A Coimisiún um Rialáil Fóntais

Commission for Regulation of Utilities

CRU's Electricity Network Tariff Structure Review

Objectives, Principles & Call for Evidence

Consultation Paper

Reference:	CRU/21/123	Date Published:	18/10/2021	Closing Date:	13/12/2021

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CRU Mission Statement

The Commission for Regulation of Utilities (‘CRU’) mission is to protect the public interest in Water, Energy and Energy Safety.

The CRU is guided by four strategic priorities that sit alongside the core activities we undertake to deliver on the public interest. These are:

- Deliver sustainable low-carbon solutions with well-regulated markets and networks;
- Ensure compliance and accountability through best regulatory practice;
- Develop effective communications to support customers and the regulatory process; and
- Foster and maintain a high-performance culture and organisation to achieve our vision.

Executive Summary

The electricity system in Ireland and across Europe is undergoing rapid and far-reaching change as we transition to a low carbon future. Decentralisation and digitalisation are placing electricity consumers right at the centre of this transition and are changing the way that we consume, produce and think about electricity. Over the course of the last 20 years the use of the electricity networks, and the demands placed upon them, have changed dramatically, and these changes are accelerating today. Additionally, there have been new challenges and opportunities introduced through the Clean Energy Package (CEP), Climate Action Plan (CAP)[1] and the National Development Plan 2021-2030.[2]

In contrast to these changes and challenges, there have been no major changes to the structure of electricity network tariffs that the electricity network companies levy for the use of their networks since 2000. This Call for Evidence Paper starts a programme of work that the CRU is undertaking to review the structure of these network tariffs to ensure they are in the best interest of consumers, are fit-for-purpose for the modern evolving electricity networks and help facilitate a low carbon future.

Tariff Structure Review

Electricity network tariffs recover the costs of developing, operating and maintaining the networks from the users connected to the electricity networks. Network costs are one of four components alongside wholesale costs, supply costs and taxes & levies, that constitute an electricity consumer's overall electricity bill. Combined network costs make up approximately 31% of the standard domestic electricity bill, with circa 8% coming from transmission network costs and 23% coming from distribution network costs.

How network tariffs are structured, and the accuracy with which they reflect actual cost causation, can directly influence how generators and demand customers use the networks. This in turn has the potential to impact system stability; system investment needs; the location of new generation and demand; the efficiency of electricity use; and equity across network users.

The Electricity Network Tariff Structure Review will focus solely on the structure of the tariffs that are levied on network users to recover the network costs that arise from the development, operation and maintenance of network infrastructure in Ireland. As a result, areas such as connection costs, losses and tariffs that recover non-network costs and all-island costs are outside the scope of the review. The review will consider various network tariff structural features such as, *inter alia*: cost allocation rules, tariff class categorisation and tariff components. In order to best consider changes to the current tariff structures, this paper sets out a set of project objectives and proposed principles that the CRU will use throughout the review to guide its deliberations and decisions. The nine proposed principles and two objectives of the review are set out in Figure 1 below and are also discussed further in Section 2.

[1] We note that an update to Ireland's Climate Action Plan is imminent, and that this may be published while this Call for Evidence Paper is being consulted upon. The CRU will take into consideration any material changes resulting from updates to Ireland's Climate Action Plan.
[2] The National Development Plan states "*The NDP Review commits to increasing the share of renewable electricity up to 80% by 2030*".

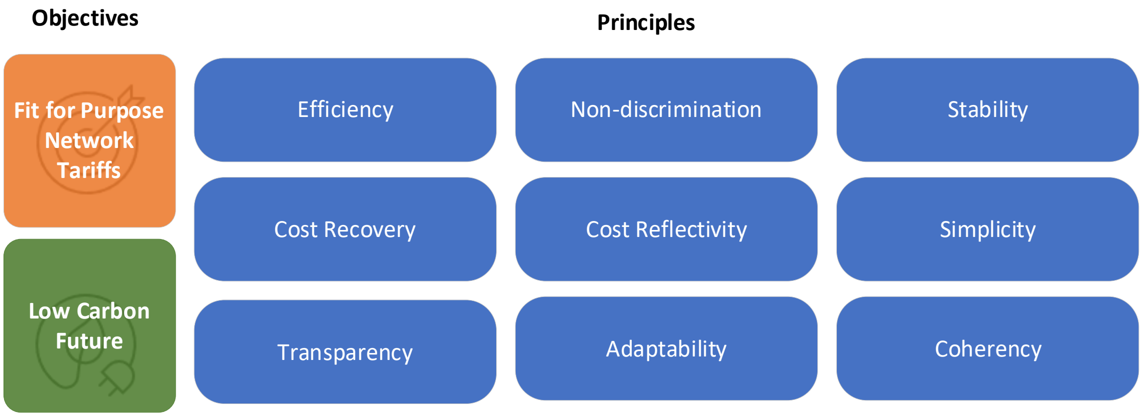

Figure 1 Network Tariff Review: Objectives and Principles

For most network users, the current network tariffs are composed of a mix of energy and capacity/fixed charges, with energy charges being the most significant component. There are very limited locational and time-of-use elements within the current transmission or distribution network tariffs. The current tariff structures are principally based on cost allocations that were formulated in 2000. The relationship that was estimated then between individual charges and the costs that different network users impose on the network may no longer hold. Even if the methodology used in 2000 was considered appropriate, there are other reasons why reviewing the structure of network charges is needed.

Drivers for Change

The rapid change in electricity power systems in Ireland has largely been driven by several key trends such as the growth of intermittent renewable energy resources, the decarbonisation of the energy system, the increasing decentralisation of power systems and the increase in electricity demand.

Over the course of the last 20 years the use of the electricity networks, and the demands placed upon them, have changed dramatically. There have been significant developments in the electricity landscape and changes in the volume of network users, types of network users (both generators and demand users) and patterns of use on both electricity networks. Ireland's total annual electricity demand increased by 52% from 20.24 TWh in 2000 to 30.8 TWh in 2020 and its peak electricity demand increased by 43% from 3.84 GW in 2000 to 5.48 GW in 2020. Over the same period Ireland's installed wind generation capacity increased by orders of magnitude (3,591%) from 116.5MW to 4,300 MW.

Other important changes that have occurred are an increase in embedded generation at distribution level, the start of the smart metering rollout, an increase in demand side response and the uptake of Electric Vehicles (EVs), heat pumps and new storage technologies. This will introduce new challenges for network companies and new opportunities for stakeholders and consumers to play a more active and engaged role. These changes are all set to accelerate in the coming years as the energy transition continues.

The CRU will seek to take account of these changes and other known upcoming policy developments, social trends and technological trends out to 2030 (and beyond) when considering network tariff reforms. Some of the drivers for change and the impact on networks are captured in Figure 2 below and are further elaborated on in Section 6.

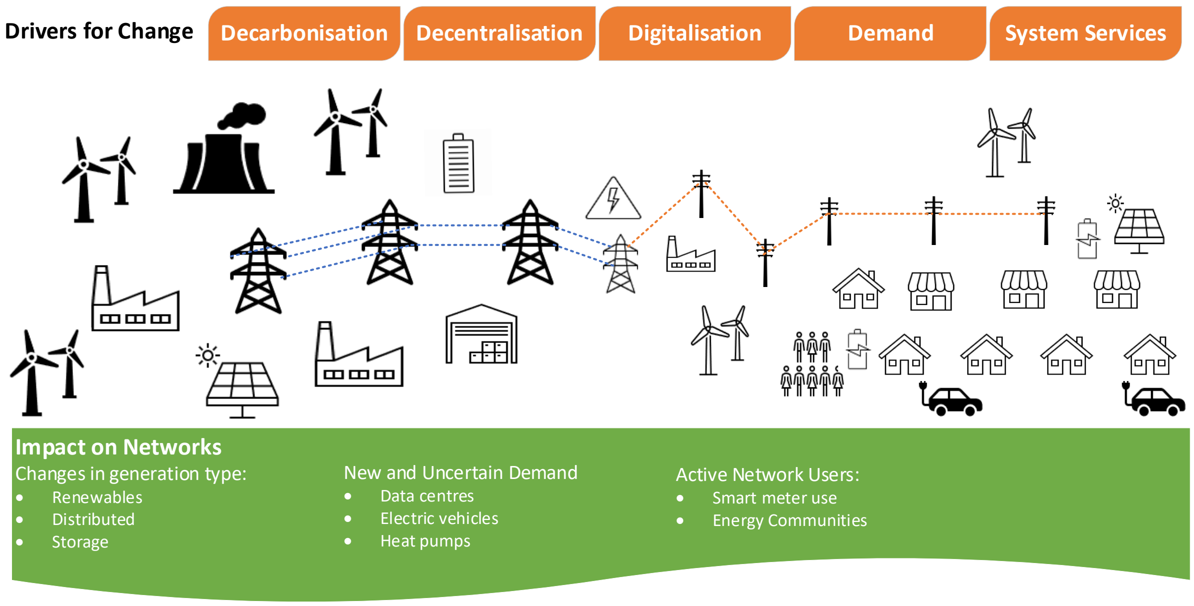

Figure 2 Drivers for Change

Potential Tariff Reforms

There are a number of potential considerations for network tariff reforms, such as, adjusting shares of revenues recovered via tariff components (fixed vs variable), time-of-use tariffs, locational tariffs, interruptible tariffs, generator DUoS, dynamic network tariffs (e.g., close to real time price signals) etc. To consider some potential reforms and to learn from other jurisdictions, the CRU has commissioned a review of tariff structures and reforms in a number of relevant international jurisdictions. The conclusions of this review are summarised in Section 7 of this paper and also set out in detail in a paper (CRU/21/123a) published alongside this Call for Evidence.

Call for Evidence

This Call for Evidence Paper starts a process and programme of work that the CRU is undertaking to review the structure of charges that the electricity network companies levy for the use of their networks. The review will seek to put in place a framework for how network tariffs should be structured to ensure they are fit-for-purpose and best serve consumer interests now and into the future. This framework will aim to be adaptable and accommodate changes in, for example, network usage, costs and technological trends that materialise at different points in time over the coming decade and beyond. This Call for Evidence Paper represents the first step towards reviewing the current network tariff structures. Stakeholder feedback throughout the review will be essential and the CRU will ensure there are opportunities to engage throughout the project.

The CRU is seeking to proactively engage with stakeholders throughout the review and, with regards to this paper, is seeking input from a wide range of stakeholders regarding:

1) The objectives and proposed principles of the review;

2) The current electricity network tariff structures;
3) Future developments that may have significant implications for the networks and network users; and
4) Whether, and how, the network tariff structures could be reformed in anticipation of these future developments.

Specific questions related to the above are set out throughout this paper, with the full set of questions listed in the Call for Evidence section of this paper. The CRU welcomes input on these questions as well as any other comments or suggestions that current and potential future users of the electricity networks, the Network Companies and other interested parties may wish to provide regarding the Electricity Network Tariff Structure Review. Responses to this paper will form a critical input into the next stage of this review, and will shape our thinking and approach to how we review and consider potential tariff structural reforms.

Interested parties are invited to respond to the questions set out in this paper by email to networktariffreview@cru.ie.

Public Impact Statement

This Call for Evidence Paper starts a programme of work that the CRU is undertaking to review the structure of charges that the electricity network companies levy for use of their networks. This may lead to changes in the electricity bills that individual network users pay. The review comes at an important time for the evolution of the electricity networks and will play an important role in contributing to the transition to a low carbon power system.

This paper sets out the objectives of the review and the proposed principles that will guide the work of the review. It describes the changes in the use of the electricity networks that have occurred from 2000 to the present and that are expected to occur in future. It describes the current electricity network tariff structures and discusses potential tariff structure reforms.

Electricity transmission and distribution network tariffs are set each year and cover the costs of developing, maintaining, and operating the electricity networks. Network costs (transmission and distribution) make up *circa* 31% of an electricity consumer's overall electricity bill (alongside wholesale costs, supply costs and taxes & levies). The total development, maintenance and operational costs of the networks to be recovered each year is determined as part of the CRU's revenue controls which take place every 5 years. The allowed revenues that are set for the total period flow through to determining the annual revenue and tariff setting process.

The Electricity Network Tariff Structure Review will not affect these revenue controls but will instead review and, where necessary, redefine the structure of the network tariffs that recover the revenue from network users.

The review therefore will concern changes in *how* the total allowed network revenue is recovered across all network users, rather than changes to the overall allowed revenue amount. For example, making changes to the structure of network charges, such as introducing time-of-use tariffs or adjusting the relative weighting of the variable (energy) component and the fixed / capacity components of network charges, could result in some customers facing lower bills and others facing higher bills. It's important to note that suppliers ultimately decide how to structure the retail tariffs they offer to end-user consumers to recover their costs, including other non-network related costs.

However, in the longer term it is possible that the total revenue requirements for each network will be affected by any changes made to the structure of the tariffs, as different tariff structures may lead to different behaviours by network users and different demands placed on the networks, and subsequently different investment needs into the future.

This paper asks a series of questions throughout as well as in the Call for Evidence section. The CRU is interested in responses to these questions from current network users, potential future network users, industry stakeholders, the Network Companies and any other interested parties. Stakeholder input to these call for evidence questions will help inform and provide a critical input to the CRU's considerations and decision making with respect to network tariff reforms.

Table of Contents

Glossary of Terms and Abbreviations

Term or Abbreviation	Definition or Meaning
ACER	The European Union Agency for the Cooperation of Energy Regulators
AIE	Access to Information on the Environment
CAP	Climate Action Plan
CEER	Council of European Energy Regulators
CEP	Clean Energy Package
CRU	Commission for the Regulation of Utilities
DUoS tariff	Distribution Use of System tariff
DG	Distribution Use of System Group
DLAFs	Distribution Loss Adjustment Factors
DS3	Delivering a Secure, Sustainable Electricity System
DSO	Distribution System Operator
DTS	Demand Transmission Service
D-TUoS tariff	Demand Transmission Use of System tariff
DSO	Distribution System Operator
EirGrid	The company that is licensed to fulfil the role of TSO.
ESBN	Electricity Supply Board Networks, the company that is licensed to fulfil the role of DAO, DSO and TAO.
Electricity Directive	Directive (EU) 2019/944 on common rules for the internal electricity markets
EU	European Union
EV	Electric Vehicle

FAC	Fully Allocated Costs
FOI	Freedom of Information
G-TUoS tariff	Generation Transmission Use of System tariff
GW	Giga Watt
KVA	Kilo-volt-amperes or Apparent Power
KVArh	Kilo-volt-amperes reactive hours or Reactive Energy
LEU	Large Energy User
LFG	Landfill Gas
LPF	Low Power Factor
LRMC	Long Run Marginal Costs
MIC	Maximum Import Capacity
MW	Mega Watt
NRAs	National Regulatory Authorities
PES	Public Electricity Supplier
PR	Price Review
PV	Photovoltaic
Renewables Directive	Directive (EU) 2018/2001 on the promotion of use of energy from renewable resources
SEM	Single Electricity Market
TAO	Transmission Asset Owner
TWh	Tera Watt hours
TLAFs	Transmission Loss Adjustment Factors
ToU	Time of Use
TSO	Transmission System Operator

TUoS	Transmission Use of System
UN	United Nations

1. Introduction

This Call for Evidence paper starts a programme of work that the CRU is undertaking to review the structure of charges that the electricity network companies levy for the use of their networks.

The electricity landscape in Ireland, and in particular the demands placed on the networks, has undergone significant changes in the last two decades, while the structure of the charges for the use of these networks has remained largely unchanged. This is an opportune time to launch a review of the electricity network tariff structures in order:

- to deliver network tariff structures that are in the best interest of consumers and are fit-for-purpose for the modern evolving electricity networks; and

- to deliver network tariff structures that help facilitate a low carbon future that is secure, competitive and cost-effective.

This paper represents the beginning of a review of the network tariff structures that will take place over a number of years. The review will seek to put in place a framework for how tariffs will be structured now and into the future. This framework will aim to be adaptable and accommodate changes in, for example, network usage, costs and technological trends that materialise at different points in time over the coming decade and beyond.

1.1 Why CRU is carrying out this review

1.1.1 CRU's strategic objectives

One of the CRU's four strategic priorities, as outlined in its Strategic Plan 2019-21[3], is to deliver sustainable, low-carbon solutions with well-regulated markets and networks. One of the strategic objectives which lie underneath this priority is to ensure network policies and infrastructure development deliver a low-carbon future whilst supporting competitiveness and security of supply. A number of outcomes that are linked to the delivery of this objective are relevant to this review, and are outlined below:

- A review of network tariff structures is commenced to ensure they are suitable for a decentralised generation world with smart metering, smart grids and distributed generation;
- Secure and competitive supplies of electricity, gas and water are maintained; and
- High levels of electricity demand growth are accommodated.

[3] The CRU's *"2019-2021 Strategic Plan"* – Available here.

1.1.2 Rationale for carrying out the review

This is an opportune time to launch a review of the electricity network tariff structures. The energy system is in the process of rapid evolution. This has been caused by three primary drivers: decarbonisation, decentralisation and digitalisation. Decarbonisation is driving the energy transition and decentralisation and digitalisation are placing consumers at the centre of this transition. New technologies are becoming available which will change the way end-users consume, self-produce and store electricity. Electricity systems are transitioning to a low carbon future over the next few decades. In order to account for, and best facilitate, these changes, there is a need to rethink the current electricity network tariff structures.

There have been no major changes to the structure of the demand transmission tariffs or the distribution tariffs since 2000.[4] Since then, over the course of more than 20 years, the use of the electricity networks, and the demands placed upon them, have changed dramatically. There have been significant developments in the electricity landscape and significant changes in the volume of network users, types of network users (both generators and demand users) and patterns of use on both networks. These developments are discussed in Section 5 of this paper.

Changes in the use of the electricity networks are due to continue and indeed accelerate in the coming years. Already, for example, there are additional challenges and opportunities coming down the line in respect of the Clean Energy Package (CEP) and Climate Action Plan (CAP). These future developments are discussed in Section 5 of this paper.

Network tariffs can play a key facilitating role by creating the right incentives, and also opportunities, for how generators and demand customers use the network, which in turn impact system stability; system investment needs; the location of new generation and demand; the efficiency of electricity use; and equity across network users.

If the existing electricity network tariff structures are not fit-for-purpose they could cause harmful distortions in how, and when, network users use the networks, and they could hinder the changes that are necessary for the electricity system in the coming years in order to deliver a secure and cost-effective low-carbon future.

1.2 Why Network Tariffs matter

Network tariffs matter as they impact all end-users' electricity bills. Electricity network tariffs recover the costs of developing, operating and maintaining the networks from the users connected to the electricity networks. Network costs are one of four components, alongside

[4] In 2003 and 2004 the CRU (then called CER) undertook a review of the transmission use of system (TUoS) and distribution use of system (DUoS) and PES (Public Electricity Supplier) customer tariffs. This review represented the CRU's first opportunity for a comprehensive review of tariff structures since market liberalisation in 2000. The aim of this review was to evaluate these legacy structures with a view to presenting alternative tariff structures which more adequately, and equitably, delivered costs and benefits amongst all electricity consumers. However, no changes to the structure of the network tariffs were implemented due to this review.

wholesale costs, supply costs and taxes & levies, that constitute an electricity consumer's overall electricity bill.

Figure 3 below provides a conceptual overview of the electricity system[5] from generation to customer supply. This review covers the transmission and distribution network tariffs as captured by the red dots in the graphic below.

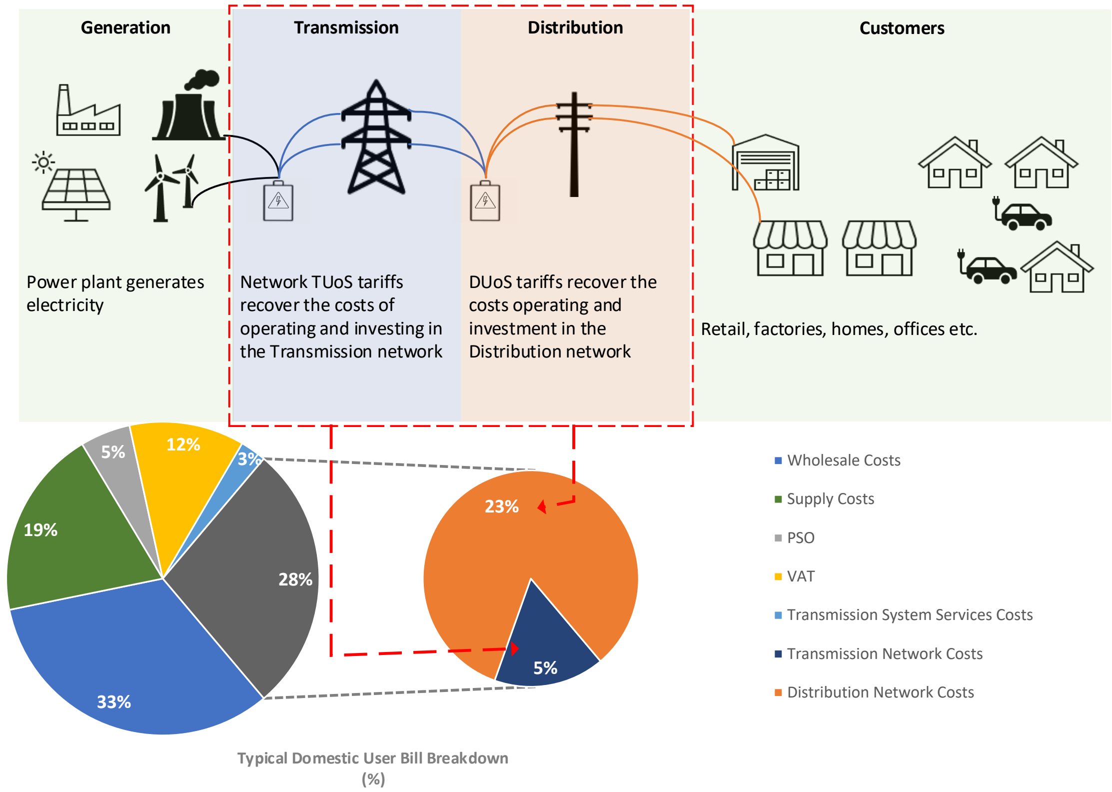

Figure 3 Overview of Review scope and Typical Customer Bill[6]

As illustrated by the pie charts above, the transmission and distribution network tariffs, which recover the costs of operating and investing in each network, combined currently represent approximately 31% of a typical domestic end user electricity bill. This review covers network costs that make up approximately 28% of typical domestic end user bill (23% relates to distribution network costs and 8% relates to transmission network costs). Please note that transmission network 'system services' costs, which make up approximately 3% of a typical end user bill, are out-of-scope of this review.

Changes to network tariff structures, and the accuracy with which tariffs reflect actual cost causation, can directly influence how generators and demand customers utilise the transmission and distribution networks. This in turn has the potential to effect system stability; system

[5] It should be noted here that this is a conceptual overview of the traditional electricity system. The electricity system is evolving into a more complex system as discussed throughout this paper.
[6] These figures are based on March 2021 data sent by suppliers to CRU. The precise cost components of domestic electricity bills differ for each supplier. Therefore, the cost breakdown of bills shown here is an indication rather than an exact representation. These percentages can fluctuate over time.

investment requirements; the location of generation and demand; the efficiency of electricity use; and equity across network users.

For example, tariff design features such as geographic basis of charging; tariff components (e.g., fixed, capacity and variable charge components); tariff categories; and how costs are allocated across these categories can directly impact:

- **Efficient use of electricity** - how strongly end-users are incentivised to use the system efficiently and reduce consumption or move consumption to different times during the day or year. This in turn can alleviate (or potentially worsen) the demands placed on the system, and can either delay (or expedite) the need to invest in the network to accommodate demand growth, to the benefit (or detriment) of all users of the network.

- **Where users of the system locate on the network** – this can alleviate (or worsen) 'bottlenecks' on the network where capacity is tight, which in turn impacts the security of supply of parts of the network.

- **When users use the network** – as costs can vary by the time at which the network is used, tariffs can vary by time also, through time-of-use charges. This can be, for example, time of day, e.g., day/night or even more granular, or by season, e.g., winter/summer.

- **Fairness** - Network users with similar characteristics that place similar demands on the system and impose similar costs on the networks should make a similar contribution to those network costs. This applies to both existing network users, as well as future users that may have similar or different needs as technology and society develop.

This review may lead to changes in the electricity bills that individual network users pay. The review will not seek to revisit past CRU decisions on the total revenues that the network companies can collect from network tariffs. However, making changes to the structure of network charges, such as introducing time-of-use tariffs or adjusting the relative weighting of the energy component and the fixed / capacity components of network charges, could result in some customers facing lower bills and others facing higher bills.

The following two subsections provide a high-level overview of revenues associated with the existing tariffs that are applied for use of the transmission and distribution networks.

1.2.1 Transmission Use of System Tariffs

The transmission network is the high voltage grid along which bulk power is transported from large electricity generators to the lower voltage distribution system, and to transmission-connected demand, across all regions of Ireland. It is the backbone of the power system. The main charge for transporting power across the transmission system is the Transmission Use of System (TUoS) charge. TUoS charges are separate from the cost paid by customers for electricity itself. EirGrid operates the transmission network.

The total annual revenue required to safely develop, operate and maintain the electricity transmission system in Ireland for the 2021 calendar year was set at €537.4m[7].

Currently, for the 2020/21 tariff year, TUoS tariffs paid by demand network users (D-TUoS tariffs) recover approximately €257 million[8] and this makes up approximately 5% of an average residential customer's electricity bill. D-TUoS can make up a larger proportion of the typical electricity bill for medium sized businesses but makes up a lower proportion of the typical electricity bill for very large energy users.[9] There are five separate D-TUoS tariff groups each with their own tariff.

The overall TUoS requirement, and component tariffs, are currently set in advance of a charging period (a 12-month period) and the D-TUoS tariffs do not make use of any seasonal, or more granular, time-of-use elements.

1.2.2 Distribution Use of System Tariffs

The distribution network in Ireland transports electricity from both the transmission network and distribution-connected generators to approximately 2.4 million customers, of which approximately 2 million are residential customers. The total annual revenue required to safely develop, operate and maintain the electricity distribution system for the 2021 calendar year has been set at €920.7 million[10]. ESB Networks (ESBN) operates the distribution network.

The main tariff for recovering these costs is the Distribution Use of System (DUoS) tariff. The DUoS tariff is charged by ESBN to electricity Suppliers for (the Suppliers' customers') use of the distribution System. There are a number of separate DUoS Groups each with their own DUoS tariff (DG1 to DG10). This reflects the different costs that different types of network users impose on the network. Electricity customers are classified into DUoS Groups based on several factors including the voltage the customer's premises is connected at, the type of meter installed, and whether or not the customer exports, as well as imports, electricity.

The DUoS tariffs account for approximately 23% of the average residential electricity consumer bill. DUoS tariffs can make up a larger proportion of the typical electricity bill for medium sized businesses but make up a much lower proportion of the typical electricity bill for very large energy users.[11]

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[7] CRU Information Paper (CRU20/095) – "*Electricity Transmission Network Allowed Revenues for 2021 and Demand Transmission Use of System (D-TUoS) Tariffs 2020/21*" – Available here.
[8] Note that we are not including the Transmission System Services charge here.
[9] Business customers and large energy users usually have bespoke electricity contracts with their supplier which means that the cost breakdown can differ a lot from one customer to another.
[10] CRU Information Paper (CRU20/084) – *"Electricity Distribution Network Allowed Revenue 2021, Distribution Tariffs 2020/2021 & Distribution Loss Adjustment Factors"* Available here.
[11] Business customers and large energy users usually have bespoke electricity contracts with their supplier which means that the cost breakdown can differ a lot from one customer to another.

Similar to TUoS tariffs, DUoS tariffs are currently set in advance of a charging period (a 12-month period) and do not make use of any seasonal variation and very limited time-of-use elements.

1.3 Review Approach

The Electricity Network Tariff Review will involve a significant number of decisions over the next number of years. The tariff structure decisions will need to be made iteratively. This will mean that, as the review progresses, tariff structural options are removed (for qualitative and/or quantitative reasons) in order to focus on a refined set of tariff structural options to model. There will be three broad phases to the project. These are summarised in Figure 4 below.

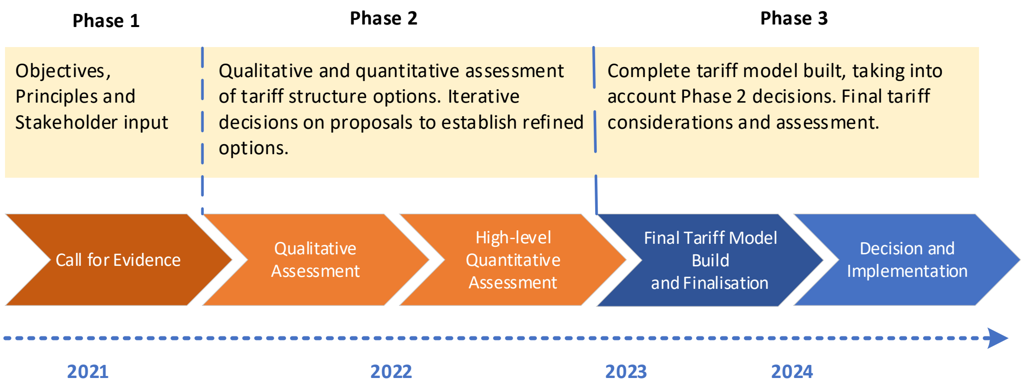

Figure 4 Electricity Network Tariff Review Approach[12]

The main reasons for adopting the three phased approaches are:

- To ensure stakeholders have opportunities to provide input throughout the process;
- To ensure tariff structural options are thoroughly considered and assessed; and
- To consider a wide range of tariff structural options prior to making decisions.

This review represents the beginning of a process of tariff structural reform over the coming years. The review will seek to put in place a framework for how tariffs should be structured to ensure they are fit-for-purpose and best serve consumer interests now and into the future. This framework will aim to be adaptable and accommodate changes in, for example, network usage, costs and technological trends that materialise at different points in time over the coming decade and beyond.

The detail of the papers to be published under this approach and the detail of the review timeline will be set out in a future paper.[13]

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[12] Please note that Figure 4 illustrates a tentative timeline. The review timeline will be updated and refined in a future paper.
[13] The CRU expects to publish this paper in Q2/Q3 of 2022.

1.4 Stakeholder Engagement

The Electricity Network Tariff Structure Review will take place over a number of years and will involve a number of detailed publications. The outcomes of the review could result in impacts to customers connected to the transmission and distribution networks and may result in changes to retail bills. In order to gain insights and views from a wide range of stakeholders, the CRU will create a strategy to proactively and effectively engage with stakeholders throughout the Review. This strategy will need to consider both existing and potential future stakeholders.

The rapidly changing and evolving energy system has meant that the type of consumers that interact with the electricity network has changed and will evolve. The power system is becoming more complex and less centralised. Stakeholders are now involved in smart energy consumption, energy communities, small- and large-scale storage, micro-generation, demand response and more.

In order to create an effective stakeholder strategy, the CRU is considering the use of existing stakeholder groups, bilateral meetings, establishing a dedicated Electricity Network Tariff Structure Review stakeholder group (to discuss and give feedback on CRU consultations and tariff reform considerations throughout the review) etc. The CRU's publications will form one part of this strategy to engage and inform stakeholders, however, we are seeking views as to how best to further engage and accommodate additional stakeholder feedback. In developing such a strategy, the CRU will need to be cognisant of a number of constraints (for example, resource, costs and time constraints). The finalised strategy will aim to balance these constraints with the goal of proactively engaging with key stakeholders.

Stakeholder Engagement

1. How should the CRU engage with stakeholders over the course of the Electricity Network Tariff Review?
2. If a dedicated Electricity Network Tariff Structure Review stakeholder group is established, would you be interested in participating? If such a group was over-subscribed, how should the CRU limit the number of members?

1.5 Structure of this paper

The remainder of this paper is structured as follows:

- **Section 2:** outlines the objectives of the review and the proposed principles that will guide the work of the review.
- **Section 3:** details the CRU's relevant legal remit and duties.
- **Section 4:** sets out the scope of the review.
- **Section 5:** describes changes in the use of the electricity networks that have occurred from 2000 to the present and that are expected to occur in future.
- **Section 6:** describes the current electricity network tariff structures and discusses potential tariff structure reforms.

- **Section 7:** provides the conclusions of a review of electricity network tariff structures in other EU Member States and other relevant jurisdictions.
- **Section 8:** discusses potential interactions with other regulatory policies and arrangements.
- **Section 9:** outlines the call for evidence questions.
- **Section 10:** sets out the next steps to this paper.

1.6 Responding to this paper

Responses containing feedback to the questions asked in this paper, as well as any other comments or suggestions that interested parties may wish to provide regarding the Electricity Network Tariff Structure Review, may be submitted until COB 13 December 2021 and should be emailed to networktariffreview@cru.ie.

Unless marked confidential, all responses from companies or organisations may be fully published on the CRU's website. Respondents may request that their response is kept confidential. The CRU shall respect this request, subject to any obligations to disclose information. Respondents who wish to have their responses remain confidential should clearly mark the document to that effect and include the reasons for confidentiality.

Responses from identifiable members of the public will be anonymised prior to publication on the CRU website unless the respondent explicitly requests their personal details to be published.

The CRU privacy notice sets out how we protect the privacy rights of individuals and can be found here: Privacy Notice - Commission for Regulation of Utilities (cru.ie).

Respondents should note that the CRU is subject to the Freedom of Information Act 2014 (FOI) and the European Communities (Access to Information on the Environment) Regulations 2007 to 2018 (AIE Regulations).

2. Objectives and Principles

2.1 The Objectives of the Review

The CRU's Strategic Plan 2019-2021[14] includes the following objective and outcome:

- **Objective:** Ensure utility network policies and infrastructure development deliver a low carbon future whilst supporting competitiveness and security of supply.
- **Outcome:** A review of the network tariff structures is commenced to ensure they are suitable for a decentralised generation world with smart metering, smart grids and distributed generation.

The objectives of the Electricity Network Tariff Structure Review are set out in the Figure below and capture the ambition of the review.

To deliver network tariff structures that are in the best interest of consumers and are fit-for-purpose for the modern evolving electricity networks.

To deliver network tariff structures that help facilitate a low carbon future that is secure, competitive and cost-effective.

Figure 5 Network Tariff Structure Review Objectives

Fit-for-Purpose Network Tariffs

The CRU's first objective is to deliver network tariff structures that are in the best interest of consumers and are fit-for-purpose for the modern evolving electricity networks. This objective involves delivering new or changed tariff structures, where necessary and appropriate, that best serve the interests of consumers now and into the future. In order to achieve this, the CRU will review the current network tariff structures and, to the extent necessary, work to design updated network tariff structures that are future-proofed, as far as possible and practicable, for known upcoming policy developments, social trends and technological trends out to 2030 (and beyond).

[14] The CRU is currently finalising its Strategic Plan for 2022-2024.

Low Carbon Future

The second objective focusses specifically on supporting Ireland's pathway to a low carbon future. The network tariff structures should be consistent with realising a low carbon future in a way that does not risk security of supply, avoids distortion of competition among network users, and is cost-effective.

2.2 The Proposed Principles that will guide the work of the Review

This section sets out the proposed principles that will guide the work of the review. The CRU will take account of these principles over the course of the review and will use them to evaluate options and aid decision-making. The CRU's proposed principles are outlined in Figure 6.

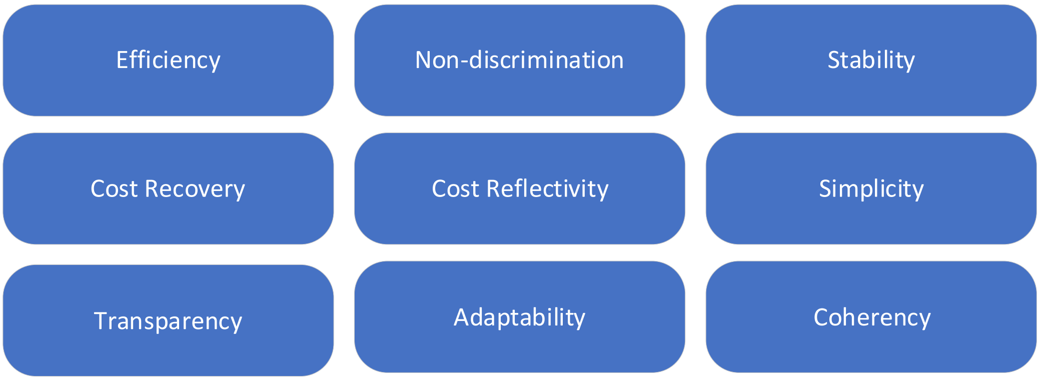

Figure 6 Network Tariff Review Principles

Ultimately the principles will guide how the objectives of the review are pursued and achieved. An explanation of each proposed principle is set out in Table 1 below.

Table 1 Principles and Explanation

Principle	Explanation
Cost Reflectivity	Tariffs should aim to reflect, as far as is practicable, the costs that users impose on the network.
Efficiency	Tariffs should incentivise the efficient use of the network.
Cost Recovery	Tariffs should be set to ensure network system operators fully recover the costs they have incurred in the efficient provision, maintenance and operation of the network.
Transparency	All relevant information on network tariffs, and the methodologies used to determine them, should be available to all stakeholders.

Non-discrimination	Similar network usage should not face any undue differences in network charges.
Simplicity	The network tariff structures should, as far as possible, be easy to understand and implement.
Stability	Tariffs should be relatively stable such that individual network users whose circumstances are unchanged do not face undue changes in the charges they have to pay from year to year due to the tariff structural changes.
Adaptability	The design of the tariff structures should have sufficient flexibility to allow the network operators to respond to developments in future years.
Coherency	The tariff structures for transmission and distribution networks should avoid creating regulatory arbitrage between the two networks. The tariff structures should complement, or at a minimum should not conflict with, other policy objectives of the CRU.

It is clear that some of these principles may conflict with each other at times. The principles as a whole contain inherent trade-offs making it impossible to fully satisfy them all simultaneously. Therefore, the principles will have to be balanced against each other when they are used to guide the work of the review and to evaluate various options over the course of the review.

These inherent trade-offs are especially clear when balancing the principle of cost reflectivity against the other principles. For example, an absolutist approach to cost reflectivity would arguably entail very granular cost reflective tariffs. This may be in direct conflict with the principles of simplicity, transparency and stability. This is due to the fact that it would need a very complex methodology sitting behind it and could lead to highly volatile tariffs and uncertainty of charges for customers.

Another area where the inherent conflicts and trade-offs are obvious is the balance between the principle of stability versus the principle of adaptability. Stable tariffs facilitate efficient long-term investment decisions by network users, but the changing nature of the electricity system and networks means that network tariffs may need to evolve over time.

A balance clearly needs to be struck when designing electricity network tariff structures. It is the CRU's role to design, and approve, electricity network tariff structures that achieve an effective balance of these principles and meet the needs of the broad range of stakeholders. The CRU must also be mindful here of its over-arching mission to protect electricity consumers.

Objectives

3. Do you agree with the objectives of the Electricity Network Tariff Structure Review? Please state your reasoning.

4. Should the CRU include any other objectives? If so, please explain your reasoning.

Proposed Principles

5. Do you agree with the proposed principles of the Electricity Network Tariff Structure Review? Are they clearly defined?

6. In your view, should any further principles be added, or any existing proposed principles be removed? Please explain your reasoning.

3. CRU's Legal Remit and Duties

This section sets out the CRU's legal remit to carry out this review under the Electricity Regulation Action 1999. It also outlines a number of provisions in European legislation regarding transmission or distribution tariffs and their methodologies that are relevant to this review.

3.1 Electricity Regulation Act 1999

The CRU has responsibility for licensing and regulation of the electricity Network Companies under the Electricity Regulation Act 1999 ("the Act").

Under Section 35 of the Act, the CRU may give directions to the Network Companies from time to time regarding the basis for charges for use of the transmission or distribution network. The Network Companies must then prepare a statement for the approval of the CRU setting out the basis upon which charges are imposed for use of the transmission network or distribution network, within such time as the CRU directs.

These directions from the CRU to the Network Companies may provide for:

- the methods of charging to be included in the statement;
- the form and the extent of the information to be provided by the Network Companies to network users;
- the form of charges and information about those charges to be included in the statement;
- the procedure to be adopted in the submission by the Network Companies of a statement of charges and the approval by the CRU of same; and
- the nature of information to be provided to applicants seeking use of the transmission or distribution network and its presentation and transparency.

Section 35 of the Act states that a charge for the use of the transmission or distribution network must be calculated in accordance with directions given by the CRU so as to enable the Network Companies to recover:

- the appropriate proportion of the costs directly or indirectly incurred in carrying out any necessary works, and
- a reasonable rate of return on the capital represented by such costs.

Section 35 of the Act also states that the CRU, solely, will determine what constitutes an ‘‘appropriate proportion’’ and a ‘‘reasonable rate of return’’ as referred to above.

Under Section 36 of the Act, any charges referred to in the statement submitted to the CRU by the Network Companies shall not apply until the statement has been approved by the CRU. The CRU shall consult with the Network Companies, and have regard to any submission made by them, before making a decision on whether or not to approve a submitted statement. The CRU can make modifications to any charges referred to within a statement as it considers appropriate.

3.2 EU Regulation

Regarding EU legislation, EU Directive 2019/944[15] states, under Article 59, that each regulatory authority has the duty to fix or approve, in accordance with transparent criteria, transmission or distribution tariffs or their methodologies, or both.

EU Regulation 2019/943[16], under Article 18, prescribes the following rules that are relevant for this review:

- Charges applied by network operators for access to networks, including charges for connection to the networks, charges for use of networks, and, where applicable, charges for related network reinforcements, shall be cost-reflective, transparent, take into account the need for network security and flexibility and reflect actual costs incurred insofar as they correspond to those of an efficient and structurally comparable network operator and are applied in a non-discriminatory manner.

- Those charges shall not include unrelated costs supporting unrelated policy objectives.

- The method used to determine the network charges shall neutrally support overall system efficiency over the long run through price signals to customers and producers and in particular be applied in a way which does not discriminate positively or negatively between production connected at the distribution level and production connected at the transmission level. The network charges shall not discriminate either positively or negatively against energy storage or aggregation and shall not create disincentives for self-generation, self-consumption or for participation in demand response.

- Tariff methodologies shall reflect the fixed costs of transmission system operators and distribution system operators and shall provide appropriate incentives to transmission system operators and distribution system operators over both the short and long run, in order to increase efficiencies, including energy efficiency, to foster market integration and security of supply, to support efficient investments, to support related research activities, and to facilitate innovation in the interest of consumers in areas such as digitalisation, flexibility services and interconnection.

- Where appropriate, the level of the tariffs applied to producers or final customers, or both shall provide locational signals at Union level, and take into account the amount of network losses and congestion caused, and investment costs for infrastructure.

[15] "*Directive (EU) 2019/944 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU (recast)"* – Available here.
[16] *"REGULATION (EU) 2019/943 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 5 June 2019 on the internal market for electricity (recast)"* – Available here.

- There shall be no specific network charge on individual transactions for cross-zonal trading of electricity.

- Distribution tariffs shall be cost-reflective taking into account the use of the distribution network by system users including active customers. Distribution tariffs may contain network connection capacity elements and may be differentiated based on system users' consumption or generation profiles. Where Member States have implemented the deployment of smart metering systems, regulatory authorities shall consider time-differentiated network tariffs when fixing or approving transmission tariffs and distribution tariffs or their methodologies and, where appropriate, time-differentiated network tariffs may be introduced to reflect the use of the network, in a transparent, cost efficient and foreseeable way for the final customer.

- Distribution tariff methodologies shall provide incentives to distribution system operators for the most cost-efficient operation and development of their networks including through the procurement of services. For that purpose regulatory authorities shall recognise relevant costs as eligible, shall include those costs in distribution tariffs, and may introduce performance targets in order to provide incentives to distribution system operators to increase efficiencies in their networks, including through energy efficiency, flexibility and the development of smart grids and intelligent metering systems.

- By 5 October 2019 in order to mitigate the risk of market fragmentation ACER shall provide a best practice report[17] on transmission and distribution tariff methodologies while taking account of national specificities. That best practice report shall address at least: (a) the ratio of tariffs applied to producers and tariffs applied to final customers; (b) the costs to be recovered by tariffs; (c) time-differentiated network tariffs; (d) locational signals; (e) the relationship between transmission tariffs and distribution tariffs; (f) methods to ensure transparency in the setting and structure of tariffs; (g) groups of network users subject to tariffs including, where applicable, the characteristics of those groups, forms of consumption, and any tariff exemptions; (h) losses in high, medium and low-voltage grids.

- ACER shall update the best practice report at least once every two years.

- Regulatory authorities shall duly take the best practice report into consideration when fixing or approving transmission tariffs and distribution tariffs or their methodologies.

[17] ACER's latest published Report on Transmission Tariff Methodologies in Europe was published in December 2019 – Available here and their Report on Distribution Tariff Methodologies in Europe was published in February 2021 – Available here.

4. Scope of the Review

4.1 What is In-scope

The tariff structure review will focus solely on the structure of the tariffs that are levied on network users to recover the network costs that arise from the development, operation and maintenance of network infrastructure in Ireland. As a result, areas such as connection costs, losses and tariffs that recover non-network costs and all-island costs are outside the scope of the review.

The scope of the Electricity Network Tariff Review will cover analysis and review of:

- **the electricity demand Transmission Use-of-System (D-TUoS) tariff structure**[18]; and
- **the electricity distribution Use-of-System (DUoS) tariff structure**.

The structure of the electricity generation transmission Use-of-System (G-TUoS) tariff, and the balance of cost recovery between D-TUoS and G-TUoS, are outside the scope of the review as these are set on an all-island basis and determined by the SEM Committee.[19]

The demand D-TUoS charges comprise two components: "Network charges", for the use of the transmission system infrastructure for the transportation of electricity and "System Services Charges" for the recovery of the costs arising from the operation and security of the transmission system. The structure of the transmission "System Services Charges", and the costs that this charge recovers, are also out-of-scope. Demand transmission system service charges recover costs which are not explicitly associated with the development and maintenance of transmission network infrastructure. The transmission system services charges include non-network components of TSO costs (for example interconnector services and I-SEM project costs).

The graphics below further illustrate which of the transmission and distribution network charges and revenues shares are in-scope and out-of-scope.

4.1.1 Transmission Network Tariffs – In-Scope

The graphic below illustrates the overall CRU allowed revenue requirement to be recovered from the TUoS charges (the monetary amounts reflect the CRU's decision[20] for the 2020/21 tariff year). It shows how the total revenue requirement is currently differentiated into either "System Services" costs and "Network Costs". The Network Costs are then sub-divided into costs to be recovered from 'Generation' network users and 'Demand' network users as per the aforementioned SEM Committee decision. The 'Demand' TUoS charges, which recover costs via a 'capacity charge' and 'energy transfer charge' component from demand network users, are in-scope in this review, which is identified within the green-shaded box below. The 'Demand'

[18] Please note, the structure of the Transmission "System Services Charges" (which is a component of the TUoS charges) is out-of-scope.
[19] For more detail on the G-TUoS Charging Decision Paper please see here and for more detail on the Methodology please see here.
[20] *"Electricity Transmission Network Allowed Revenues for 2021 and Demand Transmission Use of System (D-TUoS) Tariffs 2020/21"* – Available here

transmission Use of System penalty charge for breaching contracted Maximum Import Capacity (MIC), known as the Unauthorised Usage Charge, is also in-scope. All other charges, and revenue streams, are out-of-scope.

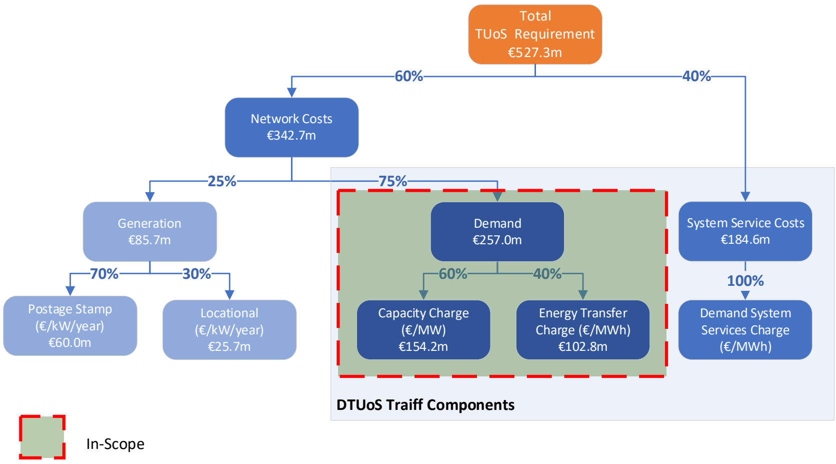

Figure 7 In Scope Transmission Network Tariffs

4.1.2 Distribution Network Tariffs – In-Scope

The graphic below illustrates the overall CRU allowed revenue requirement to be recovered from the DUoS charges (the monetary amounts reflect the CRU's decision[21] for the 2020/21 tariff year). It shows how the portions of the total revenue requirement that is currently recovered across all of the DUoS tariff categories via energy, standing and capacity charges. All of the DUoS charge structures are in-scope of this review as illustrated by the green shaded box below. The penalty charge for breaching Maximum Import Capacity (MIC) and Low Power Factor (LPF) surcharge are also in-scope.

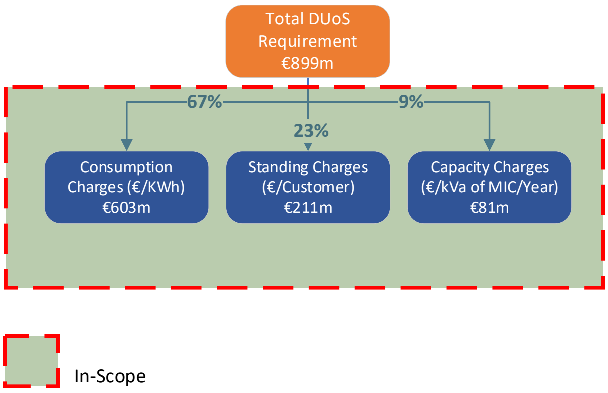

Figure 8 In Scope Distribution Network Tariffs

21 *"Electricity Transmission Network Allowed Revenues for 2021 and Demand Transmission Use of System (D-TUoS) Tariffs 2020/21"* – Available here

4.1.3 Scope of the Analysis

The scope of the review will cover analysis and review of various network tariff structural considerations, such as, *inter alia*:

- **the cost basis of setting tariffs**, for example Fully Allocated Cost (FAC) or Long Run Marginal Cost (LRMC);
- **cost allocation rules** (across tariff class categories and tariff components);
- **tariff class categories** (how network users are grouped into tariff categories and whether the existing categories are appropriate and/or new categories should be introduced);
- **tariff components** (consideration of different types of tariff components (such as fixed, capacity/power and energy charges); and
- **tariff dimensions** (such as locational charges and/or time-of-use charges).

The review will also look at behavioural responses from different types of network user and customer to different tariff structures and will assess the impact of new options for tariff structures on:

- electricity bills for different types of network user and customer;
- revenue recovery by the Network Companies; and
- how well each tariff structural option meets the principles and objectives of the review.

This review will involve a robust assessment of tariff structural considerations across both the transmission and distribution networks. The approach will include both qualitative and quantitative assessments to refine the structural options as the review progresses.

Note that this is the CRU's initial view of the scope of the review and the final scope will be informed by responses to this Call for Evidence paper.

4.2 What is Out-of-scope

For the avoidance of doubt, and to help inform responses to this Call for Evidence paper, the following areas are out-of-scope of the review, *inter alia*:

- Generation Transmission Use-of-System (G-TUoS) tariff methodologies as set by the SEM Committee;
- Transmission System Services charges;
- Any penalty charges and surcharges outside of the transmission's demand network unauthorised usage penalty charge for breaching MIC ("Unauthorised Usage Charge"), and the distribution penalty charge for breaching MIC and the LPF surcharge;
- Interconnector charges;
- Transmission Loss Adjustment Factors (TLAFs);
- Distribution Loss Adjustment Factors (DLAFs);
- Demand Reduction Incentive Schemes;
- Transmission and Distribution connection policies;
- Transmission and Distribution connection charges;

- Delivering a Secure Sustainable Electricity System (DS3/DS3+); and
- The allowed revenues, or any decision, set by the CRU under PR5.

Scope

7. Do you agree with the areas that are identified as in-scope and out-of-scope for the review? Please state your reasoning.

8. Acknowledging that resources are finite, are there any other areas that should be included in, or excluded from, the in-scope and out-of-scope areas for the review? If so, please explain your reasoning.

5. Changes in the use of the electricity networks

The use of the electricity networks, and the demands placed upon them, have changed dramatically since 2000, and are anticipated to undergo further transformational change in the coming years. These changes have, and will have, considerable implications for the electricity network tariff structures.

This section first outlines the changes that have occurred in the use of the electricity networks since the current electricity network tariff structures were introduced in 2000 and discusses what these changes mean for electricity consumers. Following this, it then introduces the policies that will shape coming network developments, namely the Climate Action Plan (CAP) and the EU's Clean Energy Package (CEP).

The final sub-section then outlines the future developments that are coming for the electricity networks and the challenges facing the electricity networks as a result, and the implications of these changes for the electricity network tariff structures.

5.1 Developments since 2000

5.1.1 Summary of changes

As stated previously, network tariff structures have not been reviewed since 2000. Over the course of the last 20 years there have been significant developments in the electricity landscape and changes in the volume of network users, types of network users (both generators and demand users) and patterns of use on both electricity networks.

The biggest changes that have occurred are the increase in electricity demand and the increase in renewable generation. In 2000[22] Ireland had a total annual electricity demand of 20.24 TWh and a peak electricity demand of 3.84 GW. By 2020[23] the total annual electricity demand had increased by 52% to 30.8 TWh and peak demand had increased by 43% to 5.48 GW. EirGrid's median forecast for 2030 is that total annual electricity demand will increase by a further 33% to 40.9 TWh and peak demand will increase by a further 20% to 6.57 GW.

In 2000 Ireland had a total installed generation capacity of 4,290 MW. Only 116.5 MW, or 2.7%, of this was wind generation capacity. By the end of 2020 wind generation capacity had increased by orders of magnitude (3,591%) to 4,300 MW. In order to reach Ireland's target of at least 70% of electricity coming from renewables by 2030, EirGrid estimates that an installed capacity of just over 11,000 MW of renewables (coming from bioenergy, onshore wind, offshore wind, solar and hydro) will be needed.

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[22] *"Energy Policies of IEA Countries: Ireland 2003 Review"* – Available here.
[23] *"EirGrid All Island Generation Capacity Statement 2021-2030"* – Available here.

Other changes that have occurred include, *inter alia*:

- Electricity Retail Market opening (on a phased basis from 2000 to full market opening in 2005);
- Introduction of new All-Island wholesale market arrangements with Northern Ireland (the Single Electricity Market, SEM) in November 2007;
- Significant amendments to the SEM to bring it in line with the EU electricity target model in October 2018;
- Introduction of new system services under the DS3 project to provide support to the electricity system during times of high intermittent renewable generation;
- Changes in the types of network users (for example, the introduction of large data centres);
- Increases in embedded generation at distribution level (such as small scale CHP; solar PV; small scale hydro; biomass/LFG; and distribution-connected wind);
- Commencement of the smart metering roll-out;
- Increases in the number of Electric Vehicles (EVs) and heat pumps;
- Increasing use of demand side response mechanisms to manage loads;
- Increases in the participation of storage technologies (predominantly battery
- storage), including in hybrid format; and
- Increases in consumer participation in the market and on the network, either as individuals or groups, as envisaged within the Clean Energy Package.

Some of these changes are only beginning and are discussed further in Section 5.3 which deals with future developments.

5.1.2 What these changes have meant for electricity consumers

The changes in the electricity system over the last twenty years have meant that the role of electricity consumers has started to evolve, for domestic, commercial and industrial customers. Traditionally, electricity consumers were passive participants in the electricity system – simply receiving and using electricity for their needs and paying accordingly. The network and electricity system were designed and operated to meet these needs.

Electricity consumers now often have the capability to generate or store their own electricity, thereby playing a more active role in the system, and becoming an increasingly important element in electricity system operation and balancing. System flexibility was once met exclusively by large generation plants adjusting their outputs, but there is currently a growing role for consumers to play in flexibility, such as participation in demand side response. Advances in smart technology and digital services, and the growing complexity of the electricity system, mean that opportunities for customers to play a more engaged role are increasingly emerging. This situation will evolve much further over the coming years, and this is addressed further in section 5.3.

5.2 Policies that will shape network developments

The following sub-sections summarise the known polices that will shape network developments in the coming years. These policies will influence the Network Tariff Review.

5.2.1 The EU's Clean Energy Package (CEP)

The EU's Clean Energy Package (CEP)[24] aims to achieve a target of a 40% reduction in the EU's greenhouse gas emissions by 2030 compared to 1990 levels, in order to fulfil the EU's Nationally Determined Contribution to the UN's 2015 Paris Agreement[25], as well as aid in facilitating the transition towards the use of cleaner energy.

The CEP consists of the following eight legislative acts:

1) Energy Performance of Buildings Directive 2018/844;
2) The recast Renewable Energy Directive (EU) 2018/2001;
3) The revised Energy Efficiency Directive (EU) 2018/2002;
4) Governance of the energy union and climate action (EU) Regulation 2018/1999;
5) Regulation on risk-preparedness in the electricity sector (EU) 2019/941;
6) Regulation establishing a European Union Agency for the Cooperation of Energy Regulators (EU) 2019/942;
7) Regulation on the internal market for electricity (EU) 2019/943; and
8) Directive on common rules for the internal market for electricity (EU) 2019/944.

A number of key aspects of the CEP are related to the changing use of the electricity networks, and are either directly related to network tariffs, or could benefit from a review of the electricity network tariff structures. These aspects include, *inter alia*:

- Active Consumer and Energy Community development - including new energy undertakings such as aggregation, storage, energy sharing and demand response;
- Role of the DSO – including flexibility in distribution networks and the integration of electromobility into the electricity networks; and
- Role of the TSO – including network development and the power to make investment decisions.

5.2.2 Climate Action Plan (CAP)

The Climate Action Plan (CAP)[26] charts Ireland's course towards an ambitious decarbonisation target. A number of actions within the CAP (for which the CRU is responsible) are related to the

[24] *"Clean energy for all Europeans package" – Available here.*
[25] *"Paris Agreement"* – Available here.
[26] "*Climate Action Plan 2019" – Available here.*

changing use of the electricity networks. These actions are either directly related to network tariffs, or could benefit from a review of the electricity network tariff structures.

These actions are outlined below:

- **Action 18 -** Identify required changes to implement more hybrid connections in the market;
- **Action 20 -** Develop longer term measures to facilitate data centres and minimise grid reinforcement;
- **Action 22 -** Establish regulatory frameworks and market rules for private networks/direct lines;
- **Action 23 -** Implement regulatory arrangements to support new interconnection, including hybrid assets;
- **Action 24 -** Review of policy and regulatory frameworks for electricity storage to facilitate an efficient level of electricity storage to help meet the 2030 renewable electricity target of 70%;
- **Action 30 -** Assess the impact of the current structure of electricity bill charges (including PSO and standing charges) on renewable self-consumers and other consumers; and
- **Action 59 -** CRU to progress Smart Metering Programme and Billing for Electricity (formats etc.).

We note that an update to Ireland's Climate Action Plan is imminent, and that this may be published while this Call for Evidence Paper is being consulted upon. The CRU will take into consideration any material changes resulting from updates to Ireland's Climate Action Plan.

5.3 Future Developments of the Electricity Networks and their implications for tariff structures

5.3.1 Introduction

Over the next decade, a transformation of the system is expected with many trends – such as decarbonisation – intensifying. There will be changes to the composition of the users of the transmission and distribution networks, there will be changes in the patterns of generation and demand, and there will be changes to the nature and direction of energy flows as we evolve to a decentralised system. Increasing focus on climate change targets will speed up decarbonisation activities. Decentralisation and digitalisation trends will continue to have greater impact on how the system is operated and also provide new opportunities.

Figure 9 summarises the drivers for change and the impact these drivers will have on our network. These are further discussed in Section 5.3.2.

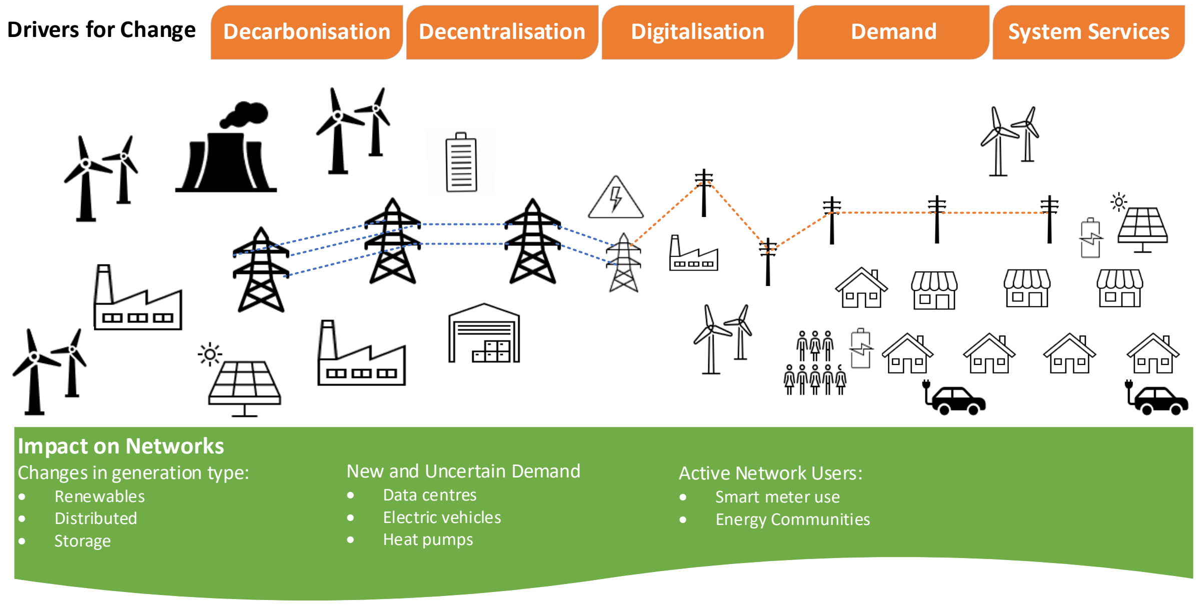

Figure 9 Future Developments of the Electricity Networks

The evolution of the networks will bring about big changes for electricity consumers, and big changes in how electricity networks are used and managed. Networks will need to adapt to increasing demand loads from technologies such as electric vehicles (EVs) and heat pumps, increased levels and forms of distributed generation and storage, and a growing need for flexibility. Electricity consumers will have opportunities to play a more active role in supporting the system operation and benefit from new services.

The following sub-sections set out changes that are likely to happen in the future electricity system, the impacts on the electricity networks and the implications for network tariffs. It also provides an overview of what this means for key stakeholders such as consumers, communities, and network operators.

5.3.2 Key changes in the future energy system

Ireland's energy sector is undergoing a major transition which will drive transformational change in the electricity networks over the Price Review Five (PR5) and Price Review Six (PR6) periods (2021-2030) and beyond.

Key drivers behind the energy transition are:

- **Decarbonisation**: Ireland's ambitious decarbonisation targets are driving changes in both electricity supply and demand. For example, there is continued growth in renewables and increased electrification in transportation and heating from EVs and heat pumps respectively.
- **Digitalisation**: the advances in digital technologies and greater access to smart services are changing the way that electricity is generated, transported, stored and consumed. The way that the consumer perceives and uses electricity are also changing with access to new types of propositions such as time-of-use retail tariffs.

- **Decentralisation of electricity generation**: traditionally, electricity was produced by large transmission-connected generators. This is changing to smaller forms of generation technology, often connected to the distribution networks, and often with greater intermittency.
- **Changes in electricity demand**: the increased uptake of EVs and heat pumps (due to decarbonisation) means demand for electricity in the future will grow. New technologies will also change the profile of demand. The growth of data centres also increases electricity demand and can cause local security of supply issues where networks are constrained.
- **Increasingly important role of system services**, including electricity storage, in both balancing supply and demand and ensuring that renewable electricity resources are utilised as fully as possible while maintaining the security and stability of the system.

In addition, there are opportunities and a desire for consumers and communities to have an increasingly active role in the electricity system – as outlined in the Clean Energy Package. This is shaping changes in the electricity system.

The following sub-sections list and describe some of the key changes that are expected in the electricity system in the coming decade and beyond, and the impact of these on the electricity networks.

5.3.3 Changes in generation

The coming years will see a continued shift to renewable electricity generation and embedded generation assets connected on the distribution networks. Both of these trends' present challenges to network management.

Renewable electricity

The need to decarbonise the electricity system will drive continued expansion of renewable electricity generation. The Government's Climate Action Plan sets out a target of 70%[27] of electricity being generated by renewables by 2030, and a phase out of coal and peat generation by the end of 2025. To meet this target, EirGrid estimates that Ireland will need an installed capacity of just over 11,000 MW of renewables (coming from bioenergy, onshore wind, offshore wind, solar and hydro) by 2030. This compares with Ireland's wind generation capacity at just over 4,300 MW in 2020. The new Programme for Government has also increased the Offshore Wind target from 3.5GW to 5GW by 2030. The CRU will take into consideration any material changes resulting from updates to Ireland's Climate Action Plan.

This more than doubling of renewable electricity capacity over the next decade presents major challenges to the transmission and the distribution networks. Facilitating the connection of this capacity will require significant network investment and ensuring security of supply will require the uptake of storage technologies and flexibility solutions.

[27] Note that the National Development Plan 2021-2030 "…*commits to increasing the share of renewable electricity up to 80% by 2030*".

Behind-the-meter generation & self-consumption

Behind-the-meter technologies, such as solar panels or wind turbines, are becoming more commonly installed by domestic and non-domestic electricity consumers. These enable consumers to generate, as well as consume, their own electricity. This electricity can be consumed on-site (known as self-consumption) or fed back into the electricity grid. Increasing numbers of homes and businesses are expected to install these technologies, thereby enabling them to play a more active role in the electricity system either as individuals, using aggregators or through energy communities. This change means that more generation assets are connected to the distribution networks and a growing role for operators to manage supply and demand in these networks.

5.3.4 Changes in demand

Demand for electricity will rapidly grow over the next decade, with changing patterns of use between different types of users. EirGrid's forecast demand for the PR5 period is expected to increase by *circa* 14%. The PR5 demand forecast[28] is set out in Figure 10.

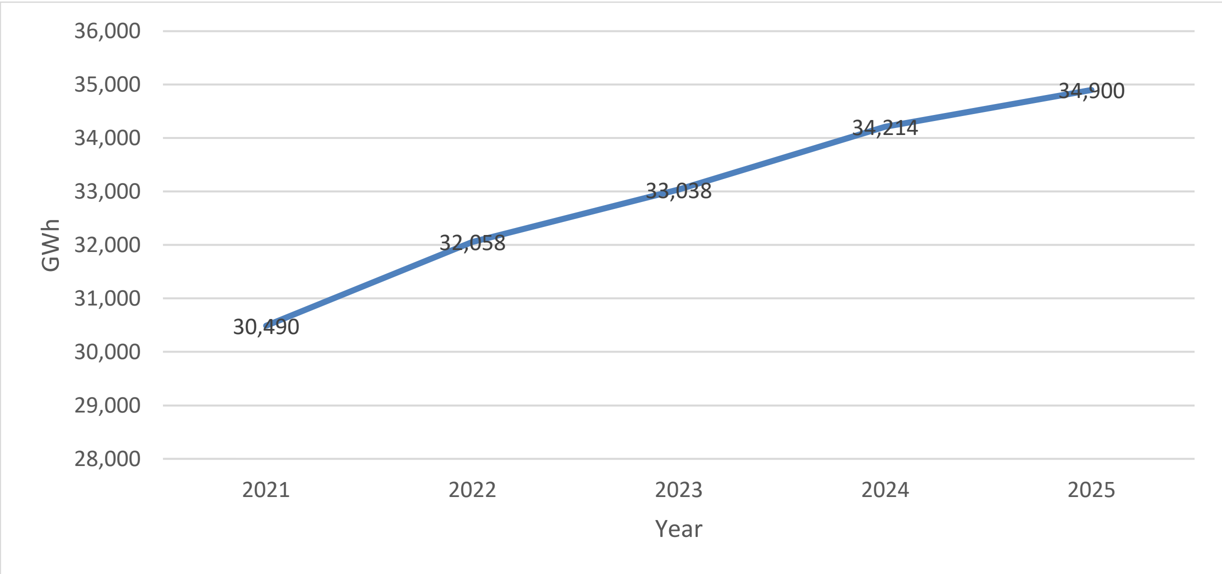

Figure 10 EirGrid's PR5 Annual Demand Forecast (GWh)

Some of the most impactful and significant changes are explained below.

LEUs & Data Centres

Significant electricity demand growth in Ireland in the coming years will be driven by large energy users (LEUs) and particularly from increased data centre connections. These are typically large demand sites connected to the transmission network.

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[28] Price Review Five Determination: *"TSO Revenue Model" – Available here.*

The propensity for these large energy users to connect in or near Dublin has increased network congestion and constraints in the Dublin area in recent years. This situation may worsen in the future if this trend continues.

The continued connection of large energy users, and particularly data centres, in congested areas of the network, could also hamper delivery of Ireland's renewable energy targets. Much of Ireland's renewable energy generation – such as wind – is located outside of the Dublin area. This means the electricity from these generation sites will need to be transported over longer distances to meet the needs of the LEUs.

If new large energy users were to connect in less congested areas of the network, and closer to sources of renewable energy, then the scale and cost of required network reinforcements would be reduced, and less renewable generation would have to be dispatched down.

Electric vehicles (EVs)

Electrification of transport is one of the pillars for decarbonisation of the transport sector and for decarbonisation of the economy generally. With a target of 1 million EVs by 2030, as set out in the Climate Action Plan, a steep rise in EVs is expected in the coming years.

EVs will lead to increased demand loads on the distribution network, particularly the low voltage network with charging points distributed across homes, businesses on street and dedicated public stations. Integrating a large number of EVs requires a need for more capacity and represents a significant challenge. The scale of this challenge will depend in part on the extent to which consumers and businesses are willing to charge their EVs at times which reduce stress on the networks at critical times.

Vehicle to grid (V2G) technology allows EV batteries to discharge electricity back to the electricity grid. The development of this technology may, in the future, enable EV owners to sell electricity back to the network at times of system stress and high electricity prices.

Heat pumps

The electrification of heat will also play a key role in decarbonisation through an increase in the uptake of heat pumps. The Climate Action Plan sets out a target to install 600,000 heat pumps by 2030. Like EVs, heat pumps will place additional demands on the electricity networks by increasing overall demand for electricity and increasing peak demands. The demand profile of heat pumps will also impact when electricity is required at different times of the day and through different seasons.

5.3.5 Changes in balancing – growing need for storage and flexibility

The changes in the demand and supply of electricity outlined above will result in a more complex electricity system. The growing share of renewable generation is more difficult to manage due to its intermittent nature – its output is less predictable, controllable or flexible. Increased demands for electricity, as outlined above, mean the networks need greater capacity. However, whilst reinforcement of the electricity networks will inevitably be part of the solution, it cannot be the sole solution. This is where flexibility, storage and demand response have an increasingly important role to ensure that generation always matches demand in the system, and reinforcement is minimised where possible.

Electricity storage

Electricity storage – in various forms – will become more common over the coming decade. Storage enables network users to draw electricity from the network at times of low demand and price, store it and then export or consume it when the electricity networks are constrained and/or the price of electricity is high. On a domestic level, storage can be in the form of a dedicated battery (often connected to a Photovoltaic (PV) system) or an EV, which essentially acts as a battery. On a large scale, storage connected to the network or at generation sites will be a crucial factor for enabling more renewable electricity generation to integrate into the electricity system. Adequate storage will be needed to allow intermittent renewable generation to meet inelastic electricity demand whilst also ensuring that generation matches demand at all times in the system.

Demand side response and flexibility services

Demand side response allows network users to change their energy usage from their normal or current consumption patterns, and to increase, decrease or shift their energy demand in real-time. Demand response is an increasingly important tool to help ensure a secure, sustainable and cost-efficient low-carbon electricity system. Demand response can reduce peaks in demand to reduce stress and congestion of the networks – this can help to avoid expensive reinforcements and prevent the possibility of disconnections to manage constraints. Demand response can also help the system operators at times when renewable electricity generation is more abundant. It can also provide significant benefits for electricity customers in the form of reduced bills.

New technology such as smart meters, digital automation and electricity storage are enabling quicker and more efficient demand side response.

Digitalisation's role in flexibility and storage

Increased digitalisation is a driver and enabler for changes in the energy system. The roll-out of smart metering, increased digitalisation, data collection and analytics will mean faster flow of information and improved ability to manage the increasing number of stakeholders in the electricity system. It has the potential to shift demand patterns and curves for the benefit of the electricity system – for example, shifting it away from peak periods. It will enable electricity demand to become increasingly responsive, and therefore play a role in demand response. In addition, the advance of smart services and increasing real-time demand side management has the potential to spawn new business models which will transform the way we buy, and sell, electricity.

5.3.6 Need for whole system approaches

Overall, the changes presented in this section mean big changes for how the electricity networks are managed. This presents a growing challenge for electricity network operators, and a growing requirement for a whole systems approach.

On the generation side, there are expected to be increased amounts of renewable electricity generated and embedded generation connected to the distribution networks. On the demand side, electricity demand will grow significantly and there will be changes across users and with changing patterns of use. Overall, the system is expected to be much more flexible and responsive than it has been previously.

These changes mean significantly greater complexity in how electricity networks are managed and optimised, and overall, mean that a whole systems view will be increasingly needed to effectively operate them. There is a challenge in enabling a whole systems approach and the level of central coordination and control this requires, whilst balancing the need for greater decentralisation and autonomy with a level of complexity which is difficult to manage and coordinate centrally.

There will be a need for increasing interactions between the distribution and transmission networks. For example, the use of distributed generation for local network management could have impacts on the wider network. Rapidly evolving patterns of generation and demand across both networks make it more difficult for the Network Companies to predict where future network investment will be needed, including whether it is best to invest at the transmission or distribution level.

5.3.7 Changing roles of different parties across the networks

This section outlines what the changes outlined above mean for the changing role of consumers, communities and network operators.

Consumers as active participants

Traditionally, electricity consumers were passive participants in the electricity system – simply receiving and using electricity for their needs. Electricity flowed in one direction – from large generators to consumers, moving from higher to lower voltages as it was transmitted and distributed. Total electricity demand at any given point in time was largely "fixed" and generators were the "flexible" part of the system, adjusting their generation output to meet demand. However, the electricity system is undergoing a transformation and increasing in complexity. As part of this, the role of the consumer changes. Opportunities for consumers to play more active and engaged roles will open up.

Consumer electricity demands will change – as outlined earlier, we will see consumers adopting more low carbon technologies, many of which have impacts on the electricity networks. As well as consuming electricity, consumers can increasingly generate their own electricity – as well as store it and participate in demand side response. The purchase of an EV, for example, means a consumer's demand profile will change, but it also presents them with choices of when to charge their vehicle based on electricity prices at different times of the day. The future development of V2G will also likely present them with opportunities to generate revenue by exporting electricity.

Changes in energy business models will also impact consumers' role in energy and electricity systems specifically. A move to service-based models, such as Heat as a Service or Mobility as a Service, rather than product ownership, is expected. This has potential to change the way consumers interact and manage their energy. Consumers will have a wider set of choices and greater influence in the system, enhanced by increased digitalisation, smart meters and demand side management. Service based models also allow for more complex operation of energy assets by professional companies, with customers simply specifying the outcome (such as thermal comfort) required.

Consumers may also play a greater role within larger communities, as listed below. They may also have increased participation as a group of consumers through the use of aggregators.

Jointly Acting Consumers as active participants

Electricity consumers in apartment buildings or complexes will also have the ability to participate in the energy transition in ways that were previously only available to individual households or landlords. In efforts to enable all final customers to be able to contribute towards the clean energy transition, the CEP set out entitlements for tenants and individuals living in apartment buildings to be able to participate in the energy sector.

Scenarios could include the shared consumption of generation produced by renewable assets such as solar panels installed on the premises of the apartment building, storage of group-produced energy from renewable assets, or potential supply of excess generated energy back to the grid.

Renters and owners of apartments in these complexes will work together to identify what specific energy undertakings will be pursued by the group and will collectively make decisions with regards to their participation in the clean energy transition.

Energy Communities

Energy Community is a term used by the CRU to jointly identify a Citizen Energy Community as defined under the Electricity Directive[29], and a Renewable Energy Community as under the Renewable Directive[30].

Citizen Energy Communities as defined under the Electricity Directive, can be summarised as a group of consumers who jointly partake in electricity activities such as generation, supply, storage, energy-sharing or aggregation. Participation should be open and voluntary, and their primary purpose should not be for financial profits, but rather for environmental or societal benefits.

Renewable Energy Communities, as defined under the Renewables Directive, can partake in many of the same electricity activities as Citizen Energy Communities but there are some differences in their operational practices. For example, Renewable Energy Communities have a proximity requirement, meaning that all members have to be physically close to other community members or the renewable assets, whereas Citizen Energy Communities do not.

The CRU is currently progressing implementation of the requirements in both Directives. Due to the many overlapping rights, obligations and entitlements of Citizen Energy Communities and Renewable Energy Communities the CRU considers that they should be reviewed in tandem and that a single regulatory framework could potentially encapsulate the activities of both types of communities. The CRU published a Call for Evidence paper on Energy Communities on 26

[29] DIRECTIVE (EU) 2019/944 – *“Common rules for the internal market for electricity and amending Directive 2012/27/EU (recast)*” – Available here.

[30] “DIRECTIVE (EU) 2018/2001 – *“The promotion of the use of energy from renewable sources (recast)*” – Available here.

August 2020[31] and a consultation paper on Energy Communities and Active Consumers on 5 March 2021.[32] The CRU Conclusions Paper will be published shortly.

The CRU is of the view that Energy Communities could potentially provide both:

- consumer benefits, such as allowing individuals and groups to be part of the decarbonisation efforts in Ireland, to manage their demand better, to become involved in electricity production, and to potentially reduce their energy bills; and
- network benefits, such as allowing Communities to assist with managing network constraints through demand side response and creating opportunities for innovative projects.

Evolving role of network operators

The ongoing changes in the use of the electricity networks is leading to increasing interactions between the transmission and distribution networks, and a much greater role for active management of supply and demand on the distribution network than was previously the case. There is a growing need for parties to evolve away from traditional roles, and a need to think about how best to enable both existing and new network users to support network and system operation.

The continued growth of distributed generation and technologies such as EVs and heat pumps may lead to reduced distribution network capacity availability and new constraints emerging on the network. These impacts need to be managed appropriately, including through the use of active management approaches and innovative solutions (for example, the co-location of demand and generation).

Historically, electricity has flowed from the transmission network to the distribution network. However, the growth of distributed generation will reduce the need for the distribution network to import energy. Indeed, the growth of distributed generation leads to increased instances of the distribution network exporting electricity to the transmission network. This may potentially create stresses on the transmission network, which may require investment to address. Evolving generation and demand patterns across both networks will also make it harder for the Network Companies to predict where future investment will be needed, including whether it is best from a whole system perspective to invest at the transmission or distribution level.

Increased decentralisation of electricity generation will also mean that distribution network operators, and distribution network users, will have to play a more active role in managing power supply and demand. System services and electricity storage will play a more important role in both balancing supply and demand and ensuring that renewable electricity resources are utilised

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[31] CRU Call for Evidence (CRU/20/099) - *"Call for Evidence on Energy Communities under the Clean Energy Package"* - Available here.

[32] CRU Consultation Paper (CRU/21/028) – "*Consultation on Energy Communities and Active Consumers"* – Available here.

as fully as possible while maintaining the security and stability of the system. This opens up the opportunity for network users to play a greater role in providing such services in the future.

5.3.8 Impacts of future changes and implications on network tariffs

Network tariff structures can play a role in the energy transition and the Electricity Network Tariff Structure Review will need to consider how the design and formulation of the network tariff structures could help network users avail of the opportunities that will open up as result of the energy transition.

The impacts of the future changes identified above and their implications for tariffs can be considered as follows:

- **Impact on demand**: Most of the changes have some form of impact on electricity demand which will therefore affect the network charges consumers pay.
- **Tariff structure and cost recovery**: The changes in demand and cost mean it is unlikely that current tariff structures and levels will generate the required revenues to cover the network companies' costs.
- **Incentivisation**: For some of the changes to happen efficiently and effectively, incentives may be needed to encourage consumers to change behaviour. One candidate would be rebalancing the structure of tariffs to provide financial incentives for consumers to act in ways that reflect their impact on network costs.
- **Impact on broader DSO Services**: The energy transition will mean that network companies will have greater requirements for balancing and managing the energy flows on their networks. One of the levers to support this could be network pricing.
- **Customer impacts**: The transition needs to be carefully balanced to ensure that consumers are treated equitably and the new forms of values and benefits are accessible to all consumers. This includes the exposure consumers have to network charges.

Future Developments of the Electricity Networks and their implications for tariff structures

9. How do you see the use of the electricity networks in Ireland changing and developing in the future?
10. In your view, are there any drivers of change in the future use of the electricity networks that the CRU hasn't covered in this paper? If so, please identify them and explain your answer.
11. How do you think the roles of different parties/stakeholders across the networks will change in the coming years?
12. How could changes to the electricity network tariff structures facilitate and/or encourage a whole system approach to network investment, network management and system operation? Please explain your answer.
13. How do you foresee the increasing uptake of behind-the-meter generation for the purpose of self-consumption changing the load profile of electricity consumers, particularly domestic electricity consumers, in the future?

14. What are your views on the impacts of future changes identified in this Section and their implications for electricity network tariffs?

15. Do you think that there are implications or issues that need to be addressed for electricity network tariffs that we have not mentioned in this paper? If so, please explain what these implications are and why they need to be addressed.

16. How do you think changes to the electricity network tariff structures could help stakeholders avail of opportunities opening up due to future changes to the electricity networks?

6. Tariff Structures

The Network Tariff review will examine changes to tariff classes, the rebalancing of revenue recovered through tariff structural components as well as examining changes to the components of network tariffs. This section discusses the current tariff structures and summarises a number of potential tariff structural considerations.

For clarity, the four key potential components of network tariffs are outlined below:

- **Fixed (€) charge:** A flat annual or monthly tariff component. Network users usually pay a fixed tariff based on the tariff group that they are categorised into.
- **Energy (€/kWh) charge:** A tariff component charged based on the amount of electricity used (i.e., per kWh). The basic starting point for an energy tariff component is a single time-independent tariff, but it can be differentiated for different times using a Time-of-Use dimension.
- **Capacity (€/KW) (contracted or ex-ante) charge:** A tariff component charged based on the contracted capacity of a demand connection, i.e., per kW of MIC (Maximum Import Capacity).
- **Power (€/KW) (measured or ex-post) charge:** A tariff component charged based on measured power consumption, i.e., per kW of peak power demand in a month or year. The basic starting point here again is a single time-independent tariff, but it could also be differentiated for different times.

6.1 Current Tariff Structures

For most network users, current network tariffs are composed of a mix of energy and capacity/fixed charges. More details on the current tariff structures are set out in the sub-sections below.

6.1.1 Transmission Demand Network Tariffs

Demand Transmission Use-of-System (D-TUoS) charges are based on both MIC and energy use. A total of 60% of a demand user's allocation of network costs are charged on a capacity (MW) basis through what is called the Network Capacity Charge, and the remaining 40% are charged on an energy (per MWh) basis through what is called the Network Transfer Charge.

There are five distinct classes of demand users under which TUoS charges are levied to suppliers. These classes are called Demand Transmission Service (DTS) Schedules, and are outlined in the table below.

Table 2 DTS Schedule Groups

DTS Schedule Group	Description	Possible End Customer
DTS-T (LEUs)	Suppliers serving customers connected directly to the transmission system or who are within DUoS Group DG10.	Large industrial site, large manufacturing site
DTS-D1 (LEUs)	Suppliers serving customers connected to the distribution system and having a MIC of 0.5MW or above who are not served under DTS-T, and who have quarter-hourly interval metering and is a Large Energy User (LEU).	Factory, manufacturing site, large commercial buildings
DTS-D1 (Non-LEUs)	Suppliers serving customers connected to the distribution system and having a MIC of 0.5MW or above who are not served under DTS-T, and who have quarter-hourly interval metering and is not a Large Energy User (LEU).	Large hotel, commercial buildings, hospital
DTS-D2 (LEUs)	Suppliers serving all other users connected to the distribution system who are not served under DTS-T or DTS-D1 and who is a Large Energy User (LEU).	University, factory, manufacturing site, hotel
DTS-D2 (Non-LEUs)	Suppliers serving all other users connected to the distribution system who are not served under DTS-T or DTS-D1 and who is not a Large Energy User (LEU).	Home, shop, bar

DTS-T Network Capacity Charge

Transmission connected demand users are contracted to an MIC under the terms of their transmission connection agreement. The MIC is the specification to which the connection is designed and forms the basis of the Network Capacity Charge for the demand user. The Network Capacity Charge incorporates a bandwidth for reasonable seasonal variation in demand. This means that a demand user reducing its peak demand either temporarily or permanently and thus not utilising their full MIC may pay lower capacity charges. A demand user with an MIC less than 20 MW and whose highest metered demand is less than 80% of their MIC will be charged based on 80% of their MIC. A demand user with an MIC greater than 20 MW will be charged based on their MIC minus 4 MW, providing their highest metered demand does not exceed this. Quarter-Hourly Interval Metering is used to measure actual consumption.

DTS-D1 Network Capacity Charge

Network Capacity Charges for Distribution connected demand users under the DTS-D1 schedule are calculated in a similar way to those under DTS-T, but they also include an adjustment to reflect the fact that Distribution connected demand users, through the diversity of their demands, do not have the same effect on the Transmission system at the Grid Exit Point as a directly connected user. This means that Network Capacity Charge for demand users under the DTS-D1 schedule is less than the corresponding charge under the DTS-T schedule.

The charge under the DTS-D1 schedule also incorporates a bandwidth to allow for a reasonable seasonal variation in demand.

DTS-D2 Network Capacity Charge

Distribution connected demand users under the DTS-D2 schedule are charged a proxy capacity charge that is based on daytime metered energy.

Network Transfer Charge

The Network Transfer Charge is the same for demand users under all three schedules above and is based on actual MWh consumption of energy, reflecting the associated use of the transmission network to transfer that energy.

Unauthorised Network Usage Charge

The Unauthorised Network Usage Charge applies to demand users under the DTS-T schedule only. It is levied on electricity imported in excess of the user's MIC, and is charged on a per MWh basis. It acts as an incentive for demand users to contract for the appropriate level of MIC. It is a flat per MWh rate and does not change by time or for times of system stress.

Network users are also charged the Transmission System Services charge, but this is out-of-scope of this review. Further detail regarding demand transmission network tariffs, including distinctions in tariff rates for LEUs and non-LEUs, can be found in EirGrid's 2021-22 Statement of Charges.[33]

6.1.2 Distribution Network Tariffs

The Distribution Use-of-System (DUoS) charges are split by type of customer and voltage level, according to distinct DUoS Groups. The DUoS Groups are outlined at a high level in Table 3 below.

[33] "*EirGrid Statement of Charge Applicable from 1st October 2021"* – Available here.

Table 3 DUoS Customer Groups

DUoS Group	Description	Typical Network End User
DG1	Urban Domestic Customers	Urban home
DG2	Rural Domestic Customers	Rural home
DG3	Unmetered Connections inc. Public Lighting	Street lighting
DG4	Local Authority Unmetered Connections inc. Public Lighting	Street lighting
DG5	Low Voltage Non-Domestic Customers (non-Maximum Demand)	Shop, school, bar
DG6	Low Voltage Business Customers (Maximum Demand)	Hotel
DG7	Medium Voltage Customers (Maximum Demand)	University
DG8	38kV Looped Customers (Maximum Demand)	Factory
DG9	38kV Tailed Customers (Maximum Demand)	Manufacturer
DG10	110KV Maximum Demand Customers	Data Centres

DUoS charges have different components, which vary according to the DUoS Group. These components are explained below.

Standing Charge

The Standing Charges are fixed charges which serve to recover customer-related costs that do not vary with energy usage or size of customer, such as metering costs. All the DG Groups apart from DG3 and DG4 have a Standing Charge, with the charge varying by customer category according to the associated costs.

Energy Charge

Energy Charges are levied per kWh of energy consumed and recover costs that vary with energy delivered over the distribution network. Currently Energy Charges are applied on a 24-hour basis or on a Day/Night basis, and vary across DUoS Groups.

Capacity Charge

A distribution-connected demand user's Maximum Import Capacity (MIC) is the contracted maximum electrical capacity of the connection point agreed between ESBN as Distribution System Operator (DSO) and the customer. Capacity Charges apply to DUoS Groups DG6 to DG10 and are charged based on each demand user's kVA of MIC per annum. There are different rates across the relevant groups.

Maximum Import Capacity Surcharge

This is a penalty applied when a demand user exceeds its contracted MIC. Its purpose is to discourage demand users from exceeding their MIC, which has considerable safety implications. Where a demand user's peak demand (in kVA) exceeds its MIC, then:

- for Non-Quarter-Hourly metered installations a surcharge of 6 times the capacity charge rate multiplied by the excess kVA is applied in the billing period during which the MIC was exceeded; and
- for Quarter-Hourly metered installations a surcharge of 5 times the capacity charge rate multiplied by the excess kVA is applied in the billing period during which the MIC was exceeded.

Low Power Factor Surcharge

This is a penalty for the amount of reactive power that a demand user consumes and is charged on a per KVArh basis. It applies to DUoS Groups DG5 to DG10 with varying flat rates across groups.

Further detail regarding demand distribution network tariffs can be found in ESBN's 2020-21 Statement of Charges.[34]

6.1.3 Consideration of the current tariff structures

The current electricity network tariff structures are principally based on cost allocations that were carried out in 2000.[35] The relationship that was estimated then between individual charges and the costs that different network users impose on the network may no longer hold. Even if the methodology used in 2000 was considered appropriate, the current structure of charges may need to be updated.

There are other reasons why a change in the structure of charges may be appropriate. The current structure of charges was formulated using historic costs. It may be the case that network users would be better incentivised to use the network in ways that minimise the need for future investment if the network charges were based on future costs and sent forward-looking price signals.

The current tariff structures are weighted quite heavily towards energy charge components. Historically, time-independent volumetric network tariffs (per kWh) have worked relatively well, given the strong correlation between energy and peak power, and the lack of quarterly/hourly data from conventional meters. Such tariffs incentivise network users to reduce their overall electricity consumption. However, they do not specifically incentivise network users to reduce

[34] *"ESB Networks DAC Statement of Charges"* – Available here.
[35] In 2010 the network tariffs were rebalanced to change the relative amounts of total revenue recovered from domestic customers and LEUs following direction from the Minister – see here.

electricity consumption at peak times, or at other times that are most advantageous to the networks, as the savings to the consumer will be the same whatever time of the day or year the reduced energy consumption occurs. With the advent of smart meters, smart appliances and more sophisticated price comparison tools there is an opportunity for network tariff structures to provide more sophisticated price signals, aimed at peak times and peak capacity. The current tariff structures are not adequate to take full advantage of this.

Another issue to consider is that the increase in behind-the-meter generation, combined with net metering, may be incompatible with continuing to rely on energy charges to recover a large share of network costs. Network users can reduce their network charges by offsetting their demand, without reducing the costs they impose on the network accordingly. This either leads to an under-recovery of costs by the network companies or an increase in the energy charges levied on those customers that do not offset their demand. Increased energy charges may incentivise more customers to offset demand, further reducing the base of customers paying such charges. In the long-run, absent a change in the tariff structure the outcomes could be very high tariffs for the few customers unable to offset their demand and, possibly, the network companies being unable to recover their costs.

The Current Network Tariffs

17. In your view, how do the current network tariff structures impact different types of network users? Do any network users have particular challenges or issues with the current network tariff structures? Please explain your answer.
18. In your view, could the existing electricity network tariff structures hinder the changes that are necessary for the electricity system in the coming years? Please explain your answer.
19. In your view, do the price signals within the current electricity network tariffs sufficiently affect behaviour and influence use of the electricity networks? Please explain your answer.

6.2 Tariff Considerations

This section considers some options relating to how electricity network tariff structures could be reformed. Depending on the challenges and opportunities identified in the early phases of the review, there should be a wide range of options that could be considered. The following is provided to illustrate the range of options that may be open to the CRU to consider. It is not meant to be an exhaustive or definitive list of options. Responses to this Call for Evidence Paper will provide the CRU with further considerations to review. Firstly, potential rebalancing of the existing structures is discussed, and then various potential changes that could be introduced are discussed.

6.2.1 Rebalance existing tariff structural components

Rebalancing the existing network tariffs would mean maintaining the current broad structure of the tariffs but changing the weighting of the revenue recovered across each tariff component. This could be done in various ways.

For example, in an environment where behind-the-meter generation and self-consumption is increasing then there may be a case to decrease energy charges and increase capacity charges, as capacity charges ensure more stable cost recovery for the Network Companies. However, increased capacity charges would not incentivise current network users to use electricity more efficiently or at certain times that are beneficial to the network, although they would send a forward-looking price signal to future network users to consider how their choice of contracted capacity will affect their network tariffs in the long run. This would incentivise future network users to minimise their capacity requirements and reduce network investment costs in the long run. Reducing energy charges may somewhat reduce the utility of installing solar panels and other behind-the-meter generation, alongside stabilising cost recovery for the Network Companies, however it must be remembered that network tariffs make up only one part of a network user's electricity bill.

Another option for rebalancing would be to increase power charges on peak measured power consumption while reducing energy charges. A relatively high power charge sends a strong signal to network users to be aware of, and manage, their own peaks in electricity demand and incentivises them to reduce those peaks. This should reduce network investment costs in the long run, especially if the level of the charge is based on the long-term incremental cost of developing the network.

On the other hand, increasing the "weighting" of the power charge component could pose somewhat of a risk to the Network Companies regarding short-term cost recovery as if network users adapt their behaviour and reduce their peak electricity demand accordingly then the Network Company revenue will fall. However, in the long-term this should be offset by reduced need for network investment. Another potential disadvantage to a higher power charge is that smaller consumers may find it difficult to react to the price signals from these tariffs.

6.2.2 Time-of-Use network tariffs

A Time-of-Use (ToU) element could be introduced to electricity network tariffs. ToU tariffs would charge cheaper rates at certain times, when electricity demand is usually relatively low, and charge higher rates at other times when demand is usually relatively high. They are generally considered to be more cost-reflective than time-independent tariffs.

The simplest ToU tariff is a day/night tariff, with cheaper rates being charged during the night hours. ToU tariffs are designed to incentivise customers to use more energy at off-peak times, and less energy at peak times, in order to balance demand more evenly throughout the day.

ToU tariffs are "static", in that both the different rates and the time durations in which they apply are fixed and do not change close to real time. This means that they do not incentivise customers to respond to real time changes in demand and short-term instances of system stress.

ToU network tariffs can offer a reasonable balance between cost-reflectivity and simplicity. The level of granularity of any static ToU network tariff would affect the balance between cost-reflectivity and simplicity here, with day/night tariffs obviously being the most simple type of static ToU network tariff but offering the least cost-reflectivity. As the level of granularity increases, the ToU network tariff becomes more cost-reflective but less simple.

On the other hand, ToU network tariffs could lead to sudden shifts in load at the change of hours when the price of the ToU tariff decreases or increases. For example, such shifts could occur when the ToU tariff decreases significantly between two hours and automation and smart technology results in a large number of users responding by increasing their demand all at once. The increasing penetration of EVs and heat pumps could likely increase these effects. ToU tariffs could be beneficial for the owners of heat pumps and EVs but could result in new peaks in network demand and new peaks in network stress occurring at times when they never occurred before and when the TSO and more significantly the DSO are not used to them.

ToU price signals could also be counterproductive if they incentivise a response from customers in parts of the network where it is not needed (to solve any network issue or congestion) and thus perhaps cause a problem rather than solving one. This could be especially acute in areas of the distribution network. For this reason it is arguable that ToU network tariffs, in order to be most effective, should be combined with locational price signals so that the response is only incentivised in constrained parts of the network where it is needed.

There is also a possibility that ToU network tariffs designed at a certain point in time could become counter-productive in future as the use of the networks changes over time and the ToU price signals become out-of-date. For this reason, it is important to consider the adaptability of ToU network tariffs into the future.

6.2.3 Locational network tariffs

A locational element could be introduced to electricity network tariffs, whereby the tariffs vary by location on the networks. The justification to introduce a locational element to network tariffs is that the costs of serving network users across the distribution and transmission networks vary by location. Furthermore, the need to send price signals regarding network capacity constraints may differ between locations.

The variation of network costs across locations can be driven by things such as network user density; distance from large generation or demand; network characteristics such as overhead or underground lines; and spare capacity.

The two main types of locational tariffs are nodal and zonal. Nodal tariffs require detailed understanding of the network and are typically based on load flow models. They result in a large number of different tariffs, one for each node in the network. Zonal tariffs can be based on, inter alia, geographical regions or areas where there are major load flow constraints. They are simpler to implement than nodal tariffs.

Locational network tariffs are a viable option for transmission network tariffs but may be difficult to implement for distribution network tariffs. Firstly, the actual detailed knowledge of the distribution network may be limited, particularly at lower voltages. Secondly, the volume of calculations that would be needed would be several orders of magnitude higher for the distribution network than for the transmission network. And thirdly, any public perception of unfairness could make it politically difficult to charge distribution network users in different parts of the same country different prices for the same level of service. These factors may also limit the preciseness and effectiveness of the locational price signal, even if locational distribution network tariffs were introduced.

However, even with the above said, locational network tariffs should still be considered as they could send an important signal to network users and could be an important tool to help relieve congestion on the network and to delay or remove entirely the need for expensive network reinforcements. As mentioned earlier, locational network tariffs could also be an important complement to ToU network tariffs and improve the effectiveness of ToU signals.

6.2.4 Interruptible network tariffs

An interruptible element could be introduced to electricity network tariffs. Generally speaking, interruptible tariffs are lower than normal tariffs and are applied to customers with interruptible loads, i.e., customers that agree to reduce their consumption during times of system stress or emergencies.

In terms of electricity network tariffs, interruptible network tariffs would apply where customers agreed to have their import capacity reduced during times of system stress or emergencies. Any network user that was willing to accept less than firm, constant access to the network could in return benefit from lower network tariffs. Their charges could be based more on their "interruptible" access rights rather than their usage, and could more accurately reflect how their actions increase or decrease network costs in their particular location. Interruptible network tariffs can only be applied where the relevant system operator (TSO or DSO) has the technical capability to actually reduce a connection's import capacity.

A lower interruptible network tariff should not lead to an unintended unfair socialisation of network costs between customer groups and, therefore, any reduction to the network tariff should only reflect the value of the provided flexibility (i.e. the avoided costs or the generated benefits) for the system.

Any interruption to import capacity would have to meet certain criteria. For example, the actual interruptions should only occur in order to support the network in certain well-defined situations. Such situations would usually happen for only a small number of limited periods in a given year and would mostly occur on a very local scale. This should guarantee that any interruptions only occur when there is a proven benefit to the relevant system operator and do not discriminate between network users or between network users and other providers of flexibility.

6.2.5 Forward-looking charges and residual charges

A forward-looking element could be introduced to the electricity network tariffs alongside residual charges.

In Great Britain, for example, there are two distinct elements to transmission network charges for use of the system:

1) Forward-looking charges, which are designed to ensure network users and/or suppliers receive price-signals that reflect the costs they impose on the network depending on how and when they use the network. These cost-reflective price signals incentivise network users to be flexible in their use of the network, in ways that both increase overall network efficiency and reduce their own electricity bills.
2) Residual charges, which are designed to recover the rest of the network company's allowed revenues once forward-looking charges have been levied. Residual charges do not send signals to network users but are necessary as forward-looking charges do not usually recover the full allowed revenues.

The forward-looking charges could be based on energy and/or peak power, while the residual charges could be based on contracted capacity and/or a flat charge per connection, varying by customer class or tariff group.

6.2.6 Dynamic network tariffs

Dynamic network tariffs could be introduced. A dynamic network tariff is one where the level of the tariff, and thus the price signal, is defined at shorter notice, possibly close to real-time. This contrasts with static Time-of-Use (ToU) tariffs, where the price signals are associated with predetermined time periods and do not change. The roll-out of smart meters and improvements in the available information about the real-time status of the networks make it more feasible now to implement dynamic network tariffs, whereas it wouldn't have been realistic in the past.

A properly designed dynamic network tariff should promote more efficient use of the network where:

(i) use of the network has become more uncertain due to increased intermittent generation and changing electricity consumption patterns; and
(ii) new technology such as smart meters, automation and electricity storage are enabling quicker and more efficient demand side response.

Dynamic network tariffs allow price signals regarding network costs to be sent to network users closer to real time, which increases the cost-reflectiveness of the tariffs and should achieve a more cost-efficient use of the network, benefitting all network users in the long run. Dynamic network tariffs should also vary by location on the network in order to send the most effective signals.

With that said, there a number of important issues that need to be considered regarding dynamic network tariffs.

Firstly, dynamic network tariffs will interact with dynamic electricity (commodity) prices. If they align then they will send a very strong combined price signal to the consumer, enabling the consumer to decide at each moment how much to consume for a given price. However, where the two price signals do not align then they will dampen each other and reduce each other's effectiveness. The two price signals will not always align as a dynamic network tariff measures scarcity on the network (at a local level) while a dynamic electricity (commodity) price measures scarcity in the wholesale market (or balancing market) (at system level).

Secondly, there are a number of requirements that should be met before dynamic network tariffs could be introduced. Smart meters, automation and electricity storage are required for dynamic network tariffs to be effective. Realistically, a number of other things are also required, such as:

- Detailed forecasting models, which would be used by the DSO and/or TSO to determine the critical periods for each network location;
- Detailed and robust estimates of long-term avoided network costs;
- IT systems to calculate the dynamic network tariffs close to real-time; and
- IT systems to send the price signals to network users.

These requirements could be costly to implement.

Thirdly, there is a risk that dynamic network tariffs, if they are not accurate enough and are set for a larger region or time period than required to avoid the actual constraints on the network, could be counter-productive and could influence electricity consumer behaviour in a way that actually causes problems on the network, for example by causing a large amount of demand to turn off at a location or time when there was no congestion, and then turn on again all at once at a later time.

Fourthly, there are a number of regulatory issues raised by dynamic network tariffs, such as, *inter alia*:

- How customers should be informed of the dynamic tariffs;
- How the regulator should regulate dynamic tariff setting;
- Should they be voluntary or mandatory for customers; and
- How the dynamic tariffs should be integrated into the Price Control process.

Fifthly, there is a question of fairness between network users. There is risk that dynamic network tariffs would allow flexible network users with the requisite technology to avoid the high-priced periods and place an unfair burden on less flexible network users or network users with a flat-demand profile.

The CEER has recommended that NRAs should consider dynamic (distribution) network tariffs as a potential tool to improve the cost-reflectiveness of network tariffs but should also consider whether technology is sufficiently mature within their jurisdiction to allow the efficient use of such tariffs on smaller users as it requires a sufficient smart meter roll-out and a high level of automation. The CEER has further recommended that:

- Pilot schemes for dynamic network tariffs should be carried out before they are implemented in order to test their ability to promote a more efficient electricity system; and
- Any implementation of dynamic network tariffs should be preceded by a thorough cost-benefit analysis.

Dynamic network tariffs will become more viable as technology and data systems develop but they might not be a viable option at this time or in the near future in Ireland and thus might not be a viable option for this review.

6.2.7 Generation DUoS charges

Generation DUoS charges could be introduced. Generation connected to the distribution network currently do not pay Use-of-System tariffs. As discussed in Section 5.3, the increasing level of distributed generation can contribute to increasing costs for the distribution network and even the transmission network and this trend will continue as decentralisation continues. There is also an increasing need for distributed generation to support system operation as the changing generation mix, i.e., more small intermittent generators and less large heavy power plants (that provide lots of inertia), is causing an increase in frequency response requirements. Distributed generation could potentially contribute significantly to frequency response (and other system services) in future but the use of these resources to support system operation will have knock-on effects on the distribution network.

Arguably, other network users should not be expected to pay the costs to allow more distributed generation to connect to the distribution network or to provide system services (and to earn system services revenue). End-users of electricity ultimately pay all costs at the end of the day, but it may be more transparent and equitable for distributed generation to pay Distribution Use-of-System network tariffs that reflect the costs they place on the distribution network.

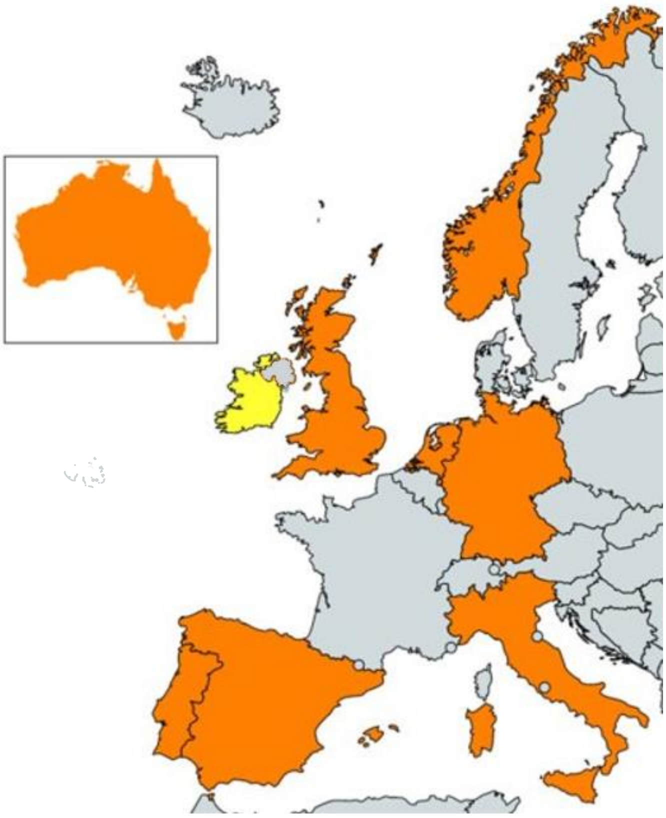
Tariff Considerations

20. What are your views on the network tariff components and considerations outlined in this paper?

21. Are there additional tariff components, structures or options not described above that the CRU should consider? If so, please identify them and provide rationale.

7. Conclusions of International Review

The CRU has commissioned a study to review electricity network tariff structures, and recent reforms of same, in eight other jurisdictions: Germany, Italy, the Netherlands, Portugal, Spain, Australia, Great Britain and Norway. The conclusions of this review are summarised in this section. More detail is provided in a separate paper (CRU/21/123a) published alongside this Call for Evidence Paper.



The motivations for choosing these jurisdictions are varied. Most are inside the European Union and consequently subject to the same European regulatory constraints as Ireland. Some of the jurisdictions have transmission networks that, like Ireland, are largely self-contained with limited scope to access energy from elsewhere, for example, Australia and Great Britain. Others, like Portugal, are part of a wider single electricity market that may have parallels with the Irish Single Electricity Market. There have been important changes in the way that networks are used in many cases, such as the roll out of smart meters. Similar to Ireland, policy goals to realise decarbonisation are an important consideration for energy regulators in many of these jurisdictions, such as the UK with its targets for 600,000 heat pumps by 2028 and no new diesel cars by 2030. Many jurisdictions have recently completed or started workstreams reviewing the structure of network tariffs (e.g., in Spain the competition authority was relatively recently given responsibility for setting tariffs and commenced a review).

None of the jurisdictions reviewed is a perfect comparator for Ireland. They do however provide useful insights and lessons that can be learned.

Three conclusions that might be drawn from these case studies are:

1) It is unusual for tariff structures not to change for a couple of decades. Many of the jurisdictions have seen relatively recent changes to the structure of charges and have ongoing consultation exercises concerning possible further changes. In some cases, this may be required by domestic legislation which defines the frequency with which a regulator has to review the structure of charges. Even where such legislation does not exist, many regulators have chosen to intervene and consider changes to the structure of tariffs fairly frequently. This does not necessarily result in regular wholesale reform of the structure of tariffs. In some cases, the changes will entail tweaks to the existing structure that only affect a subset of consumers (although the effects for these individuals may be significant).

2) Decisions on the appropriate tariff structure often depend on judgements about how to trade-off policy goals relating to fairness and efficiency. The recent trend has been towards tariffs that recover more from capacity charges rather than energy usage charges. This often reflects a judgement that such changes will send better price signals to customers, incentivising decisions that are more guided by the true costs that the customers' actions will impose on the network. Nevertheless, such changes will often mean higher network tariff for customers with low energy usage. This may be seen as unfair, and even raise concerns about how the proposed charges will affect affordability. It is not unusual for regulators contemplating such changes to have a transitionary period. Different regulators will have different views on the appropriate trade-off between the policy goals of efficiency and fairness (and/or affordability), and this will influence the choices they make about the structure of network tariffs.

3) More generally, the case studies suggest that there is not an agreed optimal structure of charges. Differences in policy goals is just one reason why different jurisdictions may have a different structure of network tariffs. It is not the only factor. The networks are not all the same, such that any cost-based charges may look different. Furthermore, differences in the uptake of smart meters, self-generation and the roll-out of EV, to give just three examples, will all affect the appropriate design of tariffs, with implications for the extent to which certain tariff structures are either feasible or necessary to incentivise behavioural change. Even the current structure of tariffs may influence what structure is deemed suitable in the future (for example, it will influence who wins and loses from any given reform). Finally, the case studies illustrate the multiple different potential factors that regulators have to consider when thinking about tariff design. The exercise is complicated, and there will not be a single 'right' answer that everyone agrees is the optimal structure even if there is agreement on the policy objectives.

As stated previously, for the detailed International Review, please refer to the Paper (CRU/21/123a) published alongside this Call for Evidence Paper.

International Review

22. Are there lessons or insights highlighted in our Advisors' Paper (CRU/21/123a) that are particularly relevant to this Electricity Network Tariff Structure Review? Please explain your answer.

23. Are you aware of any other lessons or insights from these (or other) jurisdictions that may be relevant to this review? Please explain your answer.

8. Interactions with Other Regulatory Policies and Arrangements

Any changes to the electricity network tariff structures could potentially interact with, be impacted by, or have implications for, a range of other regulatory policies and arrangements.

These other regulatory policies and arrangements could include, for example:

- Connection policy;
- Connection charging regarding distribution-connected generators;
- Smart metering capabilities and smart services;
- The rollout of EVs, heat pumps and electricity storage;
- Rules around Active Participants and Energy Communities;
- Infrastructure planning;
- Wholesale markets; and
- Flexibility markets.

While these other policies and arrangements are firmly outside the scope of the Electricity Network Tariff Structure Review, the CRU will be mindful of interactions over the course of the review.

Interactions with other policies
24. In what ways could changes to the electricity network tariff structures interact with other regulatory policies and arrangements?

9. Call for Evidence Questions

The CRU is interested in the views of both current and potential future users of the electricity networks, and any other interested parties, regarding the topics raised in this paper. The objectives and proposed principles of the Electricity Network Tariff Structure Review and the CRU's initial considerations regarding the review have been provided in this format in order to initiate discussion on the review amongst the wider electricity industry and gain their input and views. It is important that interested parties respond to this paper so that the CRU can fully consider their views.

Stakeholder responses to this paper will form a critical input into the next stage of this review, and will shape the CRU's thinking and approach to how we review and consider potential tariff structural reforms.

The questions to which respondents to this paper can provide feedback and information are outlined in this section. However, responses are not limited to these questions and the CRU is open to any other comments on the topics raised. Respondents also shouldn't feel that they have to answer every question.

Stakeholder Engagement

1. How should the CRU engage with stakeholders over the course of the Electricity Network Tariff Review?
2. If a dedicated Electricity Network Tariff Review stakeholder group is established, would you be interested in participating? If such a group was over-subscribed, how should the CRU limit the number of members?

Objectives

3. Do you agree with the objectives of the Electricity Network Tariff Structure Review? Please state your reasoning.
4. Should the CRU include any other objectives? If so, please explain your reasoning.

Proposed Principles

5. Do you agree with the proposed principles of the Electricity Network Tariff Structure Review? Are they clearly defined?
6. In your view, should any further principles be added, or any existing proposed principles be removed? Please explain your reasoning.

Scope of Review

7. Do you agree with the areas that are identified as in-scope and out-of-scope for the review? Please state your reasoning.
8. Acknowledging that resources are finite, are there any other areas that should be included in, or excluded from, the in-scope and out-of-scope areas for the review? If so, please explain your reasoning.

Future Developments of the Electricity Networks and their implications for tariff structures

9. How do you see the use of the electricity networks in Ireland changing and developing in the future?
10. In your view, are there any drivers of change in the future use of the electricity networks that the CRU hasn't covered in this paper? If so, please identify them and explain your answer.
11. How do you think the roles of different parties/stakeholders across the networks will change in the coming years?
12. How could changes to the electricity network tariff structures facilitate and/or encourage a whole system approach to network investment, network management and system operation? Please explain your answer.
13. How do you foresee the increasing uptake of behind-the-meter generation for the purpose of self-consumption changing the load profile of electricity consumers, particularly domestic electricity consumers, in the future?
14. What are your views on the impacts of future changes identified in this Section and their implications for electricity network tariffs?
15. Do you think that there are implications or issues that need to be addressed for electricity network tariffs that we have not mentioned in this paper? If so, please explain what these implications are and why they need to be addressed.
16. How do you think changes to the electricity network tariff structures could help stakeholders avail of opportunities opening up due to future changes to the electricity networks?

The Current Network Tariffs

17. In your view, how do the current network tariff structures impact different types of network users? Do any network users have particular challenges or issues with the current network tariff structures? Please explain your answer.
18. In your view, could the existing electricity network tariff structures hinder the changes that are necessary for the electricity system in the coming years? Please explain your answer.
19. In your view, do the price signals within the current electricity network tariffs sufficiently affect behaviour and influence use of the electricity networks? Please explain your answer.

Tariff Considerations

20. What are your views on the network tariff components and considerations outlined in this paper?
21. Are there additional tariff components, structures or options not described above that the CRU should consider? If so, please identify them and provide rationale.

International Review

22. Are there lessons or insights highlighted in our Advisors' Paper (CRU/21/123a) that are particularly relevant to this Electricity Network Tariff Structure Review? Please explain your answer.

23. Are you aware of any other lessons or insights from these (or other) jurisdictions that may be relevant to this review? Please explain your answer.

Interactions with other policies

24. In what ways could changes to the electricity network tariff structures interact with other regulatory policies and arrangements?

10. Next Steps

Interested parties are invited to respond to this Call for Evidence paper by COB on 13/12/2021. Responses should be sent via email to networktariffreview@cru.ie.

The CRU welcomes feedback on the questions asked in this paper, as well as any other comments or suggestions that electricity network users, both current and future, the Network Companies and other interested parties may wish to provide regarding the Electricity Network Tariff Structure Review.

The responses and feedback received will allow us to refine the objectives and principles of the review and give us a broad platform from which to launch the next phase of the review.

Responses to this paper will form a critical input into the next stage of this review, and will shape the CRU's thinking and approach to how we review and consider potential tariff structural reforms.