DISTRIBUTION GRID TARIFF STRUCTURES
FOR SMART GRIDS AND SMART MARKETS

CEDEC POSITION PAPER

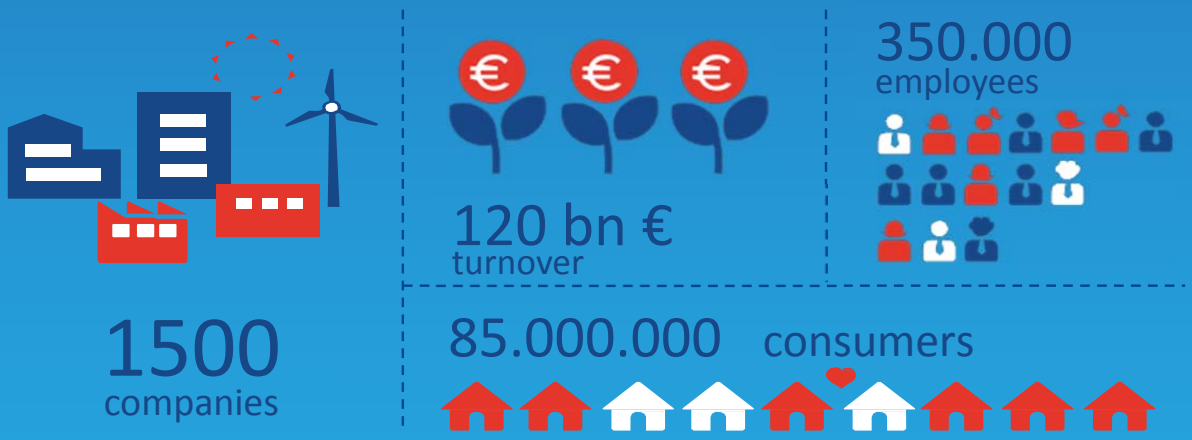
March 2014

CEDEC

CEDEC - WHO ARE WE?

CEDEC represents the interests of local and regional energy companies.

CEDEC represents more than 1500 companies with a total turnover of 120 billion Euros, serving 85 million electricity and gas consumers & connections, with more than 350,000 employees. These predominantly medium-sized local and regional energy companies have developed activities as electricity and heat generators, electricity and gas distribution grid & metering operators and energy (services) suppliers.



The wide range of services provided by local utility companies is reliable, sustainable and close to the consumer. Through their investments and local jobs, they make a significant contribution to local and regional economic development.

CEDEC
Rue Royales 55
1000 Bruxelles
+ 32 2 217 81 17
E-mail : info@cedec.com

INTRODUCTION

In the framework of the energy transition towards a more sustainable and decentralized energy landscape the existing tariff structures are being challenged: especially for residential customers, current grid tariff structures are either based on volume consumed or exceptionally – on the capacity of the connection to the grid.

However, this approach is not capable of formulating the necessary answers to the future needs of final customers, decentralized generators, commercial market parties (ESCOs, aggregators, suppliers) and distribution system operators (DSOs).

Accrued energy efficiency efforts by energy companies and consumers, stimulated by European policy on energy efficiency (2020 target, Energy Efficiency Directive), lead to lower consumption levels for consumers and to lower volumes of electricity and natural gas transported on the grid. This evolution however does not have any direct cost-reducing effect for network operators, whose costs are predominantly determined by their investments in network capacity based on current and expected connection capacity, and not by the variations in the distributed volume. On the contrary, an increasing amount of distributed generation will require higher investments in network components and IT, grid monitoring, automation and procurement of flexibility services which lead to higher distribution costs.

The spectacular development of distributed generation, mainly PV on the roofs of consumers, and the according in-feed in the distribution grid, has also led to a decrease of electricity transported on the grid. In the case of volume based tariffs, this lower volume does not allow to cover the distribution costs with the regulated tariffs.

At the same time, as the in-feed of renewable energies depends on elements like sun or wind that are not controllable, there is a clear need for more flexibility on the demand and the supply side, and for flexibility services that can give an answer to this challenge.

The way grid tariffs are structured, determines in how far grid tariffs can contribute adequately to answering these needs.

Distribution grid tariffs are a competence of Member States, implemented through the National Regulatory Authorities (NRAs). The EU legislation gives room for subsidiarity to Member States, allowing them to develop their own grid tariff methodology. Against this background, the grid tariff structures vary widely across the EU, adequately reflecting the particularities and organizational structures of the national electricity and gas systems and markets.

POLICY OBJECTIVES AND GUIDING PRINCIPLES

Distribution grid tariffs should evidently be in line with European and national policy objectives that are set in the fields of energy markets, climate policies and security of supply:

- Tariffs should promote **well-functioning** of the electricity and gas **markets;**
- Tariffs should encourage **energy efficiency;**
- Tariffs should encourage the development of **distributed generation;**
- Tariffs should contribute to **system flexibility** through demand response.

Equally, the following guiding principles should be respected when developing tariff structures and setting tariff levels for different consumer groups:

- **Cost reflectiveness:** grid tariff design should reflect the costs incurred by serving each grid user;
- **Infrastructure cost efficiency**: grid tariffs should aim to reduce infrastructure costs by reducing or shifting peak demand;
- **Operational cost efficiency**: grid tariffs should aim to reduce operational (including administrative) costs;
- **Revenue adequacy**: grid tariffs should ensure full recovery of all allowed network cost and reasonable return on capital;
- **Transparency**: determination of tariffs should be transparent, auditable and consistent.

Developing grid tariff structures that are optimally responding to these policy objectives and guiding principles is a prerequisite for finding the necessary answers to the future needs of final customers & prosumers, commercial market parties and distribution system operators.

In the following chapters we will briefly analyse the possible alternatives, and review their advantages and disadvantages for the stakeholders involved.

GENERAL NETWORK TARIFF STRUCTURES

Tariff structures generally can be reduced to one – or a combination - of the following basic alternatives: capacity tariff or volume tariff.

1) Capacity tariff

- Flat : a fixed charge based on connection capacity (kVA) or measured capacity (kW);
- Variable : different capacity levels with different tariff per level;
- Time of use : different tariffs in line with the available grid capacity (peak / off-peak); only applicable with a smart meter.

2) Volume tariff

- Proportionate : consumers pay per kWh or m^3 consumed, independent of volume level;
- Progressive : the tariff per kWh increases with an increasing consumption level;
- Degressive : the tariff per kWh decreases with an increasing consumption level;
- Time of use : different tariffs in line with the available grid capacity (peak / off-peak); a day/night tariff is possible without smart meter, whereas more complex peak and off-peak tariffs are only possible with smart meter.

These two models represent advantages and disadvantages when confronted with the guiding principles and policy objectives mentioned above:

	Volume (€/kWh)	Capacity (€/kW)
GUIDING PRINCIPLES		
Cost reflectiveness		
Infrastructure cost efficiency		
Operational cost efficiency		
Revenue adequacy		
Transparency		
POLICY OBJECTIVES		
Market functioning		
Distributed generation		
System flexibility		
Energy efficiency		

The detailed analysis of the advantages and disadvantages of both models for DSOs, suppliers and final consumers can be found in annexes 1 & 2.

Apparently, capacity driven tariffs bring the most appropriate answer to the guiding principles for tariff setting.
On the other hand, volume driven tariffs are more in line with the formulated energy and climate policy objectives.

Therefore, hybrid solutions may have to be developed to overcome this apparent contradiction.

3) Multiple component tariffs

Multiple component tariffs are such a possible hybrid solution.

For example industrial and large commercial consumers already today mostly pay a three-component tariff:

1. fixed customer tariff : covering fixed costs (e.g. metering)
2. capacity tariff : covering capacity related costs
3. volume tariff : covering volume related costs

A multiple component tariff, if properly designed, fairly reflects the cost of the service.

OPPORTUNITIES AND CHALLENGES OF TIME OF USE TARIFFS

The main objective of time of use tariffs is shifting consumption to off peak period, by stimulating reduction of peak demand through higher tariffs at peak times.

By varying the grid tariffs, economic incentives promote the efficient use of the network. An important condition for more complex time of use tariffs is that the customer has a smart (time-dependent) meter.

Grid tariffs should be transparent for customers to make an adequate response possible. Higher numbers of time periods lead to more complexity and less transparency for consumers. Pushed to the extreme this would result in real time (dynamic) grid tariffs. Regular customers can not deal with this complexity without automation operated by service providers. Real time grid tariffs will also pose serious challenges for revenue adequacy for DSOs.

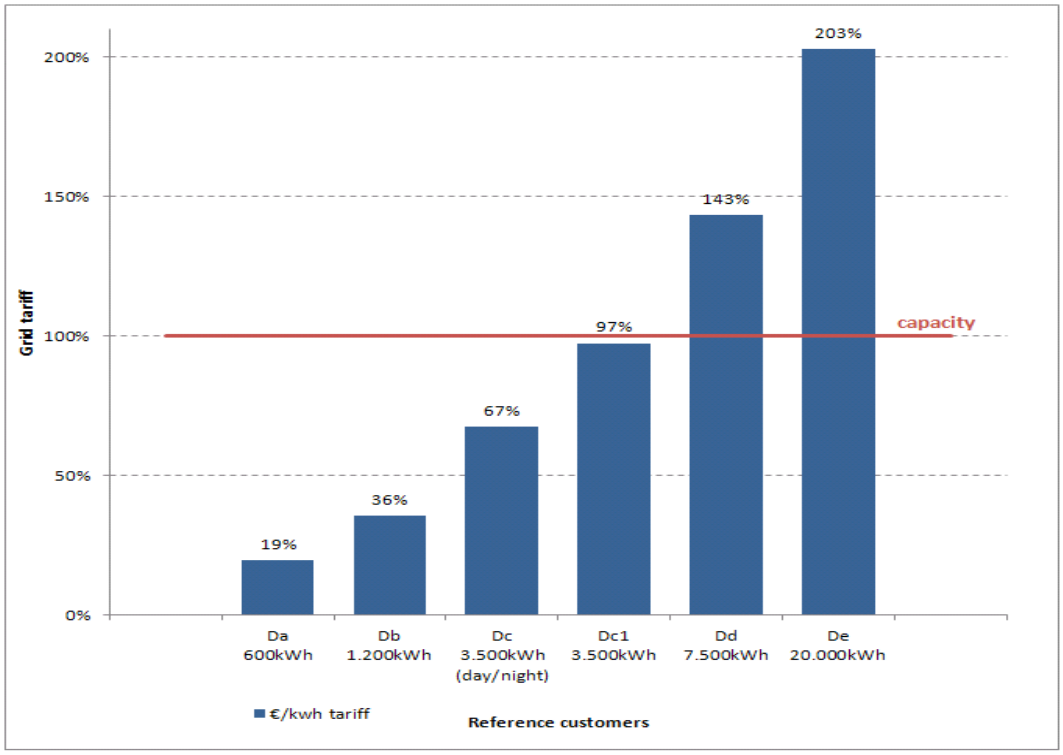
A related issue is the way time of use prices from the supplier will evolve and will be applied, especially at moments in time where adverse signals (to increase or decrease consumption) can be given by diverging time of use grid tariffs and time of use supplier prices.

IMPACT OF THE TRANSITION FROM VOLUME TO CAPACITY TARIFFS

Most countries currently charge distribution costs through volumetric grid tariffs (€/kWh).
When introducing a capacity tariff, customers with low consumption pay considerably more, as capacity tariffs lead to degressive grid tariffs.

The graph below shows the possible impact of the introduction of capacity tariffs for several reference customers defined by Eurostat.

The blue bar reflects the volume based (kWh) grid tariff, the red line reflects 1 single capacity tariff.
The blue bars do not reflect euros, but are expressed as a percentage of the single capacity tariff.



We do note that Da and Db reference customers with a below average consumption profile are not necessarily vulnerable customers, but also include second home owners and customers with a PV-installation that have hardly any consumption due to a reversing (or "net") metering system.

In countries where capacity tariffs are currently applied, instruments have been developed to tackle the financial transition problem for below average consumers.

INSTRUMENTS FOR A BALANCED SOLUTION

1) Hybrid alternative : combining volume and capacity elements

A hybrid alternative combines the advantages and restrictions of both volume and capacity systems. In this case, the grid tariff structure combines two or more components:

- Flat component : fixed payment per customer per year;
- Power component : euro per kW (measured capacity) or per kVA (connection capacity);
- Energy component : euro per kWh (proportionate, progressive or degressive).

In Italy, the electricity distribution grid tariff for household customers consists of these three components : a flat component (€ / point of delivery), a component billing the connection capacity (€/kW), and a progressive energy or volume component (€/kWh).

The gas distribution tariff for household customers consists in Italy – like in many other countries - of a fixed component (€ /point of delivery) and a variable component (€/m^3).
For an average Italian household customer, about 80 % of the bill (for electricity and for gas) is volume related and 20 % capacity based.

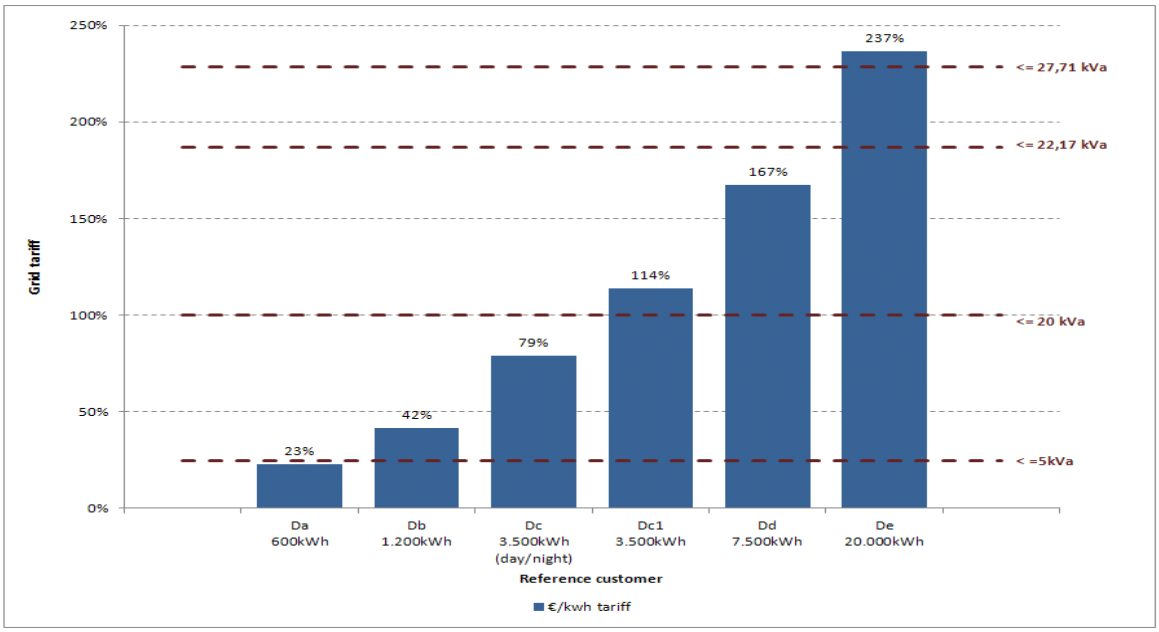
The combination of volume and capacity elements is also currently applied for industrial customers in several countries, like Belgium, France and the Netherlands.

For a complete overview of pros and cons of volume and capacity tariffs, see annexes 1 & 2.

2) Hybrid alternative : progressive capacity tariffs

Another possible alternative is the application of several and progressive capacity tariffs for rising capacity levels.

The blue bar reflects the volume based (kWh) grid tariff.
The dotted red line reflects the capacity tariff in function of different types of connection capacity (kVA). The blue bars do not reflect euros, but are expressed as a percentage of the capacity tariff of the average residential customer.



This alternative grid tariff structure has several advantages:

- Facilitates the transition from volume to capacity model;
- Reduces the financial impact of the transition for the final customer;
- Better orientation of customer choice to the most suitable connection capacity level;
- Can function without smart meters in case of connection capacity.

However, there are several requirements to put this model into practice :

- The exact connection capacity of every individual customers has to be known;
- In case the measured capacity is used, it is only possible with smart meters.

For a complete overview of advantages of capacity tariffs, see annex 2.

3) The Netherlands : energy tax "neutralizing" capacity tariffs

Whereas previously in the Netherlands the distribution tariffs were mainly volume based (77%), in 2009 the capacity tariff was introduced. The invoice differences for household customers caused by the introduction of the capacity tariffs were neutralised as much as possible through the energy tax.

The energy tax had already been introduced in the Netherlands in 1996 to stimulate energy efficiency. The energy tax consists of 2 components : a fixed amount of tax reduction (-199 € in 2008) and a variable amount per kWh (0,0752 €/kwh in 2008). The more energy a household consumes, the higher the price per kWh.

In 2009, the year of the introduction of the capacity tariff, not only the structure of the grid tariffs was changed, but also the energy tax. The fixed amount of tax reduction was increased with (nearly) the same amount of the new capacity based grid tariff. On the other hand, the volume based energy tax was also increased with (nearly) the same amount of the volume based grid tariff of 2008.

In the following table the changes in both grid tariff and energy tax are clarified (based on an average household customer) :

GRID TARIFF + ENERGY TAX	**Tariff 2008**		**Tariff 2009**		**Difference**	
Fixed amount	**-165**	**euro**	**-169**	**euro**	**-4**	**euro**
Grid tariff	34	euro	150	euro	116	euro
Energy tax	-199	euro	-319	euro	-120	euro
Volume based amount	**0,1088**	**€/kWh**	**0,1085**	**€/kWh**	**-0,0003**	**€/kWh**
Grid tariff	0,0336	€/kWh	0	€/kWh	-0,0336	€/kWh
Energy tax (0-10.000 kwh)	0,0752	€/kWh	0,1085	€/kWh	0,0333	€/kWh

This compensation ensures that households with a standard connection continue to pay more or less the same bill.

During a transitional period of 2 years, customers could reduce their connection capacity for a limited amount (50 €) or could receive a single lump-sum compensation. This compensation was mainly applied for exceptional cases (like elevators or outdoor sport fields) with high power (capacity) needs and low annual consumption.

CONCLUSIONS

Ambitious targets for energy efficiency and decentralized renewables deployment have been set in European energy policy.

Distribution grid tariff structures are in most cases still based on the old energy environment, namely with volume tariffs (sometimes 'time of use' with day and night, or peak and off peak tariffs), which is a situation that is mainly inherited from the (former) integrated energy companies.

Capacity tariffs can bring an answer to the challenges that DSOs are confronted with today (with declining and more unpredictable volumes transported on their grids), as the large majority of costs are based on capacity elements (peak capacities for grids and connections), and not on the volume consumed.

At the same time, energy customers must be stimulated to use scarce and polluting energy ever more energy efficiently: to reach this goal volume tariffs are a far better instrument. Progressive tariffs push consumers the most in the energy efficient direction, but come into conflict with a commercial energy market where 'big customers' are used to get a lower price per unit.

Balanced solutions have to be developed for the whole energy chain and for grid tariffs in particular, integrating elements from capacity tariffs and volume tariffs or prices. Issues related to distribution grid tariffs are also influenced by the coincidence with price structures of suppliers, the share of grid costs in the total energy bill and the payment of grid tariffs by (decentralized) generators.

Introducing capacity elements in energy pricing however has very diverging effects for different customer groups. Strictly applied, a single capacity tariff has an outspoken degressive effect on the price per kWh, resulting in severe financial consequences for small consumers (which are not necessarily vulnerable consumers as this category also comprises second residences and prosumers).

To tackle this issue, a multiple component grid tariff structure could be developed that combines fixed and variable elements based on both volume and capacity systems.

As an alternative, several and progressive capacity tariffs could be applied for rising capacity levels.

Another solution that has been applied already introduces the use of a corrective tax (temporary for a transition period, or permanent) to compensate the negative financial effect for below average consumers of switching from variable to capacity tariffs.

As a conclusion, on the scale between 100% volume-based and 100% capacity-based grid tariffs, a solution will have to be developed that is most adapted to the specific situation of different national or regional markets.

At the same time it should find a fair compromise between the possibly diverging interests of (small) consumers, prosumers, DSOs and suppliers of energy and energy services.

CEDEC intends to continue contributing to the clarification of these strategic choices, which will ultimately have to find their translation in adapted regulatory frameworks.

ANNEX 1

Advantages & disadvantages of volume based grid tariffs for DSOs, suppliers and final customers

Volume (€/kWh)

	DSO	Supplier	Final Customer
GUIDING PRINCIPLES			
COST REFLECTIVENESS	The volume transported through the grids does not reflect the real cost driver for the network costs.		The customer does not get the right incentives to allow the DSO to reduce network costs.
INFRASTRUCTURE COST EFFICIENCY	As volume is no correct cost driver for the DSO, a volume based tariff does not provide the correct incentives to limit investments in grid capacity.		Higher grid tariffs due to higher (suboptimal) investment levels in new grid capacity.
OPERATION COST EFFICIENCY	More complex processes for invoicing, switching and moving-out.		Higher grid tariffs due to higher operational costs.
REVENUE ADEQUACY	Volume based tariffs are putting the DSO revenue adequacy at risk. The actual decrease of transported energy caused by accrued energy efficiency efforts and by the spectacular development of distributed generation, result in lower incomes for the DSO, leading to the situation that even approved costs may not be covered. This can only be corrected by an ex-post revenue adjustment by the regulator.		Grid tariff evolutions are less predictable, as budgeted volumes have become more difficult to predict, and ex-post revenue adjustments impact future tariffs.
TRANSPARENCY	More complex processes for invoicing, switching and moving-out.		

	DSO	Supplier	Final Customer
POLICY OBJECTIVES			
MARKET FUNCTIONING	More complex processes for invoicing, switching and moving-out.		
DISTRIBUTED GENERATION			In case of net-metering, the ROI of distributed generation will be higher for prosumers.
SYSTEM FLEXIBILITY		Volume based tariffs offer more possibilities for the development of flexibility services (financial compenstion for lower volume of consumption).	
ENERGY EFFICIENCY	Volume based tariffs promote energy efficiency, as lower consumption leads directly to lower bills.		

ANNEX 2

Advantages & disadvantages of capacity based grid tariffs for DSOs, suppliers and final customers

Capacity (€/kW)			
	DSO	**Supplier**	**Final Customer**
GUIDING PRINCIPLES			
COST REFLECTIVENESS	Capacity is the real cost driver for the network costs. The network is designed to cover peak demand. The lower the capacity required, the lower the network investments will be.		The customer gets the right incentives to allow the DSO to reduce network investment costs.
INFRASTRUCTURE COST EFFICIENCY	As capacity is the correct cost driver for the DSO, a capacity based tariff leads to limited investments in new grid capacity.		Lower grid tariffs due to optimized investments in new grid capacity.
OPERATION COST EFFICIENCY	Invoicing one fixed capacity based tariff per year or month simplifies the invoicing process, and facilitates switching and moving-out.		Lower grid tariffs due to lower operational costs.
REVENUE ADEQUACY	Capacity is more stable to ensure revenue adequacy for the DSO. Changes in capacity are rare for existing customers and gradually for new customers.		More stable grid tariffs, as capacity is more stable, better predictable, and leading to considerably less ex-post revenue adjustments.
TRANSPARENCY	Invoicing one fixed capacity based tariff per year or month simplifies the invoicing process, and facilitates switching and moving-out.		
	DSO	**Supplier**	**Final Customer**
POLICY OBJECTIVES			
MARKET FUNCTIONING	Invoicing one fixed capacity based tariff per year or month simplifies the invoicing process, and facilitates switching and moving-out.		
DISTRIBUTED GENERATION			The ROI of distributed generation will decrease with the introduction of capacity tariffs, as the possibility of net-metering disappears.
SYSTEM FLEXIBILITY		Capacity based tariffs offer less possibilities for the development of flexibility services.	
ENERGY EFFICIENCY	Capacity based tariffs do not promote energy efficiency, as lower consumption does not lead to lower bills.		