Annex 2 - Defects with the current ICRP methodology

Defects with the current ICRP methodology

There are a number of challenges when setting cost reflective network charges in the current ICRP methodology that can limit the effectiveness of transmission charges in efficiently influencing behaviour. To aid understanding of the issues raised in this modification proposal, below is a description of the key building blocks of the current ICRP methodology.

Efficient transmission charges need to reflect the incremental impact of users on forward looking costs, which can be complex to identify since the true incremental impact is the result of a complex set of interactions between market participants in the electricity system.

The ICRP methodology has been developed since its first implementation in the 1990s to try to improve the way it reflects forward looking incremental costs. The original assumption underpinning ICRP was that installed capacity and peak demand were, MW for MW, drivers of transmission investment. Project TransmiT introduced significant reforms to the methodology in response to the growth in renewable energy sources (RES) and other low carbon technologies, reflecting the idea that different generation technologies may have different impacts on network investment and hence should face different charges for a given location on the network.

However, the approach taken to estimating long run marginal costs remains a heuristic representation of reality, based on a set of simplified assumptions and relationships. The relationships identified between different technologies and network investment at the time of TransmiT are also likely to have continued to evolve in response to changing dynamics of the electricity system.

Within the ICRP methodology, there are a number of examples of simplified representations of reality:

- The ICRP model **applies two backgrounds** ("Peak Security" and "Year Round") to represent all the conditions under which network investment could be triggered (i.e. due to requirements to maintain peak security or to build network to efficiently reduce constraint costs). Therefore, incremental peak security investments are implicitly assumed to be driven by a single set of generation load factors at the time of peak demand, and constraint relieving investments are equally assumed to be driven by a single scenario (which also assumes peak demand conditions). Particularly in the case of the Year-Round analysis, the generation background is actually trying to proxy for the wide range of potentially relevant network conditions.
- Any model based on LRMC needs to make an assumption about how the network should be developed in response to new connections. In the ICRP model, it is assumed that **all flows under each background can just be accommodated by the network** (i.e. the network capacity under each background is "shrink-wrapped"[1] to the resulting flow), so that incremental flows imply an immediate need for new investment. Taking account of actual spare capacity on the network could imply a different pattern and timing of incremental investment, with implications for charges.
- To calculate the incremental costs within the Transport Model **requires the definition of a "reference node"**. This is a mathematical concept which in effect can be described as a "location" on the network where incremental costs of additional injections or withdrawals from the network are zero. The current approach is to define a "distributed demand reference node" such that if 1MW of additional generation is added at a particular node, it is assumed to flow to 1MW of additional demand spread across all nodes in proportion to their share of current demand. Alternative logical approaches for defining the "reference node" are

[1] See Section on identification of network cost drivers in Annex C for background on this assumption.

possible and would imply significantly different signals between low and high load factor plant at particular locations.

- The incremental costs of building out the transmission network are embodied in a single **expansion constant** (£/MWkm) with generic onshore **expansion factors** reflecting the cost of different network asset types (e.g. 400kV, 123kV, HVDC etc.). However, this does not recognise project or location specific costs of specific network investments. Therefore, the ICRP approach abstracts from a significant amount of complexity related to network investment costs.
- A **sharing methodology** is used to adjust the incidence of Year-Round charges on different technologies. This is intended to improve cost reflectivity by broadly proxying for the contribution of different generation technologies to constraint costs (and hence the case for network investment to reduce constraint costs). The sharing adjustments, based on a methodology which is both highly complex and highly heuristic, assume a fixed relationship between the proportion of "low carbon" generation on the network and the extent to which network can be shared (i.e. the extent to which incremental flows – and hence additional generation capacity – can be added without the need for similar network investments). In practice, the approach simplifies significantly complex relationships which are likely to evolve and potentially become more complex over time.
- Once Peak Security and Year-Round charges have been calculated in the Transport Model, they are multiplied by an **estimated "security factor"** of 1.76 reflecting the need to account for redundancy (i.e. ensuring peak demand can be met even if there is a failure of network assets) as part of calculating incremental costs. The security factor value is an estimate and applied as an uplift on all network elements despite the fact that not all network elements have the same requirement for redundancy (e.g. investments that are identified as the result of a cost benefit analysis of the benefits to the electricity system of reduced congestion).
- Both Year-Round and Peak Security costs are **charged to demand on the basis of peak consumption** (i.e. "Triads"), and therefore behaviour by demand (incl. charging of storage) that is beneficial for relieving constraints and hence year round costs, is not explicitly recognised.

Improvements can be made to the approach taken in each of the ICRP methodology building blocks in order to make the simplifying assumptions more reflective of reality. Work of this nature is being carried out by the TNUoS Taskforce in respect of a number of the individual issues noted above. However, while incremental improvements can be made to individual aspects of the current methodology, ultimately it is hard to take a holistic view on the accuracy, and hence cost reflectivity, of the overall locational signals that emerge.

Ensuring cost reflectivity is also likely to become increasingly important in future given expectations of a very significant need for new investment in networks in the coming decade. This is made clear by ESO which has set out an ambitious plan for the future network investment required to facilitate the decarbonisation of the electricity system (Figure 1). As a result, there is likely to be greater value to society from ensuring efficient siting decisions by investors, than there has been historically.

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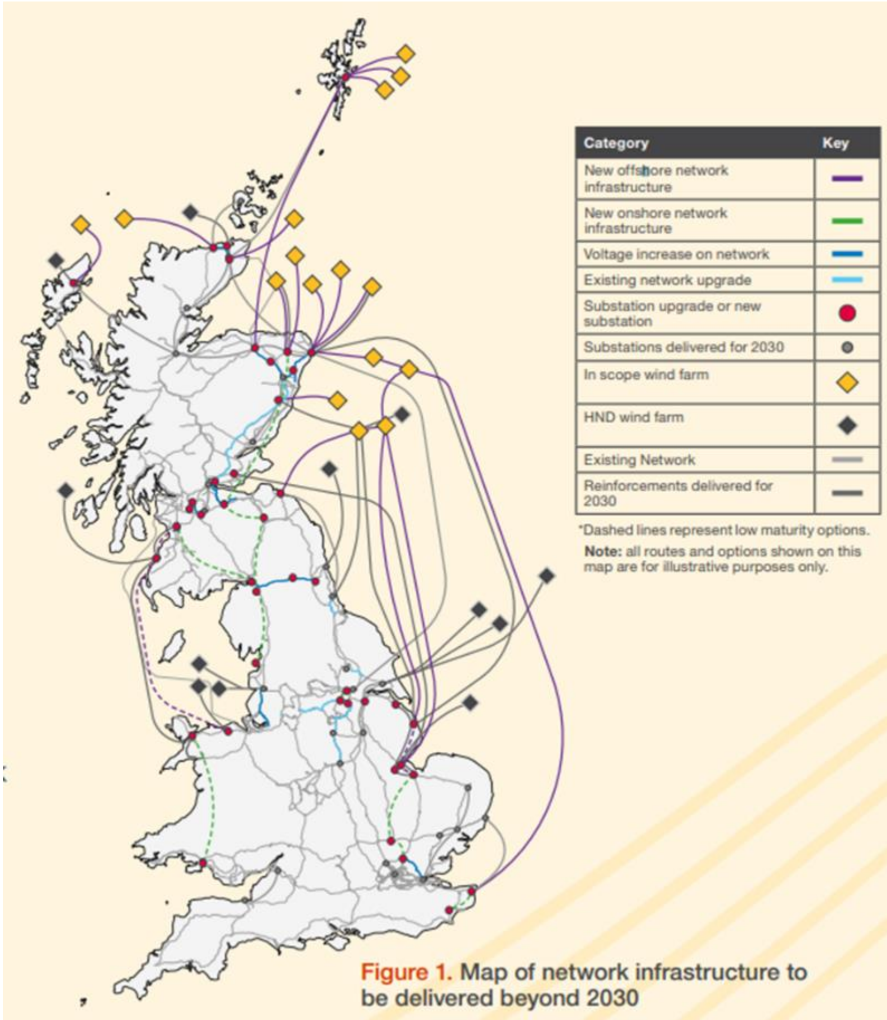
Figure 1: ESO recommendations for network upgrades beyond 2030



Source: TCSNP

In addition, even if the charging methodology is made more cost reflective at any point in time, it is also likely to be necessary to continue to update the methodology as the system evolves. For example:

- the representative background scenarios and the sharing methodology are likely to require updating as the technology mix changes or new technologies emerge; and
- the relationship between the incremental capacity of particular technologies and network costs (currently proxied for via the static sharing methodology) may also change over time. For example, it is currently assumed (in the sharing methodology) that wind output is highly correlated with periods of network constraint when the network is dominated by wind capacity, making total wind capacity a key driver of Year-Round network charges. This relationship is likely to be reasonable at current levels of wind penetration. However, at higher levels of national wind penetration, periods of excess supply of energy in the national market may increase the frequency of negative or zero national prices resulting in the "self-curtailment" of wind without the need for ESO to locationally curtail wind. In addition, based on locational signals in the Balancing Market, sources of demand (incl. storage and electrolysers) which can consume during periods of high wind would be incentivised to locate in regions with significant excess generation. In such circumstances, adding additional wind

to the network would have a smaller impact on congestion (and hence the need for network build) than is currently assumed. The current ICRP approach cannot respond to this changing dynamic without a formal update to the methodology and its underlying parameters.

In summary, while we have identified a number of specific defects within the ICRP framework, which while to some extent could be addressed within the model, the core defect that we have identified relates to the overall concept of the ICRP approach which relies on simplified representations of the electricity system and a "known" approach to network development. This is increasingly problematic for achieving cost reflectivity given a rapidly evolving energy system, with a rising need for network build and greater system complexity[2] due to the energy transition.

Table 1: Summary of ICRP defects

#	Defect	Description
1.	*ICRP overly simplifies reality of complex system*	*Approach to estimating long run marginal costs remains a representation of reality based on a set of simplified assumptions and relationships, based on which it is hard to assess the accuracy, and hence cost reflectivity, of the overall locational signals that emerge.*
1a	*Two "representative" backgrounds*	*Behaviour by market participants that drives network investment is represented by two static background scenarios.*
1b	*"Shrink-wrapping" of the network*	*The ICRP model takes no account of spare capacity on the network, as network sized to just fit all flows implied by backgrounds.*
1c	*Need to fix location of reference node*	*The "location" of the reference node must be fixed, with important implications for the relative locational signal between high and low load factor plants at the same location*
1d	*Single expansion constant*	*Costs of building out transmission network embodied in a single expansion constant (£/MWkm) and a set of expansion factors, which abstracts from project specific costs*
1e	*Sharing methodology*	*The approach simplifies significantly complex relationships which are likely to evolve (e.g. the amount of network build for a given capacity mix in a zone is likely to change over time) and potentially become more complex over time*
1f	*Security factor*	*The security factor value is an estimate and applied as an uplift on all network elements despite the fact that not all network elements have the same requirement for redundancy*
1g	*Demand not valued appropriately*	*Beneficial behaviour by demand (incl. charging of storage) for relieving constraints and hence Year-Round costs not explicitly recognised.*
2.	*ICRP applies static relationships which are cumbersome to change as the system evolves*	*While the charging methodology could be made more cost reflective at any point in time, it is likely to be necessary to continue to update the methodology as the system evolves. To achieve this under the ICRP methodology would create significant uncertainty and require significant and time consuming on-going reform through the code modification process.*

[2] e.g. increasing storage deployment over time will increase the complexity of the optimised system as storage Short Run Marginal Cost (SRMC) is based on opportunity costs rather than fuel costs or climactic conditions