

Modelled Constraint Costs

NOA 2020/21

This short paper summarises why constraint costs are increasing, what this means for consumers, and what we are doing to address the rise.

Overview: getting to net zero requires more generation and transmission infrastructure

In order to get to net zero, we must increase the amount of generation connected to the electricity network. This is needed to meet increased demand due to electrification (of transport, heat, and industrial processes) and because renewable generation has a lower load factor than conventional generation sources.

Connecting significant amounts of renewables has a downward impact on wholesale electricity prices. Renewable generation produces electricity at zero marginal cost, therefore, connecting significant amounts of new renewable generation will drive down the power price element of consumers bills. Various industry analysts have identified the potential for significant reductions in wholesale prices in the longer term¹.

While renewables drive down power prices, where there is also a requirement for additional transmission infrastructure this can add cost to consumer bills. Therefore, getting the timing of the investment right is critical.

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

Paying constraint costs is critical to the development of renewable generation capacity in the short-term and is more than offset by optimising transmission investment and the long-term power price savings they enable.

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 limits of the system. This paper focuses on thermal² 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 balance³. The specific detailed economic analysis undertaken as part of the NOA process⁴ provides insight on constraint costs over future years.

¹ For example - <https://www.cornwall-insight.com/insight-papers/wholesale-power-price-cannibalisation>

² 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.

³ Flexible demand which achieves the same effect in terms of power flow could be utilised if it is the most economic decision.

⁴ This analysis is undertaken in accordance with the NOA methodology, which is consulted upon annually and approved by Ofgem

Transmission investment and cost recovery mechanisms

The NOA 2020/21 (NOA6) highlights that there is a need for up to £16bn of transmission investment over the coming 20 years⁵. Coupled with this NOA6 indicates constraint costs will increase during the middle of this decade before reducing again (see below). The completed reinforcements (e.g. Western HVDC) and pipeline of work by the Transmission Owners, which increases network capacity and reduces constraints, is included in the NOA analysis.

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.

Constraint costs rise ahead of transmission network investment

Consistent with the analysis set out last year in the FES costings⁶, the NOA6 analysis shows modelled constraint costs increasing significantly this decade - from c. £0.5bn/year today to between £1bn and £2.5bn/year at a maximum before they then reduce again at the end of the decade when new major transmission investments come online. This is a result of the rapidly changing generation mix, with significant quantities of new renewable generation connecting, and the fact that the timescales required to make the large transmission investments to increase network capacity to fully accommodate all of this new generation can be much longer.

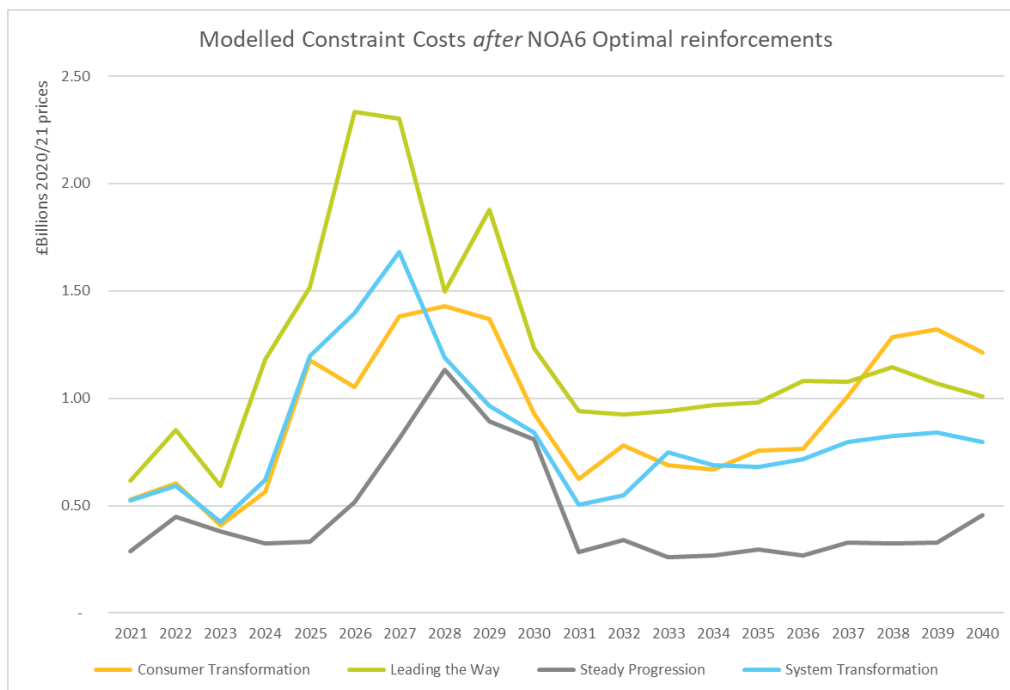


Figure 1. Modelled Constraint Costs after NOA6 optimal reinforcements

Working to mitigate increasing constraint costs

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.

⁵ The NOA analysis uses the Future Energy Scenarios as the basis for the analysis – the £16bn is based on the ‘Leading the Way’ scenario.

⁶ <https://www.nationalgrideso.com/news/analysing-costs-our-future-energy-scenarios>

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.