Network Tariffs

A EURELECTRIC position paper

March 2016

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***Carbon-neutral electricity** by 2050*

We have committed to making Europe's electricity cleaner. To deliver, we need to make use of **all low-carbon technologies**: more renewables, but also clean coal and gas, and nuclear. Efficient electric technologies in **transport and buildings**, combined with the development of smart grids and a major push in **energy efficiency** play a key role in reducing fossil fuel consumption and making our electricity more sustainable.

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KEY MESSAGES

- DSOs are key in enabling a successful energy transition, while still providing a high-quality service to all customers through the distribution system stability, power quality, technical efficiency and cost effectiveness in the future evolution of distribution networks towards a smarter grid concept.

- Full and timely recovery of network costs (OPEX, depreciation and a fair return on investment) is a necessary condition for DSOs to fulfil their duties. To this end, the impact of variations in consumption volumes on DSOs revenues should be neutralised economically and financially, otherwise they can hamper the sustainability of investment and increase the cost of capital.

- The structure of the distribution network tariffs, and in particular the balance between the capacity (€/kW) and the volumetric (€/kWh) tariff components, is an important issue for the entire electricity system.

- Tariffs should encourage overall system efficiency in the long run through price signals incentivising efficient distribution infrastructure services provided, including: network access, guaranteed power availability, injection/withdrawal of energy and power quality.

- More capacity-based network tariffs (especially for low voltage consumers) reflect the higher network costs associated with peak demand and provide customers with incentives to reduce their peak load, resulting in a more efficient use of the network. They provide better incentives for a more efficient use of energy overall.

- They should also ensure an efficient and fair allocation of costs among different customer categories, avoiding cross-subsidisation between customer classes.

- Energy efficiency and demand response can be incentivised through a wide set of instruments. The increase in the capacity part of the tariff does not hinder the use of network tariffs as a complementary instrument for this purpose and reinforces the incentive for rational behaviour.

- Time-of-Use network tariffs charge different pre-defined prices at pre-defined times of the day or year. Such prices can be set up based on capacity (power), used or contracted. They incentivise a more efficient use of the network, support flexibility, and are compatible with EU objectives on energy efficiency and active demand response.

- Dynamic network pricing assumes that the different states of the distribution network can give rise to differential pricing locally and closer to real-time. Its added value at household level has to be further studied, as dynamic pricing can entail higher complexity and implementation costs and can have an impact on suppliers' offers in some cases. On a complementary basis to implicitly incentivizing flexibility via network tariffs, DSO can procure flexibility from commercial flexibility service providers (i.e. suppliers or aggregators) in the future.

TF Network Tariffs

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1. Foreword

Distribution network tariffs[1] in low voltage are still largely based on the volume of energy used, while infrastructure costs are mainly driven by the topology of the network and by capacity.

Distribution networks are considered the backbone of the power system, providing necessary services to society. Distribution System Operators (DSOs) are expected to ensure security of supply, high quality service and efficient integration of Renewable Energy Sources (RES) in the electricity system through appropriate network development and operation.

As DSOs are regulated natural monopolies, regulators estimate their allowed revenues based on operating cost, depreciation and a fair rate of return on their assets.

A cost reflective tariff structure is one of the key elements for the effective collection of allowed revenues. Network costs are largely driven by the topology of the network. How much power and energy can flow through the network is the other main cost driver, which is mostly related to the probability of peak demand (in kW). The evolution of peak demand also has an impact on the network's future investment, operation and maintenance costs. In other words, controlling peak demand will help control long-term costs.

However, for households and small businesses, network tariffs are still mainly based on energy volumes (in kWh) in the majority of EU Member States. Table 1 shows how network tariffs for households and small industrials are built up in terms of tariff components.

		0%	0-25%	25-50%	50-75%	75-100%	100%
Households	**Energy Charge (%)**	NL	ES, SE	NO	IE, IT, PL, PT, SK, SI	AT, CY, CZ, FR, DE, GB, GR, HU, LU, RO	
	Fixed + Capacity Component (%)		AT, CY, CZ, FR, DE, GB, GR, HU, LU, RO	IE, IT, PL, PT, SK, SI	NO	ES, SE	NL
Small Industrials	**Energy Charge (%)**	NL	IT, LU, ES,	AT, PL, SI,	CZ, FI, FR, HU, SE	CY, DE, GB, GR, SK	RO
	Fixed + Capacity Component (%)	RO	CY, DE, GB, GR, SK	CZ, FI, FR, HU, SE	AT, PL, SI	IT, LU, ES	NL

Table 1: Key elements of today's European distribution household and small industrials network tariffs
Source: Study on tariff design for distribution systems, European Commission (DG Energy), January 2015

In order to ensure fair cost allocation across customer classes, distribution tariffs should be more cost reflective. This paper explains which tariff structure design would better contribute to economically efficient system use and fair cost allocation.

[1] Transportation system tariffs include charges for distribution, transmission, and balancing (if not a market activity). For the purposes of this paper, network tariffs coincide with distribution network charges.

2. Network Tariff Structures

The tariff structure should reflect the different nature of fixed and variable costs (depending on actual energy use).

Costs included in network tariffs depend on DSO roles and responsibilities. Network tariffs generally include the following direct network costs:

⌡CAPEX: incurred due to investments in assets necessary to provide network services, generally including overhead lines and underground cables (km, kVA and voltage level as cost drivers), substations (kVA and voltage level-based), control centres, information and communications technologies (ICT), metering systems and other assets. Capital costs include depreciation and a rate of return on assets.

⌡OPEX:

- Operations, including system services and maintenance (driven by km/kVA/voltage level);
- Procurement of network losses (kWh-based, where applicable);
- Customer service: metering services, invoicing, and other administrative and commercial costs. These costs depend on the number of consumers, but they are mostly fixed, regardless of customer size/consumption;
- Overhead costs: corporate costs not directly linked to the operation and maintenance of the network, but associated with network service delivery;

The tariff structure should represent the different nature of fixed and variable costs (depending on actual energy use). The basic tariff structure can have three main types of components, either alone or in combination: volumetric (€/kWh), capacity-based (€/kW), and per connection (€/year). Within each approach, there are different options encompassing a choice of fixed prices, time of consumption dependence, wholesale price dependence, etc. Tariff structure should find the right balance between desired objectives (revenue adequacy, cost reflectiveness, economic efficiency) and the final price structure without jeopardising increasing energy efficiency and demand response.

Volumetric vs capacity tariffs

Volumetric tariffs charge consumers for the total volume of energy taken from the grid, while capacity tariffs depend on contracted grid capacity or used power. The measurement unit for volumetric tariffs is generally €/kWh, whereas for capacity tariffs it is €/kW.

ToU tariffs vs Critical Peak Pricing (CPP) vs dynamically cleared prices

Time-Of-Use (ToU) tariffs are predefined fixed tariffs for specific time intervals, i.e. higher 'on-peak' prices and lower 'off-peak' prices with the objective of incentivising peak shaving and congestion mitigation. ToU tariffs can be volumetric, capacity-based or a mix of both. ToU tariffs are fixed ahead of real time, based on historical data on grid use in a particular network (each month or year).

Critical peak pricing (CPP) charges pre-defined higher prices during critical hours, which are chosen close to real time, responding to higher demand levels for network capacity. Notification is usually made 1 to 2 days in advance. A critical period can last several hours, depending on tariff design. A critical period can be understood as a 'moving ToU' interval.

Dynamic network pricing is a concept envisaging the short-notice adjustment of prices to accommodate varying demand for network use and changing network conditions (e.g. grid bottlenecks or congestion).

3. Network Cost Recovery

The long-run cost of operating the distribution grid is mostly fixed. The nature of this cost should be recognised by regulators and DSOs must be compensated as a result

Recently, many European countries have been experiencing a significant reduction in distributed energy volumes. Table 2 shows a few examples from these countries. This is mainly due to the increase in the number of prosumers, increasing energy efficiency and a prolonged economic stagnation. This can impact the DSOs' ability to recover their allowed revenues within reasonable time periods, usually set by national regulatory regimes, which can lead to cash flow issues in addition to potential tariff fluctuations overtime.

Country	Total Distributed Energy (TWh) 2011	Total Distributed Energy (TWh) 2014	Decrease (%)
CY	4.6	3.9	15.2
ES	278	259	6.8
DE*	510.6	495.9	2.9
DK	32.0	30.6	4.4
FI	60	59 (2013)	1.7
FR**	363	362	0.3
GR	45.7	42.6	6.8
IT	287	262.4	8.6
NO	118	115 (2013)	2.5
PT	47	44	6.4

*Without industrial own consumption; own consumption of small-scale producers partially included.

**Data from France provided by ERDF, who manages about 95% of France's distributed electricity. The data includes network losses.

Table 2: EU countries with declining amounts of distributed energy
Source: EURELECTRIC, March 2016

Financial (cash) exposure: the collection of DSO revenues depends on the level of consumed and distributed energy, but there is a mechanism to compensate, albeit with some delay, the mismatch between allowed and cashed revenues.

Economic exposure: the level of DSO revenues depends on the level of consumed and distributed energy, so that there is a structural or systematic mismatch between allowed and actual revenues.

In some Member States, DSOs bear a volume risk they cannot control, along with its economic and/or financial consequences. This effect was recorded in the last three years and is expected to continue in the coming years, and in some countries even increase. The DSO is generally refunded for financial deficits (the effects of lower revenues due to lower energy consumption) ex-post with a delay, but in cases where DSO revenue is entirely based on consumption volumes (for instance, in case of pure price caps with no volume adjustments), the DSO is fully exposed in actual economic terms. Table 3 illustrates this situation.

% of total revenues	Financial (cash) exposure over the last three years	Economic exposure over the last three years
< 0.5%		DE
0.5% - 5%	AT, ES, FR, GR, LV, NL	DK*, PL, PT
5% - 10%	DE, IT, PT	

*For Denmark, economic exposure is understood as the level of DSO allowed revenues depends on the delivered amount of energy.

Table 3: Volume risk borne by DSOs
Source: EURELECTRIC, 2016

More capacity-based tariffs, better reflecting the nature of distribution costs, would help address this issue by providing more stable distribution revenues and cash flows. Hereby, the term “capacity based” shall encompass tariffs that are based on contracted capacity or power, used capacity (power) or purely fixed rates. Moreover, to ensure the timely recovery of allowed revenues, other mechanisms should be put in place:

- A short pricing period[2] should be set up in order to arrive at a more accurate estimate of the level of volumes on which tariffs are calculated and to avoid relevant financial gaps that, even if temporary, can jeopardise the possibility for distribution companies to finance their investments. This does not imply that the regulatory period[3] cannot be significantly longer than the pricing period.

- In any case, DSOs should not be economically exposed to consumption volumes and so they should, at the very least, be refunded ex-post for the financial deficits generated by lower volumes. In general, from a regulatory perspective it would be more appropriate if DSO revenues were indexed to more stable and predictable cost drivers.

4. Fair Cost Allocation

A fair and non-discriminatory tariff should present identical charges to grid users with identical characteristics requiring equal guaranteed access from the distribution network and should be designed to provide an optimal economic outcome for society in general.

Network tariffs should allocate distribution costs in a fair way among users, taking into account their individual grid impact, not only energy volume and capacity, and send the right signals for efficient grid usage. Tariff design should reflect the link between connection and use of system charges as well as network customer diversity.

Self-generated electricity is one of the major factors contributing to the current decrease in the amount of grid-distributed electricity. However, self-generation per se does not necessarily reduce grid development/management costs. In fact, in many cases the opposite is true due to the need for connection and use of the distribution grid and sometimes further network extension, as well as increased automation investment.

Prosumers are, in general, no less dependent on a reliable access to the grid than traditional customers, because they still use the grid, especially at peak hours.

As long as customers are connected to the grid and use its services, they should contribute to its costs. Figure 2 illustrates the situation where maximum customer demand in net terms occurs, typically when self-generation based on PV is not taking place.

[2] Pricing period: the time during which a pricing schedule is valid, e.g. 1 year.
[3] Regulatory period: the length of the regulatory price control, which is decided by the regulator, e.g. 3-5 years or sometimes longer.

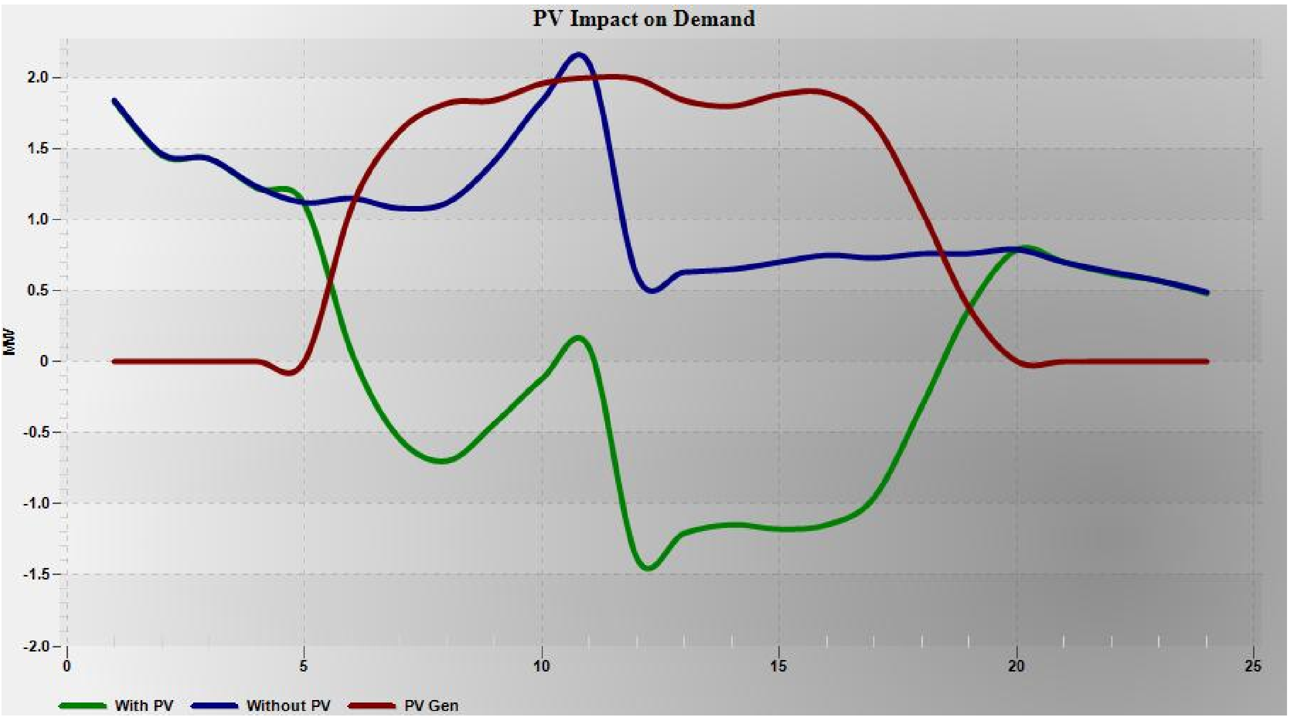

Figure 2: Solar self-generation impact on grid load
Source: Impact of PV on Distribution System Voltage Control, DNV-GL, October 2015

5. Price Signals for the Efficient Use of the Grid

The structure of network tariffs should ensure that adequate price signals are put in place to incentivise the efficient grid use.

More capacity-based network tariffs (especially for low-voltage consumers) reflect the higher network costs associated with peak demand. They can provide customers with incentives to reduce their peak load to an optimal level, resulting in a more efficient use of the network. In EURELECTRIC's view, more capacity-based tariffs result in better cost reflectiveness and more stable revenues and cash flows for DSOs.

As a result of better peak load management, further investment in available grid capacity can be deferred or reduced in the longer run, with a positive effect on overall system cost to the benefit of electricity customers.

Particularly in the presence of ToU network tariffs for consumers connected to medium or high voltage distribution lines, an increased price signal on capacity and associated incentives to transfer energy consumption out of peak hours would encourage consumers to moderate their peak demand levels. The effects of ToU capacity-based tariffs at household level must be explored further.

It would also incentivise consumers to choose energy saving appliances that can help consumption management in order to reduce peak levels.

6. Network Tariffs and Demand Response

Demand response can be incentivised through a wide set of instruments.[4] The increase in the capacity part of the tariff does not hinder the use of network tariffs as a complementary instrument for this purpose.

Through demand response, final consumers (households or businesses) provide flexibility to the electricity system by voluntarily changing their electricity consumption in reaction to overall price signals or to specific requests, while simultaneously benefiting from doing so. Flexibility can be provided using either manual or automated actions (starting, increasing, decreasing or stopping generation or demand).
According to the European Commission, Member States and National Regulatory Authorities (NRAs) should work towards enabling innovative grid tariff structures that incentivise network customers to deliver flexibility to the system[5].

Flexibility can be provided to the market (taking advantage of varying wholesale prices), to the system (often in the form of providing balancing power) and/or the grid. Flexibility provided to DSOs, in order to postpone or avoid investment, will have to be fundamentally different from the other two as it is limited to smaller geographical areas.

When it comes to demand response for DSO purposes, i.e. local congestion management:

- Customers can be incentivized to change their consumption implicitly by network tariffs as described below.
- DSOs can procure these services via flexibility markets from commercial flexibility services providers (suppliers or third party aggregators);

More capacity-based network tariffs can also activate demand-side behaviour that is good for the network, while ToU network tariffs can be applied to the capacity component. Smart meters (especially for industrial customers) allow setting different capacity network tariffs for predefined (peak/off-peak) time schedules. ToU network tariffs are still possible in the presence of an increased capacity component. This is already the case with traditional meters for larger industrial consumers, businesses or even households (in France, for example, for larger consumers connected above 36 kVA). Table 4 gives a few examples of already implemented ToU network tariffs in EU Member States.

Type of customer	Energy ToU Network Tariffs	Capacity ToU Network Tariffs
Household	AT, ES, FR, GR, LV, PL, PT	GR, (*)
Industrial	AT, ES, FR, LV, PL, PT	ES, FR, PT**

*The Netherlands completed a pilot project on ToU Capacity Network Tariffs for households in December 2015. At the time of publication, there are no full-scale plans to implement such tariffs.
**In Portugal, there is a capacity component that only applies to peak hours.

Table 4: EU countries with household and/or industrial ToU Capacity and/or Energy Distribution Network Tariffs
Source: EURELECTRIC, 2016

[4] See Everything you always wanted to know about demand response, EURELECTRIC 2015.
[5] https://ec.europa.eu/energy/sites/ener/files/documents/EG3%20Refined%20Recommendations_FINAL_clean.pdf

Different options of network tariffs activating demand-side response behaviour are discussed below.

At medium (or high) voltage level, DSOs can offer capacity-based ToU network tariffs to activate grid-optimising demand-side response. Such tariffs are intended to shift consumption so as to avoid grid constraints. ToU tariffs give incentives to customers with controllable loads to reduce their demand during expected peaks in the distribution network.

With Critical Peak Pricing (CPP), DSOs can send much stronger price signals (either capacity or volumetric) to stimulate demand response than with ToU. This is because CPP applies to a limited number of days when the network has a higher probability of being constrained. ToU periods – on the other hand - are fixed in advance. A pilot project considering such a price scheme for industrial customers is currently being implemented in Portugal.

Dynamic network pricing schemes are sometimes discussed as an option for DSOs to tackle potential grid bottlenecks or manage congestion. However, other economic instruments such as flexibility or interruptibility contracts might be more effective to activate flexibility by consumers, prosumers and other distributed generators.

7. Network Tariffs and Energy Efficiency

For consumers, the overall incentive towards system and energy efficiency results from a combination of retail prices and network charges.

The network tariff is only one part of the final price. Retail prices provide the overall price signal, which is the net result of several different price signals, some related to energy efficiency and others related to (grid) capacity efficiency.

The fraction of the final price relating to production (generation) costs is mainly volumetric and contributes to the price signal sent to consumers either to reduce energy consumption or to shift it towards times in which generation costs are lower (ToU tariffs).

Consumers - households in particular - demand electricity as a result of external short-term drivers such as external temperature, daylight intensity and duration, time of rest and activity throughout the day and week. However, in the longer run, household consumers can make choices to increase the efficiency of their electricity use, typically through investment in new equipment (or home insulation measures in case of electric heating).

An increased capacity price signal would direct the consumer towards equipment choices that can moderate their peak demand either by shifting or reducing their level of consumption.

In general, energy efficiency should be addressed in a holistic approach that optimizes and reduces the total energy consumption taking into account the different overall efficiency and environmental impact of different sources of energy used by consumers. This can mean that the use of one source of energy, e.g. electricity even increases in order to replace another, less-efficient (and more carbon-intensive) source of energy. Higher electricity consumption does not mean inefficiency if it is a consequence of fuel switching, which indeed is considered one of the measures to promote a more efficient use of energy. In fact, many electric appliances (e.g. heat pumps) are more efficient than those using other fuels. Additionally, the increasing number of electric vehicles will raise electricity demand while replacing fossil fuels. In such case, it will be necessary to redefine the "energy efficiency" concept not only as reduction of energy consumption, but also as the "smart use of energy".

EURELECTRIC pursues in all its activities the application of the following sustainable development values:

Economic Development

- Growth, added-value, efficiency

Environmental Leadership

- Commitment, innovation, pro-activeness

Social Responsibility

- Transparency, ethics, accountability

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