SO:TO Optimisation ODI

Year 2 Report

National Grid Electricity Transmission

2023

Executive Summary

This is the final System Operator: Transmission Owner (SO:TO) Optimisation Output Delivery Incentive (ODI) performance report produced in accordance with the SO:TO Optimisation guidance document issued in April 2021. This report summarises the enhanced services delivered by National Grid Electricity Transmission (NGET) and the forecast constraint saving achieved in 2022/2023 financial year (FY23), which was the second year of the trial ODI. All values in this document are quoted in 2022/23 price base unless otherwise stated.

We are pleased to report that, in the second year of the ODI, NGET has continued to work closely with the Electricity System Operator (ESO) to provide enhanced services to reduce operational costs. In the 12-month period starting at the beginning of April 2022, we have agreed and delivered 29 enhanced services to the ESO with a forecast consumer benefit in constraint savings of over £176m. This forecast consumer benefit is in excess of the £50m (in 2018/19 prices) which was the consumer benefit used to cap the incentive level for the ODI trial established at the beginning of the RIIO (Revenue Incentives Innovation Outputs) T2 period.

Our provision of enhanced services was especially invaluable in FY23, a year that saw a significant rise in constraint costs driven by the increase in wholesale energy prices caused by the war in Ukraine. The war resulted in an energy crisis in Europe which gave rise to unprecedented changes in power system flows in the England and Wales transmission system. Network congestion, whilst continuing in the north of England and Scotland, also grew significantly in the South-East where there was an increased requirement to export power to Europe through the interconnectors. All this meant a record rise in constraint costs prompting the ESO to seek more support to help to reduce the operational costs through additional enhanced services and a balanced risk approach. NGET proactively sought ways to support the ESO, providing services which were effective in reducing constraint costs. Consequently, we exceeded the incentive cap quite early into the year and, by August 2022, we had delivered consumer benefit of over £86m in forecast constraint savings.

Noting that we had reached the incentive cap with seven months of the year to go, and that the ESO expected the constraints to persist, we requested Ofgem to remove the cap for year 2 so that we could continue to actively support the ESO in reducing operational costs for the benefit of consumers. Pending a decision from Ofgem, we continued to proactively seek ways to support the ESO and continued to deliver significant consumer benefit.

Our proactive efforts and the resultant consumer savings accomplished through the second year of the ODI were highly appreciated by the ESO and completed with enormous pride from our teams.

Table 1 - SO:TO Optimisation Incentive outcome

ESO ex-ante operational savings forecast (£m)	Enhanced service provision costs (£m)	Uncapped incentive[1] (£m)	ESO ex-post constraint savings (£m)
176.0	0.8	17.6	113.0

[1] The uncapped incentive is based on 10% of the ex-ante operational savings. NGET recognise that the current Licence restricts the incentive value to £5m (2018/19 prices).

Introduction

National Grid Electricity Transmission (NGET) own and maintain the high-voltage electricity transmission network in England and Wales. Our operations are governed by the Electricity Transmission licence which requires us to develop and maintain an economic, efficient, and coordinated transmission network, compliant with relevant applicable standards, including the Security and Quality of Supply Standard (SQSS). The costs incurred to meet these licence requirements are covered by the RIIO-2 price control, which runs from 1 April 2021 until 31 March 2026. The price control includes a package of Output Delivery Incentives (ODIs) to encourage Electricity Transmission Owners (ETOs) to deliver a range of outputs that improve service and the efficient operation of the transmission network. One of these ODIs is the SO-TO Optimisation incentive.

The System Operator: Transmission Owner (SO:TO) Optimisation ODI was set by Ofgem at the beginning of the RIIO T2 period as a 2-year trial. Its purpose was to encourage the ETOs to proactively identify and provide solutions to the Electricity System Operator (ESO) to help reduce constraint costs in accordance with the STCP11-4 procedures. The SO:TO Optimisation Governance Document outlines the process and criteria for the ETOs to provide solutions eligible for this incentive trial, the reporting requirements placed on the ETOs and the ESO and the methodology the Authority will use to calculate the incentive payment during the trial period.

In line with the requirements outlined in the governance document, NGET has worked in collaboration with the ESO to identify and deliver services to the ESO to help reduce constraints costs thereby delivering value to the consumer who ultimately shoulder the cost of operating the power system. In April 2022, we submitted our year 1 report which outlined the services provided to the ESO from April 2021 to March 2022 and the forecast constraint savings achieved. We were pleased to report that, through the enhanced services provided, we had helped the ESO save an estimated £50 million in constraint savings which translated to £34.05m net consumer benefit. (2021/2022 prices).

In the second year of the ODI, the ESO saw an unprecedented rise in constraint costs due to the geopolitical situation that developed in Europe and therefore required significantly more support from the ETOs to reduce constraint costs. At the end of March 2023, we submitted our year two report to Ofgem outlining the services provided to the ESO in year two. We were pleased to report that in the 12-month period starting at the beginning of April 2022, we agreed and delivered 29 enhanced services to the ESO with a forecast consumer benefit in constraint savings of over £176m. This report provides a summary of our year two report, outlining the services provided in year two and the forecast constraint savings achieved.

Enhanced Services

What is an enhanced service?

Services procured by the ESO from the ETO, where the service has been identified as having positive impact in assisting the ESO in minimising costs on the transmission network, are termed 'enhanced services'. These services are provided by the ETO outside of business as usual (BAU), often with the ETO undertaking additional risk on its assets or incurring extra costs in order to provide the service and deliver value for consumers.

Enhanced Services Delivered

1. Weather-Based Enhancements on Overhead Lines (OHL)

All assets on the transmission network have maximum rating at which it is deemed safe for them to operate. Operating above this rating for extended periods will result in faster deterioration of the asset and present a safety hazard to those within their vicinity. In overhead lines, the prevailing ambient temperature around the line has a significant impact on its thermal rating therefore it is possible to vary overhead line circuit ratings following weather studies resulting in a possibility of higher ratings when the ambient temperature is expected to be low. Three types of weather-based enhancements were offered and delivered to the ESO throughout FY23 as explained below. In providing these services, NGET took mitigating actions to ensure that the safety of staff, the public and the equipment was maintained at all times.

i. Accelerating or extending circuit seasonal ratings

OHL circuit ratings vary seasonally with the rating being highest in the winter due to low ambient temperatures and lowest in the summer when the ambient temperature is high. The control system used in the control centre is programmed to adjust circuit ratings automatically at the start of a given season, thereby lowering or increasing the maximum flow allowed on a circuit depending on the season.

The table below shows an example of a rating schedule for an OHL

Nasap Code	Circuit Name	Autumn Pre-fault Continuous Rating (MVA)	Winter Pre-fault Continuous Rating (MVA)	Spring Pre-fault Continuous Rating (MVA)	Summer Pre-fault Continuous Rating (MVA)
XXX	Circuit 1	3002	3159	3002	2786
XXX	Circuit 2	2764	2883	2389	2126

It is possible following detailed weather and circuit studies to manually adjust circuit ratings to a higher rating than would normally be allowed, if the results of the studies indicate it is safe to do so. In the example circuits above, the circuit rating will reduce by over 200MVA following a seasonal rating change from spring to summer. If the first month of the summer is projected to be cooler than expected, and the ESO require the higher rating to prevail to manage constraint costs, the spring rating can be extended to provide extra capacity on the circuit. Additionally, if the autumn is cooler than normal and the ambient temperature deemed low enough to allow winter ratings, the winter rating can be accelerated if required, i.e., applied before the scheduled change to winter ratings, so as to provide a higher rating on the circuit. When such a service is requested by the ESO to manage constraint costs on a boundary, NGET will provide a dedicated ratings engineer to carry out daily studies for the duration of the enhancements to ensure that the weather and circuit conditions allow for the enhanced service to be provided safely. This service was offered to the ESO on three circuits in FY23 resulting in constraint savings of about £2m.

ii. Dynamic Weather-based circuit enhancements

Dynamic weather-based circuit enhancements employ weather-based ratings to enhance the overhead line's power transfer capability on a temporary basis. This involves a dedicated ratings engineer compiling near real-time weather data for a circuit and using this data to issue a temporary higher rating. This must be reviewed daily as the forecast wind and ambient background conditions that the rating is contingent on can change rapidly. This service was applied to 19 circuits throughout FY23 resulting in constraint savings of nearly £120m.

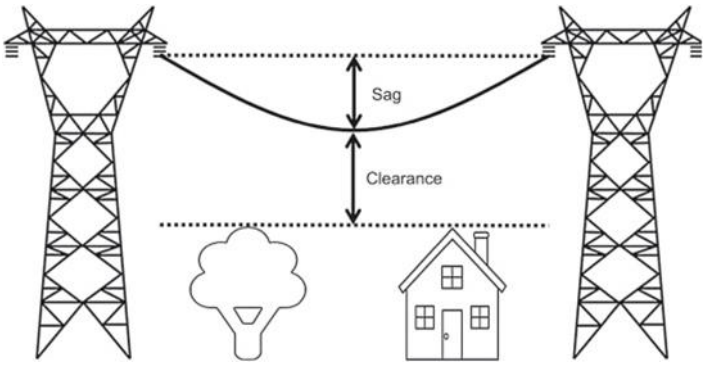
iii. Line Vision Dynamic Line Rating (DLR)

Dynamic Line Rating (DLR) also referred to as Real Time Thermal Rating (RTTR) is a philosophy for operating the power system whereby sensors are installed on OHL towers to monitor real-time ambient conditions in order to maximise the power flow across a circuit without compromising the safety of that circuit. The weather-based enhancements described above are a form of DLR which is based on forecasted weather conditions with no sensors installed. Consequently, there is an element of conservatism built into the weather-based ratings that leave opportunity for additional value to be extracted through calculations based on real-time conditions. DLR has sensors installed on the tower which carry out continuous monitoring of the ambient around the line and therefore giving real time rating adjustments as required. These allow for higher ratings to be achieved than would be possible from manual weather-based studies carried out by the rating engineer. DLR sensors were installed on one circuit in FY23 with a plan to install further sensors on the network where benefit is envisaged

2. Static temperature enhancements

When weather-based ratings are not an option to enhance an overhead line rating, or we need to achieve a higher level of enhancement than can be obtained with weather-based enhancements alone, then static temperature enhancements are considered as an option.

A static enhancement is a temporary enhancement to the normal operating temperature of an overhead line by increasing the clearance of the conductors to ground. Overhead line conductors have a commissioned operating temperature which balances maximising capacity in the overhead line against the risk of an infringement occurring due to increased sag. (Our OHL conductors are made of aluminium or aluminium alloy which expands when heated resulting in increased sag when operating at high temperatures). Where additional vertical clearance to obstacles is available for an overhead line, we can look to increase the temperature at which we operate the overhead line in order to carry additional capacity temporarily.



OHL sag Diagram

Static temperature enhancement was applied to one circuit where weather-based enhancement was not possible. This saved an estimated £6m of constraint costs.

3. Rapid post-fault switching and voltage management

Rapid post-fault switching is where NGET will agree to carrying out more post fault actions than recommended in its procedures, so as to return voltages to allowable levels within SQSS times. The SQSS states that at 400kV operation, voltages of 420kV or above can be observed post-fault for no more than 15mins. Within the England and Wales Transmission System, there are areas that are known to have high-voltage management challenges under specific fault and outage patterns during low demand conditions. This high voltage issue is normally managed through generator actions to maintain operational Security and Quality of Supply Standard (SQSS) compliance. Where there is a viable switching sequence that can be enacted quickly post-fault to return voltages to within acceptable levels, this is proposed to the ESO in leu of generator action resulting in savings in operating costs. For this service NGET agree to accept the risk of unacceptably high voltages on the transmission system for a short duration whilst switching actions are taken quickly to return voltages to acceptable levels. In preparation for this activity, NGET carry out comprehensive checks on the circuit whose fault would cause this high voltage scenario and all defects identified are rectified so as to reduce, as far as practicable, the probability of the fault occurring. In addition, an extra control engineer is required in the control room dedicated to monitoring and carrying out the rapid post-fault action should the fault occur. The affected sites also need to be manned to assist on the ground in case any difficulties are encountered during the switching operation. This action was carried out on two occasions in FY23 with an estimated constraint savings of over £30m.

4. Transformer Forced Cooling

Manually activating forced cooling on inter-bus transformers can provided higher short-term post-fault capacity on transformers. Where these transformers are situated across a constraint boundary, the ESO can request this service which results in a reduced number of pre-fault operations required to manage flows across that constraint boundary, thereby achieving a reduction in constraint costs. For this service to be provided, it is necessary for the forced cooling of transformers to be available for remote operation from the control room so forced cooling can be activated upon request from the ESO. This service was delivered on two transformers on the transmission network achieving a forecast constraint saving of £7.9m

5. Outage Flexibility

When renewable generation output is high, particularly on windy days, outages taken on high flow routes result in high constraint costs as renewable generation has to be constrained off to avoid overloading of remaining circuits post fault. If an outage is delayed from its planned date and taken when the weather is less windy, a reduction in constraint costs is achieved. NGET offered outage flexibility to the ESO where an outage on a significant three-ended circuit was delayed more than once so as to time the outage to a less windy period and achieve constraint cost savings. This achieved an estimated constraint saving of about £8.5m.

The table below shows a summary of services provided by NGET and accepted by ESO in FY23.

Enhanced Service Category	**No of services delivered**	**Cost of Delivery £k**	**Forecast Constraint savings £k**	**Ex-Post Constraint Savings £k**
Accelerating or extending circuit seasonal ratings	3	10.0	2000.0	7,080
Dynamic Weather-based circuit enhancements	19	168.4	119,883	77,083.8
Static temperature enhancements	1	3.2	6,000	2,900
Line Vision Dynamic Line Rating (DLR)	1	482.7	1,400	1,700
Rapid Post fault switching for voltage constraint management	2	103.7	30,432.0	15,000
Transformer Forced Cooling	2	3.4	7,870	784.5
Outage Flexibility	1	1.0	8,500	8,500
Total	**29**	**772.4**	**176,085**	**113,048.3**