Modelled Constraint Costs

NOA 2021/22 Refresh – August 2022

This short paper summarises our forward modelled view of costs to manage thermal constraints. We summarise why these costs are increasing, what this means for consumers, and what we are doing to address the rise.

In 2021 we published[1] the modelled constraints costs arising from the *Network Options Assessment* published in January 2021[2]. We are now able to update this forward view based on the NOA 2021/22 Refresh published in July 2022, part of *The Pathway to 2030 Holistic Network Design*[3].

The Holistic Network Design (HND) helps to unlock the UK Government's ambition for 50 GW of offshore wind by 2030, by setting out a single, integrated approach that supports large scale delivery of electricity from offshore wind, to where it is needed across Great Britain. The HND recommends significant investment in £54bn in onshore and offshore network needed to deliver the 2030 target. This investment has a notable downward impact on constraint costs in the short-term.

Overview: energy security, affordability, and net zero all require more generation and transmission infrastructure

To build greater energy security for Great Britain, reduce costs to consumers, and to get to net zero, we must increase the amount of net zero carbon generation connected to the electricity network. By increasing the output of domestic net zero carbon generation we push out expensive, polluting, and insecure fossil fuels. To make best use of these new sources of generation we must ensure that we have an electricity grid that can deliver the electricity to consumers when they need it.

Our Network Options Assessment (NOA) process analyses the potential future requirements of the electricity system, based on forecast generation and demand, and recommends the optimum timing of transmission investments. This means that in parts of the network, new renewable generation is online sooner, and at times before the new network capacity is in place. In such cases, when generation output exceeds existing network capacity, we pay generators to constrain (reduce) their output. These constraint costs are factored into the NOA process.

In the short-term, paying constraint costs is critical to the development of renewable generation capacity which lowers wholesale electricity costs most of the time – constraints only apply at the most windy times, meaning that most of the time the renewables are contributing to lowering wholesale electricity prices. It is also more than offset by optimising the timing of transmission investment and the long-term power price savings they enable.

The cost of transmission investment is recovered for the Transmission Owners (TOs) via Transmission Network Use of System Charges (TNUoS). Similarly, the costs of actions taken to manage constraints taken by the ESO are recovered through the Balancing Service Use of System Charges (BSUoS). Both costs are ultimately paid for by consumers through their electricity bills.

NOA Approach: Developing an economic and efficient transmission network

An economically efficient network should ensure that transmission investment is well timed. Early investment in networks means additional costs to consumers through 'stranded' assets and late investment means higher constraint costs to consumers. The NOA performs a cost benefit analysis of the forecast constraint cost and the timing and options of transmission reinforcements, to produce an optimal strategy for reinforcements to minimise overall consumer costs.

The constraint costs arise from there being less capacity on the network than unconstrained market positions would seek to utilise, and the ESO needing to take action to maintain the safe, reliable, and

[1] https://www.nationalgrideso.com/documents/194436-modelled-constraint-costs-noa-202021
[2] https://www.nationalgrideso.com/research-publications/network-options-assessment-noa
[3] https://www.nationalgrideso.com/future-energy/the-pathway-2030-holistic-network-design

efficient operation of the system. This paper focuses on thermal[4] constraint costs, although the ESO also takes action to resolve other constraints. The costs of constraints are two-fold – the cost of turning down a generator "behind the constraint" to relieve the constraint, and the cost of turning up another not-constrained generator to satisfy the energy balance[5] . The specific detailed economic analysis undertaken as part of the NOA process[6] provides insight on constraint costs over future years.

Constraint costs rise ahead of transmission network investment

The dataset used for the NOA 2021/22 Refresh assessment is based on the Future Energy Scenarios published in July 2021, and therefore does not include the recent increase in gas prices and the effect of the war in Ukraine. These higher gas prices have led to increased balancing costs in GB, and an increase in export flows across the interconnectors. Overall, this means we expect higher constraints costs than reported in this paper, especially in the short-term. We continue to publish more granular forecasts of short-term BSUOS costs (which include thermal constraints) on our data portal[7].

We have the modelled constraint costs this decade against all the FES scenarios. In all scenarios the modelled constraint costs increase significant this decade, due to the rapidly changing generation mix, with significant quantities of new renewable generation connecting.

The Holistic Network Design established an innovative approach for coordinating the connection of future offshore wind projects and outlining the requirements to deliver a network capable of achieving the government's target of connecting 50GW of Offshore Wind by 2030. This approach required the use of a single scenario from 2030 known as 'Leading the Way plus'. The HND had two main impacts on the constraint costs we forecast. Firstly, the recommended offshore network design proposed not only considered environmental, social and deliverability challenges but also sought to minimise onshore constraints compared to a business-as-usual radial design approach. Secondly, the HND has recommended significant investment in the onshore transmission network, including the requirement to accelerate[8] the delivery of 11 major transmission schemes ahead of the TO's current delivery forecasts to the year 2030. The combined effect of a new offshore transmission system and the acceleration of onshore reinforcement projects causes a significant drop in constraint costs in 2030 to around £1bn per year.

Beyond 2030, the constraint costs then continue to grow again, although there is more uncertainty in our forecasts in this timescale. The growth in constraints shows that further significant investment is needed in infrastructure beyond the HND as we move towards net zero. We have also signalled the need for a more fundamental reform of the wholesale market to deliver net zero[9]; and reform of the network planning processes[10]. Market reform and network investment are inherently linked, but both are needed: network investment is needed to allow the bulk transfer of low-carbon energy; reforming the market in parallel will help to ensure we make the best use of that network.

[4] Thermal limits are the maximum power that can flow along a transmission line, before the heat generated becomes a problem, causing for example overheating of equipment or too much sagging of a line.
[5] Flexible demand which achieves the same effect in terms of power flow could be utilised if it is the most economic decision.
[6] This analysis is undertaken in accordance with the NOA methodology, which is consulted upon annually and approved by Ofgem
[7] https://data.nationalgrideso.com/data-groups/balancing
[8] This acceleration would require the Government action suggested in the April 2022 British Energy Security Strategy (BESS) and equivalent activities in Scotland.
[9] https://www.nationalgrideso.com/future-energy/projects/net-zero-market-reform
[10] https://www.nationalgrideso.com/future-energy/projects/network-planning-review-npr

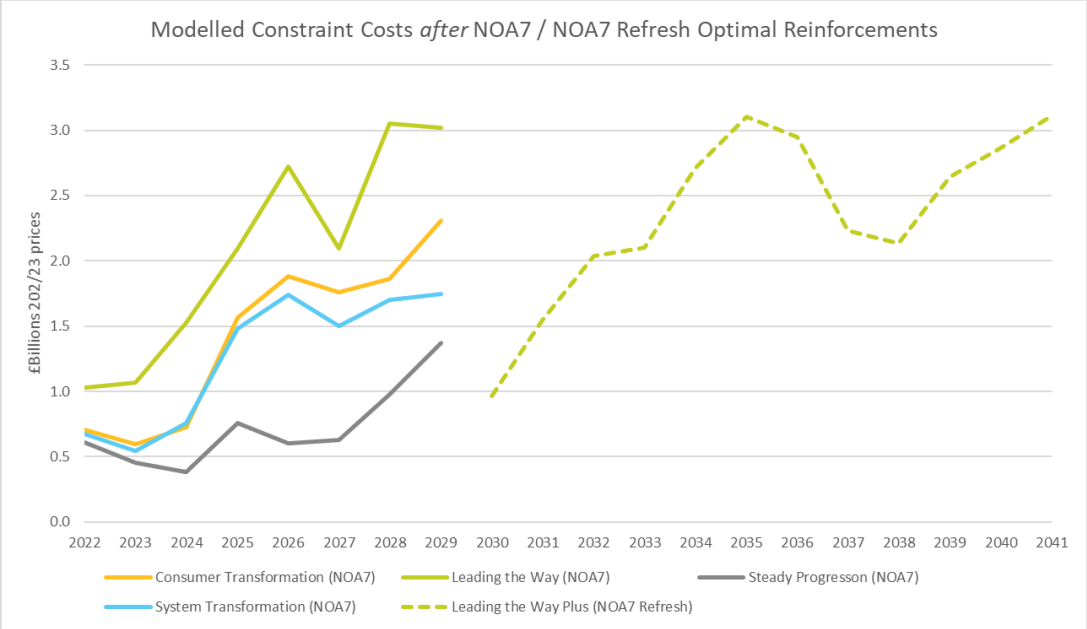

Figure 1. Modelled Constraint Costs after NOA 2021/22 Refresh optimal reinforcements

Working to mitigate increasing constraint cost

While elements of the increasing constraint costs will be part of the overall economic solution (e.g., paying constraints may be better than building a new 400kV transmission line), and they may be required to enable the transition to net zero by facilitating the connection of new renewable generation, they are nevertheless a significant cost and we recognise that they will have a real impact on consumers' bills.

Therefore, we actively manage, and seek to reduce, constraint costs through all our network planning and system operation activities. Reducing the level of these costs represents a key focus for the ESO and is closely monitored by Ofgem and industry. Recognising the potential step-up later this decade, we also have a medium/long term plan in place to mitigate these projected increases through a range of initiatives on which we are working closely with industry - please see our 5-point plan to manage constraints on the system for further information.