End-user tariff design time granularity

Theoretical and practical lessons to be learnt (focus on the residential side)

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PERÍODOS HORÁRIOS NO SETOR ELÉTRICO EM PORTUGAL CONTINENTAL
ConvERSE, Lisbon, January 15, 2026

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Spoiler alert

Balancing efficiency and social awareness

- **The crucial respect for the basic principles**
  - Economic efficiency (LRMC & residual costs)

    métrica do custo incremental das redes?

  - Additivity

    alinhamento entre a utilização das redes e os preços de energia em mercado

    · Voltage control costs!

- **Insignificance, ignorance, indifference, countereffect**

o lado, no caso do **Cliente Ativo**, o benefício

traduzindo-se em poupanças entre 1,95%

Spoiler alert (ii)

Balancing efficiency and social awareness

- Enhance energy literacy, not for today, but for tomorrow

[Bonus track, beyond network charges]

- Do not protect me, please!

TOU network tariffs

The basic principles

Additive Tariffs in the Electricity Sector

I. Apolinário, N. Felizardo, A. Leite Garcia, P. Oliveira, A. Trindade, P. Verdelho

In order to promote economic efficiency the tariff prices should be equal to the respective marginal or incremental associated cost. However with prices equal to the respective marginal costs the allowed revenues may not be recovered.

The corollary is that if the different activity tariffs are cost reflective and promote efficiency in resource allocation, the tariffs applicable to consumers (access tariffs or integral tariffs) will also reflect costs in the same manner. Therefore, besides economic efficiency, equity between non binding

Spain 2008

TOU network tariffs

Capacity Charge of Network Tariffs: the Spanish case

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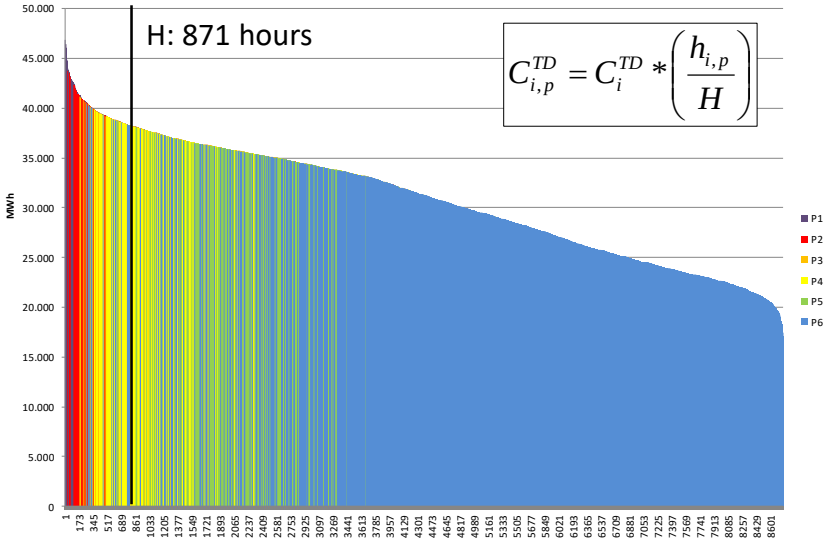
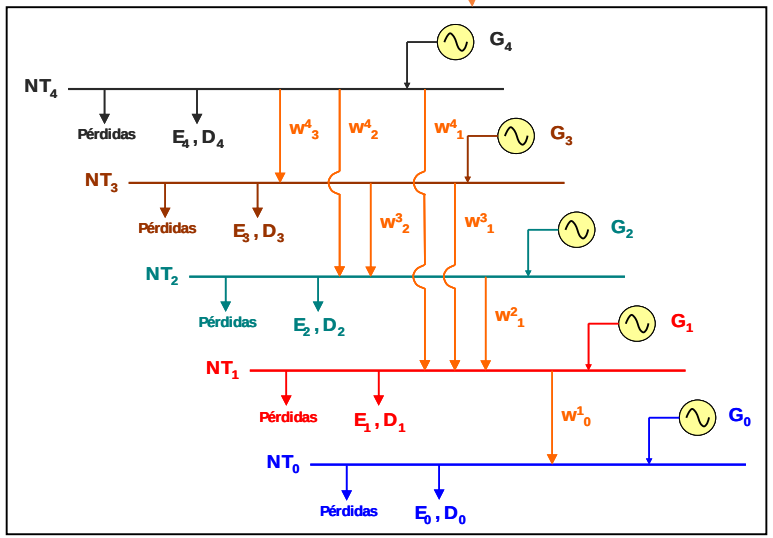
- Allocation methodology
  - Phases of the methodology
    1. Allocation to capacity and energy charge: Reference network model
    2. Allocation to TOU, based on peak participation
    3. Allocation to voltaje level, based on a simplified network model

$$C_{i,p}^{TD,NTj} = C_{i,p}^{TD} * \alpha_{j,p}^{i}$$





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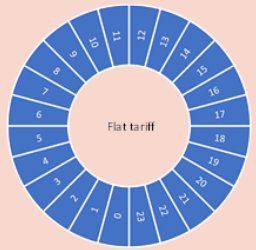
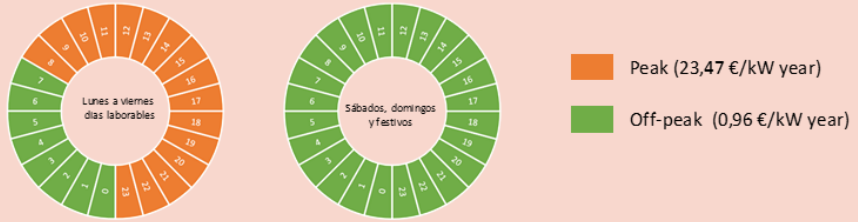
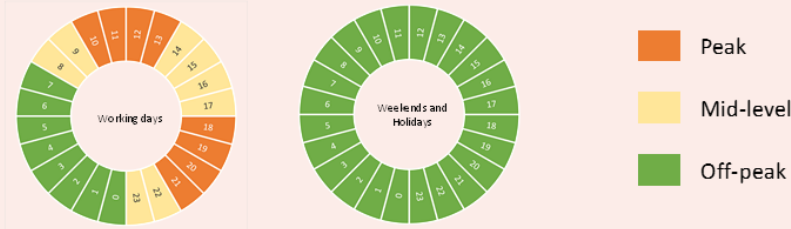
Spain 2014 onwards

Access to the system fee

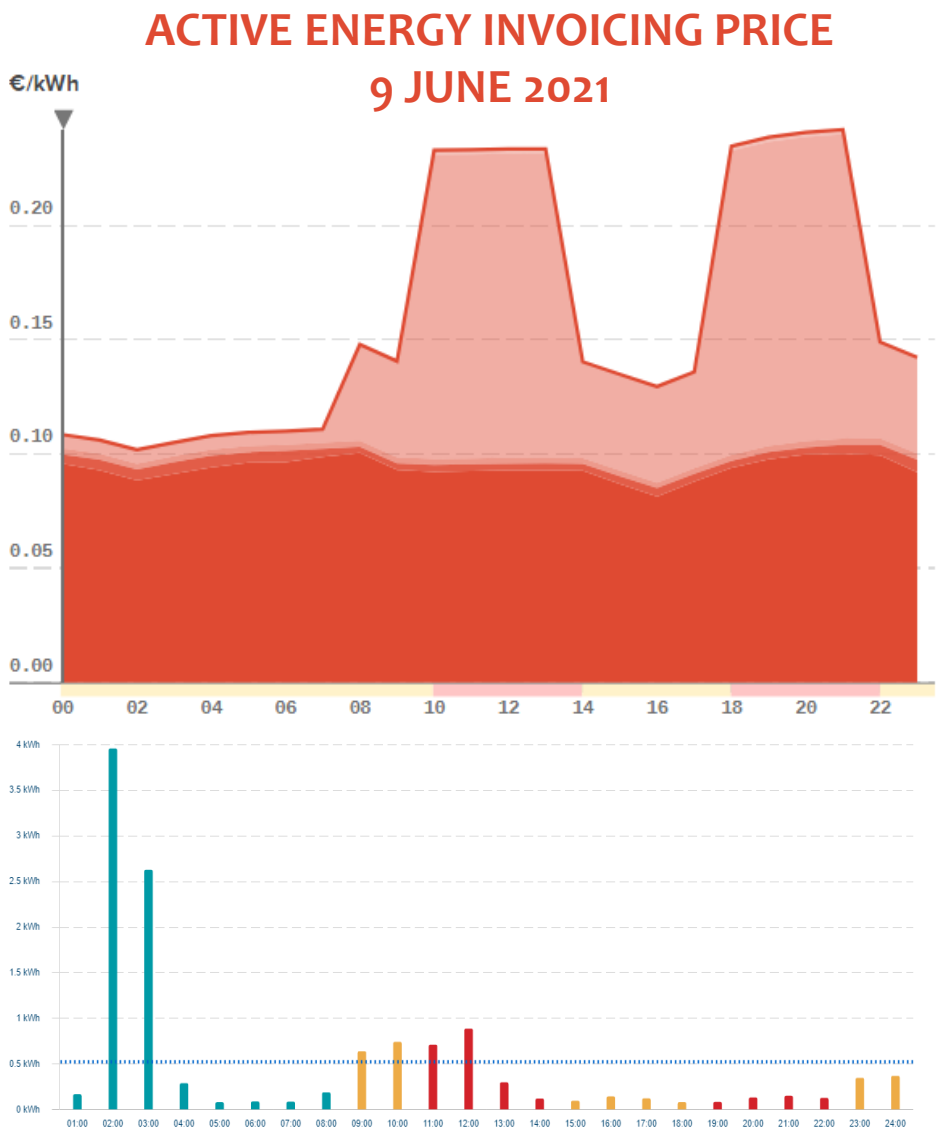
Household network tariffs: before and after

Before 1 June, 2021	1 June, 2021 onwards
Capacity ➢ No diferentation 	**Capacity** ➢ **Mandatory**: two-period tariff. The power demanded is much more expensive in peak hours than in off-peak hours 
Energy ➢ **Voluntary**: the consumer can choose not to differentiate or differentiate in two or three time periods  (*) In summer it is delayed an hour	**Energy** ➢ **Mandatory**: Three-period tariff 

PVPC 2.0

Long in the short

20 €/MWh



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Spain 2014 onwards

Lessons from the pioneering experience

Balancing socio-political acceptance and economic efficiency of electricity price signals for residential end users: lessons from the pioneering Spanish experience.
Working Paper IIT-24-286WP, first version: February 2023; this version: September 2024.

BALANCING SOCIO-POLITICAL ACCEPTANCE AND ECONOMIC EFFICIENCY OF HOURLY ELECTRICITY PRICES FOR RESIDENTIAL END USERS: LESSONS FROM THE PIONEERING SPANISH EXPERIENCE

Batlle, C. [a,b], Rodilla, P.[a], Navarrete, D. M.,[a] Bello, A.[a], Mastropietro, P.[a]

[a] Instituto de Investigación Tecnológica, Universidad Pontificia Comillas, Sta. Cruz de Marcenado 26, Madrid, Spain.
[b] Florence School of Regulation, Florence, Italy and MIT CEEPR, US.

Abstract

The activation of residential electricity end users would be a key tool to facilitate a more efficient and cost-effective decarbonization of the power system, but it cannot happen if time-granular price signals are not properly designed, balancing short-term economic efficiency with the enduring political and social view of electricity as an essential service.

In 2008, Spain's National Energy Commission proposed a groundbreaking default tariff to expose nearly 30 million households to hourly market prices and time-of-use charges. By 2014, the government began gradual reforms inspired by this proposal. Controversy peaked during the 2021–23 energy crisis, leading to another reform, supposedly aimed at protecting end users against undesired impact of price crisis of that nature.

We develop and in-depth critical review of the evolution of this default tariff—a unique real-world case of full household exposure to accurate price signals—analyzing consumer and political reactions, quantifying via a detailed numerical back testing the actual efficiency of the different designs and exploring alternatives for future-proof tariff design.

1 INTRODUCTION

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Spain 2014-2021

TOU network tariffs

Time-of-Use Network Tariffs: the Spanish case

Background

- **The price signal has worked quite well**

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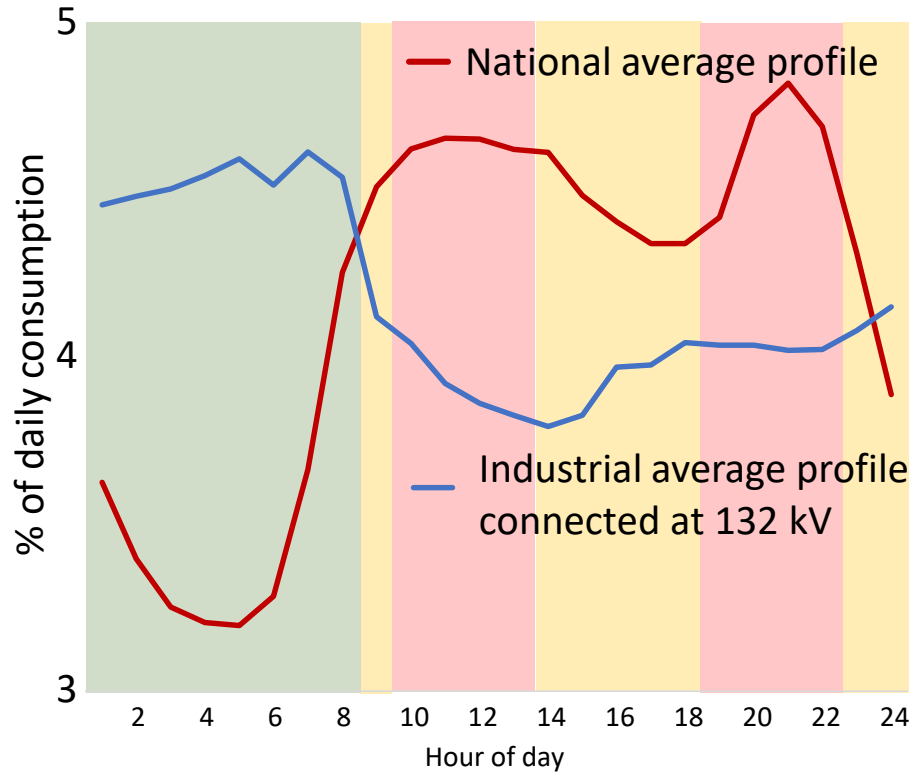
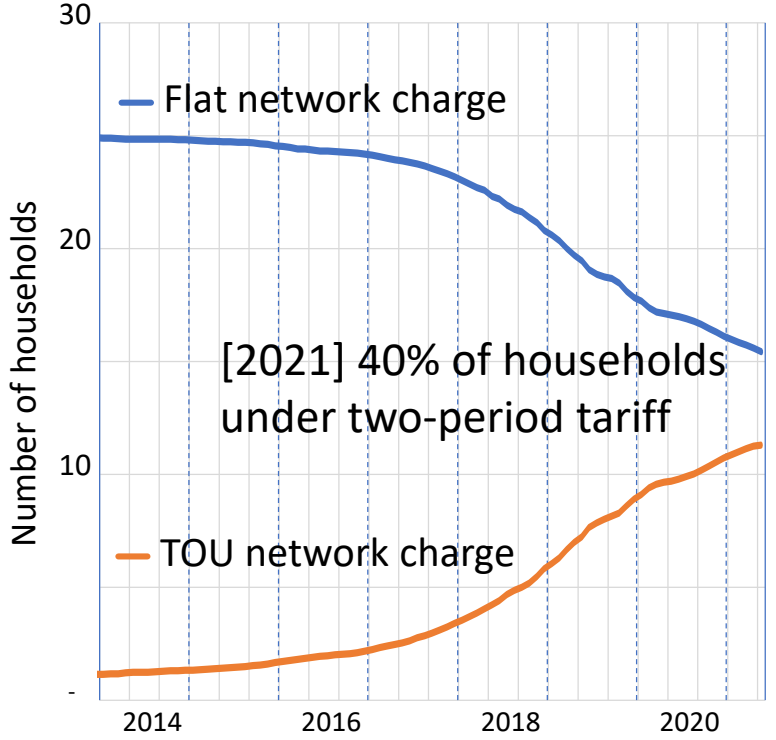
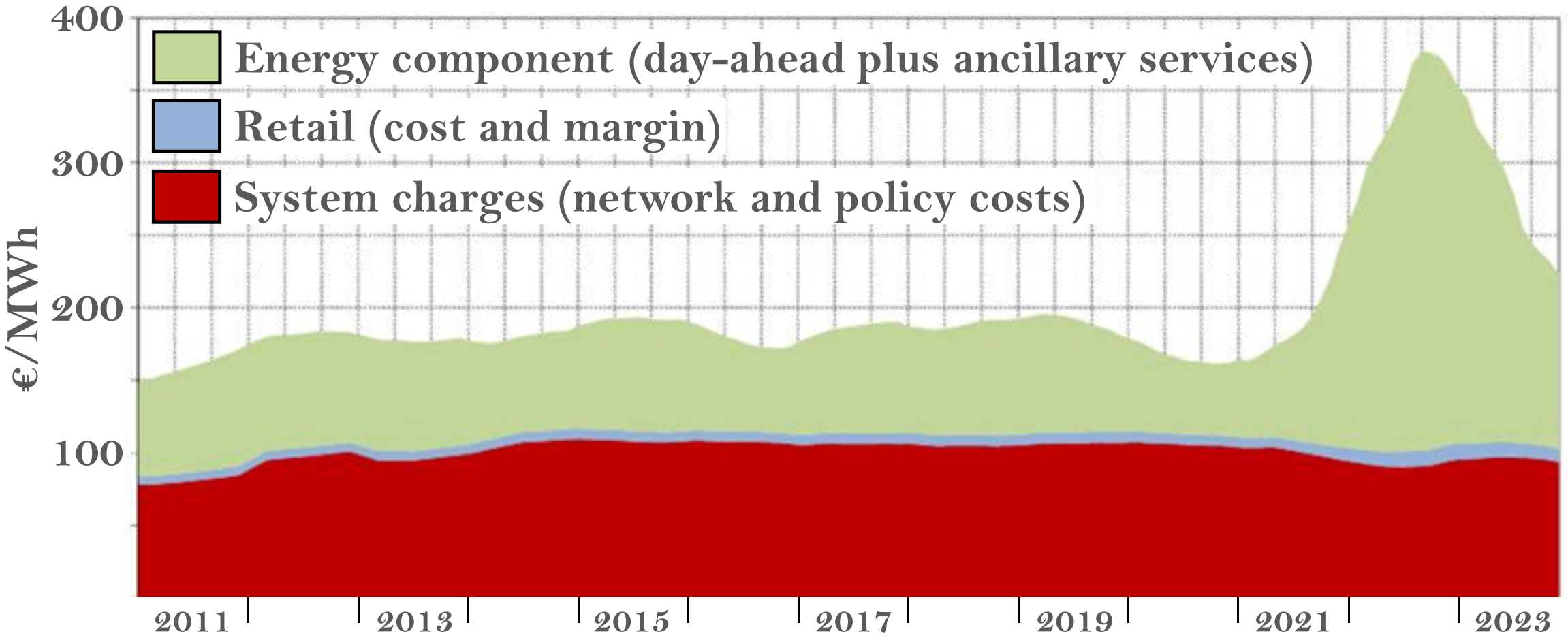




Energy crisis

The shock



PVPC 2.0

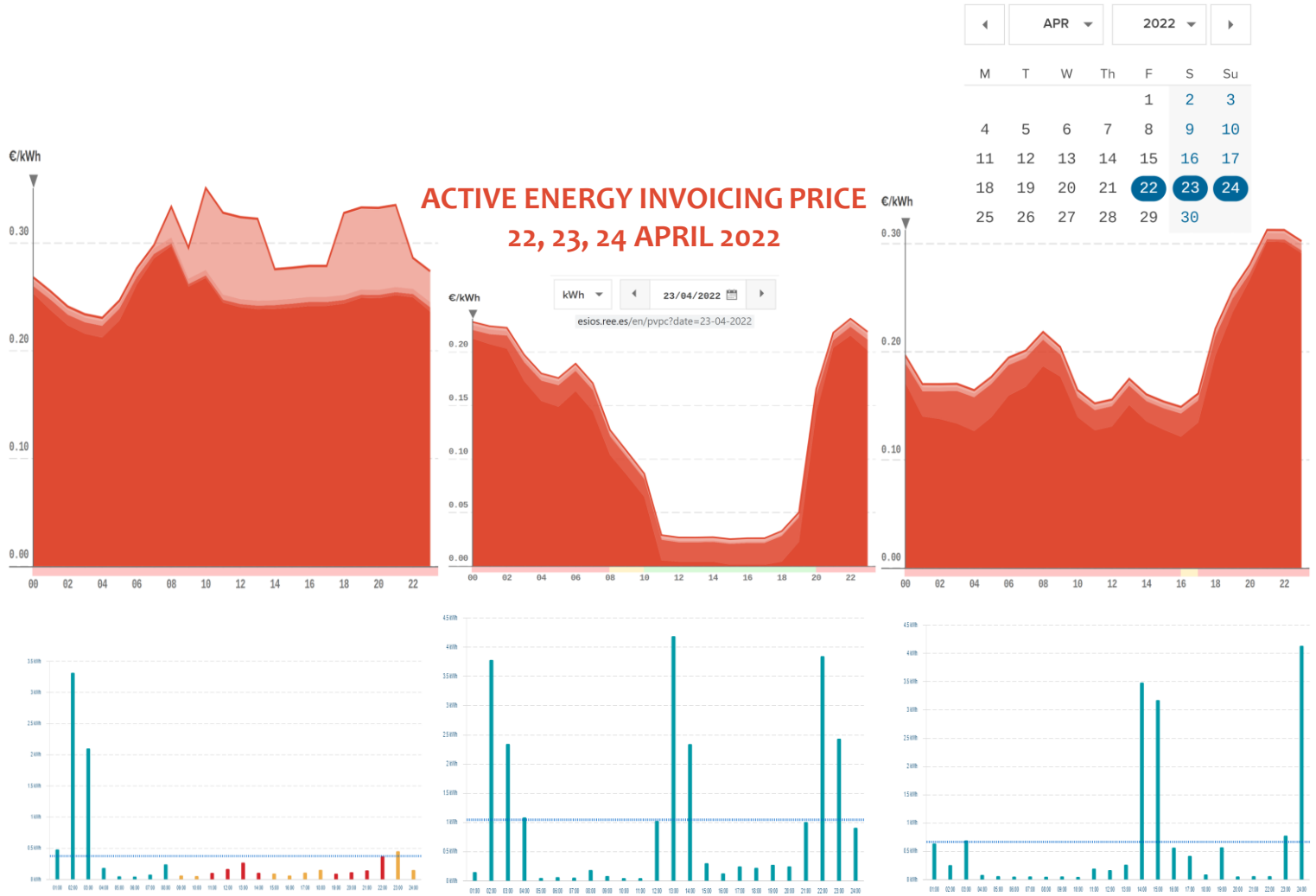
Socio-political perception

- The awakening

Default tariff

Dynamic rates, TOU demand charges

30 €/MWh



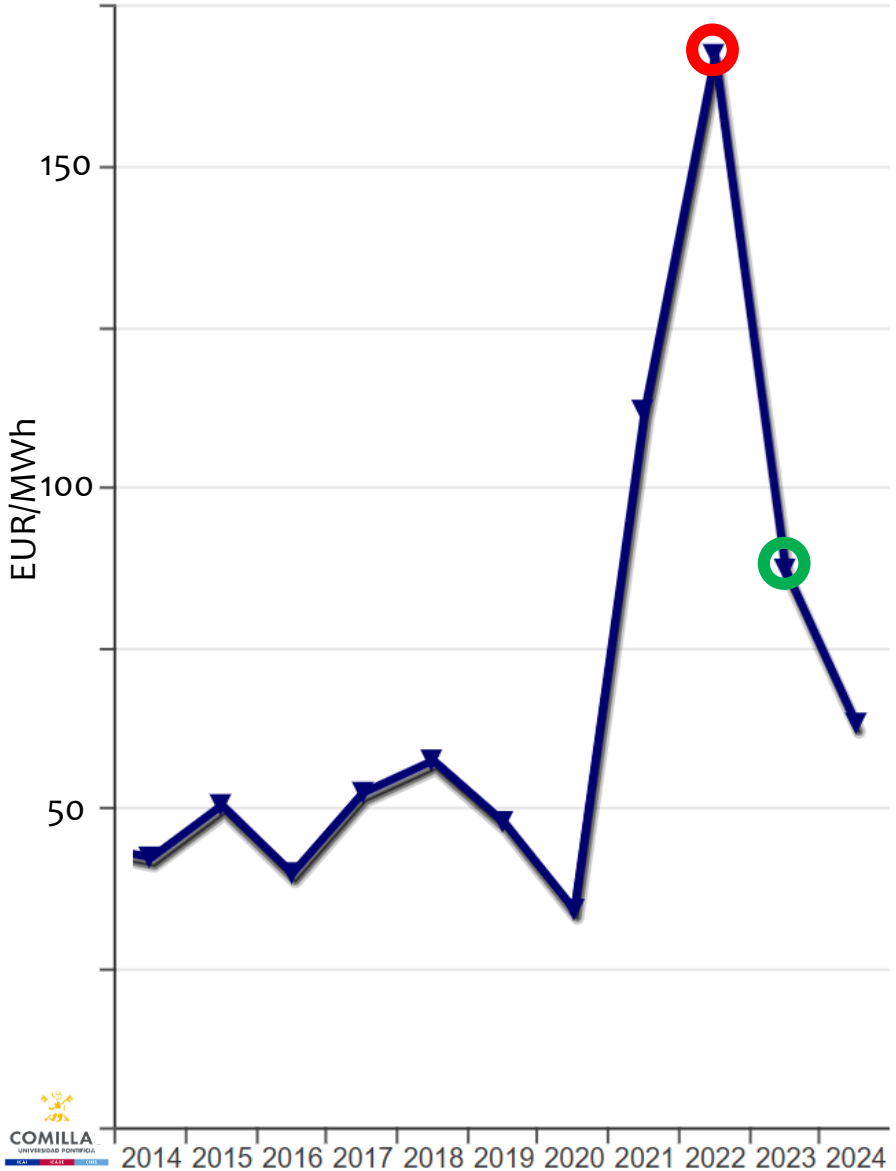
PVPC 2.0

Willingness to engage… to bother

- Diverging aims in electricity retailing
  - Free market vs. efficient signals

Energy crisis

The shock, but…



€/month	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
2023	35	43	50	59	79
2022	44	54	64	75	102

€/month	Income	Basic needs	Healthcare & education	Transport	Commu-nications	Leisure & others	Total
Quintile 1	Less than 1300	928	44	82	55	213	1323
Quintile 2	from 1300 to 1900	1231	83	155	68	391	1929
Quintile 3	from 1900 to 2600	1450	120	229	73	558	2429
Quintile 4	from 2600 to 4000	1733	177	356	83	793	3142
Quintile 5	More than 4000	2312	296	752	94	1312	4767

Spain 2014-2021

TOU network tariffs

The role of the Network Tariffs

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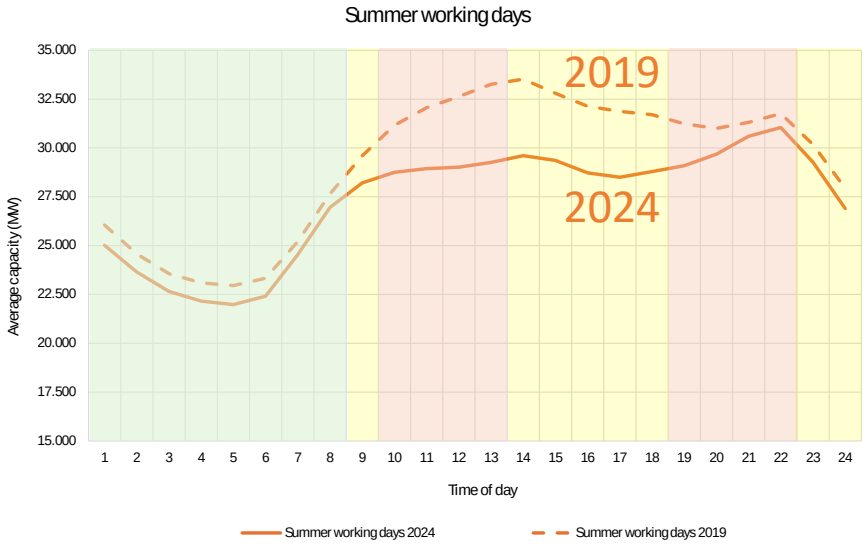
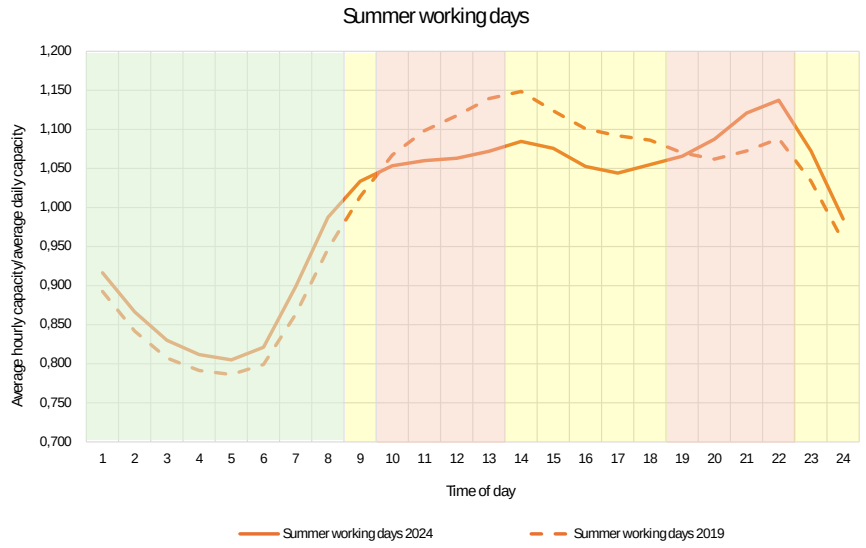
The achievements

- And in summer working days





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PVPC 3.0 (2024)

Protection (?)