UCD Energy Institute response to the CRU's Call for Evidence on the Electricity Network Tariff Structure Review

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The UCD Energy Institute welcomes the opportunity to respond to the call for evidence for CRU's Electricity Network Tariff Structure Review. The UCD Energy Institute (UCD EI) is Ireland's leading research institute focussed on decarbonisation of Ireland's energy systems. UCD EI brings together researchers from a wide range of academic disciplines to tackle the challenges associated with the decarbonisation of energy. Focusing on energy systems, energy management, and energy in society, we drive Ireland's position as a world leader in the integration of renewable energy.

Network charges are regulated to ensure that network users receive value for money while the network companies earn a reasonable return on their activities. Network operators are regulated natural monopolies that are legally and functionally unbundled[1] from generation and supply, and energy regulators, among others, set their total allowed revenues. Because the end-user delivery of electricity happens mostly on the local grid level, distribution network charges represent the main share of network charges. Our comments provided are based on our expertise and research in these areas to date. As the review process progresses it will be essential to carry out rigorous analysis of the proposed options to ensure the tariff is fit for purpose and meeting the objectives defined. We would be happy to carry out further work in this area in the future.

Questions from Consultation Paper

Stakeholder Engagement

1. How should the CRU engage with stakeholders over the course of the Electricity Network Tariff Review?

The CRU should engage with a wide range of stakeholders, representing different types of consumers and network users, including small, medium and large energy users. Focus groups should be used for engaging with residential consumers and organisations who may not have the resources to respond to detailed consultations. The CRU should also engage with organisations and charities that deal with energy poverty such as SVP.

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?

[1] Directive 2009/72/EC Concerning Common Rules for the Internal Market in Electricity and Repealing Directive 2003/54/EC, European Communities, 2009.

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UCD Energy Institute would be interested in participating in such a group. In the event of the group being over-subscribed we would recommend ensuring that representatives from a range of consumer types are included.

Objectives

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

The following objectives have been identified:

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

We support this objective if it includes the idea of fairness in the distribution of costs across consumers. As noted in the consultation document, some types of tariff (such as time of use tariffs) will result in some customers paying less while others pay more. The principal of fairness needs to be kept in mind here in terms of affordability and consumers' ability to change time at which electricity can be used.

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

This is a necessary objective given Ireland's commitments to mitigating climate change. It should be noted that a low carbon future includes energy efficiency measures as well as low carbon generation. Again, fairness should be a consideration so that consumers with lower capacity to take up low carbon technologies, such as solar PV, do not face excessive charges compared with those who do install these technologies.

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

N/A.

Proposed Principles

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

We agree with the proposed principles and they are clearly defined. As noted by the CRU within the consultation document there is a potential lack of alignment between some of the principles and trade-offs may be required. The definition of the principle of Adaptability should be extended to allow all users of the system (including suppliers and consumers) to respond to developments in future years.

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

The principles of Equity and Fairness are not explicitly included in the consultation document. It is imperative in the context of a Just Transition that those who are unable to invest in particular technologies (such as Solar PV, batteries etc.) are not unfairly disadvantaged against those who can afford them.

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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.

The scope of the review seems to be appropriate, however it is essential to be aware of the interactions between the incentives associated with different parts of the retail tariff. For example, if dynamic pricing is introduced for the network tariff and for the energy component, how do these interact? Are some behaviours more appropriately addressed under system service arrangements rather than network tariffs? The incentive for end-users will be based on the sum of all the different components, and consumers' behaviour will only change if they are provided with clear information and data (Ryan et al, 2018). If changes are anticipated to other parts of the tariff structure, there should be coordination to maintain simplicity in approach across the different parts of the consumer bill.

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.

See response to Q7.

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?

The consultation paper provides a good overview of the main changes to the development and use of electricity networks in the future. Our research modelling technology adoption shows increasing numbers of EVs and heat pumps in households geographically spread throughout the country (Meles et al, 2022; Mukherjee and Ryan, 2020). Increasing renewable generation, increasing electricity demand and more active demand will be key features of future electricity networks. This will result in the need for increased flexibility and storage, smarter systems and bidirectional flows on equipment that was not designed for this. As a result of all these changes there will be significant need for network investment and upgrades. While the design of tariffs and incentives may be able to reduce the need for investment in some areas, significant investment will still be required across the network.

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.

There has been some mention of hybrid units throughout the consultation paper which will require consideration in the network tariff review. Other areas which may be important are power to gas and other devices connecting to the power system to provide system services, e.g. synchronous compensators.

11. How do you think the roles of different parties/stakeholders across the networks will change in the coming years?

The connection of more devices to the electricity network can provide a useful source of flexibility. If consumers are expected to be more active, there will be a strong need for good information and data to support decision making. Supply companies will need to provide platforms that aggregate the data for individual customers to enable them to make informed decisions in relation to electricity use and respond to signals appropriately. There is potential for there to be more of a role for aggregators in managing some aspects of demand management.

System services are likely to play an increasingly important role. The System Operators will need to ensure that the appropriate incentives are in place. This will require support from the regulatory authorities and the wider energy industry.

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.

In order for retail tariffs to successfully encourage customers to reduce or shift electricity consumption, customers' demand for electricity must be at least somewhat elastic. Ryan et al (2018) showed that the literature on retail prices appears to demonstrate that consumers change their consumption of electricity in response to both the amount of the average electricity price and the type of price. Of particular note was that a time-varying price signal coupled with detailed information encourages consumers to shift the timing of their consumption to off-peak periods.

Ryan et al (2018) asses how the three main retail tariff components differ in their potential to support environmental objectives. A proportionately high fixed charge component in the retail tariff reduces the incentive for consumers to invest in energy efficiency or self-generating technologies in line with renewable energy targets, but does ensure that network costs are covered irrespective of energy efficiency or DG deployment. Variable, per unit energy pricing, combined with good feedback information, gives price signals to consumers to reduce their energy consumption overall and at peak times. This component could also be included in a more efficient net metering scheme or time-varying rate if desired. This will help energy efficiency and renewable energy targets. Finally, demand charges allow another price signal to improve the efficiency of operation by incentivising lower demand at peak times.

This has implications for the need for network investment to cater for energy peaks as well as implications for network management and system operation, where the demand may shift from traditional peaks to other times.

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?

La Monaca and Ryan (2017) carried out an analysis of the impact of solar PV generation on the consumption patterns of a typical Irish household. Using hourly household demand data from ESB Networks and generation data from the National Renewable Energy Laboratory (NREL) System Advisory Model, they were able to obtain an accurate estimation of self-consumption and net export potential. The analysis showed that daily peak household electricity demand does not coincide with the timing of peak PV generation in either winter or summer. PV generation is insufficient to meet the household demand in the winter time, but there is significant opportunity for export in the summer months in Ireland since there is low heating and cooling load and high generation potential.

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

Network tariffs will need to be adapted to reflect the changing nature of customers and different types of connections to the electricity system. Network tariff design must reflect the reality of the rapid growth in distributed grid resources, including DG, and the additional network costs that may arise from both microgeneration as well as a range of other grid modernisation considerations. These costs can be discussed in the context of either the economic regulation of DSOs that allows additional revenues for the additional network costs from DG integration, or on the network tariff design for grid users that adequately reflects the network costs in cost-causal and equitable manner. Here we focus on the latter, and assume that changes in the distribution tariff design for grid users

do not affect the total allowed (regulated) revenue of the DSOs and only affect the costs between grid end users.

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.

See response to Q7.

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?

There are likely to be different opportunities for different stakeholders, for example a reduction in electricity bills for those who can provide demand flexibility. Depending on the structure of the full retail tariff for different types of energy users, the impact may be different. Changes to tariff structures can also provide network operators with the ability to incentivise consumer behaviour and reduce energy peaks, and the corresponding need for network investment to deal with these peaks.

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.

Our research has not focussed on the impact of the current network tariff structures on different types of network users or their associated challenges.

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.

The electricity system is undergoing significant changes as we decarbonise our energy mix. Given the objectives of this review, the existing electricity network tariff structures could be adapted to provide more appropriate signals to help facilitate a low carbon future, e.g. shifting demand to times of higher levels of renewable generation and corresponding lower emissions on the system. A large fixed component will dampen the impact of time of use charges.

On the other hand a larger weighting on the volumetric energy consumption component of the tariff will be problematic if there is a significant shift to DG. In this case the number of customers paying the volumetric electricity consumption component will be reduced and may mean that other consumers have to pay higher amount causing an unfair distribution of costs.

A review of the network tariff design is timely and must reflect the reality of the rapid growth in distributed grid resources, including distributed generation, and the additional network costs that may arise from grid modernisation considerations.

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.

See answer to Q18.

Tariff Considerations

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

In order to ascertain the most appropriate network tariff option, detailed analysis of the options would need to be carried out. A number of scenarios and user types would need to be identified based on the projected future requirements of the electricity networks. For example, the Climate Action Plan[2] outlines increased connection for EVs and heat pumps. If the tariff is based on energy peaks, households that have invested in these technologies may be unduly penalised or the incentive may just ensure EV charging occurs at off-peak hours. Without access to detailed data on current and future peaks, the impact cannot be properly assessed.

Ryan et al (2018) showed that the literature on retail prices appears to demonstrate that consumers change their consumption of electricity in response to both the amount of the average electricity price and the type of price. Of particular note was that a time-varying price signal coupled with detailed information encourages consumers to shift the timing of their consumption to off-peak periods. This is applicable to both the Time-of-Use network tariffs and Dynamic network tariffs. The latter has an additional level of complexity compared with Time of Use tariffs, however it has the capability of responding to variability in renewable generation which could be used promote low carbon energy use or ease different types of congestion associated with distributed generation. Aspects such as locational network tariffs and generation DUoS charges would need to take the interaction with connection policy into account, while interruptible network tariffs may overlap with system services arrangements.

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.

The major costs for DSOs are sunk and fixed costs, typically representing around 60% and 20% of their total costs respectively, whereas operating costs take approximately 20% (Simshauser, 2016). This can vary depending on location, but conventionally aggregate network tariffs (excluding generation, carbon, and supply charges) follow a two-part structure which includes a fixed rate (€/period) and a uniform variable rate (€/kWh). The final residential customer may receive one bill, which incorporates networks, supply, and policy costs, two bills, which separate supply from network costs, or even three bills which separate supply, DSO, and TSO costs. As a result, the end-customer's actual comprehension of different charges, how they come about, and how they could potentially affect the costs of individual components by behavioural change may differ considerably by jurisdiction. Moreover, distribution tariffs that are based purely on uniform variable rate (e.g. one-part tariff with €/kWh) or that reflect sunk costs only marginally (e.g. two-part tariff with small fixed charge, €/kWh + €/period) will not reflect the economic reality DSOs face at very high rates of DG penetration. With the standard two-part distribution tariff, households with solar PV (or, indeed, those who invest in energy efficiency technologies that reduce overall demand but not peak instantaneous demand) may not pay network costs in proportion to their reliance on the grid, whereas households without PV (or who do not or cannot become more energy efficient) may have to pay higher rates to make up these costs (Simshauser, 2016). This is because households with PV may save on flat-rate variable charges, though their peak demand requires the same sunk and fixed cost investments from the DSO's perspective. As a result, some utilities have begun to evaluate

[2] https://www.gov.ie/en/publication/6223e-climate-action-plan-2021/

three-part tariffs (e.g. €/kWh + €/period + €/kW/period) that add an additional capacity (demand) charge (€/kW/period), due to the non-trivial growth in distributed generation, such as PV.

In terms of ensuring that rates are aligned with the fair allocation of network costs, Eid, et al. (2014) show that the combination of net metering and pure volumetric tariffs is the most detrimental with respect to cross-subsidies, compared to alternative tariff structures, such as those that include capacity (demand) charges. Another analysis (Picciariello;Vergara;Reneses;Frias;& Söder, 2015) shows that substantial cross-subsidisation from consumers to prosumers may occur, and that the magnitude of this effect depends on the amount of distributed generation connected to the grid and the network characteristics. Solutions to overcome cross-subsidization are typically capacity, demand, or power-based distribution tariffs (Tuunanen, Honkapuro, & Partanen, 2016) that include electricity demand charge (Simshauser, 2016). Tariffs with peak capacity components have been identified as more cost-reflective, equitable and sustainable from DSO's economic perspective (Honkapuro;Partanen;Tuunanen;& Niemelä, 2012).

Ryan et al (2018) also examine a number of retail tariff options, and discuss some of the merits and downfalls of the options presented. Many of these apply also to the network tariff component. A brief overview is provided below.

Demand Charges - This option appears to be included within "6.2.1 Rebalance existing tariff structural components". Demand charges constitute an additional bill payment based on the size of customers' peak usage. They implement a fee based on the maximum amount of electricity the customer may draw from the grid throughout a time period, even if overall usage is low. A demand charge can be based on customers' demand during system peak hours, with the aim of better reflecting the direct generation and network costs that are driven by peak demand. In some cases they may be based on highest demand during a given time interval, irrespective of whether demand occurs during peak or off-peak times and therefore do not promote reduction in peak demand. One of the main motivations for using demand charges is to prevent the possibility of cross-subsidization of grid users without distributed generation (consumers) to those with distributed generation (prosumers) under one or two-part tariffs (Simshauser, 2016; Strielkowski, Štreimikienė, & Bilan, 2017).

Fixed Bills - Flat billing or "all-you-can-eat" for electricity, similar to typical pricing approaches for mobile telephone service, is often mentioned as a model that is likely to gain prominence in coming years due to cost recovery concerns. Neenan et al (2016) use choice modelling to gauge customer interest in TOU and flat billing tariff options, and find that for a simulated market, 62% of customers would choose to keep a conventional (flat volumetric) rate, 27% would choose a TOU rate, and only 11% would choose flat billing. The limitations of this approach are that it would not provide incentives to improve energy efficiency or reduce peak electricity demand and is not likely to be fit for purpose.

Net metering - Under net metering, electricity customers with on-site generation capabilities, such as rooftop solar PV, may offset their total usage by the amount of self-generation and be compensated for excess generation. This behind-the-meter arrangement allows customers to be billed only for the net amount of electricity they draw from the grid. Net metering rewards self-generation, however because every kWh of generation is effectively awarded at the same rate (the retail price of electricity offset or credited), it does not incentivize self-consumption or shifting of peak demand. Net-metering can lead to distributional issues relative to tariff structure, in particular fixed charges. By reducing behind-the-meter energy usage, it means that those with the means to invest in self-generation pay a lower share of the fixed costs compared to those that don't. This in turn leads to lower revenues for utilities. Jurisdictions that employ two-part tariffs to separate out

the portion of retail charges that cover energy-only expenses and those which cover network and/or capacity costs may not be adversely affected with respect to covering those costs.

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

N/A

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.

The paper by Ryan et al (2018) highlights some examples from Finland, Massachusetts and California in relation to some of the tariff options outlined above.

Interactions with other policies

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

The consultation paper highlights a number of other regulatory policies and arrangements with which the electricity network tariff structures could potentially interact. It is worth bearing in mind that the purpose of the electricity tariff structure is for cost recovery of network investment. Our review has shown that tariff design can impact consumer behaviour, however it is important to acknowledge that this encompasses the full retail tariff and not just the network tariff component. Therefore the interaction with other components of the tariff design is of utmost important when incentivising consumer behaviour.

Some aspects such as locational charging may be better dealt with in Connection Policy as the incentive only applies at the time of connecting to the network. These signals are also likely to change with other network connections or network upgrades. Once a customer has connected, changes to locational incentives will have no impact on their ability to connect. Locational aspects to peak pricing may still influence behaviour at particular times of day or generation profiles depending on how they are designed.

It is understood that flexibility will play an increasingly important role in future electricity networks. The system service arrangements provide the investment signals for the provision of system services to the system operators. The overlap between the incentives provided through the tariff design and the system services arrangements needs to be carefully considered.

Additional Comments

While one of the objectives of this review process is to "To deliver network tariff structures that help facilitate a low carbon future that is secure, competitive and cost-effective", there has not been much focus on how electricity retail tariffs can support climate change policy. Research carried out at UCD Energy Institute and the ESRI (Ryan et al, 2018) reviews a number of design options for future retail tariffs. While the focus is on the whole tariff and not just the network components, the conclusions can be considered to be similar. The paper considered how the design of electricity retail tariff structures can be extended from cost recovery considerations to support climate and clean energy objectives. The key conclusions of the paper are:

- Responsive, low-carbon consumer demand will be critical to delivering on low carbon objectives. Consumers can respond to electricity retail prices by changing the pattern and amount of their consumption of electricity, however access to good quality, real-time information is essential to inform decision making.
- In the absence of well-functioning carbon markets, environmental policy objectives may not be implicitly included in tariff-setting considerations. There is a clear need to examine the impact of current and future retail tariff designs on environmental targets.
- A three-part tariff, made up of demand charges, fixed charges, and variable energy-only pricing, is an emerging structure that may hold advantages for retail tariffs in electricity markets with high shares of renewable electricity generation.
- In order to provide customers with stronger incentives to engage in emissions-reducing behaviour, the communication of bill components needs to be clear and easy to read, accompanied by additional, accessible energy consumption information.
- More detailed analysis is needed to understand the full environmental impacts of a retail tariff structure in any jurisdiction. Further exploration is also needed of the welfare implications of the tariff structures, especially to understand whether measures are needed to ensure that high shares of fixed components are not regressive.

UCD Energy Institute welcomes the opportunity to respond to this consultation and looks forward to continued engagement in this area. The review of network tariffs will play an important role in ensuring the appropriate incentives are in place to ensure cost recovery for the electricity networks of the future which will require significant investment as we move to decarbonise our energy mix. As the review process continues, detailed modelling and analysis of the proposals will be required to assess the implication of different types of tariffs. Interaction with research institutions and funding organisations can provide a useful pathway to performing these analyses. We would welcome the opportunity to engage further on this as the process develops.

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