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Analysis of the impact of Zonal Pricing on Transmission Network Investment

June 2025

NESO
National Energy System Operator

Context

NESO has undertaken modelling of the impact of Zonal Pricing, on the future needs for investment in the electricity transmission network – including both economic assessment and system compliance assessment.

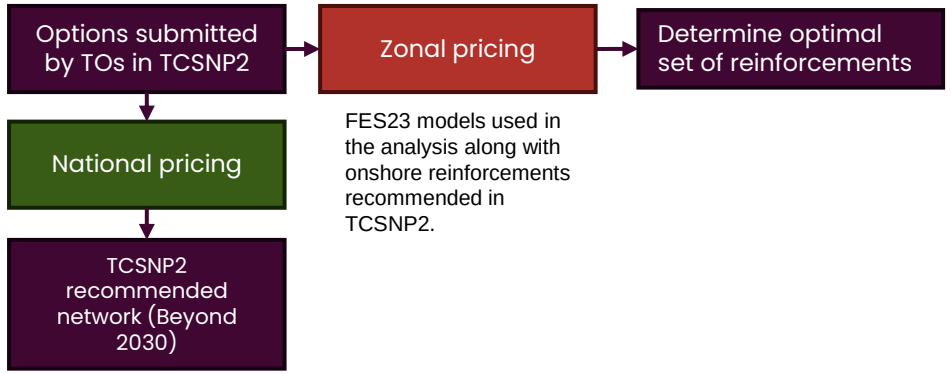
NESO Modelling Approach

NESO has undertaken our analysis of the future transmission network required under both national and zonal wholesale markets. The NESO approach is based on our network planning dataset and assesses each network reinforcement option individually.

The analysis assumes that all the HND1 onshore and offshore network is developed and assesses the additional reinforcements that is recommend in our optimal Beyond 2030 network. We assume that there has been no change in siting of generation / demand in response to a different wholesale price signal. In the assessment of both a zonal and national markets the same FES 2023 Customer Transformation scenario was used.

The national modelling - our Beyond 2030 / TCSNP2 network plan - looks out to the network required to around 2035. Therefore, no assessment has been undertaken of longer-term implication of market design on network requirements beyond the mid-2030s horizon.

For determining if a reinforcement is needed, under national pricing we follow the same methodology as the Beyond 2030 economic assessment – a reinforcement option is recommended, if the reduction is constraint cost is greater than the capital cost of the project. For the zonal pricing we replace the constraint cost with a saving in Consumer cost compared to the capital cost of the project.



System Compliance.
In addition to our economic analysis, we also evaluate the necessity of circuits to maintain a compliant and safe system.
The transmission system design must adhere to the *Security and Quality of Supply Standard (SQSS),* which specifically outlines security requirements for connecting generation and the necessary design considerations for circuit losses for the wider system. Adhering to the SQSS may necessitate the addition of circuits to mitigate security risks, even when the straightforward economic justification based on consumer benefits does not prompt an investment.

Key Message 1

Locational Pricing signals can lead to a multi-billion reduction in network costs

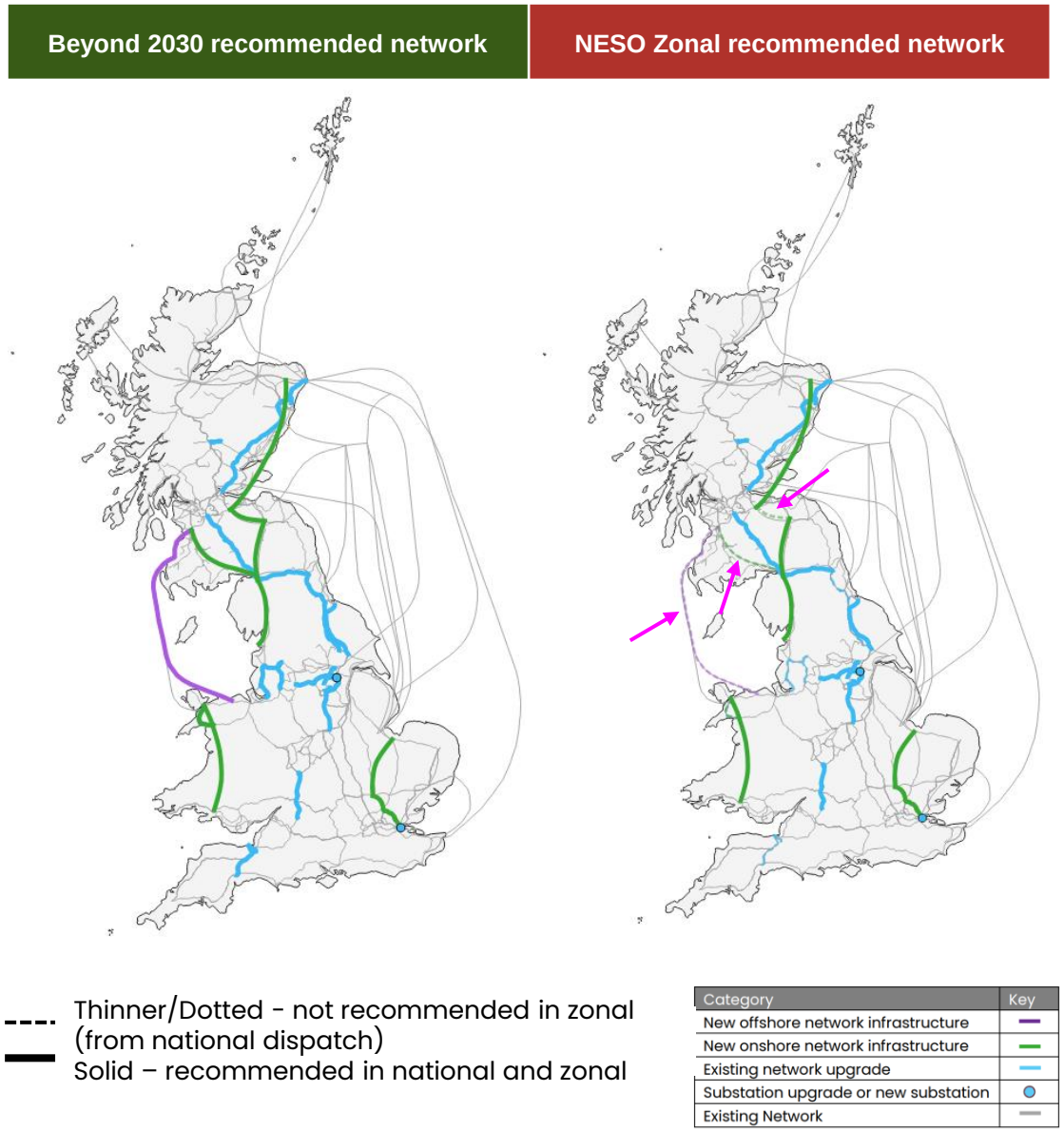
We found that three new pieces of infrastructure would not be needed in a zonal market, compared to the Beyond 2030 recommended national market network. This is equivalent to £3bn of avoided transmission network investment arising from zonal pricing.

The affected circuits are:

- The second western HVDC bootstrap (WCD4)
- A new circuit between Harburn and Gala North (HGNC)
- A new circuit between South West Scotland and North West Egland (WCN2)

In addition, around £5bn of avoided network investment has already been included in our Beyond 2030 plans, by the siting of around 8GW of additional large demand in Scotland in the early 2030's.

Locating this demand near high renewable outputs, reduces the need for transmission network and with a zonal market would allow access to cheaper power. If this demand did not connect, or were located further south, then significant additional network investment (around £5bn) would be needed. Importantly, a mechanism such as zonal pricing is needed to incentive the demand to connect in a place that minimises future network need.



Key Message 2

The need for further transmission network is based on a multitude of factors

Other assessments, such as those produced by LCP and FTI, have shown a need for significantly less transmission network investment based on economic-only assessment of the impact of zonal prices, particularly replacing energy from Scottish offshore wind generation with interconnector import in the south. However, our analysis of the impact of a zonal market shows they have overstated the benefits of reduced network build.

Reinforcements in Beyond 2030 were optimised to ensure secure compliant connections for the offshore wind in the design scope and operation and provide wider network benefit.

Around £4bn of network reinforcements are needed to connect some c.10GW of wind (and other future connections like onshore wind, etc.). These network schemes are not be required in an economic-only zonal assessment but are required to facilitate the connection of the offshore wind.

If these windfarms did not connect, it may be possible to avoid some of these reinforcement (costing around £4bn in total). However, for example, by 2034, our dispatch modelling suggests further imports or an additional 5.5TWh of unabated gas generation will be needed to meet GB demand, if this wind generation is not developed.

GB Offshore wind and the network to securely connect it are critical elements for achieving the clean power targets such as the ones set out in the carbon budget.

	Reinforcement	Dependent windfarms
BKUP	Upgrade the existing network to a higher voltage between Kintore and Blackhillock	OWPL extension (2032), Talisk (2034)
CLN2	New circuit across North West England	
CMN3	New circuit between South East Scotland and North West England	Morven (2034)
EDN3	Replace the conductors on the existing circuits between Brinsworth and Thorpe Marsh, Brinsworth and Chesterfield, and Chesterfield and Ratcliffe with higher capacity conductors	Morven (2034)
NHNC	New circuit from North East Scotland to the Central Belt	Broadshore, (2035) Muir Mohr (2034), Arven (2040), Stoura (2037)

List of reinforcements not recommended in an economic only assessment of zonal dispatch, but needed to connect future Offshore Wind

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Impacts on clean power have been estimated in this analysis as the network developed in TCSNP2 was under FES23 while the CP30 analysis uses bespoke scenarios.

Key message 3

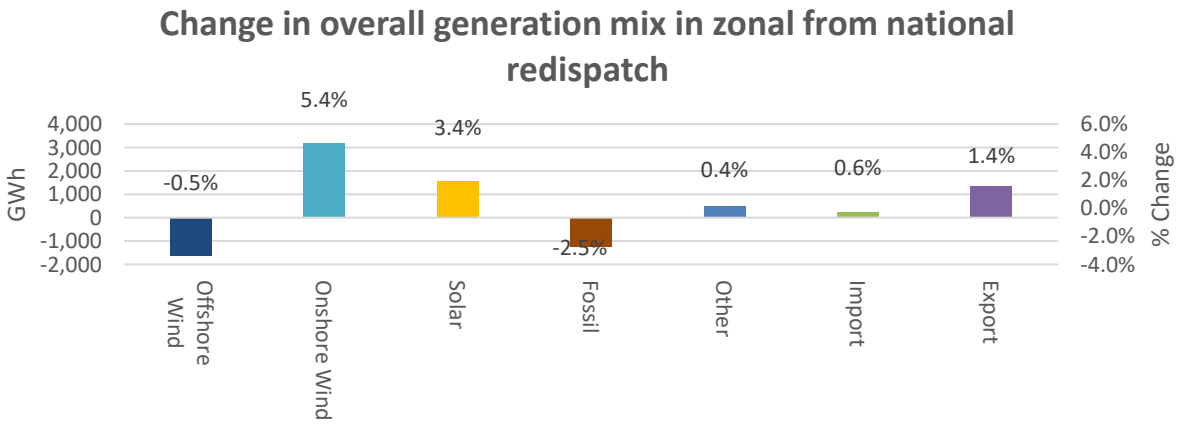
Building network alone does not fully reduce constraints, but locational signals enable a more efficient use of the network.

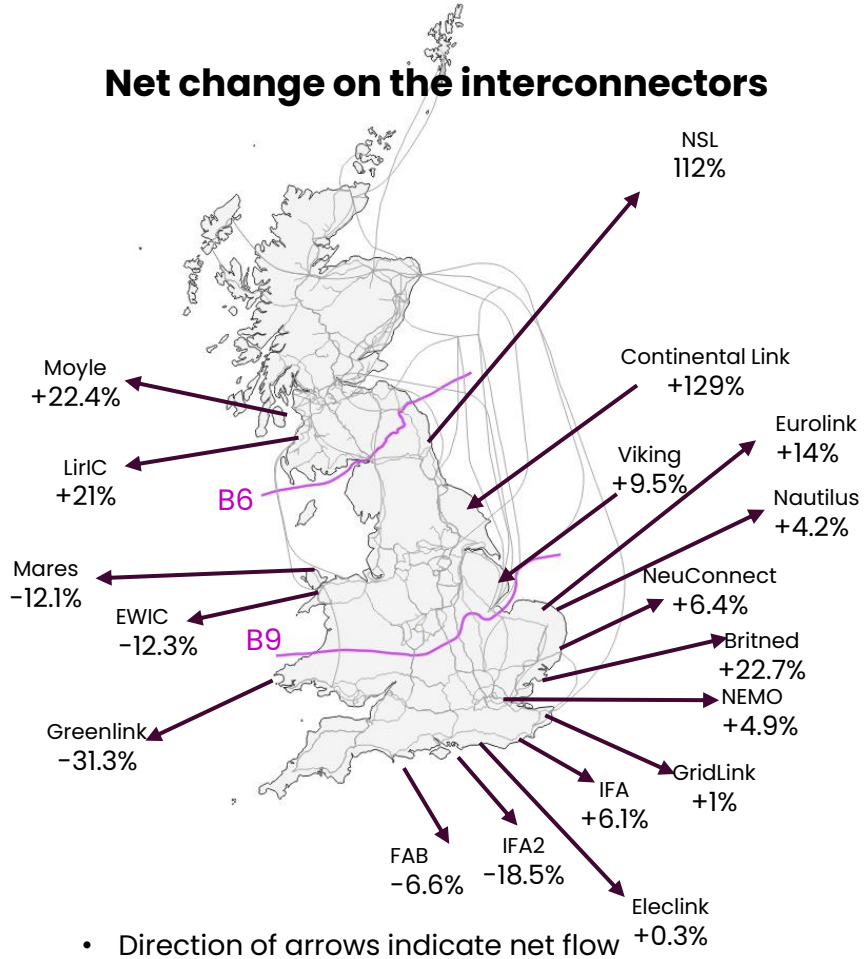
Zonal pricing has the potential to significantly reduce the forecast annual £2bn of constraint costs to customers, without the need for further additional network.

Even if the Beyond 2030 network is built in full, under national pricing, we would still expect up to £2bn of thermal constraint costs per year in the late 2030s, as a cost to consumers based on our current forecasts. These constraint costs can be reduced by the introduction of a zonal market, or stronger locational signals in dispatch timescales.

Our analysis shows that as expected we see Interconnectors in the north** export more than under a national market, and interconnectors in the south import more than under a national market.

We also see efficiency in the dispatch of the renewable resources across the country, and the use of storage assets over time and location.





- Direction of arrows indicate net flow
- % is delta from National to Zonal
- Includes all reinforcements as recommended in the TCSNP2 network design.
- **North includes NSL, Moyle and LirIC

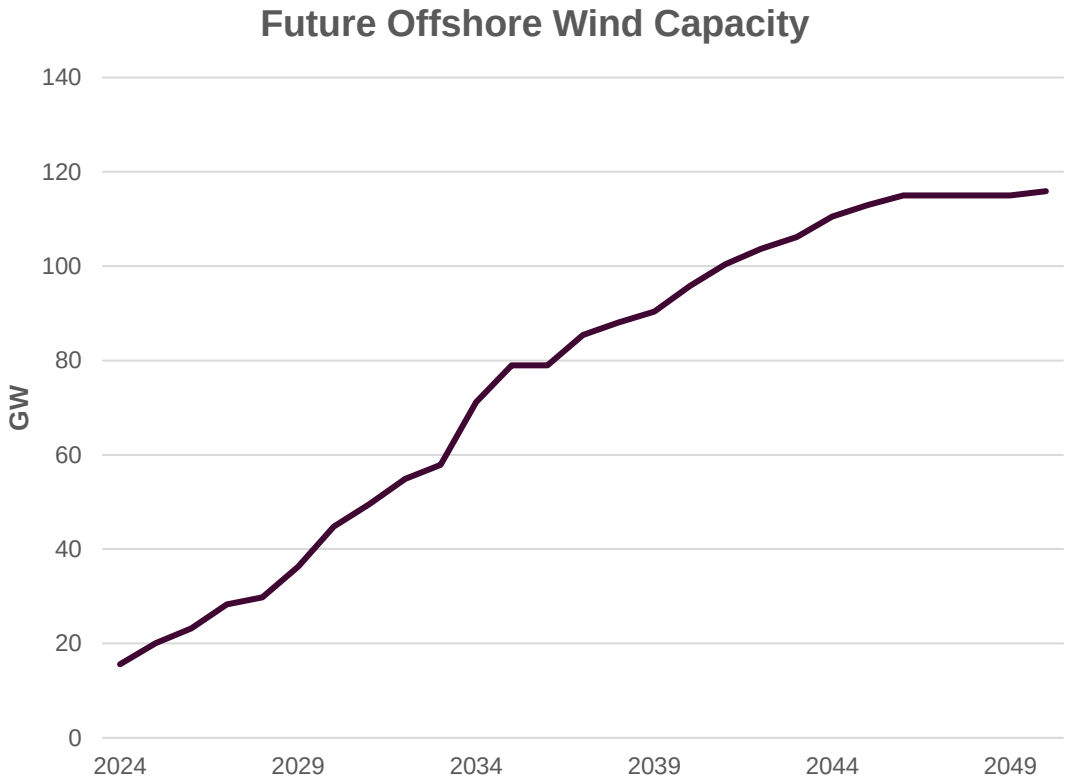
Key Message 4

The economic case for further network under a zonal market still exists

We anticipate a continued economic and technical requirement for further network investment beyond 2035, under a zonal market structure. This necessity arises from the need to integrate energy from existing sources and connect future generation, particularly as the overall demand on the electricity system increases significantly.

Our Holistic Transition Scenario from FES 2024 demonstrates that the network is designed to accommodate approximately 85GW of Offshore Wind by 2035. However, by 2050 we expect over 100GW of Offshore Wind to be required. Furthermore, the total energy demand on the system is projected to grow from around 285TWh at present, to 419TWh by 2035, and further to 667TWh by 2050. While zonal markets will enhance efficiency in siting and dispatch of generation and demand, the overall requirements placed on the network will be substantially greater.

Additionally, under zonal pricing if there is underutilized low-carbon renewable resources on the network, due to network restrictions between pricing zones, it should signal the utilization of that low marginal cost energy—either through the siting of demand or by developing the network to reach met demand areas. It is important that any support mechanism provided to renewable generation do not distort the benefits of additional low-cost electricity.



Assumptions

1. The modelling assumes all generation, including windfarms, are built as per the FES23 scenario. The modelling under a zonal wholesale prices show some windfarms have a low forecast utilisation (in some cases as low as 15%) and the forecast CFD prices are unchanged to reflect this.
2. National pricing tends to develop the transmission network more however, the zonal dispatch relies more on the distribution network more to move power. This impact on the distribution network is not modelled to a detailed level in our analysis.
3. In this analysis, we have used 21 zones. This assumes that almost all internal constraints are removed, by using a high number of zones. This is therefore potentially an overestimate the benefit of reduction in constraints. Depending on the choice of price zones, it is highly likely that some constraints will still exist (within zones), however, the design of a zonal structure based on factors including the largest of the expected system constraints will eliminate significant consumer cost through the reduction of constraints.

Annex: Consumer Cost Components