

The Consumer Voice in Europe

Consumers and the future electricity grids

How to make flexible consumption a win-win



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Why it matters to consumers

Household consumers across Europe pay on average one third of their electricity bill on the costs of transporting and distributing the electricity they use at home. The energy transition may require some additional investments in order to reinforce and digitalise the electricity grid which will have impact on consumers' bills. Some consumers can help to lower these investments by using their flexibility in consumption: for example, they can use their batteries, including those in electric cars, and store or use electricity when less people use the grid. To bring consumers in, the flexibility needs to be rewarded and the economic benefits of using flexibility in the electricity grid need to reach all consumers.

Executive Summary

The electricity system is undergoing a radical transformation as part of the decarbonisation process. But this transformation has many uncertainties.¹ There is significant uncertainty about whether, and if yes by when, reinforcement of the grid will be needed.

We expect that many areas of energy consumption will switch from fossil fuels to electricity: for example, through electric cars and heat pumps. This will increase electricity use. On the other hand, energy efficiency might lower the electricity consumption.

At the same time, many household consumers are expected to become more flexible in their consumption. More and more households will have storage as well as smarter appliances that can adapt to price signals. Many heat pumps, combined with smart systems, can be flexible whilst maintaining a comfortable temperature.

Consumers can also change their behaviour when it comes to electricity consumption. Thanks to more studies into how consumers really behave we understand better what triggers consumers to use less electricity or use it differently.

This flexibility from consumers can be used to avoid or mitigate needs to invest and maintain the electricity grid.

Member States, National Regulatory Authorities and distribution system operators have and are already considering how to make the most of this growth of household's ability to be flexible in their electricity consumption. How can they best incentivise changes in the household so that the overall costs of the distribution grid decrease?

This paper explores two ways in which the grid can make use of the flexibility from consumers:

Firstly, through time-differentiated charges, which will give price signals to lower or increase electricity consumption.

¹ BEUC, "[The future of energy consumers](#)", September 2019.

Secondly, by using a market-based approach, where they will call for market participants to provide flexibility through a market-based approach. That is, the grid will pay participants to use less to avoid congestion in the grid. For example, some distribution system operators already use an auction to find which participants are willing to lower their consumption. Household consumers can participate in the markets that the system operator will create through aggregators that will group several households to provide enough reduction.

There is no one-size-fits-all solution to the grid tariff design. In order to ensure future grid tariffs are consumer-centric and forward-looking, BEUC provides recommendations to Member States, National Regulatory Authorities and/or distribution system operators on what should be considered when designing these tariffs and when appraising how to best activate consumer flexibility.

1. Recommendations

1.1. Take a consumer-centric approach

- **Measure the economic impact of a change in network tariffs or a market-based approach to households' flexible consumption on different types of consumers, as well as the impact on their wellbeing.** BEUC recommends investigating especially the impact on those with low income, those in vulnerable situations, as well as those in rented houses and/or in multi-storey buildings. These are typically consumers who find it more difficult to invest in products that can provide flexible consumption, such as batteries and electric cars or which improve energy efficiency.
- **Consider real behaviour based on robust behavioural insights.** Consumers are starting to get more price sensitive. But they often react to incentives in unexpected and counter-intuitive ways. Theoretical models will not work to predict consumers' response.
- **Ensure that the benefits of reducing costs of the grid thanks to consumer's flexibility are passed on to consumers.** It should not be the case that distribution system operators get all the benefits from lower costs, whilst consumers bear the risks.
- **Make sure that all consumers always have the option to choose** a tariff that does not change at different times of the day or on different days of the week.
- **Make clear what grid charges there are for households.** Most of the flexibility is likely to come from products that require high initial investments, such as electric cars or batteries. The more the uncertainties, the lower the number of consumers that will invest in these products.
- **Keep time-differentiated grid charges structures as simple as possible.** The more complex the tariff, the more difficult it will be for the consumer to know how to change behaviour in order to save money. Even when consumers use automation, they must be able to understand what they are paying for.

1.2. Increase transparency and oversight

- **Conduct regular monitoring of the impacts on different consumer groups.**
- **Ensure that consumers have adequate information before any change:** either when changing grid charges or moving to a market-based procurement of flexibility.
- **Guarantee that there is enough oversight, enforcement and consumer protection for all new services** that will harness consumer flexibility for the grid. For example, for aggregation services or automated decision-making services.
- Ensure **distribution system operators share relevant, complete and reliable information with decision-makers.** For example, information on the costs of reinforcing the grid compared to costs to digitalise it should be made available.
- **Involve consumer organisations in the decision-making process.** For example, through consultation or other forms of meaningful stakeholder engagement. The decision making must be participative and transparent. This should include a clear description of the objective and the problem that the proposed change or intervention is supposed to solve. Information of the revenues and costs of the distribution system operator must be accessible by all.

2. Introduction

Grid costs are one of the most important parts of household consumers' electricity bills across Europe. They represent on average one third of the electricity bill. The impact of grid costs for consumers differ greatly across Europe: they are the highest in Norway where they represent almost half of the bill and are lowest in Greece where they amount to less than one fifth.²

In October 2018, BEUC commissioned a research on fairness and grid tariff structures to the Center for Competition Policy. This research concluded that there is not a simple definition of "fairness", and that the currently used principle of cost reflectivity is considered fair. It also concluded that there is not a one size-fits-all solution to grid tariffs, as cost drivers differ greatly across Member States.³

The electricity goes through two types of grid, each operating at a different level: the transmission grid has higher voltage and is used for long distances; and the distribution grid has lower voltages and is used for short distances. Most of what households pay for the grid is for the distribution grid. In this paper we focus on the distribution grid and how to lower its costs through flexibility.

A study commissioned by the European Commission lists a few important drivers of costs of the distribution and how they have an impact on consumers' electricity bills. The maximum level of demand of electricity at a given time, called peak demand, is a main driver of the distribution grid costs.⁴

The time of peak demand changes not only country by country, but even at local level. It has a weekly component: in the UK for instance this takes place between 5pm-5.30pm to

² ACER, "[Market Monitoring Report 2017 – Electricity and Gas Retail Markets Volume](#)", October 2018.

³ L.Lu and C.Waddams-Price, "[Designing distribution grid tariffs that are fair for different consumer groups](#)", BEUC-x-2018-099, October 2018.

⁴ AF-Mercados, REF-E, Indra, "[Study on Tariff Design for Distribution Systems](#)", European Commission, 2015.

6pm each weekday evening.⁵ But it also has a seasonal component. In Spain, the peak in 2017 took place on 18 January 2017, but the all-time high was recorded in December 2007.⁶

The transformation of the electricity system affects how the grid is used and its costs, but it can bring flexibility and energy efficiency to reduce the need for additional investments.

Until recently, the system was defined by inflexible demand: consumers used electricity when they needed it. Electricity was generated by large power plants that could feed many consumers that were far from the production point.

This is rapidly changing. More and more consumers generate electricity at home or within their communities.⁷ Energy consumption is expected to become more efficient, and hence lower the electricity demand.

Moreover, it is expected that electricity from renewable sources will substitute fossil fuels in heating, for example through heat pumps, and in transport, through electric cars. Heat pumps and electric cars can provide flexibility in consumption. This can help for better management of peaks within a day. Smart appliances and better understanding of how consumers respond to nudges can also help in bringing flexibility (and increase energy efficiency) in the grid.

All these drivers contribute positively or negatively to peak demand. However, it is difficult to predict how much can be achieved through flexibility.

Many distribution system operators are already using flexibility to reduce grid costs, for example by giving reductions to energy-intensive industry to not consume electricity during peak hours, or by conducting auctions to manage congestion.⁸

Household consumers have also been incentivised to be more flexible in their consumption through day and night tariffs, lower weekend prices, or peaks in prices on certain days of the year.⁹

Today, there are more sophisticated ways to manage the system. This can lead to more granular and efficient use of households' flexibility consumption.



Source: E DSO, "[Why smart grids](#)", last accessed September 2019.

⁵ C.Gavin, "[Seasonal variations in electricity demand](#)", DECC, 2014.

⁶ Red Eléctrica de España, "[The Spanish Electricity System - 2017](#)", February 2018.

⁷ European Commission, "[Study on Residential Prosumers in the Energy Union](#)", 2017.

⁸ For example, Scottish Power Energy Networks launched in September 2019 a flexibility tender, seeking up to 95MW of flexibility services. Scottish Power Energy Networks, "[Flexibility](#)", last accessed October 2019.

⁹ See for example, ieadsm, "[Tempo electricity tariff - France](#)", last accessed October 2019.

3. Household flexibility can lower grid costs.

European organisations representing the regulators and the system operators published papers on how to achieve active system management and better use of flexibility.^{10,11} Both papers put forward two approaches that can harness household consumer flexibility:

- **Time-differentiated grid charges:** prices go up when the grid is reaching its maximum capacity; prices go down when the grid has spare capacity. Those consumers who can change their consumption patterns will use less electricity during the most expensive times and more during the cheapest.
- **Distribution system operators use a market-based approach to get flexibility:** the distribution system operator uses a market-based approach to reduce use of the grid. This can be provided by many players, including aggregators that will act on behalf of consumers.

In perfect market conditions¹² both approaches would lead to the same volume shift and the same prices. But real consumer behaviour does not mirror that of a stylised economic model. In fact, we are always in a situation of market failure.

Member States will need to decide when to use each of the two approaches. Below, we analyse the pros and cons of above approaches from the consumer perspective and provide recommendations for when decision makers consider each approach.

3.1. Triggering flexibility through time-differentiated grid charges

The Regulation on the internal market for electricity¹³ states that:

“Charges applied by network operators for access to grid, including charges for connection to the grid, charges for use of grid, 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.”

Theoretically, there are many ways to design tariffs that incentivise consumers to be flexible in their consumption and still be cost-reflective. For simplicity, we consider:

- **Static:** the charges are set in advance for the whole regulatory period: for example, a year. Each time slot of the day has a different charge level. They can be set at the same level, or have more complex structures, for example weekend/weekday prices or seasonal prices.

¹⁰ ENTSO-E, “[TSO-DSO report: An Integrated Approach to Active System Management](#)”, April 2019.

¹¹ CEER, “Conclusions Paper on Flexibility Use at Distribution Level”, C18-DS-42-04, July 2018.

¹² The conditions are: a large number of buyers and sellers; perfect information; homogeneous products; well defined property rights; no barriers to entry or exit; every participant is a price taker; perfect factor mobility; profit maximization of sellers; rational buyers; no externalities; zero transaction costs; non-increasing returns to scale and no network effects; a well-functioning anti-competitive regulation in place.

¹³ Official Journal of the European Union “[Regulation \(EU\) 2019/943 of the European Parliament and of the Council of 5 June 2019 on the internal market for electricity](#)”, 2019.

- **Real time:** the prices are set as close to the time slot as possible, where the grid utilisation is forecasted more accurately. For wholesale this is set the day before. We expect that real-time grid charges could also be set one day in advance with closer input on predictions of demand/supply.

The time slots can be as precise as 15 minutes for households, as this is the level of granularity given by the most advanced smart meters.

Simplicity is essential for consumers to make the right choices. When looking at overall electricity offers, the European Commission found that *"Consumers were [...] less likely to choose the cheapest deal if the price structure was more complicated."*¹⁴

Consumers might find it difficult to understand how to change their behaviour and save money with time-differentiated charges, and struggle to see whether it is worth investing in appliances that can provide flexible consumption. Digitalisation and home automation could help to make these decisions, but only up to a point. Consumers should be able to understand what is behind the algorithms supporting and influencing their decision making.¹⁵

This does not mean that time differentiation does not work. The distribution network operator Mitnetz in Germany, for example, proposes a tariff with three levels. During the day, the grid charges vary between these tariffs according to the level of grid congestion. The applicable tariff is communicated with a time lead of 72 hours in advance, for example. The network operator conducted an analysis on the impact of these tariffs. It concluded that the expansion of the electricity grid in their area was reduced by 36 percent. The three tariff levels only apply to flexible consumers, that is consumers have the option to a non-time-differentiated tariffs.¹⁶

Consumers should be able to choose at least one grid tariff structures that is not-time differentiated. Consumers that cannot afford products that can provide flexibility (such as batteries or electric cars), or change behaviour, should be protected against increased costs.

The Center for Competition Policy paper on fairness in network tariffs concluded that optional tariff structures, where consumers can choose amongst several possible structures of grid charges, can be both cost reflective and fair.¹⁷ Similarly, the Regulatory Assistance Project also concludes that as a default, households should be set in a tariff that is not time-differentiated. Simpler time of use tariffs, such as day and night tariffs, should be accessible by consumers as an option.¹⁸

Time-differentiated grid charges might be insufficient to change behaviour. Next to grid charges, consumers' electricity bills include also taxes, fees, levies and electricity costs. These other costs represent on average two thirds of the costs, depending on the Member State. The variations in grid tariffs then might, in view of these other costs, be so small that it is not worth changing behaviour.

Moreover, in the future, consumers will be able to access tariffs where the electricity costs also change every 15 minutes based on the daily wholesale costs. It is possible that when the grid costs go up, the wholesale price goes down, and vice-versa. Thus, the changes in grid charges and wholesale prices can send contradictory signals to consumers. To

¹⁴ Directorate-General for Justice and Consumers, "[Understanding and choosing energy deals](#)", 2017.

¹⁵ Grid charges are already quite complex without adding time differentiation. They typically include a fixed element (x €/month), a capacity-based element (x €/kw), and/or a volume-based element (x €/kwh).

¹⁶ Midnetz, "[Elemente eines dynamischen und zukunftsfähigen Netzentgeltsystems](#)", September 2018.

¹⁷ This is already the case for example in Belgium for day and night network tariff.

¹⁸ C.Kolokathis, "[Designing Retail Electricity Tariffs for a Successful Energy Union](#)", September 2018.

understand if consumers will react to certain changes in costs, decision makers need to conduct studies to ascertain actual consumer behaviour, not theoretical.

Cost reflectivity in theory and in practice are quite different things. According to the revised Electricity Regulation, grid charges should be cost reflective. But in practice it is difficult to understand what cost is imposed by each consumer. In other words, it is not simple to allocate each of the different costs of the grid to each consumer. According to the Florence School of Regulation the lack of a perfect proxy for grid cost drivers is a main challenge to set cost-reflective tariffs.¹⁹

This is becoming even more complex as distribution system operators and National Regulatory Authorities will need to forecast many of the cost drivers or their proxies in order to make a decision. This increased number of variables renders accurate forecasting extremely difficult. In short, there will be more information that needs to be treated and more proxies that need to be considered.

Thus, trying to have exact costs for individual consumers at 15-minute intervals may become impossible in both static and dynamic tariffs. Digitalisation, big data and advanced algorithms might help, but only up to a point. The complexities of the calculations and the ability of National Regulatory Authorities and/or distribution system operators to reach a figure needs to be weighed against the potential reductions of other costs.

3.2. Accessing consumer flexibility through a market-based approach

A market-based approach in some areas could reduce the cost of the grid. This could be the case when procuring flexibility. The revised Directive on the internal market for electricity²⁰ establishes that:

"Member States shall provide the necessary regulatory framework to allow and provide incentives to distribution system operators to procure flexibility services, including congestion management in their areas, in order to improve efficiencies in the operation and development of the distribution system. [...]. Distribution system operators shall procure such services in accordance with transparent, non-discriminatory and market-based procedures unless the regulatory authorities have established that the procurement of such services is not economically efficient or that such procurement would lead to severe market distortions or to higher congestion."

This approach comes with risks. The distribution system operator (under the supervision of National Regulatory Authorities) will have to use proxies and assumptions to procure flexibility in the most efficient way. They will need accurate estimates on how much increase of usage they expect, and how much they will need to reduce. If they overestimate this, costs will be inflated unnecessarily.

To implement this approach, the distribution system operator must assess how much flexibility is accessible. If there is too little flexibility available and a tender is used, the prices will increase when compared to other approaches. Lower numbers of service providers also increase the incentives for the companies to game the auction (for example through bid rigging). Similarly, having a well-designed tender is essential to avoid gaming.

From the consumer perspective, individual households will find it difficult anytime soon to participate in such markets individually. They will use third-party intermediaries, called aggregators, that group several households and conduct the auction on their behalf.

¹⁹ Tim Schittekatte, "[The Future Direction of Network Tariff Structures](#) , European University Institute / Florence School Regulators", October 2018.

²⁰ Official Journal of the European Union, "[Directive common rules for the internal market for electricity](#)", 2019/944, 2019.

Aggregators for household consumers already participate in other markets: capacity markets, balancing markets or grid ancillary services.

Aggregators can help increase the value of consumer's assets through a market-based approach, especially if the aggregator, through pooling many consumers, can use the flexibility assets in several markets (balancing, congestion management, capacity mechanisms). However, they will keep part of the value of the flexibility service to cover their own costs plus a margin.

Moreover, in view of the unpredictability of revenues and the potential diversity of products and offers from aggregators, **consumers might find it difficult to shop around, to compare and find the best solution for themselves.**

Aggregators for households might simply not appear. If they appear, there might be not enough companies providing these services to have a competitive market for consumers.

Member States should also ensure that households have access to reliable information on opportunities and risks when shopping around for aggregators' services, for example through price comparison sites.

Adequate consumer protection should be in place before procuring aggregation services. The revised Electricity Directive provides a framework for consumer protection and alternative dispute resolution for consumers contracting services with aggregators.²¹ The protections should be implemented as soon as possible so there are no gaps for those consumers taking on these contracts.

4. Conclusions

Household consumers across Europe pay on average one third of their electricity bill on grid costs. If enough households provide flexibility to the system, this can help to reduce the costs paid by all. Now is the right time to look at how to tap into this flexibility. In this paper, we investigate two main approaches. First, making grid charges time-differentiated, so it is more expensive to use the grid at peak times. Second, a market-based approach, where the grid pays directly the person or organisation that can provide cheapest flexibility. The best approach for consumers will depend on a series of factors that will change from country to country. Hence, there is no one-size-fits-all solution. Instead, we provide a list of factors that decision-makers should consider in order to harness household flexible consumption whilst protecting the interests of all consumers.

²¹ Official Journal of the European Union, "[Directive common rules for the internal market for electricity](#)", Directive 2019/944, 2019.



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