Electricity Transmission

London: Future Network Blueprint

nationalgrid

Contents

Executive summary

Information gathering

Insights and analysis

Develop options

Executive summary

Executive summary
Purpose

Our whole system vision
To collaborate with our stakeholders to optimally plan, develop, and operate the transmission network, protect vulnerable customers, and deliver whole system benefits while ensuring the delivery of the energy transition by 2050.

In alignment with our national Business Plan, these Future Network Blueprints (FNB) serve to deliver a strategy centred on our whole system vision*, while addressing the unique needs and opportunities within each area. By focusing on national and regional differences and leveraging local opportunities, whilst minimising local impact, we aim to succeed in delivering the grid that is needed by all in the future.

The circumstances in which we build and operate our network are changing rapidly, driven by:

- greater reliance on electricity across various sectors to achieve a decarbonised society and economy
- rising numbers and diversity of customers requiring connections at specific locations
- need for expansive network development to address the requirements of multiple sites and circuits within a region, rather than isolated solutions
- increasing complexity of the network with more variable power flows.

We recognise our FNB 'regions' do not fully reflect the geographic or administrative borders that one might expect to see. This is because in defining these regions we have also had to consider electrical factors such as power transfers and access for planned outages. However we have aligned to Distribution Network Operator (DNO) and local authority boundaries where feasible to do so.

'Whole system' – A collaborative and integrated approach with networks and other stakeholders.

More information can be found in our short video.

* https://www.nationalgrid.com/electricity-transmission/our-future-network/our-whole-system-approach

These changes require a new approach to network development, which is where our Future Network Blueprints play a crucial role. The strategy outlined in these documents detail our process and projected outcomes, ensuring readiness for future requirements.

"Our Future Network Blueprints embed a forward-thinking approach, offering a pathway to enhance efficiency, boost collaboration, and improve visibility for whole system working at the local level."

Ben Haggerty
Head of Whole Systems,
National Grid Electricity Transmission

Executive summary
Our future network blueprint strategy

In developing our Future Network Blueprints, we used the following process:

Step 1
Information gathering

Regional context
Review the region as a whole, understanding broader interactions beyond the network to ensure alignment and identify interdependencies.

Current network view
Collect key data on the current NGET network in each region to understand the baseline for future development.

Design the right network
We place stakeholders at the heart of our network planning process. This approach helps us navigate uncertainties and ensures we have a comprehensive regional understanding of network needs.

Step 2
Insights and analysis

Stakeholder engagement
Enhance our understanding along the way through ongoing engagement and partnerships, enabling us to better foresee forecasts, identify risks and explore opportunities.

Connections
Provide perspective on customer demand and generation trends, helping us forecast future service requirements and growth areas.

Safe and reliable network
Provide critical asset health, maintenance, and operational performance data to ensure the blueprint delivers a dependable network throughout the journey to Net Zero.

Strategic infrastructure
Align with government initiatives and the National Energy System Operator (NESO) to provide input on large-scale projects, shaping long-term infrastructure investments.

Step 3
Develop strategic options

2050 backwards
Step back assessment to ensure we are being ambitious enough to meet our 2050 commitments.

Network design principles
Check we are applying the three NGET Design Principles: are we enabling investments; do it once, do it right; and whole system network planning.

Network compliance
Ensure all projects meet with network security and quality of supply standards [National Electricity Transmission System (NETS) Security and Quality of Supply Standard (SQSS)] to maintain secure and reliable supplies.

Executive summary
Key regional highlights

11

substation investments;
7 new and 4 major interventions in the region

£2.8bn

of investment

to maintain, upgrade and develop our network in T3

9 GW

demand

contracted to connect*, **8.2 MVA** of additional capacity expected to be installed in T3

9 GW

of generation

contracted to connect*; **114 MW** estimated to connect in T3

213 km

of overhead line

reconductoring planned within T3, equating to 29% of the region

1

strategic infrastructure project within the region

65 km

of cable replacement

investment planned in T3, 16% of the region

*Including T3 and beyond

Information gathering

In this section

London
Regional context

National Grid's London network region encompasses the 32 boroughs that make up the capital and includes parts of Surrey and Hertfordshire. London's energy demand is among the highest in the UK due to its dense population, vast commercial sector and critical infrastructure, including transport networks and public services. The city's electricity consumption is concentrated and constant, requiring a highly reliable and resilient transmission network.

London's energy needs are growing due to continuing population growth and the increasing decarbonisation of heat and transport networks and public services. Demand is being further accelerated by the growth in the digital sector and associated data centres in and around London, which require significant amounts of energy. The UK Government recognises the growing importance of the data economy, highlighting the need for safe, secure, and resilient infrastructure on which data relies.

The Greater London Authority aims for a zero-carbon city by 2030, tackling air pollution and ensuring the region benefits from the clean tech sectors of the future such as data centres, whilst also hitting targets for new housing developments. We are committed to supporting this ambition by coordinating with distribution networks to create capacity and bring clean, reliable power into the capital.

Building and maintaining electricity infrastructure in London presents unique challenges due to the city's dense urban environment. The city needs a robust electricity network to meet its energy needs, with new infrastructure or upgrades to the existing network to meet the needs of the future. Just as people move across the city below surface level, much of London's electricity is also transported deep underground. The construction phase of our London Power Tunnels project is well underway and due to be operational by 2027. This project reduces disruption during construction, for future maintenance work whilst also ensuring future demands can be met.

9.4m

London is home to around 9.4 million people

London
Current network view

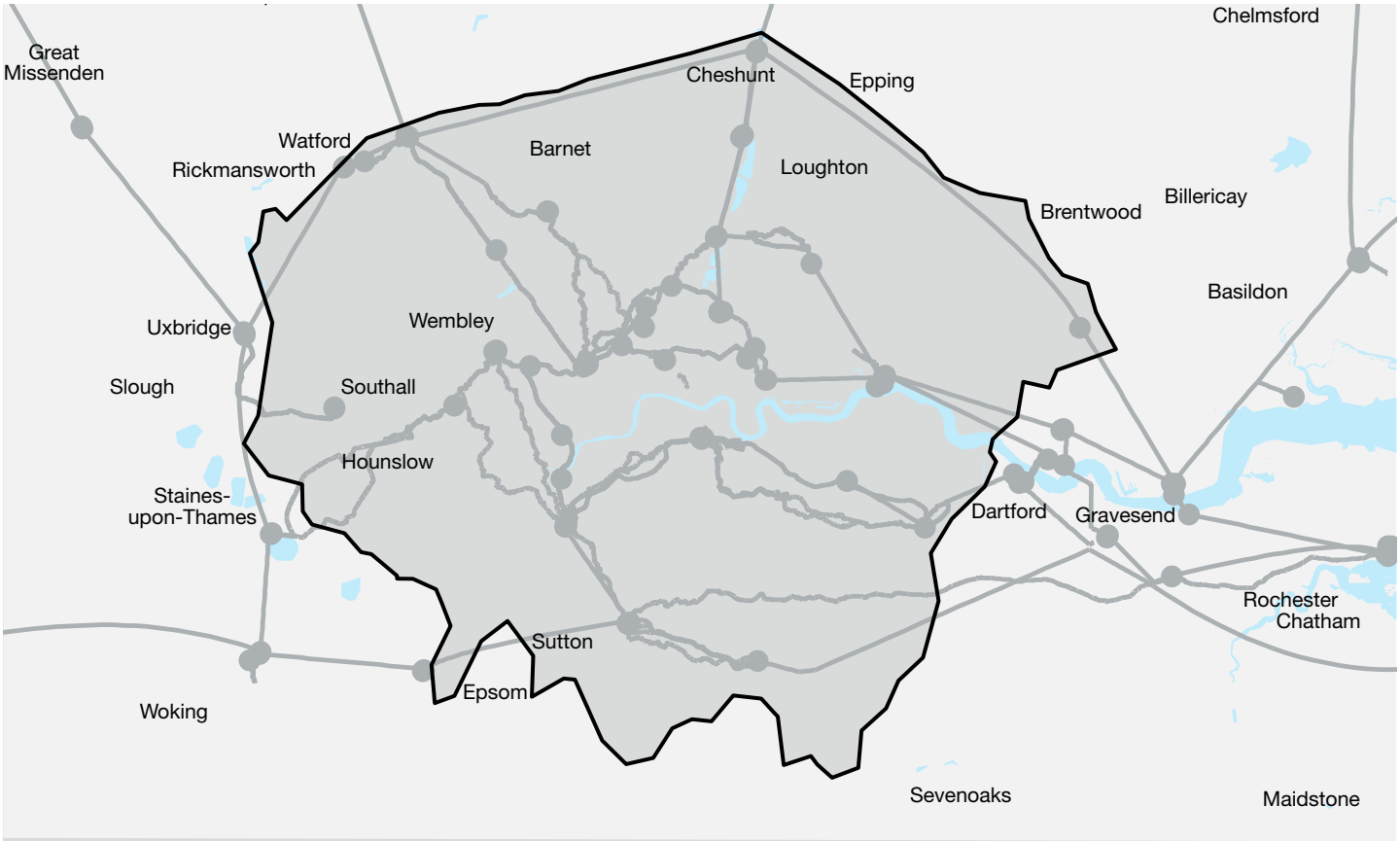
Network overview

The current London network comprises a 275 kV ring network, a mixture of overhead and cable circuits feeding into a central 400 kV cable network. The London network is fed by a wider outer 400 kV network with infeed from surrounding regions. There are also 400 kV export routes towards the Thames Estuary and the wider South East. High commercial loads, from air conditioning in the capital, mean that peak demand during summer heatwaves can exceed winter peaks.

Power flows in London are heavily influenced by the flows on the power interconnectors in the South East to mainland Europe. Interconnectors are high voltage cables that are used to connect the electricity systems of neighbouring countries. They allow excess power to be traded between different countries providing valuable export capability for excess renewables. The London network acts as an entry point into the South East. Projects to reinforce the network around London have started to both help feed expected growth in demand in the capital as well helping move this power around rather than through London.

The Central London network has been significantly enhanced and expanded through the two major London Power Tunnels projects. They are essential in securing the long-term reliability and security of the network. Alongside these, we are also addressing other ageing infrastructure in the region that requires upgrading with a more holistic, long-term approach, for example the installation of a new substation at Barking and new transformers at City Road substation.

The increasing demands for commercial and housing developments in West London have created capacity constraints. NGET is coordinating closely with distribution networks and local authorities to address these and anticipated future requirements. This is being done via a combination of current, tactical, strategic transmission and distribution reinforcement initiatives. Like other regions in England and Wales, we are focused on balancing long-term demand growth alongside the integration of local embedded generation through the distribution networks to ensure optimal level of transmission infrastructure.



Design the right network
Stakeholders

Context

As we embark on our RIIO T3 journey, we recognise that the landscape has evolved significantly since our last price control period. The UK Government's ambitious targets for a decarbonised power system, coupled with the devolved Government powers now enabling regional energy decarbonisation planning, necessitate a fresh, collaborative, and holistic approach.

We made a commitment to place stakeholders at the centre of our network planning and listened to over 12,000 stakeholders representing all regions and stakeholder types.

This helped us in getting a balance of needs and priorities across all our stakeholder groups – from those impacted by the upgrade, those dependent on it (across each region) and those funding it (all consumers).

This insight formed our overarching ambition and created stakeholder design principles to initially assess the approach we took to each network blueprint, ensuring we had a fair and consistent approach to planning from the start.

This is our starting position, but we have also been forming partnerships with those representing the region to help inform and shape what we design and build locally.

This includes the new Regional Energy Strategic Planner (RESP) role set up by the NESO in which we have already started aligning and working with.

Local priorities and needs are crucial to our planning process, which is ongoing and continuously evolving.

>12,000

We have received feedback from >12,000 stakeholders as part of the listening phase of our price control engagement programme

Design the right network
Our ambitions

Ambition A

Deliver the grid of tomorrow, today

Deliver with urgency the Transmission Network needed for Great Britain's future growth and decarbonisation

A1: Maintain world class levels of network performance and resilience, ensuring that the new network we build is designed to reflect future security and climate challenges

A2: Deliver the capacity our customers need now, looking holistically across multiple investment drivers to deliver at the pace and scale required to support the Government's ambition on growth and decarbonisation

A3: Future-proof our network with strategic capacity and flexibility for the longer term, using the network modeling capabilities we developed in RIIO-T2 to surface insights and inform strategic decisions

A4: Invest in the next generation of innovative technologies to make sure that we are planning and building a network that is ready for tomorrow

Ambition B

Do the right thing for consumers, communities and the environment

How we deliver is as important as what we deliver

B1: Maximise the value we create by controlling our costs as our network grows, seek opportunities to create additional value for consumers

B2: Play a leading role in accelerating a net zero, nature positive future, including by reducing our own emissions and environmental impact

B3: Support vulnerable consumers and have a positive impact in our communities through our operations and construction, leaving a lasting legacy

B4: Represent the diverse communities we serve by maintaining our sector-leading record on workforce diversity and inclusion

Ambition C

Transform the way we work

Transform our capabilities to deliver for consumers

C1: Transform our asset management, network development, and network operation capabilities to ensure we can deliver the step-up in work required during this period, and manage a larger, more complex, decarbonised network

C2: Grow our workforce capability by positioning National Grid as the best place to work in the electricity sector

C3: Put into practice new supply chain strategies to secure the long-term capacity we need

C4: Leverage digital and data capabilities to transform how we work with our stakeholders to maintain and operate our network

Insight and analysis

In this section

Insight and analysis
Our approach

To develop a comprehensive and informed strategic plan, we engaged in a process of data collection and analysis, leveraging insights from both internal departments and external stakeholders. This involved a combination of analysing technical data as well as incorporating feedback from engagement workshops, which ensured a balanced and holistic approach.

The combination of external feedback and internal insights, allowed us to create a blueprint that is responsive to both operational realities and future national and regional transmission needs.

Stakeholder engagement	Safe and reliable network	Connections	Strategic infrastructure
Local regional stakeholder input from bodies such as the Distribution Network Operators, local authorities, and community representatives gathered understandings on market dynamics and future expectations at a local level.	Provided critical data on asset health, maintenance, and operational performance, ensuring the blueprint aligns with current capabilities and future needs.	Offered insights on customer demand and generation trends, helping us forecast future service requirements and growth areas.	Delivered input on large-scale projects and alignment with government initiatives, plus network compliance which are pivotal in shaping long-term infrastructure investments.

Stakeholder engagement London

Distribution networks

Scottish & Southern Electricity Networks

UK Power Networks

Within your region, what do you see bringing the greatest demand for connections to the electricity network over the next 10 years?

The engagement sessions found that there is an opportunity to address asset health on the London network and improve resilience, coupled with increasing demand requirements from areas like housing growth and surge in data centres all provide options to co-optimise the networks in this region. Strategically placed upgrades and new infrastructure will unlock capacity in the network and ensure a resilient supply of electricity for homes and businesses in the capital.

What did stakeholders in London tell us?

‘There is a silo of information and a silo of decision making, there needs to be greater convening of data and decision making.’ – (Water Transport)

‘We have members that have abandoned projects because of long connection timelines. Connections are being offering in the late 2030s, to which they say ‘that doesn’t work for us any more.’ – (Industry Representative)

‘There needs to be a look at deliverability of some of these projects. If there’s a finite amount of trained people, does that mean we need to train more people.’ – (Academic)

We are working with local distribution networks (DNOs) to understand the impacts and requirements in that region. Working with the DNOs, we collaboratively and continually make certain that a whole system approach is always considered in our planning.

We have been engaging with DNOs to strengthen our regional strategic partnerships and develop robust whole system capabilities.

21

The above number indicates the amount of whole system opportunities we have identified in London.

A ‘**whole system opportunity**’ refers to areas where we can collaborate to find more integrated solutions. This could involve infrastructure planning, enhancing the quality and depth of data, or improving network design.

Safe and reliable network

There are over 500 substations, 7,200 km of overhead line (OHL) and 1,400 km of high voltage cable on the NGET network.

Our Asset Management Strategy provides direction to the management of these.

For RIIO T3 we are required to submit a portfolio view of our assets with supporting narrative providing justification on the level and type of investment.

Typically, the default position in asset operations is to incrementally upgrade and replace assets as and when required.

In developing our strategic plan, our Asset Operations colleagues conducted a thorough review of the asset health data across the region relating to:

- **Reliability:** Network growth will be at its highest in T3, we will proactively identify, manage, and address asset failure risk ensuring reliability across our network is maintained at the current industry leading level.
- **Risk:** Our plan delivers value to consumers by achieving a significant reduction in risk.
- **Environment:** We will seek to maximise environmental benefits by identifying and replacing assets which contribute to environmental harm.

Key metrics across London

We continuously monitor and maintain our assets on a regular basis, undertaking replacements or refurbishments of assets when determined necessary to ensure the reliability of the network.

We have identified six high voltage substations in the region with enhanced asset health requirements. Apart from requiring asset replacements due to condition, these sites also have other site-level structural and equipment issues. These will be addressed via a combination of portfolio asset interventions and major projects.

A total of 83 km of overhead line in London require replacement in the next 10 years. Some of this will also be uprated alongside other work.

Natural hazard resilience
By the end of 2025, all relevant London sites will be fully compliant with Energy Networks Association standard 138 on flood protection.

Physical security resilience
With increasing generation and demand we are investing in enhanced physical security at sites within the region.

6
High voltage substations identified in region that require enhanced asset health intervention

83 km
High voltage cable to be replaced in the next 10 years

Asset health intervention regional metrics

5
Super grid transformer

138
Circuit breakers

106
Voltage management assets

411
Bay assets

Customer connections
Regional overview

We leverage National Energy System Operator (NESO)'s future energy scenarios and market intelligence to chart the pathway that defines the required energy mix and informs our investment plans. Beyond this, we continuously analyse various scenarios and their underlying network drivers to understand how the energy mix might evolve, incorporating these insights into our regional assumptions.

The investments to achieve the energy mix required will drive how we think about these at site and regional level. For example:

Standalone connection

Typically there is a specific customer need at a site. The connection usually requires less investment and is relatively straightforward in terms of complexity.

Site strategy

Where ageing infrastructure, fault level restrictions or physical space is unavailable at an existing site we may not be able to connect customers, therefore a more holistic site strategy is required such as building a new substation.

Circuit strategy

When we review circuit health, we will assess the long-term growth and capacity needs in a region. This will help us determine whether to maximise the line ratings or consider increasing the voltage and upgrading the associated substations.

Regional demand and generation

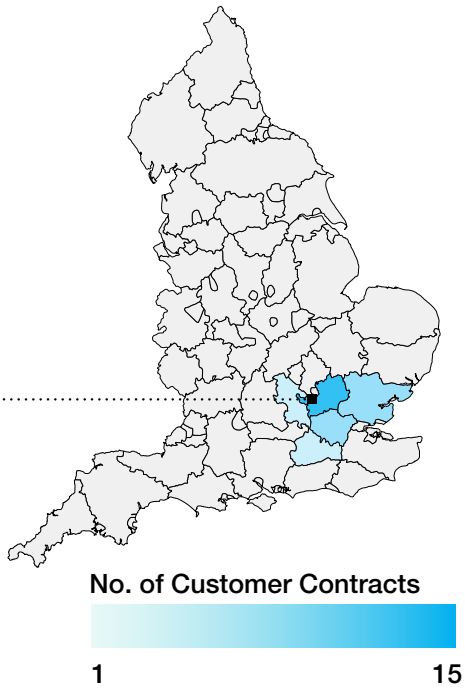
Demand connections – where power is taken from the grid

Generation connections – where power is added to the grid

Demand:
9 GW

Generation:
9 GW

Shows a heat map for the number of contracted connections within London region out to 2034.



Customer connections
London demand and generation breakdown

New connections in the region: Generation

London is predominantly a net importer whereby excess power on the Transmission Network flows into this region and heads to the interconnectors to mainland Europe in times of high wind and solar generation in the UK.

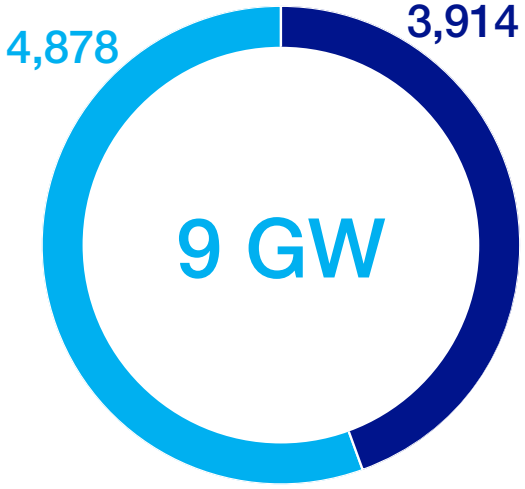
We have contracts for our customers to deliver into the mid 2030s which would connect up to 9 GW of generation. However, not all of this is expected to connect to the network

New connections in the region: Demand

There is about **9 GW of demand connections** in London. However, not all of this demand is expected to connect.

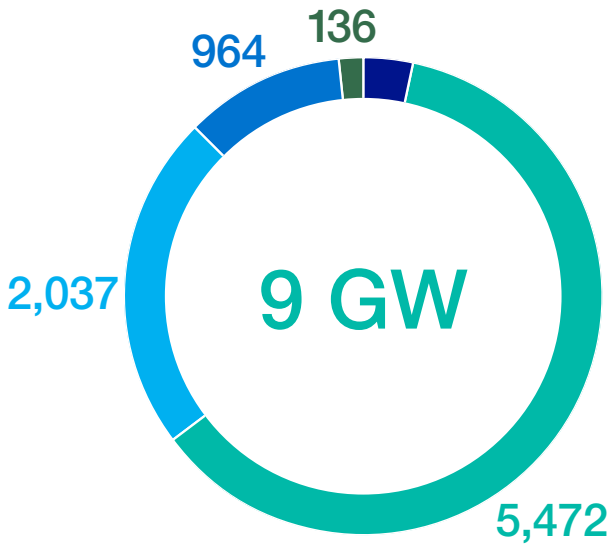
We expect to add 8.2 GVA of capacity in T3.

- Battery storage
- Battery storage – hybrid
- Fossil fuel



Over 100 MW of new battery storage is expected to connect in T3

- Construction supplies
- Data centre
- Embedded demand
- Embedded demand – data centre
- Rail



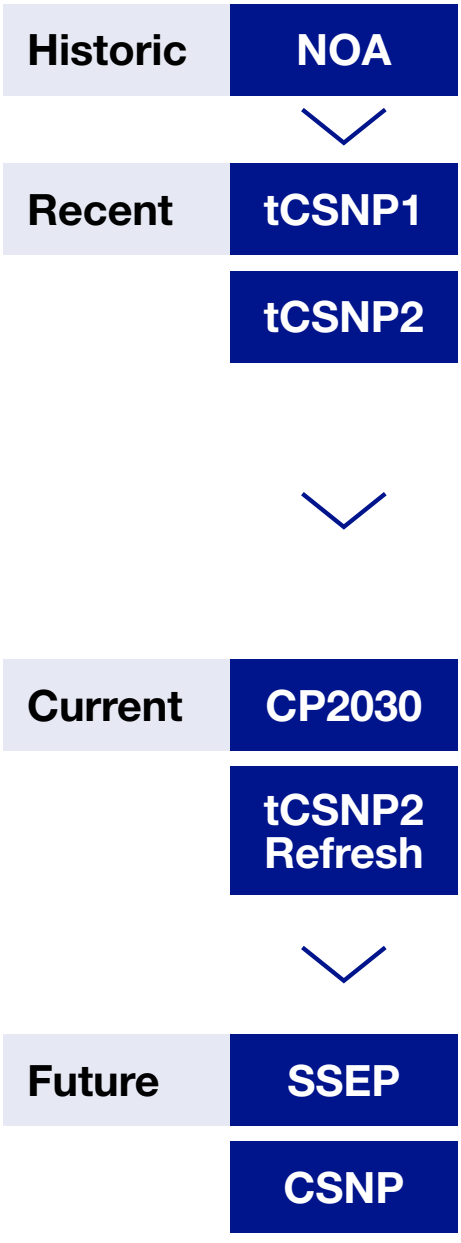
8.2 GVA of capacity to be added in T3

By providing a future ready system through our investments we are also creating options for additional connections.

Strategic infrastructure
Background

The National Energy System Operator (NESO) process for identifying strategic infrastructure on the electricity transmission network has significantly evolved to meet the changing demands of the energy landscape. NESO incorporates scenario analysis, market intelligence, and stakeholder engagement to predict future energy needs.

This includes integrating renewable energy sources, enhancing network resilience, and aligning with government policies on decarbonisation. The evolved process aims to ensure that strategic infrastructure development is proactive, addressing both current and future challenges, and supporting the transition to a sustainable and reliable energy system.



Network Options Assessment (NOA):

The NOA is the annual process through which the ESO (now NESO) provided its recommendation for which network reinforcement projects should receive investment, and when.

Transitional Centralised Strategic Network Plans (tCSNP1 and tCSNP2)

In recent years, the planning processes managed by the NESO has started to take a more holistic approach to network reinforcement with the introduction of the Holistic Network Design (HND), which has combined with the NOA to create the 'transitional Centralised Strategic Network Plans'.

- tCSNP1 is the combination of HND1 and the NOA 2021/22 refresh and identified the 'Accelerated Strategic Transmission Investment' (ASTI) projects. The report published by the NESO is also referred to as "Pathway to 2030".
- tCSNP2 is the combination of the HND Follow up Exercise (HND FUE) and the NOA, published in 2024 and facilitates the connection of an additional 21 GW of offshore wind, plus other low carbon generation across Britain. The report published by the NESO is also referred to as "Beyond 2030".

Clean Power 2030 (CP2030)

In November 2024, the NESO provided advice to government on how to achieve clean power by 2030. The Government published its Clean Power Action Plan in December 2024. This will inform the policies, investments in renewable energy and network, and technological advancements required to achieve clean power by 2030.

tCSNP2 Refresh

NGET is developing the options recommended in the tCSNP2 to a greater level of maturity and those options will be re-assessed by NESO through the tCSNP2 Refresh.

Strategic Spatial Energy Plan (SSEP):

The NESO will produce the SSEP with the first plan being published by the end of 2026. It will assess the optimal locations, quantities and types of energy infrastructure required to meet our future energy demand, helping enable the clean, affordable and secure supply, and be a key input into the CSNP.

Centralised Strategic Network Plan (CSNP):

The CSNP will be produced on a 3-year cycle, allowing a more integrated approach to network planning and more developed recommendations than the NOA. It will provide a more strategic, long-term view of the transmission network's development, using the SSEP as a key input. The first CSNP is due to be published by the end of 2027.

Strategic infrastructure
London projects

In **London** we will develop new infrastructure and enhance existing networks to ensure adequate capacity for electricity transmission in and out of the capital. This plan includes upgrading the current circuits and infrastructure around the city's outskirts.

We have significantly reinforced our Central and South London networks over the last decade through the London Power Tunnels projects; LPT2 and LPT3.

In T3 we are reinforcing some of the main arterial power flow routes into North and East London to increase capacity to meet higher power flow growth requirements in the region.

Specific projects include:

North London Reinforcement (NLR)
NLR project between Hackney and Pelham – T3 period

neso.energy/publications/clean-power-2030

Develop options

In this section

Develop options
Our strategy

We carry out 3 simple steps to test our thinking around strategic options.

‘2050’ Backwards

We take step back and look across the network region by region to understand if we are being ambitious enough.

Q. Are we embedding the stakeholder design principles that have been set?

Q. Have we provided a long-term focus?

Q. Have we addressed possible operability challenges in the future?

Q. Have we considered all known and potential drivers for the site/circuit?

Network compliance

System analysis is undertaken to plan and develop the network to meet the requirements of the Security and Quality of Supply Standards (SQSS).

- Ensure the transmission network can withstand equipment faults and failures.
- Determine network solutions that provide the necessary transmission infrastructure to maintain the long-term secure and resilient supply of electricity to consumers.
- Deliver new connections to the transmission network.

Network design principles

We then test our view against our Network Design Principles.

- **Enabling investments** – We will plan and build a network platform today that is ready for future requirements, making sure we are not the blocker to the energy transition.
- **Do it once, do it right for the future –** We will plan the scope and timing of network investments to address multiple drivers at once. We will coordinate delivery to reduce system access requirements, increase efficiency and minimise disruption to communities.
- **Whole system network planning –** We will work with other utilities, across vectors and with stakeholders at all levels to ensure planning and delivery of our future network is coordinated and optimised for the UK.

Our plan

National Grid’s electricity transmission strategy in London focuses on upgrading and reinforcing the network to increase capacity to feed the growing demands and secure long-term resilience. This will enable the capital to meet its decarbonisation and net-zero ambitions.

We have significantly enhanced the Central London network through our London Power Tunnel projects. In North London we are reinforcing existing routes to improve power flows into Central and East London.

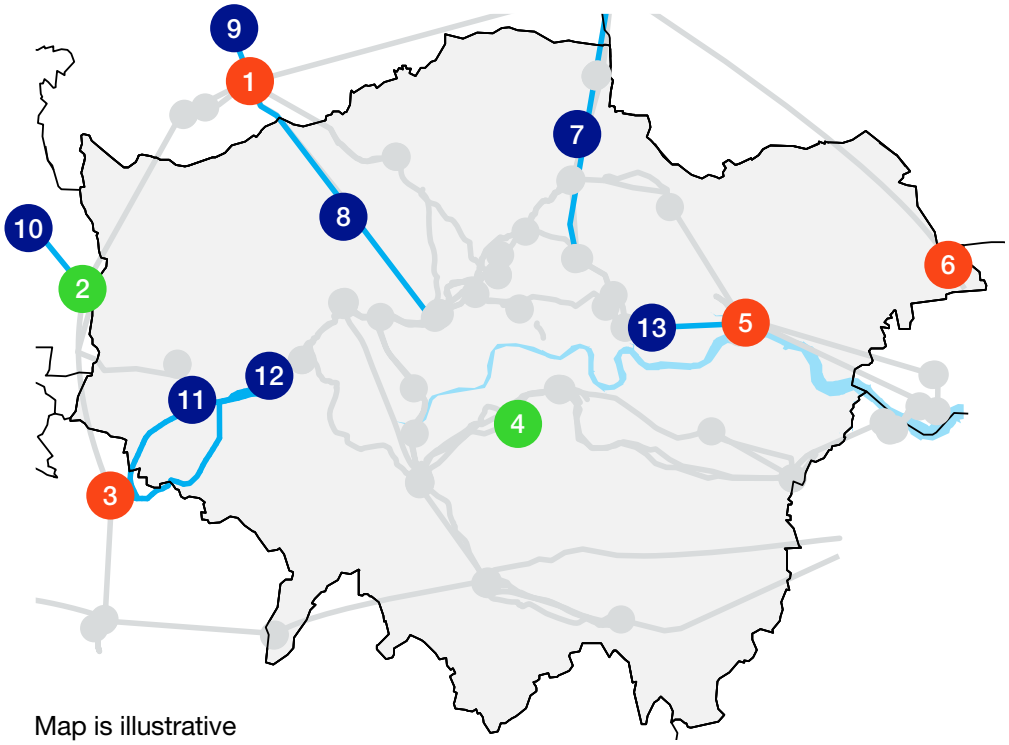
In West London we are enabling capacity at a number of sites to meet increasing demand needs of new housing infrastructure and data centres that are forming an increasingly important part of the UK digital economy.

London Strategy

Substations

1. **Elstree 400 kV** Upgrade – Beyond T3
2. **Uxbridge Moor 400 kV and 132 kV** – New Substation – T3 Period
3. **Laleham 132 kV** Upgrade – T3 period
4. **Bengeworth Road 132 kV** New Substation – T3 Period
5. **Barking 275 kV** Rebuild – Beyond T3
6. **Warley 275 kV** Rebuild – Beyond T3

7 new substations including Bengeworth Road and Uxbridge Moor



Map is illustrative

- Major site strategy
- New substation
- Coastline
- Existing network
- Upgrade existing
- New build
- Developing only*

Circuits

7. **NLR – Hackney-Tottenham-Waltham Cross** – Upgrade circuit – T3 period
8. **ESC1 – Elstree-St Johns Wood** – New circuit – Beyond T3
9. **Elstree-Sundon** – Reconductor OHL circuit – T3 period
10. **Iver – Amersham – East Claydon** – Reconductor OHL circuit – T3 period
11. **Ealing-Laleham 1 and 2** – Cable replacement – Beyond T3
12. **Ealing – Willesden** – Cable replacement – Beyond T3
13. **BWRE – Barking – West Ham** – Reconductor OHL circuit – T3 period

Map is illustrative. New build and some upgrades are subject to planning permission. The lines shown here should therefore not be regarded as defined or proposed routes but reflective of various required reinforcements published by NESO. Includes baseline and pipeline projects. Major site strategy includes existing substations where we plan a rebuild or significant extension (> £20m). Does not include new tCSNP2 circuits onshore and offshore which are subject to the outcome of NESO's tCSNP2 refresh. This network region reflects the geographical area of East Anglia, but includes some network from parts of neighbouring regions.

*As indicated by NESO; final network solution/route may differ.