NORTH HYDE GRID SUPPLY POINT: STRATEGIC DEVELOPMENT PLAN

Our network serving communities in West London

Draft for consultation

12/2024

Scottish & Southern Electricity Networks

CONTENTS

1. EXECUTIVE SUMMARY

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

The focus area of this SDP is that supplied by North Hyde Grid Supply Point (GSP) in the west London area shown below.

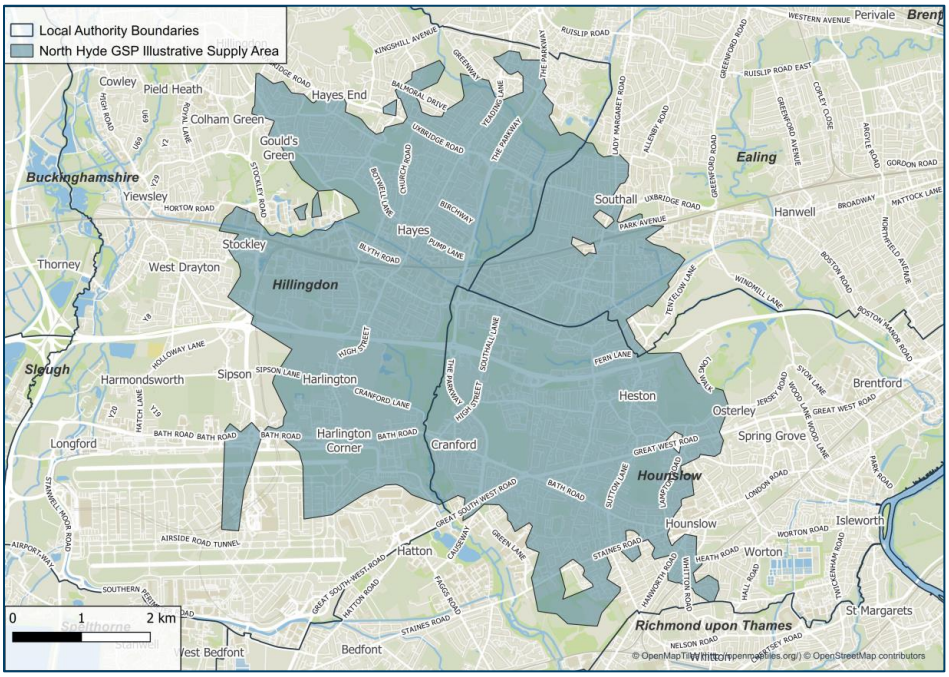

Figure 1 Area of focus for this SDP

This report documents the stakeholder led plans that are driving net zero and growth in the local area, the resulting electricity demands, and the network needs arising from this. Plans across Hillingdon, Ealing, and Hounslow as well as the wider GLA have been considered in preparation of this plan. In the case of North Hyde GSP, significant work has already been triggered through the Distribution Network Option Assessment (DNOA) process. Much of this work has strategically been sized to support 2050 projected demands under the Consumer Transformation scenario from the Distribution Future Energy Scenarios (DFES).

As part of this work, we aim to identify further needs for the relevant network study area. In the case of North Hyde GSP, no further Extra High Voltage (EHV) work has been identified. However, there are projections for significant network intervention across the High Voltage (HV) and Low Voltage (LV) networks. This will be reassessed on an annual basis to understand the network impact of updated forecasts.

As a result of the work undertaken for this report, we make recommendations for further study of projects that could enter the DNOA process. Currently, as we see no further EHV requirements the recommendations focus on delivery of triggered works and re-assessment to identify any additional works that arise off the back of future insights and policy updates that may impact forecasts.

2. INTRODUCTION

The goal of this report is to demonstrate how local, regional, and national targets link with other stakeholder views in the area to provide a robust evidence base for load growth out to 2050 across the North Hyde Grid Supply Point (GSP) area. A GSP is an interface point with the national transmission system where SSEN then take power to local homes and businesses within a geographic area. Context for the area this represents is shown in Figure 1.

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

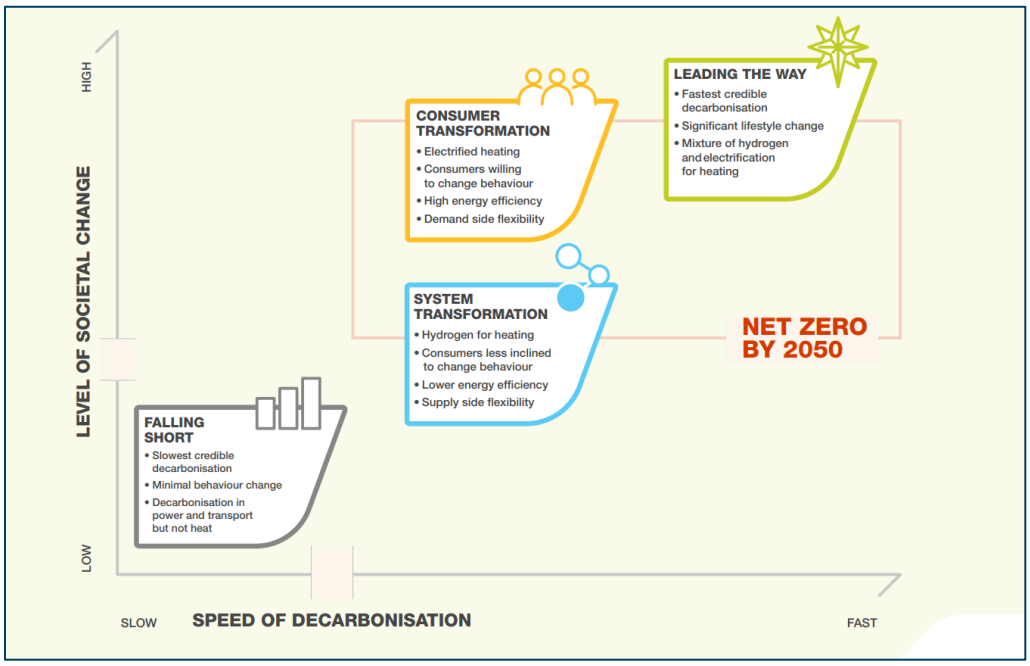

Figure 2 The 4 Future Energy Scenarios adopted for the DFES. *Source: ESO FES*

Using the DFES, power system analysis has been carried out to identify the future system needs of the electricity network. These needs are summarized by highlighting the year the need is identified under each of the four scenarios, and the projected 2050 load. Here, system needs are identified through power system analysis using the Consumer Transformation scenario in alignment with evidence gathered in preparation of the SSEN ED2 business plan. We also model across the other three scenarios to understand when these needs arise and what demand projections should be planned for in the event each of these scenarios is realised.

The DNOA process then provides more detailed optioneering for each of these reinforcements, improving stakeholder visibility of the strategic planning process. Opportunities for procurement of flexibility are also be highlighted in the DNOA, to cultivate the flexibility markets, and to align with SSEN's flexibility first approach.

3. STAKEHOLDER ENGAGEMENT AND WHOLE SYSTEM CONSIDERATIONS

3.1. Local Authorities and Local Area Energy Planning

The main local authorities that are supplied by North Hyde GSP are Hillingdon, Hounslow, and Ealing, as shown in Figure 3. SSEN also engage extensively with the Greater London Authority (GLA) on developments across West London. The local area energy plans (LAEPs) and 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.

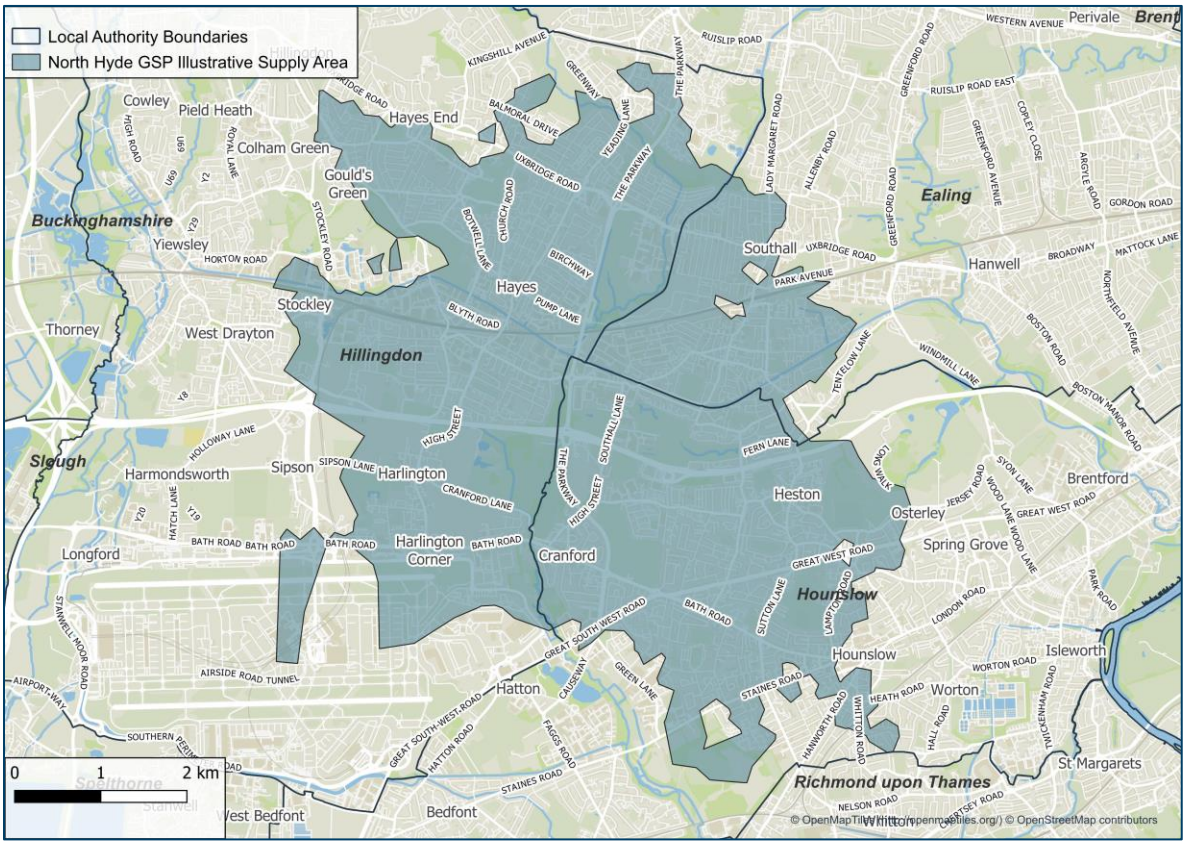

Figure 3 North Hyde GSP Supply Area and Local Authority Boundaries

3.1.1. Greater London Authority

The Mayor of London targets for the city to be zero-carbon by 2030, following an 'Accelerated Green pathway'[1] which emphasizes improved energy efficiency, electrification of heating, district heat networks, reduction in car travel, and phaseout of fossil fuel powered transport.

1 Pathways to Net Zero Carbon by 2030 | London City Hall

The GLA's 2021 London Plan[2] sets out the strategic direction of economic, social, and environmental development across the city. Sustainable modes of transport and sufficient electricity infrastructure to power heat and transport have been noted as priorities. In addition to net zero pathways, wider development activities are likely to impact load on the electricity system. The London Plan identifies Heathrow, Hayes, Old Oak/Park Royal, and Southall as Opportunity Areas. There are also numerous identified Strategic Industrial Locations across the three boroughs. Ealing, Hillingdon, and Hounslow's 10-year housing targets (to 2028/2029) are 21,570 units, 10,830 units, and 17,820 units, respectively.

The GLA funded Phase One of a west London subregional LAEP[3], which some of the underlying boroughs are now progressing into Phase Two. New homes and commercial floorspace, heat pumps, electric vehicles, and data centres are highlighted as key sectors of growing electricity load across the subregion. Deep and shallow retrofit scenarios to improve energy efficiency along with expanded solar PV generation are also explored.

3.1.2. Ealing Council

Over the past decade (2011 to 2021) the population of Ealing increased by 8.5% to approximately 367,100[4]. The borough is strategically placed with Heathrow Airport to the West and the new High Speed 2 (HS2) terminus at Old Oak Common opening in 2030 to the North-East of the borough. Five new Elizabeth Line stations opened across the borough in 2022 in addition to the existing underground and mainline stations.
Ealing Council have published multiple action plans and strategies highlighting their net zero ambitions, including their target to become carbon neutral by 2030[5].

3.1.3. Hillingdon Council

Hillingdon's population increased by 11.7% to approximately 305,900 residents within the 10 years to 2021[6]. The borough has metropolitan and district centres at Uxbridge, West Drayton, and Hayes. Heathrow Airport comprises substantial land area in the southern region of the borough, and there are ongoing plans to expand airport capacity through addition of a third runway to the northwest of the current footprint, along with other works such as enhanced public transport links and an additional terminal[7]. The Council has also committed to its own operations reaching carbon neutrality by 2030[8].

3.1.4. London Borough of Hounslow

As observed in Ealing and Hillingdon, the population of Hounslow has increased significantly over the past decade. Between the last two censuses (2011 and 2021), the population of Hounslow increased by 13.5% to around 288,200 in 2021[9]. Hounslow Council adopted their most recent Local Plan in 2015, which will form part of the Borough's planning framework until 2030. As with all Local Plans across London Boroughs, it follows the key

2 The London Plan 2021.

3 West London Local Area Energy Plan Phase 1.

4 Census 2021, January 2023, How life has changed in Ealing: Census 2021.

5 Ealing Council, January 2021, Climate and Ecological Emergency Strategy

6 Hillingdon Council, January 2021, How life has changed in Hillingdon: Census 2021.

7 Plan overview | Heathrow

8 Hillingdon Council, July 2021, Strategic Climate Action Plan.

9 Census 2021, January 2023, How life has changed in Hounslow: Census 2021.

policy requirements set out in both the National Planning Policy Framework (NPPF), and the London Plan. Key policy requirements from these plans will impact SSEN's electricity network[10].
In addition to the Local Plan, London Borough of Hounslow have published a Climate Action Plan further demonstrating local ambition and pursuant to their target of net zero by 2030[11].
In November 2022, Hounslow approved a strategy which aims to deliver over 2,000 new charge points across the borough, providing a range of different charge point types, with the aim of delivering a good minimum level of service for all residents and businesses.[12]

3.2. Whole System Considerations

3.2.1. West London Capacity Constraints

The west London electricity capacity constraints are well known and understood. Over the past few years, there has been a steep increase in the number of new electricity connection requests across west London, driven by new housing developments, commercial investment and datacentres. In response, we have led collaboration with NGET, NESO, and UKPN and key stakeholder the Greater London Authority (GLA) – supported by Ofgem – that has aimed to provide solutions to the constraints highlighted above. SSEN has provided some immediate solutions in West London.[13]

Following this, a total of 10.5MVA of demand capacity is now being provided through ramped connections solutions. This has enabled, 7,800 new homes to be unlocked through GLA support and introduction of the 1MVA ramping solution (as of March 2024). This includes how flexibility services can be deployed to help accelerate connections.

3.2.2. Heathrow Airport

Heathrow Airport is a strategic transport hub that is currently supplied by multiple GSPs in the area. As shown in Figure 3, North Hyde GSP supplies the area to the Northeast of the airport. There are also dedicated supplies to other parts of the Heathrow Airport site. SSEN work closely with Heathrow Airport to develop a co-ordinated strategic plan for their future needs, including decarbonisation. The impact of EVs traveling to Heathrow airport is explored in section 5.2.

3.2.3. Transmission interactions

SSEN regularly engage with both NGET and NESO to understand the interactions between the distribution and transmission networks in the area. The West London Capacity Constraints work described above is a strong example of the benefits arising from this engagement.

There is planned 275kV circuit reinforcement on NGET's network between Iver and North Hyde with an estimated completion date in the early 2030s. The existing Iver – North Hyde 1 and 2 circuits need to be replaced and uprated to a larger capacity. Build of a third circuit between the two sites is also planned. Alongside this, NGET are also undertaking a wider, strategic review of the 275kV cable circuits in West London and future network requirements.

10 London Borough of Hounslow, 2015, Local Plan 2015 to 2030 volume one.

11 London Borough of Hounslow, 2023, Climate Emergency Action Plan Annual Report 2023.

12 London Borough of Hounslow, 2022, Hounslow Electric Vehicle Charging Strategy (link)

13 West London electricity capacity constraints, GLA: West London electricity capacity constraints | London City Hall

3.2.4. 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.[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 August 2024 and recruitment through the Mini-Competition process in October 2024.[14]

Areas across North Hyde 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.

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

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

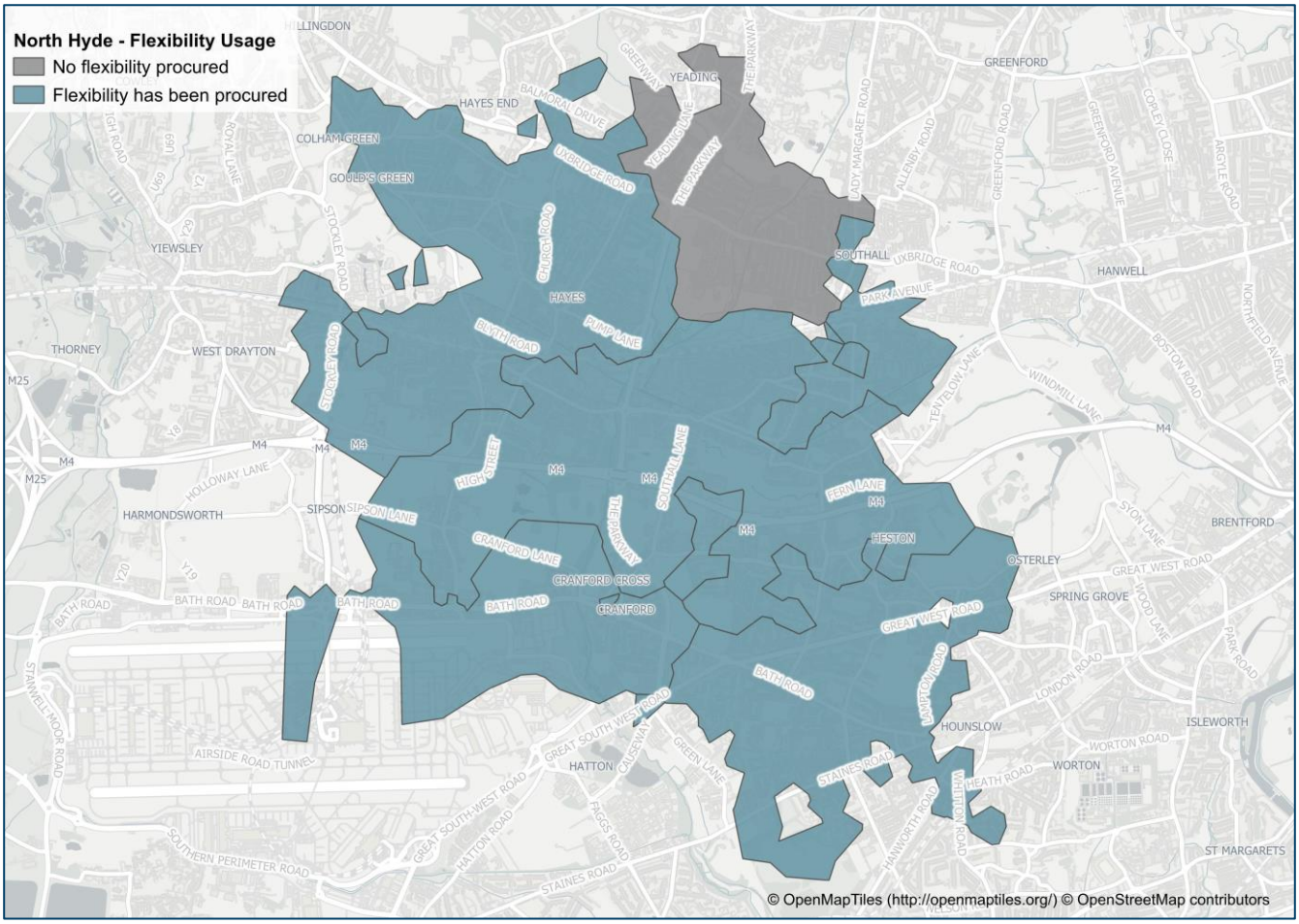

Figure 4 Illustrative areas across North Hyde GSP where Flexibility Services have been procured.

4. EXISTING NETWORK INFRASTRUCTURE

4.1. North Hyde Grid Supply Point Context

The North Hyde GSP network is made up of 66kV, 22kV, 11kV, 6.6kV, and LV circuits. It is an urban network located in west London where the land use is a mix of residential, commercial, and industrial with no agricultural land. It is worth noting that there are two sites where the SSEN Distribution network connects to Heathrow Airport within the GSP area. In total the GSP serves approximately 64,000 customers with the breakdown for each substation shown below in Table 1.

Substation Name	Site Type	Number of Customers Served	2023/24 Substation peak recorded MVA
North Hyde (B)	Grid Supply Point	63,577	169.44
North Hyde (D)	Bulk Supply Point	15,894	28.15
North Hyde (E)	Primary Substation	16,081	43.37
Bath Road East	Primary Substation	3,049	7.55
Hayes	Primary Substation	17,300	31.44
Springfield Road	Primary Substation	8,476	12.81
The Green	Primary Substation	4,279	8.50
Vicarage Farm Road	Primary Substation	17,484	24.33

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

4.2. Current Network Topology

The geographic view of the network supplied by North Hyde GSP is shown below in Figure 5.

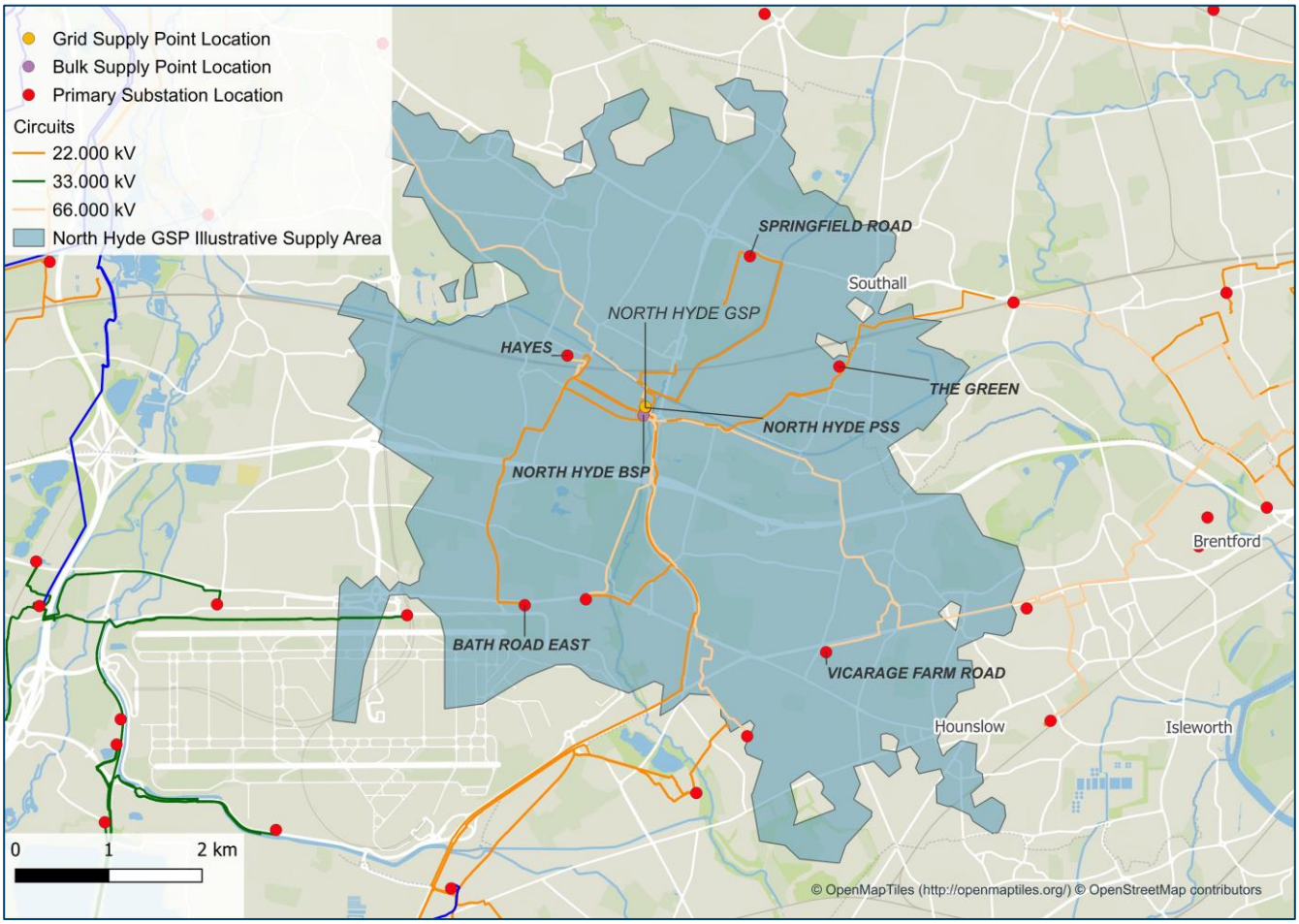

Figure 5 North Hyde GSP - GIS View

4.3. Current Network Schematic

The network schematic for the current arrangements is shown below in Figure 6.

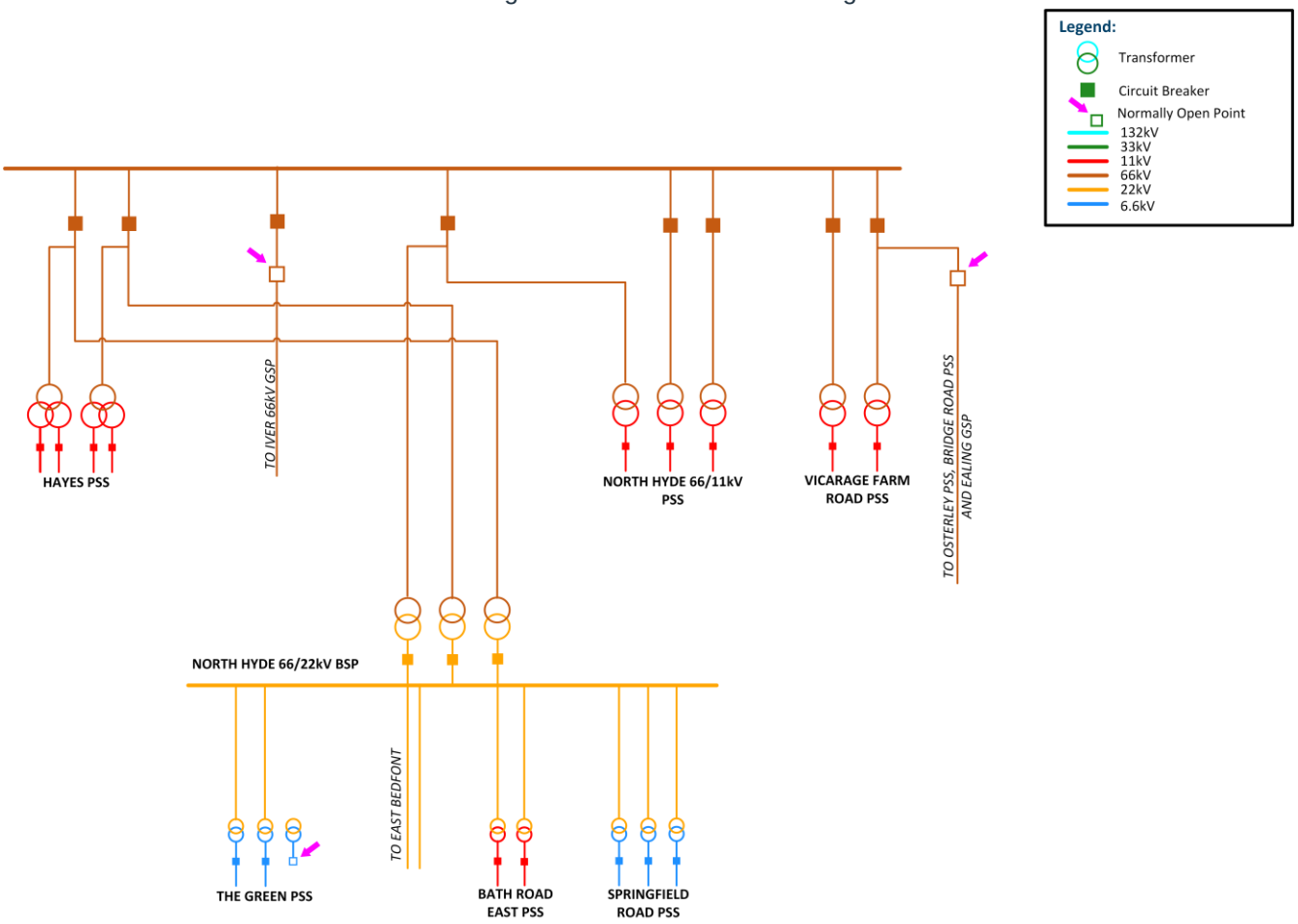

Figure 6 North Hyde GSP - Existing Network Schematic

5. FUTURE ELECTRICITY LOAD AT NORTH HYDE GSP

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

- These projections relate to the GSP supply area highlighted in Figure 1 and are not directly aligned to a particular local authority.
- Where MW values are presented in this section, they represent ***total installed capacity.*** When conducting network studies these values are appropriately diversified to represent the coincident maximum demand of the entire system rather than the total sum of all demands.

For future iterations of the DFES, additional work will be carried out to ensure that the demand projections are rationalised against the West London LAEP. Work is ongoing for this to be complete ahead of the DFES 2024.

5.1. Distributed Energy Resource

Due to the dense built environment of the North Hyde GSP supply area, we wouldn't expect to see a significant number of large-scale generation sites.

5.1.1. DFES Projections

Generation

The DFES projections show a dramatic increase in the amount of Solar PV across the area ahead of 2050 across all four scenarios. Under the Leading the Way scenario, 66.71MW of Solar PV is projected for 2050 in contrast, the Falling Short scenario projects 29.37MW in the same time frame. The existing baseline of connected Solar PV in the area is 5.88MW. In the DFES projections, the solar PV is mostly attributable to the smaller scale building blocks (<10kW and 10kW-1MW). While this is projected across all building types, it is important to note that some of this may relate to council owned properties. The opportunity for this has been identified by local authorities relevant to this area.

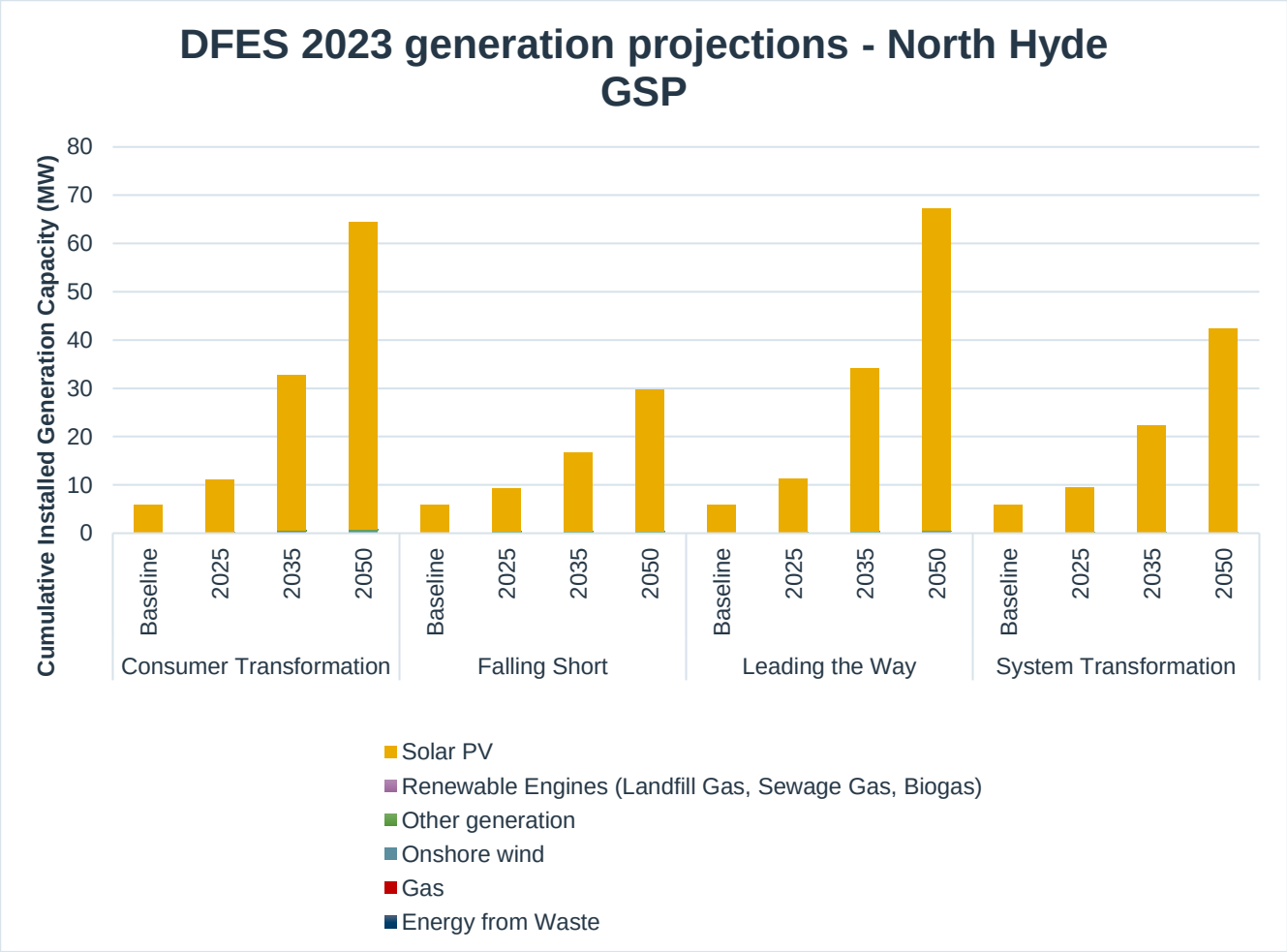

Figure 7 Projected cumulative distributed generation capacity North Hyde GSP (MW). *Source: SSEN DFES 2023*

Storage

There are no large-scale storage projects projected in the DFES 2023 for this area, however there is a significant increase in the amount of domestic battery storage with the Consumer Transformation scenario estimating a total of 15.03MW by 2050. Alongside this 7.12MW of battery storage at high energy user sites is expected to arise by 2050 should the Consumer Transformation scenario be realised.

5.2. Transport Electrification

A key consideration for demand growth across west London is the shift to more electrified transport. The DFES mostly focused on decarbonisation of road transport with aviation and rail not included in any of the ENA agreed technology building blocks. North Hyde GSP supplies some of Heathrow airport as well as having a supply to Network Rail, it is important to consider how further electrification of different transport vectors may impact the electricity network further than the DFES introduced here.

5.2.1. DFES Projections

Under the Consumer Transformation scenario, 67,798 electric vehicles are projected to be located across the North Hyde GSP supply area by 2050. It is important to understand the network facing demand arising from

these vehicles, so the DFES projects the number of domestic off-street chargers and the total installed capacity of other EV charger types. By 2050 the Consumer Transformation scenario projects 41,435 domestic off-street chargers. The breakdown of installed capacity for other charger types is shown in Figure 8 below. We can see that a significant proportion of the total EV charging demand is projected to arise from 'En-route national network' chargers, this is to be expected when considering the busy road network in the area and requirement for accessible road travel to Heathrow Airport and associated airport parking.

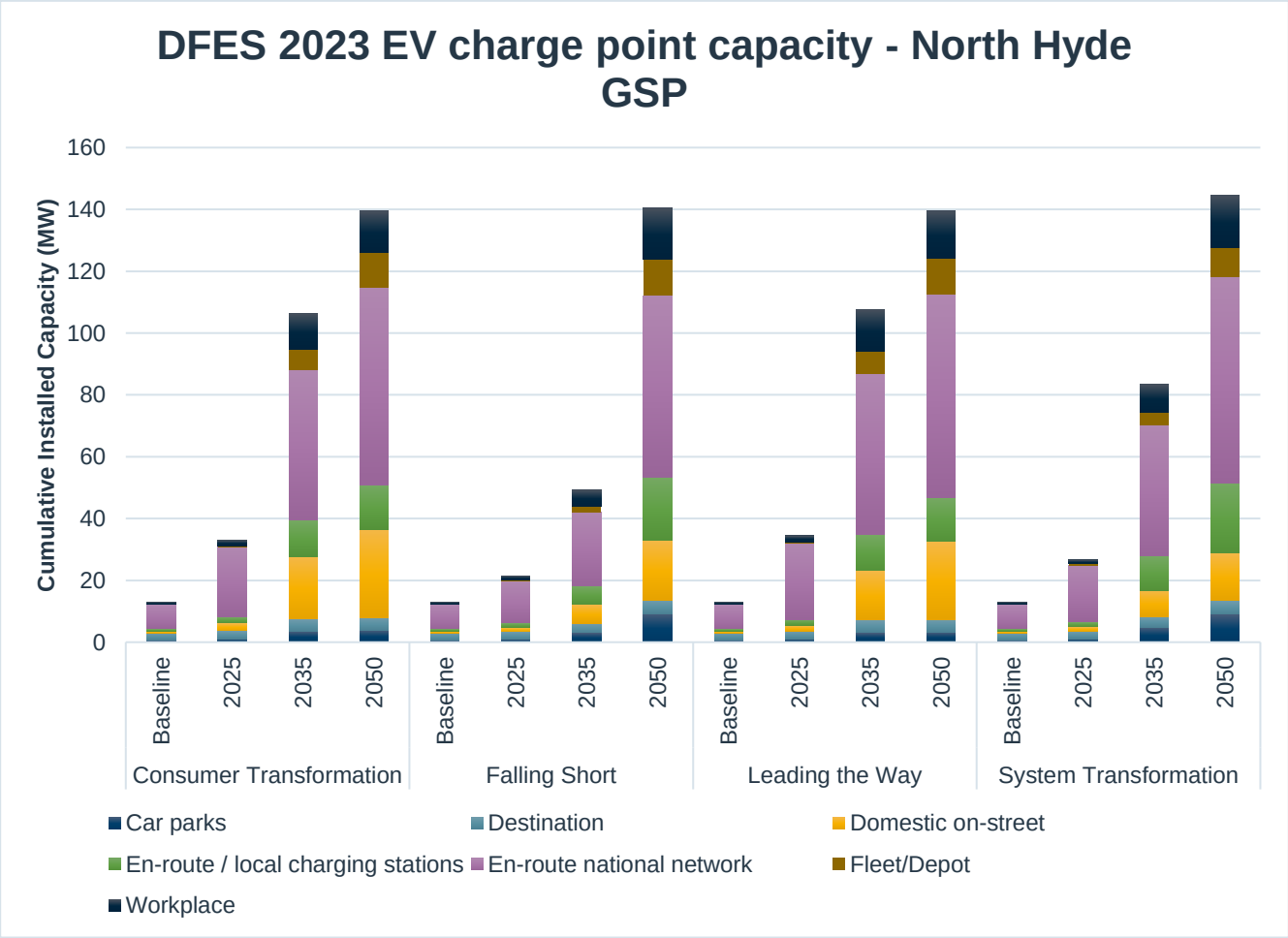

Figure 8 Projected EV charge point capacity across North Hyde GSP. *Source: SSEN DFES 2023*

5.3. Electrification of heat

The route to decarbonisation of space heating will have an impact on the future requirements of the electricity distribution network. Engagement with the Greater London Authority (GLA) has informed SSEN that there are aspirations for the development of heat networks across the west London area. Viable sites have been identified in the West London Local Area Energy Plan (LAEP) and are emerging through Department for Energy Security and Net Zero (DESNZ) national heat network zoning. These will be incorporated into the 2024/25 DFES where available and form part of future Strategic Development Plans.

Currently, the presence of heat networks is considered through the DFES analysis using heat network project pipelines[16] in the near term and DESNZ opportunity areas for district heating networks[17] in the longer term. This is aligned to targets for heat networks to serve 20% of domestic heating by 2050. This impacts the projections through a decrease in the number of standalone air source heat pumps in the DFES across dense urban areas. While heat networks do not have a standalone technology projection in the current DFES, this will be carefully considered with the possibility of inclusion in further iterations.

5.3.1. DFES Projections

Under the Consumer Transformation scenario, we see a dramatic increase in the number of domestic heat pumps with 144 in the baseline rising to 47,866 by 2050. A different route to heat decarbonisation is presented through the System Transformation scenario where heat decarbonisation is considered more likely to be delivered using Hydrogen. As expected, significantly less heat pumps are projected under this scenario with 26,021 to be installed by 2050. The uptake projections for other heating/cooling technologies are shown below in Figure 9.

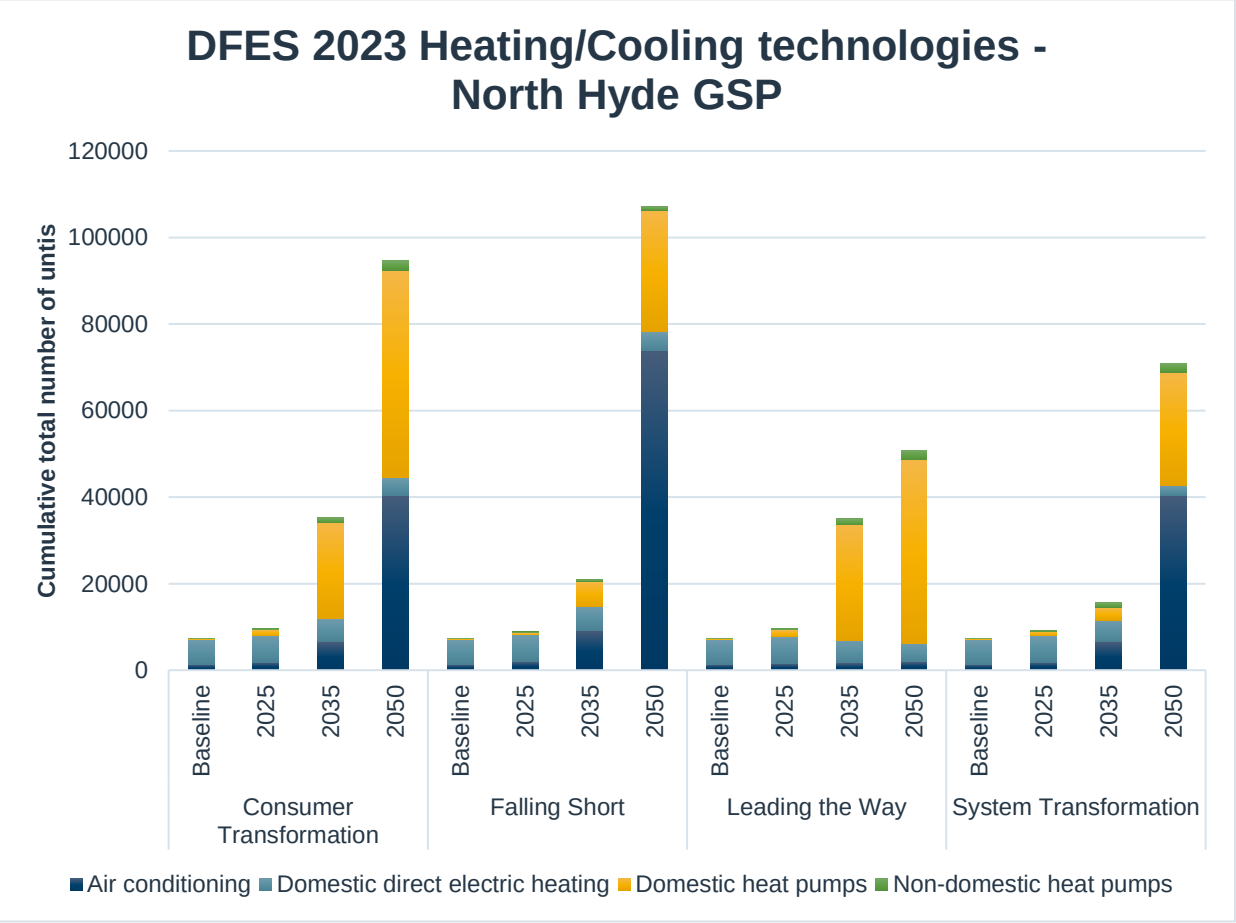

Figure 9 Projected number of heating/cooling technologies across North Hyde GSP. *Source: SSEN DFES 2023*

16 Heat networks pipelines - GOV.UK

17 Opportunity areas for district heating networks in the UK: second National Comprehensive Assessment - GOV.UK

5.4. New building developments

A key stage in producing the DFES is engagement with Local Authorities. On an annual basis local authorities are requested to provide their current best view on new development plans to inform these projections. The results presented here are the information shared by local authorities during the DFES 2023 update process. Where we do not have responses from local authorities these values are determined from published documents for example adopted local plans.

5.4.1. DFES Projections

In the North Hyde GSP supply area, the total number of new domestic developments (number of homes) is projected to be 10,530 by 2050. The DFES also includes projections for different types of non-domestic floorspace with the breakdown for this presented in Figure 10. Please note that as this information is directly fed from local authorities the projections are closely aligned across the four scenarios.

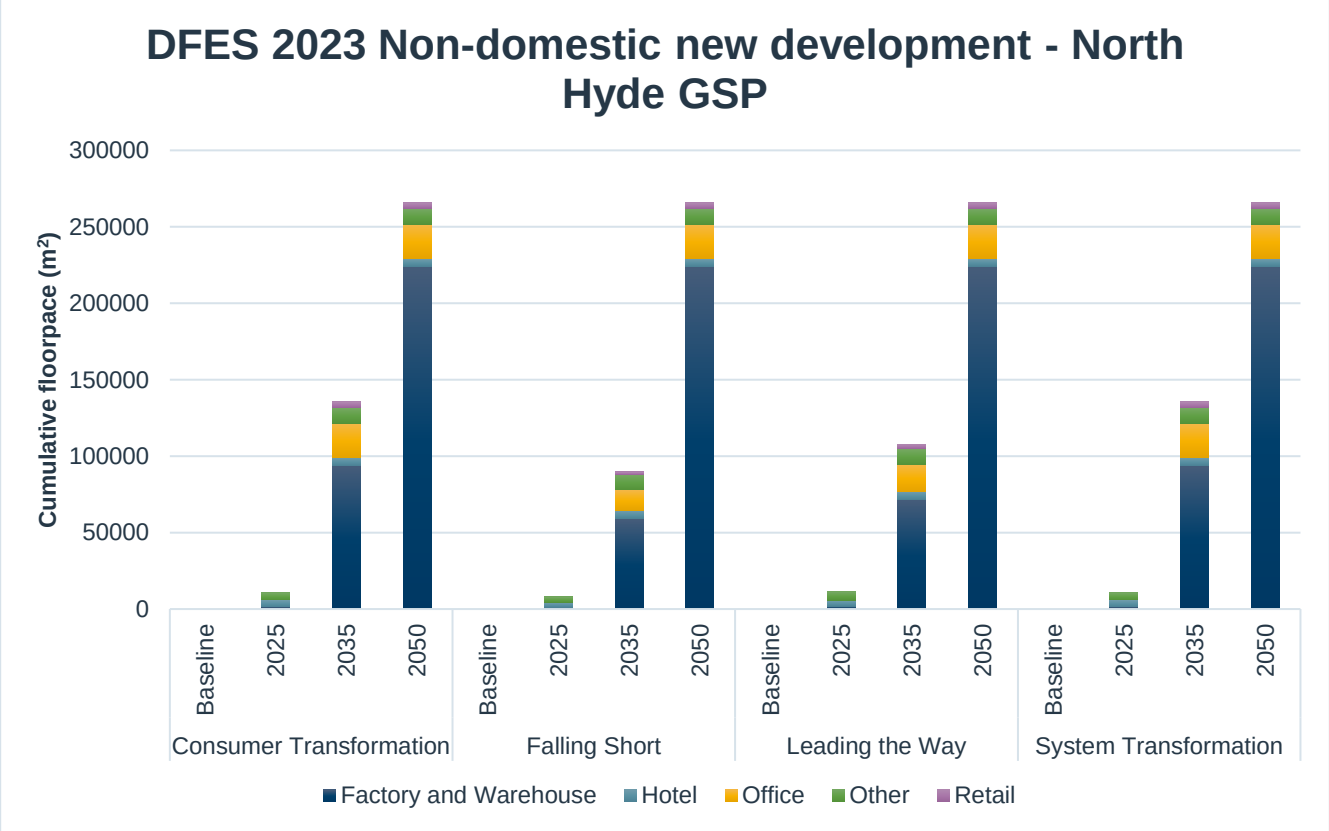

Figure 10 Projected non-domestic new development across North Hyde GSP. *Source: SSEN DFES 2023*

5.5. Commercial and industrial electrification

5.5.1. Data Centres

The increased demand from data centres across west London and the resulting capacity issues is well documented. Recent reports by CBRE indicate that the demand for data centre space in London remains strong, though a lack of available electricity capacity remains an inhibitor to growth.[18] There are multiple data centres already connected across North Hyde GSP but there are currently no additional contracted data centre connections.

Historically and for the DFES 2023, data centre projections have been modelled using the connections pipeline. The NESO FES projections now include GB projections for distributed data centre energy consumption. The DFES 2024, will build on the historic approach coupled with the NESO FES projections to provide a more accurate view of projected data centre capacity. The iterative nature of the SDP process will allow these insights to be studied further in the next update of this document. In addition, SSEN would welcome further engagement with stakeholders in the area to understand further insights on future capacity provision for data centres in the area.

Due to their significant power requirements, data centre projects may be held up based on constraints on National Grid Electricity Transmission's (NGET) network instead of or as well as SSEN's distribution network. It is important for us to continue working closely with NGET and the NESO to continue to develop solutions that will enable data centre connections in the future.

18 CBRE UK, 2023, UK Real Estate Market Outlook 2024: Chapter 17 Data Centres

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 North Hyde 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 network considered for long-term modelling is shown in Figure 11. Summary of existing works shown below:

Substation	Description	Driver	Target completion date	Fully resolves future strategic needs to 2050?	Schematic reference
North Hyde GSP to Vicarage Farm Road PSS 66kV Circuits	Overlay 66kV fluid filled cables from North Hyde GSP to Vicarage Farm Road PSS	CV7 – Asset Replacement	2027		1
Hayes PSS	Installation of a third 60MVA 66/11kV transformer and replacement of 11kV switchboard with new arrangement.	CV1 – Primary Reinforcement	2030		2
Bath Road East PSS	Replacement of two existing transformers at Bath Road East PSS with 40MVA 66/11kV transformers and the 11kV board. New circuits to connect directly to the new North Hyde BSP 66kV busbar.	CV1 – Primary Reinforcement	2030		3
North Hyde BSP	New 132kV double busbar installed (operated at 66kV), connect North Hyde BSP (22kV) to the new busbar, Hayes PSS, and North Hyde PSS initially.	CV1 – Primary Reinforcement	2028		4
The Green PSS	Move all connected secondary substations to Springfield Road	CV2 – Secondary Reinforcement	2030	N/A	5

	PSS through, making The Green PSS redundant.				
North Hyde PSS	Replace the three existing transformers with new 60MVA 66/11kV transformers and replacement of 11kV switchboard with new arrangement.	CV1 – Primary Reinforcement	2028		6
Springfield Road PSS	Reinforcement of three transformers with 66/11kV 40MV transformers, replacement of 11kV board, three new circuit breakers and circuits to connect to North Hyde BSP at 66kV.	CV1 – Primary Reinforcement	2030		7
Vicarage Farm Road PSS	Reinforcement of both 66/11kV transformers with new 3-winding 80MVA 66/11kV transformers. New 11kV busbar arrangement.	V3 – Connections	2028		8

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

Where the above works are marked as not providing sufficient capacity for 2050 peak demands, it is important to note that when considering the further works identified in this report, the holistic plans provide overall capacity across the GSP for 2050. An example of this is explored in the High Voltage networks section (8.2.1.) where the future requirement to rationalise the 6.6kV network under Springfield Road primary substation to 11kV is discussed. This additional work will then provide sufficient capacity for the current 2050 demand projections. Alongside these asset solutions being deployed, flexibility solutions are also being used to release additional capacity, as introduced in section 3.3.

6.1. Network Schematic (following completion of above works)

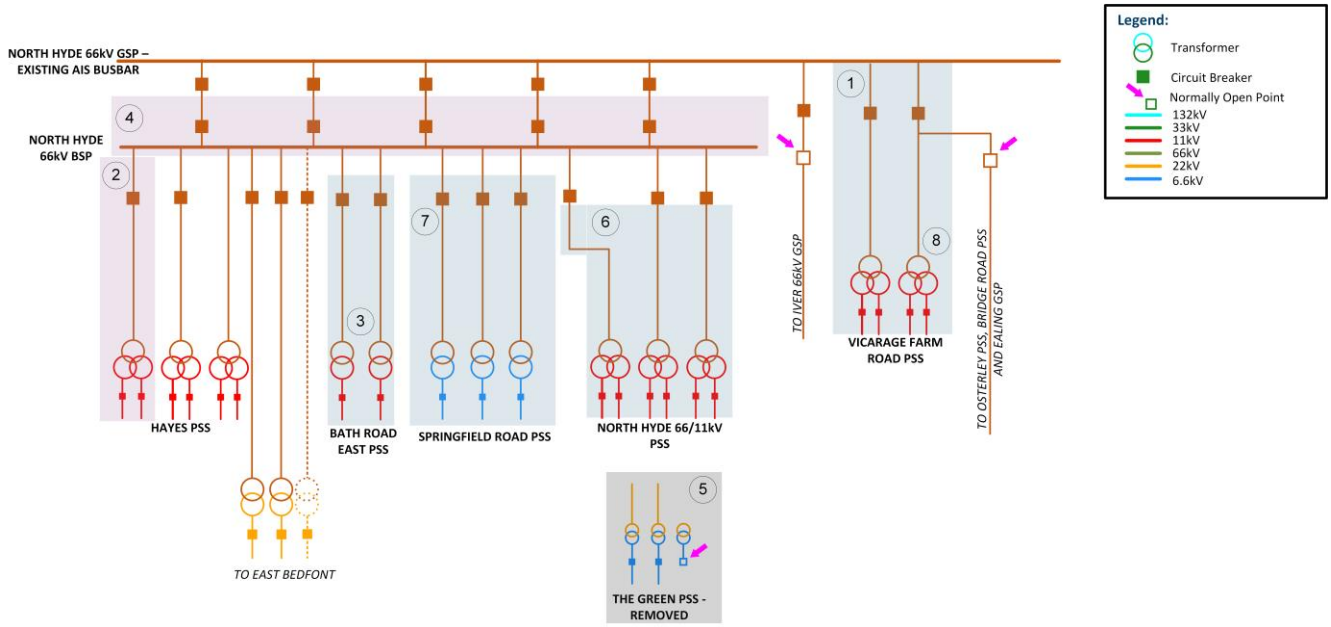

Figure 11 North Hyde GSP - Network Schematic following completion of triggered works

7. SPATIAL PLAN OF FUTURE SYSTEM NEEDS

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

We have created spatial plans at a primary substation level (66/11kV, 22/11kV, and 22/6.6kV) and secondary substation level (11kV/LV and 6.6kV/LV). Snapshots are provided for 2028, 2033, 2040, and 2050 enabling clear visualisation of future system needs beyond the network capacity.

They are currently based on 2023 DFES Consumer Transformation forecasts with the additional plans for other DFES scenarios shown in Appendix B and Appendix C.

7.1. Extra High Voltage / High Voltage spatial plans

Figure 12 shows the projected headroom or capacity shortfall across the illustrative primary substation supply areas. The values are taken from the Network Scenario Headroom report (NSHR), part of the Network Development plan (NDP). Negative values indicate a shortfall in capacity, positive values indicate headroom. These are presented for each of the four DFES scenarios to understand how the projected availability of network capacity changes across each of these scenarios, the Consumer Transformation scenario is shown below (see Appendix B for other scenarios). It should be noted that the NSHR is produced annually and last published in May 2024, where work has been triggered between this date and the time of publication of this report, future capacity may not be reflected.

It should be noted that the NSHR is produced annually and last published in May 2024, where work has been triggered between this date and the time of publication of this report, future capacity may not be reflected.

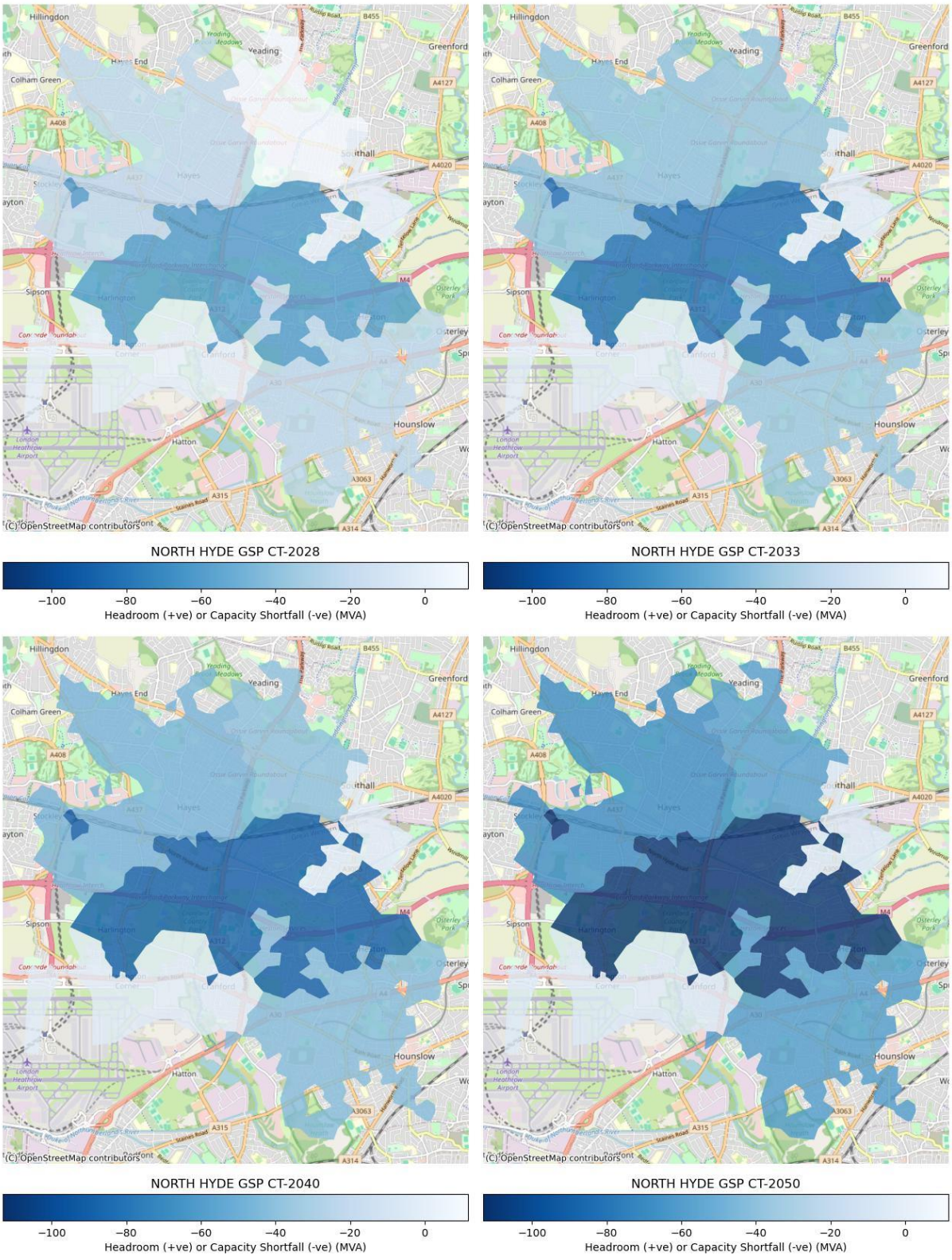

Figure 12 North Hyde GSP - EHV/HV Spatial Plans - Consumer Transformation

From the figure above we can see that the area just south of the main railway line is the area where capacity is projected to significantly grow above the existing asset rating. The area to the Southeast of the supply area has the lowest capacity needs, however this shouldn't be correlated with energy plans at Heathrow airport as this is connected through multiple supplies direct to the airport which are not shown here.
While similar geographic trends are shown across the scenarios, we can see that some of the DFES scenarios result in higher demands than others (see Appendix B for comparison).

7.2. High Voltage / Low Voltage spatial plans

To understand, where load is growing at a more granular level, we have used information from the SSEN load model that is produced by SSEN's Data and Analytics team.
Across Figure 13 we see large numbers of secondary transformers either approaching or exceeding loading of 100% in the near term. This represents a near term risk that will need to be addressed. There are pockets of lower loaded secondary transformers, and it could be possible to shift load through LV load transfers as a short-term solution before the network is either reinforced or more assets built to incorporate the increased growth in demand.

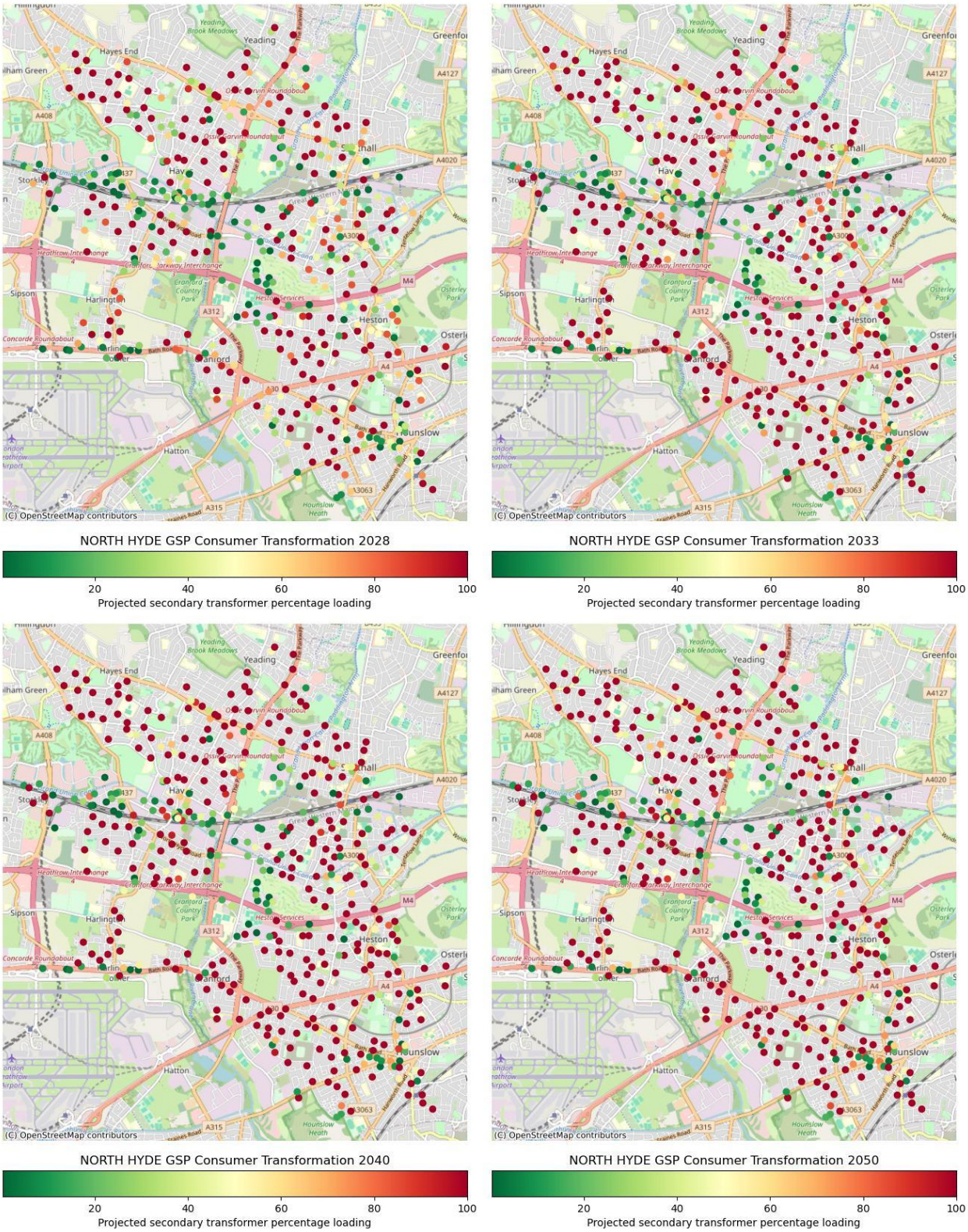

Figure 13 North Hyde GSP - HV/LV Spatial Plans - Consumer Transformation

8. SPECIFIC SYSTEM NEEDS AND OPTIONS TO RESOLVE

As introduced in the Works in Progress section, significant work has been triggered across North Hyde GSP. Every primary substation with downstream HV networks owned and operated by SSEN across the GSP group have works triggered at them.
It is therefore unsurprising that when modelling the network with the DFES 2023 in this area, no further work is identified. It should be noted that this is based on our current projections, this position may change as projections develop. This is captured in the annual reassessment. 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: The triggered works must be delivered before capacity is released for new customers.
Risk: Customers must wait for reinforcement to be complete before they are able to connect to the network.
Mitigation: There are a range of access products that may enable customers to connect ahead of completion of reinforcement. An example of one of these initiatives is the ramping agreement introduced in the West London Capacity Constraints section of this report. Further to this, flexible services may be used to enable customer connections in the future.

8.1. 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 high voltage and low voltage network needs to 2050.

8.1.1. 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.
Some specific HV system needs have already been identified at Springfield Road primary substation to enable future capacity. The work triggered at the site resolves capacity constraints out to 2050 based on current projections, however voltage rationalisation of the 6.6kV network to 11kV will be required to enable this capacity at the HV level. The current estimate for delivery of this HV work is 2034, as with all schemes based on long-term forecasts, this will need to be consistently reassessed.
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.

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

For the 6 primary substations supplied by North Hyde 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.

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 across smaller customer groups. Where the magnitude of an overload is too large for flexibility to be feasible, addition of new assets or asset replacement will be necessary.

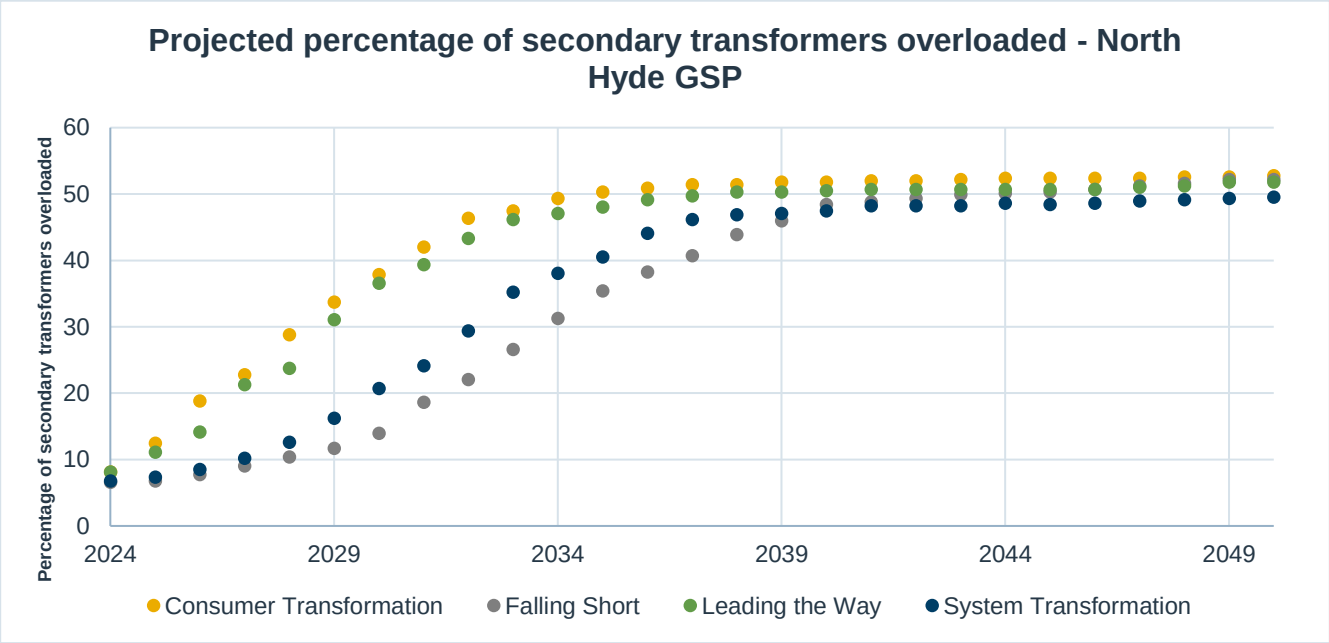

Figure 14 North Hyde GSP Projected Secondary Transformer Loading. *Source: SSEN Load Model*

8.1.2. Considering the Just Transition in HV development

SSEN are building on the findings from the Vulnerability Future Energy Scenarios (VFES). This innovation project investigated how the use of new foresighting techniques, along with data analytics and expert validation could be used to identify and forecast consumers in vulnerable situations as we move toward net zero. Use of the outputs from the VFES enable SSEN to develop the network in a way that truly accounts for the levels of vulnerability their customers in different locations face.

One of the outputs from this innovation project was the report produced by the Smith Institute.[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

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)

complex relationships that exist between the two. The resulting group numbers and descriptions are shown in Table 3.

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

Table 3 VFES Groupings

To understand the vulnerability groupings across North Hyde 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 Consumer Transformation scenario), we begin to understand the crossover between network capacity needs and areas categorised as high vulnerability through the VFES work. This is shown below in Figure 15.

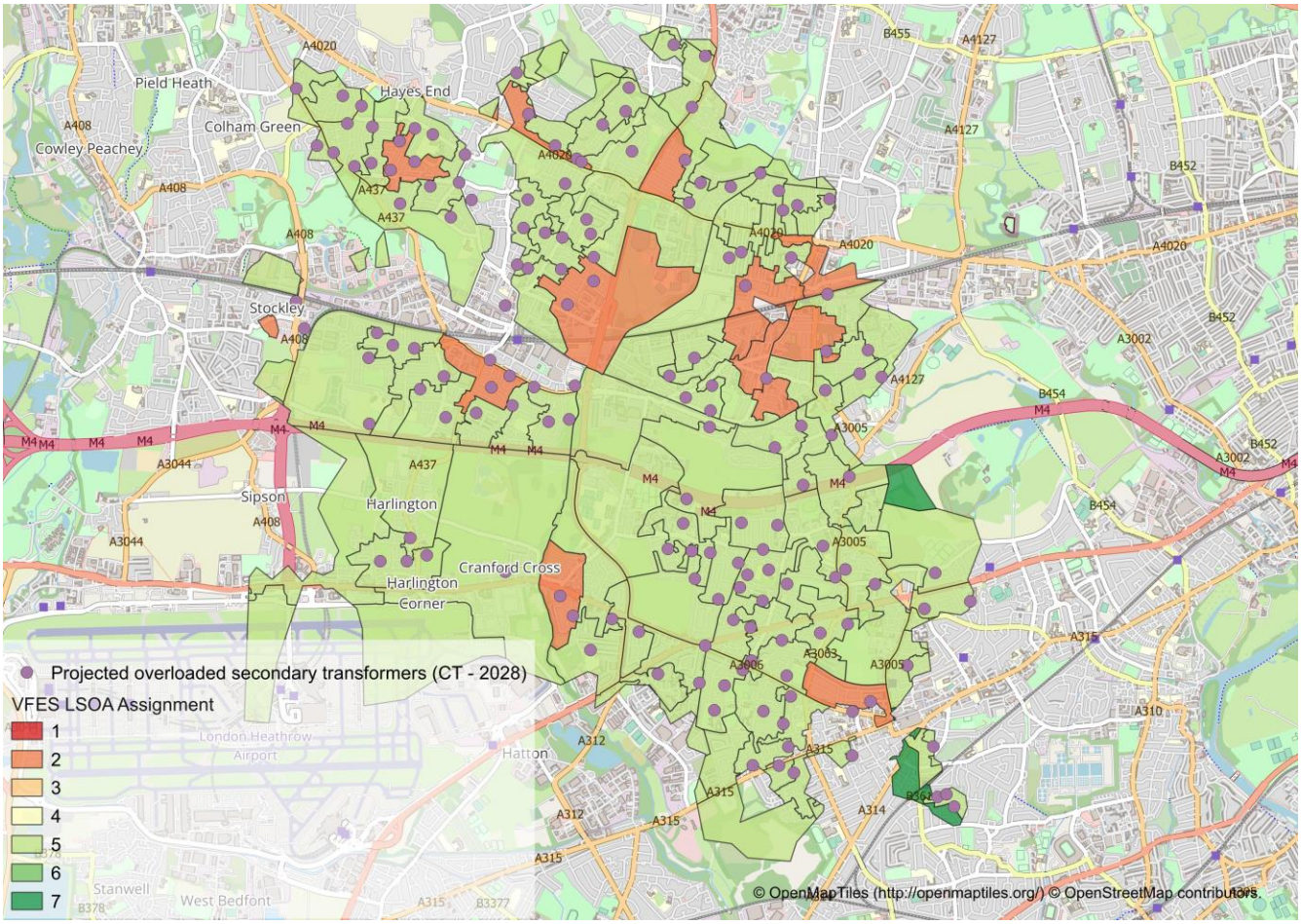

Figure 15 North Hyde GSP VFES Output with secondary transformer overlay.

We can see that the majority of the area falls within group 5 – slightly lower than average vulnerability. This categorisation is driven down by lower elderly population levels and larger levels of ethnic diversity, increased by higher household sizes and greater provision of care. In some areas, to the North of the supply area we see a number of LSOAs falling into the group 2 – high vulnerability. Driven up by larger household sizes, reduced by lower elderly population levels.

By overlaying the point locations of secondary transformers projected to be overloaded (in 2028 under the Consumer Transformation scenario) we identify areas that are categorised as more vulnerable and also may have capacity shortfalls at the secondary network level.

More vulnerable groups may have lower level of adoption of LCTs and therefore provide less ability to manage overloads through flexibility services. Further they may point towards areas of social housing where there could be a more sudden rollout of LCTs such as heat pumps in the future.

We will use these insights to prioritise heavily loaded areas of our network ensuring the network remains secure, stable, and resilient in the areas where vulnerable customers would be most disadvantaged by outages.

8.1.3. Low Voltage Networks

Drivers for interventions in low voltage networks may either be capacity related or 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 development of this strategy. Enhanced network visibility through smart meter data analytics and low-cost substation feeder monitoring is also necessary to enable appropriate dispatch of services and network reconfiguration.

Initial thermal analysis indicates that by 2050 15-20% of LV feeder first legs will be thermally overloaded. We see an initial increase in 2028 under the Consumer Transformation and Leading the Way scenarios with this slightly deferred to 2032 under the other two scenarios. We see a steep increase in the requirement throughout the 2030s with this then starting to level off from 2040 to 2050. While there is not an immediate need, due to the timeline to grow workforce, it is necessary to start recruitment and initiate programmes ahead of need to be able to deliver the required volumes from 2028 onwards.

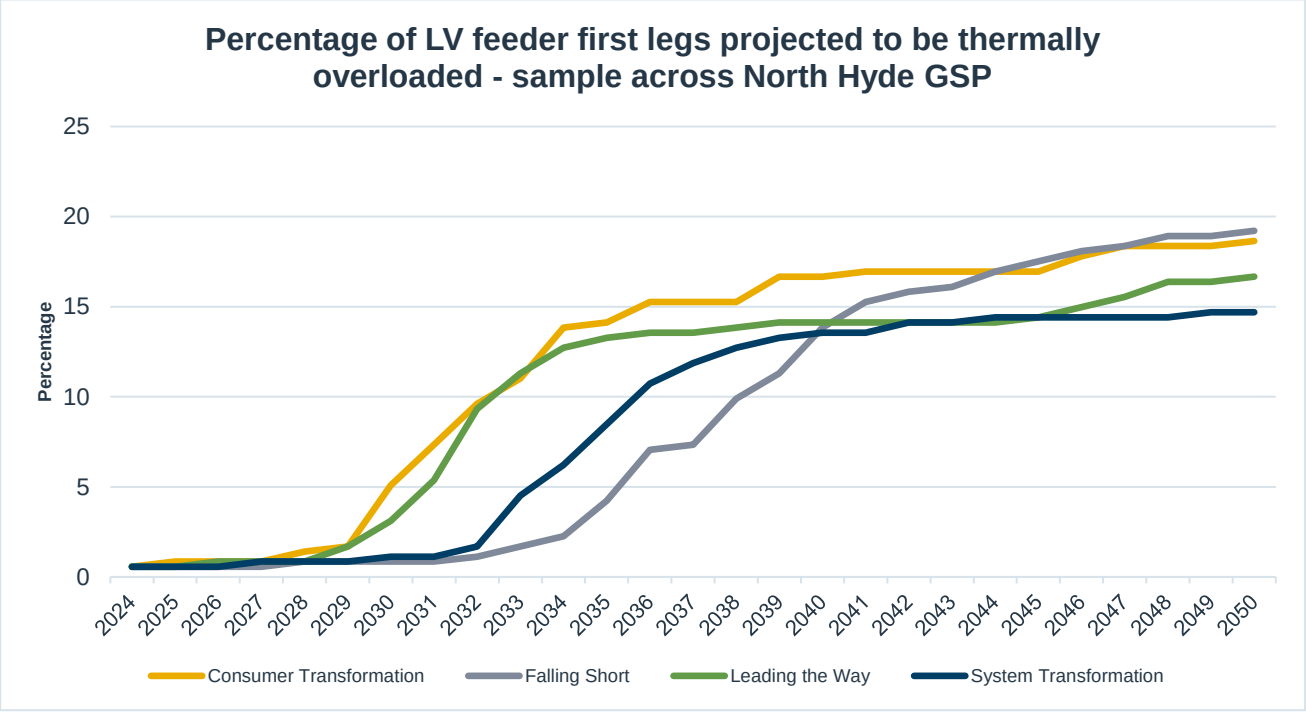

Figure 16 Percentage of LV feeders projected to be overloaded under North Hyde GSP

9. RECOMMENDATIONS

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

Across North Hyde GSP group, a large amount of work has already been triggered through the DNOA process and published in the DNOA Outcomes Reports. These are driven by customer connections and system needs that will arise this decade but are being developed to meet 2050 needs.

The findings from this report have provided evidence for 4 key recommendations:

1. Development of our longer-term projections so that we are capturing large scale new demands with a greater level of confidence. This will enable anticipatory investment to provide capacity for these new demands.

2. During delivery of the triggered work, continued use of innovative solutions for example ramped connection agreements should be used to enable development in the local area.

3. SSEN should engage closely with local authorities in the area to better understand new demands that may not be captured in our existing processes (for example heat networks).

4. Prioritisation of heavily loaded secondary substations supplying vulnerable consumers. This report has identified secondary substations in need of future reinforcement that supply our more vulnerable communities. It is recommended that these are prioritised in future interventions.

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 Relevant DNOA Outcome reports

DNOA Outcome Report

Southall and Harlington (North Hyde BSP) Ref. 0724-34

Scheme description

- North Hyde BSP supplies areas across Ealing, Hillingdon, and Hounslow local authorities. Postcode(s): TW4, TW5, TW6, UB1, UB2, UB3, UB4.
- Load related – substation and circuits overload during FCO conditions due to forecasted demand growth.

Proposed option

- Asset solutions: Extension of the North Hyde GSP 66kV busbar to be established as a remote 66kV switchboard at North Hyde BSP.
- This option facilitates further works to upgrade the networks to meet the forecasted 2050 demands and enables rationalisation of non-standard voltages. The CEM tool found the deferral of reinforcement through flexibility solution was uneconomical.
- Capacity released: 195MVA

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: N/A
- Utilisation: N/A

Reinforcement timeline

- Reinforcement delivery by 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	-	-	-	-(34.11)	-(36.48)	-(39.05)	-(41.42)
ST	-	-	-	-(32.35)	-(33.89)	-(35.64)	-(37.10)
LTW	-	-	-	-(35.51)	-(38.12)	-(41.29)	-(44.08)
FS	-	-	-	-(31.96)	-(33.31)	-(34.80)	-(36.19)

Constraint management timeline

44 | Scottish and Southern Electricity Networks Distribution | **DNOA Outcomes Report July 2024**

DNOA Outcome Report

Harlington and Southall (North Hyde PSS) Ref. 0724-28

Scheme description

- North Hyde primary substation supplies areas across Ealing, Hillingdon, and Hounslow local authorities. Postcode(s): UB2, UB3, TW5.
- Load related – Thermal overloading of substation during FCO conditions due to forecasted demand growth in the area.

Proposed option

- Asset solutions: Upgrade three 66/11kV transformers with new 60MVA rated transformers. New 66kV underground circuits. Replacement of the 11kV switchboard.
- This option meets the projected demands out to 2050. Use of flexibility was determined not to be viable in this area due its availability falling short of the required amount.
- Capacity Released: 43.8MVA

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: N/A
- Utilisation: N/A

Reinforcement timeline

- Reinforcement delivery by 2028/29.

Estimated peak MW outside firm network capacity under each scenario

Grey text relates to estimated peak MW without reinforcement delivery

	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31
CT	-	-	-	-	-	- (2.40)	- (4.65)
ST	-	-	-	-	-	-	-
LTW	-	-	-	-	- (1.37)	- (4.65)	- (7.20)
FS	-	-	-	-	-	-	-

Constraint management timeline

38 | Scottish and Southern Electricity Networks Distribution | **DNOA Outcomes Report July 2024**

Appendix B EHV/HV spatial plans for other DFES scenarios

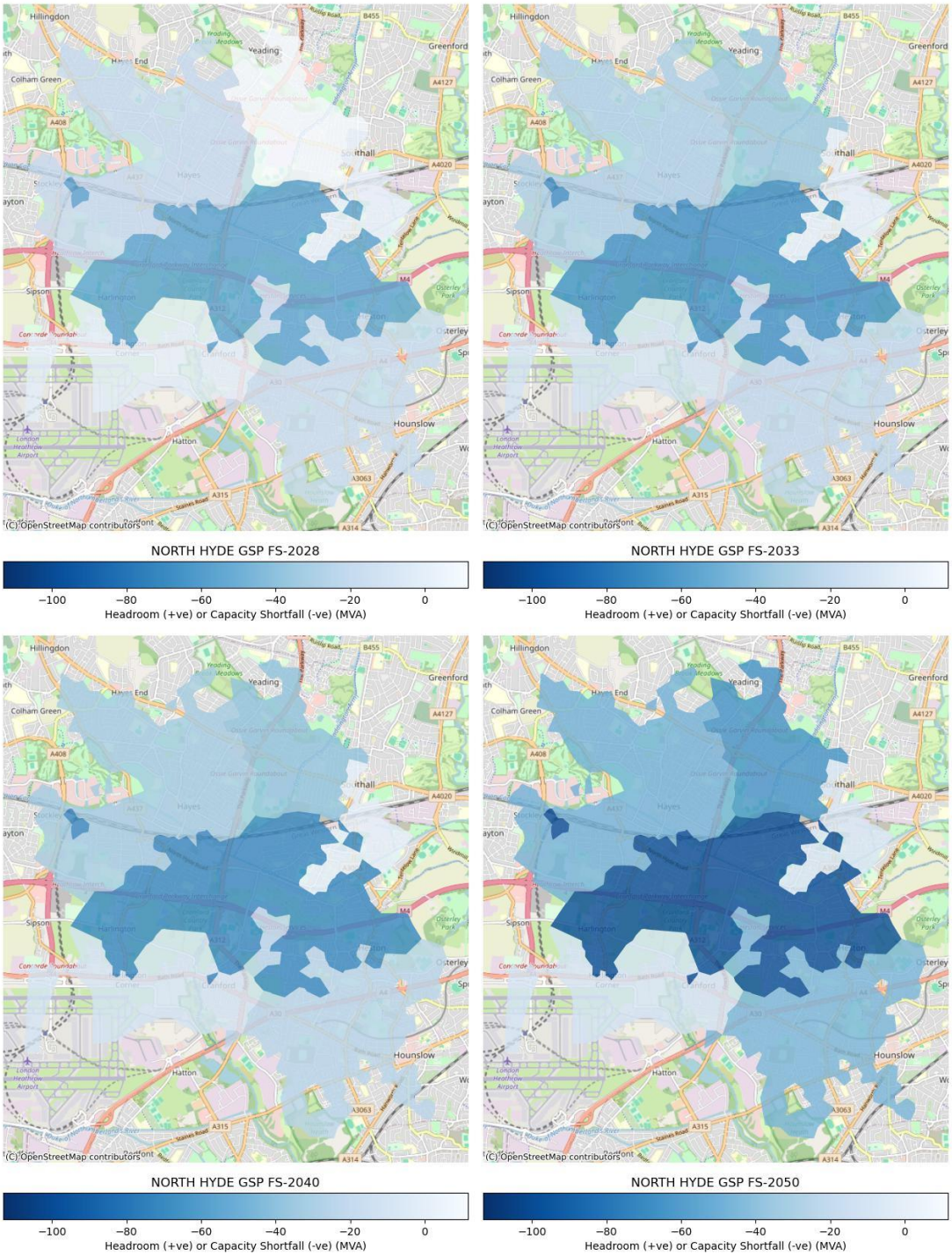

Figure 17 North Hyde GSP - EHV/HV Spatial Plan - Falling Short

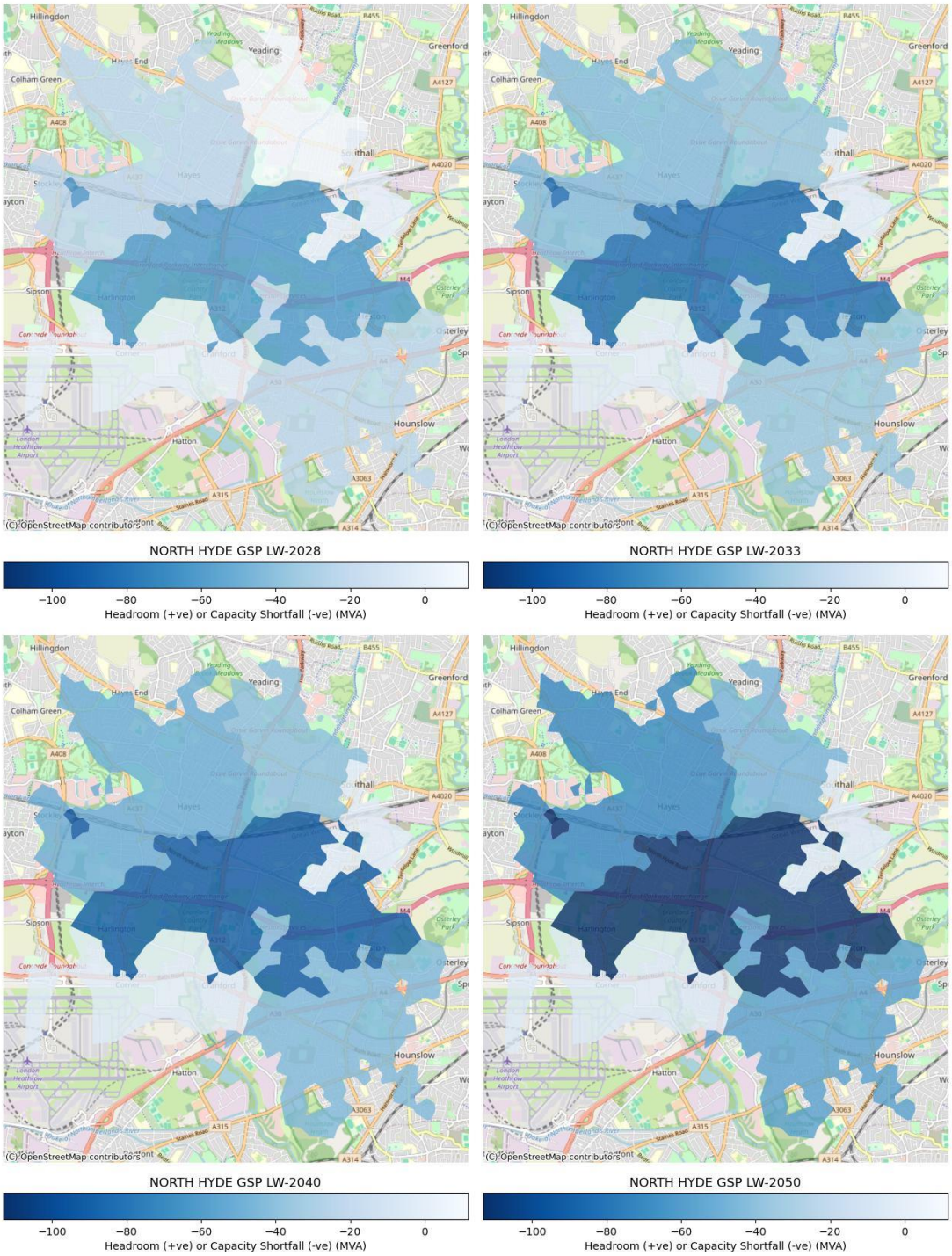

Figure 18 North Hyde GSP - EHV/HV Spatial Plan - Leading the Way

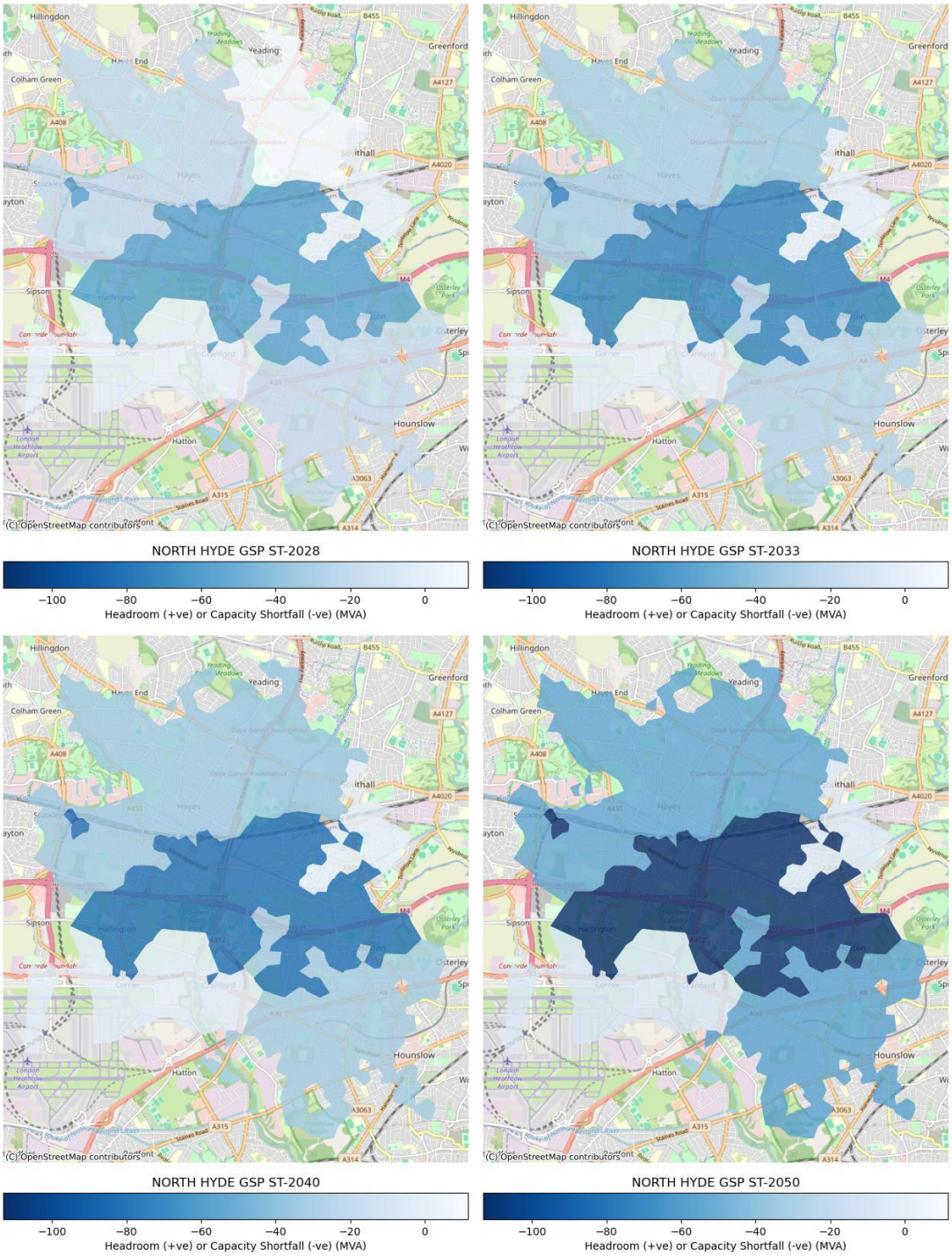

Figure 19 North Hyde GSP - EHV/HV Spatial Plan - System Transformation

Appendix C HV/LV spatial plans for other DFES scenarios

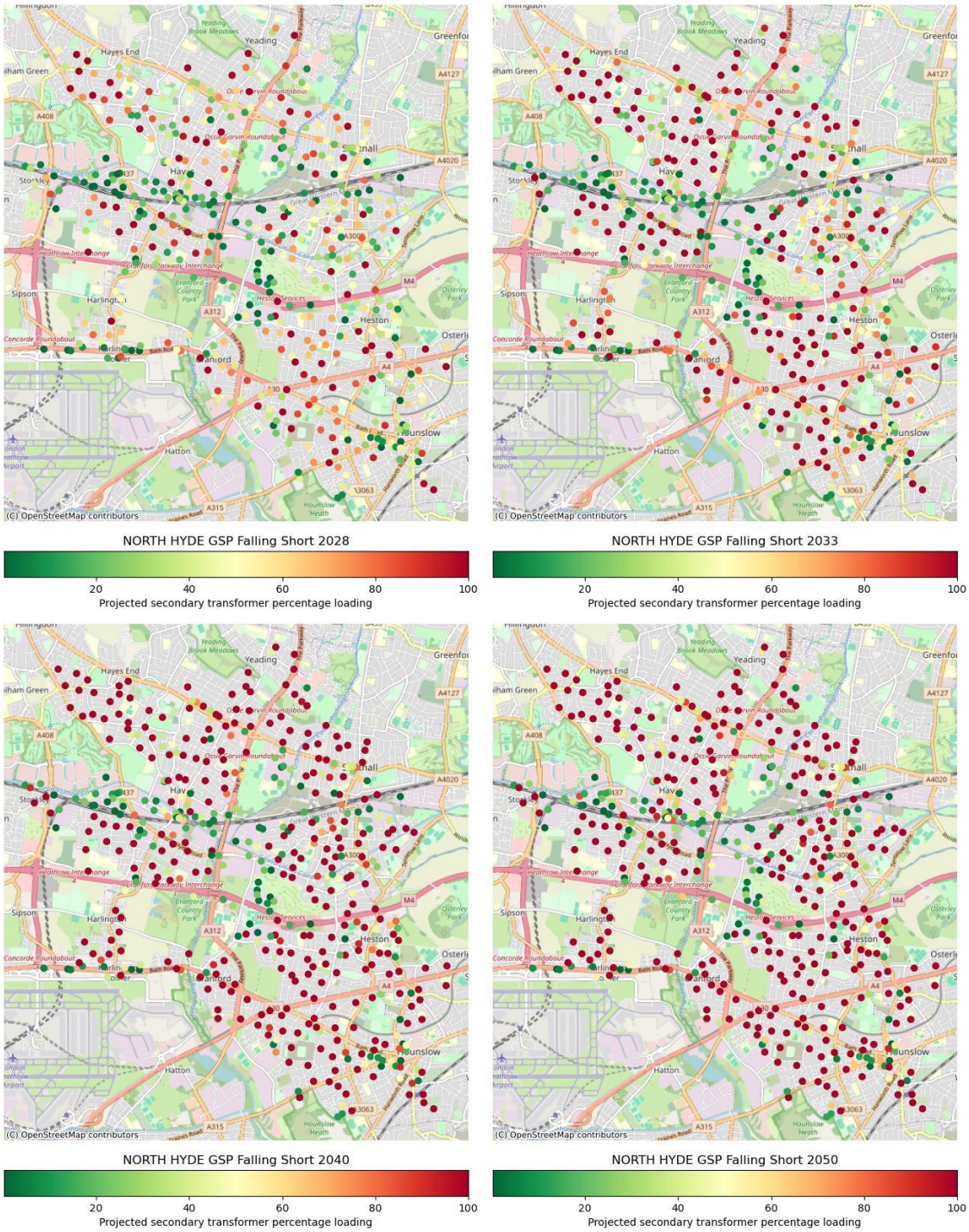

Figure 20 North Hyde GSP - HV/LV Spatial Plan - Falling Short

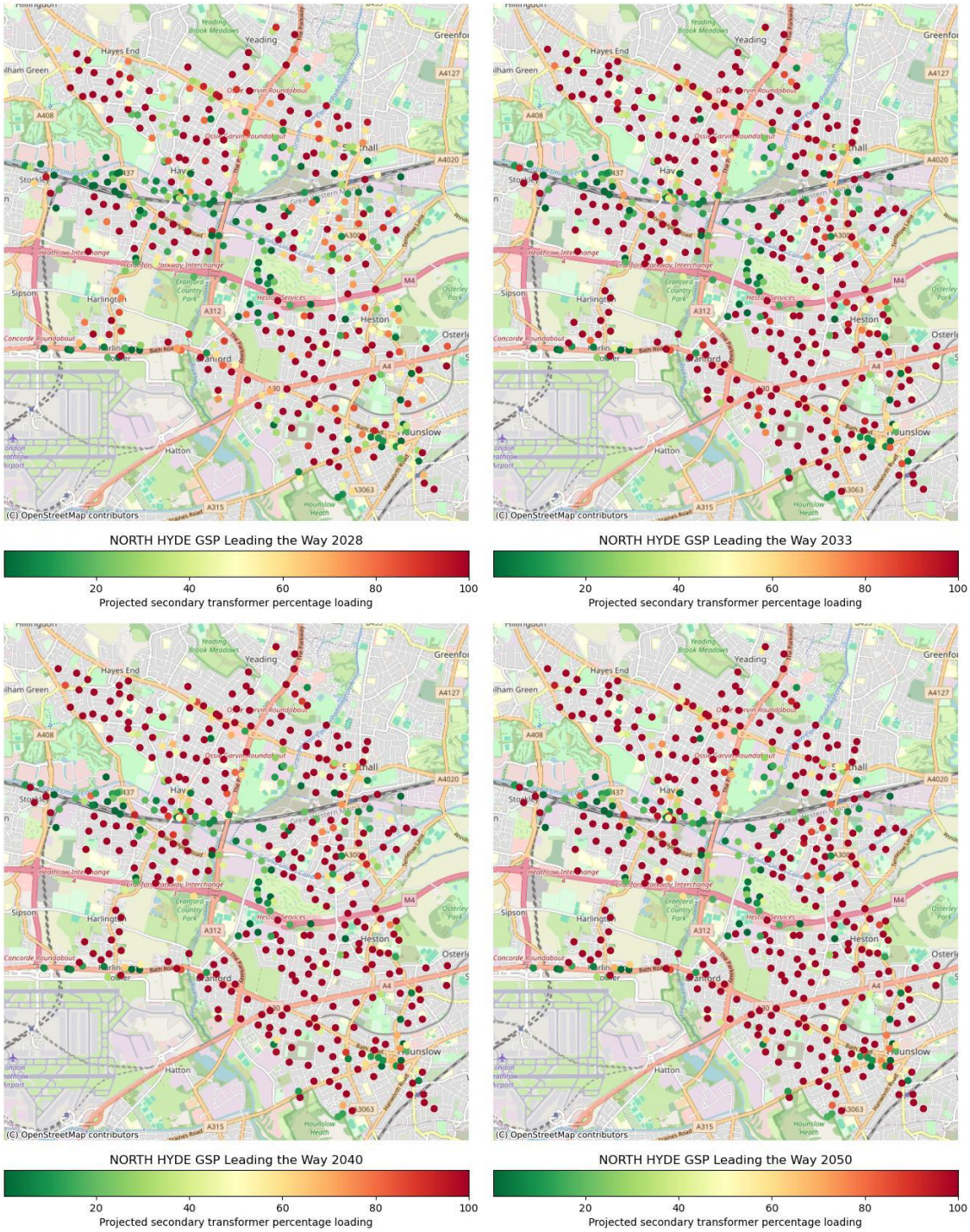

Figure 21 North Hyde GSP - HV/LV Spatial Plan - Leading the Way

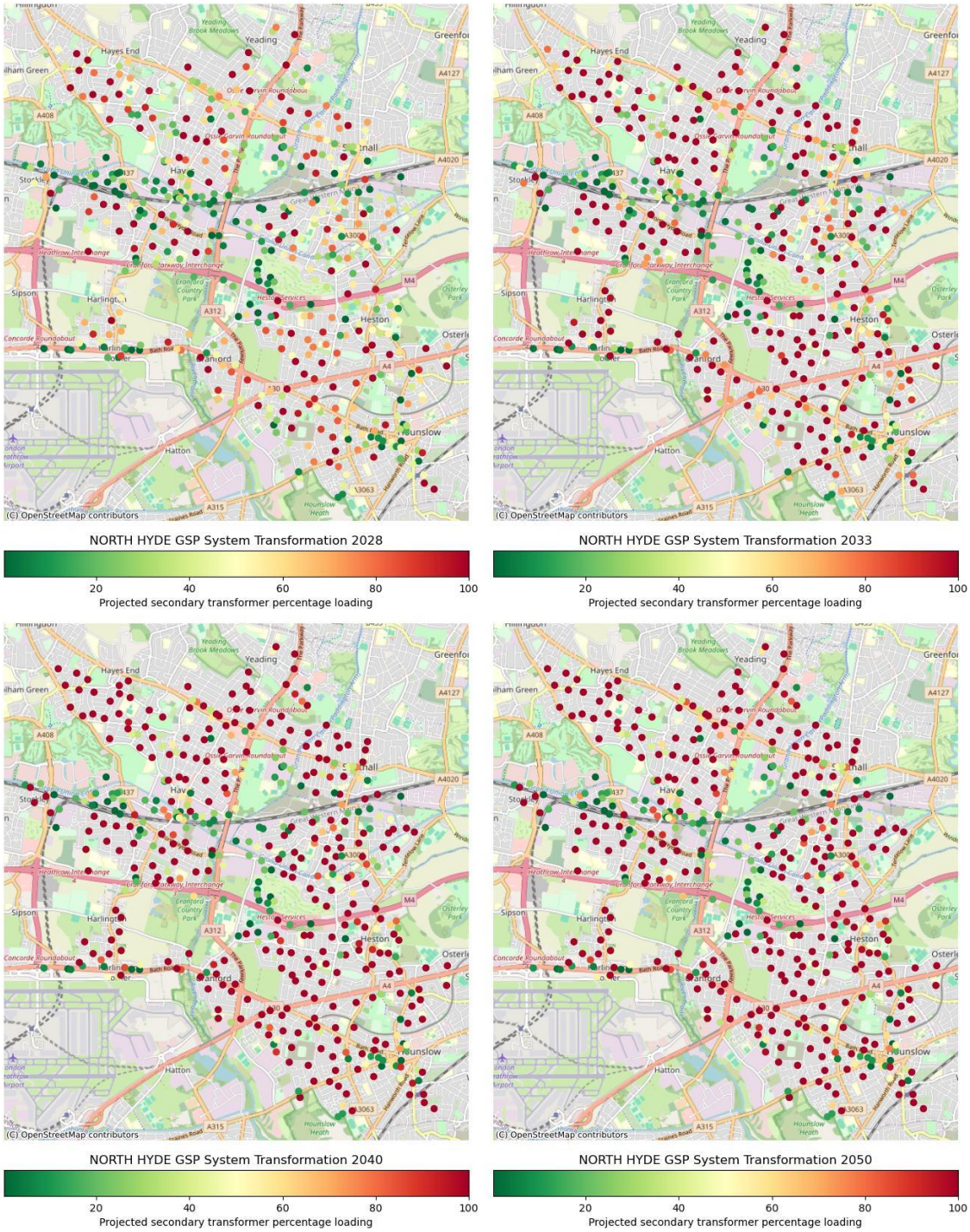

Figure 22 North Hyde GSP - HV/LV Spatial Plan - System Transformation

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
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
DSR	Demand Side Response
EHV	Extra High Voltage
EJP	Engineering Justification Paper
ER P2	Engineering Recommendation P2
NESO	National Energy System Operator
NGET	National Grid Electricity Transmission
ENA	Electricity Networks Association
EV	Electric Vehicle
FES	Future Energy Scenarios
FS	Falling Short
GIS	Gas Insulated Switchgear

GLA	Greater London Authority
GSPs	Grid Supply Point
HV	High Voltage
kV	Kilovolt
LAEP	Local Area Energy Planning
LCT	Low Carbon Technology
LENZA	Local Energy Net Zero Accelerator
LV	Low Voltage
LW	Leading the Way
OHL	Overhead Line
PSS	Primary Substation
PV	Photovoltaic
NSHR	Network Scenario Headroom Report (part of the Network Development Plan)
MW	Megawatt
MVA	Mega Volt Ampere
ODM	Operational Decision Making
OPDC	Old Oak Common and Park Royal Development Corporation
RIIO-ED1/2	Revenue = Incentives + Innovation + Outputs, Electricity Distribution 1 / 2 (regulatory price control periods)
SDP	Strategic Development Plan
SEPD	Southern Electric Power Distribution
SLC	Standard Licence Condition
SSEN	Scottish and Southern Electricity Network
ST	System Transformation
UKPN	UK Power Networks
UM	Uncertainty mechanism
VFES	Vulnerability Future Energy Scenarios
WSC	Worst Served Customers

CONTACT

whole.system.distribution@sse.com

Scottish & Southern Electricity Networks