COWLEY GRID SUPPLY POINT: STRATEGIC DEVELOPMENT PLAN

Our network serving communities across Oxfordshire and High Wycombe

(Draft for consultation)

12/2024

Scottish & Southern Electricity Networks

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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 Cowley Grid Supply Point (GSP), covering Oxfordshire and parts of Buckinghamshire and the Cotswold.

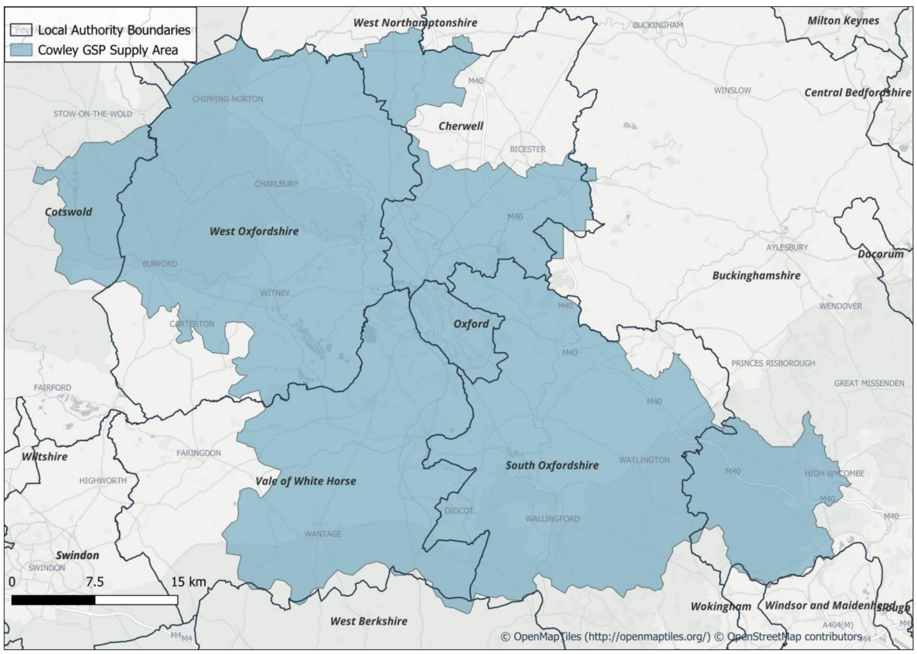

Figure 1 Area of focus for this SDP

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. In the case of Cowley 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 Cowley GSP, several additional network reinforcements were needed to provide capacity out to 2050. This will be reassessed on an annual basis to understand the network impact of updated forecasts.

As a result of the work undertaken for this report, we make recommendations for further study of projects that could enter the DNOA process. For this GSP area, 13 reinforcements have been recommended to the DNOA process for more detailed assessment.

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 Cowley Grid Supply Point (GSP) area. A GSP is an interface point with the national transmission system where SSEN then take power to local homes and businesses within a geographic area. Context for the area this represents is shown above in **Figure 1**.

To identify the future requirements of the electricity network, SSEN commission Regen to produce the annual Distribution Future Energy Scenarios (DFES). The DFES analysis is based off the National Grid Energy System Operator (ESO) Future Energy Scenarios (FES) while accounting for more granular stakeholder insights from agencies such as local authorities and new demand and generation connection applications. The DFES provides a forward-looking view of how demand and generation may evolve under four different scenarios as we move towards the national 2050 net zero target. These scenarios are 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.

Recently, we have seen significant customer connection requests across Cowley GSP. Where this demand has not been captured in the DFES we have commented on where this is the case to ensure that we are capturing where near-term connections requests maybe driving system needs rather than DFES scenarios.

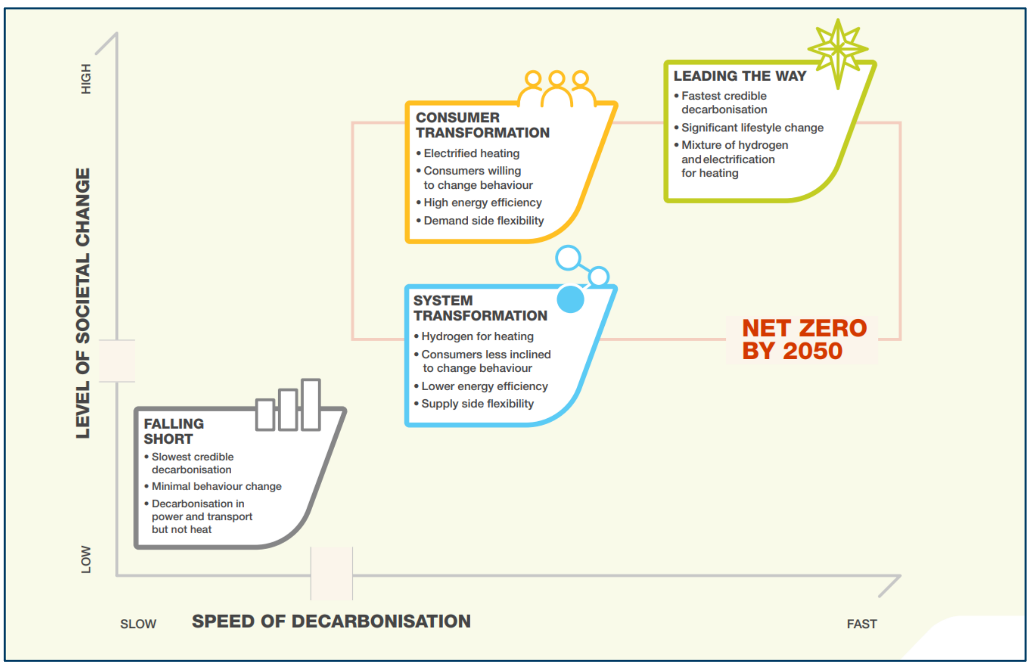

Figure 2 The four future energy scenarios from the FES, adopted for the DFES. *Source: NESO FES*

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

3. STAKEHOLDER ENGAGEMENT AND WHOLE SYSTEM CONSIDERATIONS

3.1. Local Authorities and Local Area Energy Planning

The main local authorities that are supplied by Cowley GSP are Oxfordshire County Council, West Oxfordshire District Council, Cherwell District Council, Oxford City Council, Vale of White Horse District Council, South Oxfordshire District Council, and to a lesser extent Buckinghamshire District Council, and Cotswold District 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.

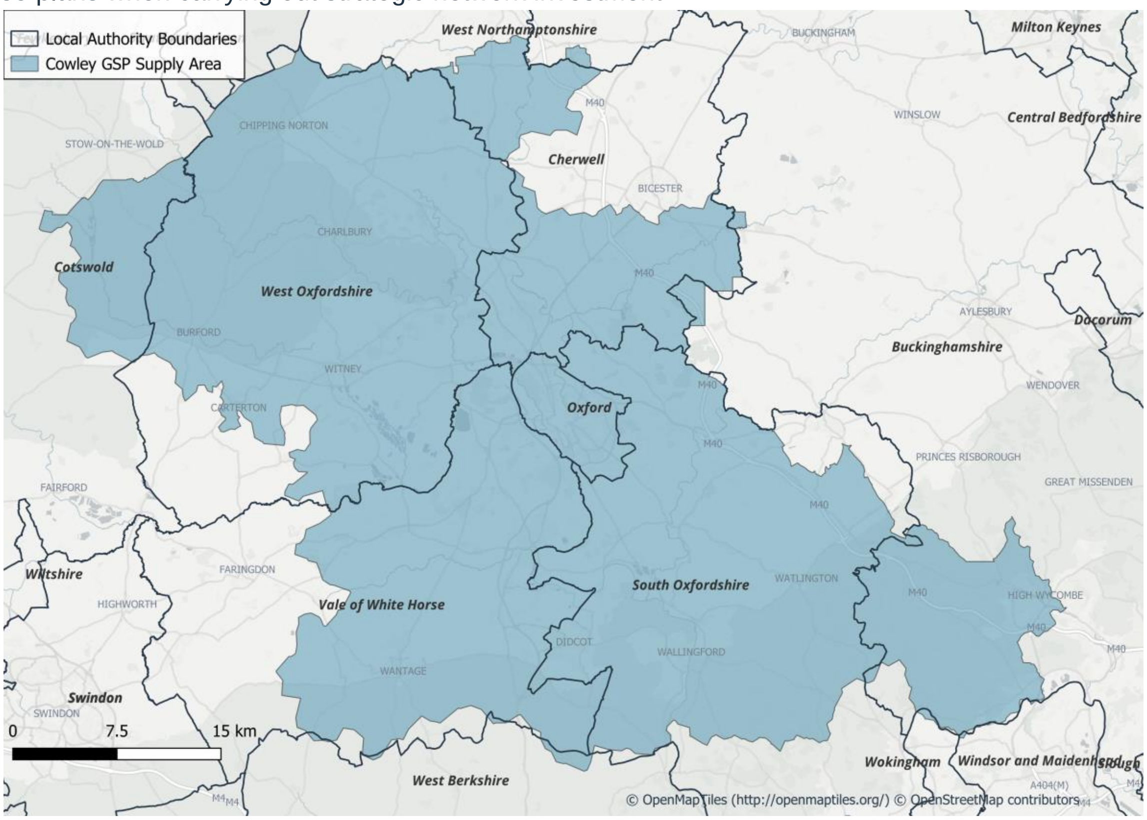

Figure 3 Cowley GSP supply area and relevant local authority boundaries

3.1.1. 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'[1] to ensure progress is up to date and new actions are identified. The council has also

1 Carbon Neutral by 2030 | Oxfordshire County Council

received Zero Emissions Bus Regional Area funding[2], funding 159 electric buses in Oxfordshire and was also awarded LEVI funding of £3.6 million to triple public electric vehicle charging provision by 2025.[3]
In addition to this the council was also one of three that SSEN partnered with through the RESOP Project to trial LAEP+ (now LENZA), an innovative local area energy planning tool created by Advanced Infrastructure and is currently in process of working with district councils to develop an Oxfordshire LAEP. SSEN also sits on the County Council's energy planning working group and executive steering board.

3.1.2. West Oxfordshire District Council

West Oxfordshire District Council has seen population growth of 9% from just under 104,800 in 2011 to around 114,200 in 2021[4]. The council a target of delivering 1,210 homes a year from 2021-2031 and has adopted its' Sustainability Standards Checklist[5] in March 2024 for new developments, this ensures that net zero carbon goals are met through criteria such as ultra-low energy building fabric, fossil fuel free heating, and having set limits for embodied carbon emissions. Furthermore, the district council has made a commitment to becoming carbon-neutral by 2030 guided by its Carbon Action Plan[6], agreed in 2020 (the latest version approved in 2024) which sets out several key targets. The council also has a shorter-term climate change strategy[7] from 2021 to 2025 which includes policy such as continuing to support the development of Eynsham LAEP and delivering EV infrastructure across Council owned sites. As well as this, the council has also invested in low carbon infrastructure such as constructing six electric charging hubs[8] and providing a loan in 2020 to the Southill Solar Community Project[9].

3.1.3. Cherwell District Council

Cherwell District Council has seen significant population growth of 13.5% from around 141,900 in 2011 to around 161,000 in 2021[10]. In its last local plan, it set a target of delivering 1400 homes a year from 2011-2031 and agreed to build an additional 4400 homes by 2030 to help meet the housing needs of Oxford City Council[11]. The council declared a climate emergency in 2019 and aims to ensure its operations and activities are carbon neutral by 2030[12]. 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 CO_2. To

2 https://news.oxfordshire.gov.uk/successful-funding-bid-set-to-bring-159-electric-buses-to-oxfordshire/

3 Oxfordshire awarded £3.6 million to triple public electric vehicle charging provision by 2025 - South Oxfordshire District Council

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

5 Sustainability Standards Checklist - West Oxfordshire District Council

6 Our route to carbon neutral - West Oxfordshire District Council

7 Climate change strategy - West Oxfordshire District Council

8 Electric vehicle charging points - West Oxfordshire District Council

9 Renewable energy - West Oxfordshire District Council

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

11 Adoption | Adopted Cherwell Local Plan 2011-2031 (Part 1) Partial Review - Oxford's Unmet Housing Need | Cherwell District Council

12 Climate Action | Climate Action | Cherwell District Council

ensure continued progress the district council has several plans and initiatives, with plans to improve air quality[13], access to EV charge points in Council car parks[14], and encourage recycling habits in Cherwell[15]. 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[16].

3.1.4. Oxford City Council

Oxford City Council has seen population growth of 6.7% from around 151,900 in 2011 to around 162,000 in 2021[17]. To meet the expected growth in population the council set a target of building 10,884 new homes from 2016-2036, and is being supported by surrounding councils to meet its housing need. The city has a goal of net zero carbon emissions across by 2040[18]. To help achieve this goal, the Council has set up the Zero Carbon Oxfordshire Partnership (ZCOP), a partnership of Oxford City Council, ERM, Oxfordshire Greentech, BMW, ARC Oxford, SSEN Distribution, and Unipart Logistics aiming to increase capacity and capability within local organisations to decarbonise[19].

3.1.5. Vale of White Horse District Council

Vale of White Horse District Council has seen population growth of 14.8% from around 121,000 in 2011 to around 138,900 in 2021[20]. To meet the expected growth in population the council set a target of building 22,760 new homes between 2011-2031[21]. It has a Climate Action Plan for 2022-2024[22], which sets plans to become carbon neutral council by 2030, with a 75% reduction by 2025. Actions include installing EV charge points in council depots and other locations to meet the needs of the council's vehicle fleet, as well as a plan to install public EV charging points.

3.1.6. South Oxfordshire District Council

South Oxfordshire District Council has seen population growth of 11% from around 134,300 in 2011 to around 149,100 in 2021[23]. To meet the expected growth in population, the council has a target of building 30,056 new homes between 2011-2035[24]. The council has a target to become carbon neutral in 2030 and has already secured funding to decarbonise its buildings, such as the Council's art centre[25] where solar PV panels and a heat pump will be installed. To support Oxfordshire County Council's Local Transport and Connectivity Plan[26],

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13 Plan to care for district air | Cherwell District Council

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

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

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

17 Census 2021, January 2023, How life has changed in Oxford: Census 2021.

18 Zero Carbon Oxford | Oxford City Council

19 Home - Zero Carbon Oxford Partnership Net Zero 2040 ZCOP

20 Census 2021, January 2023, How life has changed in Vale of White Horse: Census 2021.

21 Local Plan 2031 - Vale of White Horse District Council

22 Vale-Climate-Action-plan-2022-2024.pdf

23 Census 2021, January 2023, How life has changed in South Oxfordshire: Census 2021.

24 Adopted Local Plan 2035 - South Oxfordshire District Council

25 Council secures funding to install renewable energy at its arts centre - South Oxfordshire District Council

26 Local Transport and Connectivity Plan | Oxfordshire County Council

the Council has produced the ambitious Electric Vehicle Infrastructure Strategy that lays the groundwork to accommodate the projected growth in EVs over the next several years. One of several targets outlined in this strategy is to convert 7.5% of local authority owned car park space to EV charge points by 2025[27]. The Council's Park and Charge project, part of the Oxfordshire Electric Vehicle Infrastructure Strategy, is funding the rollout of charge points across the county to achieve this target[28].

3.1.7. Cotswold

Cotswold District Council has seen population growth of 9.6% from around 82,900 in 2011 to around 90,800 in 2021[29]. To meet the expected growth in population a target of building 836 additional new homes between 2022-2031 has been set[30]. Gloucestershire County Council aims for the county to reach net zero by 2045[31], a number of schemes are being run across the county and district level to support this. Gloucestershire council with 10 key areas highlighted to support this, such as plans to install 1,000 electric vehicle charge points by 2025 and support residential electrification of heat through a home upgrade grant[32] running until March 2025 for off-gas, low-income homes throughout Gloucestershire. In April 2022, Cotswold District Council launched a Climate Investment Programme that raised £500,000 to roll out electric vehicle charge points and install solar PV, along with other initiatives[33].

3.1.8. Buckinghamshire

Buckinghamshire Council has seen population growth of 9.5% from around 505,300 in 2011 to around 553,100 in 2021[34]. The Council was formed in 2020, combining the four local councils of Aylesbury Vale, Chiltern, and South Bucks. It is currently developing its first Local Plan and has produced the Council's Climate Change and Air Quality Strategy, which aims to reduce 75% of council emissions by 2030 and meet the national net zero target by 2050 as a minimum with ambitions to reach this target earlier[35]. In March 2024, the council was successful in securing £1.9 million of government LEVI funding to install hundreds of publicly accessible EV chargers[36], supporting its target of 1000 EV chargers by 2027. The council has also started a new home energy efficiency grant scheme for grants up to £30,000 to be used for energy efficiency improvements in home across the county[37], making these houses more suitable for the installation of heat pumps. Furthermore, in April 2024, the council released their Housing Strategy for 2024 to 2029[38], where energy efficiency is placed front and centre.

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27 Preparing Oxfordshire for the electric vehicle revolution

28 EV charging has doubled in first six months of the council scheme - Vale of White Horse District Council

29 Census 2021, January 2023, How life has changed in Cotswold: Census 2021.

30 Annex A - draft Cotswold Housing Strategy - Technical consultation document.pdf

31 We will | Gloucestershire County Council

32Home Upgrade Grant | Warm and Well

33 Cotswold Climate Investment - Cotswold District Council

34 Census 2021, January 2023, How life has changed in Buckinghamshire: Census 2021.

35 Climate Change and Air Quality Strategy | Buckinghamshire Council

36 Buckinghamshire Council seeks nominations on new EV charging point locations | Buckinghamshire Council

37 New home energy efficiency grant scheme launches in Bucks | Buckinghamshire Council

38 Council unveils ambitious Housing Strategy for 2024 to 2029 | Buckinghamshire Council

3.1.9. Summary

As detailed above, a significant number of initiatives being driven by the relevant local authorities will have an impact on the electricity network across the Cowley SDP study area. It is important for our long-term planning to be driven by local insight. Through inclusion in the DFES, the load growth arising from the above initiatives can be captured and used to understand the future electricity network required to facilitate the ambition of the local authorities listed above.

3.2. Whole System Considerations

SSEN has strong working relationships with stakeholders across Oxfordshire through various innovation projects and trials. Project Local Energy Oxfordshire (LEO) and TRANSITION were collaborative, cross sector, multi-year projects that involved coordination with local councils, the Low Carbon Hub, University of Oxford, Oxford Brookes University, and commercial partners. SSEN has also onboarded Oxford City Council, South Oxfordshire Council, Vale of White Horse District Council, West Oxfordshire, Cotswold, and Buckinghamshire, onto SSEN's GIS tool for local area energy planning, LENZA.
Oxfordshire County Council was also one of three councils with whom SSEN partnered through the RESOP Project to trial LAEP+, an innovative local area energy planning tool created by Advanced Infrastructure, the precursor to the LENZA tool. As a co-founder of the International Community for Local Smart Grids, SSEN collaborates with and feeds into research led by the University of Oxford, which is centred on local pathways to net zero.

3.2.1. Large Industrial Consumers

As well as working with local councils, we also engage with large industrial energy consumers. Stakeholder teams within SSEN are currently engaging with the Zero Cabon Oxfordshire Partnership (ZCOP) to understand industrial decarbonisation across the county. Many industrial parties are members of ZCOP including BMW and Unipart Logistics. Through this work we are collaboratively ensuring there is capacity for growth and any net zero ambitions they may have.

We are also aware that Oxfordshire is a centre for innovation and technological development. We will continue to work with facilities such as the Oxford Science Park and Culham Campus to understand their future energy needs.

3.2.2. Project LEO/LEO-N

Project LEO was a collaborative DSO demonstrator project involving multiple partners which aimed to provide evidence for the technological, market, and social conditions needed to create a net zero energy system[39]. The objectives for the perspective of SSEN were to:

- Prove investable business models.
- Build a community of skilled energy people in Oxfordshire.
- Develop the markets for DSO.
- Develop the mapping tools for Local Area Energy Planning.
- Trial flexibility in the area.

The activities of project LEO in 2022 have formally ceased, however several spin-off projects were created such as, project Local Energy Oxfordshire – Neighbourhoods (LEO-N).

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39 Home - Project LEO

Project LEO-N, submitted for SIF application in November 2022, built on the outcomes from the previous project LEO. The project looks to coordinate a range of local actors including local authorities, community groups and DNOs to scale the net zero transition, develop customer journeys fit for the future and identify options for local governance arrangements to better coordinate the transition[40]. The project was successful in its Alpha stage application, and which concluded in April 2024, however, bidding to take project LEO-N to its next round of funding was not successful in October 2024.

3.2.3. Transmission Interactions

SSEN regularly engage 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 Cowley GSP, with works estimated for completion in 2030/31. Technical planning is completed but negotiations are ongoing regarding the complex asset ownership at the site with the 132kV busbar owned by SSEN, but the site area owned by NGET.

A new GSP is planned at Didcot, with the current estimated completion date 2037. Continued engagement and Whole System planning will enable the optimal use of this development.

3.2.4. Flexibility Considerations

Flexible connections

Flexible connections are those generation connections which have specific limitations within their contractual arrangements. There are currently Active Network Management (ANM) schemes planned to relive constraints in the Drayton bulk supply area of the Cowley GSP network.

Flexibility services

SSEN procures Flexibility Services from owners, operators, or aggregators of Distributed Energy Resources (DERs) or Consumer Energy Resources (CERs), which can be generators, storage, or demand assets. These services are needed in areas of the network which have capacity constraints at particular times or under certain circumstances. SSEN purchases Flexibility Services from all types of providers (e.g. domestic or commercial). Information on the process for procurement and how to participate are published on the Flexibility Services website and information on real time decision making on which providers are dispatched can be found in the Operational Decision-Making document.[41,42]

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.[41] For more detailed information on future flexibility usage see Appendix F for the Cowley DNOA outcome reports.

Areas across Cowley GSP where flexibility has been procured is shown below in Figure 4.

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40 LEO-N | SSEN Innovation

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

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

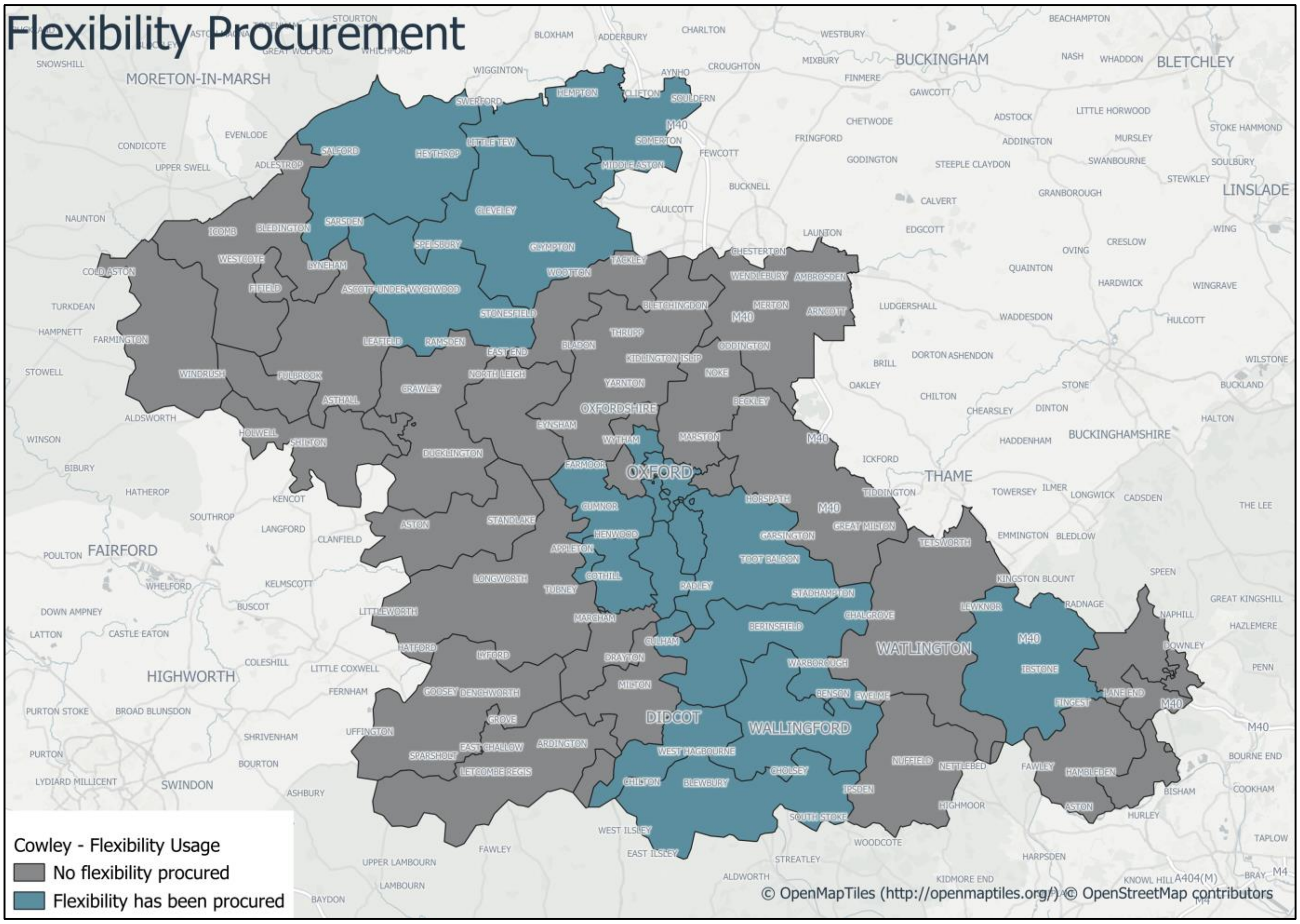


Figure 4 Flexibility procurement areas across Cowley GSP

4. EXISTING NETWORK INFRASTRUCTURE

4.1. Cowley Grid Supply Point Context

The Cowley GSP Network is made up of 132kV, 33kV, 11kV, and LV circuits. It is largely rural network spanning across the county of Oxfordshire and to a lesser extent Buckinghamshire and Gloucestershire. Despite much of the land use being for agricultural purposes, there is also a mix of residential, commercial, and industrial land due to the city of Oxford and towns such as Didcot and High Wycombe. In total, the GSP supplies approximately 270,000 customers with the breakdown for each GSP and BSP shown in Table 1. Information for Primary substations can be found in Appendix A.

Substation Name	Site Type	Number of Customers Served	2023/2024 Substation Peak MVA (Season)
Cowley GSP	Grid Supply Point	270,958	570.4 (Winter)
Cowley Local Reserve	Bulk Supply Point	8,141	24.7 (Winter)
Cowley Local Main	Bulk Supply Point	39,196	59.70 (Winter)
Drayton	Bulk Supply Point	46,355	99.93 (Winter)
Headington	Bulk Supply Point	22,776	59.01 (Winter)
High Wycombe	Bulk Supply Point	44,715	84.95 (Winter)
Oxford (Osney)	Bulk Supply Point	32,008	72.20 (Spring/Autumn)
Witney	Bulk Supply Point	40,406	76.69 (Winter)
Yarnton	Bulk Supply Point	36,785	73.74 (Winter)

Table **1** Customer counts and 2023/24 peak demand readings for substations across Cowley GSP

4.2. Current Network Topology

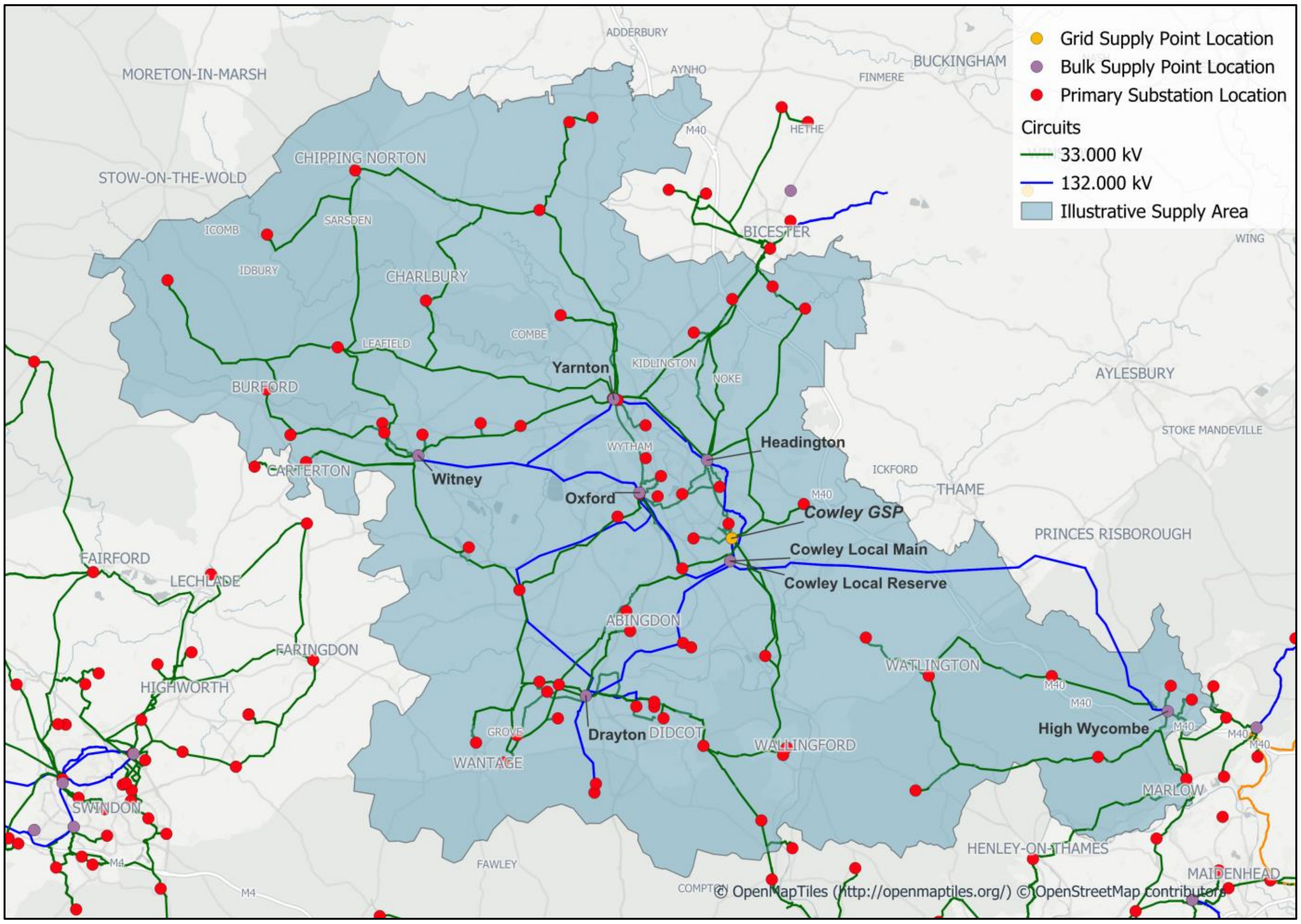


Figure 5 Cowley GSP - GIS view

4.3. Current Network Schematic

132kV Network Schematic shown here, please see Appendix B for 33kV network schematics for the current network.

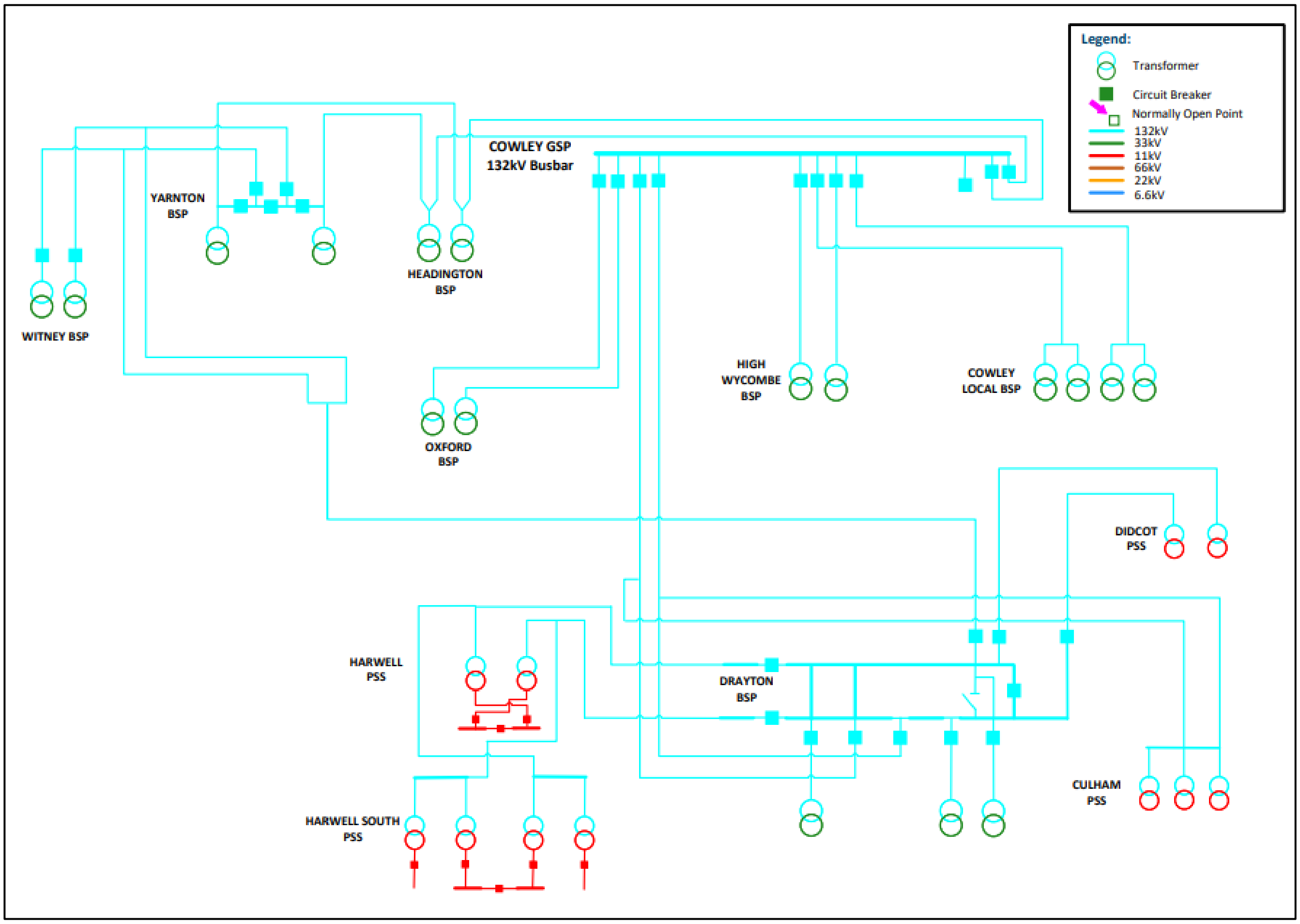


Figure 6 Cowley GSP 132kV network - existing network

5. FUTURE ELECTRICITY LOAD AT COWLEY GSP

The following section details load growth across the technologies projected in the Distribution Future Energy Scenarios (DFES). 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 LAEPs produced in the Cowley GSP area. Work is ongoing for this to be complete ahead of the DFES 2024.

5.1. Distributed Energy Resource

In the Cowley GSP area, there are several distributed energy resources. Due to the rural landscape covered by Cowley GSP there are a number of large-scale solar farms, the current installed capacity of these equates to 224.76MW, with the installed capacity projected to reach 1054.78MW by 2050. Also, existing natural gas generation in the area is expected to convert to hydrogen gas generation in the mid-2030s in the DFES projections, explaining the constant gas generation to 2050 predicted by the DFES CT scenario.

5.1.1. DFES Projections

Generation

Based on the DFES projections, under the Consumer Transformation scenario, distributed generation across Cowley GSP group will increase significantly from 423MW in the currently connected baseline to 1520MW in 2050 (as shown in Figure 7). We see decommissioning of diesel generation ahead of 2035 however, the use of gas as generation stays relatively constant across all 4 scenarios. This is due to the assumption in the DFES that by 2036 an open-cycle gas turbine is will convert to a hydrogen peaking power station, SSEN regularly engages with generation operators and owners where possible to develop an understanding of re-powering and decommissioning plans for fossil fuel powered generators. Solar PV is currently the biggest contributor to the baseline energy mix, and this is only expected to grow out to 2050 with the CT scenario predicting 91% of the installed generation capacity will be solar PV in 2050. Most of this increase in solar will come from large scale solar sites (>=1MW).

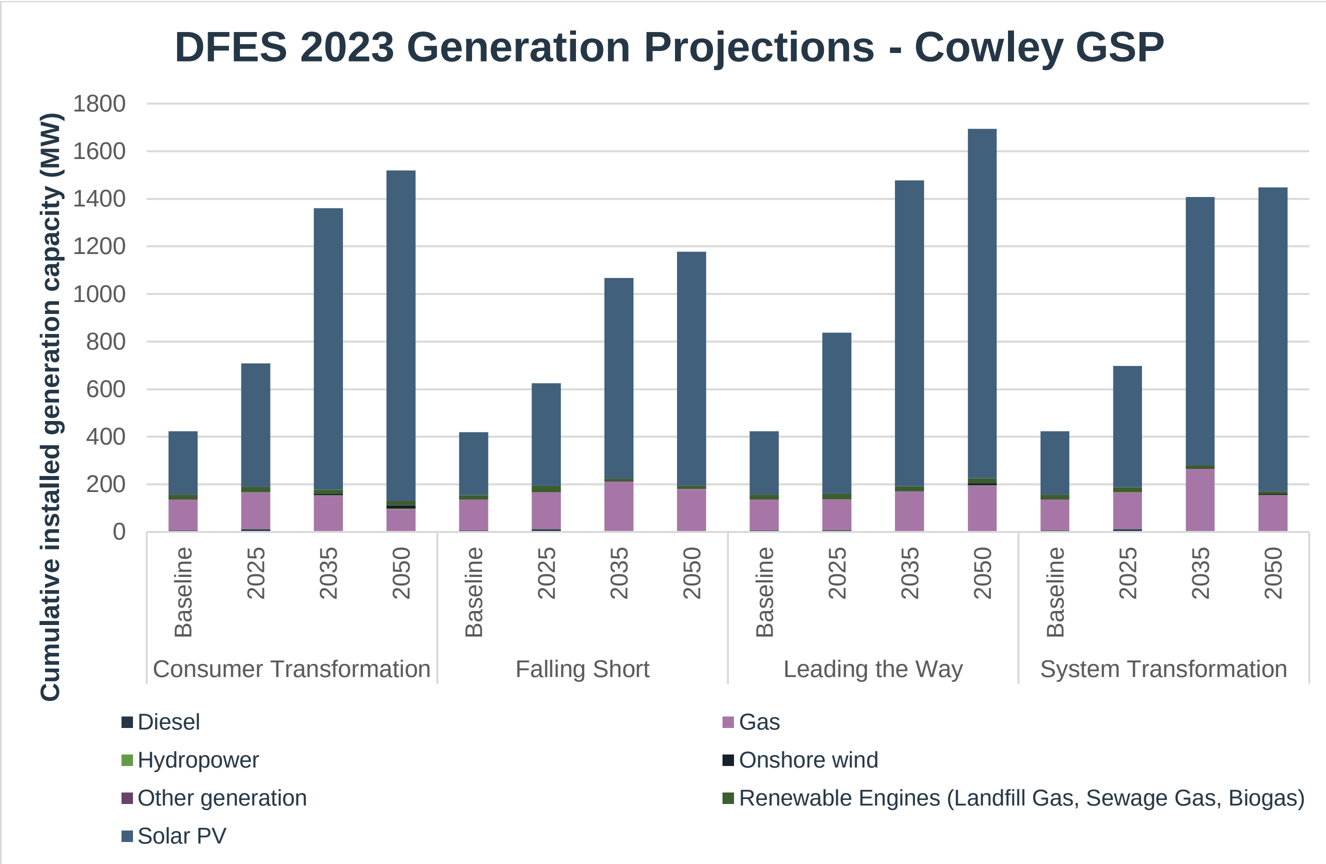


Figure 7 Projected cumulative distributed generation capacity across Cowley GSP (MW). *Source: SSEN DFES 2023*

Storage

In the Cowley GSP area, there is an increase uptake in energy storage out to 2050. The consumer transformation, leading the way, and system transformation scenarios all see a significant increase in battery storage out to 2050, with 319.20MW predicted by the CT scenario by 2050. The biggest battery storage sub-technology is generation co-location, with a predicted increase of 102.76MW by 2050. This is mostly driven by the high number of large solar developments in the area. There is also a significant increase in the amount of domestic battery storage with the Consumer Transformation scenario estimating a total of 81MW by 2050.

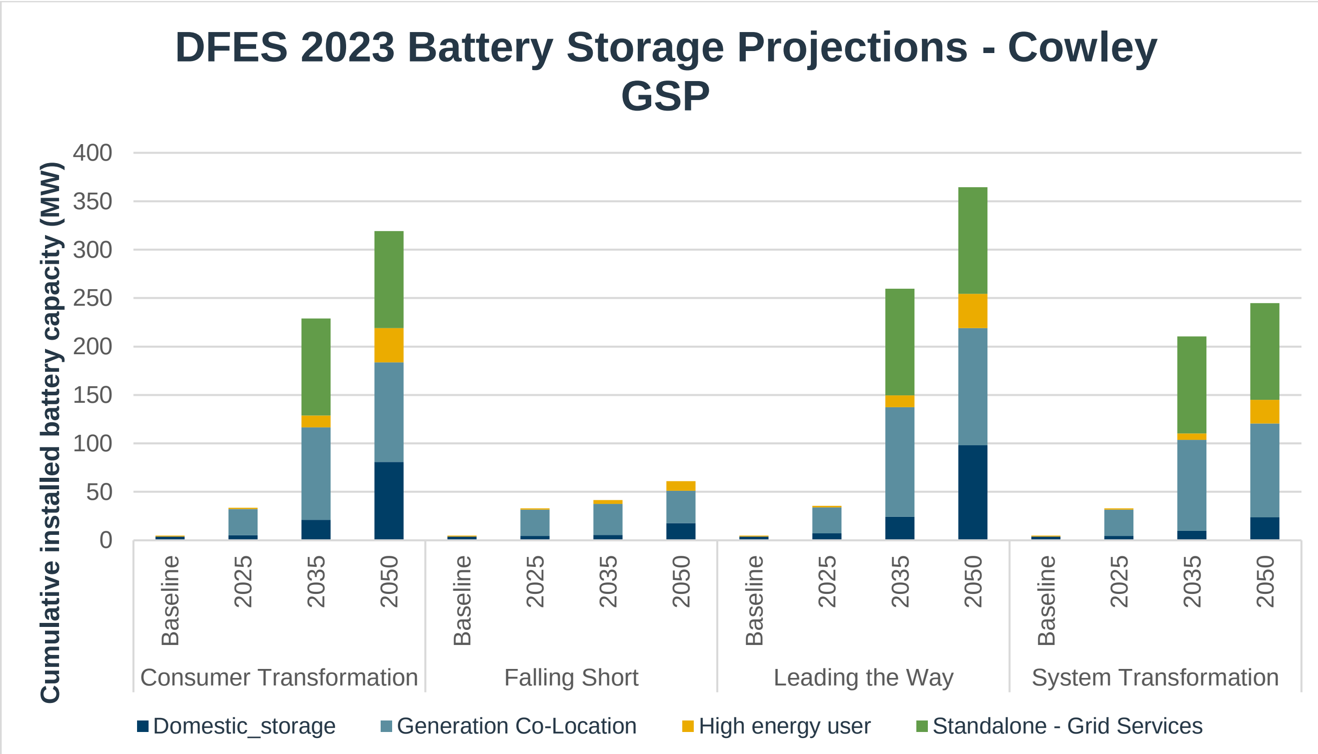


Figure 8 Projected battery storage capacity across Cowley GSP. *Source: SSEN DFES 2023*

5.2. Transport Electrification

The shift to electrified transport is likely to be a large source of electricity load growth across the Cowley GSP area and will be a key consideration for strategic planning. As the M40 motorway and main national rail lines run through the area, it is important to consider how further electrification of these different transport vectors may impact the electricity network. This includes the future requirements of Motorway Service Areas (MSAs). While electrification of road travel is captured in DFES building blocks, engagement should take place to better understand the impact of further rail electrification in the area.

5.2.1. DFES Projections

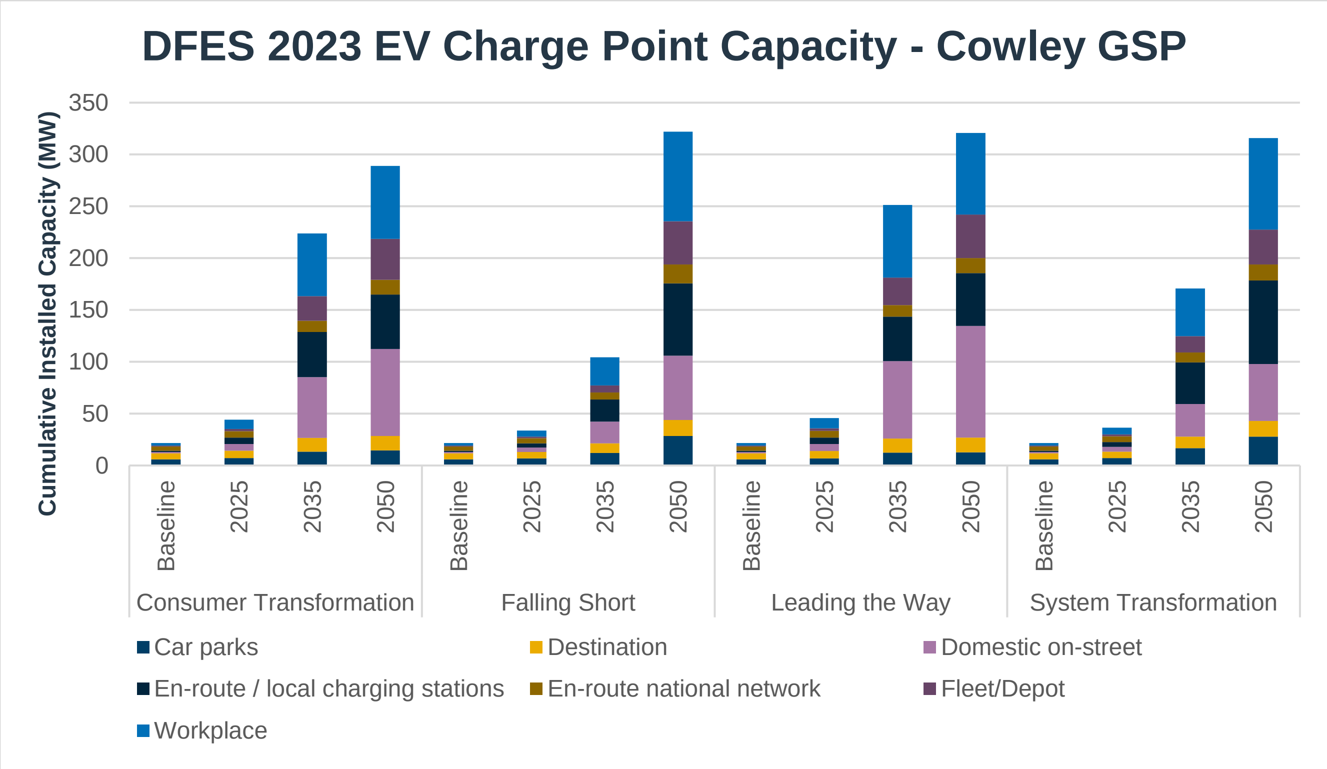


Figure 9 Projected EV charge point capacity across Cowley GSP. *Source: SSEN DFES 2023.*

As the network operator, it is important for SSEN to understand the network facing demand of EVs. To do this we can use the projected EV charger capacity (MW) from SSEN's DFES analysis. The SSEN DFES project that the total connected EV charge point capacity under Cowley GSP, excluding off-street domestic chargers, could total 224MW by 2035 under the CT scenario (as shown in Figure 9). It is important to note that this value represents the ***total*** installed capacity and does not consider diversity. In our studies for future system needs diversity is taken into consideration.

5.3. Electrification of heat

5.3.1. DFES Projections

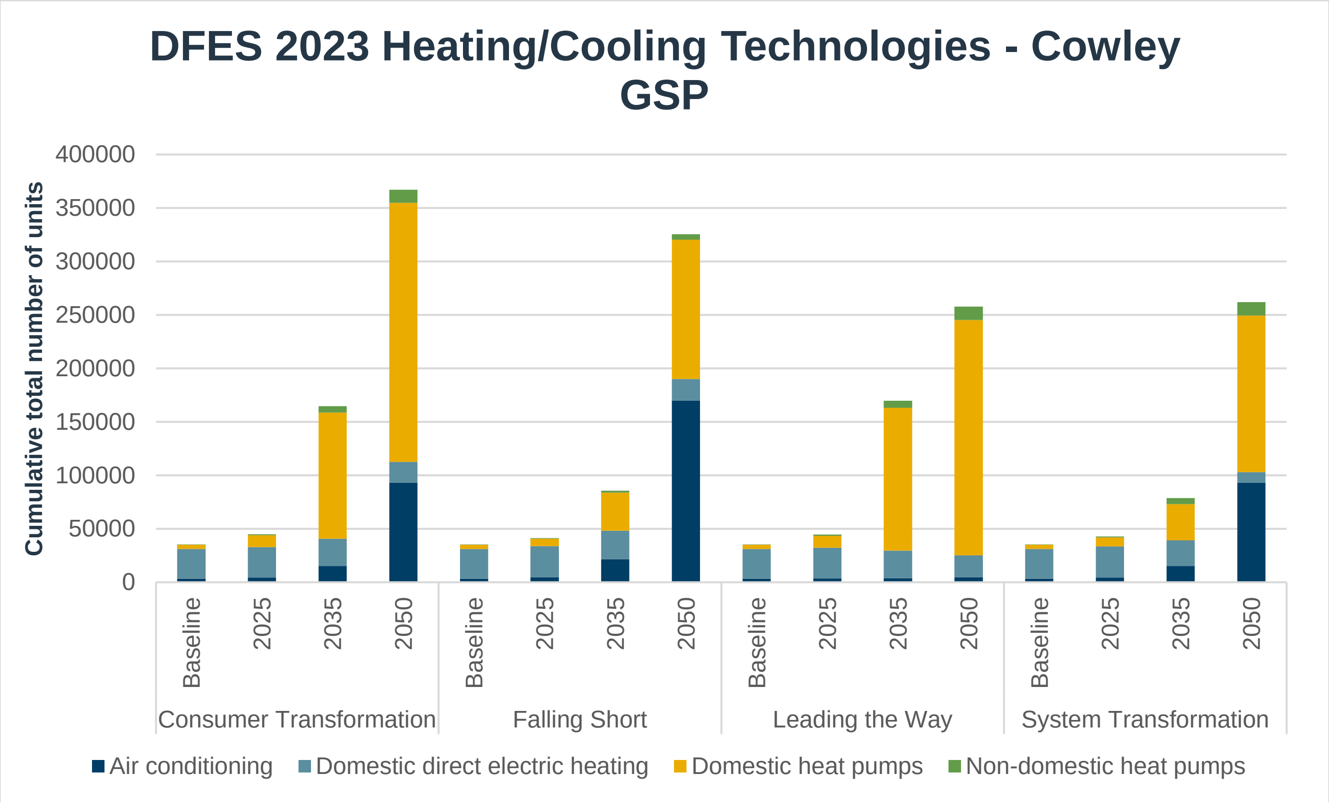


Figure 10 Projected number of heating/cooling technologies across Cowley GSP. *Source: SSEN DFES 2023.*

Under the Consumer Transformation scenario, we see an increase from a baseline of around 4000 domestic heat pumps to almost 250,000 connected to the network under Cowley GSP by 2050 (as shown in Figure 10). The baseline currently shows a high proportion domestic direct electric heating which is set to reduce out to 2050. Air conditioning also dramatically increases in the Falling Short scenario due to behavioural change.

5.4. New building developments

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

5.4.1. DFES Projections

In the Cowley GSP supply area, the total number of new domestic developments (number of homes) is projected to be 64,620 by 2050 (under the Consumer Transformation scenario). The DFES also includes projections for different types of non-domestic floorspace with the breakdown for this presented in Figure 11. Please note that as this information is directly fed from local authorities the projections are closely aligned across the four scenarios.

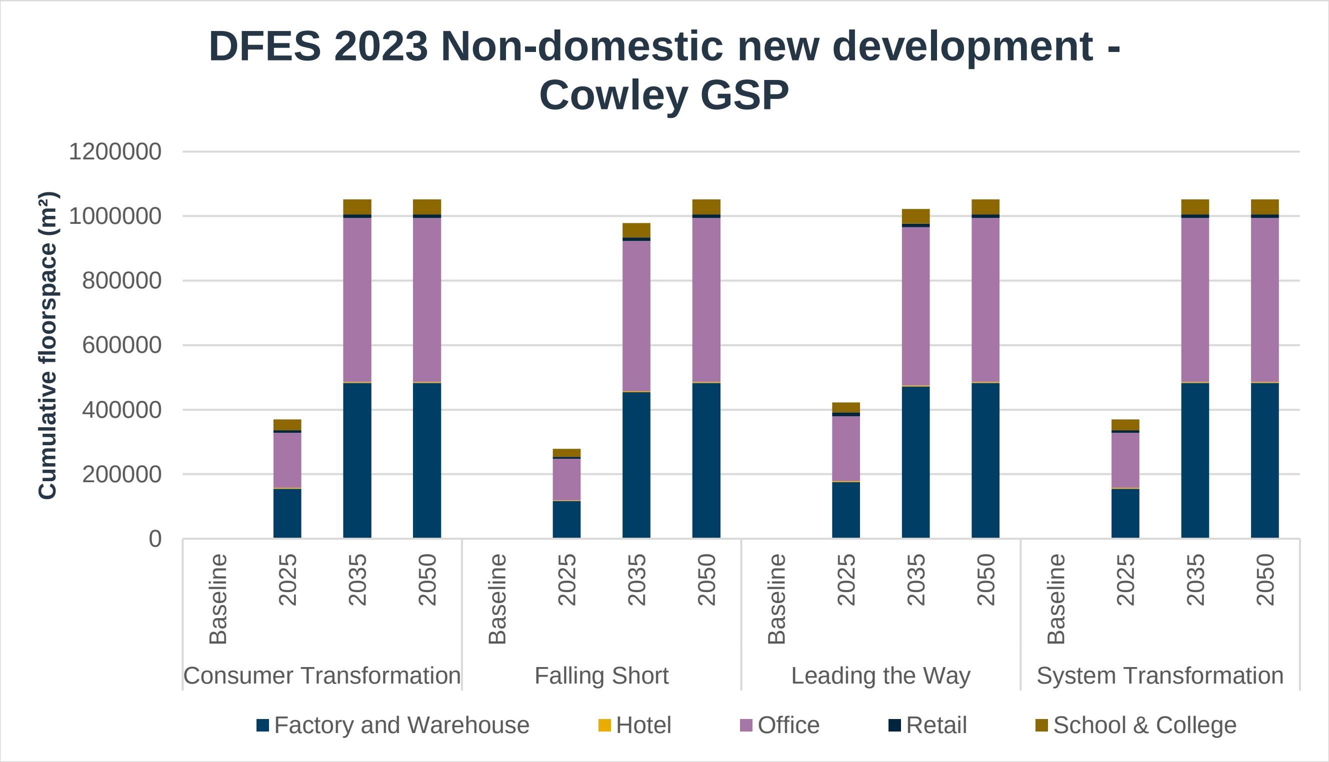


Figure 11 Projected non-domestic new development across Cowley GSP. *Source: SSEN DFES 2023.*

5.5. Commercial and industrial electrification

5.5.1. Data Centres

Cowley GSP does not expect to see the same levels of data centre connection as other part of the network such as West London. However, there have been recent data centre applications and connections in the area. As large demand users, the impact on network capacity is significant even though only a relatively small number have applied.

5.5.2. Industrial energy users

SSEN regularly engage with large industrial demand users in the area. Close collaboration on required capacity and how best to facilitate this is carried out. This is key to enable investment and development of the local economy.

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 Cowley 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 Figures 12-19. Where the driver of a project is listed as 'DNOA process' the relevant DNOA reports can be found in appendix E. Summary of existing works shown below:

ID	Substation	Description	Driver	Forecast completion	Fully resolves future strategic needs to 2050?
-	Cowley Grid GSP	Cowley GSP substation upgrade to Gas Insulated Switchgear (GIS).	DNOA process	2031	-
1	Cowley Local BSP	Installation of an additional 132/33kV transformer, 2.5km of circuits and a new 132kV switchboard.	DNOA process	2029	
2	Oxford (Osney) BSP	Installation of an additional 132/33kV transformer and 132kV circuit reinforcement.	DNOA process	2032	
3	Witney BSP	Installation of an additional 132/33kV transformer, new 132kV Air Insulated Switchgear (AIS). Reinforcement of the Yarnton – Witney 132kV circuits. New 33kV circuit breakers at Witney BSP and at two downstream primary substations.	DNOA process	2029	
4	Yarnton BSP	Construction of 14.7km of new 132kV circuit from Cowley GSP to Yarnton BSP. New 33kV GIS busbar rebuild at Yarnton BSP.	DNOA process	2031	
-	New Didcot BSP	Installation of two new 132/33kV transformers and 20.37km of 132kV circuits.	Customer connection	2037	
5	Headington BSP	Installation of 11.98km of 132kV dual circuit between Cowley GSP and Headington BSP. Circuits from Cowley GSP to Headington will no longer be shared with Yarnton and Witney BSPs.	Customer connection	2030	

6	Yarnton BSP	Installation of an additional 132/33kV transformer and 1.12km of 132kV circuit onsite to allow for GIS re-configuration.	Customer connection	2027	
7	Yarnton BSP	Replacement of the two existing 132/33kV transformers.	Customer connection	2027	
8	Harwell South RAL PSS	Replacement of the two existing 132/11kV transformers.	Customer connection	2030	
9	Culham PSS	Installation of a third 132/11kV transformer and replacement of the two existing 132/11kV transformers.	Customer connection	2030	
10	Berinsfield PSS	Replacement of the two existing 33/11kV transformer replacement.	DNOA process	2033	
11	Berinsfield PSS	11.2km of dual 33kV underground cables to replace existing overhead line circuit.	DNOA process	2034	
12	Cowley Local PSS	Reinforcement of the three existing 33/11kV transformers at Cowley Local PSS with higher rated units. Reinforcement of the three 33kV supply circuits.	Customer connection	2027	
13	New Oxford Science Park PSS	Addition of two 33/11kV transformers and 3.6km of 33kV dual circuit.	Customer connection	2027	
14	Rose Hill PSS	Reinforcement of the two existing 33/11kV transformers.	DNOA process	2029	
15	Rose Hill PSS	Reinforcement of 6.3km of 33kV circuit between Cowley Local BSP and Rose Hill PSS.	DNOA process	2031	
16	Wallingford PSS	Reinforcement of the two existing 33/11kV transformers.	DNOA process	2032	
17	Grove PSS	Reinforcement of the two existing 33/11kV transformers.	DNOA process	2026	
18	Drayton BSP to Culham PSS circuits.	Reinforcement of 11 x 33kV circuit breakers at Drayton BSP and reinforcement of 2 x 7.71km 132kV circuits between Drayton and Culham tee.	Customer connection	2027	

19	Fulscot PSS & Cholsey PSS	20.4km of 33kV circuit reinforcement under Drayton BSP.	DNOA process	2034	
20	Arncott PSS	Reinforcement of the two existing 33/11kV transformers.	Customer connection	2026	
21	Wheatley PSS	Reinforcement of the two existing 33/11kV transformers.	DNOA process	2027	
22	Stokenchurch PSS	Reinforcement of the two existing 33/11kV transformers.	Customer connection	2025	
23	Stokenchurch PSS	Reinforcement of 11.4km of 33kV circuit between High Wycombe BSP and Stokenchurch PSS.	DNOA process	2031	
24	Chisbridge PSS	Reinforcement of 1.71km 33kV circuit between High Wycombe BSP and Chisbridge PSS.	DNOA process	2031	
25	Watlington PSS	Installation of two additional 33/11kV transformers.	DNOA process	2031	
26	Eynsham PSS	Reinforcement of the 33kV circuits from Witney BSP to Eynsham PSS.	DNOA process	2029	
27	Standlake PSS	Installation of two additional 33/11kV transformers	Customer connection	2026	
28	Lovelace Road PSS	Installation of an additional 33/11kV transformer at Lovelace Road with new indoor 33kV busbar.	Customer connection	2028	
29	Yarnton PSS	3rd Yarnton PSS 33/11kV transformer installed.	Customer connection	2028	

Table 2 Triggered work across Cowley GSP

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. As shown in section 3.2.3, alongside the asset solutions detailed in the table above, there is active flexibility service procurement ongoing across areas of the Cowley GSP area.

6.1. Network Schematic (following completion of above works)

132kV Network Schematic shown here, please see Appendix C for 33kV network schematics for the current network.

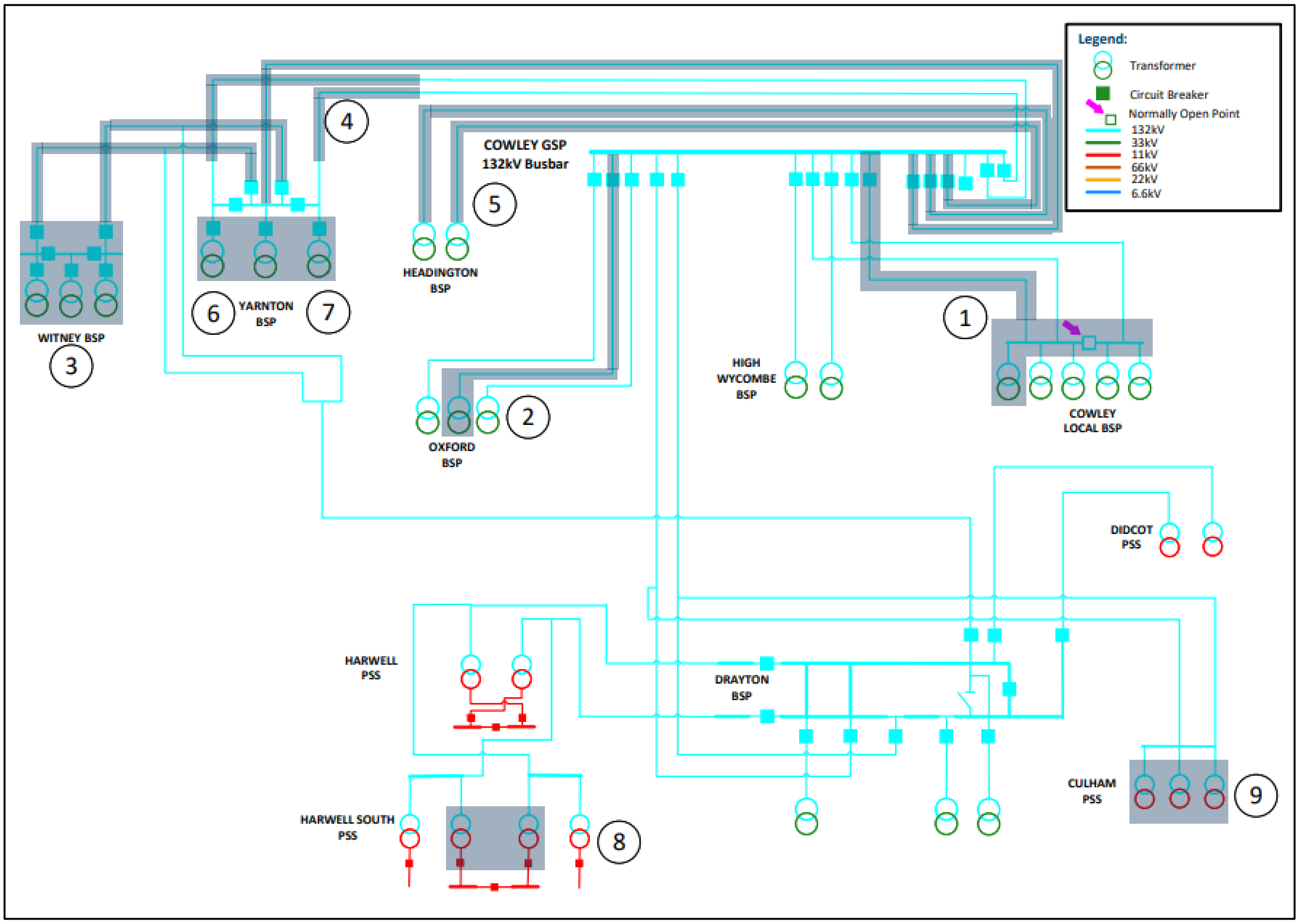


Figure 12 Cowley GSP 132kV Network - Following completion of triggered works.

7. SPATIAL PLANS OF FUTURE NEEDS

The previous section summarised Cowley GSP's forecast future demand and generation requirements. We have used this information to understand what this means for the local networks in the Oxfordshire 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 (132/11kV, and 33/11kV) and secondary substation level (11kV/LV and/or 6.6kV/LV). Snapshots are provided for 2028, 2033, 2040, and 2050 enabling clear visualisation of future system needs beyond the network capacity following completion of triggered works. They are currently based on 2023 DFES Consumer Transformation forecasts with the additional plans for other DFES scenarios shown in Appendix C and Appendix D.

7.1. Extra High Voltage / High Voltage spatial plans

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

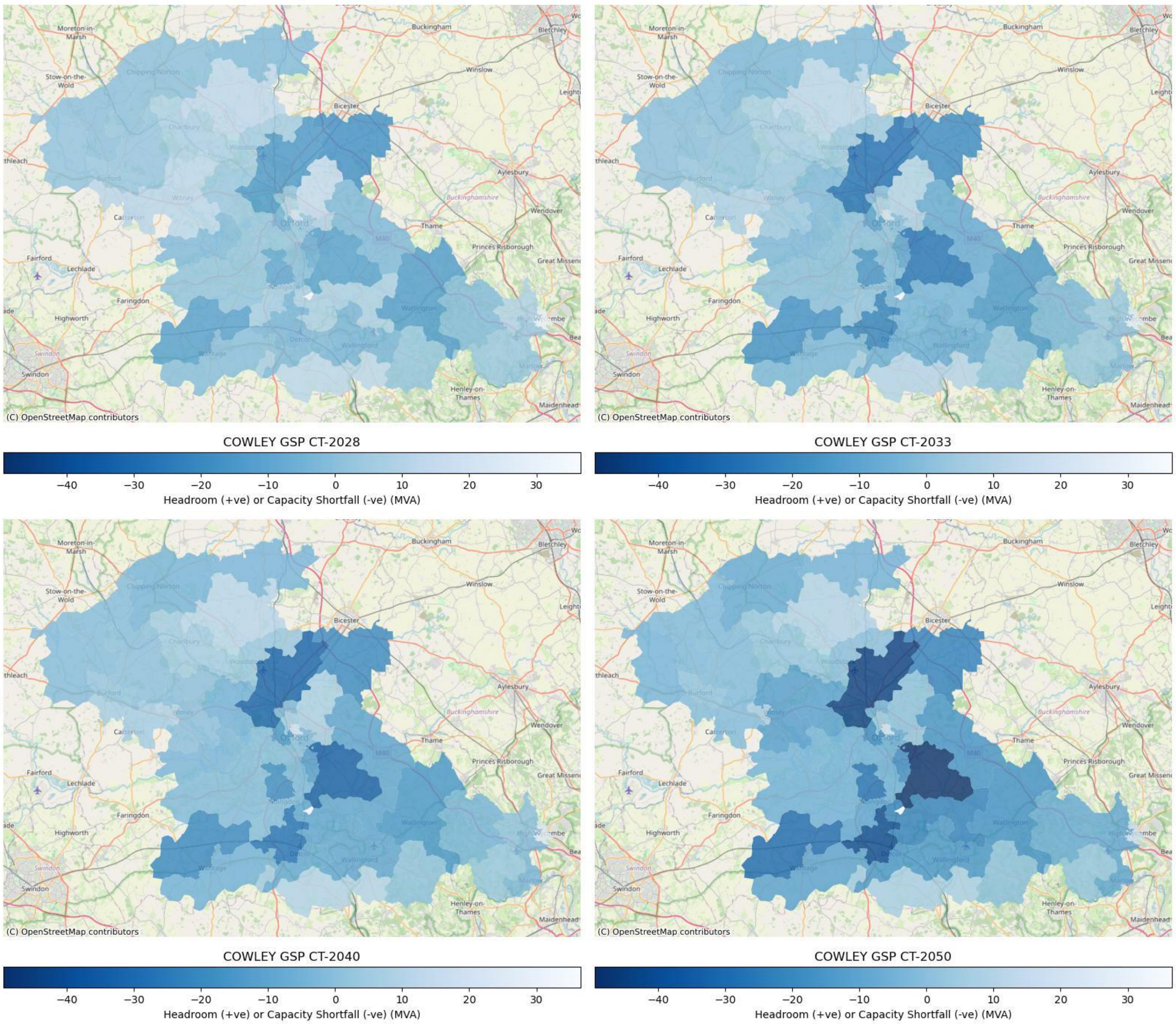


Figure 13 Cowley GSP - EHV/HV Spatial Plan - Consumer Transformation

7.2. High Voltage/Low Voltage spatial plans

To understand, where load is growing at a lower granularity, we have used information from the SSEN load model that is produced by SSEN's Data and Analytics team.

In Figure 21 we see a number 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. We see the requirement for additional capacity at the secondary substation level increase as we approach 2050.

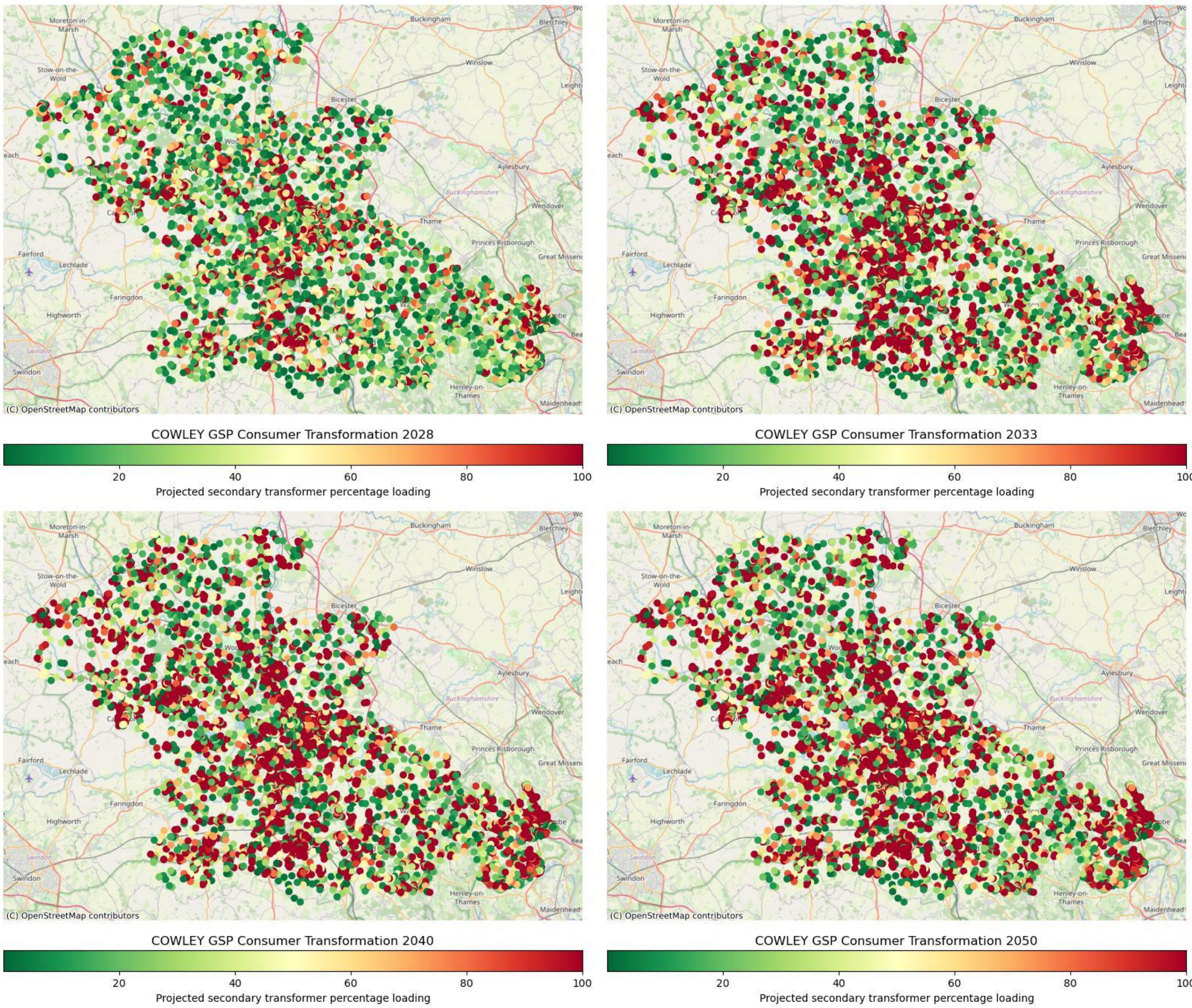


Figure 14 Cowley GSP - HV/LV Spatial Plans - Consumer Transformation

8. SPECIFIC SYSTEM NEEDS AND OPTIONS TO RESOLVE

In this section we summarise the more specific needs arising from our future spatial plans. We also propose some initial options to resolve. If required during the next seven years, these will be further developed through the DNOA process, where they will be considered alongside the potential for flexibility.
The section is split into three parts:

- Future EHV system needs to 2040 – these needs are more certain and therefore we have more clearly defined options to meet the requirements. For needs within the next seven years, we recommend that these are progressed through the DNOA process. In all cases we are proposing solutions that meet the projected requirements for 2050. We also provide a summary of more strategic elements that also need to be considered in these timeframes.

- Future EHV system needs to 2050 – there is a greater degree of uncertainty of outcomes in this time frame. This also provides more opportunity to work with stakeholders to develop strategic plans and our outline solutions reflect this initial phase of the work as we look to engage with interested parties.

- Future HV/LV system needs to 2050 – the future needs of the HV and LV networks are locationally specific but can be considered as an aggregated volume. In this section we provide information on our future forecasts for local HV and LV network needs.

8.1. Overall dependencies, 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: Works proposed here are dependent on the Cowley GSP fault level reinforcement works. Work is expected to be completed in 2031.
Risks: Works delay potential interventions downstream and/or do not provide flexibility of future investment.
Mitigation: Continue productive engagement with National Grid Electricity Transmission to enable the detailed design and planning of Cowley GSP upgrades.

Dependency: Cowley GSP remains in the same group demand class (ENA Engineering Recommendation P2/8 Security of Supply).
Risks: If Cowley group demand exceeds 1500MW ahead of 2050 and load transfer to existing or new GSPs is not possible the GSP may need to be split, or an additional site constructed. Information gathered through ZCOP on the decarbonisation of industrial processes is also expected to make this more likely.
Mitigation: Continue to model projected load growth at the GSP, to develop understanding of capacity of any new GSPs constructed in the area. Furthermore, the option of transferring demand at Drayton BSP to the new Didcot GSP should be investigated, with more detailed discussions with NGET and NESO taking place. This will provide a whole electricity system approach as it will enable both transmission and distribution capacity.

Dependency: The triggered works must be delivered before capacity is released for new customers.

Risks: In some cases, 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. Further to this, flexibility services may be used to enable customer connections in the future.

Dependency: Procurement of flexibility services is required to optimise load related needs.
Risks: Insufficient flexibility in the relevant area to resolve system reinforcement.
Mitigation: Flexibility viability assessments are carried out as part of the DNOA process. Last build date identified to allow time for traditional reinforcement if procurement for flexibility services is not successful in procuring the required capacity.

Dependency: Procurement of new land across Oxfordshire is likely to be necessary.
Risks: High cost of land and the challenge of finding suitable sites, especially in urban areas such as Oxford.
Mitigation: Identify need ahead of time to allow long timescales for procurement of land.

8.2. Future EHV System Needs to 2040.

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

Location of proposed intervention	CT Year	ST Year	LW Year	FS Year	CT Worst case asset loading (%)	Network state	Comments
High Wycombe BSP transformers.	Ahead of 2030	Ahead of 2030	Ahead of 2030	Ahead of 2030	157.0	N-1, outage of one of the two lines from Cowley to High Wycombe.	High Wycombe BSP sees overloading of first the transformers under N-1 conditions. A short-term solution would be to install a new transformer at High Wycombe; however, the circuits will soon be overloaded. Potential options to resolve both issues are shown in the below entry.
High Wycombe BSP 132kV circuits.	Ahead of 2030	Ahead of 2030	Ahead of 2030	Ahead of 2030	102.4	N-1, outage of one of the two lines from Cowley to High Wycombe.	The lines from Cowley GSP to High Wycombe BSP are overloaded as well as the transformers, high-level options to resolve both these constraints are: • Installation of a third 132kV transformer at High Wycombe, along with the third circuit from Cowley GSP. This third circuit would be an expensive option due to the distance of Cowley GSP from High Wycombe (approximately 35km), and the fact that a third circuit would likely have to be an underground cable. • Feed High Wycombe from Loudwater BSP (fed from Amersham GSP) or directly from Amersham GSP. While keeping the circuits from Cowley as an N-2 back feed. This option relies on the

							upgrade of Loudwater BSP to release capacity there. • Feed High Wycombe directly from Amersham GSP. Reliant on enough capacity being available at Amersham GSP, however this may be complicated due to Amersham being a GSP that is shared between three DNOs. • Shift load on the 33kV network to Maidenhead after completion of the works at Fleet-Bramley GSP in 2032.
Drayton BSP transformers.	Ahead of 2030	Ahead of 2030	Ahead of 2030	Ahead of 2030	100.8	N-2, outage of two of the transformers at Drayton BSP.	Increasing demand and generation requirements at Drayton require additional capacity release in order to maintain P2/8 obligations at Drayton. Initial optioneering has taken place and a detailed plan is expected to be suggested in 2025. Potential options are: • Additional fourth transformer at Drayton BSP. • Replacing the three 90MVA transformers with 120MVA transformers at Drayton. • Utilisation of flexibility followed by the addition of the fourth Drayton transformer.
Headington BSP transformers.	Ahead of 2030	Ahead of 2030	Ahead of 2030	Ahead of 2030	109.4	N-1, outage of one of transformers at Headington BSP.	Works have been triggered to solve the 132kV circuit constraints from Cowley GSP to Headington BSP. However, DFES projections show that the transformers at Headington could be overloaded in N-1 conditions by 2030. Potential options to resolve this could be: • Construction of a 132kV GIS busbar at Headington BSP, and an additional 90MVA transformer. • Reinforcement of the two existing 90MVA transformers at Headington BSP to 120MVA transformers – option would not be sufficient in providing N-2 security of supply which is projected to be required at a later date. • Load transfer to neighbouring BSP(s) on the 33kV network. More detailed studies to understand feasibility – unlikely to be a long-term solution.
Wootton Road PSS transformers.	Ahead of 2030	Ahead of 2030	Ahead of 2030	Ahead of 2030	127.5	N-1, outage of one of transformers at Wootton Road PSS.	Wootton Road PSS is predicted have a transformer constraint issues under N-1 conditions. The substation is fed from Oxford BSP, and its closest substation is Winsmore Lane PSS. Potential options to resolve this constraint are: • Upgrade the transformers at Wootton Road and the 33kV supply circuits, however this would be costly due to the

								distance from Wootton Road to Oxford BSP. • Load transfer to Winsmore Lane maybe possible but as this primary substation is also projected to be constrained ahead of 2030 it will not be a long-term solution. A new primary in the area may be the most effective option to provide sufficient future capacity.
Deddington PSS transformers.	Ahead of 2030	Ahead of 2030	Ahead of 2030	Ahead of 2030	112.8	N-1, outage of one of transformers at Deddington PSS.	Deddington PSS is predicted to have constraint issues under N-1 conditions. Potential options to resolve this constraint: • Reinforcement of the transformers at Deddington PSS. • Load transfers on the 11kV network to Kiddington PSS.
Winsmore Lane PSS transformers.	Ahead of 2030	Ahead of 2030	Ahead of 2030	Ahead of 2030	97.9	N-1, outage of one of transformers at Winsmore Lane PSS.	Winsmore Lane PSS is predicted have constraint issues under N-1 conditions. Potential options to resolve this constraint are: • Reinforcement of the transformers at Winsmore Lane and the circuits feeding it. • Construction of a new primary in the area that could support load growth currently projected at Wootton Road PSS and Winsmore Lane PSS.
North Hinksey PSS transformers.	Ahead of 2030	Ahead of 2030	Ahead of 2030	Ahead of 2030	96.9	N-1, outage of one of transformers at North Hinksey PSS.	North Hinksey PSS is predicted have constraint issues in N-1 conditions. A potential option to resolve is: • Reinforcement of transformers at North Hinksey.
33kV circuits Oxford BSP to Wooton Road PSS and Kennington PSS.	Ahead of 2030	2030 - 2035	Ahead of 2030	2030 - 2035	99.1-99.5	N-1, outage on either the 33kV circuit from Oxford BSP to Wootton Road PSS or the 33kV circuit from Oxford BSP to Kennington PSS.	The 33kV circuits in this area will require intervention. Potential options to resolve are: • Reinforcement of existing circuits with higher rated conductors. • Use existing circuits from Oxford BSP to Kennington PSS as dedicated 33kV supply circuits. Build new 33kV circuits from Oxford BSP to Wootton Road PSS. Both PSS to have dedicated supplies – dependent on availability of new 33kV CBs at Oxford BSP.
Grove PSS and Wantage PSS 33kV circuits.	2030 - 2035	2035 - 2040	2030 - 2035	2035 - 2040	Up to 96.6	N-1, outage on either the Drayton BSP to Wantage PSS 33kV circuit or Drayton BSP to Grove PSS 33kV circuit.	These 33kV circuits are projected to require intervention. Potential options to resolve are: • Reinforcement of the existing 33kV circuits – may require undergrounding of circuits or upgrade of poles for required OHL conductor. • New 33kV circuit from Drayton BSP to Grove PSS and sever the connection from the Wantage PSS – Grove PSS – Drayton BSP circuit. This will mean

							Grove and Wantage no longer share a 33kV supply circuit.
Witney BSP 33kV circuit ring (Windrush Park PSS – Burford PSS – Rissington PSS – Leafield PSS).	Ahead of 2030	2030 - 2035	Ahead of 2030	2030 - 2035	>95	N-1, outage of either Witney BSP to Windrush Park PSS 33kV circuits.	Intervention is projected to be required on this 33kV ring network. Potential solutions could be: • Reinforce existing 33kV circuit sections projected to be overloaded. • Build a new 33kV circuit from Witney BSP to Windrush Park PSS, sever the existing Windrush Park PSS to Burford PSS circuit and connect to the newly constructed circuit. Windrush Park PSS will now be removed from the ring. Resolves the near-term need, further work required to reach 2050 capacity for example construction of a new circuit to Leafield PSS and connect to the Leafield PSS - Rissington PSS circuit (sever existing connection). Reinforcement of the existing Leafield PSS – Rissington PSS circuit section will then provide sufficient circuit capacity to 2050. Option is subject to the availability of 33kV CBs at Witney BSP.
Leafield PSS transformers.	Ahead of 2030	2030 - 2035	Ahead of 2030	2030 - 2035	95.0	N-1, outage of one of transformers at Leafield PSS.	Potential options to resolve this constraint: • Reinforcement of the transformers at Leafield PSS. • Load transfer on the 11kV network - likely to be challenging due to the rural area.
Milton 33kV supply circuits (and later Milton transformers).	Ahead of 2030	Ahead of 2030	Ahead of 2030	Ahead of 2030	>95.0	N-1, outage on any of the existing 33kV circuits from Drayton to Milton.	Demand growth has been driven by data centre connections in the area. Further LCT growth is also anticipated. Potential solutions to provide capacity could be: • Reinforcement of existing assets. • Construction of a new primary substation to accommodate the growing demand in the area. Timeline of this need means that this is required ahead of the current estimated completion date for the new Didcot GSP (2037). Connection to Drayton BSP in the near-term is dependent on availability of CBs. Potential for flexibility services to manage any potential overload until new infrastructure is constructed.
Yarnton BSP 33kV ring (Woodstock PSS – Kiddington PSS – Charlbury PSS	Ahead of 2030	Ahead of 2030	Ahead of 2030	Ahead of 2030	>97.2	N-1, outage of Yarnton BSP to Woodstock PSS 33kV circuit or Winey BSP to Leafield PSS.	The circuit is predicted to have a constraint in outage conditions. Potential options to resolve this constraint are: • Reinforcement of the existing 33kV circuits – likely to be expensive and require undergrounding as overhead

– Chipping Norton PSS – Bleddington PSS – Leafield PSS).							line conductors for the projected capacity would require new poles. • New 33kV circuit to split the ring, there are multiple options for how this is split. These should all be considered in detailed optioneering. Costs are likely to be high due to the long distances across rural areas between primary substations.
Cowley GSP to Culham PSS 132kV circuits.	2030 - 2035	2030 - 2035	Ahead of 2030	2030 - 2035	95.9	N-1, outage of one 132kV circuit supplying Drayton BSP from Cowley GSP.	The 132kV circuits supplying Culham from Cowley are predicted be overloaded during N-1 conditions in 2032. Potential options to resolve this are: • Reinforcement of the existing circuits supplying Culham from Cowley. • Additional circuit from Cowley GSP to Culham PSS. • Separate Culham PSS from Drayton BSP so Culham is directly fed from Cowley GSP. • For the last two of the above proposals, circuit breakers at the GSP may prevent these options being viable.
Fryers Lane PSS transformers (and later circuits).	2030 - 2035 (Circuits 2040 - 2045)	2035 - 2040 (Circuits 2045 - 2050)	2030 - 2035 (Circuits 2035 - 2040)	2035 - 2040 (Circuits 2045 - 2050)	96.5	N-1, outage of the transformers at Fryers Lane PSS or one of the circuits supplying it.	Potential options to resolve this constraint are: • Reinforcement of existing transformers at Fryers Lane PSS. • Load transfer on the 11kV network, potentially to High Wycombe Town PSS however more detailed analysis will be needed.
Fyfield PSS transformers.	2030 - 2035	2035 - 2040	2030 - 2035	2040 - 2045	97.1	N-1, outage of in-service transformer.	Fyfield PSS is predicted have constraint issues under N-1 conditions. Potential options to resolve this constraint are: • Reinforcement of existing transformers at Fyfield PSS. • Load transfers on the 11kV network unlikely due to rural location and long 11kV circuits to neighbouring primary substations.
Standlake PSS 33kV supply circuit.	2030 - 2035	2035 - 2040	2030 - 2035	2040 - 2045	96.4	Intact network – site is normally fed by single 33kV circuit.	Potential options to resolve this constraint are: • Reinforcement of existing 33kV circuit from Witney BSP to Standlake PSS would provide capacity on the intact network for the medium-term but does not greatly increase network resilience or security of supply. • A longer-term option would be to reinforce the existing Witney BSP – Standlake 33kV circuit and build an additional 33kV circuit from Witney BSP (subject to availability of a new 33kV CB). An additional 33kV circuit from

							Standlake PSS to Fyfield PSS could then be constructed (may require extension of 33kV busbar at Standlake PSS). In detailed development a CBA would be carried out to determine whether the benefit to customers justifies the higher cost if this option were to be progressed.
Drayton BSP to Winsmore Lane PSS 33kV circuits.	2030 - 2035	2040 - 2045	2040 - 2045	2030 - 2035	95.0	N-1, outage of either of the 33kV circuits between Drayton BSP and Winsmore Lane PSS.	Potential options to resolve this constraint are: • Reinforcement of existing 33kV circuit. • Build of new circuit less likely to be best option as it would require an additional 33kV CB at Drayton BSP.
Union Street PSS transformers.	2035 - 2040	2035 - 2040	2030 - 2035	2040 - 2045	95.4	N-1, outage on either of the normally in-service transformers or supply circuits.	Potential solution: • Reinforcement of existing transformers. • Load transfer on the 11kV network maybe possible due to close proximity to neighbouring primary substations, more detailed work required to understand 11kV capacity for load transfer.
Yarnton BSP to Eynsham PSS 33kV circuits (backfeed that is in-service under N-1 conditions).	2030 - 2035	2040 - 2045	2030 - 2035	2040 - 2045	97.4	N-1, outage of the network intact circuit from Witney.	Potential solution: • Reinforcement of existing 33kV backfeed circuit. • Laying of additional circuit from Witney or Yarnton BSP. • Load transfer on the 11kV network, however further study would be needed due to the low density of primaries in the area.
Witney Town PSS transformers and 33kV supply circuits.	2035 - 2040	2040 - 2045	2030 - 2035	2045 - 2050	96.4	N-1, outage on one of the transformers or 33kV supply circuits at Witney Town PSS.	Potential options to resolve: • Existing transformers are the max rated units for this voltage level. Addition of third transformer at this site may require expansion of site. Construction of third circuit from Witney BSP requires a new 33kV CB at Witney BSP. • Build a new primary substation to provide capacity for some of the existing load across the area. Dependency on availability of CBs at Witney BSP.
Wantage PSS transformers.	2035 - 2040	2045 - 2050	2035 – 2040	2045 - 2050	95.3	N-1, outage on one of the transformers at Witney Town PSS.	Customer connections alongside projected growth in the DFES is driving the reinforcement requirement. Potential option to resolve: • Reinforcement of existing transformers would provide sufficient capacity for projected 2050 demands.
Frenchay Road transformers.	2035 - 2040	Post 2050	2035 - 2040	2045 - 2050	97.0	N-1, outage on one of the	Potential options to resolve this constraint are:

						transformers at Frenchay Road PSS.	• Reinforcement of the transformers at Frenchay Road PSS, no requirement for circuit reinforcement so this will provide sufficient capacity for projected 2050 demands.
Carterton PSS transformers and 33kV supply circuits.	2035 - 2040	Post 2050	2035 - 2040	Post 2050	96.6	N-1, outage on one of the transformers or 33kV supply circuits at Carterton PSS.	Potential options to resolve: • Reinforcement of existing assets will enable sufficient capacity for 2050 projected demands. • Addition of a third circuit and transformer may also be viable but would require a new 33kV circuit breaker at Witney BSP.

Table **3** Future EHV system needs projected to arise ahead of 2040.

8.3. Future EHV System Needs to 2050.

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

Table 4 below summarises the specific system needs we have identified.

Location of proposed intervention	CT Year	ST Year	LTW Year	FS Year	Worst Case Asset Loading (%)	Network State	Comments
Cowley to Headington 132kV circuits.	2040 - 2045	Post 2050	2045 - 2050	Post 2050	95.2	N-1, outage of the 132kV circuit between Cowley GSP and Headington BSP.	Headington BSP has works in progress for two new circuits directly to Cowley GSP, and a need has been identified for two new transformers ahead of 2030. Based on current projections, there may be a further need in the future under an N-1 outage. The BSP is also projected to have a group demand greater than 100MW ahead of 2050 so will need some security of supply under an N-2 outage. Potential options to resolve: • Construction of a third 132kV circuit from Cowley GSP to Headington BSP. Subject to the availability of 132kV CBs at the GSP.
St Ebbes PSS transformers.	2040 - 2045	Post 2050	2035 - 2040	Post 2050	95.5	N-1, outage of either transformer at St Ebbes PSS or outage of either 33kV circuit between St Ebbes PSS and Oxford BSP.	Potential options to resolve this constraint are: • Reinforcement of the two existing transformers at St Ebbes PSS. • Load transfers on the 11kV network maybe possible due to close proximity to other primary substations – dependent on capacity of neighbouring substations and the 11kV network.

Burford PSS transformers.	2040 - 2045	2045 - 2050	2035 - 2040	2045 - 2050	96.4	N-1, outage of the 15MVA rated primary transformer at Burford PSS leaves the 6.3MVA rated primary transformer overloaded.	Potential option to resolve this constraint are: • Reinforcement of the existing 6.3MVA rated primary transformer at Burford PSS to 15MVA will match the rating of the other existing unit and provide sufficient capacity out to 2050.
Woodstock PSS transformers.	2040 - 2045	Post 2050	2040 - 2045	Post 2050	97.0	N-1, outage on one of transformers at Woodstock PSS.	This issue should be considered alongside any circuit work in the area that has been highlighted in the section above. Potential options to resolve this constraint are: • Reinforcement of the two existing transformers at Woodstock PSS.

Table 4 Future EHV system needs projected to arise between 2040 and 2050.

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

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

8.4.1. 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.[43]

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 all of the primary substations supplied by Cowley 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 22 demonstrates how this percentage changes under each DFES scenario from now to 2050.

To satisfy these requirements a variety of solutions will need to be investigated. It is likely that a combination of flexibility and asset replacement will be employed to resolve the projected HV system needs. It is important to note that for HV needs, flexibility is likely to be provided through Distributed Energy Resources (DER), Consumer Energy Resources (CER), and domestic/commercial Demand Side Response (DSR). One of the challenges associated with procuring flexibility to High Voltage and Low Voltage system needs is that only a small number of customers can provide a flexible service due to the requirement to be supplied by a specific secondary transformer. As the role of aggregators develops, we may see a shift in the potential for flexibility in an area. Where the magnitude of an overload is too large for flexibility to be feasible, addition of new assets or asset replacement will be necessary.

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

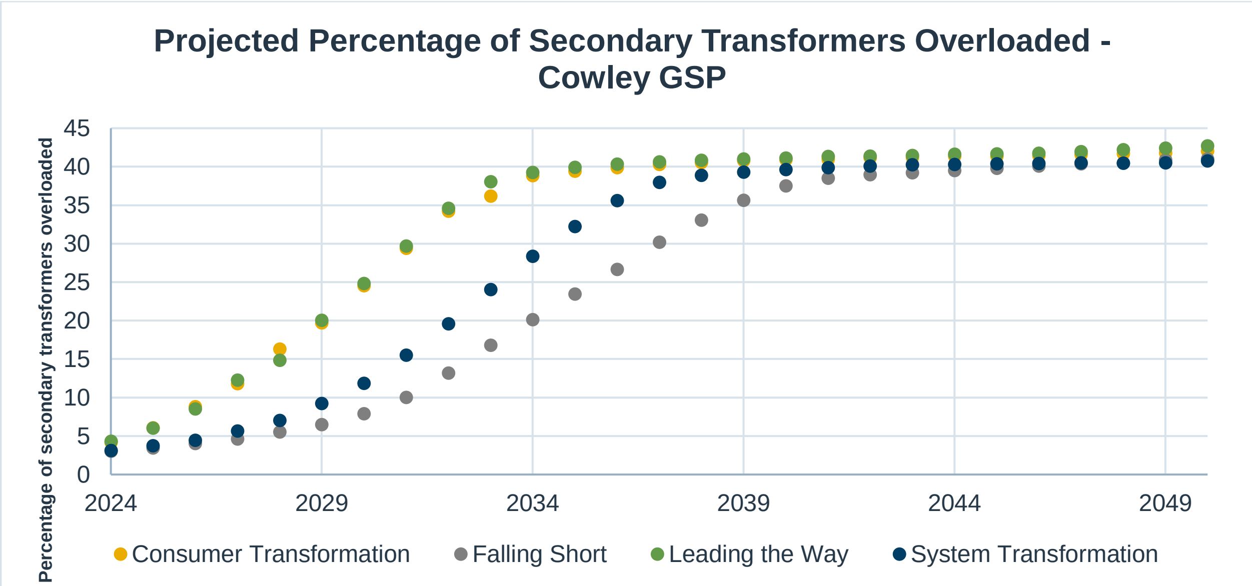


Figure 15 Cowley GSP projected secondary transformer overloading. *Source: SSEN Load Model*.

Considering the Just Transition in HV development

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

One of the outputs from this innovation project was the report produced by the Smith Institute.[44] This work groups LSOAs[45] 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 5.

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.

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

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

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 5 VFES Groupings

To understand the vulnerability groupings across Cowley 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 23.

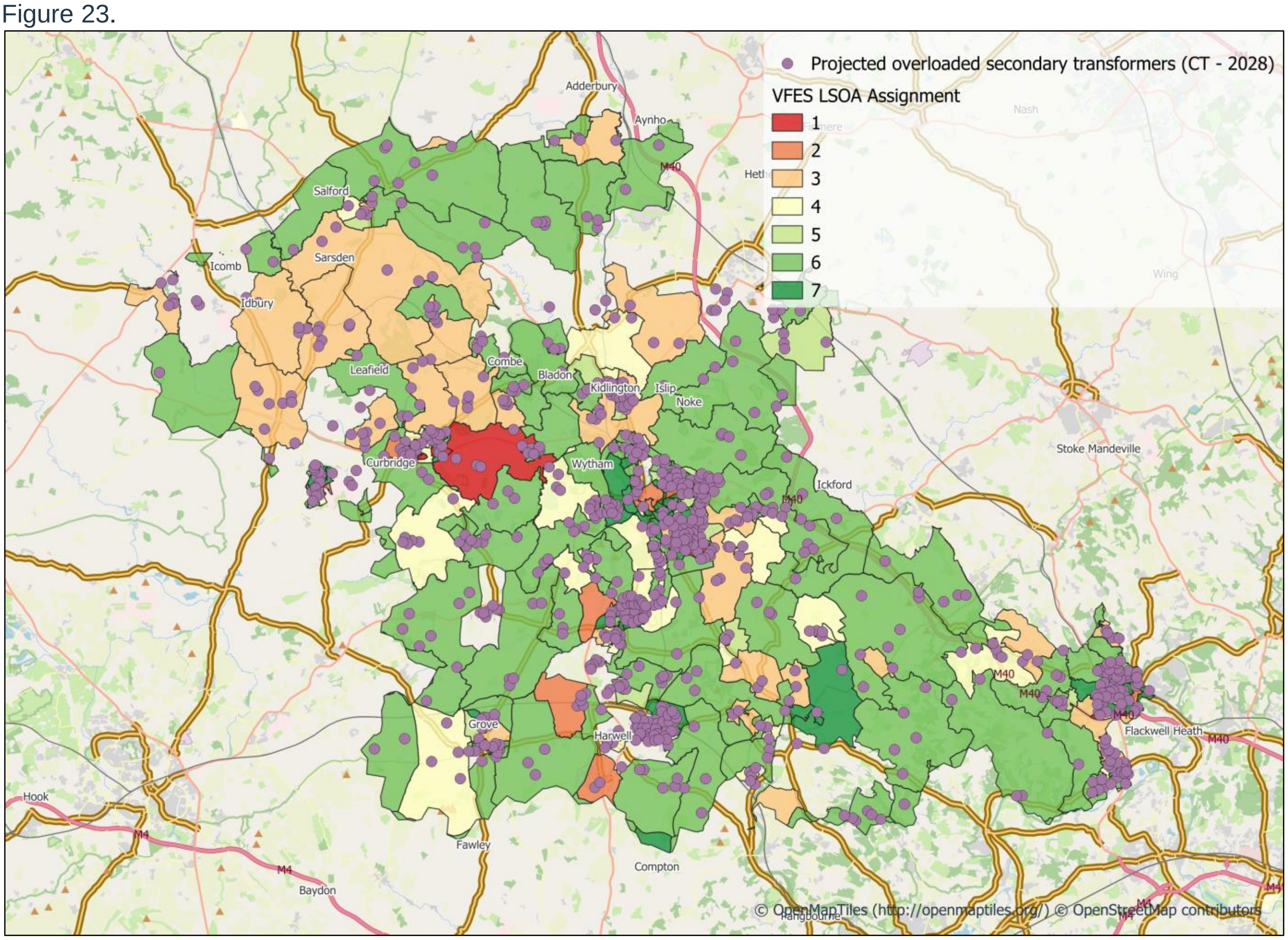


Figure 16 Cowley GSP VFES Output with secondary transformer overlay.

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

By overlaying the point locations of secondary transformers projected to be overloaded (in 2028 under the Consumer Transformation scenario) we identify areas that are categorised as more vulnerable and also may have capacity shortfalls at the secondary network level.
More vulnerable groups may have lower level of adoption of LCTs and therefore provide less ability to manage overloads through flexibility services. Further they may point towards areas of social housing where there could be a more sudden rollout of LCTs such as heat pumps in the future.
We will use these insights to prioritise heavily loaded areas of our network ensuring the network remains secure, stable, and resilient in the areas where vulnerable customers would be most disadvantaged by outages.

8.4.2. Low Voltage Networks

Drivers for interventions in low voltage networks may be either capacity related or be driven by voltage requirements. We are progressing options to resolve both 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.

Initial analysis indicates that across the study area, 19.9% of low voltage feeders may need intervention by 2035 and 23.1% by 2050 under the CT scenario as shown in Figure 24. 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.

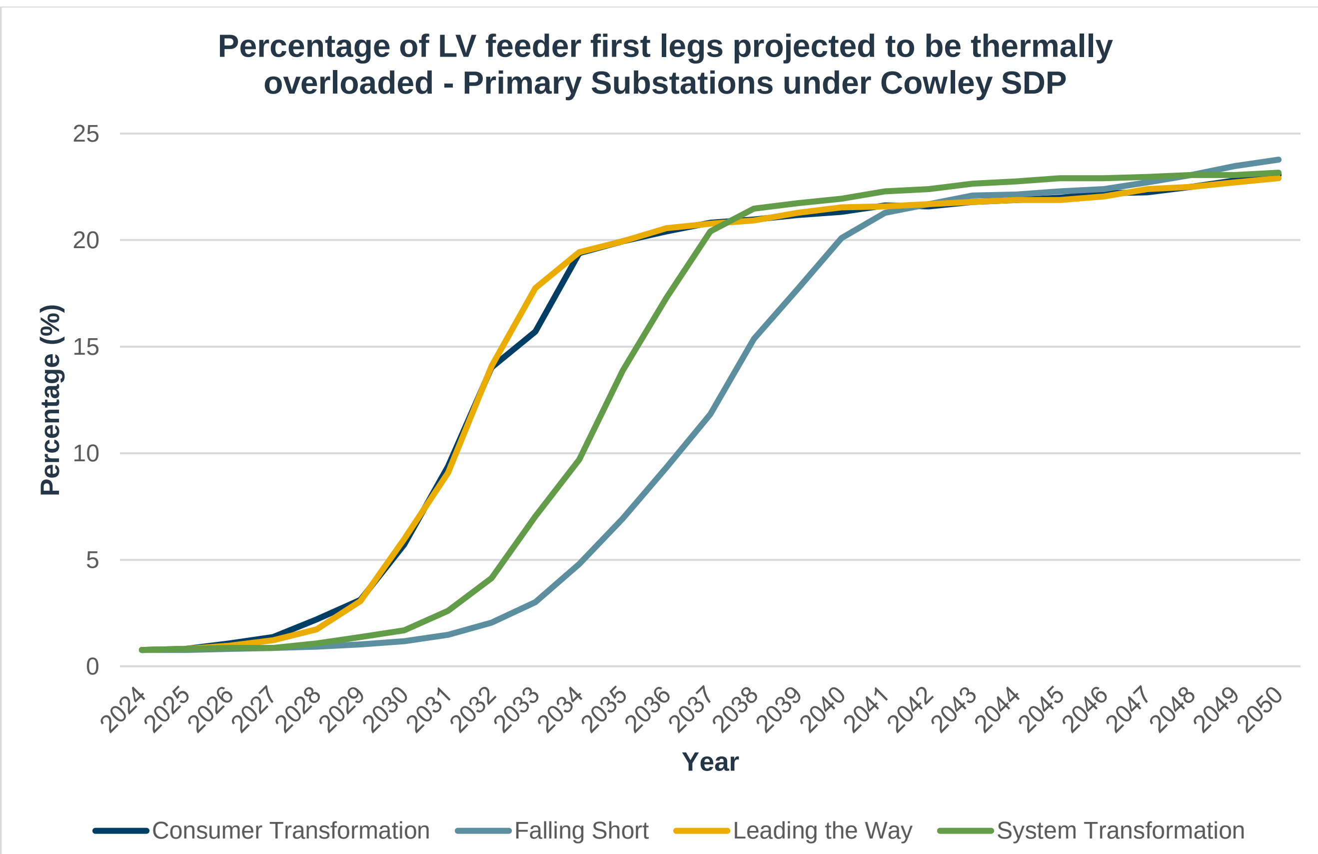


Figure 17 Percentage of LV feeder first legs projected to be overloaded that are supplied from Cowley GSP.

9. RECOMMENDATIONS

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

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

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

1. Where we have identified work that is required in the near term (ahead of 2030), this should be progressed through the DNOA process. Through detailed study we will understand the network requirements in more detail and progress these where appropriate. This includes the following system needs:
    a. High Wycombe BSP transformers and 132kV circuits
    b. Drayton BSP transformers
    c. Headington BSP transformers
    d. Wootton Road Primary transformers
    e. Deddington Primary transformers
    f. Yarnton BSP 33kV ring (Woodstock PSS – Kiddington PSS – Charlbury PSS – Chipping Norton PSS – Bleddington PSS – Leafield PSS)
    g. Winsmore Lane Primary transformers
    h. North Hinksey Primary transformers
    i. 33kV circuits from Oxford BSP to Wootton Road PSS and Kennington PSS
    j. Grove and Wantage 33kV circuits
    k. Witney BSP 33kV circuit ring (Windrush Park PSS – Burford PSS – Rissington PSS – Leafield PSS)
    l. Leafield Primary transformers
    m. Milton 33kV supply circuits (and later Milton Primary transformers)

    It is possible that some of the above constraints may not have a near term system need based on actual load growth, and therefore will not initially result in an DNOA outcome. Annual reassessment will enable us to confirm whether these system needs are likely to arise. When carrying out this annual reassessment the delivery timelines of the work should be considered alongside the potential for flexibility services to manage network capacity.

2. Continue to work with large scale demand users to understand capacity requirements to decarbonise industrial processes and consider these requirements in plans for our future network plans. By doing so we are enabling both commercial/industrial and domestic decarbonisation while also supporting growth

in the local economy. Furthermore, an increasing number of flexible assets on the network may help increase capacity for large scale demand users.

3. Engagement with NGET should be proactive so that alongside delivery of any future Grid Supply Points (for example Didcot GSP), we can plan the distribution network in parallel. This will enable efficient capacity release at both Transmission and Distribution level. This should include development of strategic plans to understand how Cowley demand can be managed in the event total demand exceeds 1500MW.

4. While electrification of road travel is captured in DFES building blocks, engagement should take place to better understand the impact of further rail electrification in the Cowley GSP area.

Actioning these recommendations will allow SSEN to develop an electricity network that supports local net zero ambitions and enables growth in the local economy.

10. APPENDICIES

Appendix A Primary substation existing network

Substation Name	Site Type	Number of Customers Served	2023/2024 Substation Maximum MVA (Season)
Arncott	Primary Substation	2,746	11.82 (Spring/Autumn)
Berinsfield	Primary Substation	5,060	10.32 (Winter)
Bleddington	Primary Substation	2,137	4.13 (Winter)
Burford	Primary Substation	1,446	4.38 (Winter)
Carterton	Primary Substation	8,313	15.24 (Winter)
Charlbury	Primary Substation	4,001	5.10 (Winter)
Chipping Norton	Primary Substation	4,781	9.93 (Winter)
Chisbridge	Primary Substation	1,247	6.23 (Winter)
Cholsey	Primary Substation	3,555	5.91 (Winter)
Cowley Local	Primary Substation	13,814	20.29 (Winter)
Culham	Primary Substation	28	4.27 (Winter)
Deddington	Primary Substation	2,059	4.13 (Winter)
Eynsham	Primary Substation	4,749	9.94 (Winter)
Frenchay Road	Primary Substation	5,300	9.05 (Winter)
Fryers Lane	Primary Substation	11,084	12.87 (Winter)
Fulscot	Primary Substation	8,592	13.99 (Winter)
Fyfield	Primary Substation	4,345	8.55 (Winter)
Grove	Primary Substation	6,521	12.23 (Winter)
Harwell	Primary Substation	548	6.19 (Winter)
Harwell South	Primary Substation	3	24.33 (Spring/Autumn)
Headington	Primary Substation	9,615	16.10 (Winter)
High Wycombe	Primary Substation	6,058	19.72 (Winter)
High Wycombe Town	Primary Substation	7,890	17.73 (Winter)
Kennington	Primary Substation	3,081	4.37 (Winter)
Kiddington	Primary Substation	2,535	9.54 (Spring/Autumn)

Leafield	Primary Substation	2,515	3.62 (Winter)
Little Marlow	Primary Substation	9,028	14.70 (Spring/Autumn)
Lovelace Road	Primary Substation	4,126	4.69 (Winter)
Milton	Primary Substation	11,398	25.50 (Spring/Autumn)
North Hinksey	Primary Substation	4,285	6.55 (Spring/Autumn)
Nuffield	Primary Substation	1,621	4.19 (Winter)
Old Road	Primary Substation	6,155	16.72 (Spring Autumn)
Oxford	Primary Substation	5,492	17.25 (Winter)
Rissington	Primary Substation	3766	5.72 (Winter)
Rose Hill	Primary Substation	8,459	14.18 (Winter)
St Ebbes	Primary Substation	5,344	18.24 (Winter)
Standlake	Primary Substation	2,044	5.78 (Winter)
Stokenchurch	Primary Substation	4,537	7.74 (Winter)
Union Street	Primary Substation	9,227	14.68 (Spring/Autumn)
University Parks	Primary Substation	1,924	19.02 (Winter)
Wallingford	Primary Substation	7,696	12.59 (Winter)
Wantage	Primary Substation	6,351	10.09 (Winter)
Watlington	Primary Substation	3,250	20.42 (Spring/Autumn)
Wheatley	Primary Substation	4,260	7.72 (Spring/Autumn)
Windrush Park	Primary Substation	3,397	9.71 (Winter)
Winsmore Lane	Primary Substation	9,938	14.9 (Winter)
Witney Town	Primary Substation	12,443	18.97 (Winter)
Woodstock	Primary Substation	3,742	6.86 (Winter)
Wootton Road	Primary Substation	9,663	12.38 (Winter)
Yarton	Primary Substation	10,792	21.98 (Winter)

Table 6 Cowley GSP primary substations, customer counts, and peak demand 2023/24.

Appendix B 33kV existing network schematics

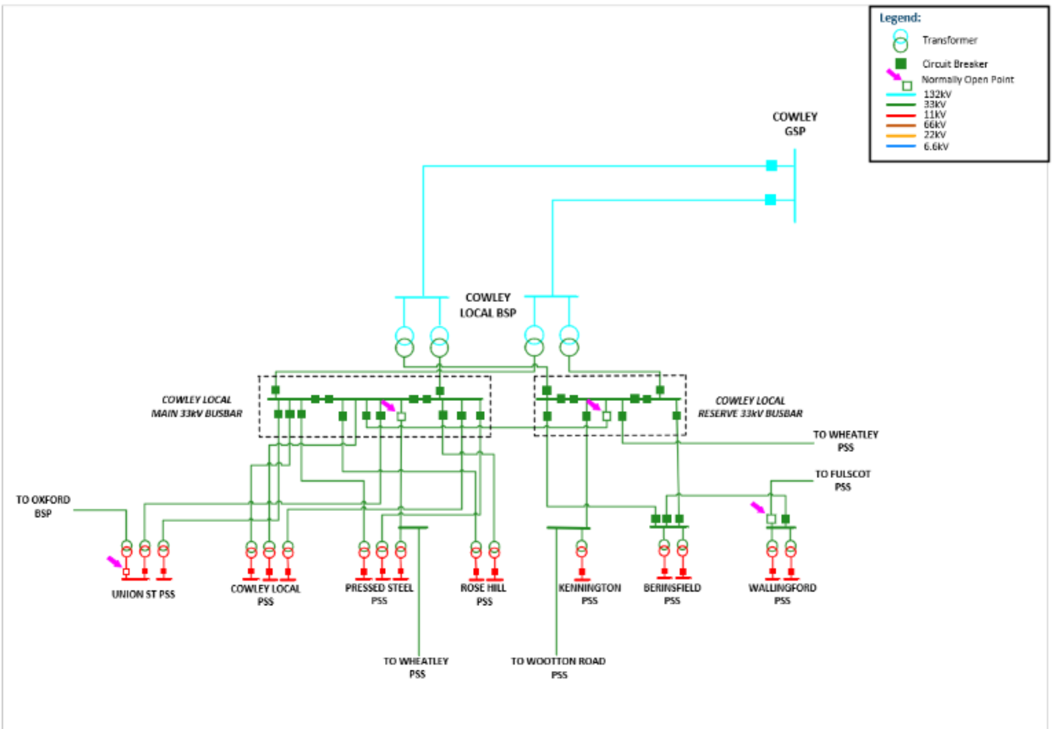


Figure 18 Cowley Local BSP - Existing network schematic

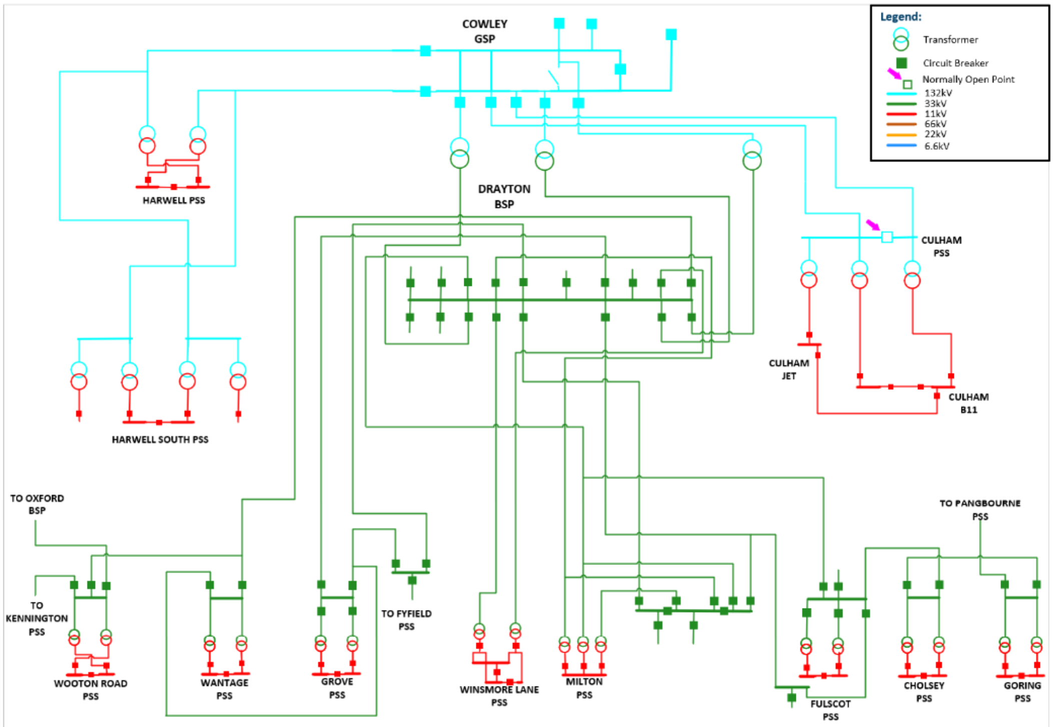


Figure 19 Drayton BSP, Culham PSS, Harwell PSS, Harwell South PSS - Existing network schematic

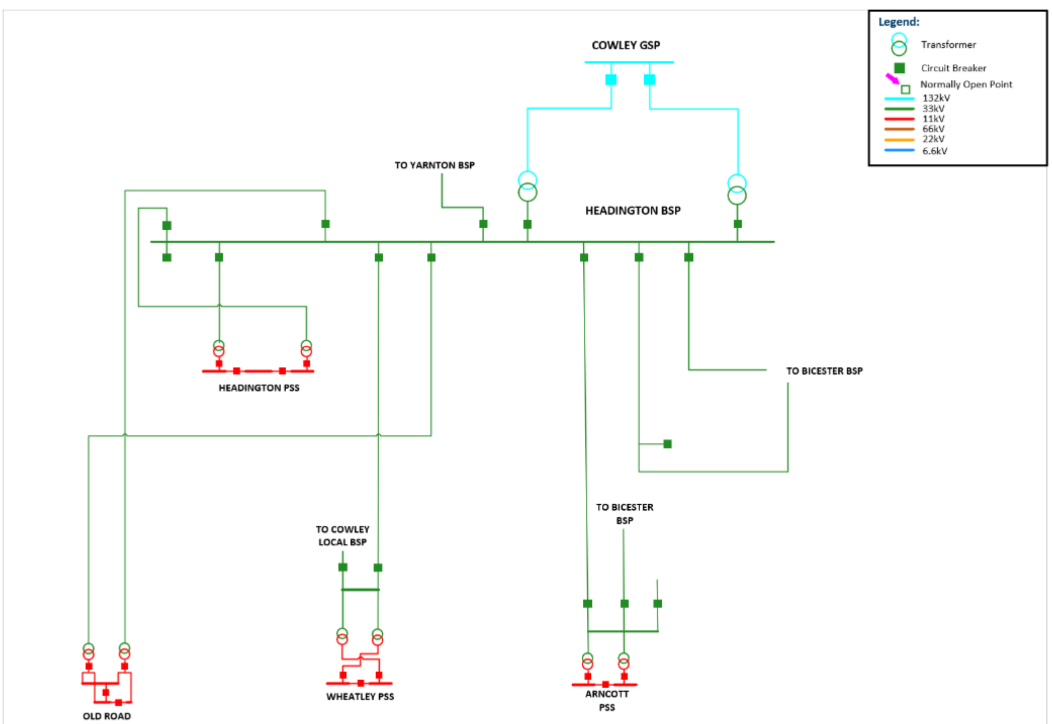


Figure 20 Headington BSP - Existing network schematic

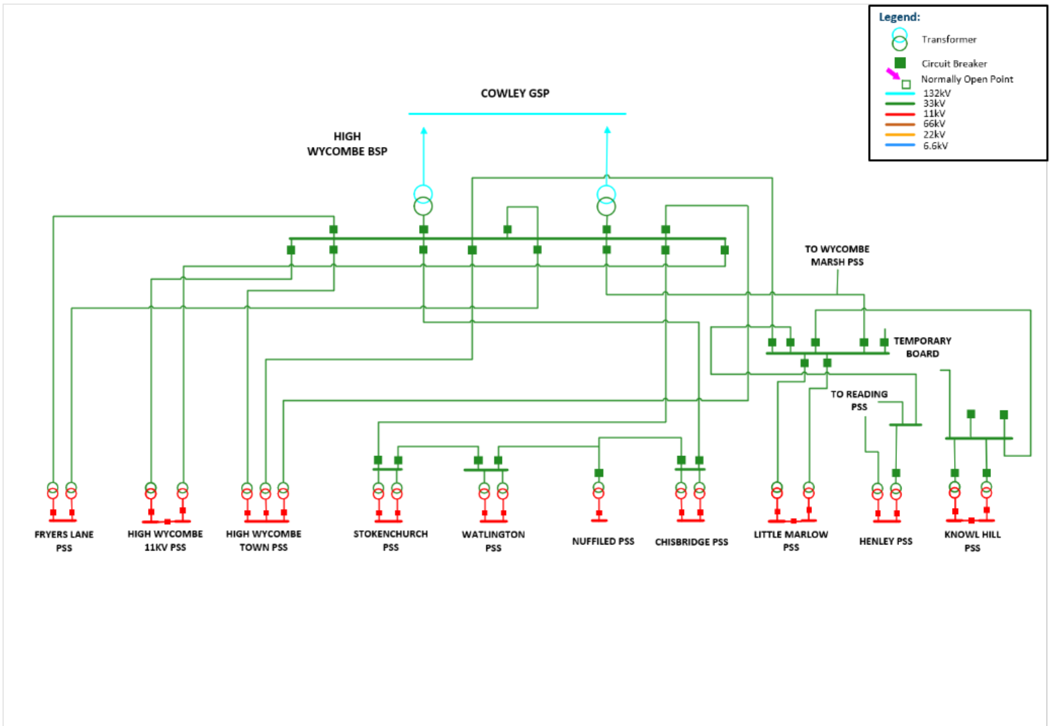


Figure 21 High Wycombe BSP - Existing Network Schematic

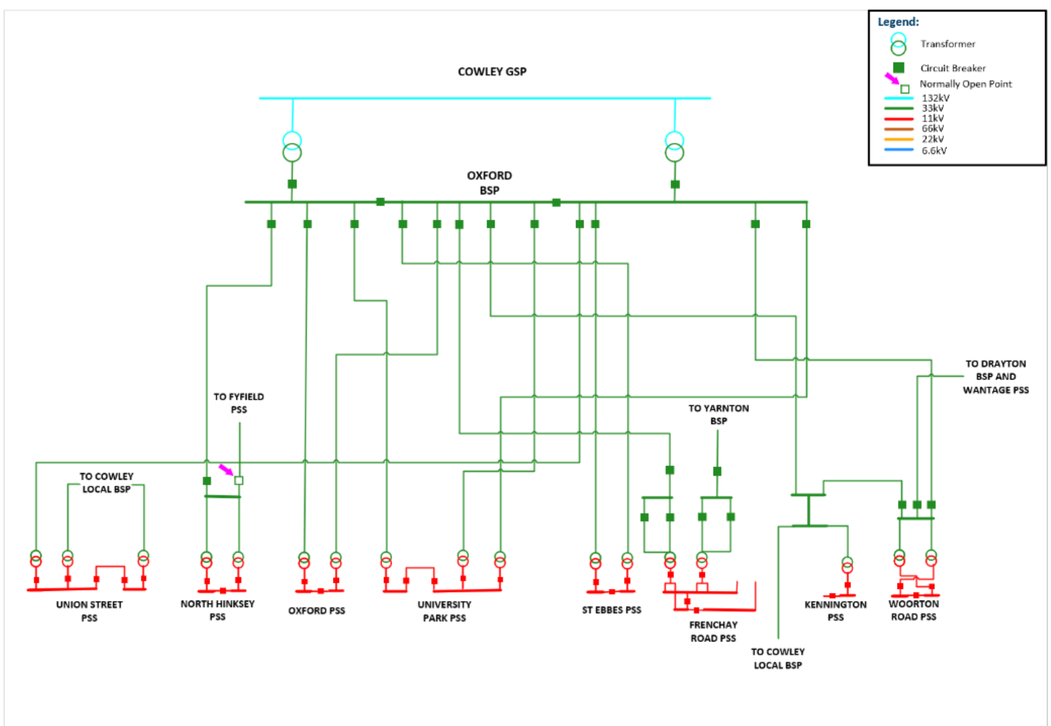


Figure 22 Oxford BSP - Existing network schematic

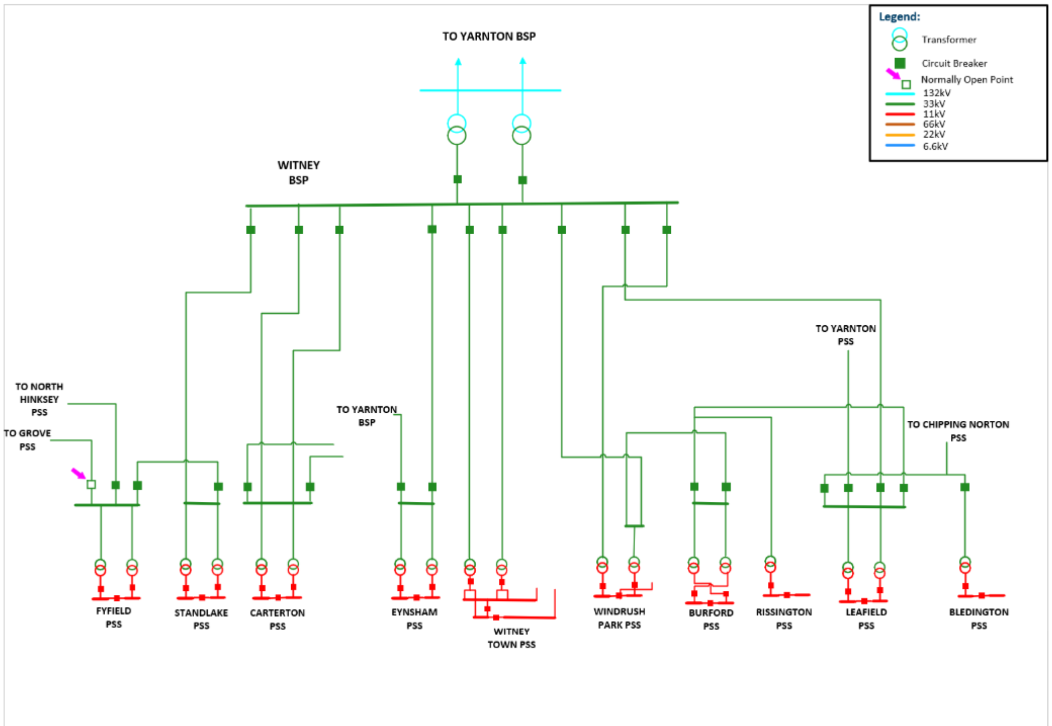


Figure 23 Witney BSP - Existing network schematic

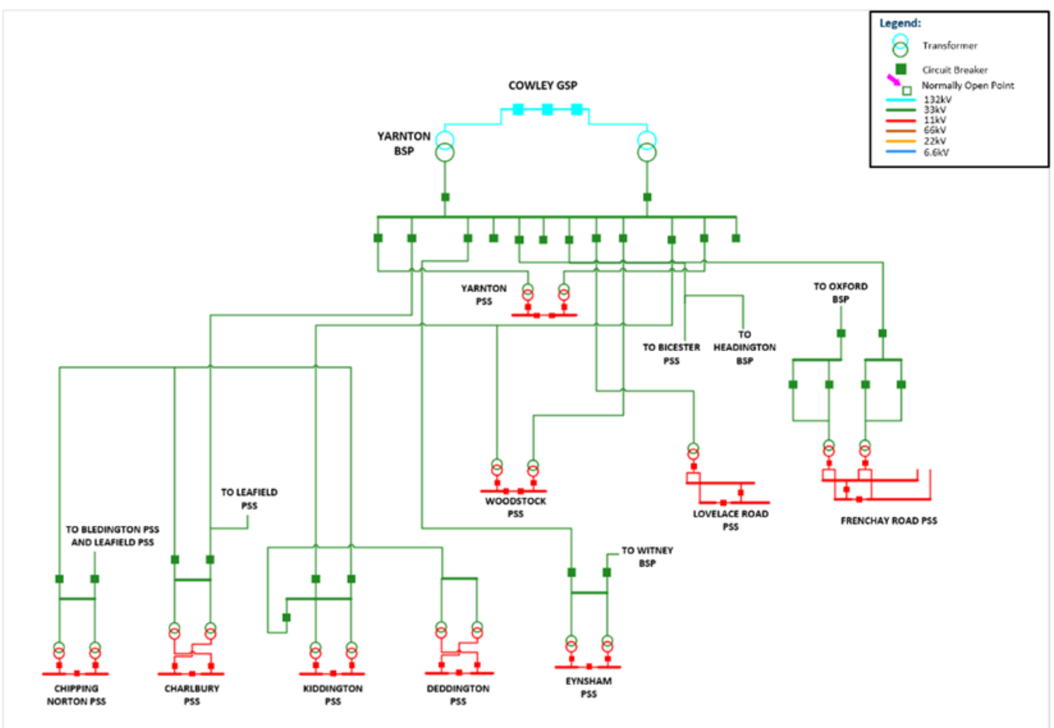


Figure 24 Yarnton BSP - Existing network schematic

Appendix C 33kV works in progress network schematics

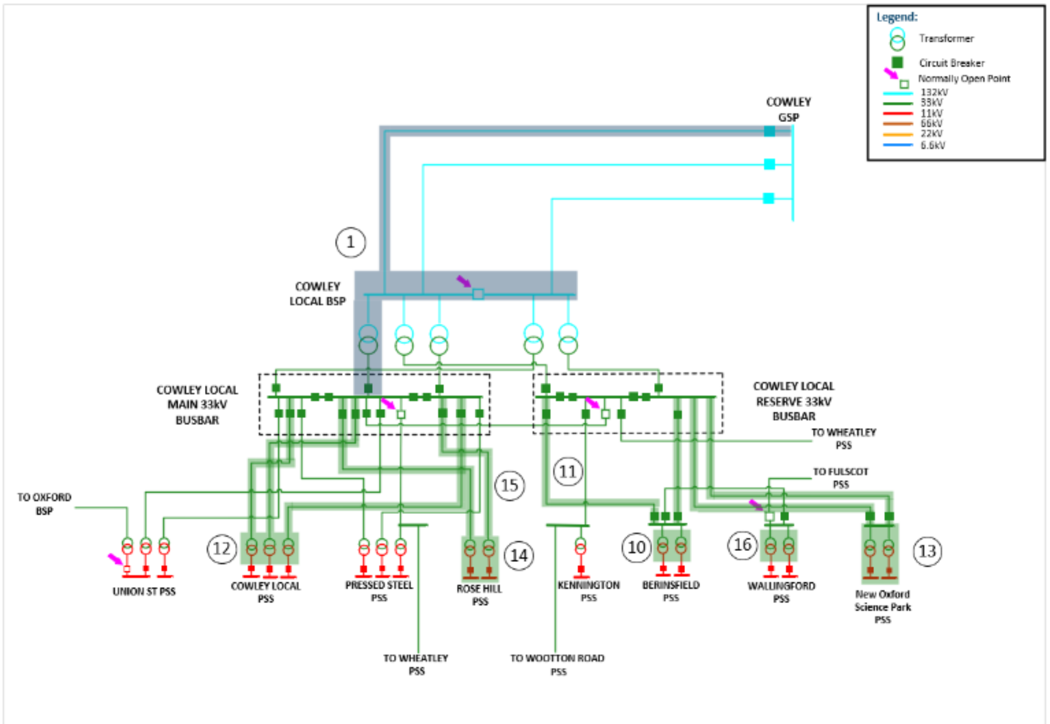


Figure 25 Cowley Local BSP Network - Following completion of triggered works.

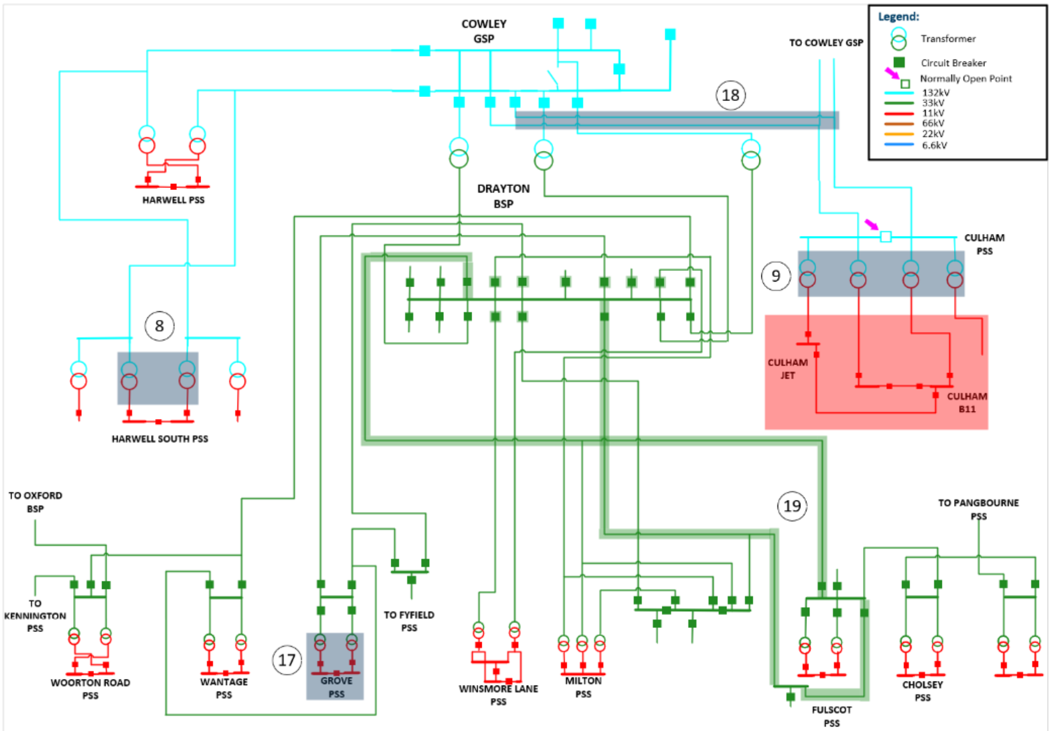


Figure 26 Drayton BSP Network - Following completion of triggered works

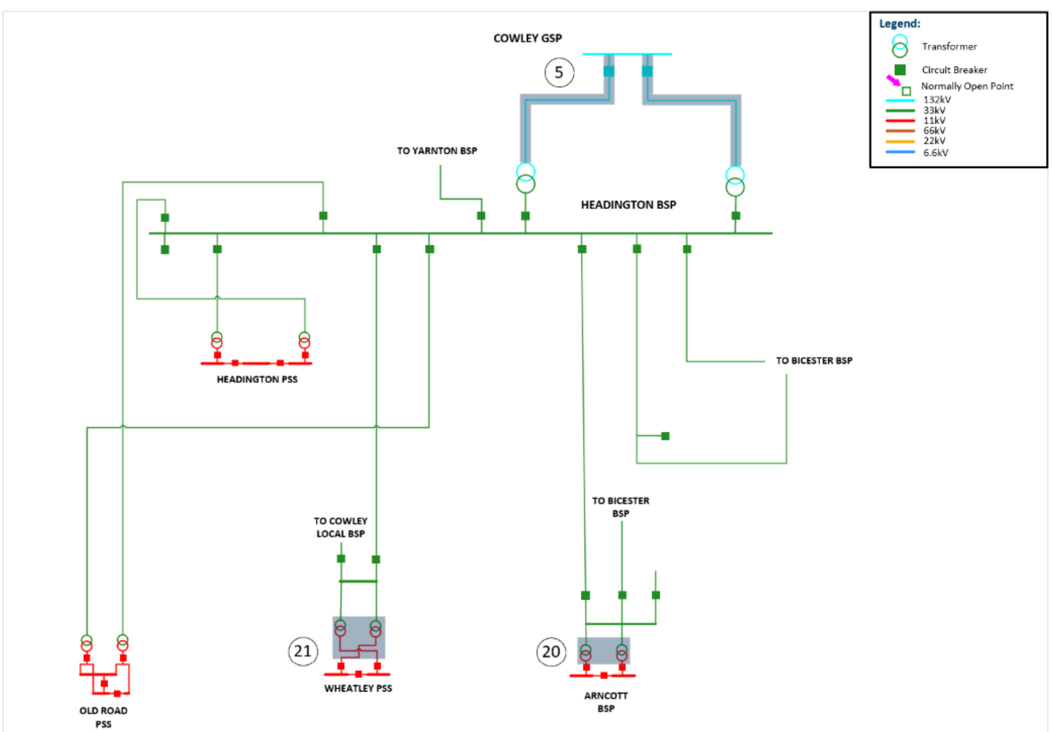


Figure 27 Headington BSP Network - Following completion of triggered works

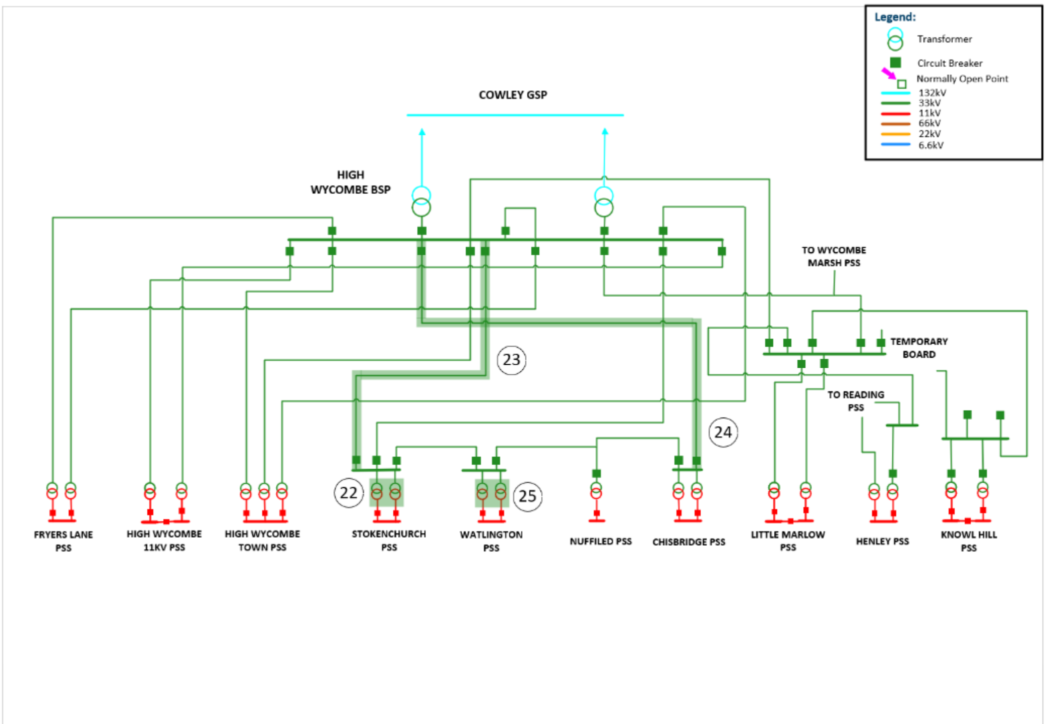


Figure 28 High Wycombe BSP Network - Following completion of triggered works.

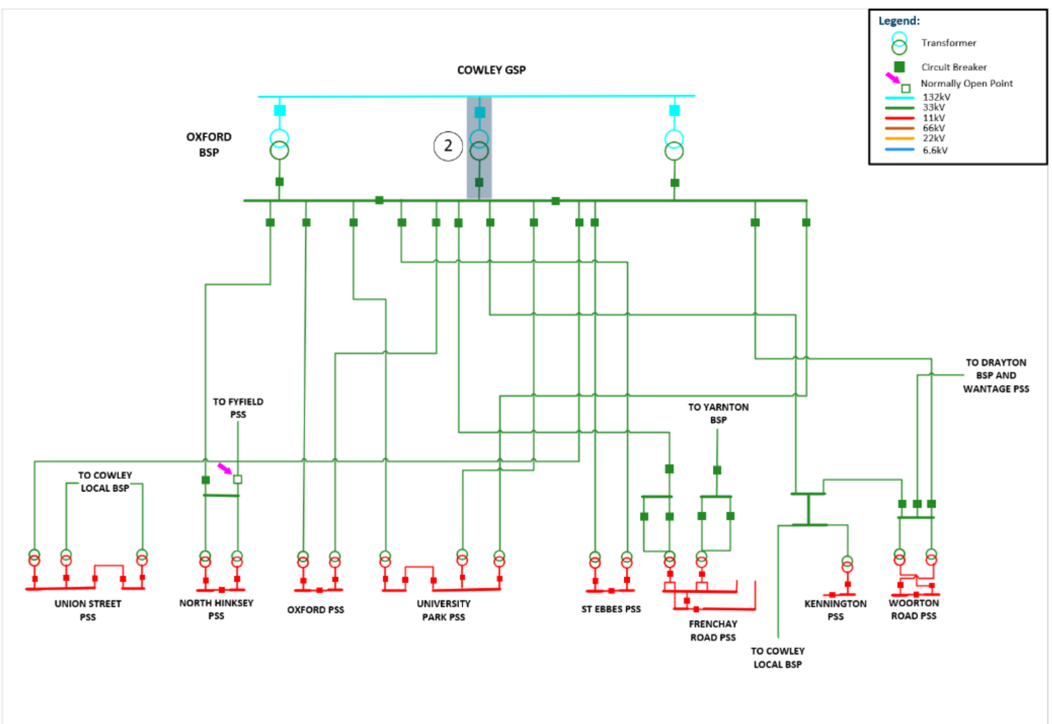


Figure 29 Oxford BSP Network - Following completion of triggered works.

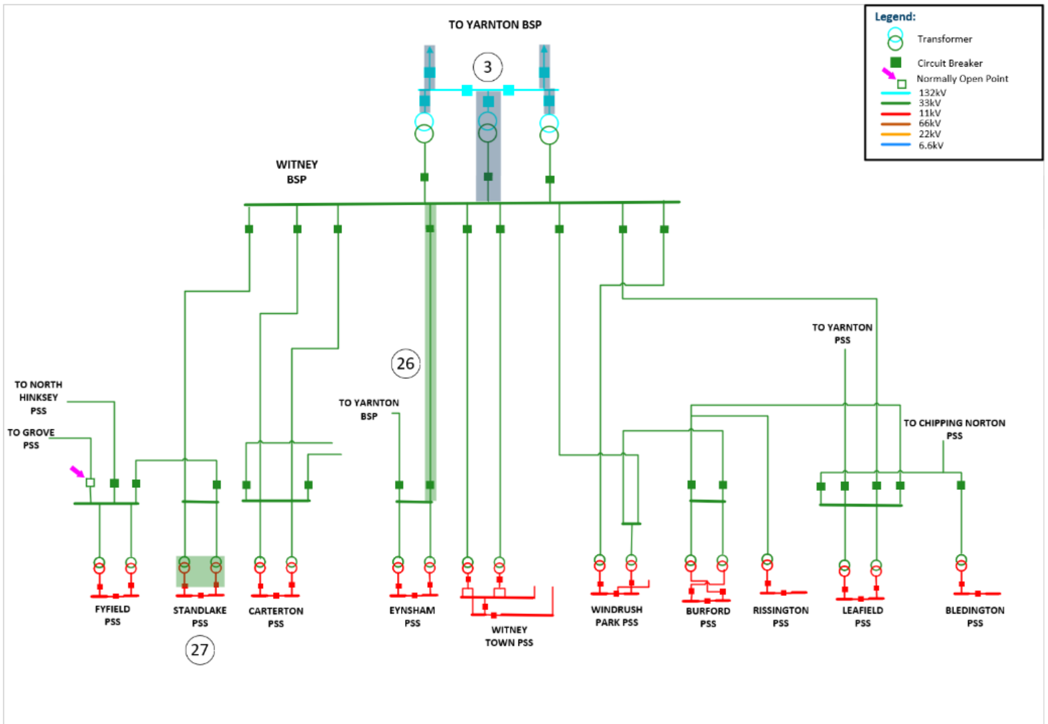


Figure 30 Witney BSP Network - Following completion of triggered works.

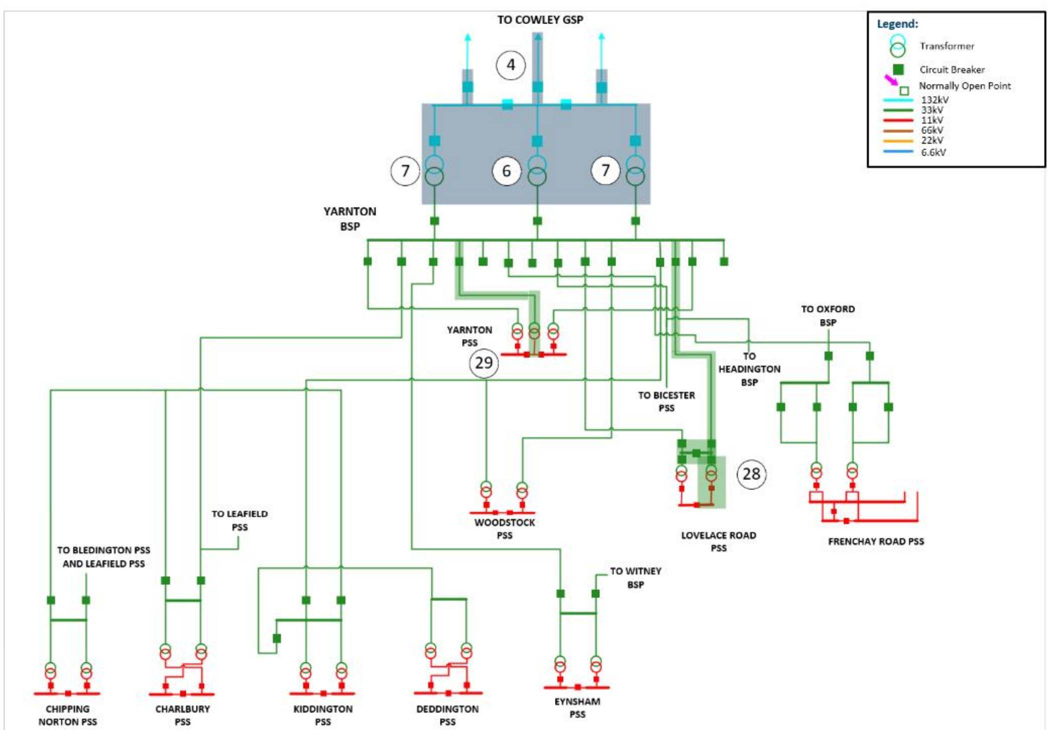


Figure 31 Yarnton BSP Network - Following completion of triggered works.

Appendix D Additional EHV/HV plans for other DFES scenarios

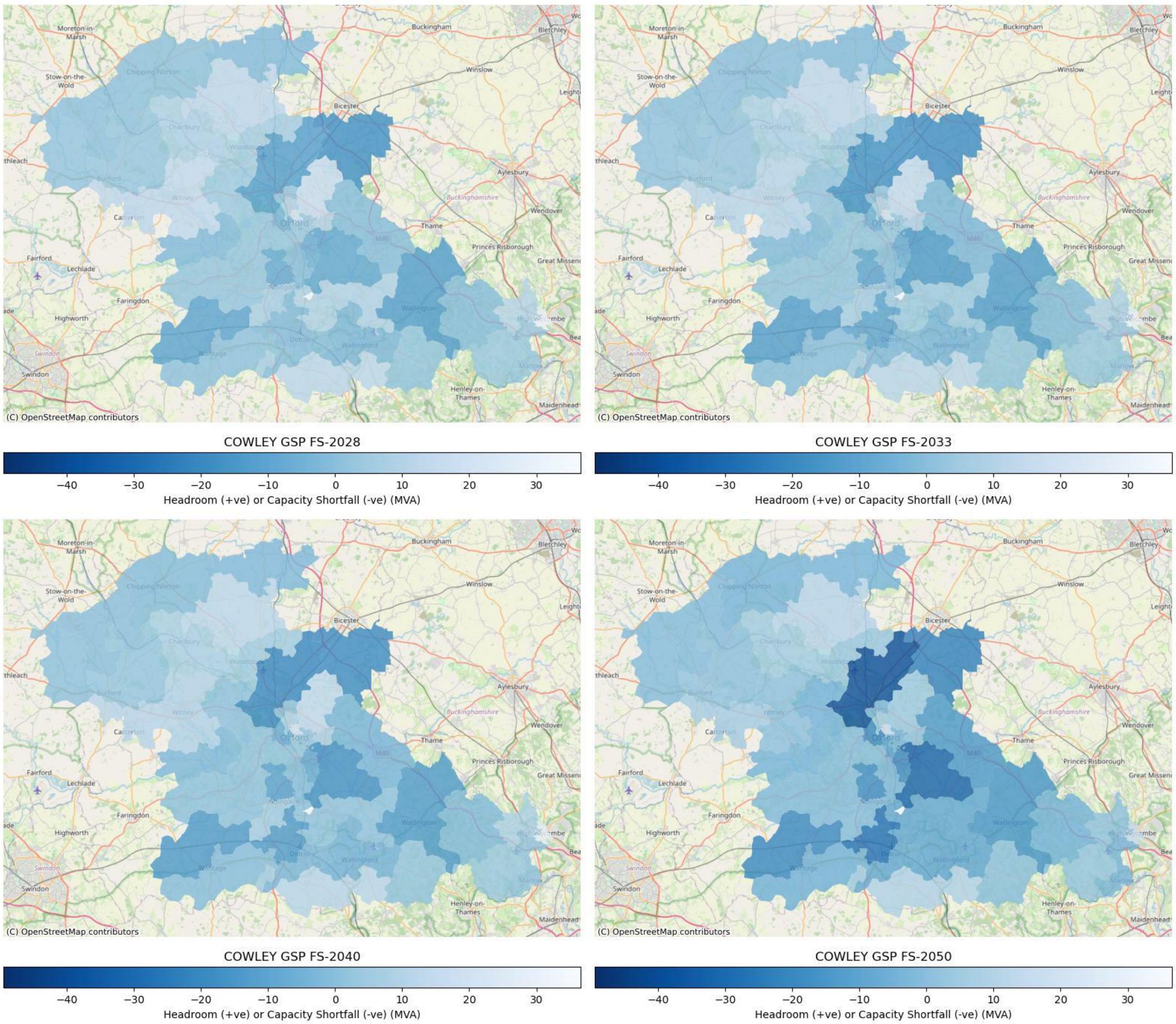


Figure 32 Cowley GSP - EHV/HV Spatial Plan - Falling Short

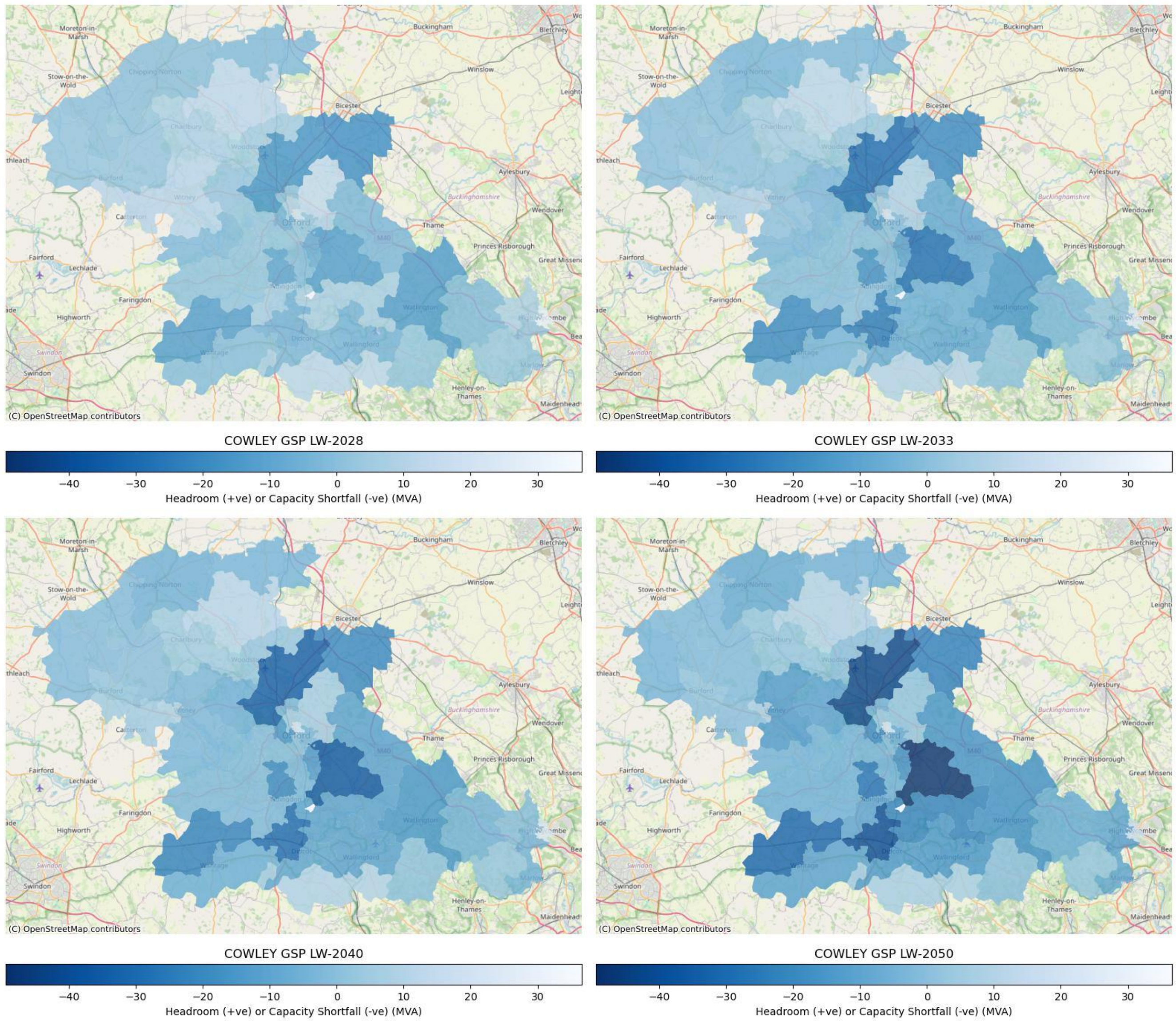


Figure 33 Cowley GSP - EHV/HV Spatial Plan - Leading the Way

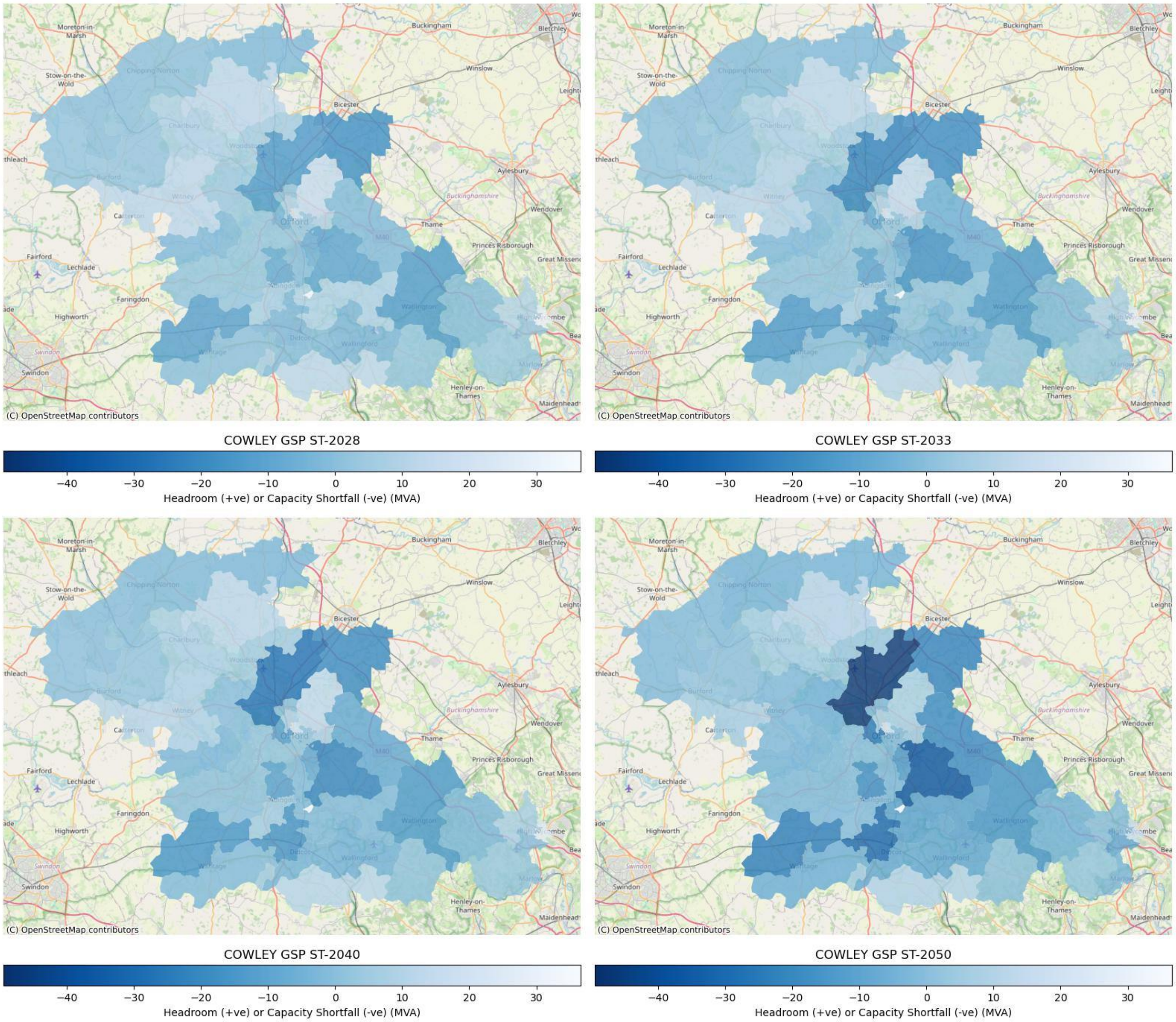


Figure 34 Cowley GSP - EHV/HV Spatial Plan - System Transformation

Appendix E Additional HV/LV plans for other DFES scenarios

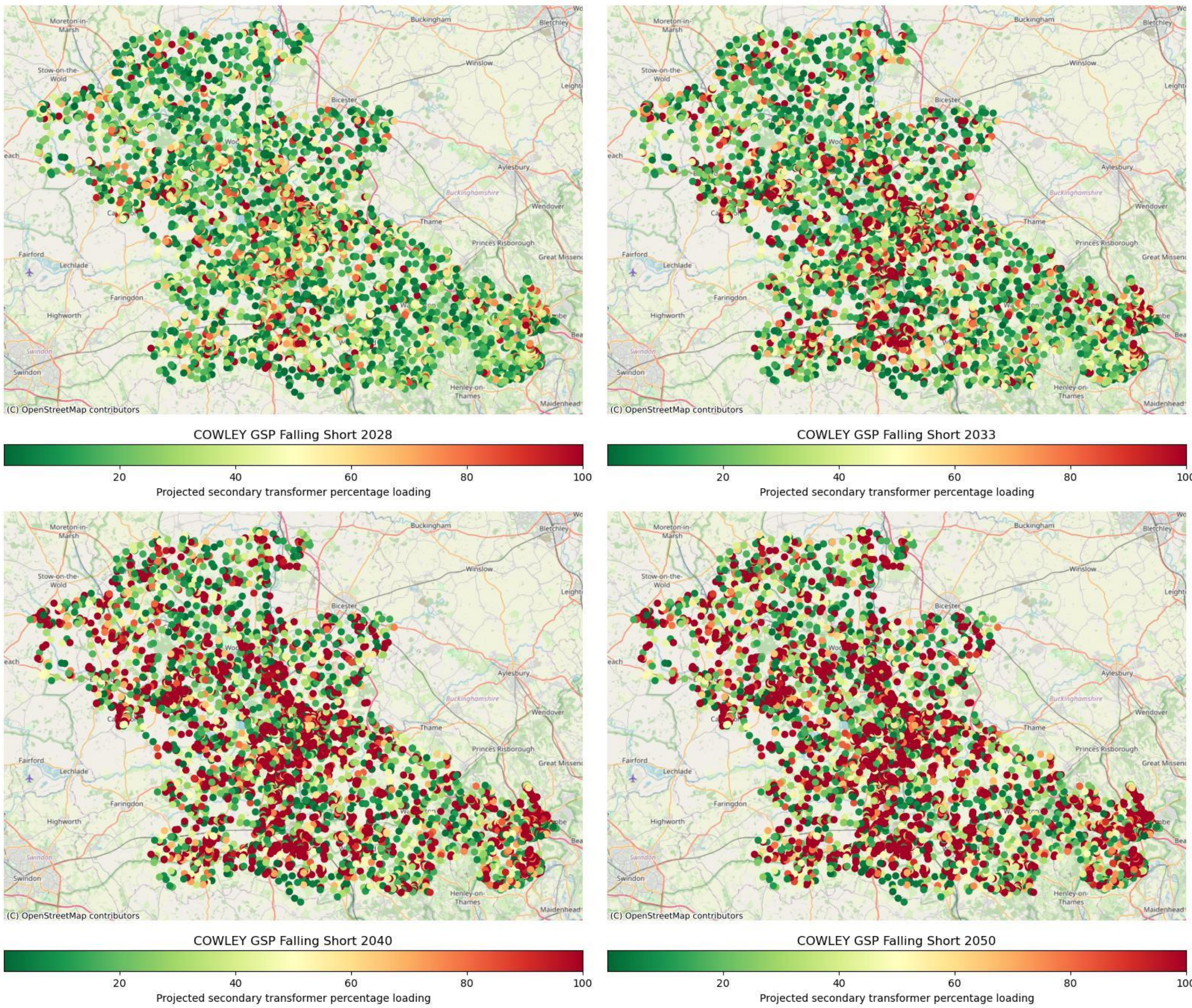


Figure 35 Cowley GSP - HV/LV Spatial Plan - Falling Short

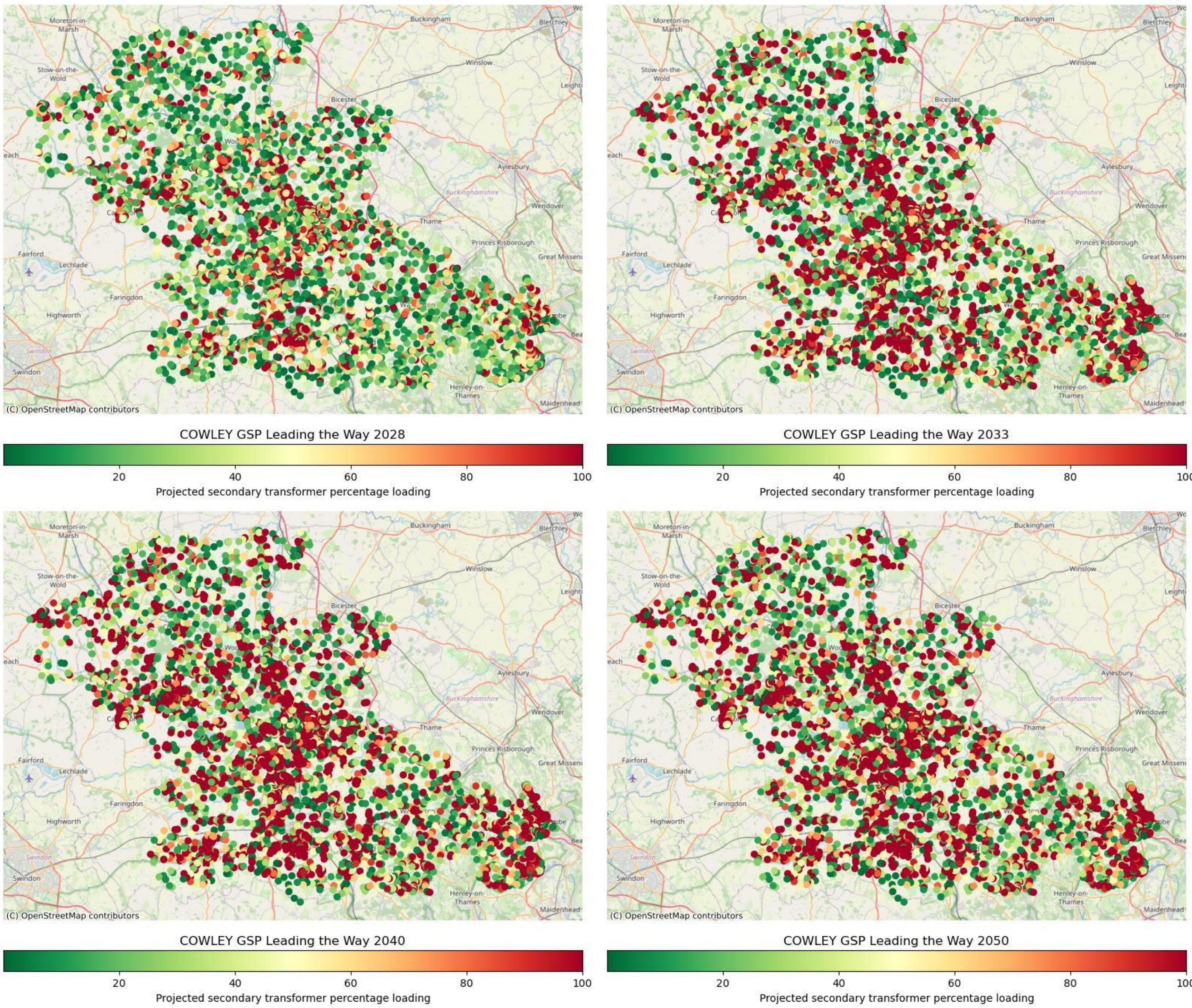


Figure 36 Cowley GSP - HV/LV Spatial Plan - Leading the Way

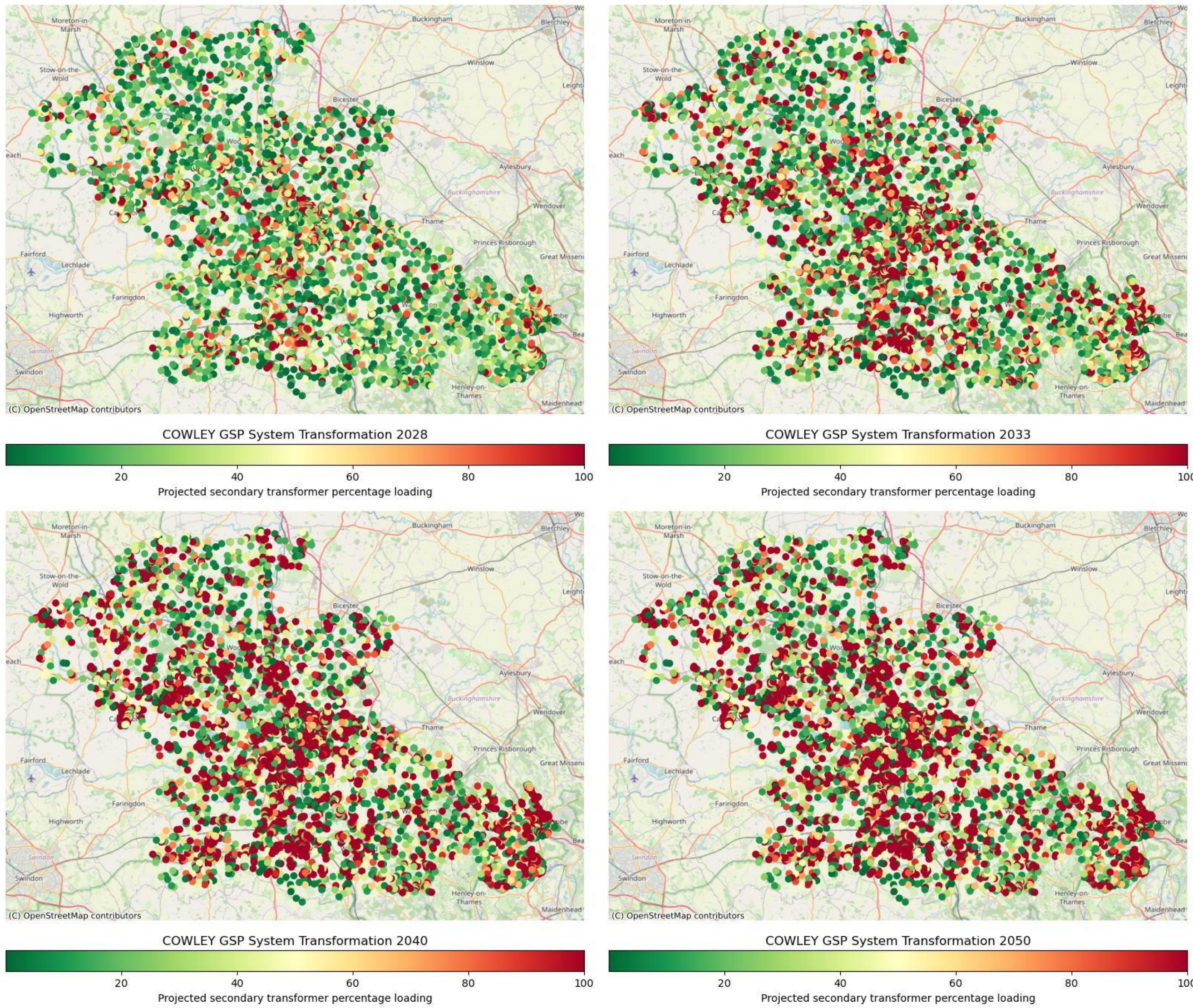


Figure 37 Cowley GSP - HV/LV Spatial Plan - System Transformation

Appendix F Relevant DNOA outcome reports

DNOA Outcome Report

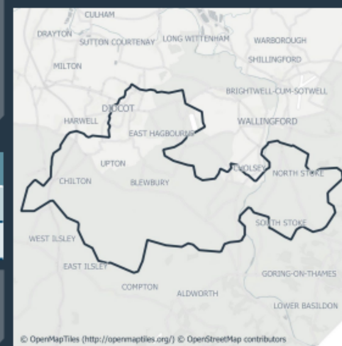
East Didcot (Fulscot and Cholsey PSSs) Ref. 0724-18

Scheme description

- Fulscot and Cholsey primary substations supply the East of Didcot town and the village of Cholsey in South Oxfordshire. Postcode(s): OX10, OX11.
- Load related – substation overload during FCO conditions due to forecasted demand growth.

Proposed option

- Flexibility solution deployed to reduce peak demand and defer capital investment for 2 years. Following this an asset solution will be progressed: reinforcement of the existing 33kV circuit.
- This option has a relatively low cost and creates optionality value as demand grows.
- Capacity released: 15.9MVA



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: £150/MW/h
- Utilisation: £200/MWh

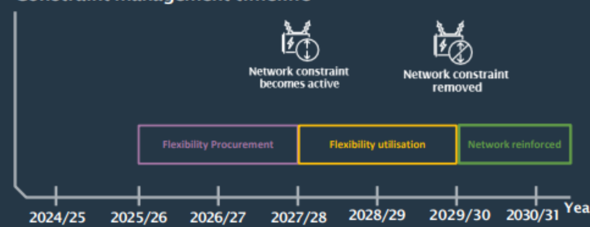
Reinforcement timeline

- Flexibility in 2027/28 and 2028/29.
- Reinforcement delivery by 2029/30.

Estimated peak MW outside firm network capacity under each scenario
Grey text relates to estimated peak MW without reinforcement delivery

	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31
CT	-	-	-	0.87	2.27	- (3.65)	- (5.23)
ST	-	-	-	-	-	- (0.19)	- (0.83)
LTW	-	-	0.68	2.15	3.60	- (5.38)	- (7.12)
FS	-	-	-	-	-	-	- (0.36)

Constraint management timeline



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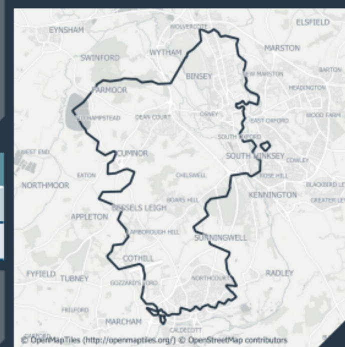
DNOA Outcome Report

Osney (Oxford BSP)
Ref. 0724-20

Scheme description
- Oxford substation is located in Osney, Oxfordshire. Postcode(s): BA13, HP14, KT20, OX1-OX5, OX7, OX9, OX10-OX14, OX20, OX26, OX28, OX44, PO37, RG7 SO45, UM5.
- Load related – substation and circuits thermal overloading under FCO conditions due to forecasted demand growth.

Proposed option
- Procure flexibility solutions – Utilise flexibility to defer reinforcement by 4 years.
- Asset Solution- addition of a new 120MVA transformer and circuit breakers at Oxford. To facilitate this, the addition of a new 132kV circuit from Cowley GSP to Oxford (Osney) BSP is needed.
- Capacity Released: 90MVA



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				

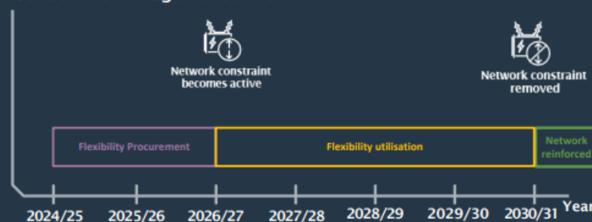
Indicative flexibility price (if available):
- Availability: £150/MW/h
- Utilisation: £200/MWh

Reinforcement timeline
- Flexibility utilisation in 2026/27-2029/30.
- Reinforcement delivery by the end of 2029/30.

Estimated peak MW outside firm network capacity under each scenario
Grey text relates to estimated peak MW without reinforcement delivery

	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31
CT	-	-	0.96	3.38	6.10	9.03	- (12.37)
ST	-	0.15	0.92	2.18	3.42	4.91	- (6.30)
LTW	-	5.10	7.58	10.81	13.99	17.98	- (21.96)
FS	-	-	-	-	-	0.47	- (1.70)

Constraint management timeline



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DNOA Outcome Report

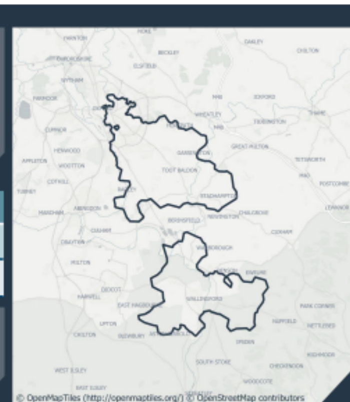
Cowley & Moreton (Cowley Local Main BSP)

Scheme description

- The reinforcement of the Cowley Local Main BSP will increase capacity in the Cowley and Moreton areas. Postcode(s): OX1, OX(3-4), OX(10-11), OX14, OX33, OX44.
- Local authority: South Oxfordshire, Oxford
- Load related – substation thermal overload issues during FCO conditions due to forecasted demand growth.

Proposed option

- Smart/Asset Solution: Installation of an additional 132/33kV transformer.
- Flexibility was unable to be utilised due to being uneconomical from CEM output.
- This option addresses the forecasted thermal overload at Cowley Local Main BSP out to 2050.
- Capacity released: 90MVA



System need requirement

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

DNOA History

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

Indicative flexibility price (if available):

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

Reinforcement timeline

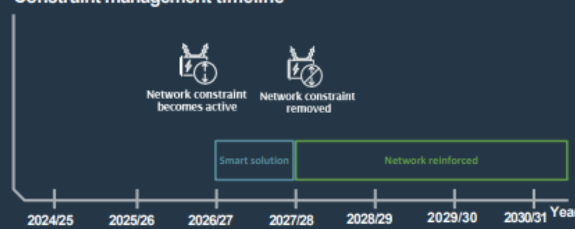
- Reinforcement delivery by the end of 2026/27.

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	-	-	4.65	- (10.55)	- (13.64)	- (16.53)	- (20.35)
ST	-	-	1.92	- (6.56)	- (8.03)	- (9.47)	- (11.28)
LTW	-	-	7.03	- (13.72)	- (17.40)	- (21.39)	- (25.95)
FS	-	-	1.03	- (5.47)	- (6.80)	- (7.98)	- (9.41)

Constraint management timeline



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DNOA Outcome Report

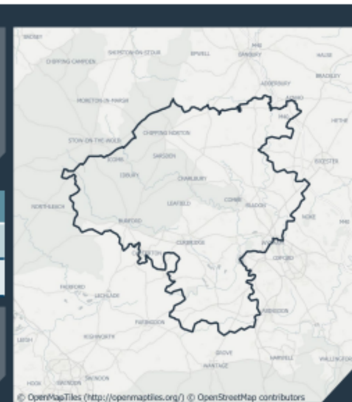
North Oxfordshire (Yarnton & Witney BSP)

Scheme description

- The reinforcement of the Cowley GSP – Yarnton BSP circuits will increase capacity in the north Oxfordshire area. Postcode(s): GL54, OX(1-5, 7, 13-15, 18, 20, 25, 27-29), SN7.
- Local Authority: West Oxfordshire, Cotswold, Vale of White Horse, Oxford, Cherwell
- Load related – circuits overload during FCO conditions due to forecasted demand growth.

Proposed option

- Flexibility/Asset Solution: Installation of an additional 132kV circuit between Cowley GSP and Yarnton BSP.
- This option addresses the forecasted demand growth on the Cowley/Yarnton network out to 2050.
- Capacity released: 282MVA



System need requirement

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

DNOA History

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

Indicative flexibility price (if available):

- Availability price: £150/MW/h
- Utilisation price: £200/MWh

Reinforcement timeline

- Flexibility solution utilised in 2024/25 and 2026/27 to 2028/29.
- Reinforcement delivery by the end of 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	7.65	-	17.44	28.05	38.78	- (89.01)	- (101.70)
ST	4.44	-	8.6	15.82	22.06	- (68.20)	- (74.71)
LTW	11.99	0.41	27.47	41.05	53.34	- (107.45)	- (122.20)
FS	3.3	-	3.39	9.16	14.45	- (59.03)	- (64.40)

Constraint management timeline

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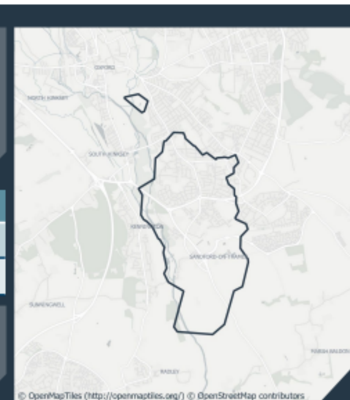
Sandford-on-Thames (Rose Hill PSS)

Scheme description

- The reinforcement of Rose Hill PSS will increase capacity in the Sandford-on-Thames area. Postcode(s): OX1, OX4, OX44.
- Local Authority: Oxford, South Oxfordshire
- Load related – substation and circuits overload during FCO conditions due to forecasted demand growth.

Proposed option

- Flexibility/Asset Solution: Reinforcement of the two 33/11kV transformers (PH1), followed by upgrade of the 33kV circuit from Cowley Local Main BSP to Rose Hill PSS (PH2).
- The phase 1 option addresses the forecasted demand at Rose Hill PSS out to 2029 while phase 2 addresses demand on the circuits out to 2050.
- Capacity released: 20MVA (PH1) & 21.3MVA (PH2)



System need requirement

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

DNOA History

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

Indicative flexibility price (if available):

- Availability price: £150/MW/h
- Utilisation price: £200/MWh

Reinforcement timeline

- Flexibility solution utilised from 2026/27 to 2029/30.
- Phase 1 reinforcement delivery by 2028/29.
- Phase 2 reinforcement delivery by 2030/31.

Estimated peak MW outside firm network capacity under each scenario

Grey text relates to estimated peak MW without reinforcement delivery

	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31
CT	-	-	1.06	1.85	0.41	1.52	- (3.01)
ST	-	-	0.29	0.68	-	-	- (0.07)
LTW	-	0.24	1.76	2.84	1.57	3.04	- (4.83)
FS	-	-	-	0.40	-	-	-

Constraint management timeline

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DNOA Outcome Report

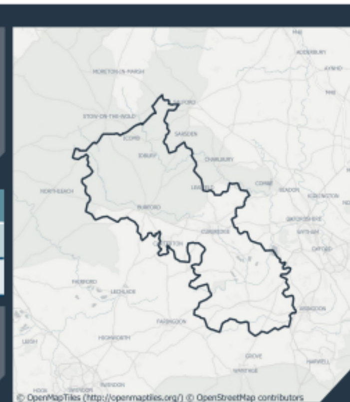
West Oxfordshire (Witney BSP)

Scheme description

- The reinforcement of the Witney BSP will increase capacity in the West Oxfordshire area. Postcode(s): GL54, OX(2, 7, 8, 13, 14, 18, 28, 29), SN7.
- Local Authority: West Oxfordshire, Cotswolds, Vale of White Horse
- Load related – substation and circuits overload during FCO conditions due to forecasted demand growth.

Proposed option

- Smart/Asset solution: Installation of additional 132/33kV transformer at Witney BSP, and reinforcement of 132kV circuit between Witney BSP and Yarnton BSP.
- Flexibility was unable to be utilised due to insufficient flexible assets.
- This option addresses thermal overloading at Witney BSP to 2050.
- Capacity released: 214.3MVA



System need requirement

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

DNOA History

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

Indicative flexibility price (if available):

- Availability price: £150/MW/h
- Utilisation price: £200/MWh

Reinforcement timeline

- Substation will be operationally managed until reinforcement delivery.
- Reinforcement delivery by the end of 2027/28.

Estimated peak MW outside firm network capacity under each scenario

Grey text relates to estimated peak MW without reinforcement delivery

	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31
CT	-	0.03	1.77	4.43	- (7.26)	- (10.31)	- (13.44)
ST	-	-	-	1.13	- (2.88)	- (4.48)	- (6.31)
LTW	-	1.97	4.37	7.38	- (10.9)	- (14.03)	- (18.02)
FS	-	-	-	0.21	- (1.73)	- (3.11)	- (4.59)

Constraint management timeline

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Glossary

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

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

VFES	Vulnerability Future Energy Scenarios
WSC	Worst Served Customers
ZCOP	Zero Carbon Oxfordshire Partnership

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