NETWORK TARIFF CHALLENGE: WHO PAYS THE PIPER?

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Overview

This research estimates the impact of capacity, volumetric, and peak-load-based network tariff schemes on different types of household consumers based on their socio-economic characteristics and actual energy demand. Due to expected significant changes in energy consumption patterns on the household level in the near future (increasing own production, in-home batteries, house-to-house electricity trading and decreasing demand), commonly applied volumetric tariffs may induce a significant imbalance between different groups of households and their respective contribution to recovering the costs of operating the grid (THINK Project Final Report, 2013). While so-called prosumers may reduce their quantities of electricity purchased via the power grid, non-prosumers completely rely on the grid for their electricity supply. Volumetric tariffs are determined by the amount of energy consumed, therefore additional burdens may shift towards non-prosumers that are still exclusively supplied by the grid and have poor access to such technologies as photovoltaic or in-home batteries for financial reasons (EURELECTRIC, 2013). This could result in even higher electricity bills for a less privileged group of consumers. It will also a priori turn into higher burdens for the households residing in apartment buildings compared to those living in single-family dwellings, as they do not have the needed property rights and space for necessary installations. An introduction of new metering technologies will allow implementation of alternative tariffs based on the amount of demand peaks produced by the household, which should reflect more accurately the nature of network costs. While there is a vast literature on optimal electricity pricing, the literature on optimal network tariffs is considerably slimmer and empirical research providing data on the impact of different network tariffs on customers, based on their socio-economic characteristics and actual energy consumption, is non-existent due to the lack of fine-grained electricity consumption data for households. The lack of such data has lead to a lack of transparency in network tariffs methodologies and a certain resistance of regulatory authorities to adjust currently applied tariffs to new circumstances, as it is unclear how the costs will be redistributed and whether such a redistribution could hurt marginalized consumers, especially low-income households. Our research provides important empirical evidence filling this gap in the literature and allows decision makers to assess the strengths and weaknesses of different tariff structures ex ante, and thereby helping to avoid electricity consumers becoming guinea pigs in the pending adaption of regulatory practice to the future electricity system.

Methods

In this paper, unprecedented data on 765 Austrian households is used, containing 15-minutes load profiles which have been observed during the period from April 2010 to March 2011, of which a number of household characteristics is known along with their equipment of electricity consuming appliances. We examine whether there is a coherence between income, household type, size, household equipment, as well as energy consumption and different tariff types in order to see which factors determine how the costs of the electricity network are reallocated when new tariffs are introduced. We construct 9 alternative tariffs and compare these to the one actually applied in the residential sector in Austria. These 9 tariffs are based on the schemes that are currently applied in the EU or suggested in the literature (V. Sakhrani, J. E. Parson, 2010; M. P. Rodríguez Ortega et al.,2008; AF-Mercados, REF-E and Indra Final report, 2015) and we extend half of them with a peak load component (for a comparison of regulatory practice across the EU see, e.g., Schmidthaler et al., 2015). All alternative tariffs meet the ultimate paradigm of defining network tariffs, namely in that they recover the same sum of network costs as the current Austrian scheme, and only the proportion of the main components of network tariff – fixed, energy and peak dependent charges – is changed. As our analysis is done ex post, possible changes in consumption in reaction to network tariff changes are not considered in the following results.

Results

Depending on the alternative tariff structure we identify extreme cases, especially in the peak load based tariffs, which would have to pay from 50% less to 300% more compared to what these households pay under the current tariff regime. We identify the types of households who will pay more or less and can actually benefit or lose from the potential change in network tariffs. We find that adapting alternative tariff models based on peak consumption can have a stronger positive effect on households with higher income, which could profit most from a fully peak-dependent network tariff. This is supported by the results of our additional analysis in which we check whether there is a difference in yearly consumption of energy and production of peaks between different households based on their level of income. According to the analysis, appliances like a dish washer or a flow heater of a higher income (third tertile) household consumes significantly less energy compared to the same equipment of a household with lower income. Also a tumble dryer of a household with low income (first tertile) produces significantly more peaks than the same tumble dryer in middle income households. This could be explained by the fact that higher and middle income households have access to more energy efficient home appliances due to their higher purchasing power, and so applying fully energy-based or fully peak-based tariffs would mostly hurt the lower income group.

Our study shows that introducing a flat capacity-based tariff with a fixed cost of 178 €, similar to the tariff applied since 2009 in the residential sector in the Netherlands, will be of advantage for households consisting of a pair with or without children, as well as for the households situated in small villages and households living in single-family dwellings. When a tariff, completely based on the amount of consumed energy with the cost of 5.06 €Cent/kWh, is implemented, households in small villages, single family dwellings and households consisting of a pair with or without children, will pay around 3 % more compared to the currently applied tariff in Austria. Assuming that Austrian authorities opt for a fully peak-load-based tariff, households with higher income, a higher number of persons, owning a single family dwelling as well as households owning a swimmingpool will profit more and pay significantly less than they do now. Finally, if any combination of peak and energy components is used, social characteristics like income, type and size of household are either not significant at all or less significant and the size of the effect is smaller. Due to such tariffs only having some equipment like tumble dryers, a saunas or, flow heaters in the household has a positive impact on how much the household must pay for grid usage.

Conclusions

Regulatory authorities have to respond to the ongoing significant changes in the way modern economies produce and consume electricity, but without empirical data any adjustment of the current tariffs can cause unfair redistribution of the costs and create asignificant financial burden for some group of consumers. According to our research a tariff combining peak-load and energy components is the most appropriate for today’s household energy consumption pattern – it is cost reflective, due to the peak-load charge, it signals the consumer the need to decrease overall consumption and produce less peaks, and it does not punish any group of consumers for a decrease in electricity demand and an increasing in the overall number of prosumers. Our analysis provides empirical evidence which helps in designing tariffs that can recover the costs needed for the sustainable operation of the grid while protecting less privileged consumers from paying an arm and a leg for electricity, necessary in the day-to-day life.

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