



Electricity
Transmission

Wales: Future Network Blueprint

nationalgrid

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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



National context

Review the nation 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 nation 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 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

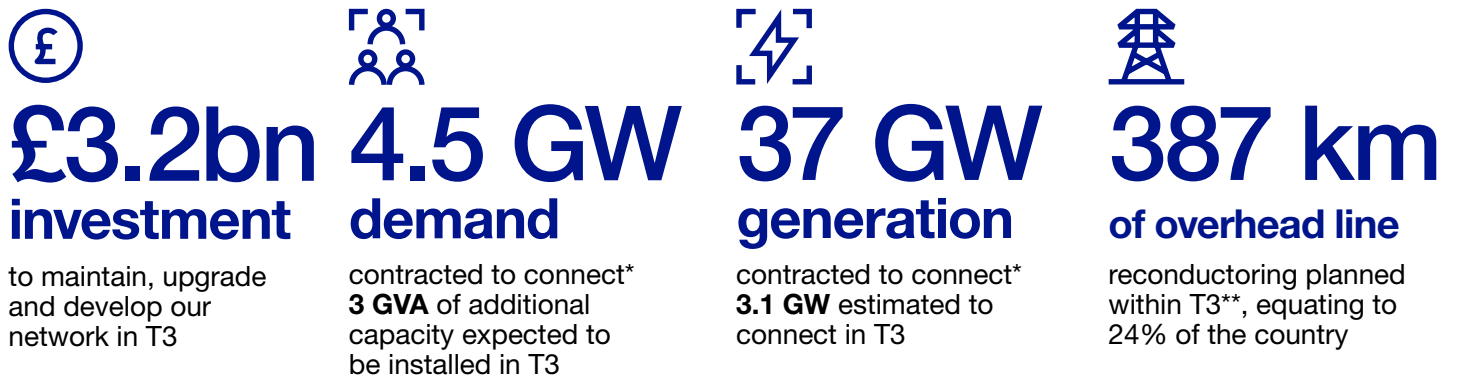
Ensure all projects meet with network security and quality of supply standards [National Electricity Transmission System (NETS) Security and Quality of Supply Standard (SQSS)] to maintain secure and reliable supplies.

Executive summary

Key highlights



substation investments,
3 new and 8 major
interventions



strategic infrastructure
projects within Wales



*Including T3 and beyond

**Some km already completed where projects started in RIIO-T2

Information gathering



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Wales

National context

Wales has a diverse landscape with urban centres, rural and mountainous landscapes and a significant coastline with many National Landscapes, formally known as Areas of Outstanding Natural Beauty. With a population of around 3.1 million, Wales has a diverse economy, including key sectors of manufacturing, services and tourism, all of which will need to decarbonise.

The Welsh Government has set a target for Wales to meet 100% of its electricity needs from renewable sources by 2035 and achieve net zero carbon emissions by 2050, ambitions which signal a significant energy transition for the country. With abundant wind and marine resources, and scope for future nuclear development at Wylfa, North Wales could become a net exporter of low carbon electricity. A new generation of floating offshore wind farms are proposed off the South Wales coast.

Decarbonisation efforts may be particularly challenging in Mid Wales owing to the lack of electricity transmission infrastructure in the area. The ability to transfer power efficiently and securely between the north and south of the country, and across the UK, has been identified by NESO as essential to meet Britain's 2030 offshore wind targets.

Domestic electricity demand is expected to grow, as is industrial demand due to significant green energy and industrial transformation initiatives. As more projects seek a connection in Wales, our plans support these ambitions by upgrading existing networks and expanding capacity for the transfer of clean power to where it's needed.



3.1m

Wales is home to around 3.1 million people



Wales

Current network view

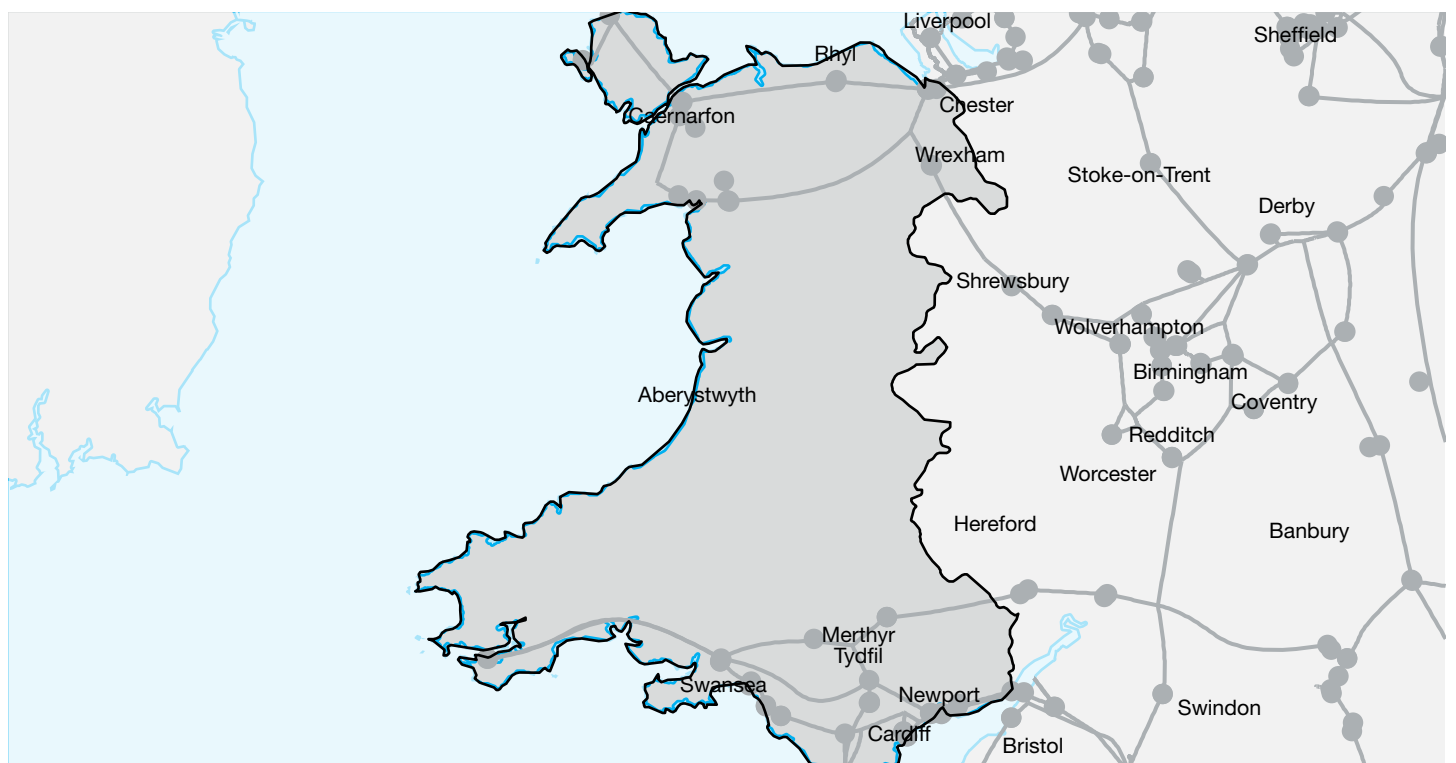
Network overview

The current transmission network in Wales is made up of a 400 kV transmission route in North Wales that interlinks via the Midlands to a 400 kV ring configuration and then a parallel mix of 400 kV and 275 kV routes in South Wales.

The transmission network in North Wales was designed for moving power from older generating plants to demand centres. The region houses Dinorwig; a hydroelectric pumped storage generator used by the system operator for strategic reserve and fast dispatch. The infrastructure assets at Dinorwig are currently undergoing a substantial programme of replacement and reinforcement due for completion in 2026.

The network in South Wales services residential urban demand centres as well as significant industrial demands, including at Port Talbot. Demand is also growing for the decarbonisation of industry, new data centres and hydrogen production. As such, demands on the transmission and distribution networks are increasing and NGET is currently assessing various options to determine the long-term reinforcement needs of the southern network.

Mid Wales currently has no transmission infrastructure and limited distribution network. However, the Welsh Government have signalled support for additional capacity in this region, as part of their energy strategy.



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

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 UK Government's ambition on growth and decarbonisation

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

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

How we deliver is as important as what we deliver

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

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

Transform our capabilities to deliver for consumers

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



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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 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 Wales

Distribution networks



What do you see bringing the greatest demand for connections to the electricity network over the next 10 years?



The engagement sessions found that opportunities exist to improve operational flexibility of the networks, improve resilience of the system through addressing asset health drivers and work alongside key stakeholders in Wales to support growing demand and generation.



What did stakeholders in Wales tell us?

‘We need ease of connections for the high voltage gridpoints for future railway projects. We need transparency about your future work and plans to help us integrate green projects.’ – (Rail Industry)

‘We all must provide a holistic picture of how individuals and communities directly and indirectly benefit.’ – (Energy Industry Group)

‘Putting in applications and getting answers of 2032 is too far away. We have the assets ready to go.’ – (Electricity and Gas)

‘Who is going to pick up the costs? Particularly for the most vulnerable.’ – (Community and Local Energy)

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 strategic partnerships and develop robust whole system capabilities.



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

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 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 Wales 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 Wales

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 three high voltage substations in the country 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 534 km of overhead line in Wales require replacement in the next 10 years. Some of this will also be updated alongside other work.

Natural hazard resilience

By the end of 2025, all relevant sites in Wales 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 in Wales.

 3

High voltage substations identified in Wales that require enhanced asset health intervention

 534 km

Overhead line in Wales that requires replacement in the next 10 years

Asset health intervention national metrics

 47

Circuit breakers

 243

Bay assets

 60

Voltage management assets

Customer connections Wales 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 assumptions.

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



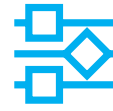
Standalone connection

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 to 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.

National demand and generation

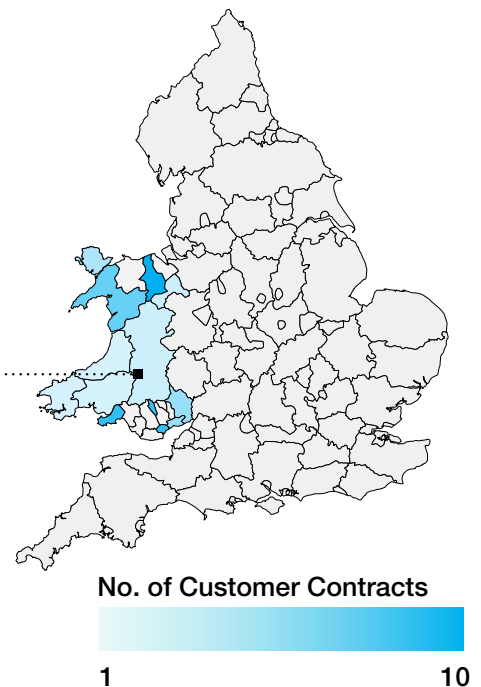
Demand connections – where power is taken from the grid

Generation connections – where power is added to the grid

Demand:
4.5 GW

Generation:
37 GW

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



Customer connections Wales demand and generation breakdown

New connections in Wales: Generation

Wales is predominantly a net exporter whereby excess power on the Transmission Network flows out of the country. Expected interest from developers in generation projects in Wales will need support from a safe and reliable network in Wales.

We have contracts for our customers to deliver into the mid 2030s which would connect up to 37 GW of generation. However, not all of this is expected to connect to the network.

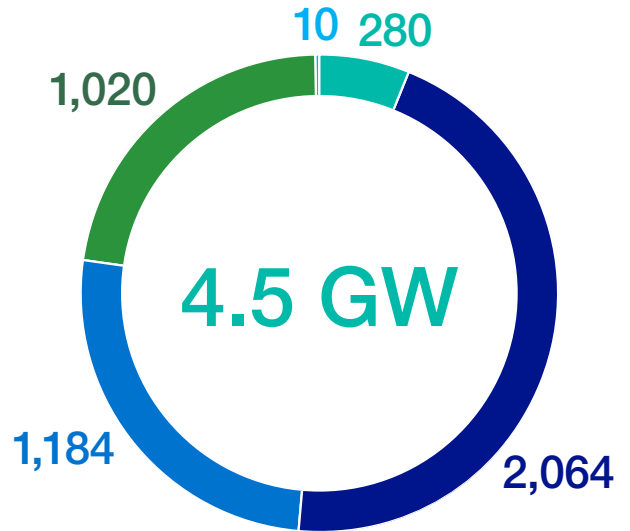
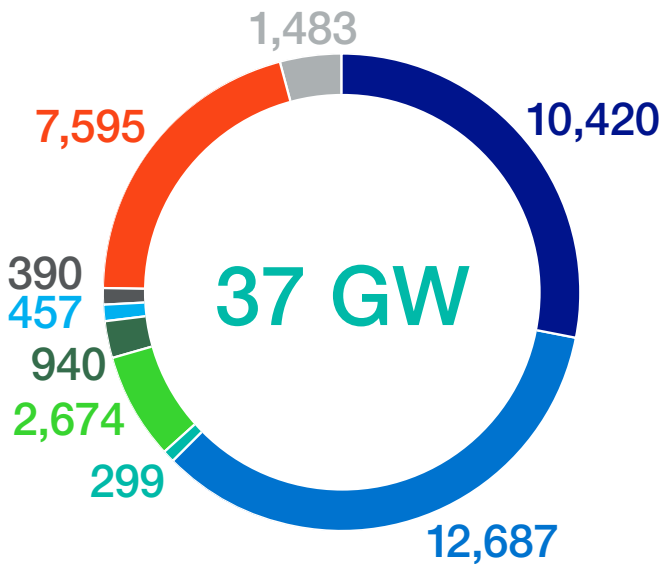
New connections in Wales: Demand

There is about **4.5 GW of demand connections** in Wales. However, not all of this demand is expected to connect.

We expect 3 GVA of capacity for demand to be added in T3.

- Battery storage
- Battery storage – hybrid
- Fossil fuel
- Interconnector
- Nuclear
- Pump storage
- Solar
- Tidal
- Transmission services
- Wind – offshore
- Wind – onshore

- Commercial
- Data centre
- Embedded demand
- Industrial
- Pathfinder



3.1 GW of generation estimated to connect in T3

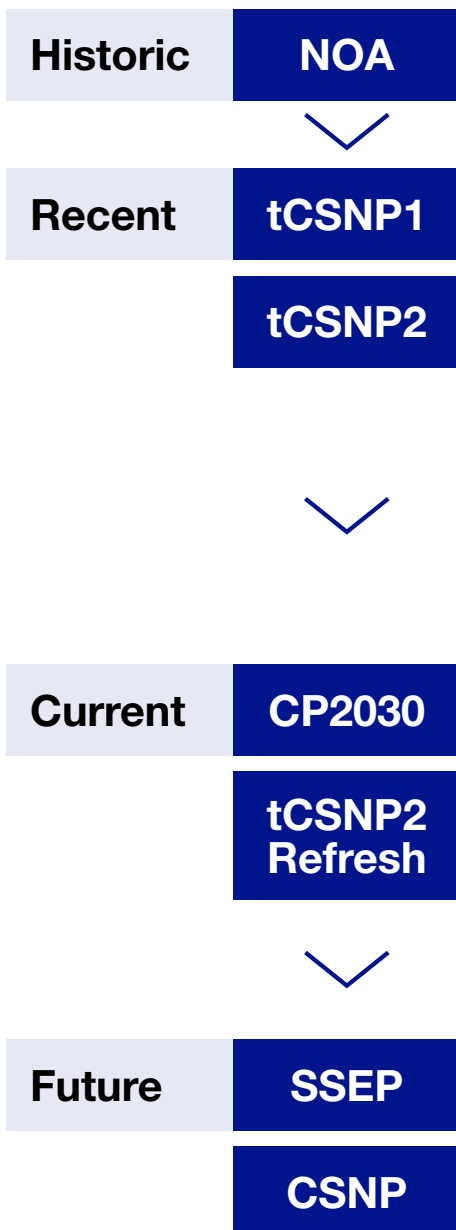
3 GVA of capacity to be added in T3

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 Wales projects

In **Wales** we will develop new infrastructure and enhance existing networks to ensure adequate capacity for electricity transmission in and out of the country.

Specific projects include:

AC6
HVDC link from Western Scotland to a substation in Wales – Post-T3

PSNC
New circuit between North Wales and South Wales – Post-T3

PTNO/PTN2
Second circuit in North Wales on an existing route – T3 period

PTC1/PTC2
Pentir to Trawsfynydd reinforcement – T3 period



[neso.energy/publications/
clean-power-2030](https://neso.energy/publications/clean-power-2030)



Develop options



In this section

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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 strategy for the electricity transmission network in Wales emphasises upgrading the existing network and constructing new infrastructure to support the integration of renewable generation in both North and South Wales.

This includes reviewing options for the potential Celtic Sea offshore wind project in line with the recommendations by the National Energy System Operator (NESO) in their Beyond 2030 publication. This will enable clean and sustainable generation for Wales whilst also supporting the expected demand growth driven by increasing industrial needs.

Additionally, we are in early stages of development for other projects recommended by the NESO in the Beyond 2030 publication for new infrastructure, assessing a range of possible options to find the optimal solution to the network requirements.

Wales Strategy



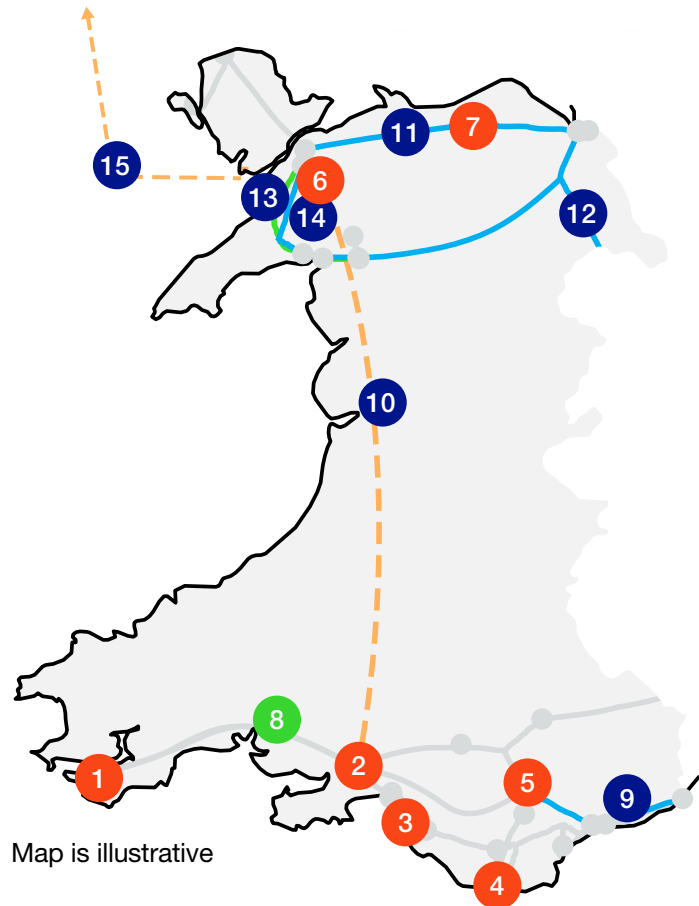
Substations

- 1 **Pembroke 400 kV**
Upgrade – T3 period
- 2 **Swansea North 400 kV –**
Upgrade – T3 period
- 3 **Margam 275 kV**
Rebuild – T3 period
- 4 **Aberthaw 275 kV and 132 kV**
Rebuild – T3 period
- 5 **Cilfynydd 400 kV**
Upgrade – T3 period
- 6 **Dinorwig 400 kV**
Rebuild – T2/T3 period
- 7 **Bodelwyddan 400 kV**
Upgrade – T3 period
- 8 **Llandyfaelog 400 kV**
New proposed substation –
T3 period

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

3

In addition we will be investing in 3 new proposed substations including Llandyfaelog



Map is illustrative



Circuits

- 9 **Cilfynydd – Seabank – Whitson**
Reconductor OHL circuit
– T3 period
- 10 **PSNC**
New circuit between North Wales
and South Wales – Beyond T3
- 11 **Bodelwyddan–Deeside–Pentir
1 and 2**
Reconductor OHL circuit
– T3 period
- 12 **Deeside – Legacy –
Trawsfynydd 1 and 2**
Reconductor OHL circuit
– T3 period
- 13 **PTNO/PTN2**
Second circuit in North Wales
on an existing route – T3 period
- 14 **PTC1/PTC2**
Pentir to Trawsfynydd
reinforcement – T3 period
- 15 **AC6 – HVDC link from
Western Scotland to
a substation in Wales**
– Beyond T3

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 Wales, but includes some network from parts of neighbouring regions.

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