BOTLEY WOOD GRID SUPPLY POINT: STRATEGIC DEVELOPMENT PLAN

Our network serving communities across Southampton, Eastleigh and South Winchester

Draft for consultation

September 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 from today out to 2050 and translate these requirements into strategic spatial plans of distribution network needs. This helps us transparently present our future conceptual plans and facilitate discussion with local authorities and other stakeholders. The overall methodology and how it fits into our wider strategic planning process is presented in the Strategic Development Plan Methodology (SSEN – Strategic Development Plan Methodology). The focus area of this SDP is the area that is supplied by Botley Wood Grid Supply Point (GSP), shown below in Figure 1.

This report documents the stakeholder led plans that are driving net zero and growth in the local area, the resulting electricity demands, and the network needs arising from this. Plans from Eastleigh, Fareham, Southampton, Winchester and Hampshire County Council 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.

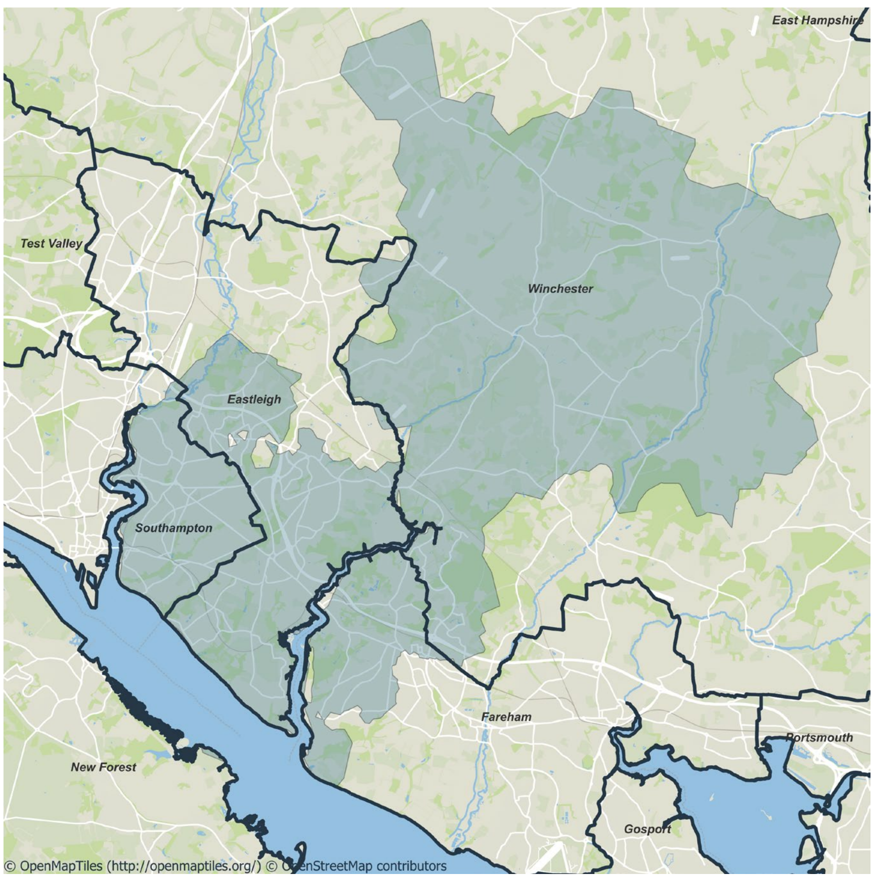

Figure 1 – The area covered by Botley Wood SDP with Local Authority Boundaries.

This SDP utilises the Distribution Future Energy Scenarios (DFES) to understand the pathways to a 2050 network that can support net zero and growth in the local economy. Recommendations from this report outline the initial steps that we believe should be taken on these pathways to develop the network in an efficient and stakeholder led way.

2. INTRODUCTION

The aim of this report is to demonstrate how local, regional, and national targets align with stakeholder ambitions in the area to provide a robust evidence base for load growth out to 2050 across the area served by Botley Wood Grid Supply Point (GSP) area. A GSP is an interface point with the national transmission system where SSEN Distribution then takes power to local homes and businesses within a geographic area. Context for the area this represents is shown above in Figure 1.

To identify the future requirements of the electricity network, SSEN commissions Regen to produce the annual Distribution Future Energy Scenarios (DFES). The DFES analysis is based on the National Energy System Operator (NESO) Future Energy Scenarios (FES), while incorporating more granular stakeholder insights from agencies such as local authorities and new demand and generation connection applications. The DFES provides a forward-looking view of how demand and generation may evolve under different scenarios as we move towards the national 2050 net zero target. These scenarios are summarised in Figure 2. SSEN uses Holistic Transition as the central case scenario, reviewing this position annually. Any more recent unforeseen demand changes, for example customer connection requests, are also considered in our forecasts to ensure that the projected load more accurately reflects what we expect to see in the future.

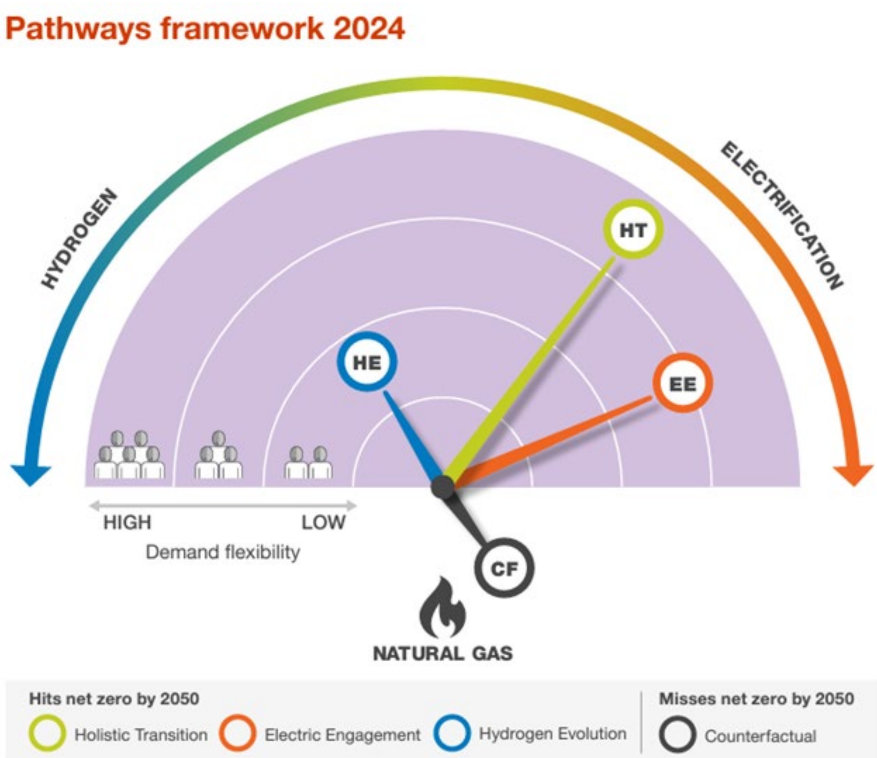

Figure 2 - The FES Scenario framework (Source: NESO)

Using the DFES, power system analysis has been carried out to identify the future system needs of the electricity network. These needs are summarised by highlighting the year the need is identified under each of the scenarios, and the projected 2050 load. System needs are identified through power system analysis using the Holistic Transition pathway and we also model across the other scenarios to understand when these needs arise and what demand projections should be planned for in the event each scenario is realised.

The DNOA process provides more detailed optioneering for each of these reinforcements, ensuring stakeholder visibility of the strategic planning process. Opportunities for the procurement of flexibility are also highlighted in the DNOA to cultivate the flexibility markets.

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

3. STAKEHOLDER ENGAGEMENT AND WHOLE SYSTEM CONSIDERATIONS

3.1. Local Authorities and Local Area Energy Planning

The local authorities that are supplied by Botley Wood GSP are Eastleigh, Fareham, Southampton, Winchester and Hampshire 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.

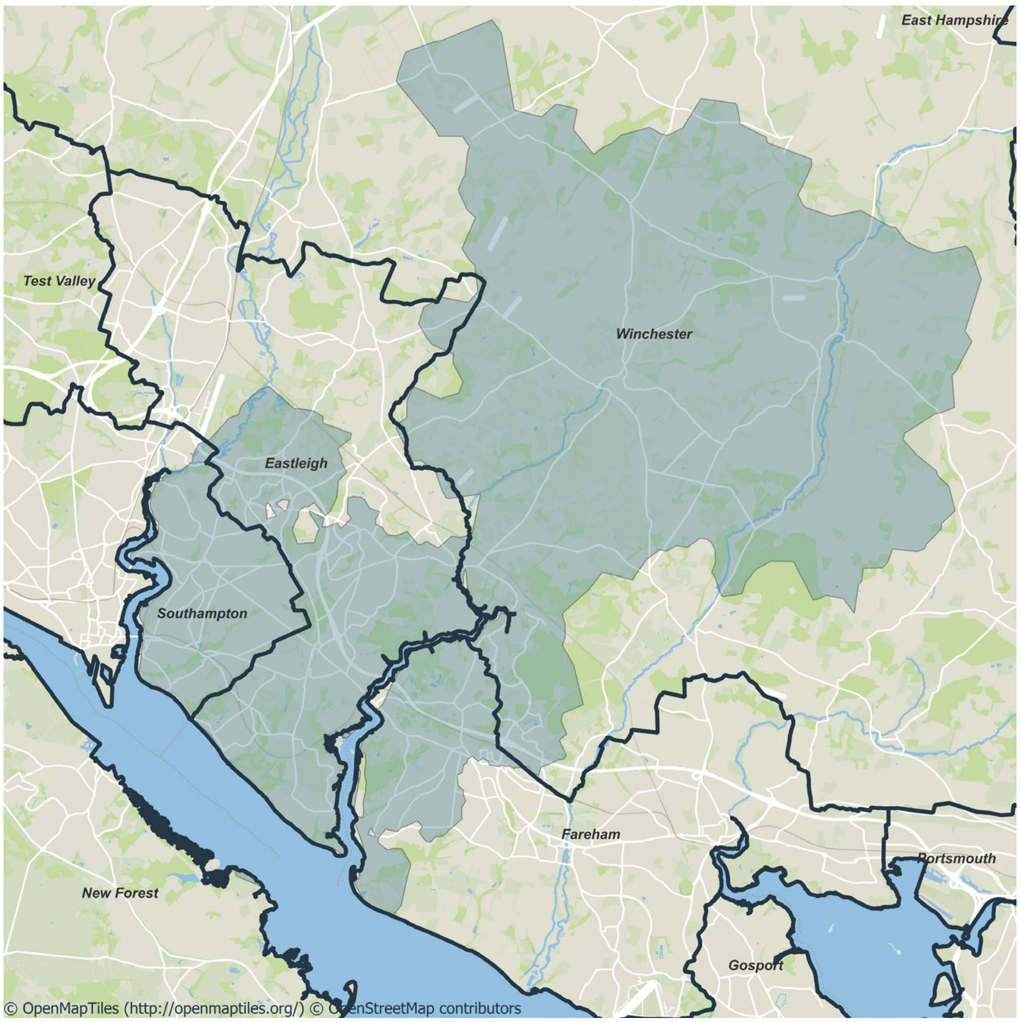

Figure 3 - Botley Wood GSP supply area and local authority boundaries.

3.1.1. Eastleigh

Eastleigh Borough Council has a target of being carbon neutral by 2025 and to support communities and businesses across the borough to achieve carbon neutrality by 2030. They plan to develop a green energy scheme at One Horton Heath which will include a solar farm and a ground source heat pump network. The Council belongs to the Warmer Homes consortium, which has been granted national funding through 2025 to subsidise the rollout of energy efficiency measures across domestic residences. This includes heat pumps and solar panels. Eastleigh Borough is also developing plans to expand its network of public electric vehicle charge points.

Eastleigh is set to benefit from its inclusion in the Solent Freeport, one of eight designated by the UK Government. Eastleigh's Navigator Quarter has been confirmed as a tax site, supporting the development of sectors such as hydrogen technologies, wind turbine manufacturing, and ultra-low-sulphur diesel, in line with the Council's sustainability objectives.

3.1.2. 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 scope 2 emissions (caused by an organisation indirectly and come from where the energy it purchases and uses is produced). 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.

3.1.3. Southampton

Southampton City Council aims for the city to be net zero by 2035, as detailed in their Climate Change Strategy. New developments will be required to generate a certain fraction of their energy demand from on-site renewable generation[1]. The Council has also initiated several projects to expand electric vehicle infrastructure in support of this target, including an electric vehicle trial for private hire cars and taxis; ongoing rollout of electric vehicle charge points across the city; electrification of the council's vehicle fleet; and a commitment to zero emissions from public transit by 2030 as detailed in their Green City Plan 2030. They have also installed solar panels on the Sea City Museum as part of the Council's Corporate Assets Decarbonisation Scheme. This scheme aims to decarbonise all corporate assets by 2030.

The City Council's Renaissance board is looking navigate future socio-economic challenges and driving investments in people, infrastructure, and the fabric of the city. The Board includes representatives from organisations such as Southampton City Council, Associated British Ports, and the cities Universities and Hospital. Net zero is highlighted as being central to the boards remit with increased electricity demand needed to facilitate this.

Southampton City Council is also keen to expand and decarbonise the city centre's 18km district heating scheme which has been operational since 1984, and are looking into deep geothermal to potentially do this[2]. They are also rolling out plans to decarbonise their social housing portfolio.

1 Southampton City Council Energy Guidance for New Developments 2021-2025

2 Heat Network Zoning Opportunity Report: Southampton

3.1.4. Winchester

Winchester City Council set 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 decarbonise freight fleets and investing in EV charge points to decarbonise 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 also launched the UK's largest ultra 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.

The Council has also committed to developing a local area energy plan (LAEP) as a priority action and is in the process of creating the first digital LAEP in collaboration with Scottish and Southern Electricity Networks Distribution and Advanced Infrastructure Technology Limited, using the Local Net Zero Accelerator (LENZA) tool. 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.

3.1.5. 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.

The council is undergoing a major governance shift through the UK Government's Devolution Priority Programme. On 17 July 2025, it was confirmed that Hampshire's first mayoral election will take place in May 2026[3]. Alongside Portsmouth, Southampton, and the Isle of Wight, the council is working to establish a Mayoral Combined County Authority (MCCA) for the Hampshire and Solent region. Under the new governance model, a directly elected mayor will be responsible for strategic regional leadership and the coordination of public services.

In terms of its own estates, the Council aims to transition to fossil-fuel-free heating, install solar PV on depot buildings, and has identified a retrofit programme for privately owned residential properties. Hampshire has also secured £6.66 million through the LEVI fund to expand EV charging infrastructure[4].

3 Devolution | About the Council | Hampshire County Council

4 Electric Vehicle Charging Infrastructure Strategy-2024-10-24-EMH2050 Decision Day

3.2. Whole System Considerations

3.2.1. Future Agricultural Resilience Mapping (FARM)

Decarbonisation of the agricultural sector is an important consideration in this geographic area. SSEN leads the innovation project 'Future Agricultural Resilience Mapping' (FARM) which aims to understand the future energy requirements and means of decarbonising the domestic farming industry. This sector is currently still largely dependent on fossil fuels, and the project will support its investigations into the impact of food production on the electricity distribution system, to work out where reinforcement is needed. A data-driven tool to inform network planning will be devised and through this work, FARM will address the gap between the energy demands for food production and future network planning.

3.2.2. Solent Freeport

The Solent Freeport area is made up of 7 tax sites and 2 custom sites, designed to incentivise investment and economic growth[5]. The sites are spread across Nursling, Fawley, Botley Wood, and Lovedean GSPs.

3.2.3. Transmission interactions

We engage with NGET on future plans for Botley Wood GSP and Lovedean GSP which neighbours it. There are currently two Super Grid Transformers (SGTs) at the Botley Wood GSP site which due to the risk of losing both transformers limits the how much load can be directly fed solely from Botley Wood GSP. We will continue to work closely with NGET on strategic network development to ensure we are coordinated on the 2050 vision for Botley Wood GSP and Lovedean GSP.

3.3. Flexibility Considerations

SSEN procures Flexibility Services from owners, operators, or aggregators of Distributed Energy Resources (DERs) or Consumer Energy Resources (CERs), which can be generators, storage, or demand assets. These services are needed in areas of the network which have capacity constraints at particular times or under certain circumstances. SSEN purchases flexibility services from all types of providers (e.g. domestic or commercial). Information on the process for procurement and how to participate are published on the Flexibility Services website and information on real time decision making on which providers are dispatched can be found in the Operational Decision-Making document.[6, 7]

SSEN regularly recruits new flexibility services providers and increases the procured flexibility services with the latest bidding round for long term requirements held in May 2025 and recruitment through the Mini-Competition process in Mid-July 2025.[2]

Areas across Botley Wood 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.

5 Homepage - Solent Freeport

6 SSEN, Flexibility Services Procurement, Flexibility Services Procurement - SSEN

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

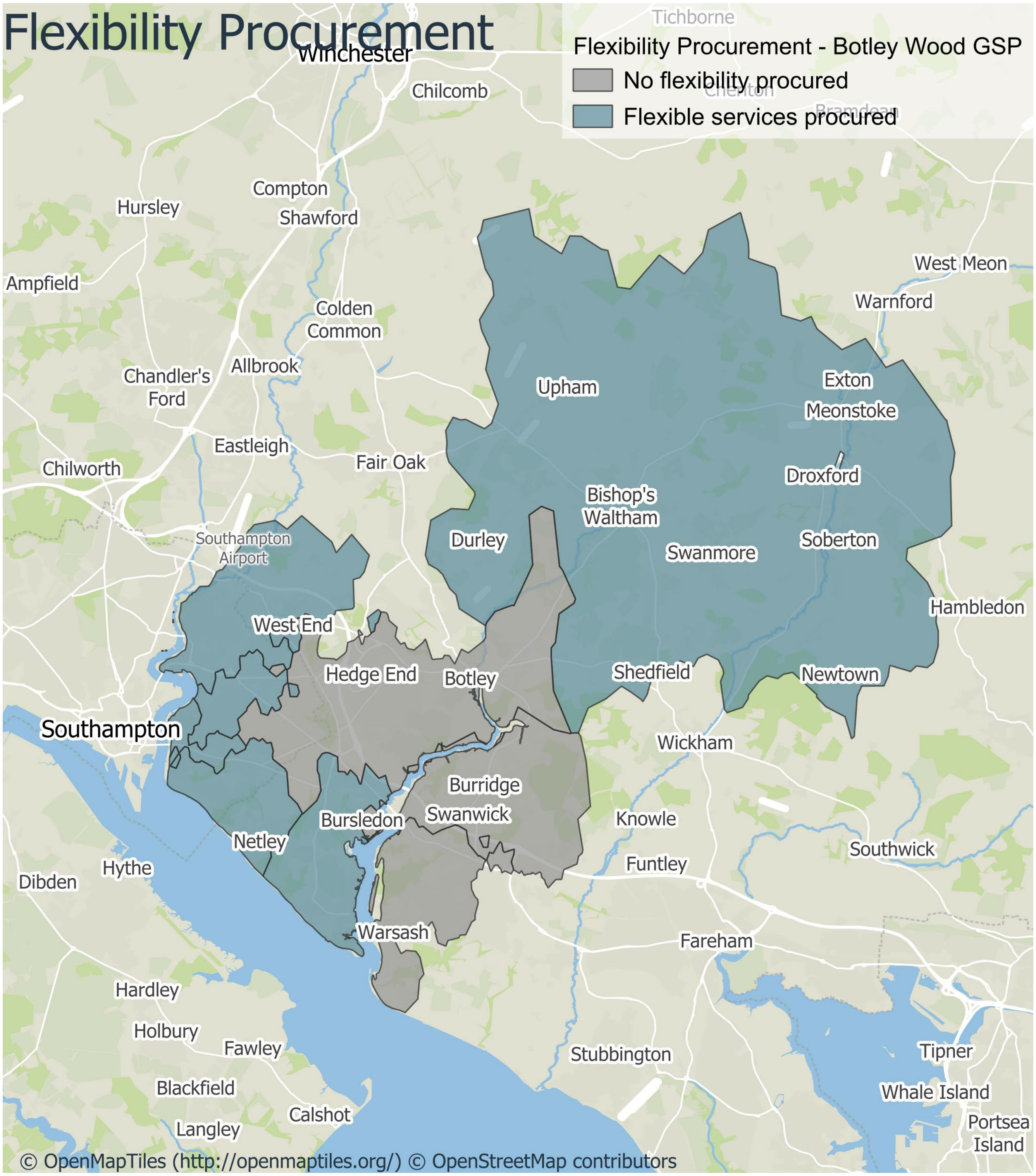

Figure 4 - Flexibility procurement areas across Botley Wood GSP.

4. EXISTING NETWORK INFRASTRUCTURE

4.1. Botley Wood Grid Supply Point Context

The Botley Wood GSP network is made up of 132kV, 33kV, 11kV, and low voltage (LV) circuits – Figure 5 shows a map with the current network topology. Botley Wood GSP feeds suburbs around Southampton as well as more rural towns and villages around South Winchester. In total, the GSP supplies approximately 85,900 customers with a breakdown for each BSP shown in Table 1. 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)	2024-2025 Substation maximum demand in MVA and season with peak demand
Botley Wood	Grid Supply Point	85,900	163.8 (Spring/Autumn)
Botley Wood	Bulk Supply Point	13,100	29.5 (Winter)
Netley Common	Bulk Supply Point	72,900	97.5 (Winter)
Bishops Waltham	Primary Substation	9,600	15.3 (Winter)
Bitterne	Primary Substation	8,100	9.1 (Winter)
Hamble	Primary Substation	5,400	16.3 (Winter)
Netley Common 11kV	Primary Substation	19,700	25.5 (Winter)
Park Gate	Primary Substation	8,300	10.9 (Winter)
Townhill Park	Primary Substation	15,700	16.6 (Winter)
Weston	Primary Substation	10,400	10.0 (Winter)
Whiteley	Primary Substation	4,800	17.6 (Winter)
Woolston	Primary Substation	4,000	7.9 (Spring/Autumn)

Table 1 – Customer number breakdown and substation peak demand readings (2024-2025) for Botley Wood GSP.

4.2. Current Network Topology

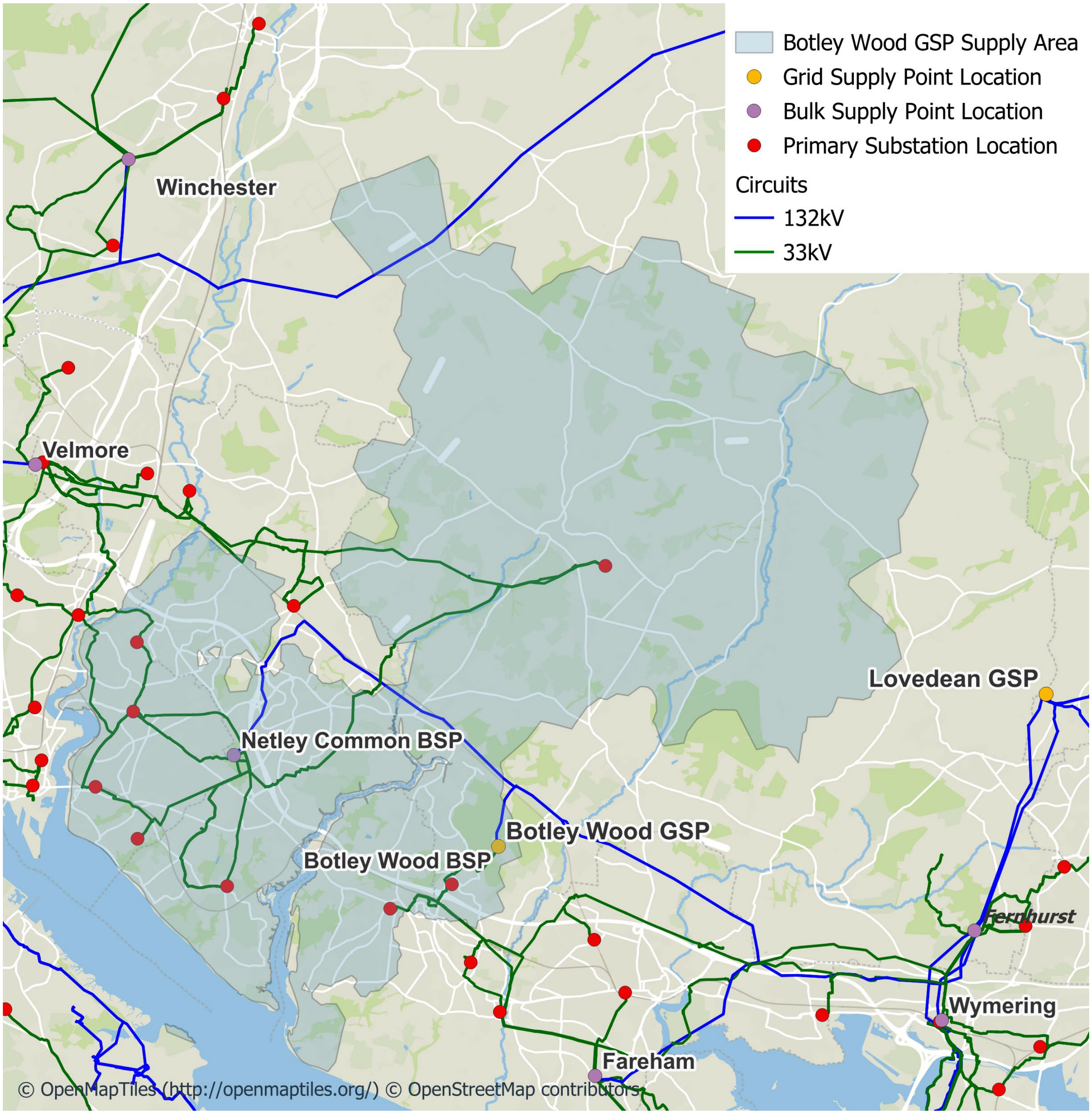

Figure 5 - Current network topology of Botley Wood GSP.

4.3. Current Network Schematic

Figure 6 summarises the EHV network within Botley Wood GSP.

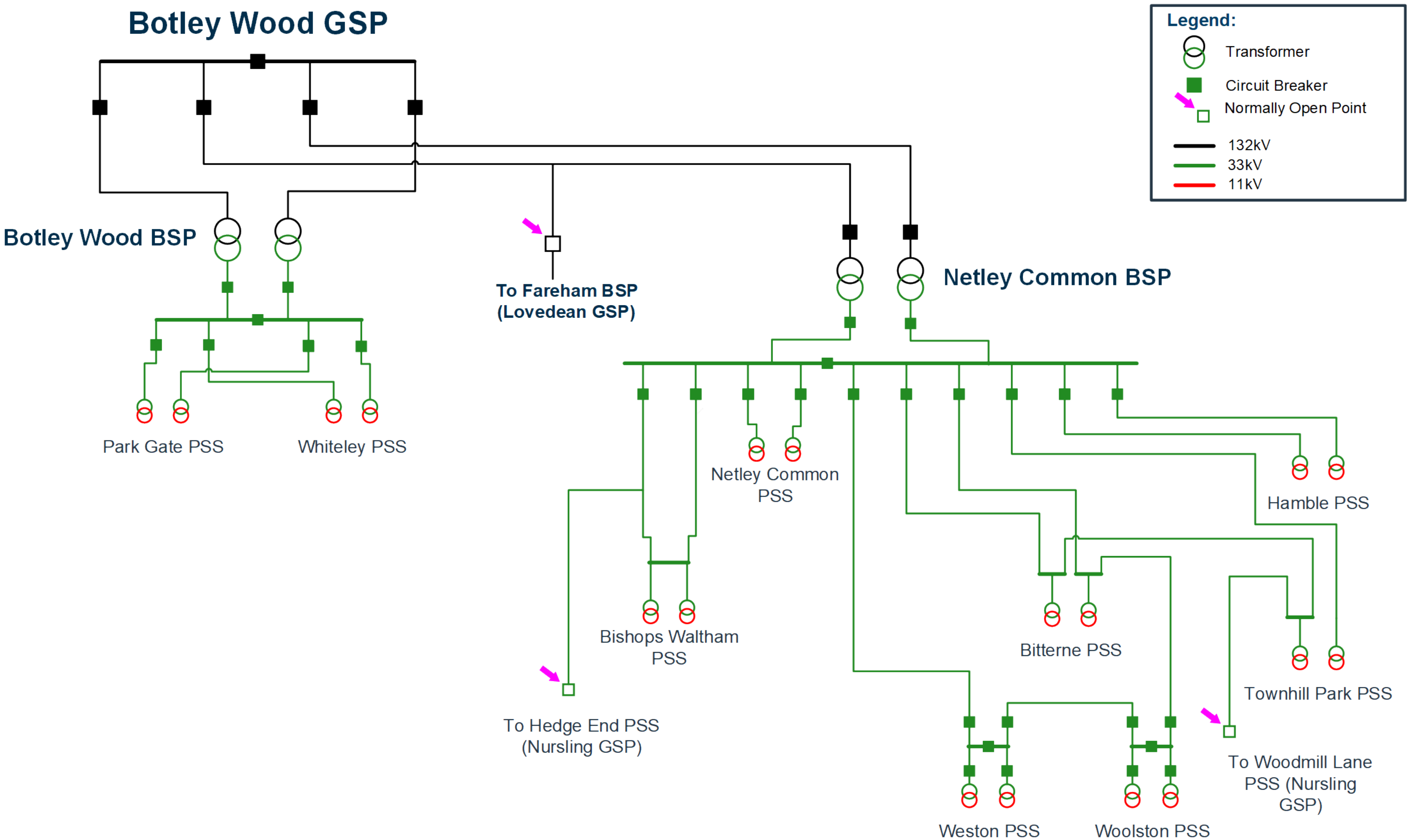

Figure 6 - Existing network supplied by Botley Wood GSP.

5. FUTURE ELECTRICITY LOAD AT BOTLEY WOOD 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:

- This SDP and the analysis conducted has been completed ahead of any changes arising from Clean Power 2030.
- These projections relate to the GSP supply area highlighted in Figure 3 and are not directly aligned to a particular local authority.
- Where MW values are presented in this section, they represent total installed capacity. When conducting network studies these values are appropriately diversified to reflect the likely peak demand experienced on the network. Diversifying load values accounts for the fact that not all demand load connected to the network peaks at the same time and so provides a more realistic total expected peak power.
- For projections specific to individual primary substations or local authorities, please refer to our online dashboard.[8]

8 SSEN DFES Technology Projections - Microsoft Power BI

5.1. Generation and Electricity Storage

DFES Scenario	Generation capacity (MW)				Electricity storage capacity (MW)			
	Baseline	2030	2040	2050	Baseline	2030	2040	2050
Holistic Transition	114MW	207MW	291MW	342MW	1MW	22MW	48MW	60MW
Electric Engagement		181MW	211MW	262MW		18MW	37MW	51MW
Hydrogen Evolution		162MW	176MW	219MW		14MW	28MW	34MW
Counterfactual		144MW	163MW	166MW		7MW	17MW	23MW

Table 2 - Projected cumulative generation capacity and electricity storage capacity across Botley Wood GSP (MW). *Source: SSEN DFES 2024*

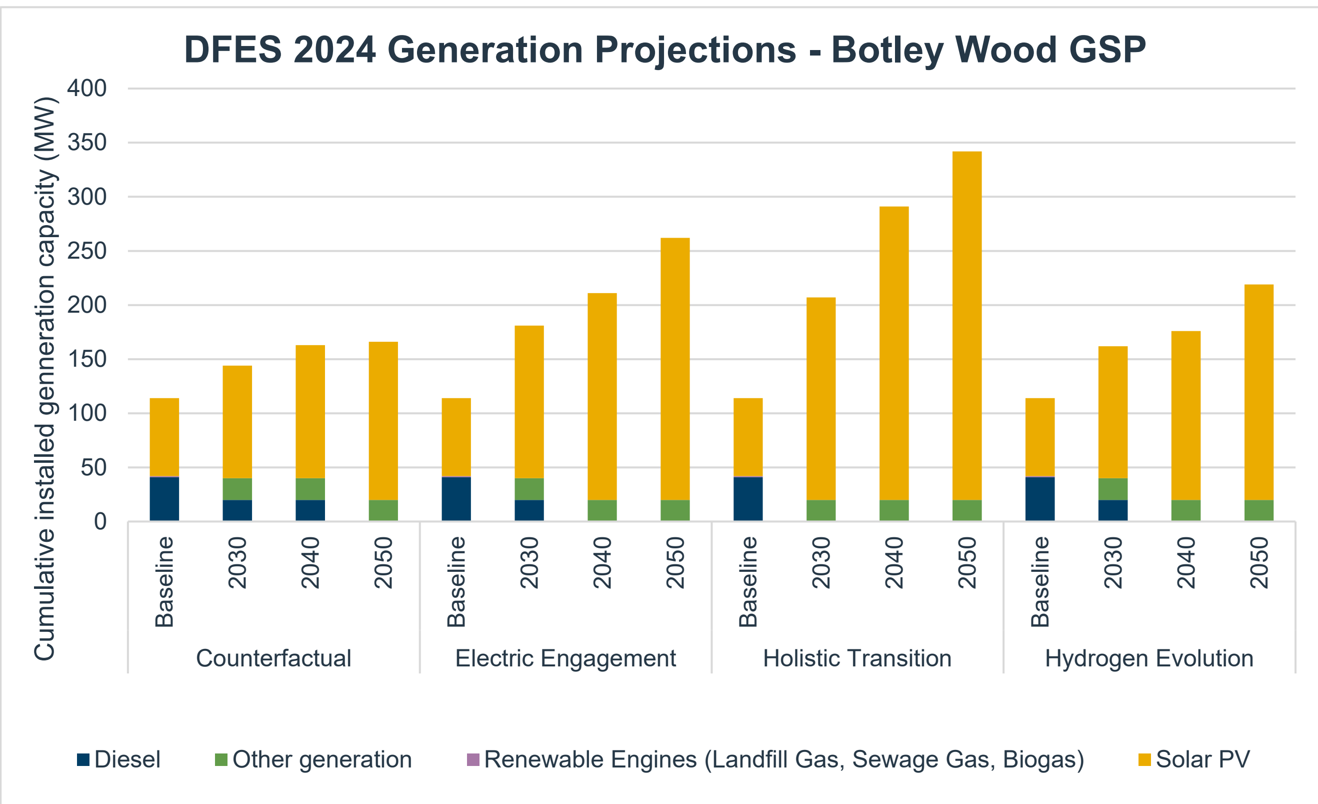

Figure 7 - Projected cumulative generation capacity across Botley Wood GSP (MW). *Source: SSEN DFES 2024*

5.2. Transport Electrification

DFES Scenario	Domestic EV chargers – off-street (number of units)				Non-domestic EV chargers & domestic on-street EV chargers (MW)			
	Baseline	2030	2040	2050	Baseline	2030	2040	2050
Holistic Transition	6,304	22,270	63,899	66,918	0MW	7MW	51MW	64MW
Electric Engagement		35,172	63,569	66,181		17MW	56MW	59MW
Hydrogen Evolution		22,177	63,497	66,123		8MW	52MW	64MW
Counterfactual		18,391	60,869	65,732		2MW	39MW	66MW

Table 3 - Projected cumulative number of domestic EV chargers (off-street) and non-domestic and domestic (on-street) EV charge point capacity across Botley Wood GSP. *Source: SSEN DFES 2024*

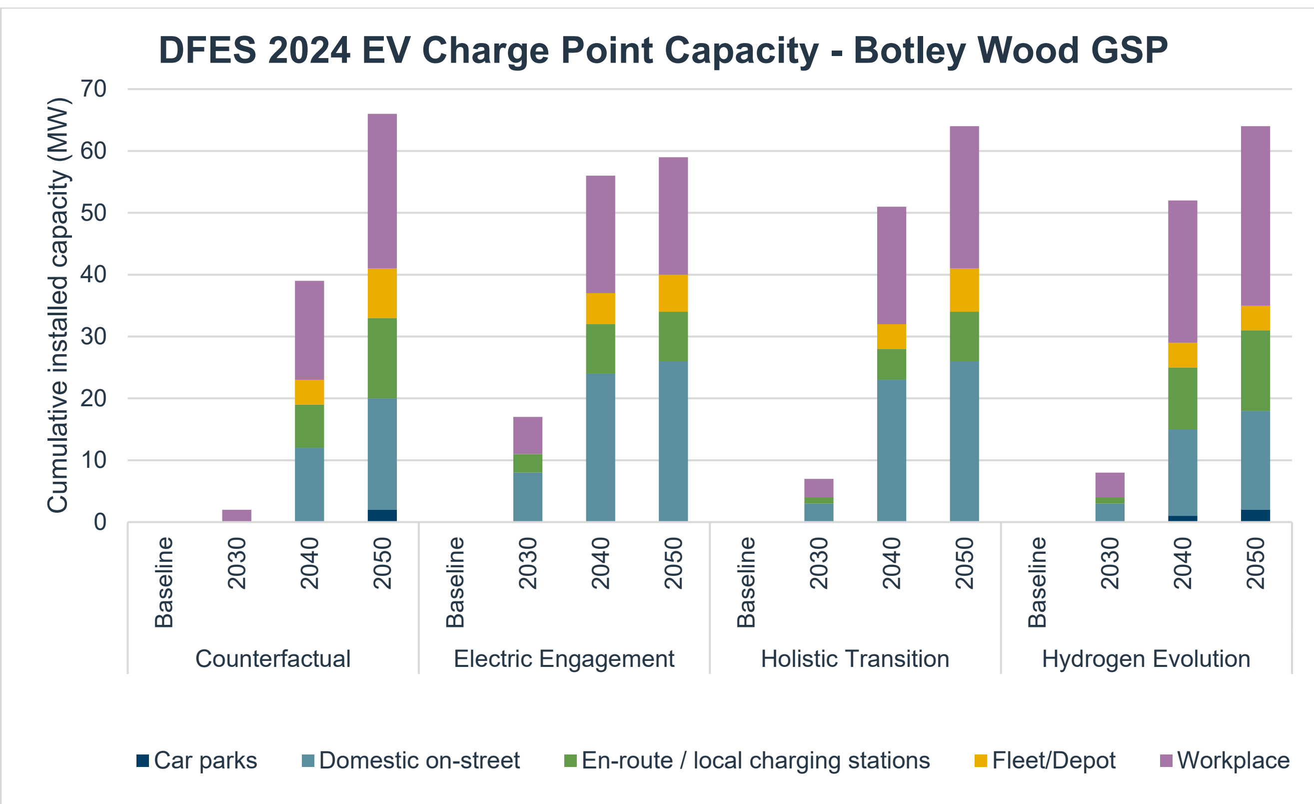

Figure 8 - Projected domestic - on-street and non-domestic EV charge point capacity across Botley Wood GSP. *Source: SSEN DFES 2024*

5.3. Electrification of heat

DFES Scenario	Non-domestic heat pumps and resistive electric heating (m^2 of floorspace)				Domestic heat pumps (number of units)			
	Baseline	2030	2040	2050	Baseline	2030	2040	2050
Holistic Transition	192,597m^2	549,559m^2	1,022,216m^2	1,214,340m^2	13,843	23,445	62,185	86,810
Electric Engagement		456,203m^2	1,068,257m^2	1,305,464m^2		24,105	68,770	123,981
Hydrogen Evolution		445,748m^2	809,518m^2	943,844m^2		24,075	63,767	115,027
Counterfactual		327,464m^2	578,069m^2	745,569m^2		20,481	44,671	128,810

Table 4 - Projected non-domestic heat pumps and resistive electric heating floorspace and number of domestic heat pumps across Botley Wood GSP. *Source: SSEN DFES 2024*

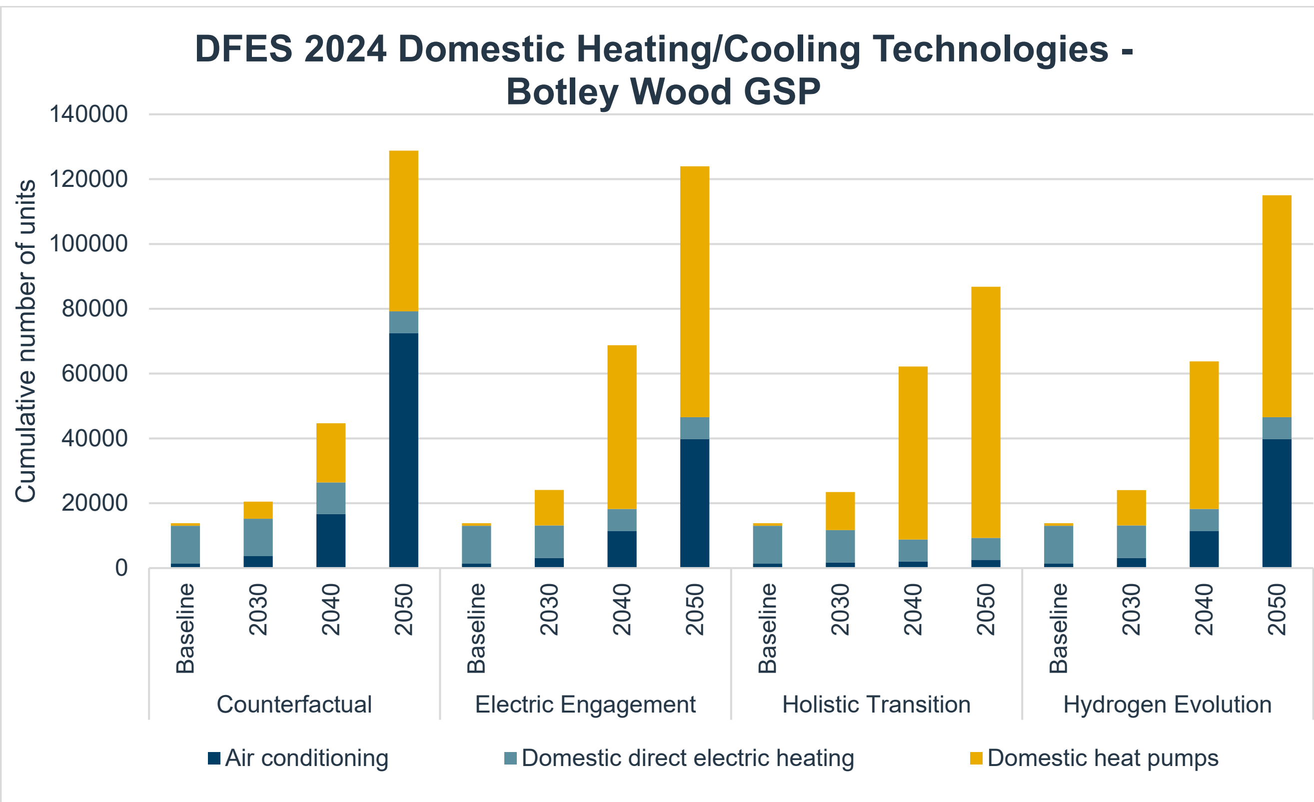

Figure 9 - Projected number of domestic heating/cooling technologies across Botley Wood GSP. *Source: SSEN DFES 2024*

5.4. New building developments

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

DFES Scenario	New domestic development (number of homes)			New non-domestic development (m^2)		
	2030	2040	2050	2030	2040	2050
Holistic Transition	3,547	6,897	10,340	50,646m²	81,434m²	81,434m²
Electric Engagement	3,538	6,278	9,237	31,790m²	81,434m²	81,434m²
Hydrogen Evolution	3,539	6,064	9,017	31,672m²	81,434m²	81,434m²
Counterfactual	3,148	5,307	7,882	26,715m²	81,434m²	81,434m²

Table 5 - Projected new domestic and non-domestic development across Botley Wood GSP. *Source: SSEN DFES 2024*

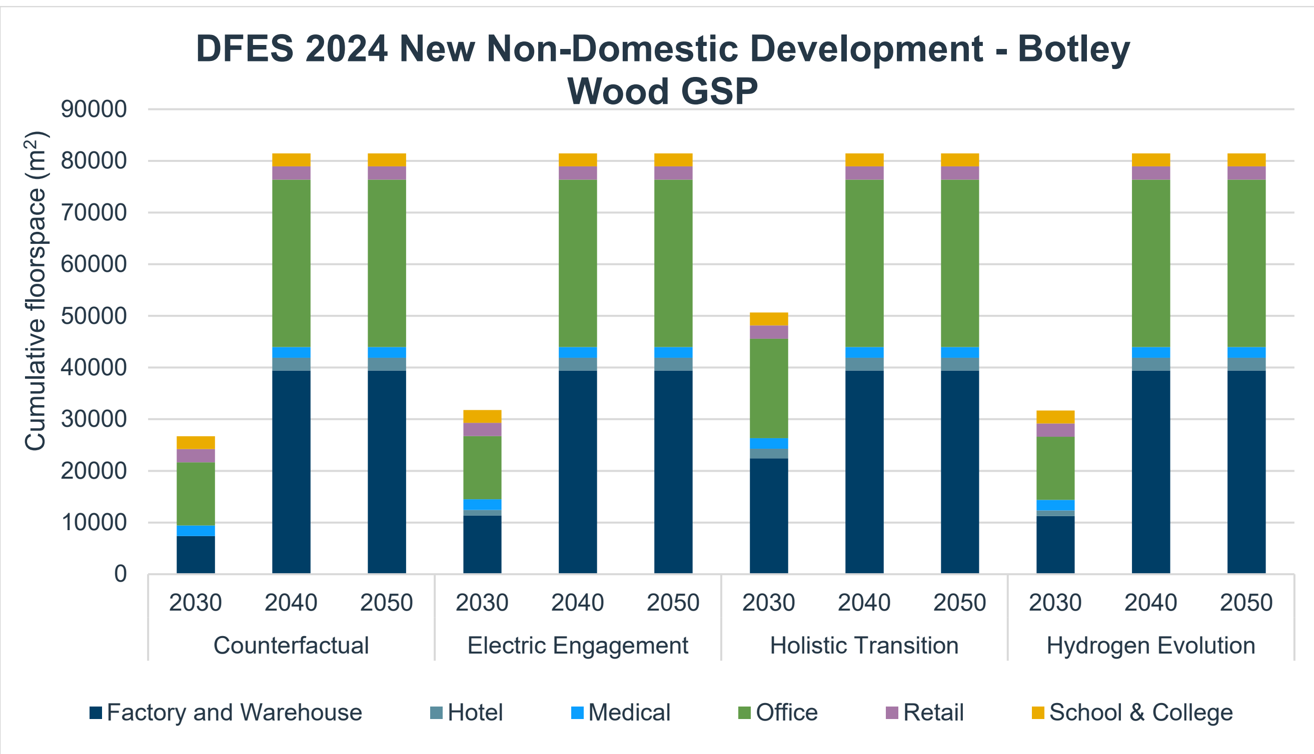

Figure 10 - Projected new non-domestic development across Botley Wood GSP. *Source: SSEN DFES 2024*

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 Botley Wood 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 where investment proposals developed through our DNOA process are driving the reinforcement work. The published DNOA outcomes relevant to Botley Wood GSP are included in Appendix C. The work included here is all work that has passed through the ID2 gate of our Distribution Governance and Investment Framework (DGIF), further information on this process is available in the DSO service statement 2025.[9] The network considered for long-term modelling is shown in Figure 11. Summary of existing works shown below in Table 6.

ID	Substation	Description	Driver	Forecast completion	Resolves future strategic needs to 2050?
		Botley Wood BSP			
1	Botley Wood BSP	Add a new 33kV GIS board at Botley Wood BSP.	Asset Replacement - Environmental	2027	
2	Whiteley PSS	Replace both existing transformers at Whiteley PSS.	Customer Connection	2027	
3	North Fareham PSS (currently fed from Lovedean GSP)	Add two new cables from Botley Wood BSP to North Fareham PSS, add a new 33kV indoor busbar at North Fareham PSS and transfer North Fareham PSS to Botley Wood BSP from Fareham BSP (part of Lovedean GSP).	DNOA Process	2028	
		Netley Common BSP			
4	Netley Common BSP	Add a third 132/33kV transformer and extend the 132kV busbar.	DNOA Process	2026	
5	Netley Common PSS	Replace both existing transformers at Netley Common PSS.	Asset Replacement	2027	

9 DSO Service Statement 2025

6	Bishops Waltham PSS	Replace both existing primary transformers and uprate sections of the 33kV circuits from Netley Common BSP.	DNOA Process	2028	
7	Bitterne PSS	Add a new 33kV switchboard with 7 indoor circuit breakers.	DNOA Process	2028	
8	Weston PSS	Replace the 6 existing circuit breakers.	Customer Connection	2028	
9	Weston PSS & Woolston PSS	Add two new 33kV circuits from Netley Common BSP to Weston PSS and add two new 33kV circuit breakers at the BSP for the cables to connect into. Uprate part of the circuit to Woolston PSS.	DNOA Process	2029	
10	Townhill Park PSS	Add a new 33kV switchboard, add a new 33kV circuit from Netley Common BSP and add a new 33kV circuit breaker at the BSP for the circuit to connect into.	DNOA Process	2031	

Table 6 - 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.

As shown in section 3.3, alongside the asset solutions detailed in the table above, there is active flexibility service procurement ongoing across the Botley Wood GSP area.

6.1. Network Schematic (following completion of above works)

Figure 11 summarises the electricity network within Botley Wood GSP following the completion of the works in Table 6.

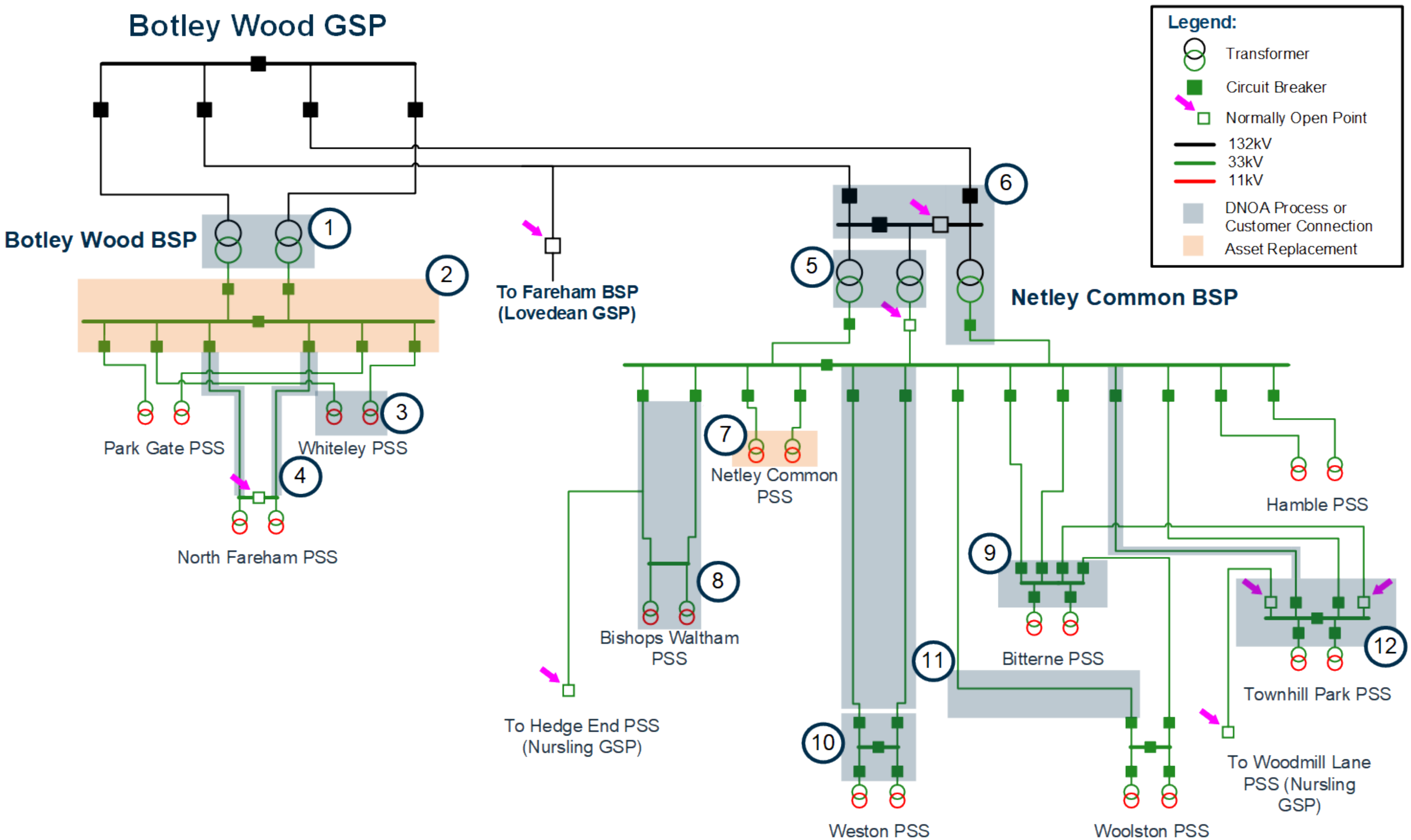

Figure 11 - Future 132kV network for Botley Wood GSP.

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 Botley Wood SDP study area. Darker shades indicate that there is a projected capacity shortfall whereas lighter shades indicate that there is headroom capacity based on current projections. EHV/HV spatial plans for the other DFES scenarios are presented in Appendix A.

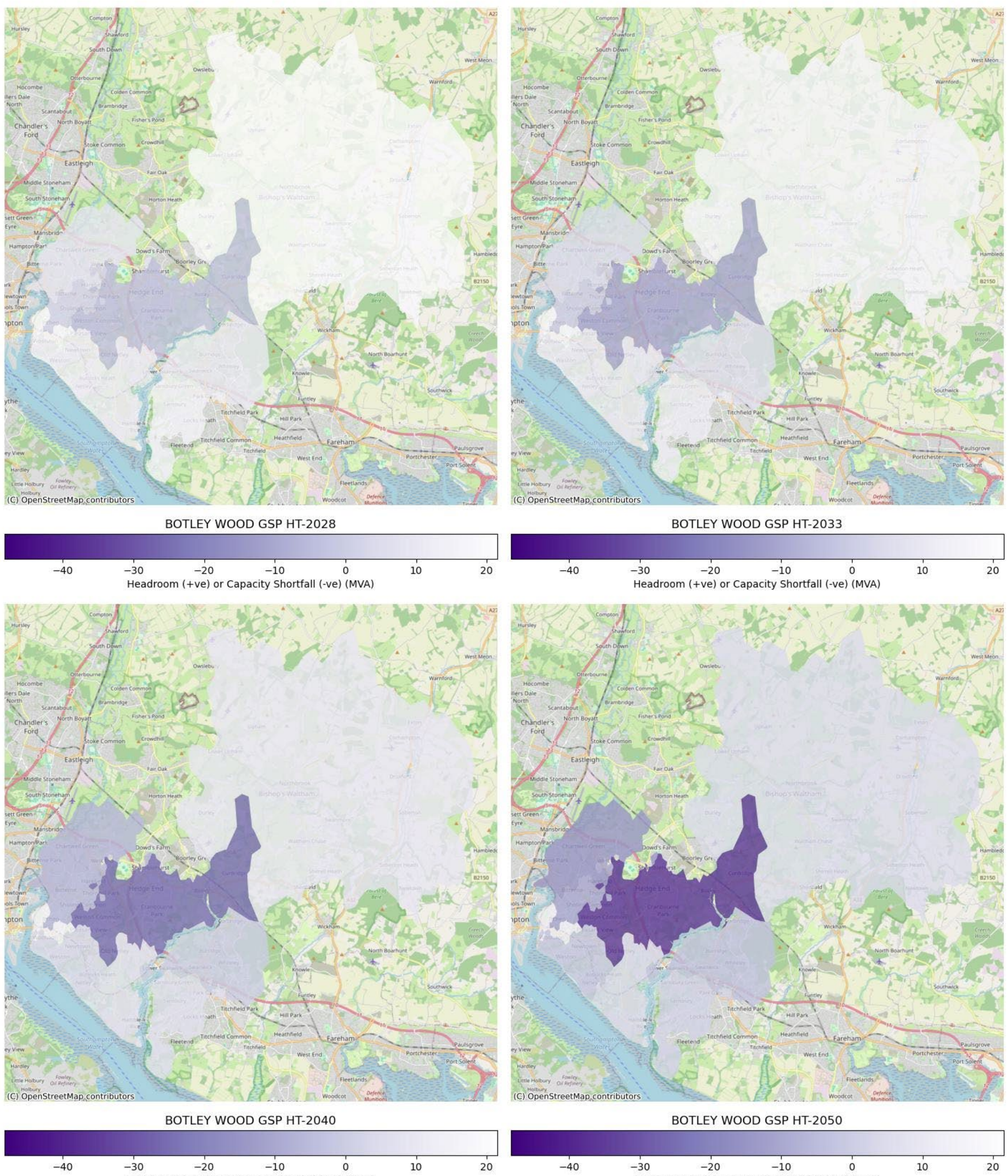

Figure 12 - Botley Wood GSP - EHV/HV Spatial Plan - Holistic Transition

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 Botley Wood GSP. The points are colourised based on the projected percentage loading with red meaning a higher percentage loading and green meaning a lower percentage loading. The HV/LV spatial plans for the other DFES scenarios are available in Appendix B.

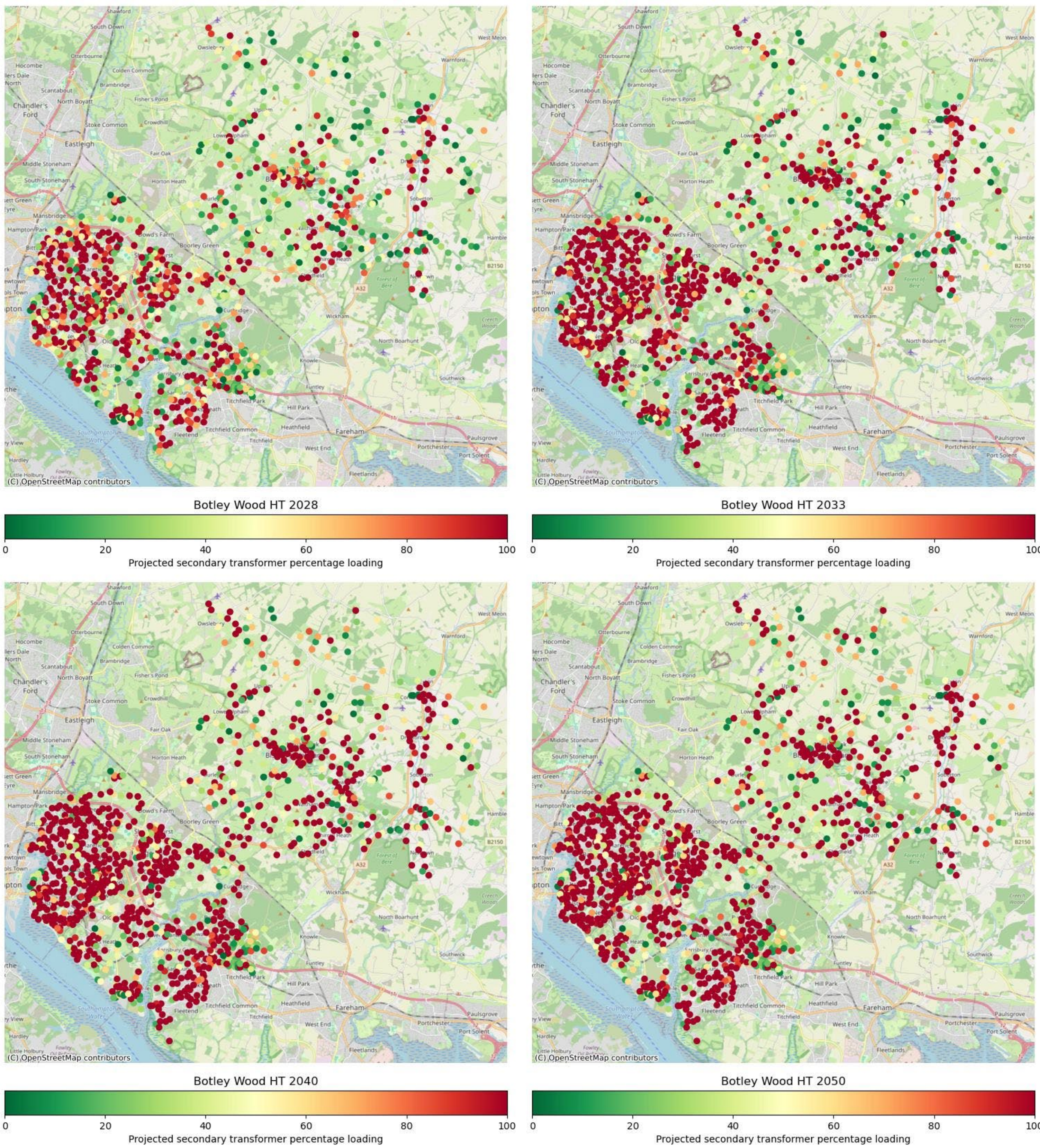

Figure 13 - Botley Wood GSP - HV/LV Spatial Plans - Holistic Transition

8. SPECIFIC SYSTEM NEEDS AND OPTIONS TO RESOLVE

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

The section consists of three sets of results:

- Future EHV system needs to 2035 – these needs are more certain and therefore we have more clearly defined options to meet the requirements. For needs within the next ten years, we recommend that these are progressed through the DNOA process. In all cases, we are proposing solutions that meet the projected requirements for 2050 and where appropriate, system needs arising in the late 2030s and early 2040s are taken into account to ensure a holistic solution. We also provide a summary of more strategic elements that also need to be considered in these timeframes.
- Future EHV system needs to 2050 – there is a greater degree of uncertainty of outcomes in this time frame. This also provides more opportunities to work with stakeholders to develop strategic plans and our outline solutions reflect this initial phase of the work as we look to engage with interested parties.
- Future HV/LV system needs to 2050 – the future needs of the HV and LV networks are locationally specific but can be considered as an aggregated volume. In this section we provide information on our future forecasts for local HV and LV network needs.

8.1. Overall dependencies, risks, and mitigations

There are 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.

Dependency: Delivery of the reinforcement work highlighted in the works in progress section (section 6) will be required to enable capacity in the near-term but may also enable the proposed future options in this system needs section.
Risks: Delays or changes to triggered works fail to release capacity in the near-term and/or do not provide flexibility of future investment.
Mitigation: Current reinforcement projects are included in this strategic development plan and dependencies are identified as part of the DNOA process and form part of the handover of work to delivery teams for consideration. Proposed work should also ensure that it is enabling future network development such as considering space constraints at the site.

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: Future works may require expansion of the Botley Wood GSP site.
Risks: Site expansion is found to be not possible due to forest surrounding the site and new or alternative sites need to be found which delays future work.
Mitigation: Assess the implications of the space constraints at the Botley Wood GSP site on future works and engage with NGET on long-term site planning.

8.2. Future EHV System Needs

In this section, a detailed list of the constraints identified through network modelling is presented alongside potential options to meet forecasted demand – note that where asset sizing is given, this is indicative and subject to further analysis in the DNOA process. The interactions between possible options have been considered to identify potential synergies and efficiencies. As such, constraints have been grouped strategically to be considered alongside each other and any additional interactions between constraints referenced.

8.2.1. System needs out to 2035

<table>
<tr><th>Constraint ID</th><th>Location of proposed intervention</th><th>HT Year</th><th>EE Year</th><th>HE Year</th><th>CF Year</th><th>Network state[10]</th><th>Comments and potential options to resolve the system need</th></tr>
<tr><td colspan="8">33kV Network</td></tr>
<tr><td rowspan="4">1</td><td>Bitterne PSS Transformers</td><td>Ahead of 2030</td><td>Ahead of 2030</td><td>Ahead of 2030</td><td>Ahead of 2030</td><td>N-1: Loss of one of the transformers or circuits feeding Bitterne PSS.</td><td rowspan="4">Bitterne PSS, Netley Common PSS, Townhill Park PSS, and Weston PSS are all fed from Netley Common BSP. The constraints under all four primary substations should be considered collectively to take into account opportunities on the 11kV network to optimise load. There are future constraints arising on the 33kV circuits in the 2040s which are detailed in Section 8.2.2 and the impact of the chosen option here on these constraints should also be explored.
Option a:
Build a new primary substation and transfer load from Bitterne PSS, Netley Common PSS, Townhill Park PSS, and Weston PSS.
Option b:
At Bitterne PSS, replace both existing transformers and add a third transformer. Replace both circuits from Netley Common BSP and add a third circuit.
Transfer load from Townhill Park PSS, Netley Common PSS, and Weston PSS to Bitterne PSS.
Option c:
At Netley Common PSS, add two additional transformers and split the primary into two.</td></tr>
<tr><td>Townhill Park PSS Transformers</td><td>2035-2039</td><td>2035-2039</td><td>2035-2039</td><td>2040-2044</td><td>N-1: Loss of one of the transformers feeding Townhill Park PSS.</td></tr>
<tr><td>Netley Common PSS Transformers</td><td>2030-2034</td><td>2030-2034</td><td>2035-2039</td><td>2040-2044</td><td>N-1: Loss of one of the transformers feeding Netley Common PSS.</td></tr>
<tr><td>Weston PSS Transformers</td><td>2035-2039</td><td>2040-2044</td><td>2040-2044</td><td>2040-2044</td><td>N-1: Loss of one of the transformers feeding Weston PSS.</td></tr>
</table>

10 Network state refers to the situation where the asset becomes overloaded. N-1 refers to a scenario where an outage is taken on the network, **or** a fault occurs. N-2 refers to a scenario where an outage is taken on the network **and** a fault occurs.

							• Transfer load from Bitterne PSS to Netley Common PSS. • At Townhill Park PSS, add a third transformer. • At Weston PSS, replace both transformers or add a third transformer and a third circuit from Netley Common BSP.

Table 7 - Summary of system needs identified in this strategy out to 2040 along with indicative solutions.

8.2.2. System needs out to 2050

Constraint ID	Location of proposed intervention	HT Year	EE Year	HE Year	CF Year	Network state	Comments and potential options to resolve the system need
132kV Network							
2	132kV circuits from Botley Wood GSP to Netley Common BSP	2035-2039	2035-2039	2035-2039	2040-2044	N-1: Loss of one of the circuits feeding Netley Common BSP.	A security of supply issue occurs during the same period for HT under loss of both circuits feeding Netley Common BSP which should be considered when assessing the options below. Option a: • Add a third 132kV circuit from Botley Wood GSP. Option b: • Replace and uprate both existing circuits from Botley Wood GSP. • Add additional 33kV interconnection points between Netley Common BSP and Botley Wood BSP and/or nearby BSPs in Nursling GSP or Lovedean GSP.
3	Netley Common BSP transformers	2045+	2045+	2045+	2045+	Intact & N-1: Loss of one of the circuits feeding Netley Common BSP.	Constraints begin to appear on the BSP transformers at Botley Wood BSP and Netley Common BSP in the same time frame across all four scenarios. However, the season in which the constraint first arises is not the same in each scenario. This is due to the scenarios having different assumptions about the types of load connecting to the network. Option a: • Add a fourth BSP transformer at Netley Common BSP. • Transfer load from Botley Wood BSP to Netley Common BSP. Option b: • Replace and uprate both transformers, or add a third transformer at Botley Wood BSP. • Transfer load from Netley Common BSP to Botley Wood BSP, options include transferring Bishops Waltham PSS. Option c:
	Botley Wood BSP transformers	2045+	2045+	2045+	2045+	N-1: Loss of one of the transformers at Botley Wood BSP.	

							• Transfer load to Lovedean GSP and/or Nursling GSP.
33kV Network							
4	Part of 33kV circuit from Netley Common BSP to Bishops Waltham PSS	2035-2039	2035-2039	2035-2039	2040-2044	N-1: Loss of the other circuit feeding Bishops Waltham PSS.	Option a: • Replace and uprate sections of the circuit.
5	33kV circuits from Netley Common BSP to Weston PSS	2045+	2045+	2045+	2045+	N-1: Loss of one of the circuits feeding Weston PSS.	The constraints on the 33kV circuits to Bitterne PSS, Townhill Park PSS, and Weston PSS should be resolved by proposed options a or b under constraint 1. If option c is chosen for constraint 1, consider the following options to resolve constraints on the Townhill Park PSS and Weston PSS: Options for Townhill Park PSS: • Replace and uprate the existing circuits. • Add a third direct circuit from Netley Common BSP. Options for Weston PSS: • If a third transformer is added, the third circuit from Netley Common BSP will resolve the constraint. • If the transformers are replaced, uprate both existing circuits.
	33kV circuit from Netley Common BSP to Bitterne PSS (1)	2040-2044	2045+	2045+	2045+	N-1: Loss of one of the circuits to Townhill Park PSS.	
	33kV circuit from Netley Common BSP to Bitterne PSS (2)	No issue	2045+	2045+	2045+	N-1: Loss of one of the circuits feeding Woolston PSS.	
	33kV circuits from Netley Common BSP to Townhill Park PSS	No issue	2045+	No issue	2045+	N-1: Loss of one of the circuits feeding Townhill Park PSS.	
6	Whiteley PSS transformers	2045+	No issue	2040-2044	No issue	N-1: Loss of one of the transformers.	Option a: • Replace and uprate the existing transformers and circuits. Option b: • Add a third transformer and a third circuit from Botley Wood BSP.
	33kV circuits from Botley Wood BSP to Whiteley PSS	2040-2044	2040-2044	2040-2044	2045+	N-1: Loss of one of the circuits feeding Whiteley PSS.	
7	33kV circuit from Netley Common BSP to Woolston PSS	No issue	2045+	2045+	2040-2044	N-1: Loss of one of the circuits feeding Woolston PSS.	Option a: • Replace the existing circuits to Woolston PSS with two direct circuits from Netley Common BSP. Option b: • Add a third circuit from Netley Common BSP.
8	Park Gate PSS transformers	No issue	No issue	No issue	2045+	N-1: Loss of one of the transformers	Under the Counterfactual scenario, there is a significant rise in load in the late 2040s in the summer seasons. For the three parts of the network listed here, constraints have not arisen ahead of the late 2040s, and they experience this large summer load under the Counterfactual scenario. This means there is a constraint seen only under the Counterfactual scenario. Options to resolve constraints on the Park Gate PSS transformers and circuits: Option a1: • Replace and uprate both transformers and both circuits feeding Park Gate PSS.
	33kV circuits from Botley Wood BSP to Park Gate PSS	No issue	No issue	No issue	2045+	N-1: Loss of one of the circuits feeding Park Gate PSS.	
	North Fareham PSS transformers	No issue	No issue	No issue	2045+	N-1: Loss of one of the transformers	

							Option b1: • Add a third transformer and a third circuit from Botley Wood BSP. Option c1: • Upgrade North Fareham PSS through either Option a2 or b2 below and transfer load from Park Gate PSS to North Fareham PSS. Options to resolve constraint on the North Fareham PSS transformers: Option a2: • Replace and uprate both transformers. Option b2: • Add a third transformer. Option c2: • Upgrade Park Gate PSS through either Option a1 or b1 below and transfer load from North Fareham PSS to Park Gate PSS.

Table 8 – Summary of system needs identified in this strategy out to 2050 along with indicative solutions.

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

Our HV/LV spatial plans have shown that there while the overloading of the secondary network is mostly apparent around areas of high population density, within these areas there is no clear trend. We are therefore planning on a forecast volume basis, and this section provides further context on this work for both the Botley Wood high voltage and low voltage network needs to 2050.

8.3.1. High Voltage Networks

As well as the EHV system needs identified in the previous section, increased 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, we have used the load model that is produced 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 the primary substations supplied by Botley Wood 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 to 2050 where it is projected that without intervention, 55.7% of secondary transformers will be overloaded under the HT scenario.

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.

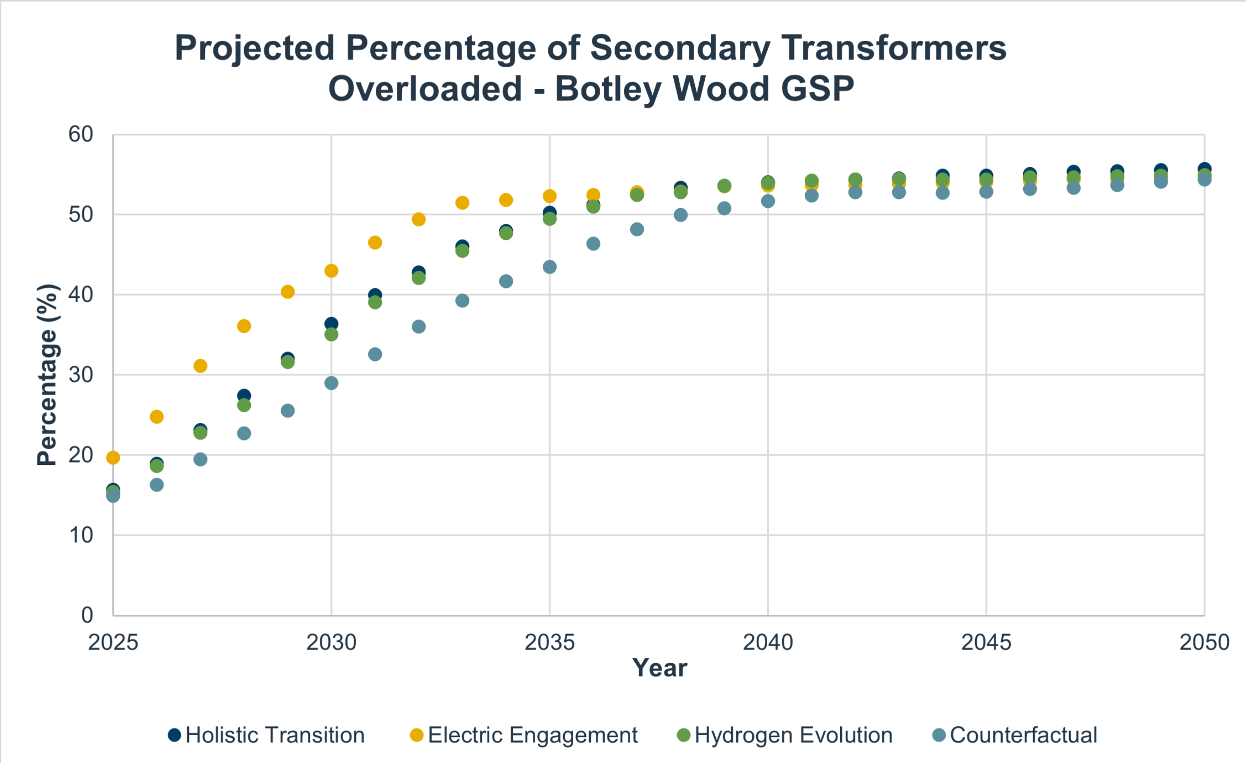

Figure 14 - Botley Wood GSP Projected Secondary Transformer Loading. Source: SSEN Load Model

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 their customers in different locations face. Inclusion of the use of the VFES also acts as an example of how this data can be used more broadly by SSEN as well as other organisations for spatial planning. For example, it can help us identify areas where energy efficiency mechanisms could help reduce the need for network investment.

One of the outputs from this innovation project was the report produced by the Smith Institute[11]. This work groups LSOAs[12] 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 9.

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

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

Group Number & Level of Vulnerability	Description of Group
1 – Very high	Driven up by higher levels of poor health and disability/mental health benefit claimants, reduced by smaller household sizes.
2 – High	Driven up by larger household sizes, reduced by lower elderly population levels.
3 – High	Driven up by larger elderly population levels, reduced by lower levels of disability and mental health benefit claimants.
4 – Slightly higher than average	Driven up by larger elder population levels and moderately higher provision of care, reduced by smaller household sizes.
5 – Slightly lower than average	Driven down by lower elderly population levels and larger levels of ethnic diversity, increased by higher household sizes and greater provision of care.
6 – Low	Driven down by lower levels 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 9 - VFES Groupings

To understand the vulnerability groupings across Botley Wood GSP supply area we have visualised the LSOA categorisation for the study area. By overlaying secondary transformers that are projected to be overloaded by 2028 (under the Holistic Transition pathway), we begin to understand the crossover between network capacity needs and areas categorised as high vulnerability through the VFES work. This is shown below in Figure 15.

The majority of the Botley Wood GSP area falls into category 6 with low vulnerability. There is a notable cluster of projected overloaded secondary transformers by 2028 under HT around Southampton which coincide with areas of very high vulnerability (category 1).

More vulnerable groups may have a 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. They may also highlight areas where there is an evidential need for energy efficiency measures.

We recommend the use of these insights to prioritise work in 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 power outages.

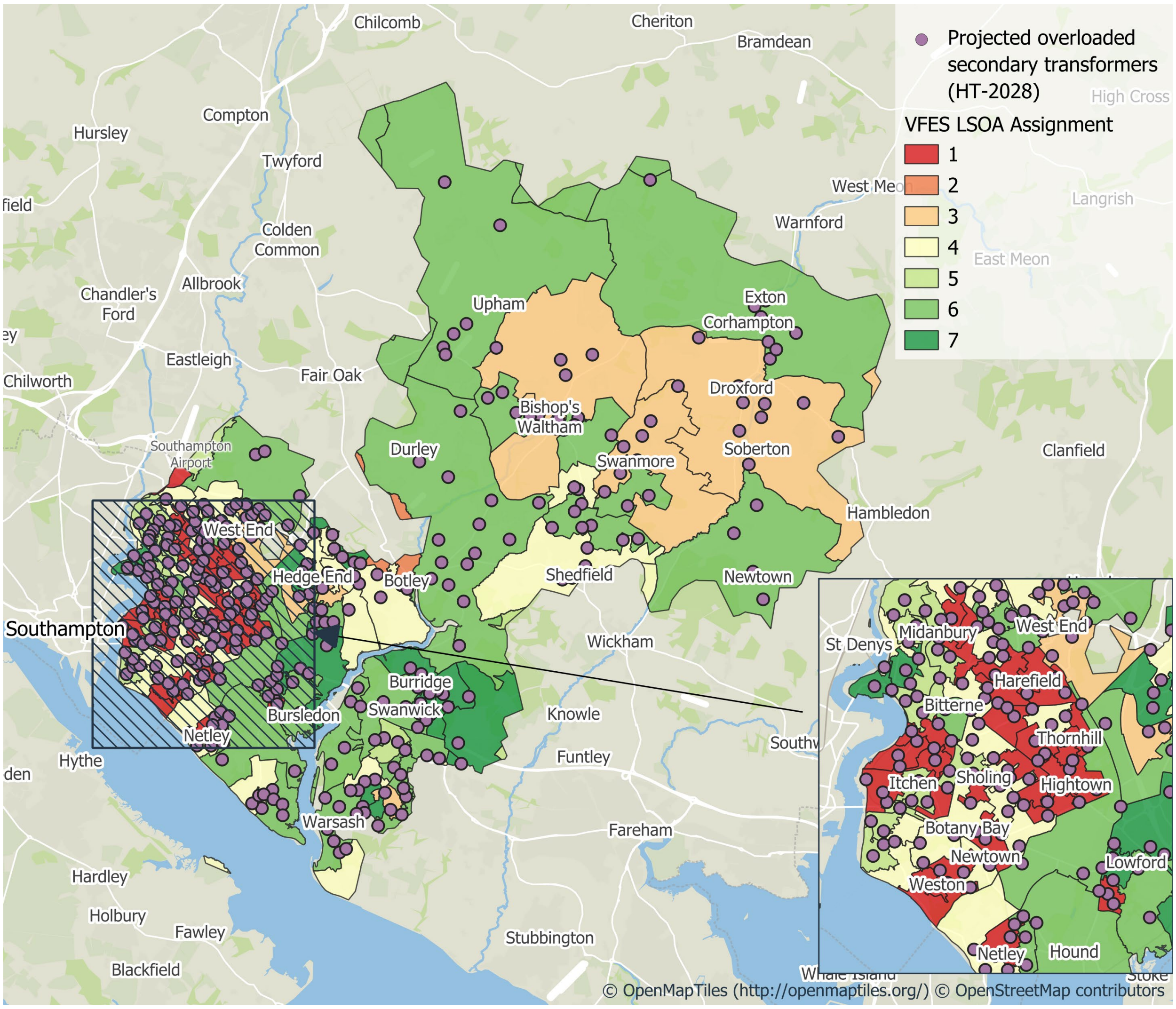


Figure 15 - Botley Wood GSP VFES heat map with overloaded secondary transformers.

8.3.2. Low Voltage Networks

Drivers for interventions in low voltage networks may be either capacity related or be driven by voltage requirements. We are progressing options to resolve both drivers. From a network perspective the solution typically involves upgrading the number of LV feeders to split/balance the load and improve voltage or to install another substation at the remote end of the LV network to balance load and improve voltage. In both instances, flexibility at a local level, especially voltage management products linked to battery export and embedded generation such as solar is likely to be required alongside traditional reinforcement.

We are leveraging recent innovation work through Project LEO (Local Energy Oxfordshire) and My Electric Avenue to inform this strategy. Enhanced network visibility through smart meter data analytics and low-cost substation feeder monitoring is also necessary to enable appropriate dispatch of services and network reconfiguration.

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

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

Initial analysis indicates that across Botley Wood GSP, 45.5% of low voltage feeders may need intervention by 2035 and 53.3% by 2050 under the HT 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.

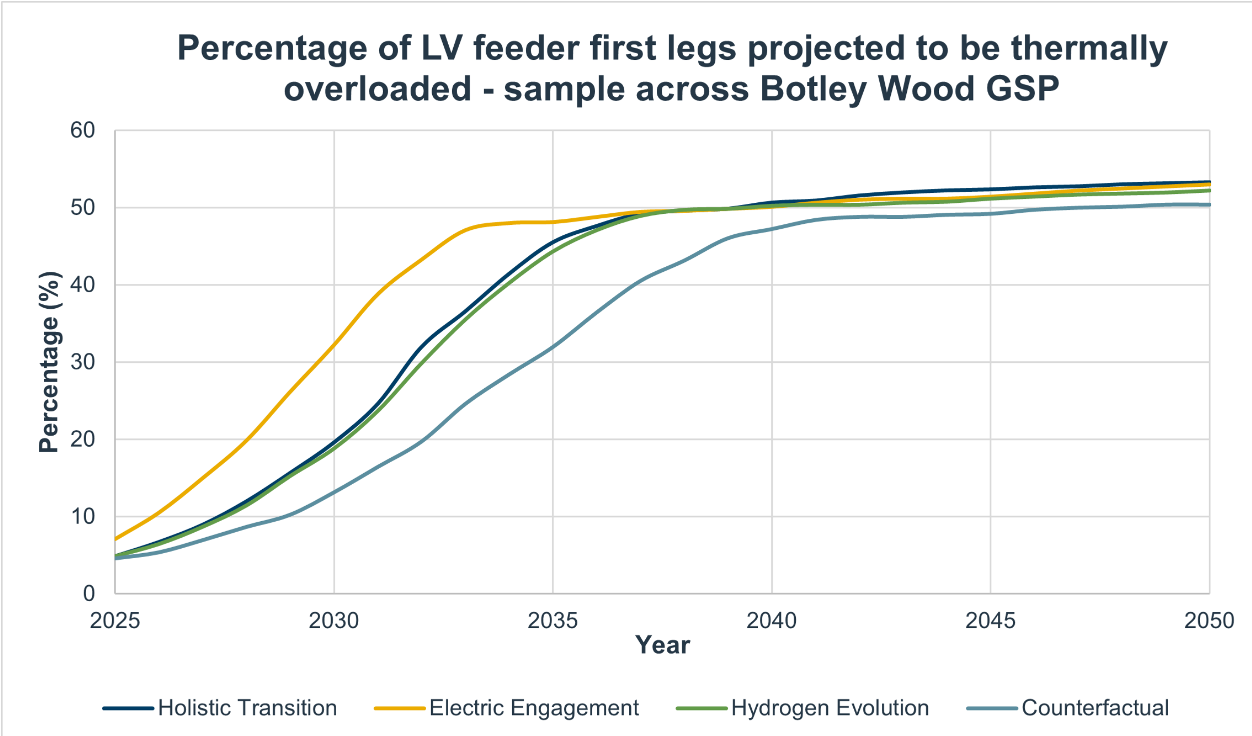


Figure 16 - Percentage of LV feeders projected to be overloaded under Botley Wood GSP.

9. RECOMMENDATIONS

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

There are 3 key recommendations from this report:

1. Where we have identified work that is required in the next 10 years, this should be progressed through the DNOA process. Through detailed study we will understand the network requirements in more detail and progress these where appropriate. This includes the following system needs which are forecasted to arise ahead of 2035:
    a. Bitterne Primary Transformers
    b. Netley Common Primary 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 a DNOA outcome. Annual reassessment will enable us to confirm whether these system needs are likely to arise. When carrying out this annual reassessment the delivery timelines of the work should be considered alongside the potential for flexibility services to manage network capacity.

2. There are a significant number of secondary transformers due to be overloaded by 2030 and by 2050. These are primarily concentrated around Southampton – further investigation into these requirements as well as possible efficient solutions is recommended to ensure capacity of the HV/LV network.

3. As demand load grows under Botley Wood GSP, the security supply limits of the GSP site should continue to be considered alongside the Strategic Development Plans for Lovedean and Nursling GSPs to ensure efficient and strategic planning across the South Coast.

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: EHV/HV plans for other DFES scenarios

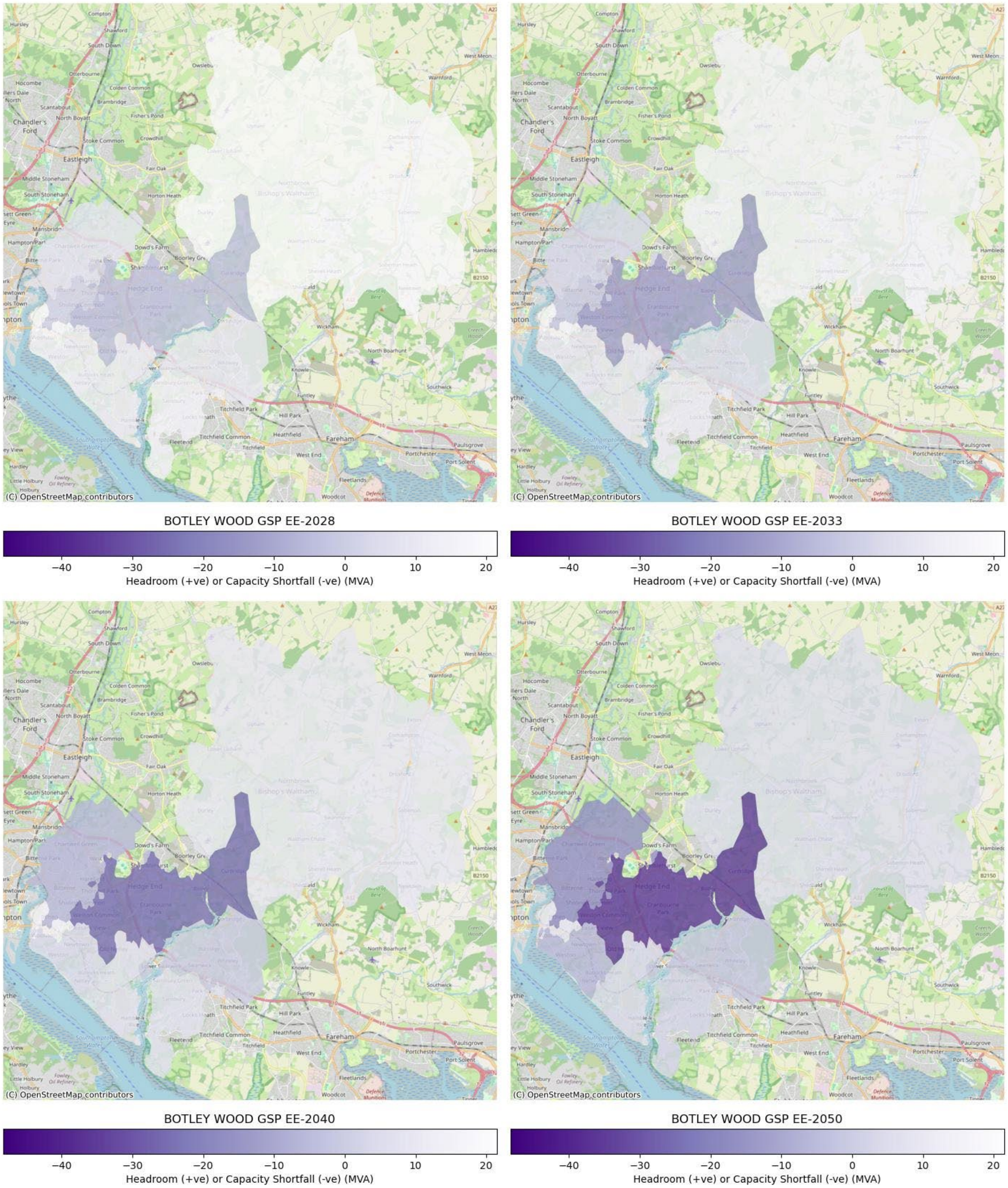


Figure 17 - Botley Wood GSP - EHV/HV Spatial Plan - Electric Engagement

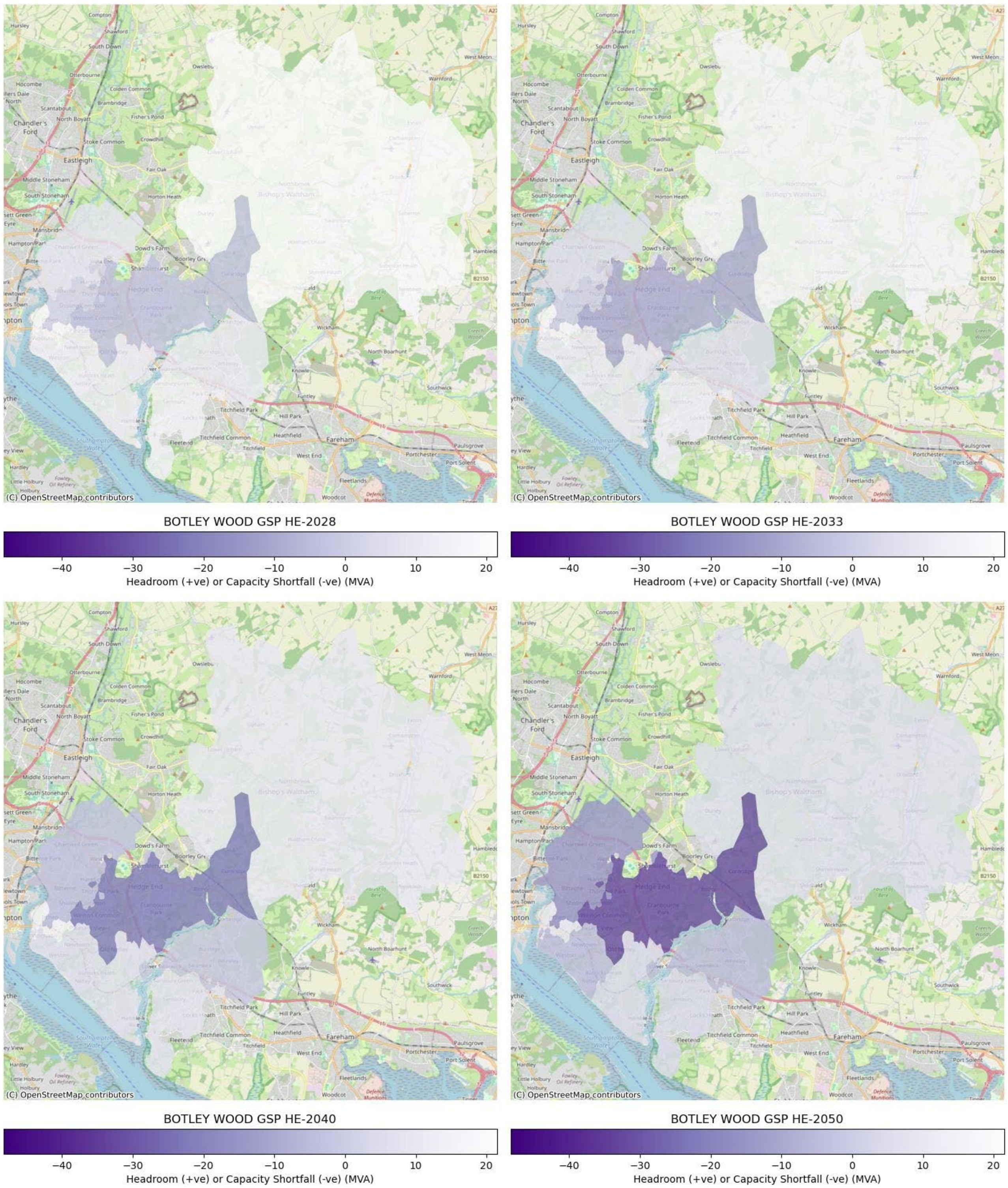


Figure 18 - Botley Wood GSP - EHV/HV Spatial Plan - Hydrogen Evolution

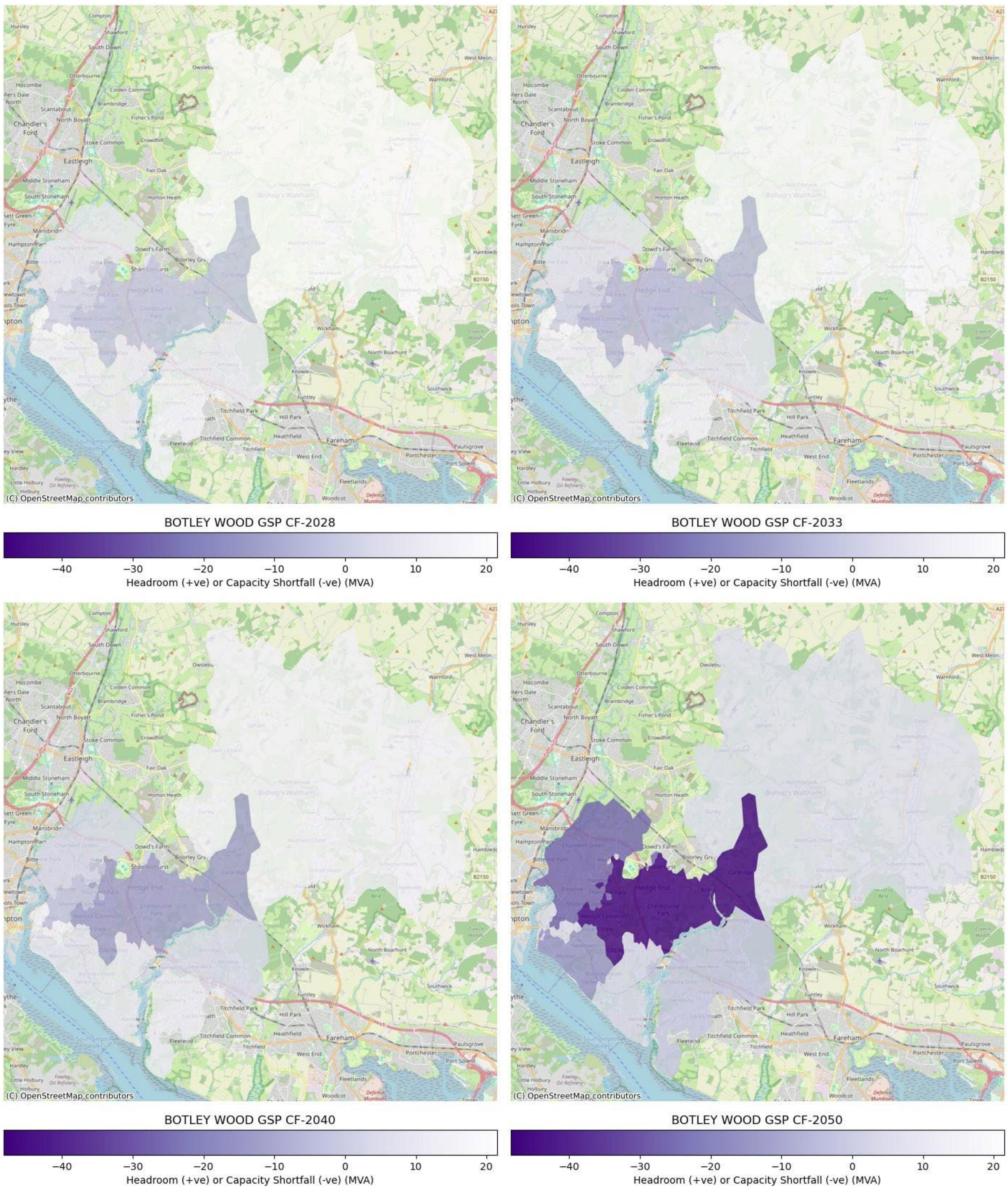


Figure 19 - Botley Wood GSP - EHV/HV Spatial Plan - Counterfactual

Appendix B: HV/LV plans for other DFES scenarios

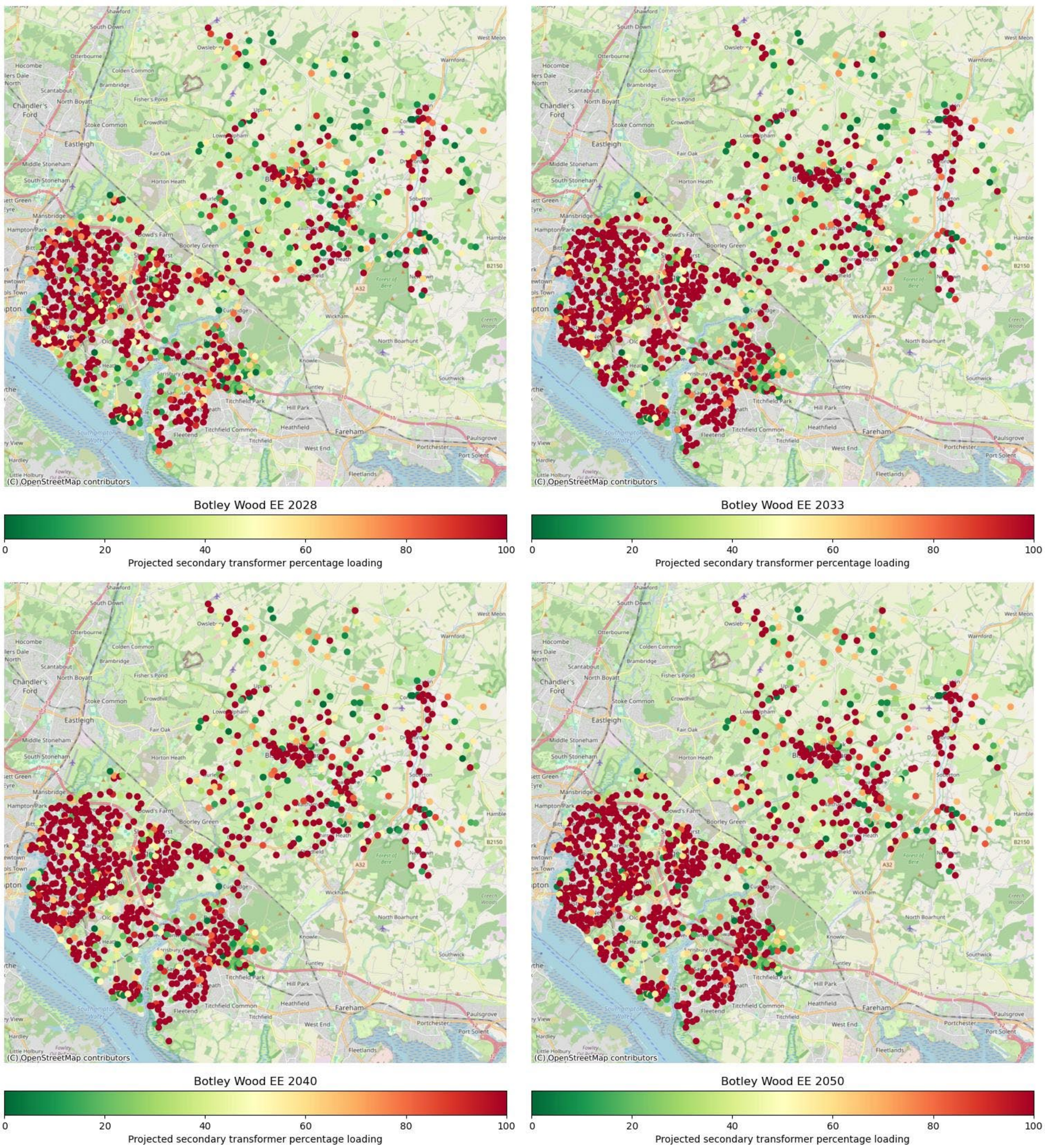


Figure 20 - Botley Wood GSP - HV/LV Spatial Plan - Electric Engagement

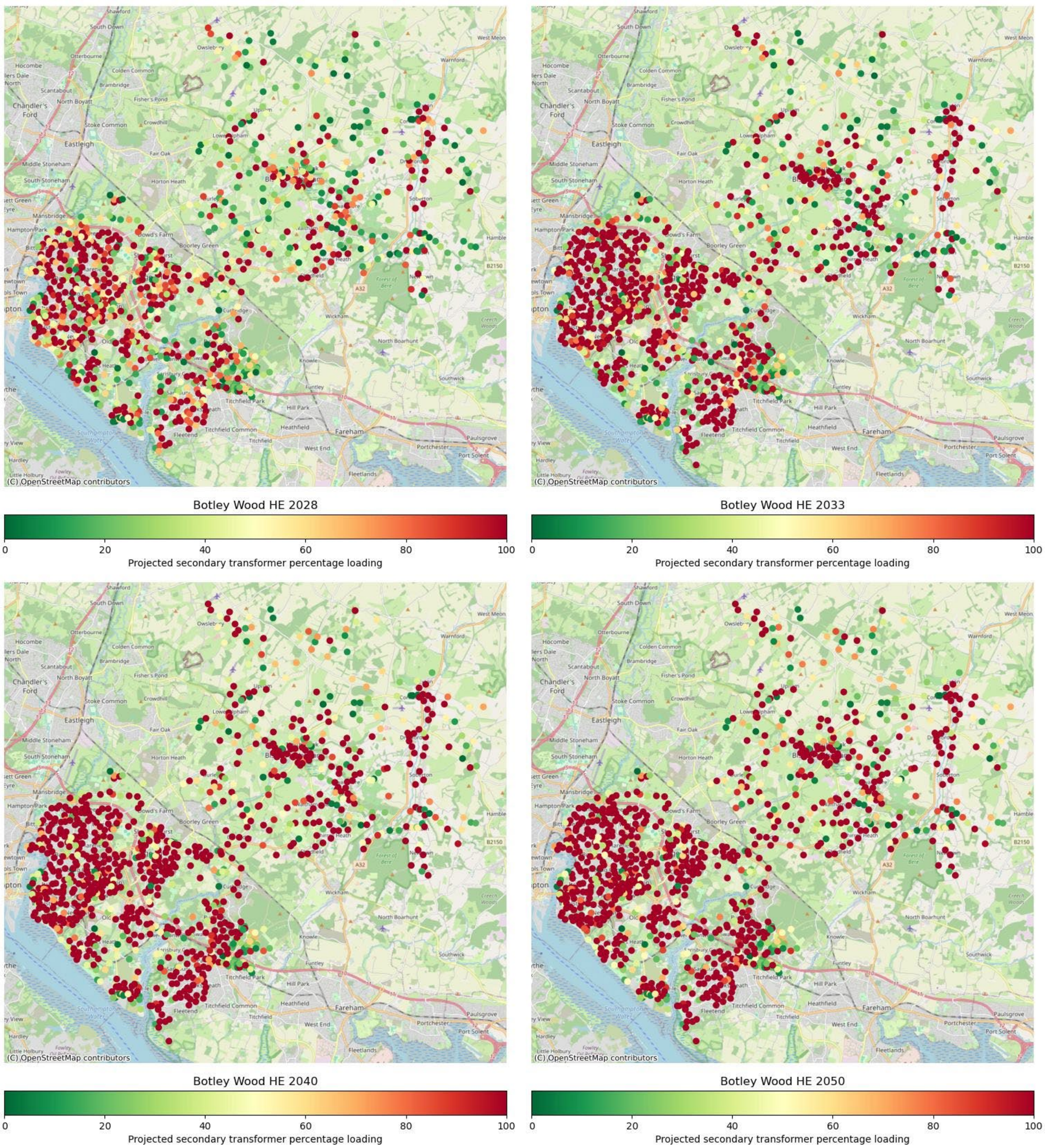


Figure 21 - Botley Wood GSP - HV/LV Spatial Plan - Hydrogen Evolution

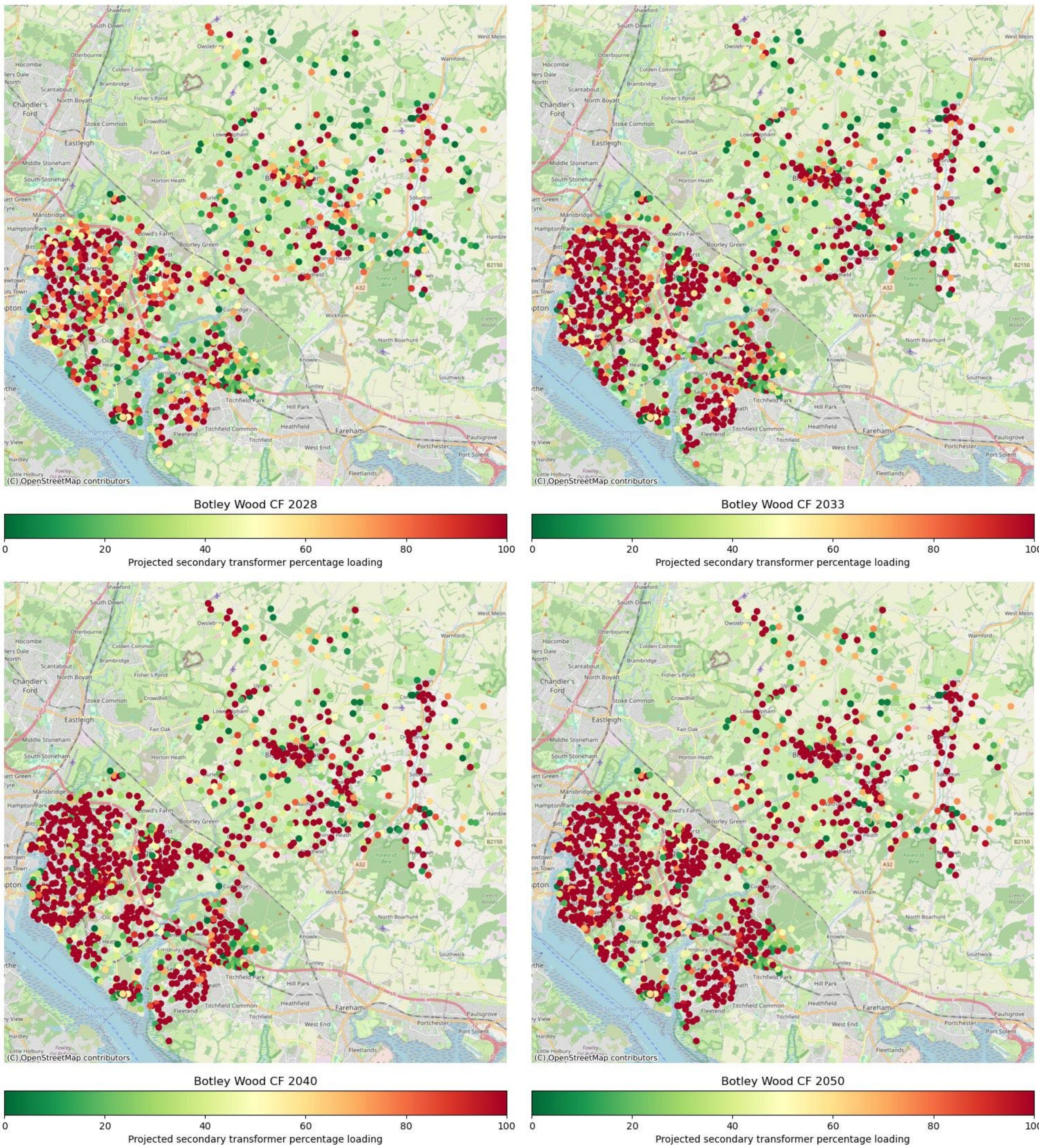


Figure 22 - Botley Wood GSP - HV/LV Spatial Plan - Counterfactual

Appendix C: Relevant DNOA Outcome Reports

November 2024 DNOA Report

DNOA Outcome Report

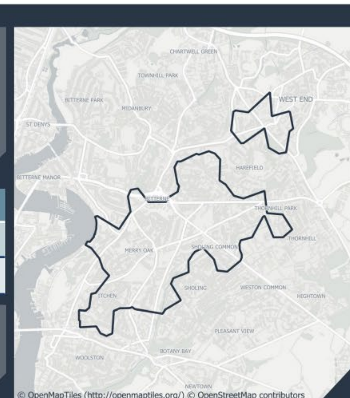
East Southampton (Bitterne PSS)

Scheme description

- The reinforcement of the Bitterne PSS will enable efficient use of existing capacity in the east Southampton area. Postcode(s): SO18-19, SO30.
- Local authority: Southampton, Eastleigh
- Load related – 33kV circuit thermal overload issue during FCO conditions due to forecasted demand growth.

Proposed option

- Smart/Asset Solution: Reinforcement of Bitterne PSS busbars to allow greater usage of the existing capacity, by redirecting the load from the constrained assets to unconstrained assets.
- Flexibility was unable to be utilised as the capacity is released through a rearrangement of the network topology.
- This option addresses the forecasted thermal overload out to 2032.



System need requirement

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

DNOA History

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

Indicative flexibility price (if available):

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

Reinforcement timeline

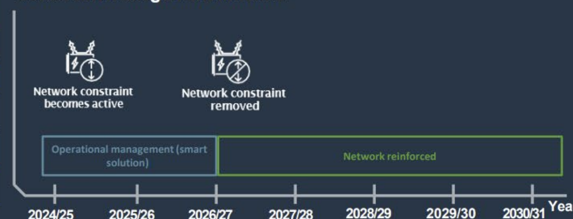
- Reinforcement delivery by the end of 2025/26.

Estimated peak MW outside firm network capacity under each scenario

Grey text relates to estimated peak MW without reinforcement delivery

	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31
CT	1.80	3.58	- (5.08)	- (6.27)	- (9.26)	- (12.23)	- (14.03)
ST	0.83	2.13	- (2.66)	- (2.94)	- (4.82)	- (6.79)	- (7.26)
LTW	2.71	4.68	- (6.24)	- (7.80)	- (10.84)	- (14.29)	- (16.39)
FS	0.82	2.12	- (2.53)	- (2.91)	- (4.86)	- (6.84)	- (7.28)

Constraint management timeline



DNOA Outcome Report

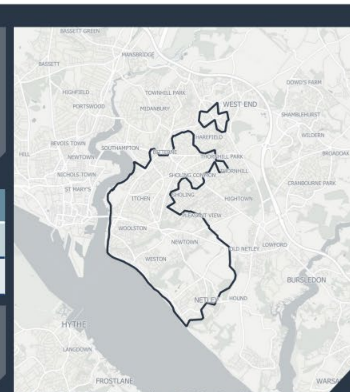
East Southampton (Weston, Bitterne and Woolston PSS)

Scheme description

- The reinforcement of the 33kV circuit which supplies Weston, Bitterne and Woolston PSS will increase capacity in the east Southampton area. Postcode(s): SO14-19, SO30-32, SO40, SO45, SO50, SO53.
- Local authority: Southampton, Eastleigh
- Load related – 33kV circuit thermal overload issue during FCO conditions due to forecasted demand growth.

Proposed option

- Flexibility/Asset Solution: Two new 33kV circuits from Netley Common BSP to Weston PSS which removes Weston PSS from a constrained circuit it shares with Woolston PSS and Bitterne PSS.
- This option addresses the forecasted 33kV circuit thermal overload out to 2050.
- Capacity released: 42MVA



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: £116/MW/h
- Utilisation price: £152/MWh

Reinforcement timeline

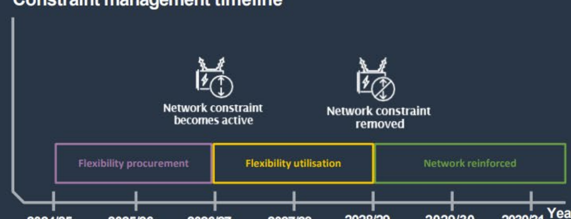
- Flexibility solution utilised from the start of 2026/27 until the end of 2027/28.
- Reinforcement delivery by the end of 2027/28.

Estimated peak MW outside firm network capacity under each scenario

Grey text relates to estimated peak MW without reinforcement delivery

	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31
CT	-	-	0.46	1.43	- (4.16)	- (6.91)	- (8.43)
ST	-	0.038	1.34	2.68	- (5.50)	- (8.71)	- (10.48)
LTW	-	-	-	-	- (0.55)	- (2.47)	- (2.85)
FS	-	-	-	-	- (0.55)	- (2.48)	- (2.84)

Constraint management timeline



Appendix D: 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
CF	Counterfactual
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
EE	Electric Engagement
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
HE	Hydrogen Evolution
HT	Holistic Transition
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
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 Networks
ST	System Transformation
UM	Uncertainty mechanism
VFES	Vulnerability Future Energy Scenarios
WSC	Worst Served Customers

Scottish & Southern
Electricity Networks

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