Electricity Networks: Regulation, capacity and connections

This paper sets out how electricity networks are regulated and the rules that they are bound (through licence conditions) to adhere to; system capacity; and the principles of network connection costs.

Introduction

The role that electricity networks play is crucial to meeting Government's decarbonisation objectives. Scotland's net zero pathway, as laid out in Government's Climate Change Plan Update (2020), includes a fully zero carbon electricity system in Scotland by the end of this decade.

Additionally, in the lead-up to COP26, the Scottish Government committed to: "Publishing a revised and updated Energy Strategy, reflecting our commitment to net zero and key decisions on the pathways to take us there." Consequently, in late 2022, a draft Energy Strategy and Just Transition Plan (ESJTP) will be published for consultation and refinement. It will provide a road map for Scotland's future energy system up to 2045 and will ensure the people of Scotland are at the heart of the transition to net zero.

Electricity networks will play an essential role in this transition and investment decisions made by these companies over the next 5 years (as part of ED2) will be critical for the Scottish 2030 interim targets.

In order to support the industry to account for devolved policy, Government has worked closely with Ofgem and network companies to agree a number of principles that should be adopted through the price control process and reflected in regulatory decision making.

Scottish Government's vision is that 'electricity and gas networks should support an efficient and effective process of decarbonisation across the whole energy system and should support broad societal and economic ambitions'.[1]

Background

Electricity and gas networks operate, with some notable exceptions relating to connections, as natural monopolies within specific regions. This is due to the nature of electricity and gas network infrastructure which is costly. The overall GB energy network is split into three areas:

- Transmission: this transports electricity and gas at high voltage/pressure from generation/import points to large industrial users and to distribution network offtakes. In Scotland the electricity transmission network is owned, maintained and improved by two transmission owners: Scottish and Southern Electricity Networks (SHE Transmission) in the north of Scotland and SP Energy Networks

[1] A Vision for Scotland's Electricity and Gas Networks: Summary 2019-2030 (www.gov.scot)

(SP Transmission plc) in the central belt and south of Scotland.

- Distribution: electricity and gas is transported at lower voltage/pressure to homes, businesses and industrial users. Increasingly distribution networks are also a point of entry for smaller scale electricity generation (e.g. small scale solar can put power back onto the grid at a distribution level). In similarity to transmission, the electricity distribution network in Scotland is owned, maintained and improved by two distribution owners: Scottish and Southern Electricity Networks (SSEN) in the north of Scotland and SP Energy Networks (SPEN) in the central belt and south of Scotland.

- System Operator: the system operator does not own any electricity or gas infrastructure but is responsible for ensuring that the system is in balance (supply is capable of meeting demand). The SO does this by entering into contracts with generators to make sure the system operates within agreed limits.

As regional monopolies, electricity and gas network companies are regulated by the independent energy regulator, the Office for Gas and Electricity Markets (OfGEM) to ensure that consumers both current and future (gas and electricity bill payers) are charged fairly for the costs of transporting gas and electricity and provided with a safe and secure network. These costs make up almost 24% of the average dual fuel (gas and electricity) bill with the RIIO 1 regulatory framework (in operation from 2013-2021 and for electricity distribution from 2015-2023) estimated to be valued in the region of £100 billion.[2]

Network Regulation (RIIO)

To ensure the protection of current and future consumers (a statutory duty under the Utility Act 2000) and the delivery of a safe and efficient network OfGEM regulates the gas and electricity network companies using the RIIO (Revenue = Incentives + Innovation + Outputs) framework.

The frameworks are split into 4 different parts (although there is similarity overall):

- RIIO T = for electricity and gas transmission
- RIIO GD = for gas distribution
- RIIO SO = for the electricity system operator
- RIIO ED = for electricity distribution

The framework is used to protect current and future consumers by limiting the amount network companies can charge and setting clear key performance indicators (outputs) for companies to meet. The framework also rewards network companies for operating in the most efficient manner (incentives) and provides opportunities to test solutions that could improve operations/meet Government policy objectives (innovation).

To plan for new regulatory periods network companies set out business plans detailing expected expenditure. This is reviewed by OfGEM and used to set the

[2] Understand your gas and electricity bills | Ofgem; July_open_letter_working_version (ofgem.gov.uk) - £96 billion of revenues to network companies

revenues that company can recoup from bill payers in a set period of time. Broadly speaking the more certainty a network company is able to provide on its future plans (for example in relation to readying the network for decarbonisation) the better.

While network companies are expected to ensure their business plans include a reasonable degree of planning it is recognised that it is not possible to accurately predict all eventualities (e.g. if Government policy changes mid-way through a regulatory period). In this event 'uncertainty mechanisms' can be used by the network companies in the event of unexpected expenditure (although depending on cost some uncertainty mechanisms require OfGEM approval).

It is worth noting that OfGEM only regulates network companies in Great Britain. Northern Ireland has a separate regulatory system and the legislation governing Northern Ireland's energy systems is devolved (where as electricity and gas legislation is, in Great Britain, reserved to the UK Government).

RIIO-ED2

Distribution Network Operators (DNOs) have prepared and submitted to OfGEM business plans for the next regulatory period RIIO-ED2 which is expected to commence 1 April 2023.[3] OfGEM has considered these plans and set forward 'draft determinations' (i.e. its draft decision on allowances) via consultation. The consultation is open until 25 August at which point OfGEM will consider representations with final determinations due towards the end of the year.

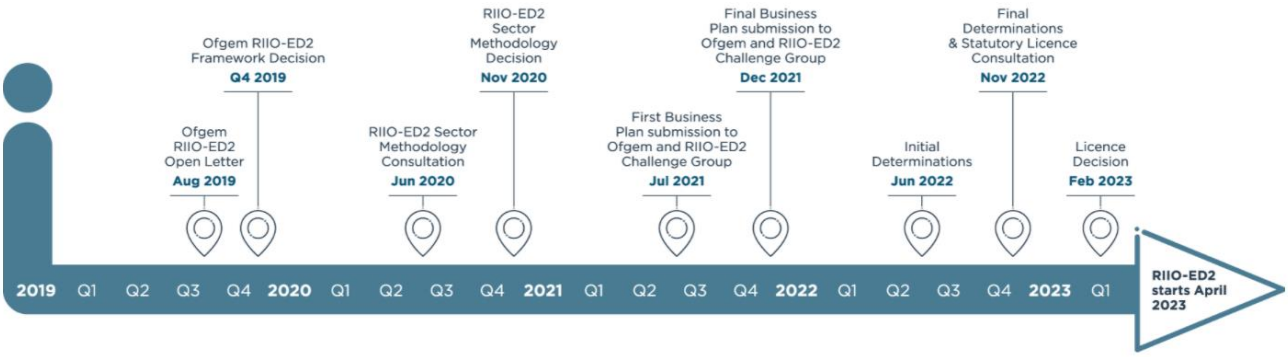
The RIIO ED2 process covers the development of the majority of the electricity distribution network. For example it provides allowances for DNOs to invest in their networks to meet general demand growth across an area and to maintain and update their network.

However, it does not cover the specific costs associated with connecting new customers to the network or upgrading an existing connection. These costs are passed onto the connecting customer via 'connection charges'. This is covered in more detail in the next section.

Future planning is key to an efficient allocation of decarbonisation cost. It is vitally important, therefore, that stakeholders continue to engage with the RIIO ED2 consultation process as this will allow DNOs to better understand the needs, views and ambitions of the network users and plan appropriately.

[3] The RIIO 2 settlements for transmission, gas distribution and system operation have already been completed with the new framework launched on 1 April and running until 2026.

Figure 1:Outline of RIIO-ED2 planning timeline.[4]



Independent Distribution Network Operators (IDNOs)

While the majority of the functions required from the electricity networks are carried out by the monopoly network companies there are some areas where competition has been introduced. This tends to be in the last-mile public network connecting a domestic or commercial development to the regional DNO network. The owners and operators of these commercially provided networks are known as IDNOs. As part of this IDNO's often own the customers' connection – the cable that connects a customer's electricity meter to the public network.

The value of the connections market is in excess of £500 million a year and IDNOs can compete with the monopoly network companies to complete some connections activity.[5] This provides those seeking connection with an alternative to using a DNO proposed solution and can, in some cases, be more cost effective.

OfGEM holds a list of the registered IDNOs who provide connection services.[6]

Meeting local electricity demand

Nationally, it has been forecast that there will be sufficient zero-carbon electricity supply to meet the demand of a zero-carbon truck fleet (battery-electric and/or hydrogen fuel-cell)[7], but at a local level the network capacity required to deliver that electricity to end users can vary significantly. Network companies are expected to make use of existing network capacity before taking forward network reinforcement work which, in the event new demand does not materialise, will have a detrimental impact on consumer bills.

There are a number of factors that will affect the size of connection a customer needs and early engagement with DNOs can mean early identification of the most cost effective solution.

Whether or not a customer's power needs can be meet within existing network capacity plays a big role in the cost of any connection offer (and the time it will take

[4] Home | SSEN (ssenfuture.co.uk)
[5] Competition in connections | Ofgem
[6] Independent Distribution Network Operators | Ofgem
[7] Zero Emission Energy for Transport Report page 30

to be delivered). This is because the user of that connection is expected to pay a proportion of connection costs in order to protect energy bill payers.

Factors affecting network capacity requirements

As OfGEM rules dictate that networks must utilise existing network capacity first there can be quite a large divergences in available capacity at local levels. For example if a factory closed in one area this would free up capacity on that part of the network, however a new factory would reduce available network capacity in the local area around the new site.

Therefore, while at a national level there is confidence that supply can meet demand, local network constraints can make it harder to get power to where demand is and network reinforcement may be required. As the above example demonstrates network constraints are not always in the same place and available capacity at a local level can be changeable depending on the changing needs of that area. Importantly, an agreement to provide power (including how much) can only be guaranteed once contracted (i.e. by entering into a Connection Agreement with the DNO). There is no ability to informally 'reserve' capacity and the DNOs are not permitted to guarantee a certain amount of power to a customer without a formal connection agreement in place.

In addition to the above there are several additional factors that impact on the cost of obtaining a connection:

- Depot locations
- No of vehicles operating at each depot
- Existing authorised capacities and current usage
- Location of charging infrastructure (at depot, on-route or destination)
- Charging profiles (peak, off peak or timed)
- Local network constraints (both at a local lower voltage level and a higher voltage level)

This means that charging capacity requirements (and the associated costs) are likely to be unique to each site/depot and assessments will need to be made by the network company on a site by site basis.

In order to fully understand additional capacity requirements (and therefore propose the most cost effective solution) DNOs will require information on how any battery electric vehicles will be charged (i.e. peak/off peak, how many vehicles charging at the same time etc).

Principles of Network Connection Costs

Network companies are expected to adopt a 'cost reflectivity' principle to requests for new electricity network connections. Broadly speaking it is expected that the organisation/company benefitting from the connection should bear some, if not all, of the costs of that connection. It is important to note that the costs passed on by the DNO to connecting customers are governed by the methods which are agreed with OfGEM and should be applied in the same way across all parts of Great Britain. Therefore DNOs have very little flexibility in allocating costs associated with a particular connection request.

There are 3 parts to a connection:

- **Customer's own direct connection:** the customer assets, including cables, transformers and switch gear, between the electricity meter and the public network. **In general the connecting customers will pay 100% of this cost.**

- **Network Reinforcement in the local area (if required):** in some cases reinforcement/upgrade work to the local distribution network might be required to meet the connection request. **The costs of this shared between the connecting customer and other users of the network. However, if you are the sole user of this connection there is the potential that you will be responsible for the full cost.** From April 2023 reforms will come into force which are expected to reduce the overall connection charge. The size of the reduction will depend on circumstances related to the individual connection request.

- **Upgrade of wider distribution and transmission networks:** Should upgrades of the wider distribution and/or transmission networks be required (unlikely for a single connection unless very large but several connections in a small area could trigger this) then **these costs are socialised in their entirety across all users of the distribution/transmission network in that part of the country.**

Importantly, there is no hard and fast rule on which connection requests will require network reinforcement. It all depends on the available (i.e. uncontracted) capacity of the local network and can vary considerably between relatively short distances. Where costs are socialised, they are covered by the DNOs price control agreements (and ultimately paid for by all customers in that DNO area, including domestic customers). Where the costs are paid by connecting customers they are subject to strict rules as set out in the industry charging methodologies

How can network reinforcement costs be minimised?

A standard electricity network connection would involve contracting with the DNO for the maximum demand you expect to use and for that capacity to be available at all times. Therefore, for a truck depot, this would involve connecting with the full capacity of all truck chargers along with the other electricity demand on the depot. Because this requires the DNO to ensure sufficient capacity is available at all time, including peak, it has the potential to involve significant expenses which, under the connection regulations, the DNOs may be required to pass onto the connectee. An alternative is to consider a **flexible** connection which considers both the installed capacity and how that capacity might be used.

There are a number of flexible solutions that those seeking a connection can consider to minimise network reinforcement costs. For example, the installation of on-site energy storage and demand management systems can help to reduce the network capacity required. However, the economics and space requirements for this type of installation would need to be carefully assessed by operators on a site-by-site

basis.

Timed connections offer another option and allow operators an authorised capacity for their depot which meets their daytime needs, but which can be increased outwith peak times to accommodate the increased vehicle charging demands.
This type of connection was adopted for the Waterloo bus depot in London allowing the customer to draw their maximum power requirement of 2.5MW in the off-peak hours and a reduced capacity of 0.5MW during the day for charging a smaller number of standby buses.

In short, DNOs can work with operators to consider how to achieve a reduction in overall demand which could mitigate, or even avoid, the need for network reinforcement. Early engagement, however, with DNOs combined with a full analysis of a depot's/ site's needs is key.