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Ljubljana

Dissemination activity 2

Reform of the Slovenian network charging methodology

Instituto de Investigación Tecnológica - IIT

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Introduction
Clean Energy Package

The **network tariff methodologies** developed under this Project are aligned with the EU Clean Energy Package

Regulation (EU) 2019/943
Art. 18: Charges for access to networks, use of networks and reinforcement
Directive (EU) 2019/944
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Regulation EU 2019/943

Art. 18. Charges for access to networks, use of networks and reinforcement

Regulation EU 2019/943 - Art. 18. Charges for access to networks, use of networks and reinforcement

(1) ***Charges applied by network operators*** *for access to networks, including charges for connection to the networks, charges for use of networks, 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 in so far as they correspond to those of an efficient and structurally comparable network operator and are applied in a* ***non-discriminatory*** *manner.*

The method used to determine the network charges shall neutrally support ***overall system efficiency*** *over the long run through price signals to* ***customers and producers*** *and in particular be applied in a way which does* ***not discriminate*** *positively or negatively between* ***production*** *connected at the* ***distribution*** *level and production connected at the* ***transmission*** *level. The network charges shall* ***not discriminate*** *either positively or negatively against* ***energy storage or aggregation*** *and shall* ***not create disincentives*** *for* ***self-generation***, ***self-consumption*** *or for participation in* ***demand response***.

(7) Where Member States have implemented the deployment of ***smart metering systems***, *regulatory authorities shall consider* ***time-differentiated*** *network tariffs to reflect the use of the network, in a transparent, cost efficient and foreseeable way for the final customer.*

Directive EU 2019/944
Art. 15. Active customers

Directive EU 2019/944 - Art. 15. Active customers

*(1) Member States shall ensure that final customers are entitled to act as **active customers** without being subject to **disproportionate or discriminatory** technical requirements, administrative requirements, procedures and charges, and to **network charges that are not cost-reflective**.*

*(2) Member States shall ensure that active customers are (e) subject to **cost-reflective, transparent and non-discriminatory network charges** that account separately for the **electricity fed into the grid and the electricity consumed from the grid** ensuring that they **contribute** in an adequate and balanced way to the **overall cost sharing** of the system.*

*(5) Member States shall ensure that active customers that own an **energy storage** facility **are not subject** to any **double charges**, **including network charges**, for stored electricity remaining within their premises or when **providing flexibility services** to system operators.*

Directive EU 2019/944
Art. 16. Citizen energy communities

Directive EU 2019/944 - Art. 16. Citizen energy communities

1) Member States shall provide that members or shareholders of a ***citizen energy community*** *do not lose their rights and obligations as household customers or active customers, and that citizen energy communities are subject to non-discriminatory, fair, proportionate and transparent procedures and charges, including* ***transparent, non-discriminatory and cost-reflective network charges****, ensuring that they* ***contribute in an adequate and balanced way to the overall cost sharing*** *of the system.*

(3) With regard to ***consumption of self-generated electricity****, citizen energy communities are* ***treated like active customers****, where* ***electricity is shared****, this shall be without prejudice to* ***applicable network charges****, tariffs and levies, in accordance with a* ***transparent cost-benefit analysis of distributed energy resources*** *developed by the competent national authority.*

(4) Member States may decide to grant citizen energy communities the ***right to manage distribution networks*** *in their area of operation and establish the relevant procedures, without prejudice to Chapter IV or to other rules and regulations applying to distribution system operators. If such a right is granted, Member States shall ensure that citizen energy communities are subject to* ***appropriate network charges*** *at the* ***connection points between their network and the distribution network*** *outside the citizen energy community and that such* ***network charges account separately for the electricity fed into the distribution network and the electricity consumed from the distribution network*** *outside the citizen energy community.*

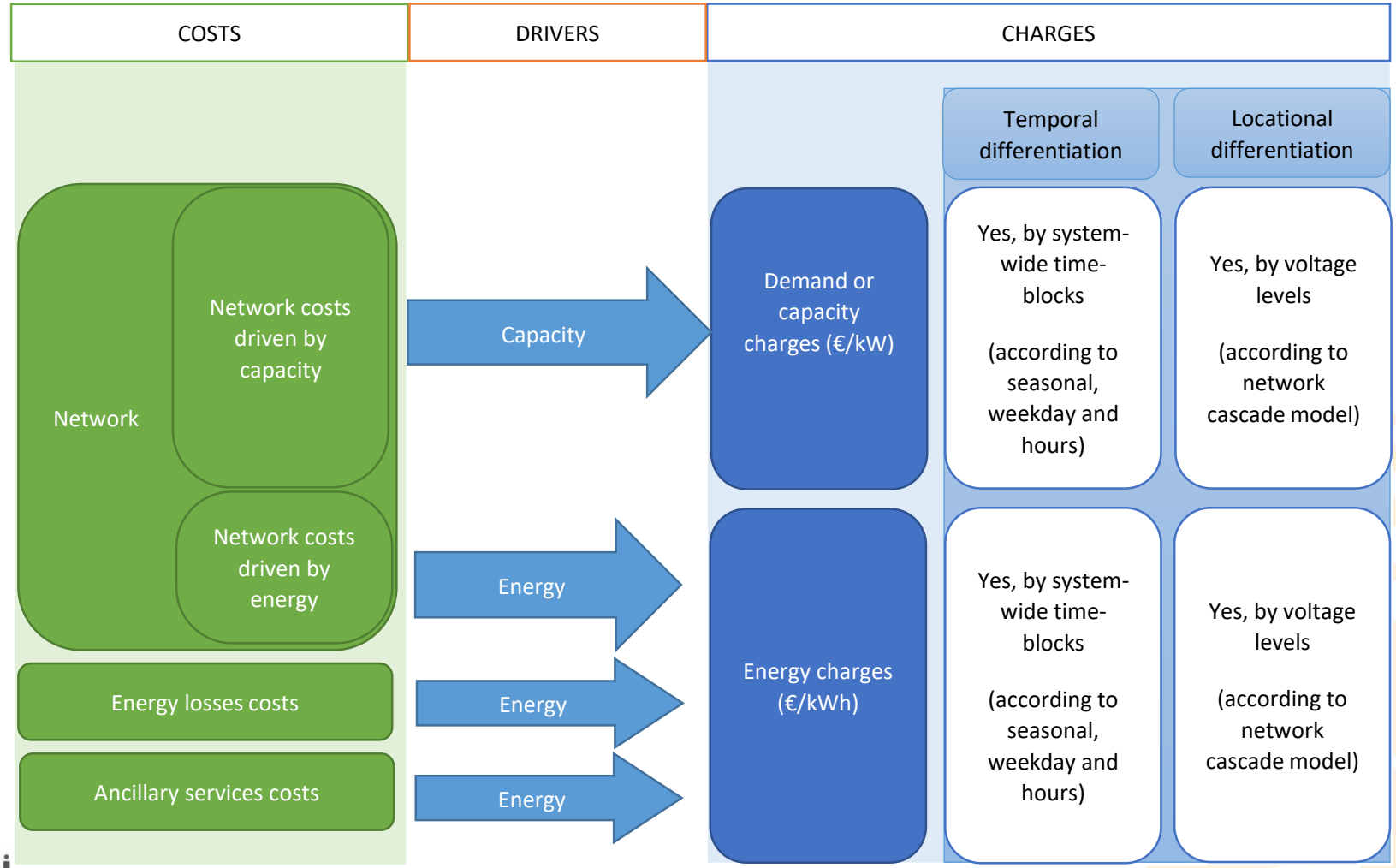
Directive EU 2019/944
Art. 32. Incentives for the use of flexibility in distribution networks

Directive EU 2019/944 - Art. 32. Incentives for the use of flexibility in distribution networks

1.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. In particular, the regulatory framework shall ensure that distribution system operators are able to* ***procure such services from providers of distributed generation, demand response or energy storage*** *and shall promote the uptake of energy efficiency measures, where such services cost-effectively alleviate the need to upgrade or replace electricity capacity and support the efficient and secure operation 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.*

Methodology 1:

ToU capacity and energy charges for withdrawal (generators and injections do not pay charges)



Resulting tariff under methodology 1

Time-blocks: B1 (peak),…,B4 (off-peak)

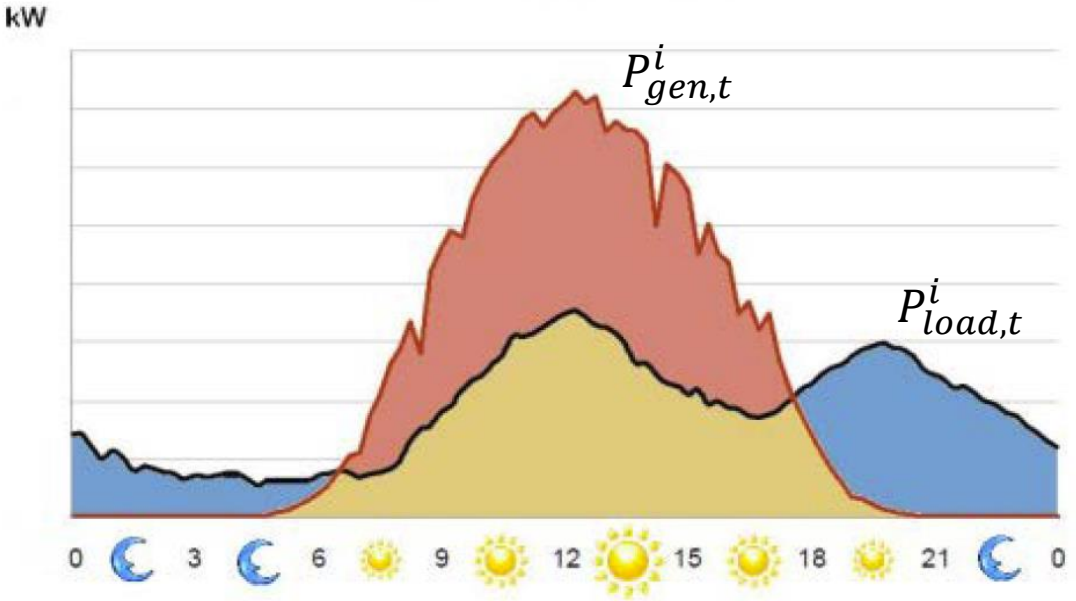
Customer groups	Capacity (€/kW)				Energy (€/kWh)			
	B1	B2	B3	B4	B1	B2	B3	B4
HV customers								
MV customers connected at HV/MV substation								
MV customers								
LV customers connected at MV/LV transformer								
LV customers								

Example of time-blocks

	B1	B2	B3	B4
High season weekday	From 7 to 13h, and from 18 to 20h	From 6 to 7 h, from 13 to 18 h, and from 20 to 22 h		From 22 to 6h
Low season weekday		From 7 to 15h	From 6 to 7h, from 15 to 22h	From 22 to 6h
Weekends and holidays				All hours

Active customers with self-consumption under methodology 1

- **Active customers with own self-generation behind the meter**. These are treated as **consumers**, only face their corresponding **capacity and energy charges** according to the **net metered withdrawal (15 min or 1-hour samples).**



i: consumer

$$P^i_{net,t} = P^i_{load,t} - P^i_{gen,t}$$

If $P^i_{net,t} > 0$, i pays network charges

Energy communities under methodology 1

Active customers as part of an energy community with shared generation units connected at the same local network (voltage level). It is assumed that the network is not owned by the energy community. The energy produced is shared among energy community customers as if they were self-consuming. These customers face in each time-block an energy network charge composed of

1. a **regular energy charge** applied to the net consumption (**total consumption less assigned self-generation in 15 min samples**),
2. a **reduced energy charge applied to the assigned self-generation**. This reduced energy charge accounts only for the network usage made by the connection between the generation units and the consumers within the energy community (at the same voltage level and ignoring the costs of transmission from upper voltage levels).
3. The **corresponding contracted capacity charge** associated to the net consumption

$$P_{gen,t} = \sum_i P^i_{gen\_assigned,t}$$

$$P^i_{load,t}$$

$$P^i_{net,t} = P^i_{load,t} - P^i_{gen\_assigned,t}$$

If $P^i_{net,t} > 0$ pay network charges

If $P^i_{gen\_assigned,t} > 0$ pay energy network charges of the voltage level where the community is located

Active customers providing flexibility services under methodology 1

- Customers will be charged according to the **net withdrawal profile** in their supply connection point
- In the case that customers offer the provision of flexibility services, they may incur in **extra-costs with respect their baseline**. In this case, they will have to **internalize those costs in their bids** when providing flexibility services, including extra-costs related to network charges, or their participation in the energy markets (intraday or balancing)
- Art. 32 of Directive EU 2019/944 mandates DSOs to procure flexibility services under **market-based procedures**

Summary of Methodology 1

- **Producers and injections** into the grid coming form active customers **are not charged**, but neither rewarded.
- Methodology 1 is only justified while the **penetration of distributed generation or active customers** is **marginal**.
- Therefore Methodology 1 is proposed as a **transition** between the current method and Methodology 2, which is more cost-reflective, but more complex.
- **Time of use** capacity and energy charges promote efficient development of **electric vehicle charging**
- **Time of use** withdrawal capacity and energy charges promote **self-consumption and energy communities with no injection** to the grid ⇒ Promotion of **storage** in this type of installations

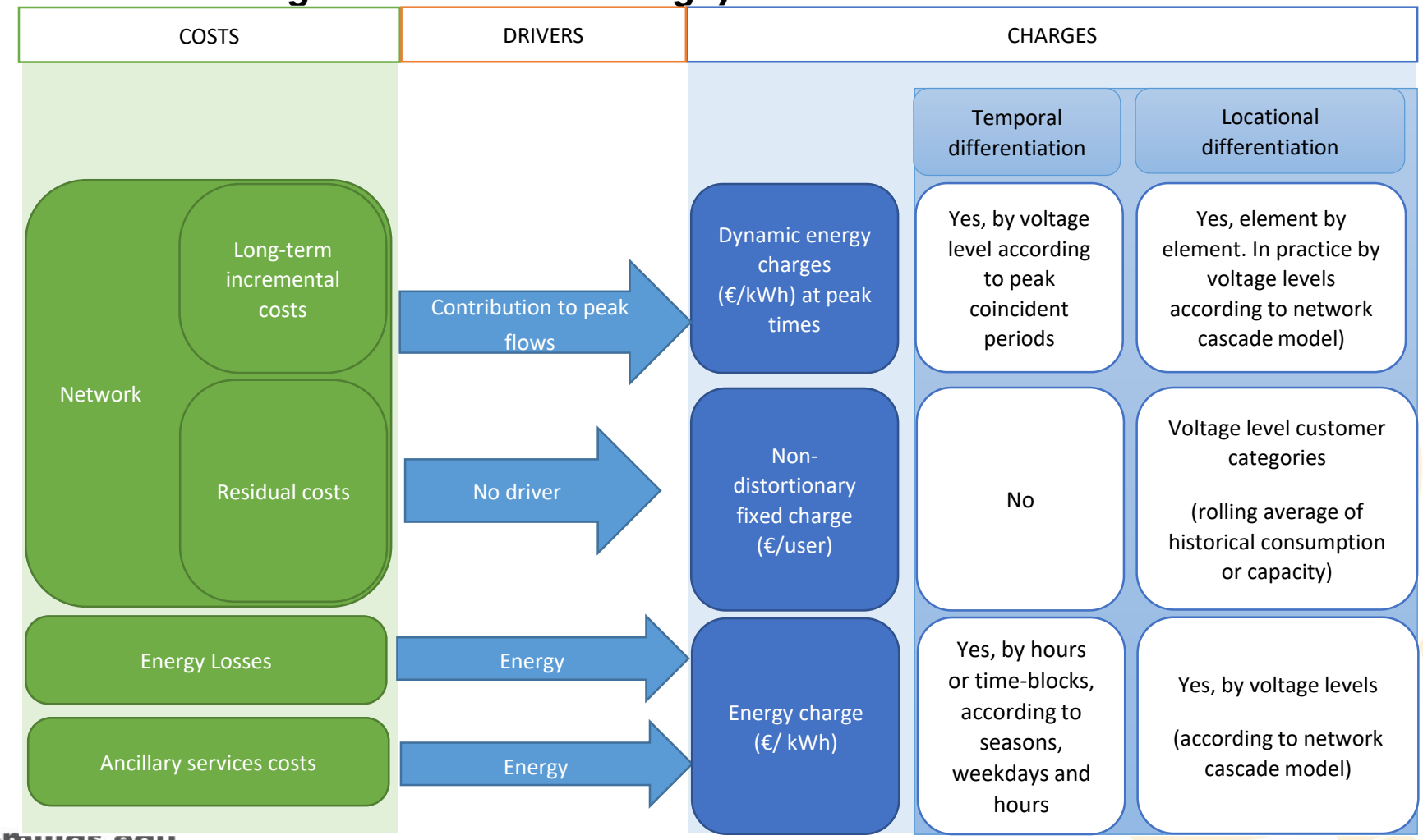
Customers without smart-meters

- For the case of LV customers without smart metering, a simplified **capacity and energy tariff with no time-blocks** is calculated as the aggregation of the different terms calculated for regular LV tariffs is applied.

- LV customers without smart-meters would face:
  - **one contracted capacity** term, assuming that the contracted capacity is the same for all time-blocks, calculated as the sum of all the time-block capacity charges for regular LV tariffs,
  - and **one energy term** (or two, depending on the electromechanical meter) calculated as the weighted average of energy time-block charges for regular LV tariffs.

Methodology 2:

Forward-looking peak coincident (symmetric for withdrawal and injection) and fixed residual charges (to customers, neither to generators nor storage)



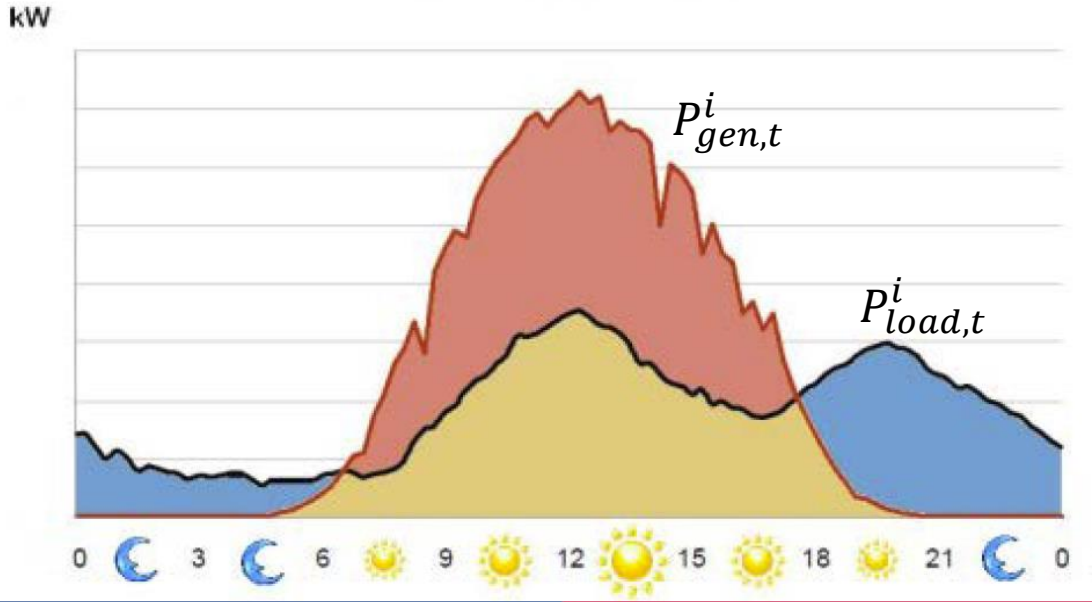
Resulting tariff under methodology 2

Customer groups	Residual (€/kW contracted, or €/kWh of historical consumption)	Peak-coincident + Energy losses + Ancillary services (€/kWh)				
		Type of day d				
		H1	H2	H3	…	H24
HV customers						
MV generation connected to HV/MV substation	-					
MV customers connected to HV/MV substation						
MV generation	-					
MV customers						
LV generation connected to MV/LV transformers	-					
LV customers connected to MV/LV transformers						
LV generation	-					
LV customers						

Active customers with self-consumption under methodology 2

Customers with self-generation are treated according to **their net withdrawal or injection into the network** in their **supply points**

- For the **energy withdrawn** from the network in their respective supply points they are **charged/rewarded the applicable peak-coincident charge**
- For the **energy injected** into the network in their respective supply points they are **charged/rewarded the applicable peak-coincident charge**
- **Residual charges** are applied to **active customers** according to the proposed methodology, based on their **contracted capacity**, their **historical consumption**, or income level.



i: consumer

T^i_t: peak coincident energy charge

$$P^i_{net,t} = P^i_{load,t} - P^i_{gen,t}$$

If $P^i_{net,t} > 0$, i is charged $T^i_t * P^i_{net,t}$

If $P^i_{net,t} < 0$, i is rewarded $T^i_t * P^i_{net,t}$

Energy communities under methodology 2

Customers forming an energy community (active consumers, producers or others) are treated according to **their net withdrawal/injection profile** in their **own supply points**

- For the **energy withdrawn** from the network in their respective supply points consumers belonging to an energy community are **charged/rewarded the applicable peak-coincident charge**
- For the **energy injected** into the network in their respective supply points, production units belonging to an energy community are **charged/rewarded the applicable peak-coincident charge**
- **Residual charges** are applied to **consumers belonging to an energy community** according to the proposed methodology, based on their **contracted capacity**, their **historical consumption**, or income level.

i: consumer j: producer

$P^{i}_{load,t}$ $P^{j}_{gen,t}$

T^{i}_{t}: peak coincident energy charge at supply point i

T^{j}_{t}: peak coincident energy charge at supply point j

If $P^{i}_{load,t} > 0$, i is charged $T^{i}_{t} * P^{i}_{load,t}$

If $P^{j}_{gen,t} > 0$, j is rewarded $T^{j}_{t} * P^{j}_{gen,t}$

Active customers providing flexibility services under methodology 2

- Customers forming an energy community (active consumers, producers or others) will be charged according to the **net withdrawal/injection profile** in their supply connection point
- In the case that customers offer the provision of flexibility services, they may incur in **extra-costs with respect their baseline**. In this case, they will have to **internalize those costs in their bids** when providing flexibility services, including extra-costs related to network charges, or their participation in the energy markets (intraday or balancing)
- Art. 32 of Directive EU 2019/944 mandates DSOs to procure flexibility services under **market-based procedures**

Summary of Methodology 2

- Methodology 2 for cost-reflective charges **does not discriminate among producers or consumers**, among withdrawals and injections into the grid.
- **Residual charges** are only allocated to **consumers**
- **Hourly differentiated network charges** efficiently signal the network impacts of injections and withdrawals, such as those caused by **electric vehicles, self-consumption, or energy storage**.
- **Energy communities** are treated as regular customers, as independent **active customers and producers** causing injections or withdrawals
- For the sake of facilitating the practical application, **time-blocks could be applied** defining typical days along the year and joining those hours with similar charges after the forward-looking charges calculation
- Customers without smart-meters could be treated as in Methodology 1, where charges are joined to one single charge. In this case, **customers without smart-meters** would face **one energy charge and one residual charge**

Thank you very much

Questions?

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Renewable energy communities

- Directive EU 2018/2001 on renewable energy
  - Renewable energy community is a legal entity:

a) based on **open and voluntary participation**, is autonomous, and is effectively controlled by shareholders or members that are located in the proximity of the **renewable energy projects that are owned and developed** by that legal entity;

b) the shareholders or members of which are **natural persons**, **SMEs** or **local authorities**, including **municipalities**;

c) (c) the primary purpose of which is to provide **environmental**, **economic** or **social community benefits** for its shareholders or members or for the local areas where it operates, **rather than financial profits**

Renewable energy communities

- Directive EU 2018/2001 on renewable energy
  - Renewable energy communities **should be able to share between themselves energy** that is produced by their community-owned installations. However, community members should **not be exempt from relevant costs**, charges, levies and taxes that would be borne by **final consumers** who are not community members, **producers** in a similar situation, or where **public network infrastructure is used** for those transfers.
  - **Cost-reflective network charges**, as well as relevant **charges**, **levies and taxes**, ensuring that **they contribute**, in an adequate, fair and balanced way, to the **overall cost sharing of the system** in line with a transparent cost-benefit analysis of distributed energy sources developed by the national competent authorities.
  - Member States shall take into account **specificities** of renewable energy communities when designing **support schemes** in order to allow them to compete for support on an **equal footing** with other market participants

Citizen energy communities

- Directive EU 2019/944 on internal market for electricity
  - citizen energy community is a legal entity that:

a) is based on **voluntary and open** participation and is effectively controlled by members or shareholders that are **natural persons**, **local authorities**, including **municipalities**, or **small enterprises**;

b) has for its primary purpose to provide **environmental**, **economic** or **social community benefits** to its members or shareholders or to the local areas where it operates **rather than** to generate **financial profits**; and

c) (c) may engage in **generation**, including from **renewable** sources, **distribution, supply, consumption, aggregation, energy storage, energy efficiency services or charging services for electric vehicles** or provide other energy services to its members or shareholders;

Citizen energy communities

- Directive EU 2019/944 on internal market for electricity
  - **cost-reflective network charges** in accordance with Article 18 of Regulation (EU) 2019/943, ensuring that **they contribute** in an adequate and balanced way to the **overall cost sharing** of the system.
  - where **electricity is shared**, this shall be without prejudice to applicable **network charges, tariffs and levies**, in accordance with a transparent cost-benefit analysis of distributed energy resources developed by the competent national authority.
  - If CECs are granted the **right to manage distribution networks** in their area of operation, they should be “subject to appropriate **network charges at the connection points** between their network and the distribution network outside the citizen energy community”.

Introduction
Some comparisons from ACER review on D-tariff

Tariffs for injection

Transmission injection charges to recover transmission costs	Transmission injection charges to recover both transmission and distribution costs	Distribution injection tariffs to recover only distribution costs
DK, IE, PT, RO	AT, BE, FI, FR, SK, SE	EE, LT, LU

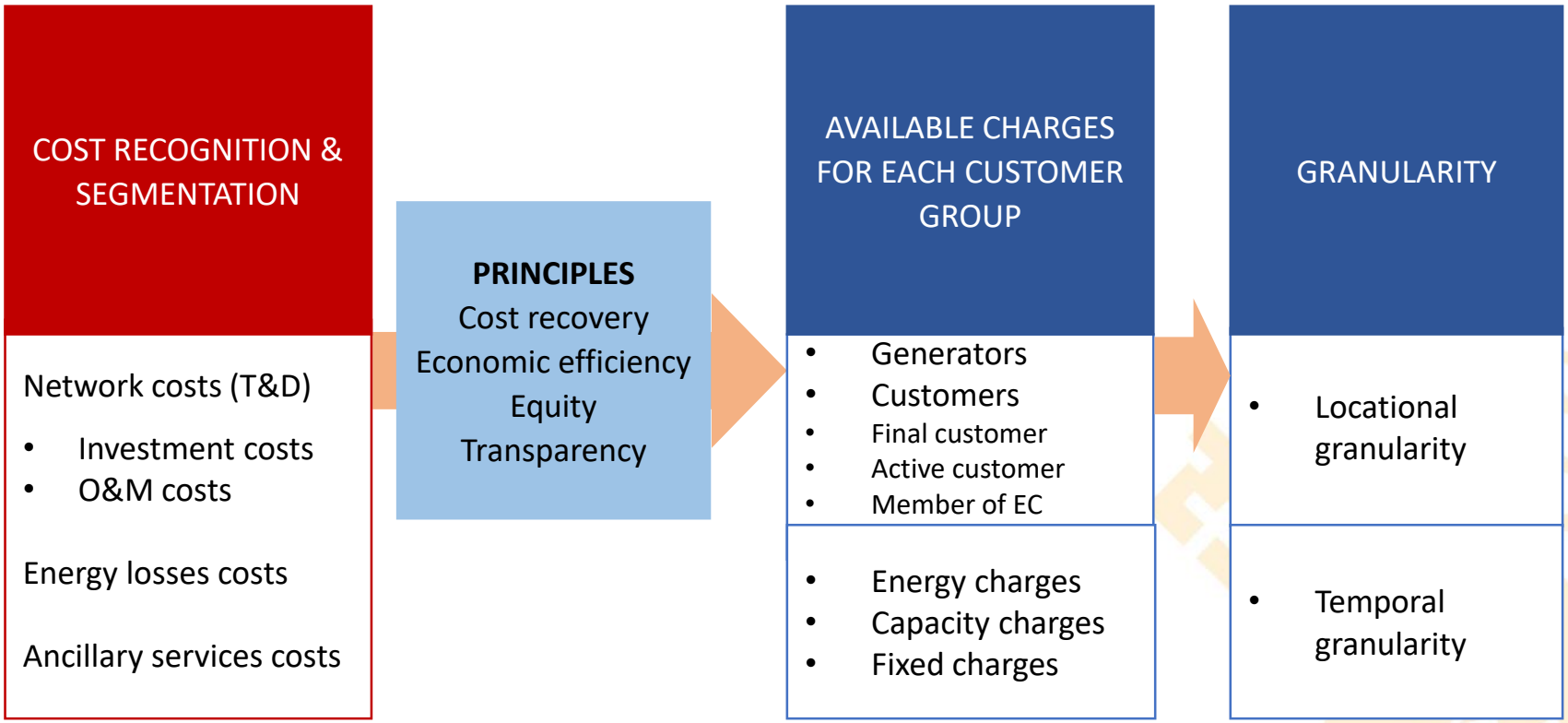
Basis for withdrawal tariffs (all MS)

Energy based	Energy + lump sum	Power + lump sum	Energy + Power	Energy + Power+ lump sum
CY, LT, RO for all, BE(Fl), BG, CZ, EE, IE, IT for some	DK for all, AT, BE (Br), EE, FI, DE, HU, IE, LU, SE for some	IT: for most users	HR, CZ, GR, LV, PT, SK, SI, ES, BE (Wa) for all AT, BE(Br, Fl), BG, EE, DE, LU for some	FR, MT, NL, PL for all EE, FI, HU, IE, SE: for some

Basis for power-based withdrawal charges

Actual maximum power	Actual power at specified time (e.g. peak periods)	Contracted or rated power	Others
BE, DK, MT, SE	HR, GR (for MV only)	CZ, FR, GR (for LV only), LV, PL, SK	NL, PT, ES

Methodology for network charging



Slovenian current network tariffs

1. Cost allocation to customer groups according to estimated contribution to system peak

2. Allocation to energy and capacity charges

3. Allocation to day-night charges

Customer group			Tariffs*			
Voltage level	Type of connection	Load factor	Capacity (EUR/kW/month	Consumed energy (EUR/kWh)		
				VT	MT	ET
HV (VN)		T ≥ 6,000 hr				
		6,000 > T ≥ 2,500 hr				
		T < 2,500 hr				
MV (SN)	Busbar MV	T ≥ 2,500 hr				
		T < 2,500 hr				
		T ≥ 2,500 hr				
		T < 2,500 hr				
LV (NN)	Busbar LV	T ≥ 2,500 hr				
		T < 2,500 hr				
		T ≥ 2,500 hr				
		T < 2,500 hr				
		charging EV				
		Without power measurement				
		household				

Introduction to proposed methodologies

First alternative: Methodology 1

- The first methodology will be focused on **improvements of the current methodology** to become more **cost reflective**
- based on available data and searching **cost drivers,**
- implementing **capacity and energy charges**
- with **time-of-use differentiation**.

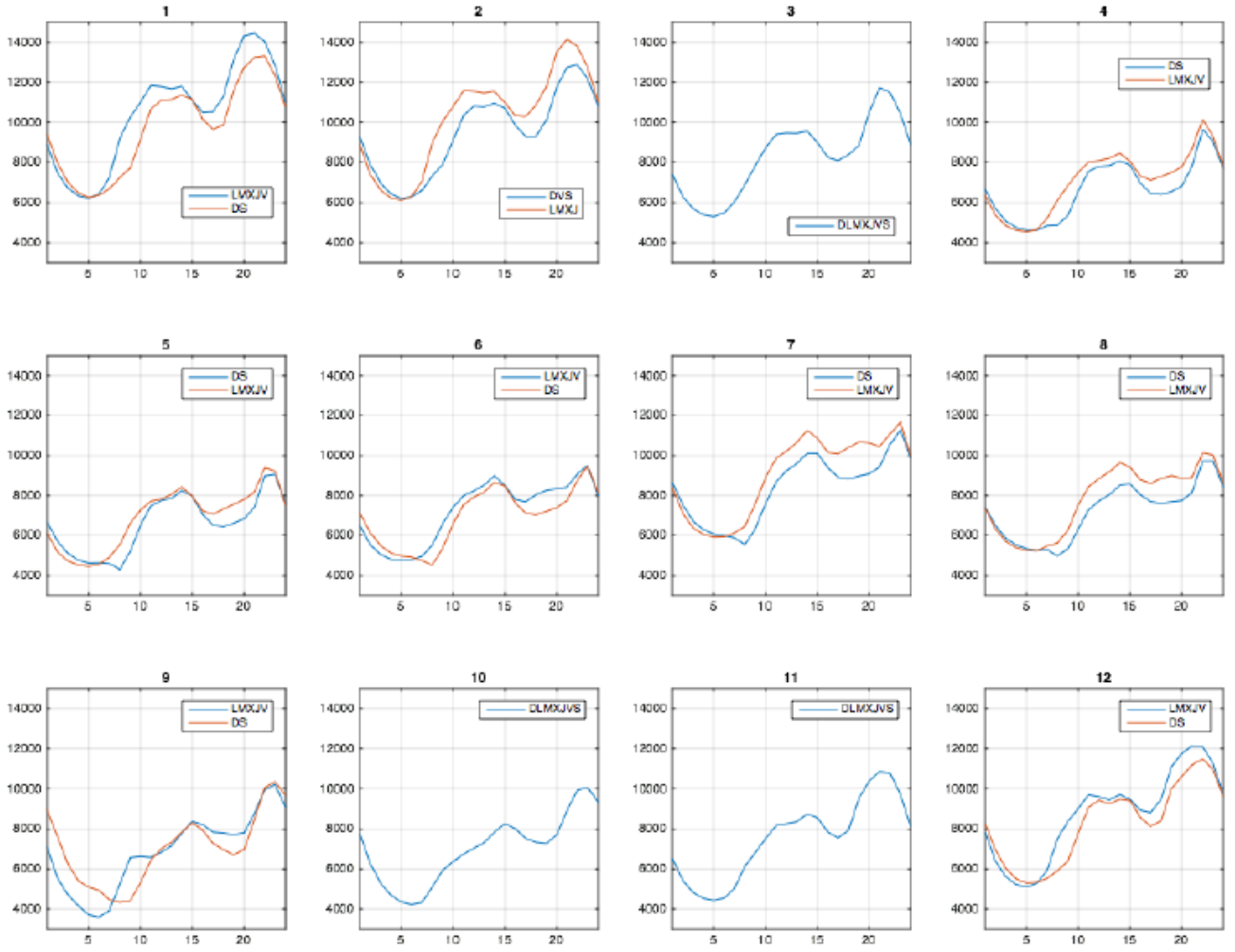
Second alternative: Methodology 2

- The second methodology will be focused on a **long-term** perspective,
- which could require a large amount of currently **unavailable data** and computational burden.
- implementation of forward looking **peak-coincident charges** based on more **dynamic** time of use discrimination
- and the use of **fixed charges** for allocating **residual network costs**

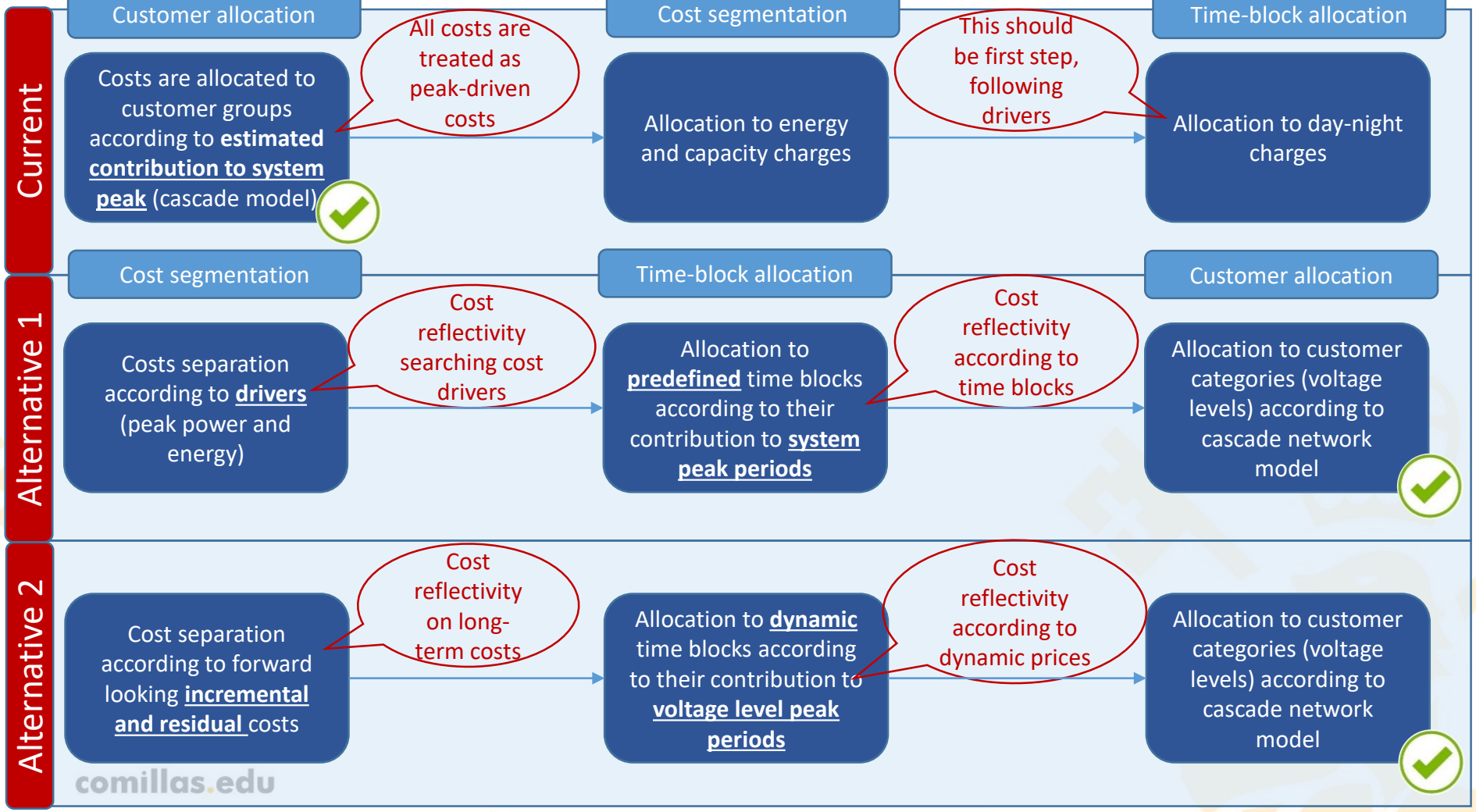
Determination of Time-blocks

Example of clustering for network usage in Spain

Clustering techniques are able to classify network usage under different time periods, and therefore can identify different time blocks per seasons, days, hours, 15-min within a day. This can be applied for whole network, or for voltage levels.



Alternatives for allocation of network asset costs



Alignment of methodologies and principles

Principles	Current	Alternative 1	Alternative 2
Cost-reflectivity	According to system peak	According to cost drivers	According to forward-looking costs ✓
Equity			✓
Simplicity and implementation barriers	✓	✓	
Transparent methodology	✓	✓	✓
Active customers efficiently integrated		✓	✓
Energy communities efficiently integrated		✓	✓

Methodology 1:
Contracted capacity and excess demand over contracted capacity

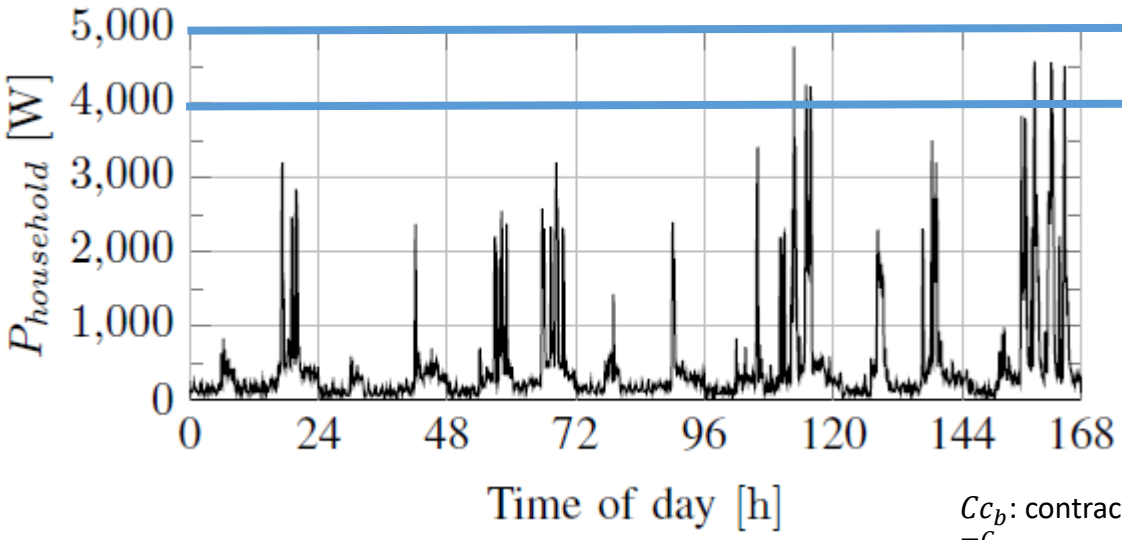
Contracted Capacity payment for time block b

$$Cc_b * T^C_{i,b}$$

Contracted Capacity= 5kW

Contracted Capacity= 4kW and excess demand = 1.21 kW

$$T^C_{Ex,b} * \sqrt{\sum_{j=1}^{n} (Cd_{j,b} - Cc_b)^2}$$

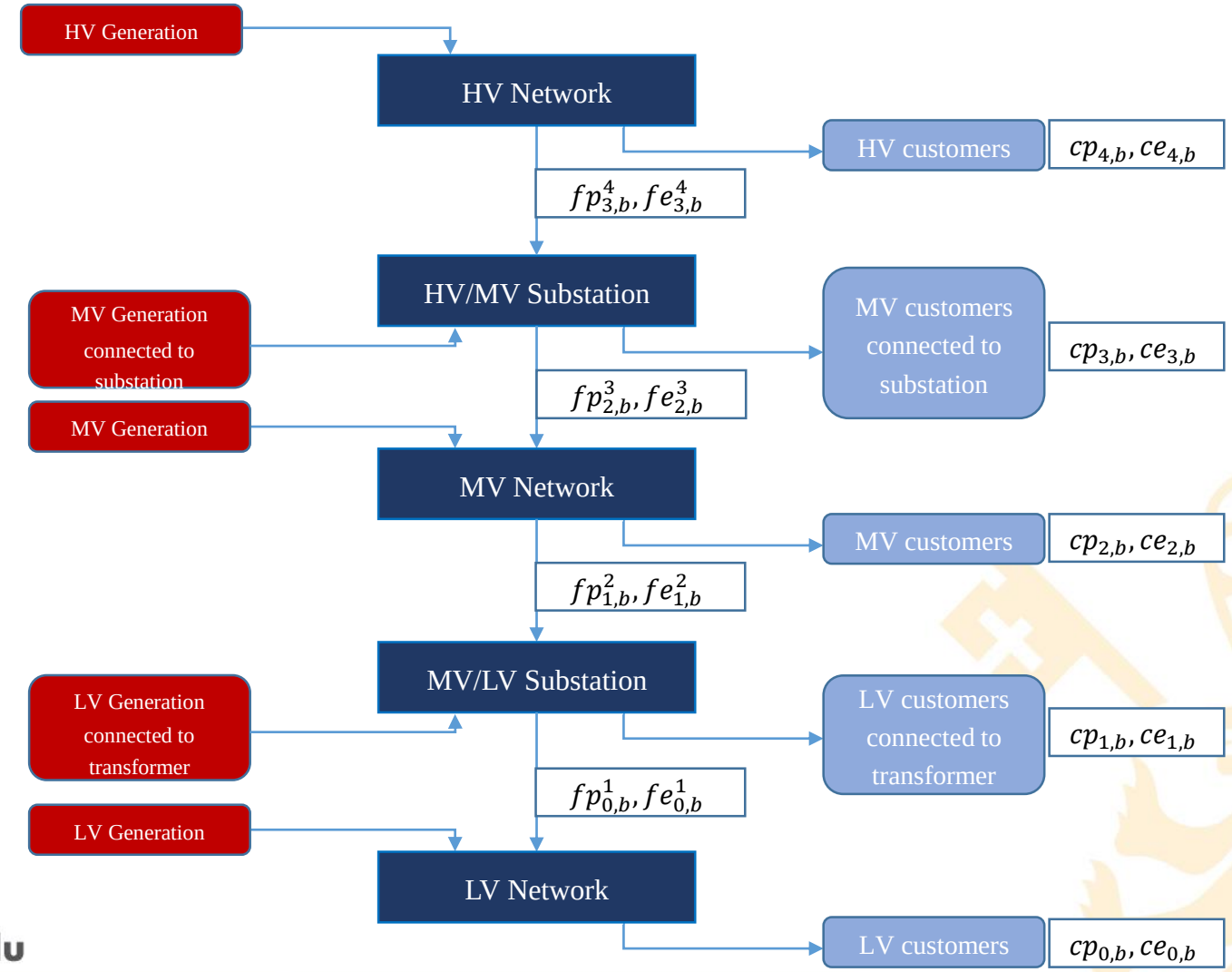


$$Capacity\ payment = contracted\ capacity\ payment + excess\ capacity\ payment$$

Excess demand = sqrt(0.8^2+2*0.2^2+3*0.5^2)=1.21 kW

Cc_b: contracted capacity for the customer at time-block b, in kW
$T^C_{i,b}$: contracted capacity tariff (€/kW) for voltage level i, and time-block b
$T^C_{Ex,b}$: cumulative excess demand charge at time-block b (€/kW), which is equal to the capacity charge for time block b and voltage level i, multiplied by an additional factor, for instance 1.2.
$Cd_{j,b}$: maximum demand consumed by the customer, in kW, for each 15-min sample when contracted capacity is exceeded in time-block b
n: total number of 15-min samples when contracted capacity is exceeded

Cascade model for Methodology 1



Methodology 1. Model for network cost allocation to capacity & energy

- Conceptual Model
  - Allocation of network costs TOTEX as CAPEX (return on investment + annual depreciation of network installations) + OPEX (operation & maintenance costs of network installations)
  - Allocation to capacity & energy based on network design criteria following the cost causality principle

Methodology 1. Model for network cost allocation to capacity & energy

- Conceptual Model
  - Allocation to capacity
    - Cost of the optimal adapted network to supply instantaneous peak demand, i.e. minimum size conductors and radial topology in LV and MV networks
  - Allocation to energy
    - Incremental cost resulting from the optimal adapted network to supply the instantaneous peak demand plus the associated energy along 8760h. Two effects:
      - Due to energy losses, the optimal size of conductors is thicker than the one to supply the peak demand
      - Reliability investment and expenses (network loops, switching equipment, maintenance crews) are associated to energy due that supply interruptions happen along the whole year
  - The obtained results for optimal adapted networks are applied in the same proportion to the cost of the existing networks
  - References

Rodríguez MP, Pérez-Arriaga JI, Rivier J, Peco J (2008) Distribution network tariffs: a closed question? Energy Policy 36:1712–1725

J. Reneses, M. Rodríguez, I.J. Pérez-Arriaga, **Electricity tariffs**, in *Regulation of the power sector. Power systems, 61*. Editors Pérez-Arriaga, I.J.. Ed. Springer. London, United Kingdom, 2013.

Definition of peak hours in methodology 2

- Peak hours are defined as the ones in which the expected load growth would overload the system beyond its security limits = estimated as the number of hours in which the existing load overpass a specific threshold (set according to the level of current network utilization)