

ITPenergised Grid Modelling Innovation

Transmission Network Use of System Charging (TNUoS)

Innovation

In keeping with our core value of innovation, ITPenergised (ITPE) has upgraded our market leading and unique TNUoS future estimates model. This paper is targeted at funds, utilities, developers, policy makers and network companies who would like to:

- Understand the current TNUoS tariff structure;
- Understand some of the current visible regulatory changes that may drive TNUoS impact;
- Understand some of the future modelling scenarios in deriving forecast TNUoS tariffs; and
- ITPE's novel techno-economic approach to TNUoS forecasting

Introduction

TNUoS charges are used to recover the cost of installing, operating and maintaining transmission assets throughout Great Britain (GB). The charges are split into two broad categories, those paid by demand customers and those paid by generators. Both categories are charged locationally.

Currently, TNUoS charges in GB are set to recover several billion pounds per annum. Demand customers pay the bulk of these - cost recovery was historically set at a fixed 73% from demand customers and 27% from generators. In recent times this split has become variable and the portion paid by generators has decreased.

Tariff structure

Within the TNUoS charges paid by generators there are three elements:

- **A Local Circuit Tariff**, which partly recovers the costs of the assets required to connect a generator to the wider transmission system and as such is site specific. If the first onshore substation which the generator connects to is categorized as a Main Interconnected Transmission System (MITS) in accordance with Connection and Use of System Code (CUSC) 14.15.33, then there is no Local Circuit charge;
- **A Local Substation Tariff**, which recovers costs associated with the transmission substation equipment which facilitates the connection of generation. The Local Substation Tariff is set by NGENO each year and is fixed for all generators; and
- **A Wider Zonal Tariff**, which reflects the cost of providing additional generation capacity in an area of the transmission network. The Wider Zonal Tariff often makes up the bulk of the TNUoS charges for onshore generators, particularly those located furthest north. The wider tariff is itself composed of a locational element and a "residual" element, the latter a uniform adjustment to locational tariffs set to achieve revenue recovery.



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Wider TNUoS tariffs

Wider TNUoS tariffs are calculated by National Grid Electricity System Operator (NGESO) using its Transport and Tariff Model which is updated each year to reflect changes throughout the transmission system. The final calculated tariffs are then set out in NGESO's Statement of Use of System Charges.

The Transport and Tariff Model consists of two parts. The first part runs "direct current load flow" (DCLF), i.e. a simplified but widely used simulation of the transmission system, on a model of the GB transmission system to ascertain the impact of adding generation to the system and to develop the relative locational differences. The second part converts this to actual tariffs, constituting the Wider Zonal Tariff for each zone.

Why do we need a TNUoS charging future estimates model?

NGESO does not provide any information on charges beyond the next five years. Given the asset life of generators is a multiple of times greater than 5 years, a forecast model of these charges is therefore essential to build out financial models of assets and portfolios over their full economic life to:

- enable business planning for existing operational assets; and
- to support investment case models in order to make Financial Investment Decisions (FID).

ITPE has developed its own inhouse techno-commercial model to provide long-term estimates for the charges to 2050. This work provides estimates for the TNUoS charges, whilst maintaining compliance with the European Commission (EC) cap in line with the Competition and Market Authority's ruling on Connection and Use of System Code (CUSC) Modification Proposal (CMP) 261. Given Brexit and the recent signing of the EU-UK Trade and Corporation Agreement, ITPE will continue to track the implications for this as information discovery unfolds.

ITPE's innovative approach to TNUoS charging modelling

ITPE uses a novel hybrid approach in finding a solution to TNUoS charges forecast modelling. We combine both a suitable technical load flow model of the GB transmission system using coding techniques along with a model that absorbs the results from the load flow model along with other commercial parameters in an excel environment.

This model is a simulation of NGESO's Transport and Tariff Model, incorporating the full amount of system nodes and fully capturing the data from the baseline Transport and Tariff Model. ITPE has done extensive testing and validation of the model against NGESO's model. The results show very strong agreement for the current charging year between the models and therefore ITPE has high confidence in the calculated results. ITPE's transport model has been produced in programming language, with a separate calculation sheet for the tariffs. It contains the same number of nodes as the NGESO model. ITPE has also developed a tariff calculation spreadsheet to convert the outputs from ITPE's transport model into the same TNUoS tariffs as given in NGESO's Transport and Tariff Model.



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To gain an appreciation of the layers to our model, we draw on large databases of input variables which affect the tariffs that are reflected in our analysis, for example:

- NGENSO published short term five-year TNUoS forecasts;
- NGENSO Future Energy Scenarios (FES) (to 2050);
- NGENSO Electricity Ten Year Statement (ETYS);
- NGENSO registers for generation and interconnectors;
- NGENSO Network Options Analysis (NOA);
- Drivers of system operator and transmission owner performance, costs, revenue recovery and 'Revenue Incentives Innovation Outputs' (RIIO) implications as per transmission owner business plans; and
- Regulatory proposals, consultations and visible future trends.

We believe our model to be unique as we blend our technical capability of modelling the GB grid alongside a commercial layer in order to calculate forecast tariff pricing.

From these data sources ITPE considers the following:

- Changes to the generation mix;
- Changes in the demand for electricity;
- Transmission system reinforcements;
- Transmission cost recovery;
- The regulatory regime; and
- TNUoS charging methodology changes.

The charges paid by demand customers and generators are paid by location, which for generators means that the charges are highest for those located furthest from the main demand centres in the south of England, e.g. northern Scotland. **Please see Figure 1 on the next page.**



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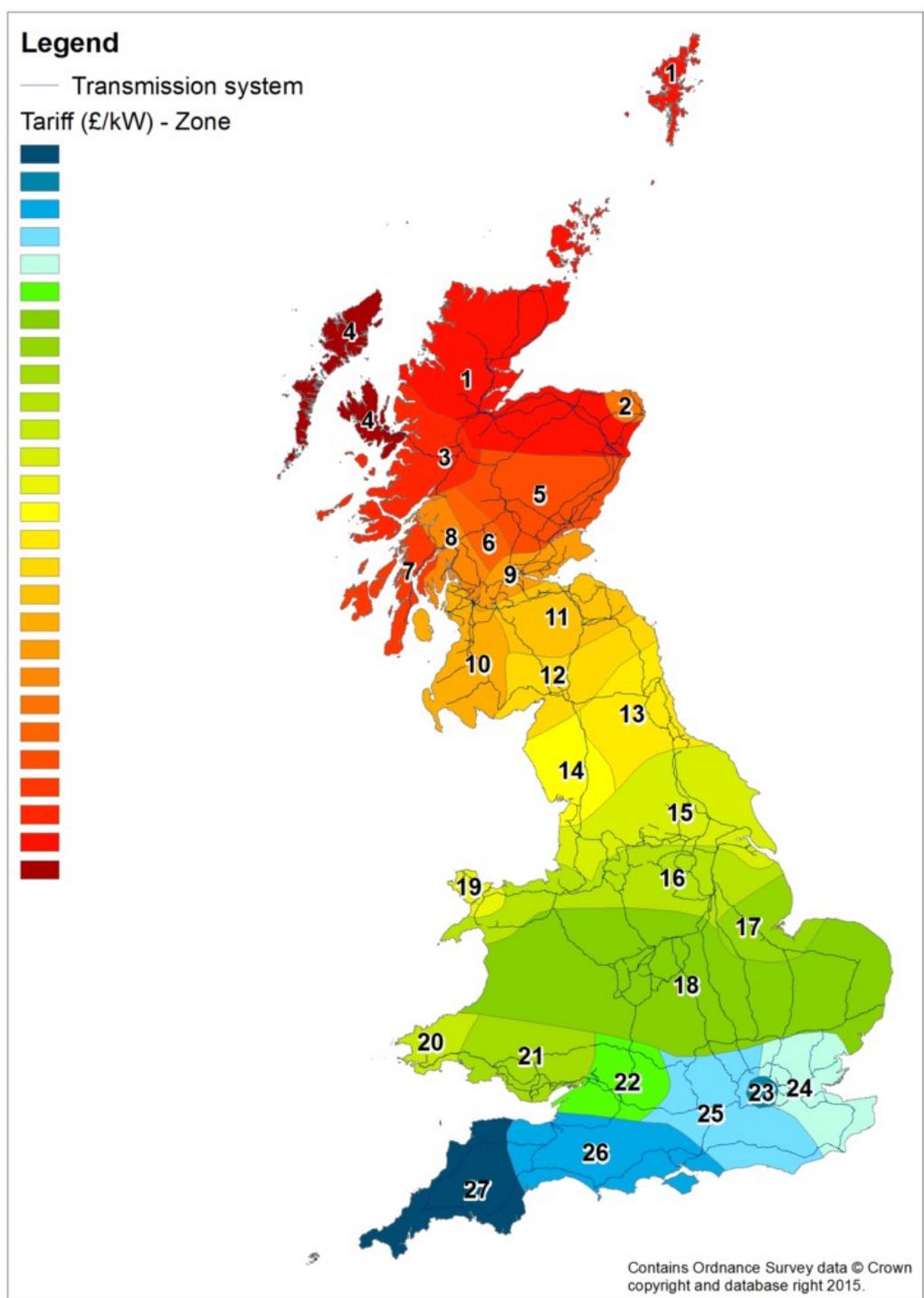


Figure 1—Illustrative TNUoS charging in the UK



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Regulatory impacts

ITPE considers a range of regulatory impacts that inform the inputs and structure to key aspects of its TNUoS modelling work. Briefly, these include:

- **Targeted charging review** - November 2019 Ofgem published its final decision on the TCR [10], stating that Ofgem will set the Transmission Generation Residual (TGR) to zero. Implementation of any changes is expected to start by April 2021.
- **Review of NGENSO CUSC Modification Proposals (CMP)** - ITPE maintains a watching brief on all CMPs and reviews / updates the TNUoS model.
- **Electricity Network Access project** - Ofgem has also established an 'Electricity Network Access' project, which is looking to coordinate the development of changes to charging arrangements across all of the current industry and Ofgem led projects. This has the potential to impact TNUoS charging in the future.
- **European Commission cap removal** - In December 2015 the Association for the Cooperation of Energy Regulators closed initial work on harmonisation of European use of system tariffs and concluded that the energy based European Commission price cap was not appropriate, implying it could be removed in the future.
- **Effect of Brexit and the EU-UK Trade and Cooperation Agreement** - This may impact the European Commission cap on TNUoS charges to generators and NGENSO's latest assumptions on the pound to euro exchange rate. At present it is very difficult to take a long-term view on this.

Revenue recovery

In order to determine the TNUoS tariffs, the required revenue recovery across all of the transmission owners needs to be estimated for each year. ITPE has estimated the revenue recovery required based on data available from NGENSO and the onshore transmission owners' last price control review (RIIO-T1) and published business plans.

Future scenarios

The current status of the national electricity transmission system and its future development is only visible with any certainty on relatively short time horizons, e.g. the next five to ten years, through sources such as the Transmission Entry Capacity (TEC) Register. To assess the potential changes in the electricity system, and hence TNUoS charges, further into the future (up to 2050) it is necessary to look at long term trends in generation, demand, transmission system reinforcement, transmission company revenue recovery and regulation. There are various forward-looking reports that can be used to predict various aspects of the future of the electricity system; however, for a consistent source for generation, demand and transmission system reinforcement information, ITPE has used NGENSO's Future Energy Scenarios. This document is updated annually by NGENSO.



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The Future Energy Scenarios consider longer term socio-economic and political factors as well as technology, commercial and regulatory developments to examine how, amongst other themes, decarbonisation of the electricity industry may proceed. To this extent it provides an ideal and well considered source of data that can be used, with various assumptions, to provide inputs to estimate TNUoS charges further into the future.

The development of the scenarios is categorised into four separate profiles or scenarios which vary from a relatively slow and conservative change to a low carbon economy, to bolder scenarios with a more rapid uptake of renewable energy generation, increased deployment of heat networks throughout the electricity system and increased uptake of electric vehicles. The bolder scenarios represent a substantial uplift in demand for electricity over the long term.

As each scenario also has other subtleties, they provide a broad view of the trends that may define TNUoS charges outside of the regulatory frameworks and the upper and lower bounds of the charges within which a view can be taken. To complete the long-term view of TNUoS charges, and as noted above, ITPE has overlaid what is visible in terms of regulatory change and the likely change in revenue recovery from transmission charges.

In total ITPE provides TNUoS forecasts to 2050 in five year increments in relation to all five of NGENSO's Future Energy Scenarios.

Conclusions

ITPE results provide a range of TNUoS tariffs from which a view can be taken. Going forward, the following should be considered and revisions to the estimates examined should be undertaken, at least annually.

- **Regulatory processes should be monitored.** Any changes that are likely to have a significant impact should then be assimilated into the TNUoS modelling to understand their impact and the revised tariffs. Regulatory change has a strong possibility of introducing step change rather than incremental change.
- **Current political and social directions and the UK Government's 2050 Net Zero Target.** This suggests that the more appropriate scenarios are those with more rapid change to a low carbon economy, with high levels of decarbonisation and societal change. This is reflected in NGENSO's latest Future Energy Scenarios 2020. However, political and social direction can change quickly, and this should be borne in mind.
- **As noted earlier, major boundary reinforcements of the transmission system also have a significant effect.** Changes to such reinforcements should therefore be monitored and assessed.

ITPE considers revenue recovery of the transmission parties a significant factor. The amount that can be recovered from generation is currently strictly limited in the TNUoS methodology and through the European Commission cap. However, possible removal of the EU cap in the future will push this up and therefore this driver should be monitored.

As can be seen in this paper, modelling of future TNUoS charges represents a significant multi-disciplinary body of work across a number of future energy scenarios. Our unique hybrid techno-economic approach to modelling is reflective of our core value of innovation.

ITPE remains available and engaged to support TNUoS tariff future estimates to 2050 for all our clients

