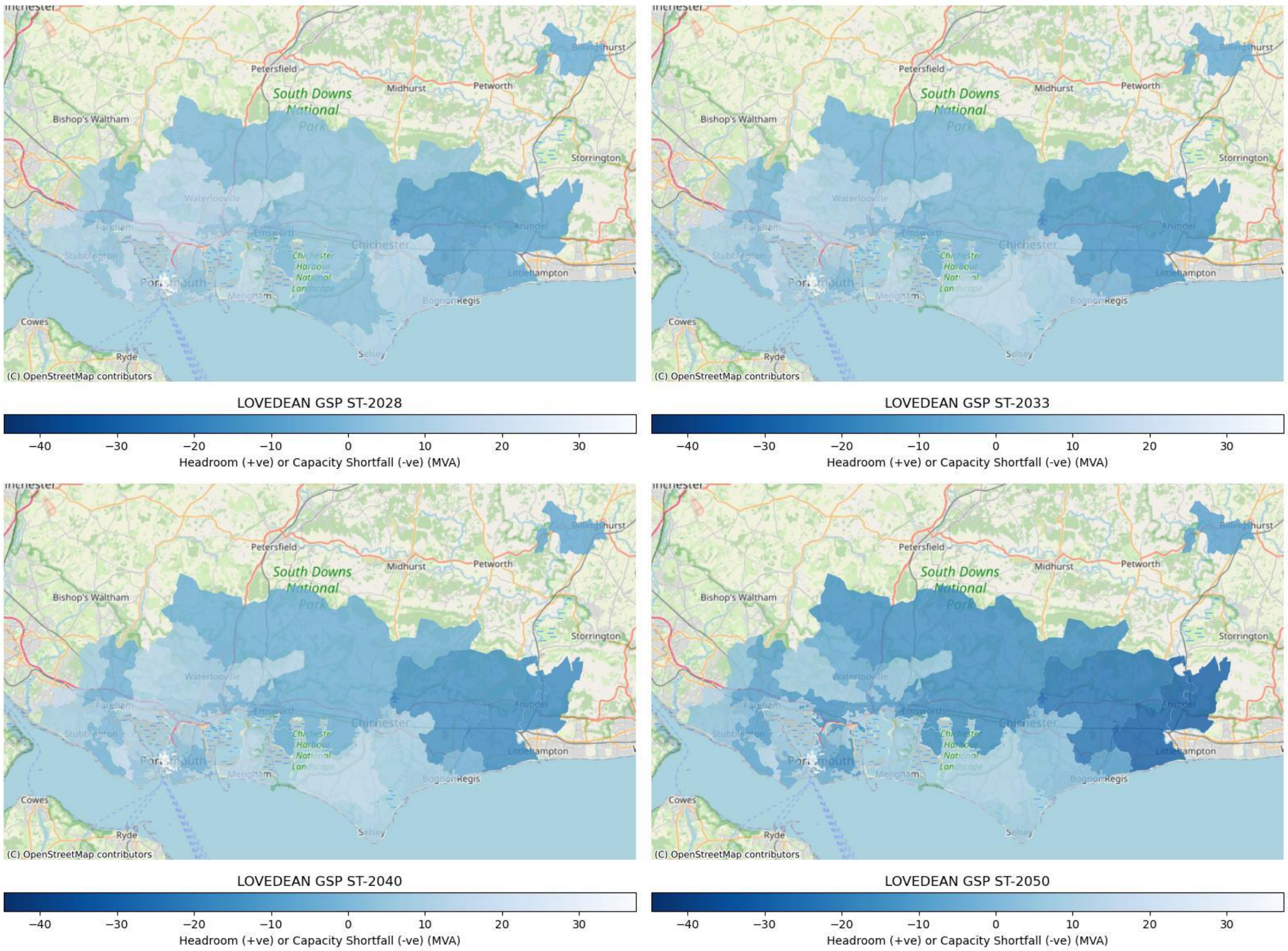

Figure 33 Lovedean GSP - EHV/HV Spatial Plan - System Transformation

Appendix E HV/LV spatial plans for other DFES scenarios

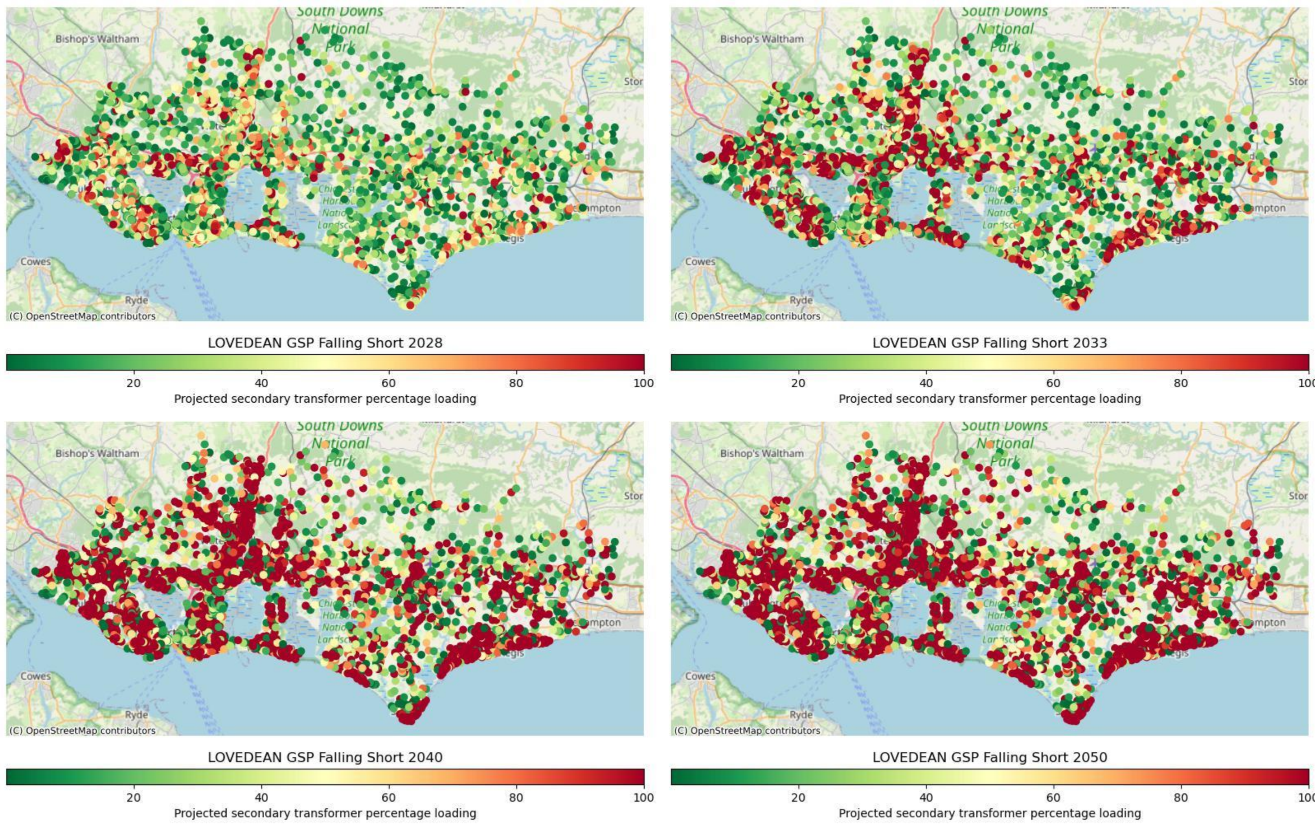

Figure 34 Lovedean GSP - HV/LV Spatial Plan - Falling Short

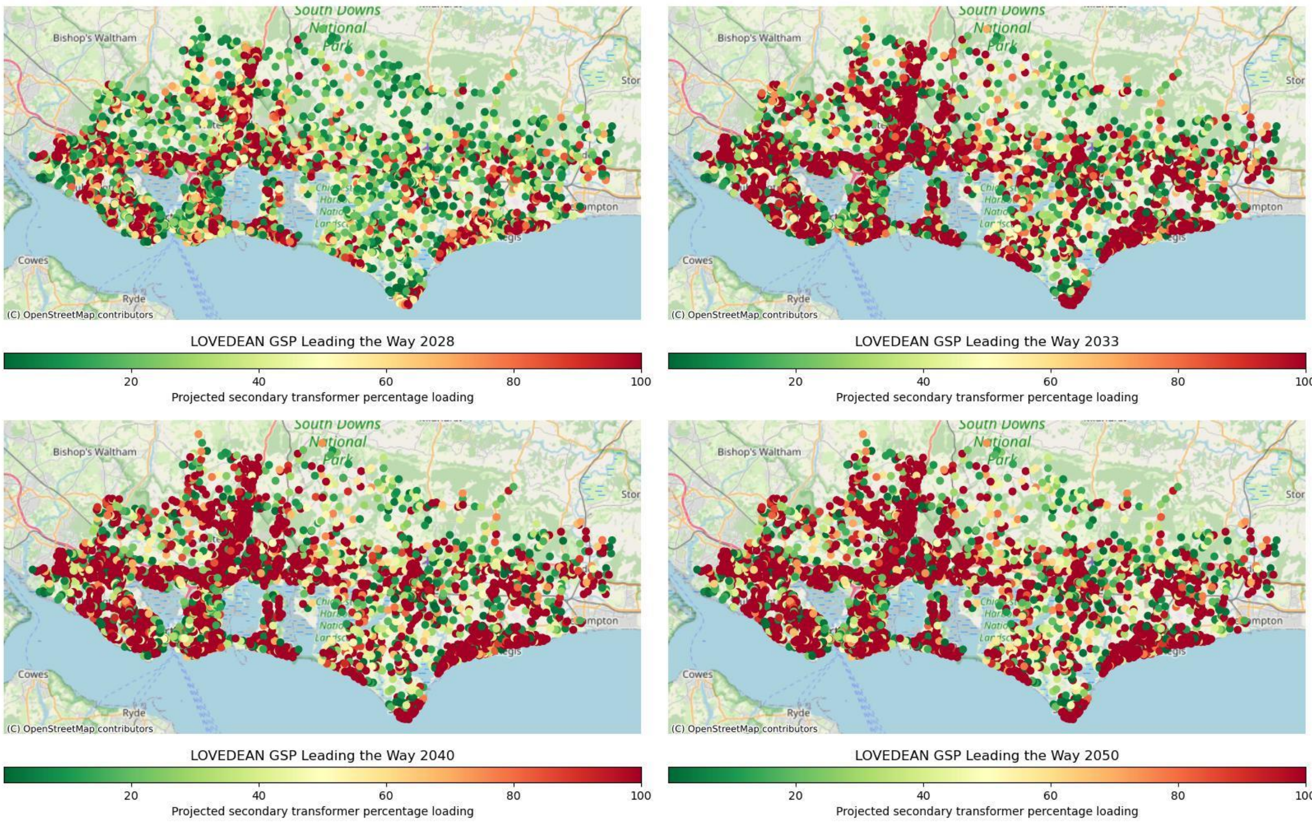

Figure 35 Lovedean GSP - HV/LV Spatial Plan - Leading the Way

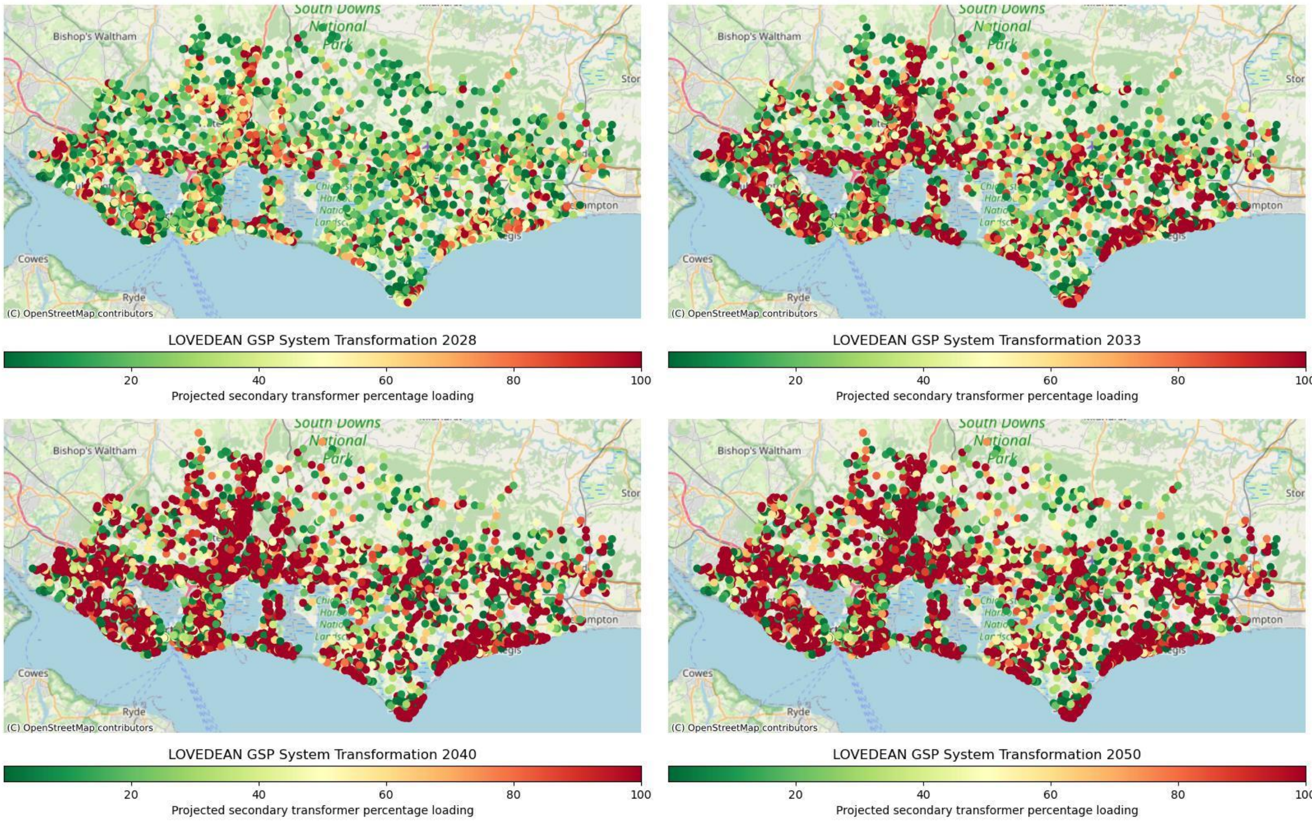

Figure 36 Lovedean GSP - HV/LV Spatial Plan - System Transformation

Appendix F Glossary

Acronym	Definition
AIS	Air Insulated Switchgear
ANM	Active Network Management
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
HV	High Voltage
kV	Kilovolt
LAEP	Local Area Energy Planning
LCT	Low Carbon Technology
LENZA	Local Energy Net Zero Accelerator
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
N-1	A fault or pre-arranged outage
N-2	A fault following a pre-arranged outage
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)
RIIO-T3	Revenue = Incentives + Innovation + Outputs, Transmission 3
SDP	Strategic Development Plan
SEPD	Southern Electric Power Distribution
SLC	Standard Licence Condition
SSEN	Scottish and Southern Electricity Network
ST	System Transformation
UM	Uncertainty mechanism
VFES	Vulnerability Future Energy Scenarios
WSC	Worst Served Customers

Appendix G Consultation Feedback

	Feedback Summary	Category	Organisation	Page number for change
1	Rename Climate Action and Biodiversity work plan to Climate Action and Sustainability work plan.	General	Arun	6
2	Remove detail on investigating a heat network in the district – this is no longer being progressed.	General	Arun	6/7

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Scottish & Southern
Electricity Networks