Least-cost distribution network tariff design in theory and practice

Tim Schittekatte[*] *and Leonardo Meeus*[†]

Executive summary

With more consumers installing solar PV panels, it makes sense to abandon the historical practice of volumetric distribution network tariffs with net-metering. However, regulators face many practical difficulties when redesigning the distribution network tariff design. We focus on two often-discussed constraints which are of a different nature: implementation issues with cost-reflective charges and fairness in the allocation of network costs among consumers. By demonstrating quantitatively how such constraints affect distribution network tariff design, we go one step further than the current academic literature.

Namely, we develop a game-theoretical model in which the regulator can decide about the distribution network tariff (volumetric, capacity and/or fixed charges) while anticipating the reaction of the active consumers to the tariff design. The regulator has to respect the condition that all grid costs need to be recovered from the network tariffs. The objectives of the regulator and the active consumers are different. The active consumers are self-interest pursuing, i.e. they can invest in solar PV and batteries and will do so if it results in lowering their private costs to serve their electricity needs. The objective of the regulator is instead to set the network tariff in a way that the actions of the active consumers not only benefit themselves but also the system as a whole. Although the rise of active consumers is rightly welcomed, the model takes into account the fact that it can also be a double-edged sword. On the one hand, the more consumers have the ability to react to price signals, in this case network charges, the more welfare gains can be made from efficient consumer behaviour as an alternative to the historical practice of 'fit-and-forget'. On the other hand, the more consumers are able to react to price signals, the more significant negative welfare impacts can result if these price signals are badly designed and are 'guiding' consumers in the wrong direction.

Using a numerical example, we illustrate a trade-off between cost-efficiency and fairness, and we show how this trade-off is impacted by the implementation issues with cost-reflective network tariffs. We find that some cost-efficiency can be sacrificed to limit the distributional impact resulting from tariff redesign. However, this works only up to a certain point without compromising grid cost recovery. If grid costs are mainly sunk, and cost-reflective charges are hard to implement, then smaller passive consumers are always worse off –tools other than 'standard tariff options' are needed to keep distributional impacts under control while limiting distortions.

Keywords: Batteries, distributed energy adoption, distribution network tariff design, game-theory, non-cooperative behaviour
JEL Codes: C7, D61, L94, L97, Q41, Q42

[*] Corresponding author: Florence School of Regulation, RITM Université Paris-Sud and Vlerick Business School. Address: Via Boccaccio 121, I-50133 Florence, Italy. E-mail: Tim.Schittekatte@eui.eu
[†] Vlerick Business School and Florence School of Regulation. Address: Bolwerklaan 21, B-1210 Brussels, Belgium

Executive summary of the article: Tim Schittekatte and Leonardo Meeus, 2020. The Energy Journal, Vol. 41 (5). http://dx.doi.org/10.5547/01956574.41.5.tsch