EAST CLAYDON GRID SUPPLY POINT: STRATEGIC DEVELOPMENT PLAN

Our network serving communities across Northeast Oxfordshire.

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 to 2050 and translate these requirements into strategic spatial plans for 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.The focus area of this SDP is that supplied by East Claydon 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 across Northeast Oxfordshire and areas of industrial growth have been considered in preparation for this plan.

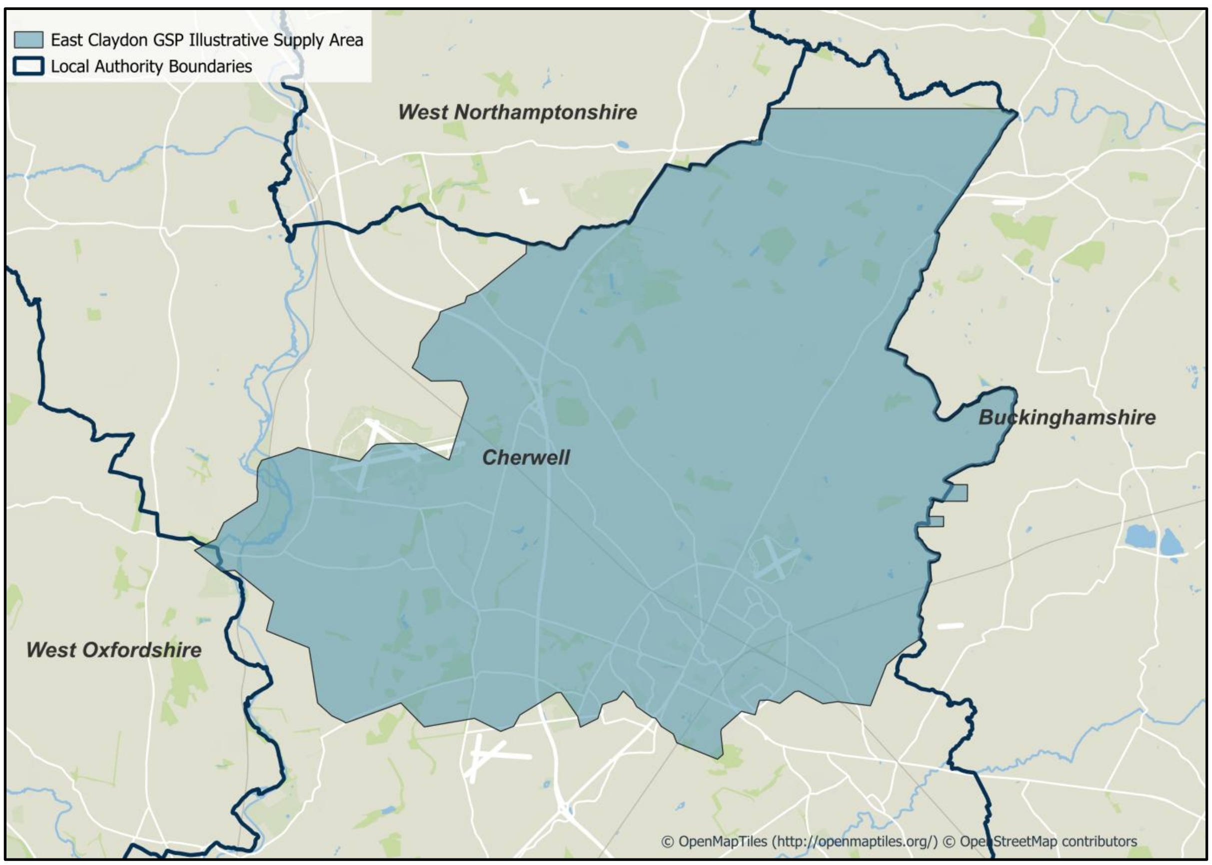

Figure 1 Area of focus for this SDP.

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

2. INTRODUCTION

The aim of this report is to demonstrate how local, regional, and national targets align with stakeholder perspectives in the area to provide a robust evidence base for load growth out to 2050 across the East Claydon 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. Following stakeholder feedback during the RIIO-ED2 development process, 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. Further information on the FES framework can be found in the DFES 2024 introductory report.

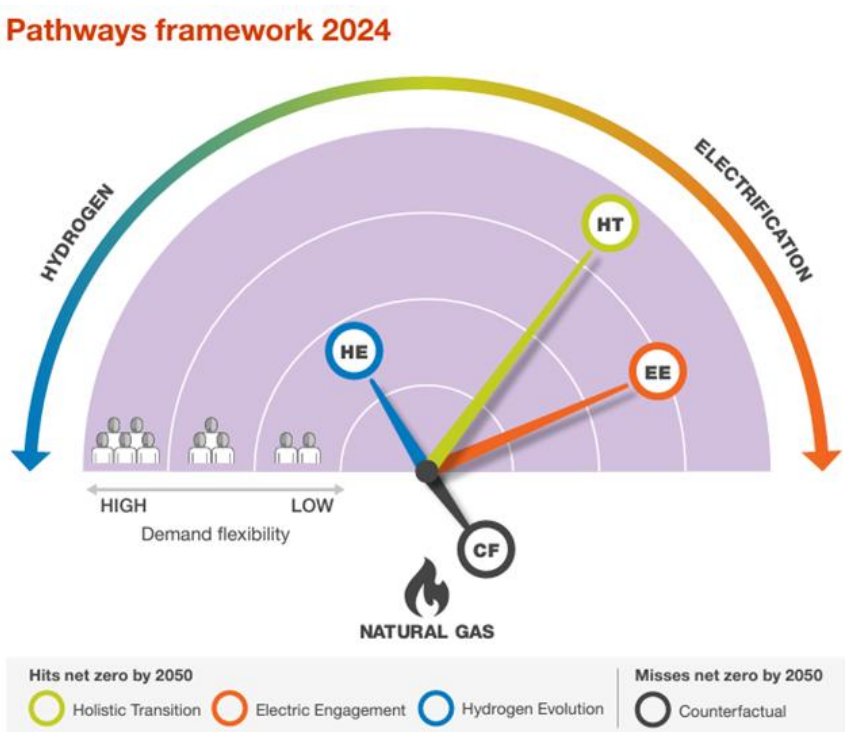

Figure 2: The FES framework (source: NESO)

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, in alignment with evidence gathered in preparation for the SSEN ED2 business plan. We also model across the other scenarios to understand when these needs may arise and what demand projections should be planned for in the event each scenario is realised.

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

3. STAKEHOLDER ENGAGEMENT AND WHOLE SYSTEM CONSIDERATIONS

3.1. Local Authorities and Local Area Energy Planning

The main local authorities that are supplied by East Claydon GSP are Cherwell, and Oxfordshire 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.

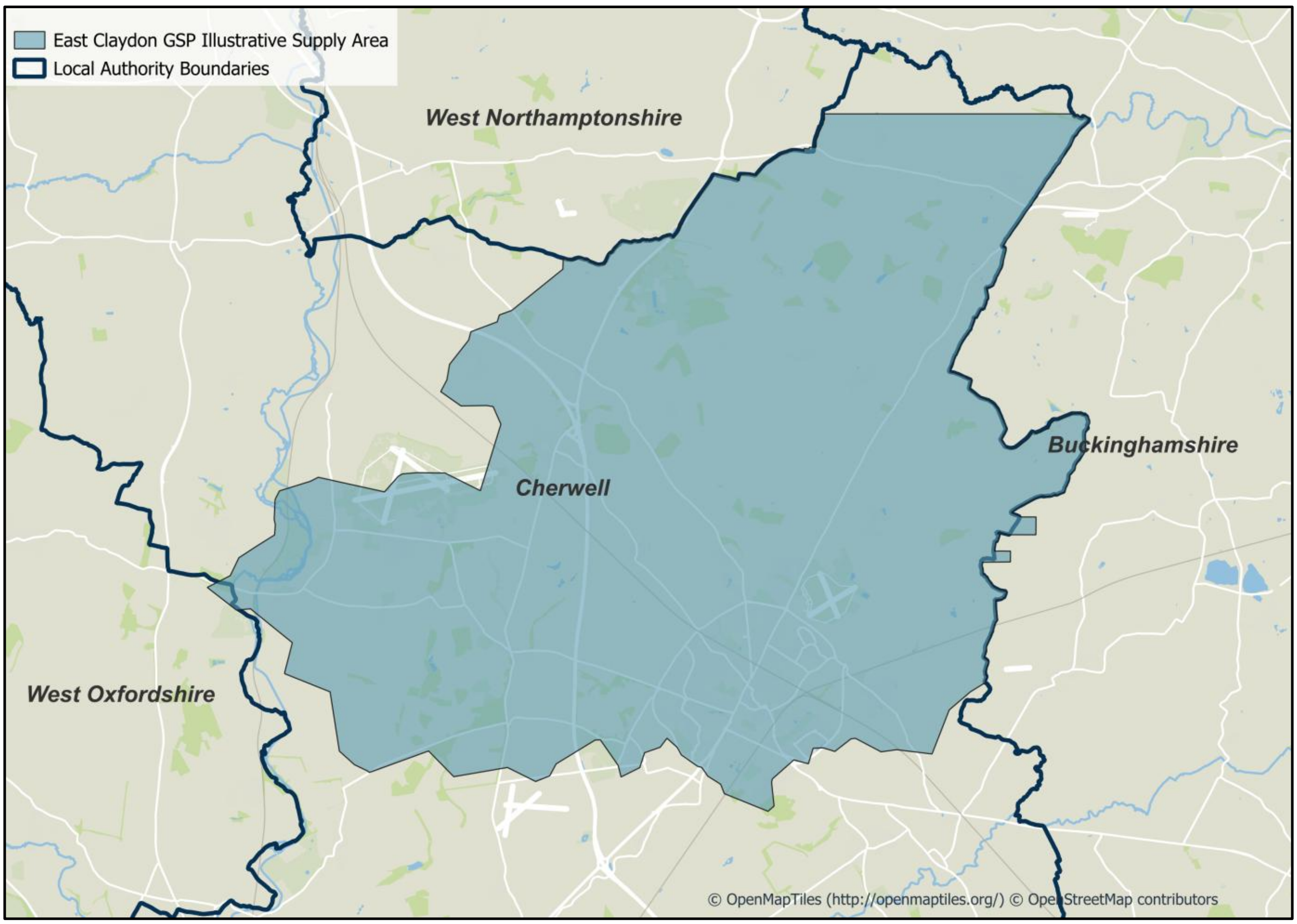

Figure 3 East Claydon GSP Supply Area and Local Authority Boundaries.

3.1.1. Cherwell

Cherwell District Council has seen significant population growth of 13.5% from around 141,900 in 2011 to around 161,000 in 2021[1]. From 2020-2024 Cherwell provided 4,477 new homes, it also has land supply for an additional 12,525 homes and has 4,400 homes planned to help meet Oxford's unmet housing need, therefore in the recent Local Plan 2042 a housing requirement of 911 homes per annum from 2020 to 2042 is proposed[2]. The council declared a climate emergency in 2019 and aims to ensure its operations and activities are carbon neutral by 2030[3]. Progress is already being made with the Council's greenhouse gas emissions down by 40% from 2009 levels and the financial year 2022/23 annual emissions were down 3% to 4077 tonnes of CO2. To ensure continued progress the district council has several plans and initiatives, with plans to improve air quality[4], access to EV charge points in Council car parks[5], and encourage recycling habits in Cherwell[6]. Furthermore, the Thorpe Lane waste and recycling depot in Banbury has been refitted with air source heat pumps and innovative batteries as part of a project to cut down Cherwell District Council's carbon emissions[7].

3.1.2. Oxfordshire County Council

Oxfordshire County Council declared a climate emergency in 2019 and has the ambition target of becoming carbon neutral by 2030. To help achieve this target the council annually publishes a review of its 'Carbon Management Plan'[8] to ensure progress is up to date and new actions are identified. For the county's longer term targets, the Pathways to a Zero Carbon Oxfordshire Report 2021[9] and the Net Zero Route Map and Action Plan 2023[10] set out how the county at large could reach net zero by 2050 and factors in all the individual district level plans and targets. This analysis formed the basis for ongoing local area energy planning (OxLAEP) work currently being undertaken in the County. In addition to this, the council was also one of three that SSEN partnered with through the RESOP Project to trial LAEP+ (now LENZA)[11].

The OxLAEP programme comprises the creation of 5 district level LAEPs + a county overview and builds the additional capacity and capability to conduct LAEP activities in-house in future years including the development of a delivery and financing plan. To support this SSEN is part of the OxLAEP governance structure as part of the Oxfordshire Leaders Joint Committee[12], sitting on the Energy Planning Working Group and the Executive Steering Board to provide network insights. Recently the Government have established the Oxfordshire Growth

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1 Census 2021, January 2023, How life has changed in West Oxfordshire: Census 2021.

2 Summary | Summary | Cherwell District Council

3 Climate Action | Climate Action | Cherwell District Council

4 Plan to care for district air | Cherwell District Council

5 New deal promises improvements at council car parks | Cherwell District Council

6 Council award created to acknowledge companies going green | Cherwell District Council

7 Climate-friendly upgrade for council depot | Cherwell District Council

8 Carbon Neutral by 2030 | Oxfordshire County Council

9 Pathways to a zero carbon Oxfordshire | Environmental Change Institute

10 Net Zero Route Map and Action Plan

11 LENZA - SSEN

12 Oxfordshire Leaders Joint Committee

Commission[13] which is tasked with addressing key issues that are acting as a barrier to growth in the County, including the need for additional electricity network capacity especially affecting development around Oxford and Bicester.

3.2. Whole System Considerations

East Claydon is experiencing high levels of battery storage and generation connection applications. The impact of Clean Power 2030 on connections relating to current works and future system needs will need to be carefully considered and this SDP will be updated in future iterations accordingly. As well as storage and generation connections, it is also understood that the GSP area has several housing developments planned for the Bicester area that will have been accounted for through the DFES projections.

3.2.1. Transmission interactions

SSEN regularly engages with both National Grid Electricity Transmission (NGET) and the National Energy System Operator (NESO) to understand the interactions between the distribution and transmission networks in the area. Currently SSEN is working together with NGET to release capacity at East Claydon GSP through regular meetings and working groups, with triggered works estimated for completion at the end of 2031.

East Claydon GSP is shared between two DNOs, SSEN Distribution and National Grid Electricity Distribution. The triggered works by NGET include the rebuild of the 400kV and 132kV substation with a significant increase in supply capacity. Continued engagement will ensure works are delivered in a coordinated and efficient way. However, it should be noted that these projects may be subject to change due to the impact of connections reform and Clean Power 2030.

3.3. Flexibility Considerations

SSEN procures Flexibility Services from owners, operators, or aggregators of Distributed Energy Resources (DERs) or Consumer Energy Resources (CERs), which can be generators, storage, or demand assets. These services are needed in areas of the network which have capacity constraints at particular times or under certain circumstances. SSEN purchases Flexibility Services from all types of providers (e.g. domestic or commercial). Information on the process of procurement and how to participate are published on the Flexibility Services website and information on real time decision making on which providers are dispatched can be found in the Operational Decision-Making document.[14,15]

SSEN regularly recruits new Flexibility Services providers and increases the procured Flexibility Services with the latest bidding round for long term requirements held in May 2025 and recruitment through the Mini-Competition process most recently opening in mid-July 2025.[36]

13 Appointment of Oxford Growth Commission Chair - GOV.UK

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

15 SSEN, Operational Decision Making (ODM), SSEN Operational Decision Making ODM

Across the East Claydon GSP supply there has currently been no flexible capacity procured[16] as shown below in Figure 4.

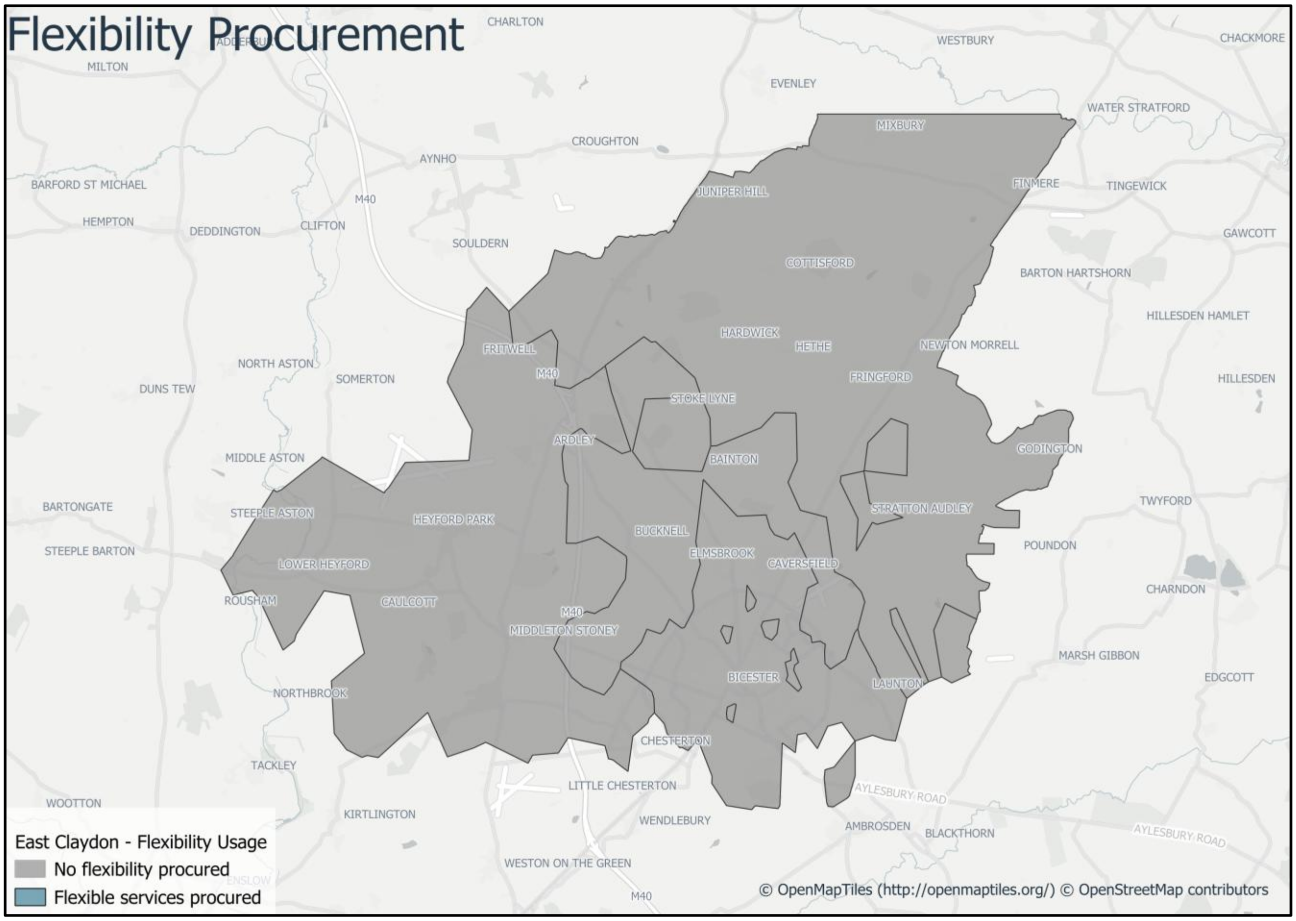

Figure 4 Flexibility procurement across the East Claydon GSP supply area.

16 SSEN, Flexibility Services Contract Register [Flexibility Services Document Library - SSEN]

4. EXISTING NETWORK INFRASTRUCTURE

4.1. East Claydon Grid Supply Point Context

The East Claydon GSP network is made up of 132kV, 33kV, 11kV, and LV circuits. It is a relatively small GSP with both areas of urban and rural network, covering urban areas such as Bicester, and the rural areas surrounding it. In total, the GSP serves approximately 20,000 customers. Table 2 shows the values for the GSP, Bulk Supply Points (BSPs), and primary substations.

Substation Name	Site Type	Number of Customers Served	2024 Substation Maximum MVA (Season)
East Claydon	Grid Supply Point	20,400	56
Bicester North	Bulk Supply Point	20,400	56
Bicester	Primary Substation	10,200	21
Bicester North	Primary Substation	7,200	17
Cottisford	Primary Substation	1,500	3
Upper Heyford	Primary Substation	1,600	7

Table 1 Customer number breakdown and substation peak demand readings (2024).

4.2. Current Network Topology

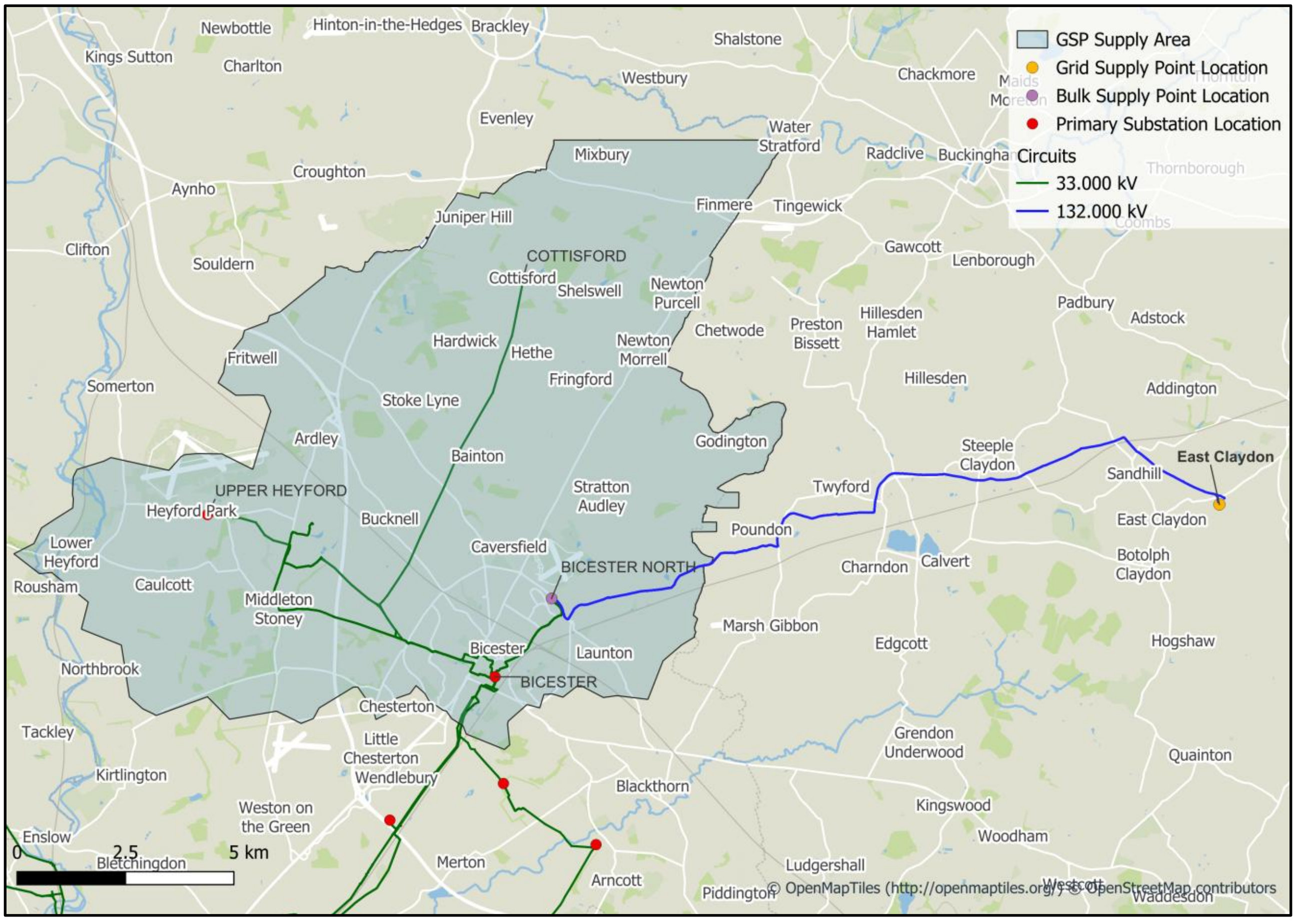

Figure 5 Geographic Information System view of East Claydon GSP electricity network.

4.3. Current Network Schematic

The existing 132kV and 33kV network at East Claydon GSP is shown below in Figure 6.

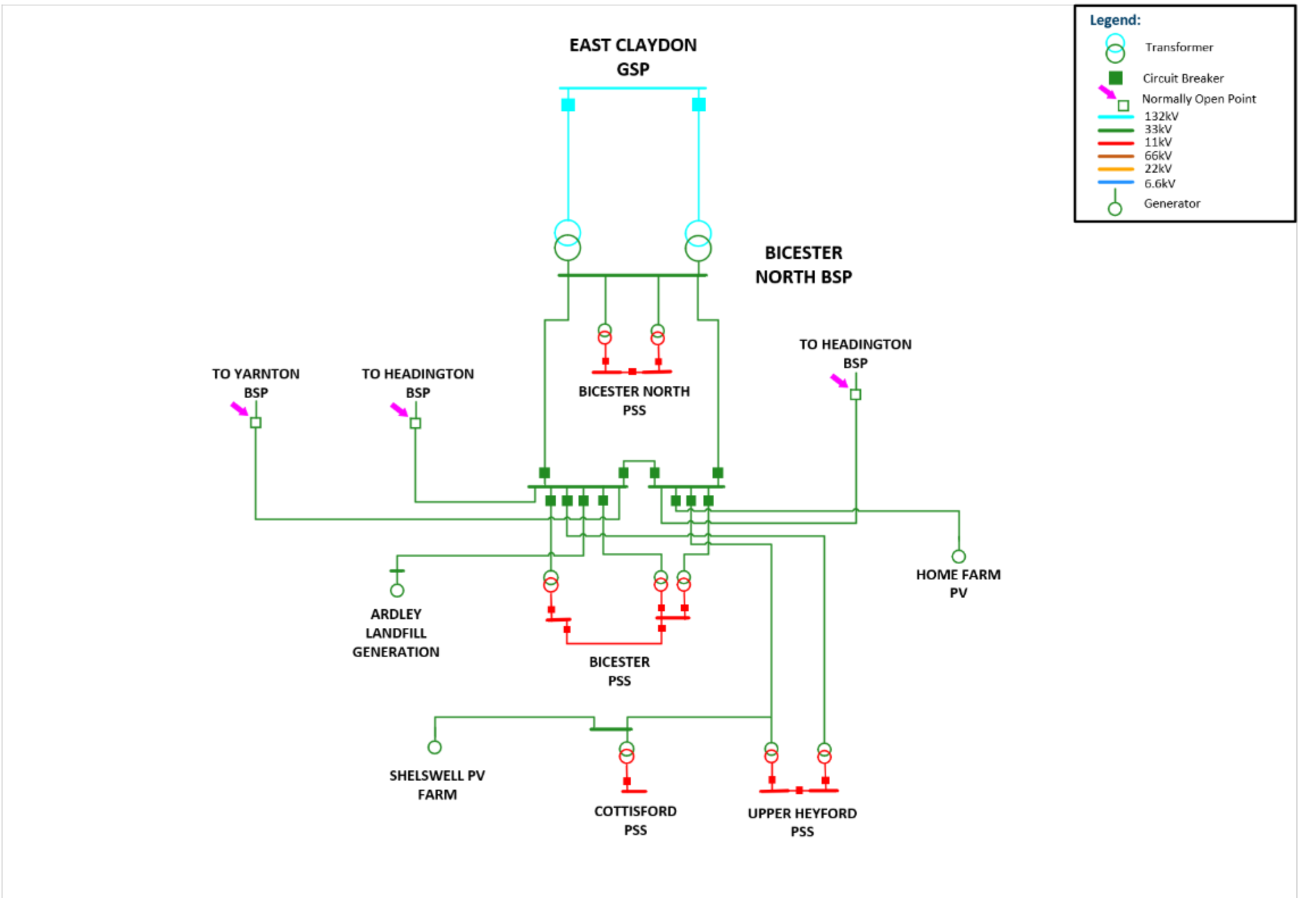

Figure 6 East Claydon 132kV and 33kV existing network.

5. FUTURE ELECTRICITY LOAD AT EAST CLAYDON 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.[17]

5.1. Distributed Energy Resource

Generation

DFES Scenario	Electricity generation capacity (MW)				Electricity storage capacity (MW)			
	Baseline	2030	2040	2050	Baseline	2030	2040	2050
Holistic Transition	49MW	65MW	103MW	86MW	0MW	46MW	53MW	57MW
Electric Engagement		109MW	141MW	121MW		44MW	52MW	55MW
Hydrogen Evolution		62MW	88MW	65MW		4MW	49MW	51MW
Counterfactual		55MW	74MW	85MW		3MW	44MW	45MW

Table 2 Projected electricity generation and storage capacity across the East Claydon GSP area.

17 SSEN DFES Technology Projections - Microsoft Power BI

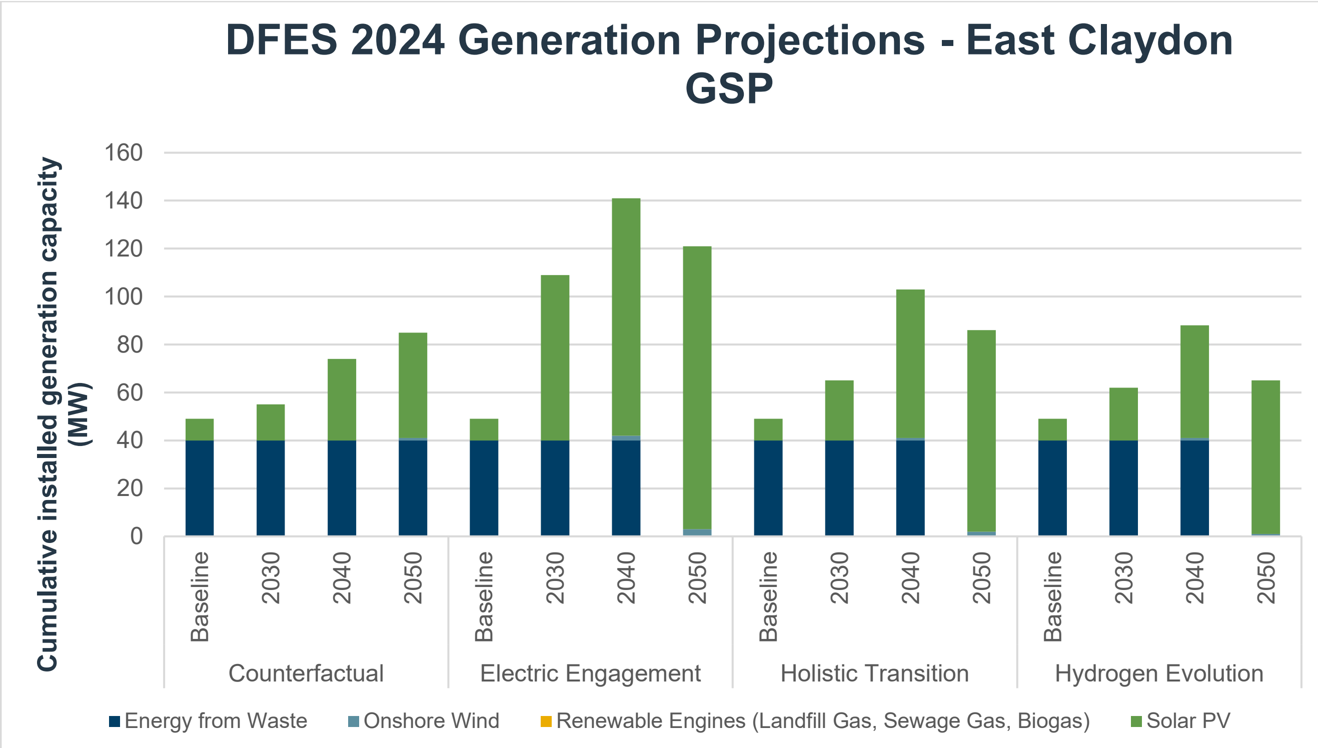

Figure 7 Projected cumulative distributed generation capacity across East Claydon GSP (MW). *Source: SSEN DFES 2024*

Storage

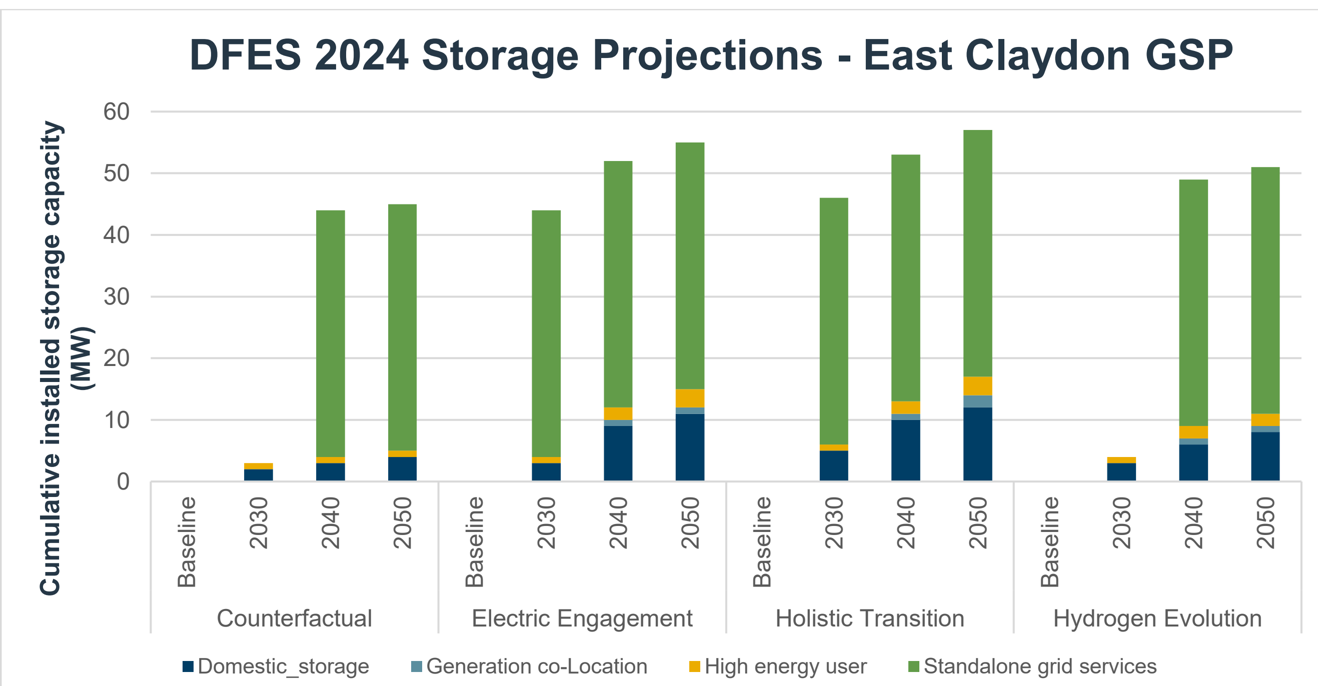

Figure 8 Projected battery storage capacity across the East Claydon GSP (MW). *Source: SSEN DFES 2024*

5.2. Transport Electrification

DFES Scenario	Chargers - domestic off-street (unit)				Chargers – nondomestic and domestic on street (MW)			
	Baseline	2030	2040	2050	Baseline	2030	2040	2050
Holistic Transition	713	4,636	14,864	15,607	2MW	3MW	13MW	16MW
Electric Engagement		7,765	14,727	15,370		8MW	13MW	15MW
Hydrogen Evolution		4,634	14,826	15,474		3MW	16MW	18MW
Counterfactual		3,705	14,218	15,421		2MW	11MW	18MW

Table 3 Projected electric vehicle chargers for domestic off-street installations (units) and nondomestic and domestic on street installations (MW).

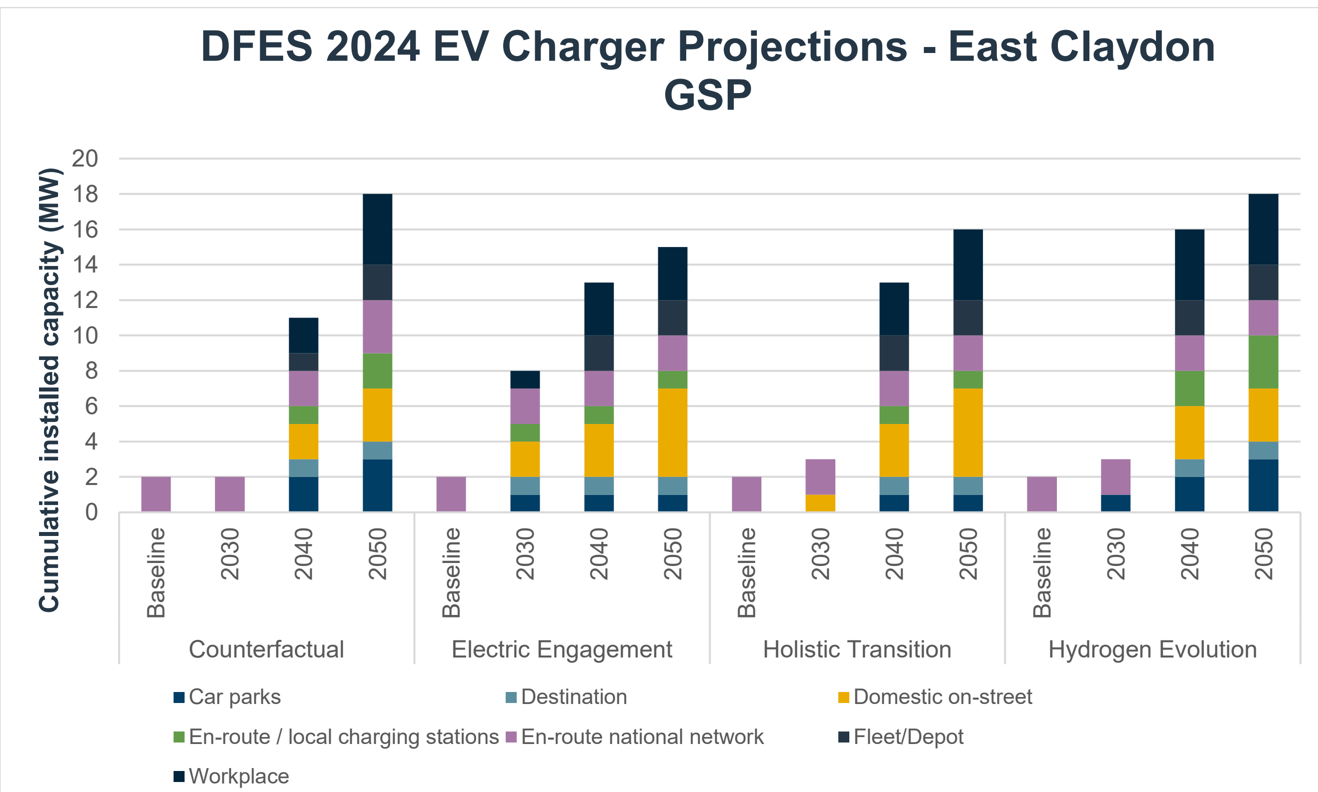

Figure 9 Projected EV charge capacity across the East Claydon GSP. *Source: SSEN DFES 2024*

5.3. Electrification of heat

DFES Scenario	Non-domestic electrification of heat (floorspace m2)				Domestic electrification of heat (units)			
	Baseline	2030	2040	2050	Baseline	2030	2040	2050
Holistic Transition	167,648	351,054	749,342	816,046	2,247	5,631	17,773	23,606
Electric Engagement		309,749	776,948	871,073		5,584	18,112	26,777
Hydrogen Evolution		293,946	652,689	698,725		5,589	17,004	24,959
Counterfactual		259,848	522,354	602,109		3,820	11,238	23,762

Table 4 Projected figures for the non-domestic electrification of heat (floorspace m2) and the domestic electrification of heat.

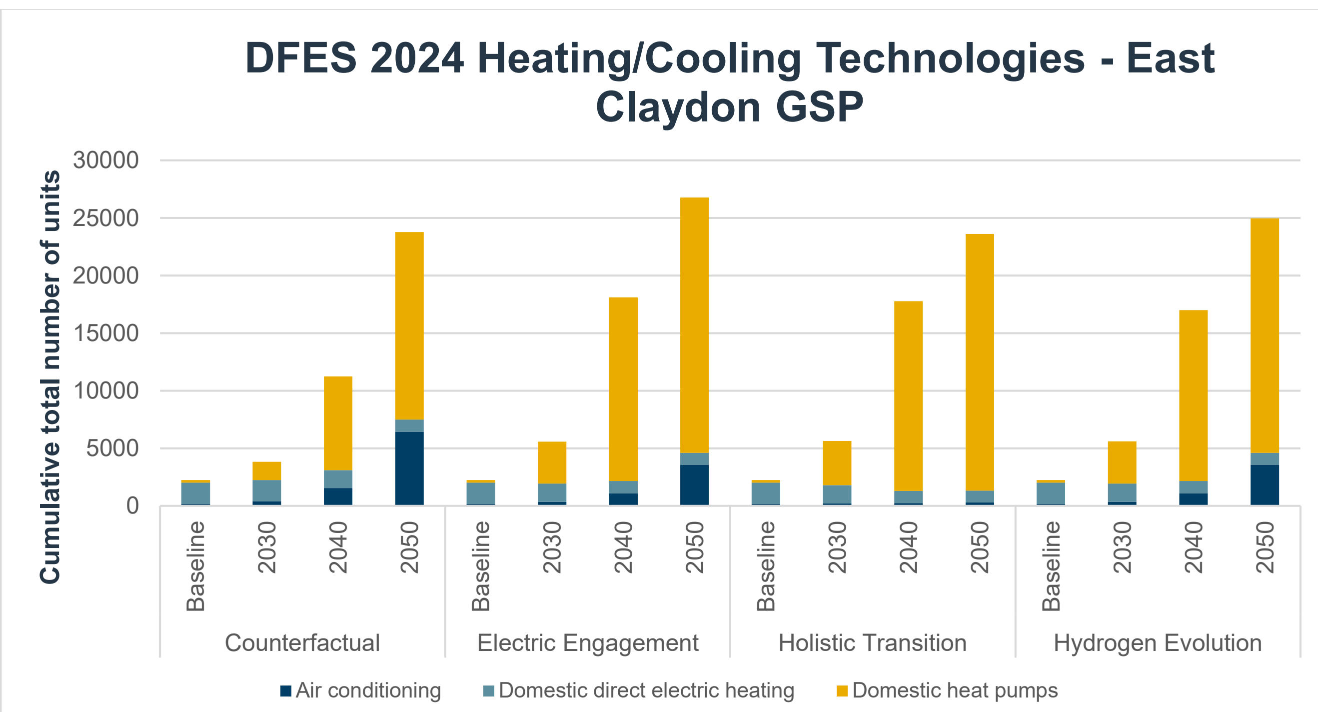

Figure 10 Projected number of heating/cooling technologies across East Claydon GSP. *Source: SSEN DFES 2024*

5.4. New building developments

DFES Scenario	New domestic development (number of homes)			New non-domestic development (m^2)		
	2030	2040	2050	2030	2040	2050
Holistic Transition	1847	4836	6625	1850	202,000	202,000
Electric Engagement	1847	4828	6426	1091	202,000	202,000
Hydrogen Evolution	1847	4828	6426	1066	202,000	202,000
Counterfactual	1153	4829	6359	0	202,000	202,000

Table 5 Projected number of new domestic developments and floorspace of non-domestic developments.

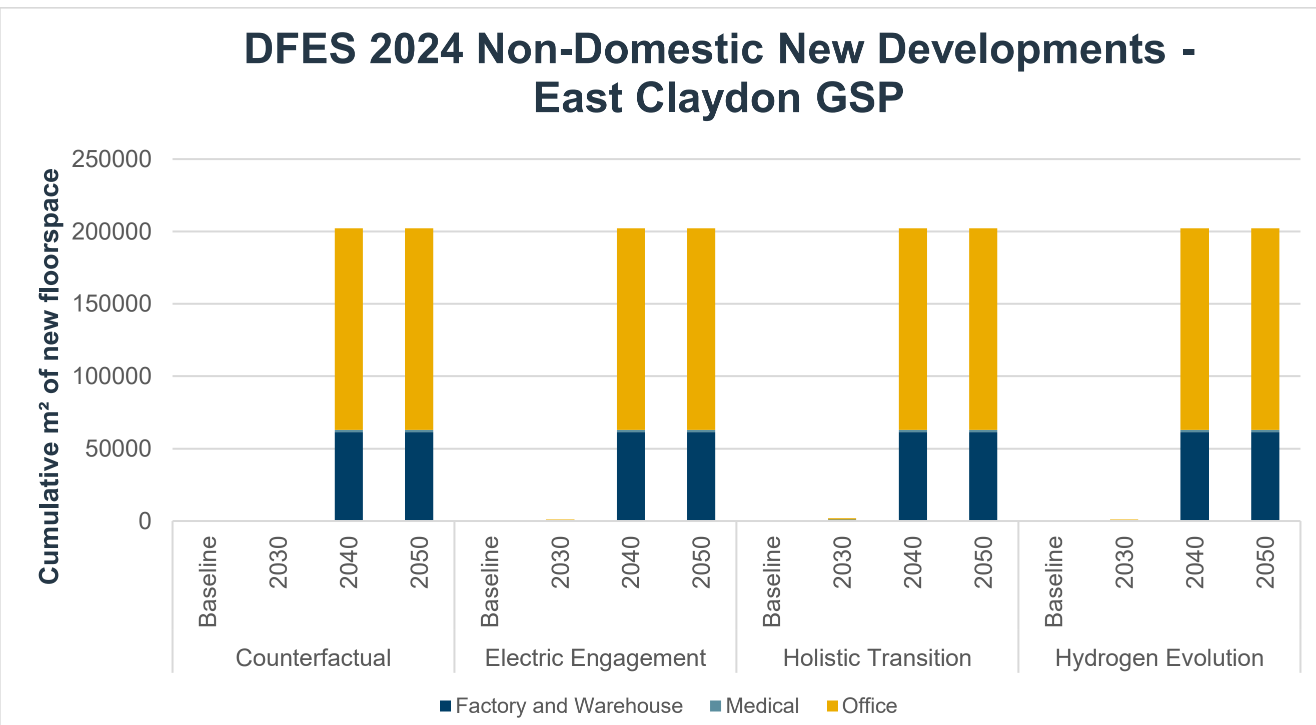

Figure 11 Projected non-domestic new development across East Claydon GSP. *Source: SSEN DFES 2024*

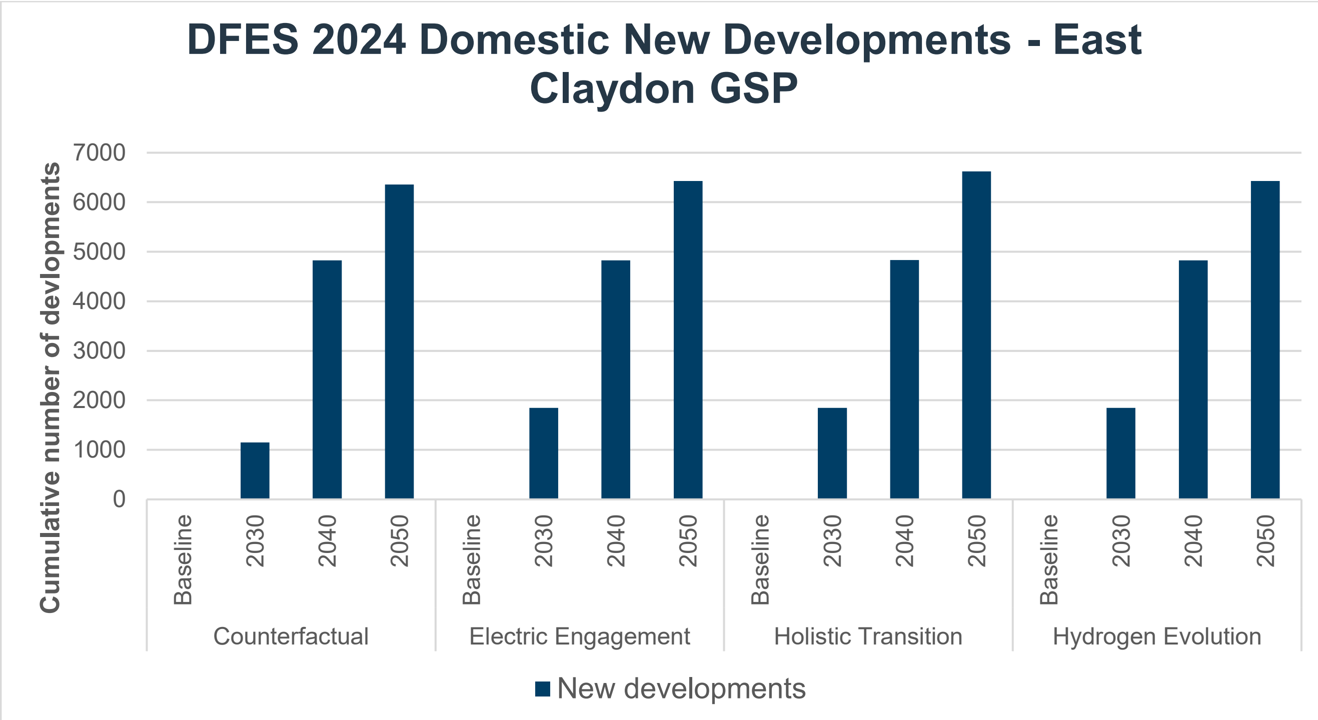

Figure 12 Projected domestic new development across East Claydon GSP. *Source: SSEN DFES 2024*

5.1. Commercial and industrial electrification

There are a significant number of industrial and domestic developments planned across East Claydon GSP, largely around the town of Bicester. Future industrial demand is expected from the science, entertainment, and information technology industries. There is also awareness of manufacturing supply chain businesses seeking connections in the future. Close collaboration on required capacity and how best to facilitate this is carried out and is key to enable investment in and the development of the local economy.

5.1.1. Motorway Services Areas

The M40 motorway passes through the East Claydon GSP supply area with motorway service areas (MSAs) along the route, such as Cherwell Valley. It's expected that as electric vehicles become more common, there will be a need for more capacity at these sites.

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 East Claydon 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.[18] Summary of existing works is tabulated below:

ID (Schematic Reference)	Substation	Description	Driver	Forecast completion	Fully resolves future strategic needs to 2050?
132kV works.					
1	Bicester North BSP.	Reinforcement of the existing 132/33kV transformers at Bicester North BSP from 90MVA to 120MVA units.	Customer connection.	2031	
2	East Claydon GSP to Bicester North BSP circuits.	Reinforcement an existing section of 132kV single circuit between East Claydon GSP and Bicester North BSP.	Customer connection.	2031	
3	East Claydon GSP to Bicester North BSP.	Third 132kV circuit added between East Claydon GSP and Bicester North BSP, along with a third 120MVA transformer at Bicester North BSP.	Customer connection.	2037	
33kV works.					
4	Bicester North BSP to the Bicester PSS –	4.4km of double 33kV cable added between Bicester North and the Bicester – Upper Heyford circuit, due	Customer connection.	2026	

18 DSO Service Statement 2025

	Upper Heyford PSS circuits.	to a constraint on the Bicester North BSP to Bicester PSS 33kV network.			
5	Bicester North BSP.	Convert the existing GIS 33kV single busbar into a new GIS 33kV double busbar.	Customer connection	2031	
6	Bicester North PSS.	Third 30MVA transformer added at Bicester North PSS.	Customer connection.	2037	

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.

Alongside these asset solutions being deployed, flexibility solutions are also being used to release additional capacity.

6.1. Network Schematic (following the completion of above works)

The 132kV and 33kV network at East Claydon GSP following the completion of works is shown below in Figure 13.

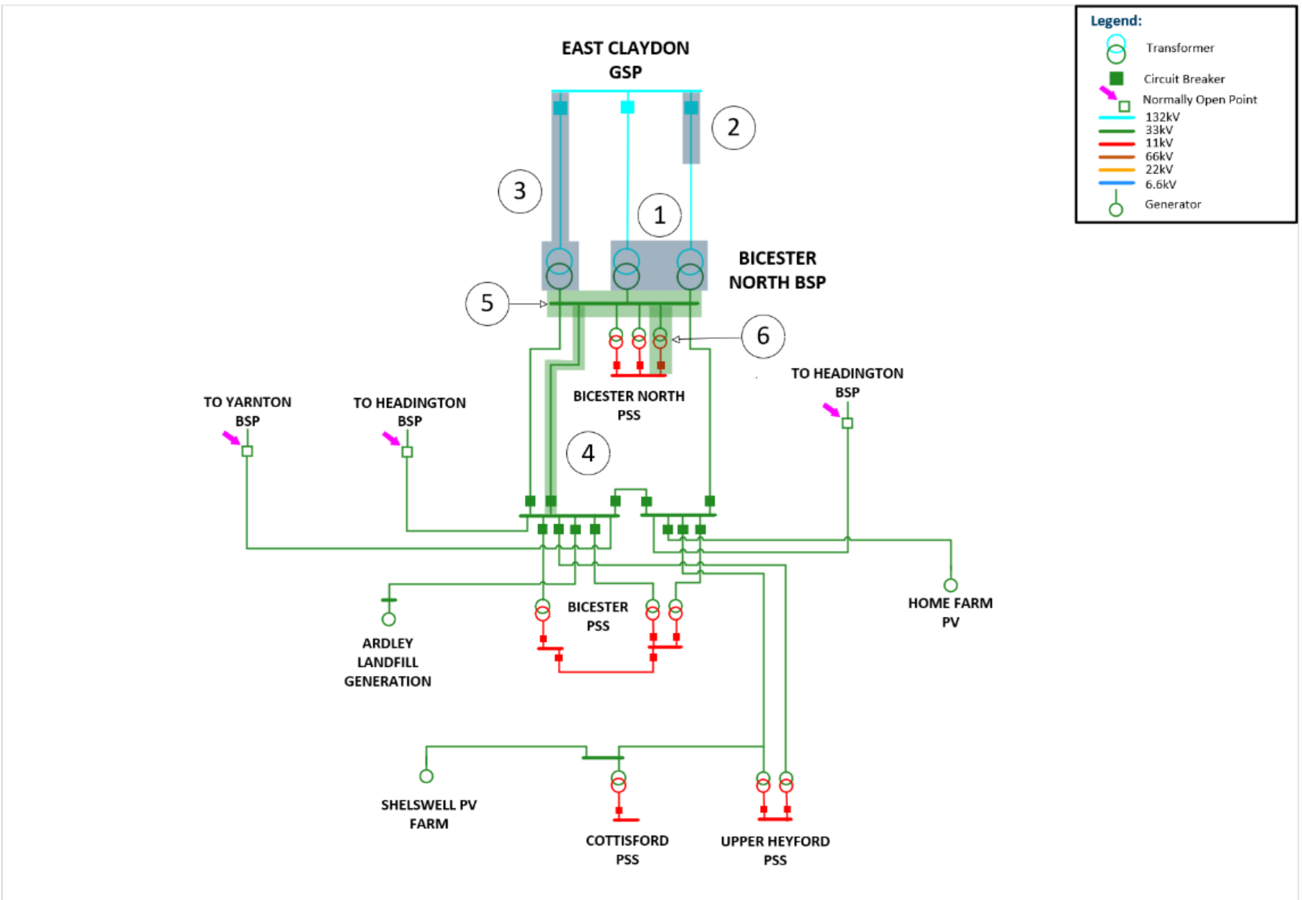

Figure 13 East Claydon GSP 132kV and 33kV Network – Following completion of triggered works.

7. SPATIAL PLANS OF FUTURE NEEDS

7.1. Extra High Voltage / High Voltage spatial plans

The EHV/HV spatial plan shown below in Figure 14 shows the projected headroom or capacity shortfall due to demand increases at primary substations across the East Claydon SDP study area. Darker purple shades indicate that there is a projected capacity shortfall whereas lighter shades indicate that there is headroom capacity based on current projections. EHV/HV spatial plans for the other DFES scenarios are presented in appendix A. The values are taken from the Network Scenario Headroom report (NSHR), part of the Network Development Plan (NDP). It should be noted that the NSHR is produced annually and was last published in May 2025, where work has been triggered between this date and the time of publication of this report, future capacity may not be reflected.

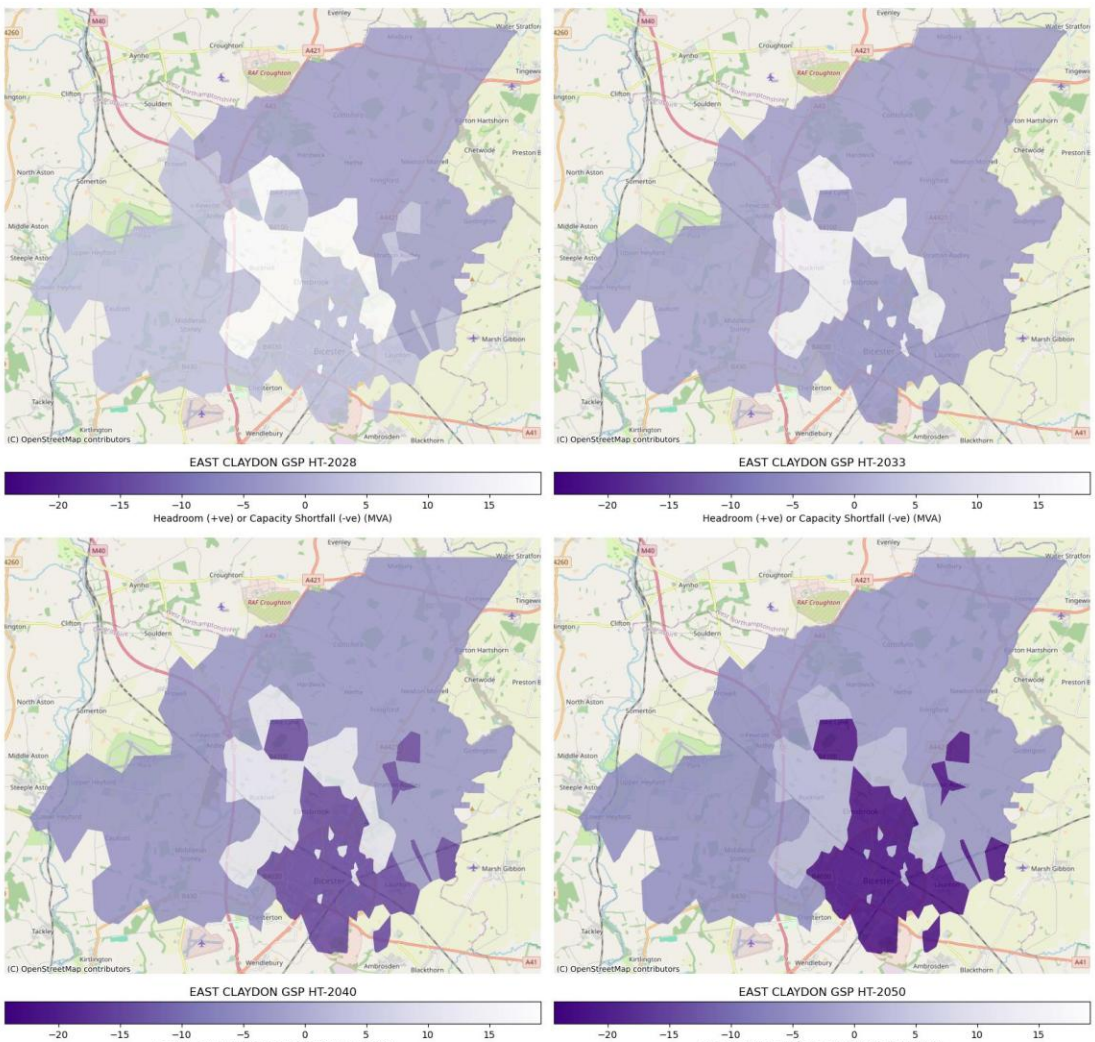

Figure 14 Example EHV network spatial plans for 2028, 2033, 2040, and 2050.

7.2. HV/LV spatial plans

The HV/LV spatial plans shown below in Figure 15 show the point locations of secondary transformers supplied by East Claydon 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 2024 scenarios are available in appendix E.

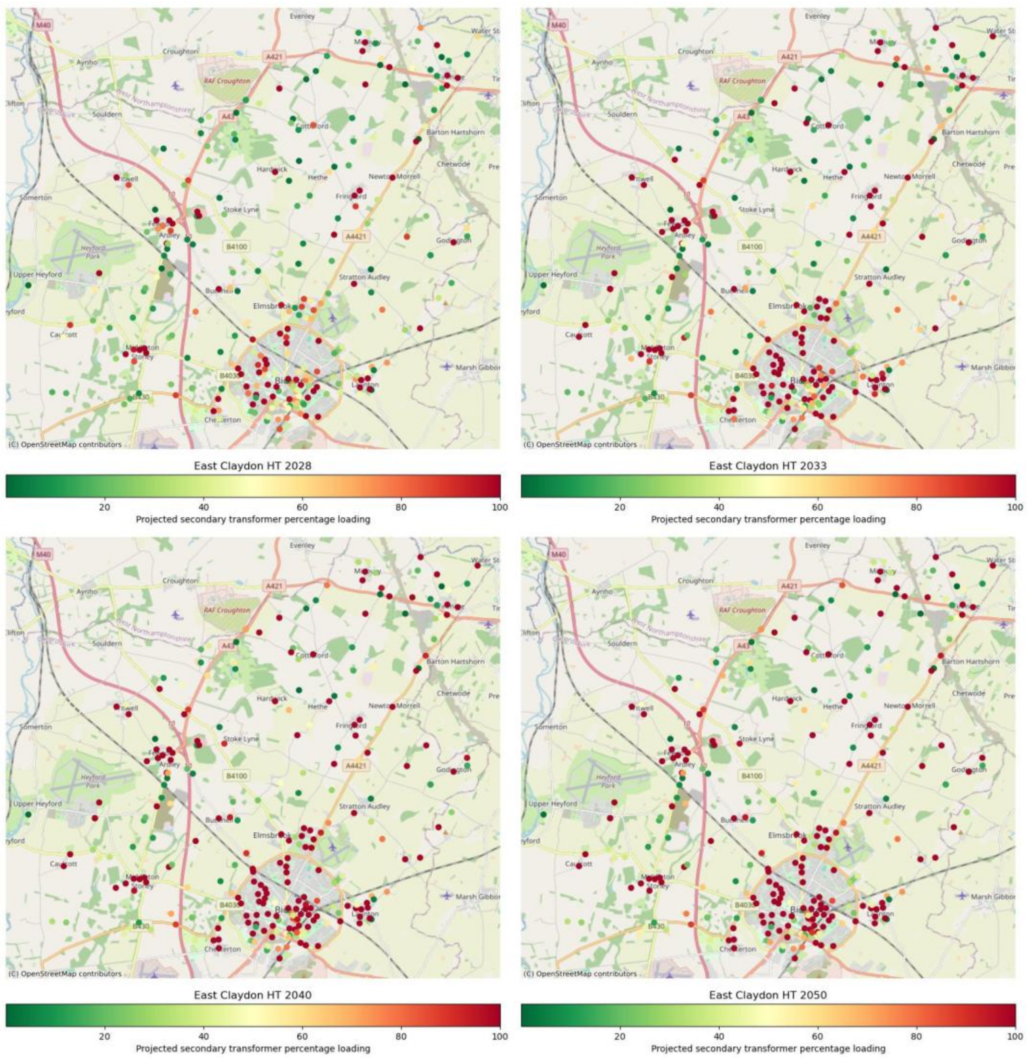

Figure 15 Example HV/LV spatial plans for 2028, 2033, 2040, and 2050.

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 also propose some initial options to resolve the needs forecasted. If required during the next ten years, these will be further developed through the DNOA process.

The section consists of three sets of results:

- Future EHV system needs to 2035 – these needs are more certain and therefore we have more clearly defined options to meet the requirements, and we recommend that these are progressed through the DNOA process. In all cases, we are proposing solutions that meet the projected requirements for 2050 and, where appropriate, system needs arising beyond this period are 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 several overarching risks to the delivery of our strategic plan. Below we list these alongside proposed mitigating actions. We will work with stakeholders to develop these mitigating actions further.

Dependency: Some of the works proposed here are dependent on the completion of works carried out by National Grid Electricity Transmission (NGET).
Risks: Works delay potential interventions downstream and/or do not provide flexibility of future investment.
Mitigation: Continue productive engagement with NGET to enable planning and coordination of works to release capacity at the GSP efficiently.

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 (CP2030) targets set by the Department for Energy Security and Net Zero (DESNZ).

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. Generation impacts on 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 and potentially drive some future system needs. The effect connections reform and CP2030 will have on generation projects connecting to the network has not yet been concluded, therefore, more detailed assessment on generation impacts will need to take place once this has been finalised.

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 8 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	HT Year	HE Year	EE Year	CF Year	Asset Loading (%)	Network State (see glossary)	Proposed option(s) to resolve
East Claydon GSP 33kV works.							
Bicester PSS transformers.	2025 - 2030	2025 - 2030	2025 - 2030	2025 - 2030	151%	N-1	The two 33kV circuits between Bicester North BSP and Bicester PSS and the transformers at Bicester PSS are expected to be overloaded in N-1 conditions. Potential options to resolve this constraint are: • Reinforce the existing circuits and transformers at Bicester PSS, either by adding additional assets or uprating the existing ones. • Shift load on the 11kV network over to Bicester North PSS. • As nearby networks are also projected to be congested, a new primary substation in the area, fed from Bicester North BSP could be constructed.
Bicester North BSP to Bicester PSS circuits.	2025 - 2030	2025 - 2030	2025 - 2030	2025 - 2030	104%	N-1	
Cottisford PSS transformers.	2025 - 2030	2025 - 2030	2025 - 2030	2025 - 2030	130%	Intact	Cottisford PSS consists of one transformer that is projected to be constrained under intact conditions. Potential options to resolve this constraint are: Reinforce the existing transformers at Cottisford, either by adding a new transformer and 33kV feeder circuit,

							or by uprating the existing transformer and reinforcing the 11kV backfeed. • Shift load on the 11kV network over to Bicester North PSS.
Upper Heyford PSS transformers.	2025 - 2030	2025 - 2030	2025 - 2030	2025 - 2030	117%	N-1	Upper Heyford PSS consists of two transformers that are projected to be constrained under N-1 conditions. Potential options to resolve this constraint are: • Reinforce the existing transformers at Upper Heyford, by uprating the existing ones. • Shift load on the 11kV network over to Bicester PSS or Kidlington PSS under Cowley GSP.

Table 7 Summary of system needs identified in this strategy through to 2035 along with indicative solutions.

8.4. Future EHV System Needs to 2050.

Location of proposed intervention	HT Year	HE Year	EE Year	CF Year	Asset Loading (%)	Network State (see glossary)	Proposed option(s) to resolve
East Claydon GSP 132kV works.							
East Claydon GSP to Bicester North BSP circuits.	N/A	N/A	2036 - 2040	N/A	101%	N-1	A section of the 132kV circuit between East Claydon GSP to Bicester North BSP is projected to be overloaded before the planned installation of a 3rd 132kV circuit. Potential options to resolve this: • Monitor the different scenarios. • Transfer load onto the neighbouring Cowley GSP.

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

8.5. 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 East Claydon GSP's high voltage and low voltage network needs to 2050.

8.5.1. 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.[19]

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 4 primary substations supplied by East Claydon 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 pathway 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.

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

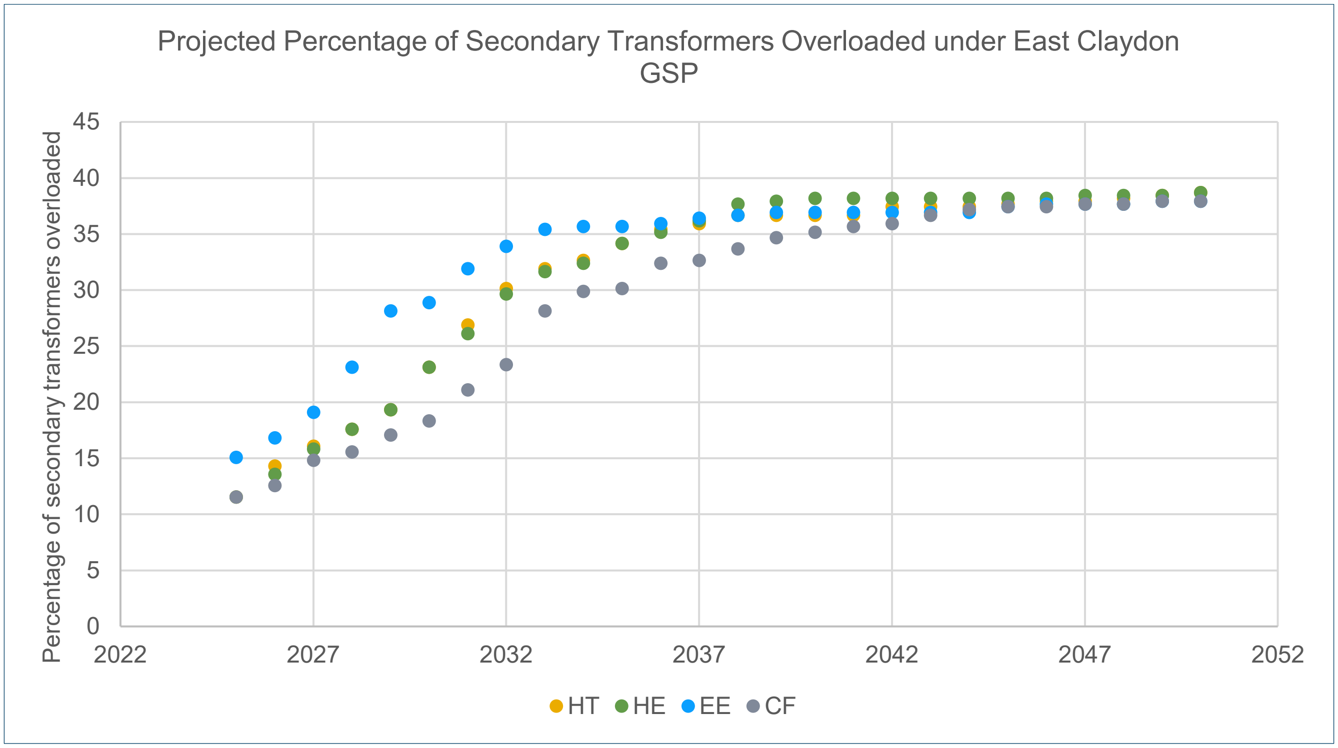

Figure 16 East Claydon GSP projected secondary transformer loading. Source: SSEN Load Model

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.[20] This work groups LSOAs[21] that share similar drivers of vulnerability. The groupings were informed by mathematical analysis of demographic data and of SSEN's priority service register, using machine learning to model the complex relationships that exist between the two. The resulting group numbers and descriptions are shown in Table 10.

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

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

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

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

Table 9 VFES Groupings

As shown in Figure 17, all the VFES groupings defined in the table above are present across the area supplied by East Claydon 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 Holistic Transition Pathway. 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.

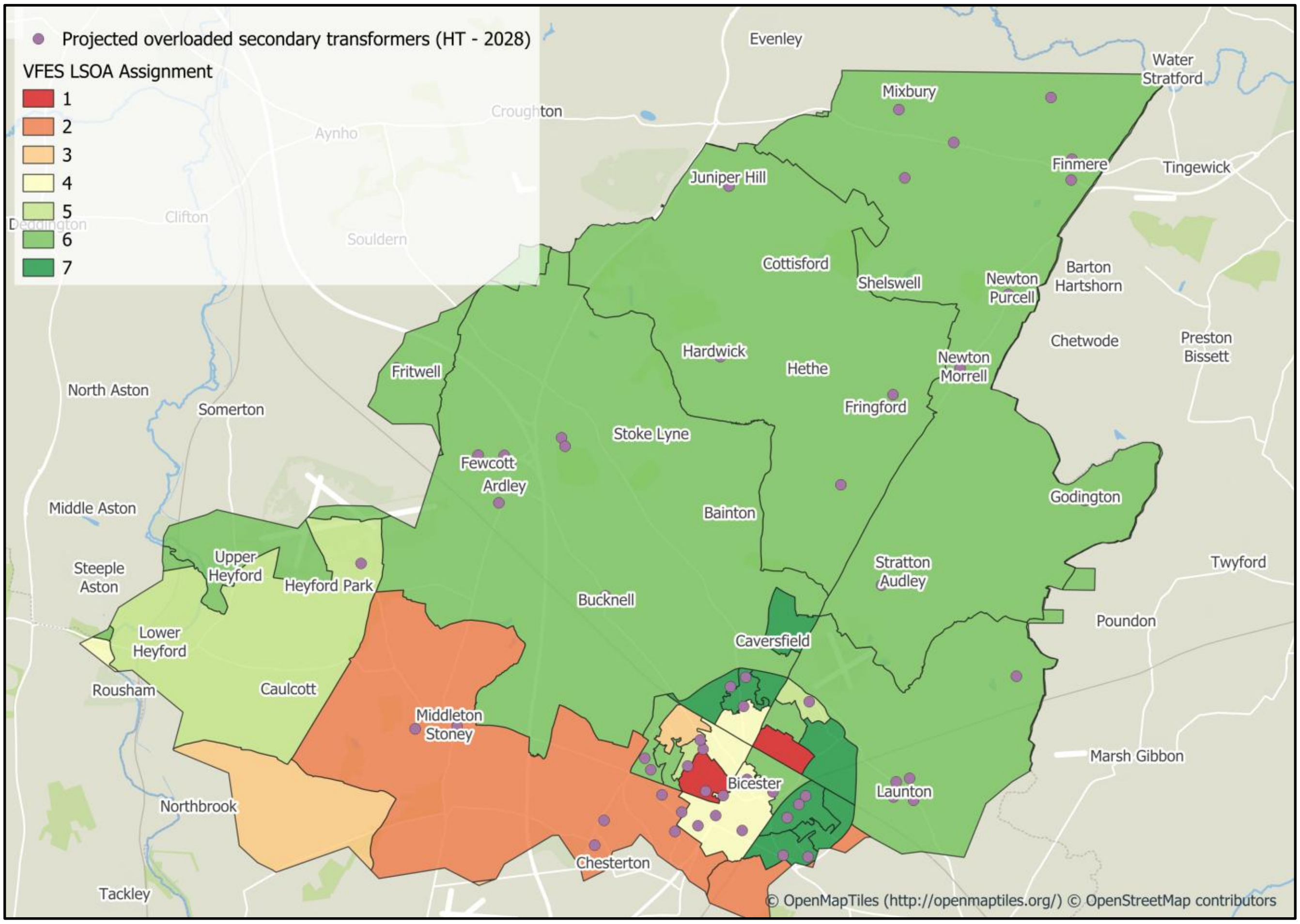

Figure 17 East Claydon GSP supply area VFES output with secondary transformer overlay.

8.5.2. Low Voltage Networks

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

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

Capacity driven needs – Thermal constraints tend to materialise in the sections of cable leading to the substation (transformer) where multiple customer loads join together. We are modelling requirements out to 2050 leveraging low voltage monitoring and metering equipment combined with analytical techniques. This will demonstrate how the magnitude of the system need of the LV network across East Claydon 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 31.4% of low voltage feeders may need intervention by 2035 and 40.5% by 2050 under the HT pathway 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.

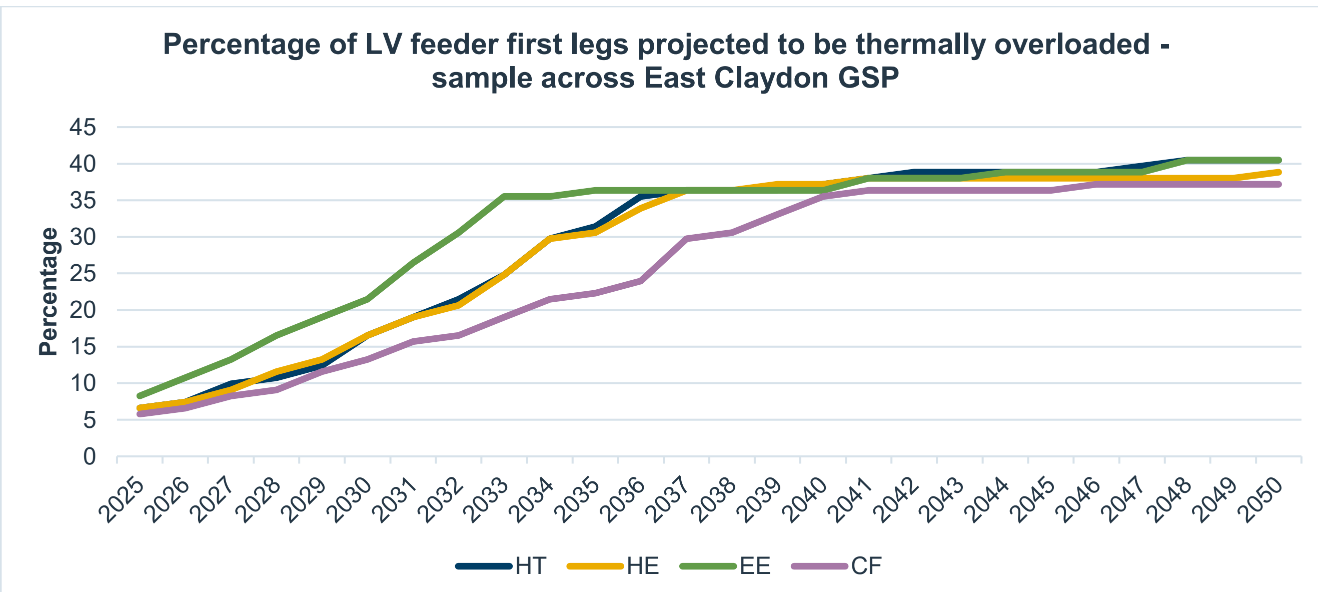

Figure 18 Percentage of LV feeders projected to be overloaded under East Claydon GSP.

9. RECOMMENDATIONS

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

The findings from this report have provided evidence for 3 key recommendations:

1. System needs that have been identified at earlier timescales (ahead of 2035) should be studied in more detail and these should be progressed through the DNOA process. This relates to the assets tabulated in section 8.2.

2. Industrial decarbonisation and domestic developments across the East Claydon GSP will increase the electricity demand out to 2050. Continued engagement with stakeholders should take place to understand planned new sites for data centres, science parks, and domestic developments.

3. Considering the significant growth in DERs expected across East Claydon GSP supply area, engagement with NGET and NESO should be proactive creating a long-term plan for the area which incorporates the outputs of CP2030 and connections reform.

Actioning these recommendations will allow SSEN to develop a network that supports local net zero ambitions. By doing so, contributing to net zero targets at a national level.

Appendix A Additional EHV/HV plans for other DFES pathways

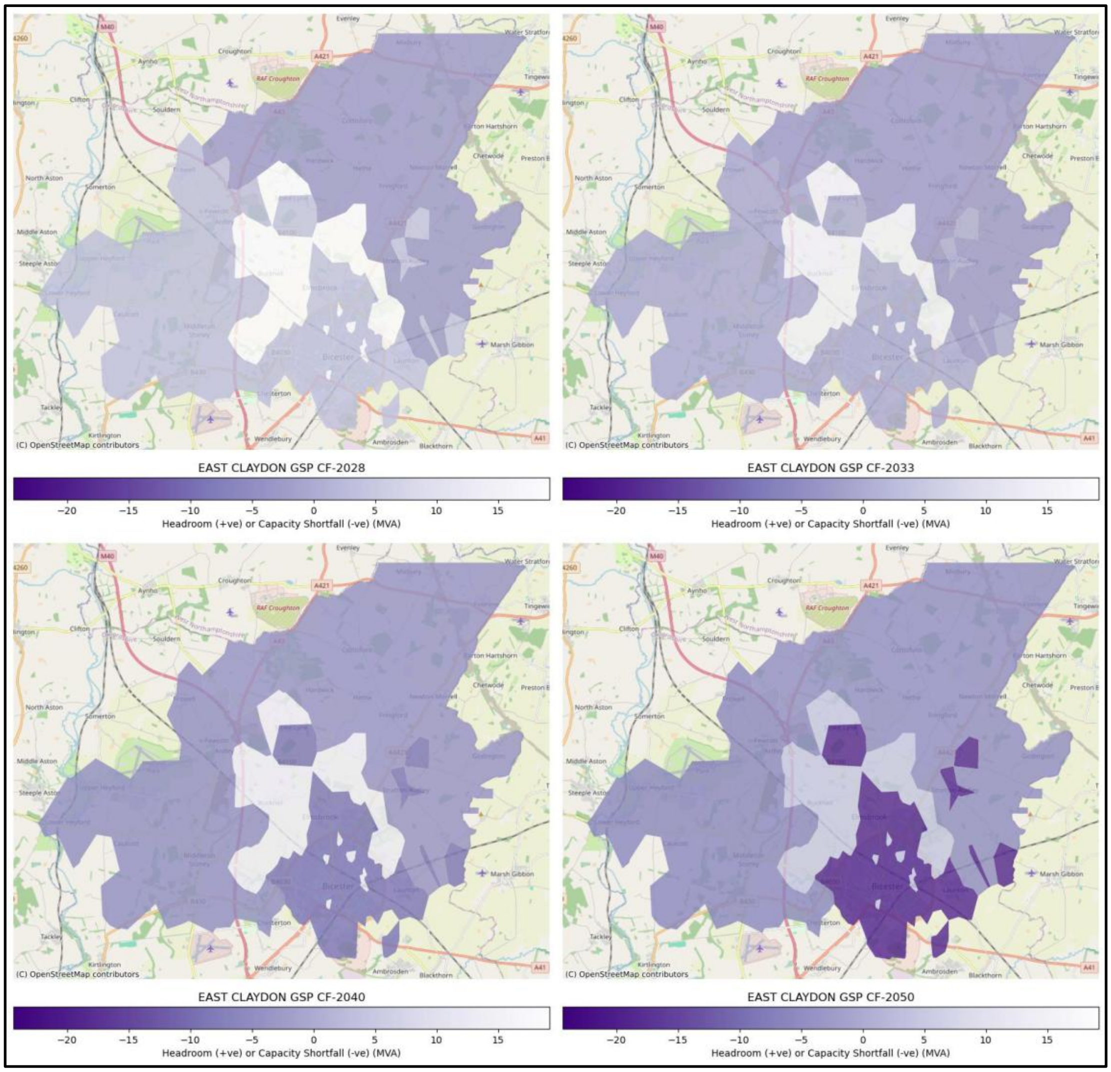

Figure 19 East Claydon GSP – EHV/HV Spatial Plan – Counterfactual

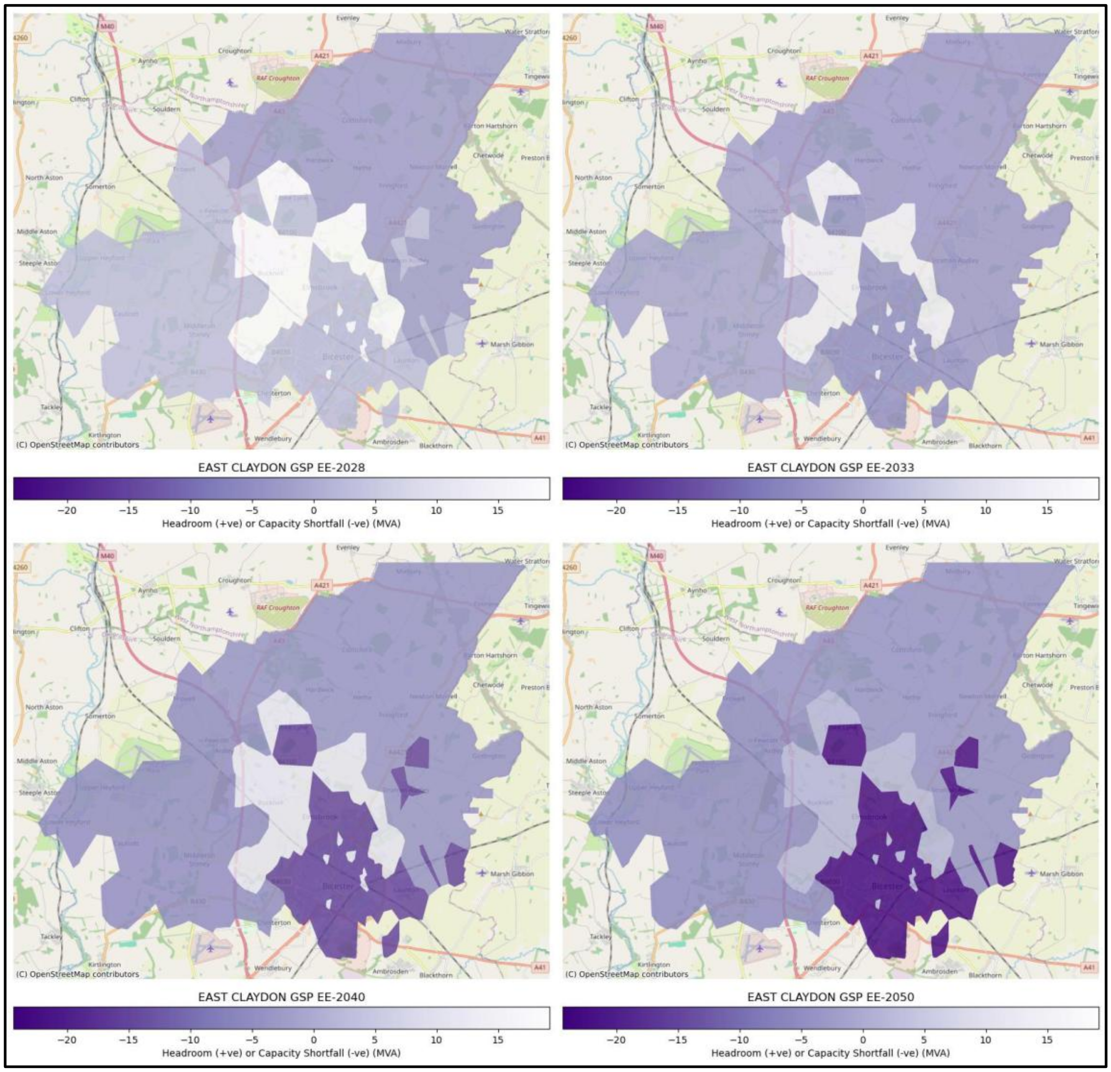

Figure 20 East Claydon GSP – EHV/HV Spatial Plan – Electric Engagement.

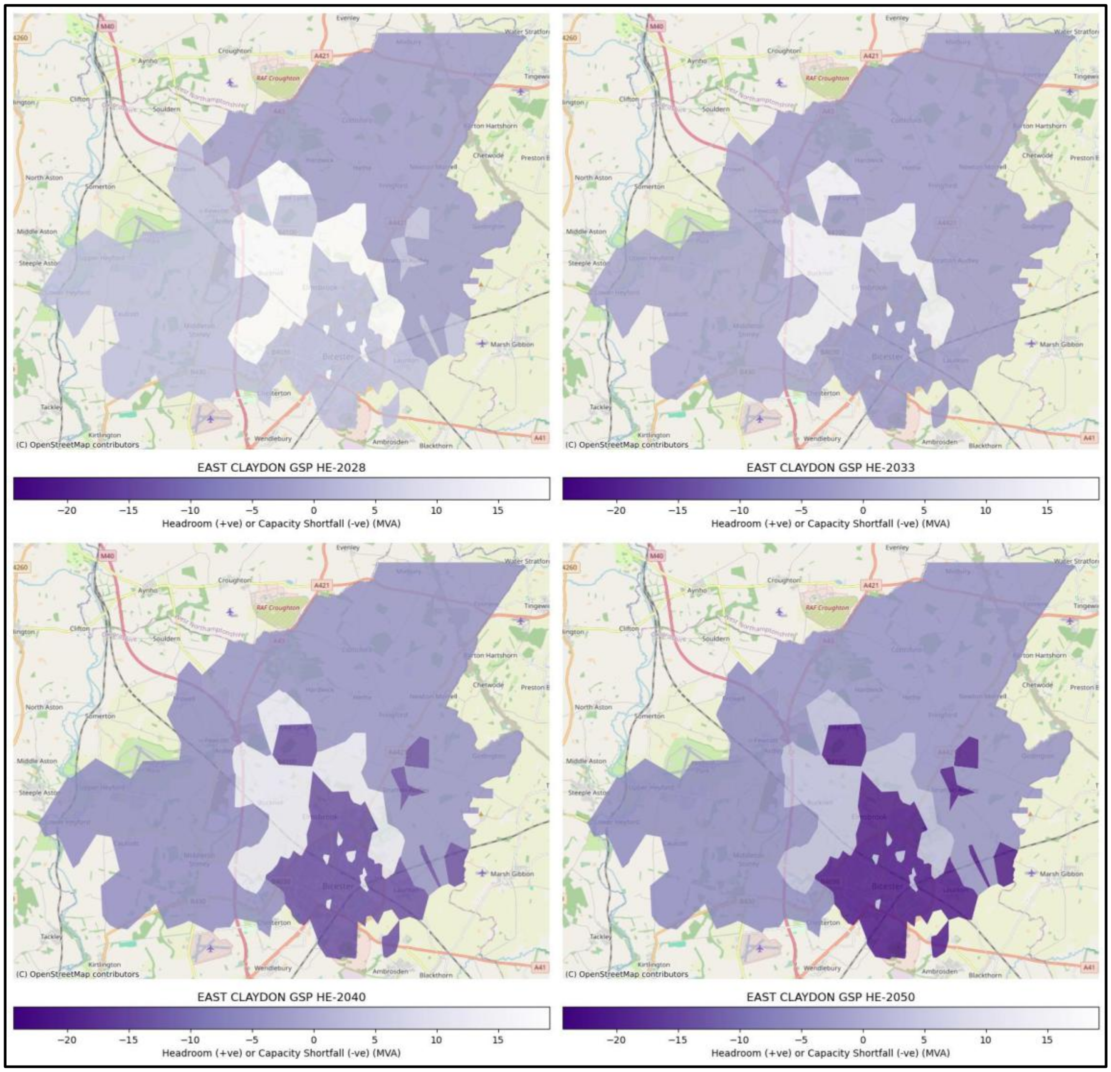

Figure 21 East Claydon GSP – EHV/HV Spatial Plan – Hydrogen Evolution.

Appendix B Additional HV/LV plans for other DFES pathways

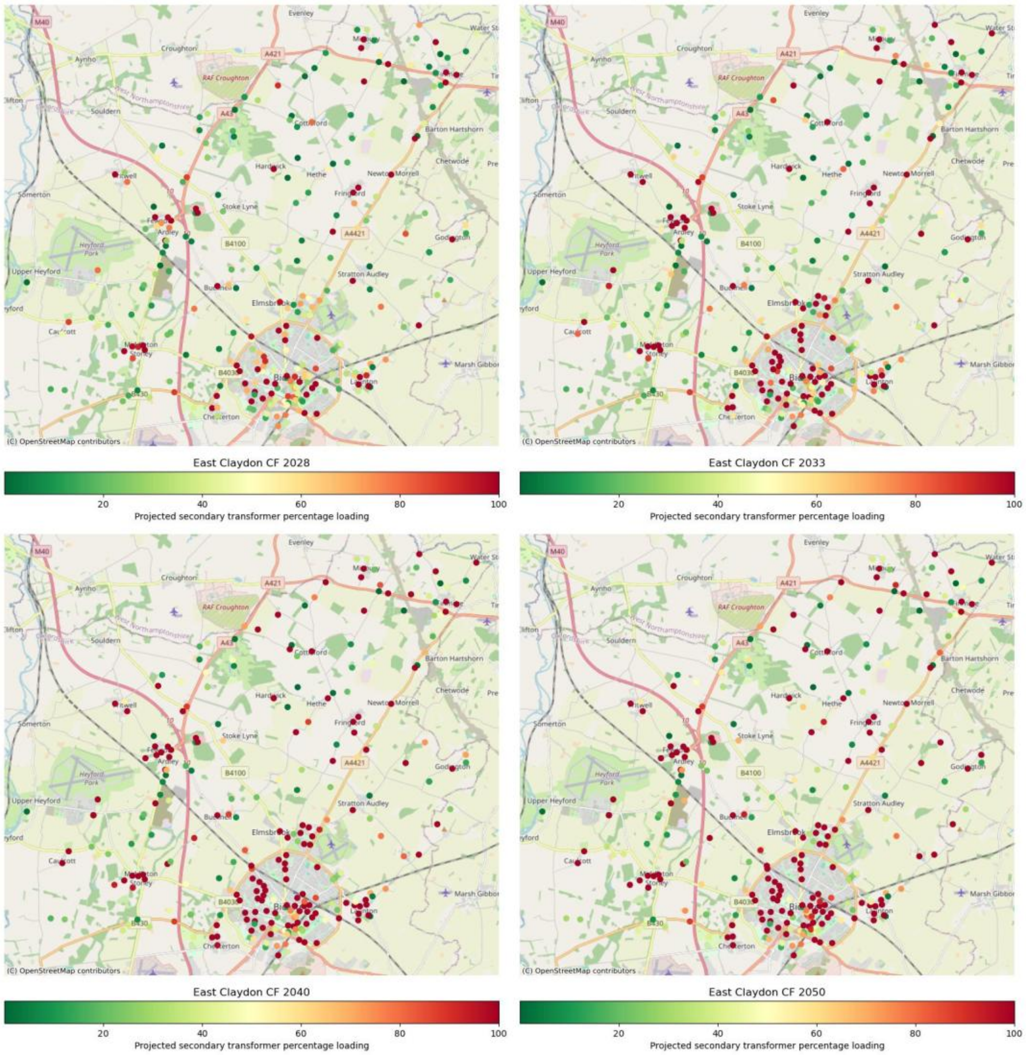

Figure 22 East Claydon GSP – HV/LV Spatial Plan – Counterfactual.

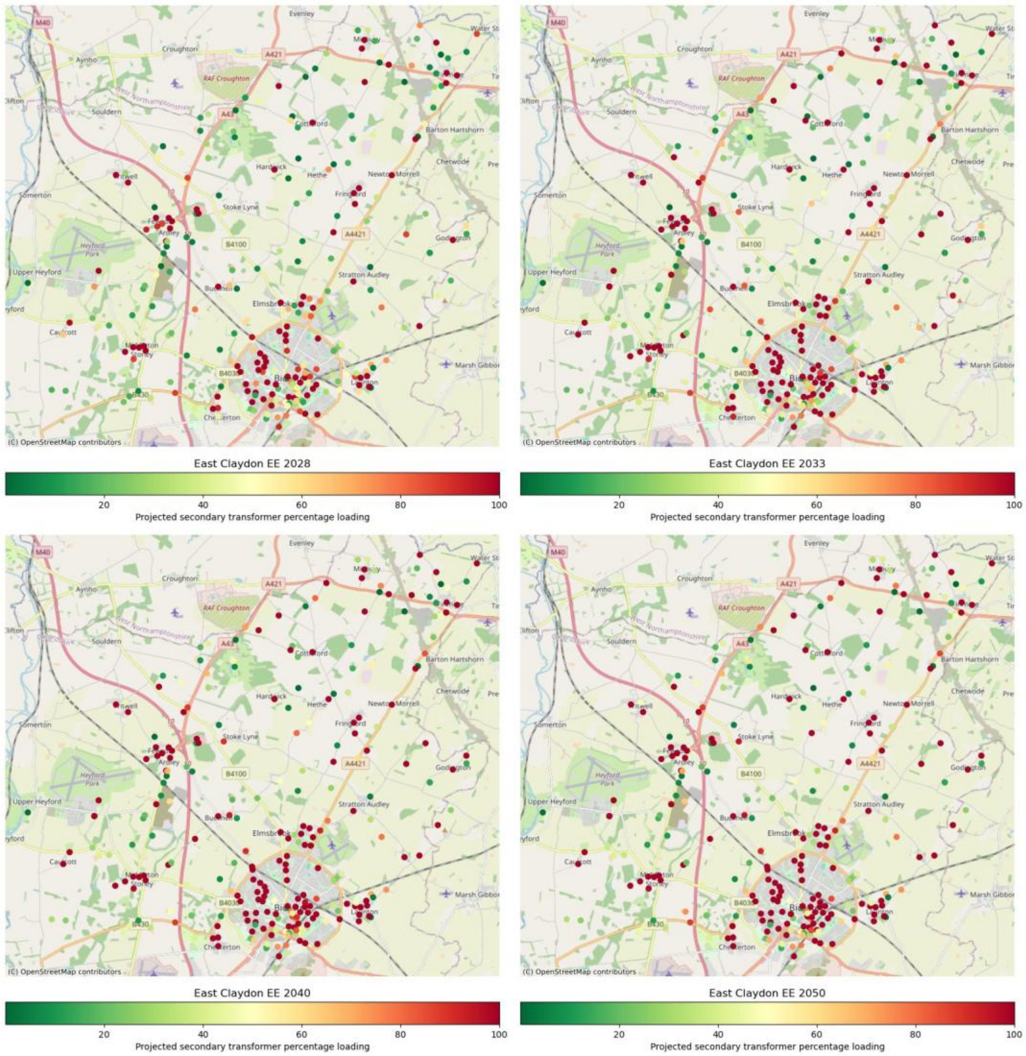

Figure 23 East Claydon GSP – HV/LV Spatial Plan – Electric Engagement.

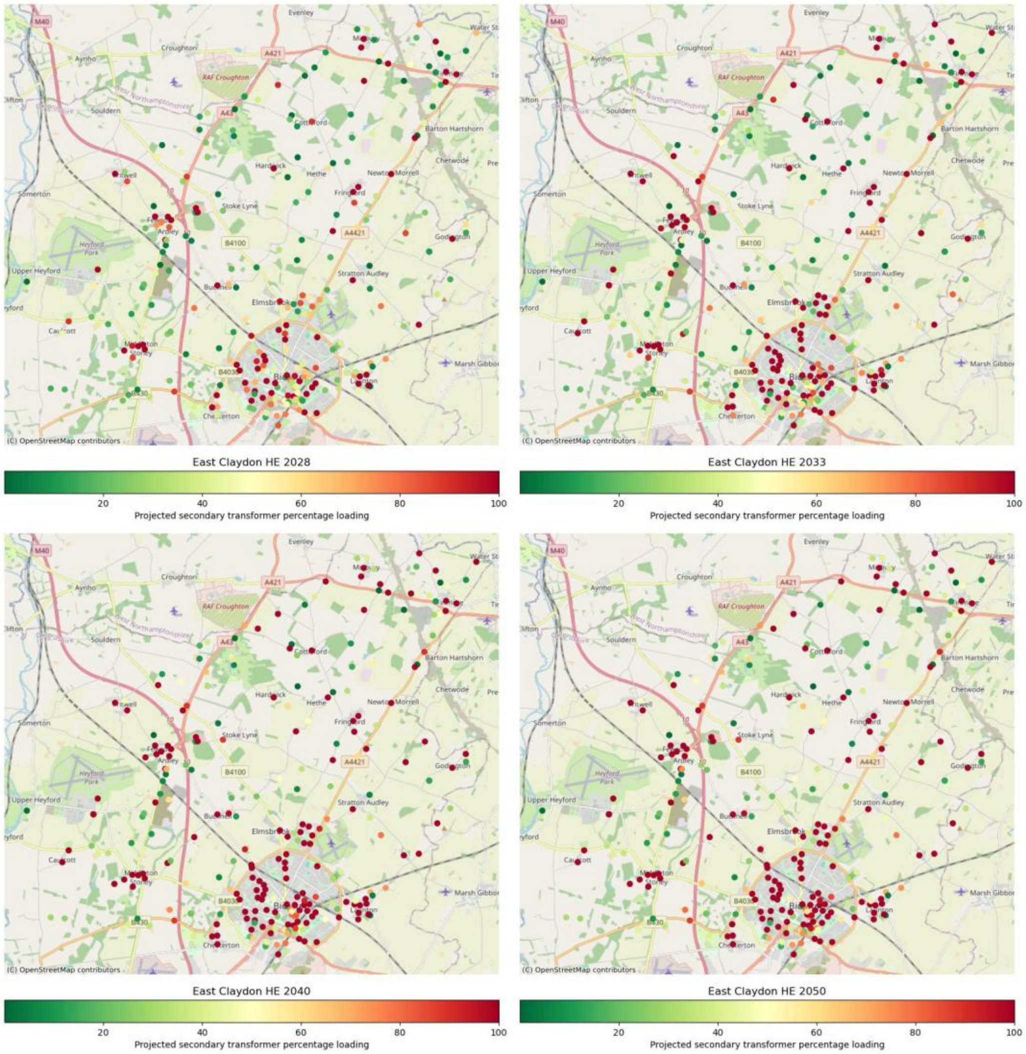

Figure 24 East Claydon GSP – HV/LV Spatial Plan – Hydrogen Evolution.

Scottish & Southern Electricity Networks

CONTACT

whole.system.distribution@sse.com

Scottish & Southern Electricity Networks