CEER

Session I: Building an integrated grid
Issues of decarbonization and RES

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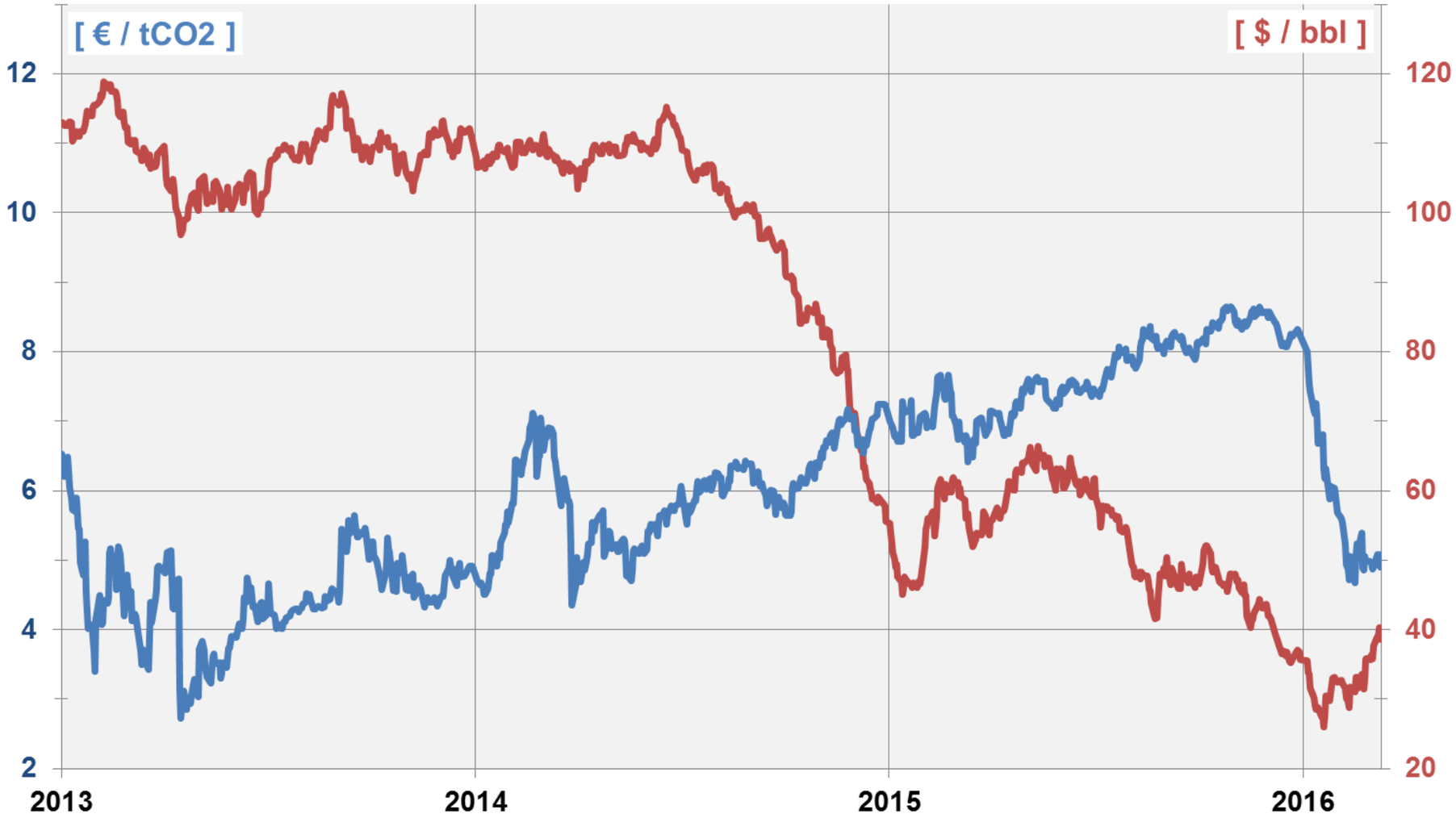
Fostering energy markets, empowering **consumers**.

Bringing RES into the market

Cost-efficiency in a low-carbon mix

- **Overarching goal: minimization of total cost of a low carbon electricity system**
- **To create a robust carbon price remains a priority —Yet it might not be enough *now***

EEX EU Emission Allowances vs. Brent Crude oil Spot FOB
January 2013 to March 2016



Sources: https://www.eex.com/en/market-data/emission-allowances/spot-market/european-emission-allowances/
https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=RBRTE&f=D

Bringing RES into the market
Cost-efficiency in a low-carbon mix

- **RES market integration to reconcile both economic & environmental sustainability**

  To achieve such a compromise, some pre-conditions are to be met:

  —*Where and if RES subsidies are still deemed appropriate…*

  - ► We must ensure they do not shield parties from short-term market signals, or lead to inefficient operating decisions.
  - ► It's crucial that allocation of support is, where meaningful, competitive (e.g. via auctions)

Bringing RES into the market
Market-compatible support mechanisms

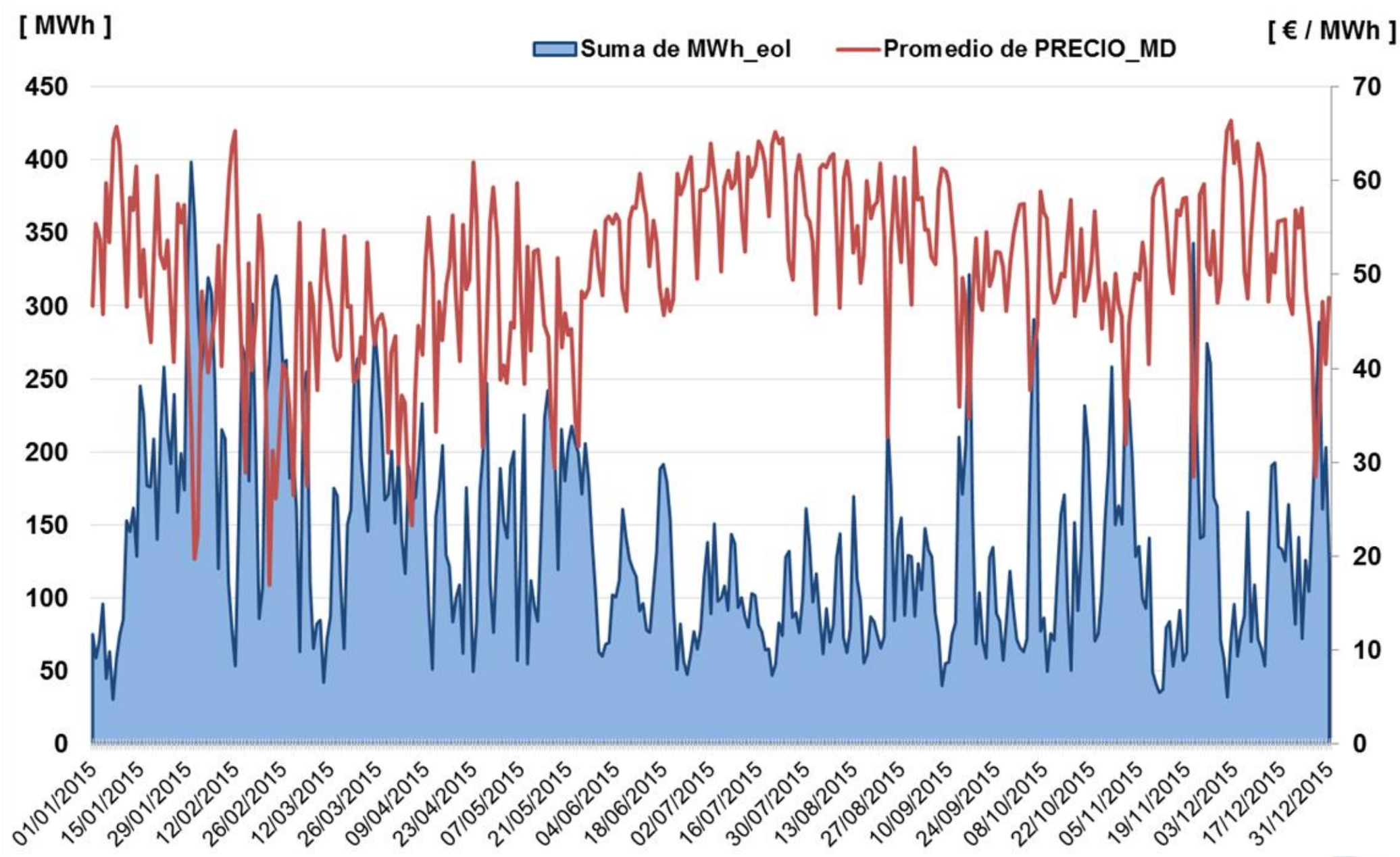
- **Ultimate target: RES-based generation should bear the same risks (and tap the same sources of income) as conventional one —The proverbial *level playing field***

- **Regulation toolkit to remove possible market integration barriers includes:**
  - ► Ensure that **balance responsibility** is applied to all RES-based generation
  - ► Ensure that **short-term markets are accessible** by all types of participants and as **efficient and harmonized** (e.g. products portfolio, gate closure time, etc.) as possible
  - ► Limit (or at least monitor) financial support promoting market-distorting behaviors, ensuring **RES-based generators are exposed to short-term price signals**

- **Grid issues (access, connection and expansion) also matter:**
  - ► System Operators should enhance coordination in grid planning and development so that RES curtailment and the need for network expansion are minimized

Bringing RES into the market
Impact on wholesale prices

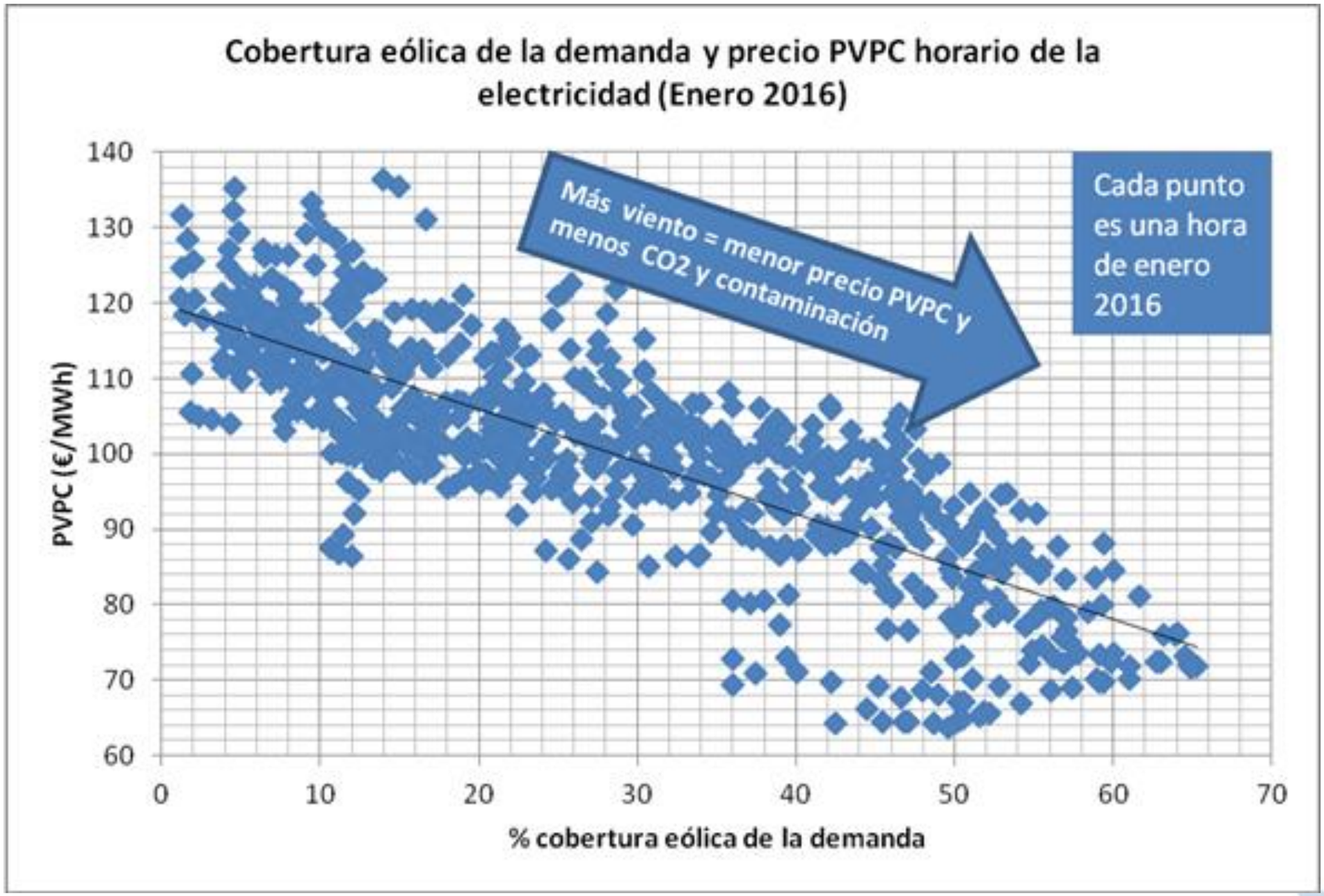
Wind generation & average day-ahead market prices | Iberian Market (ES zone), 2015



Source: Operador del Mercado Ibérico de Electricidad, www.omie.es

Bringing RES into the market
Impact on wholesale prices

Wind generation & average day-ahead market prices | Iberian Market (ES zone), 2015

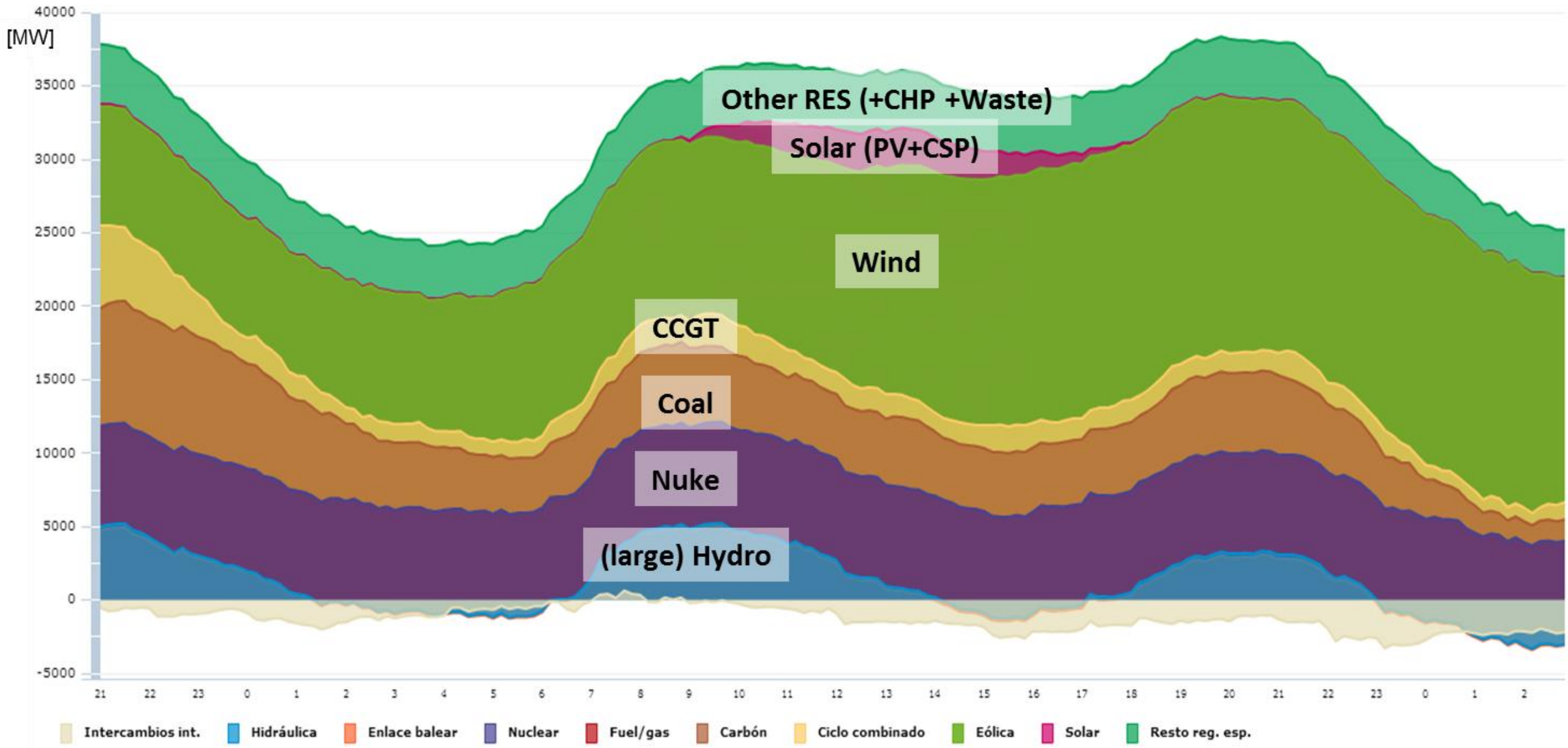


Source: Spanish Wind Energy Producers`Association

Bringing RES into the market

How to steer a 'intermittent' system?

Max. instantaneous wind generation output [hourly peak @ 19:30h; ~17,5 GWh (~ 46%)]
Iberian Market (ES zone), January 29th 2015

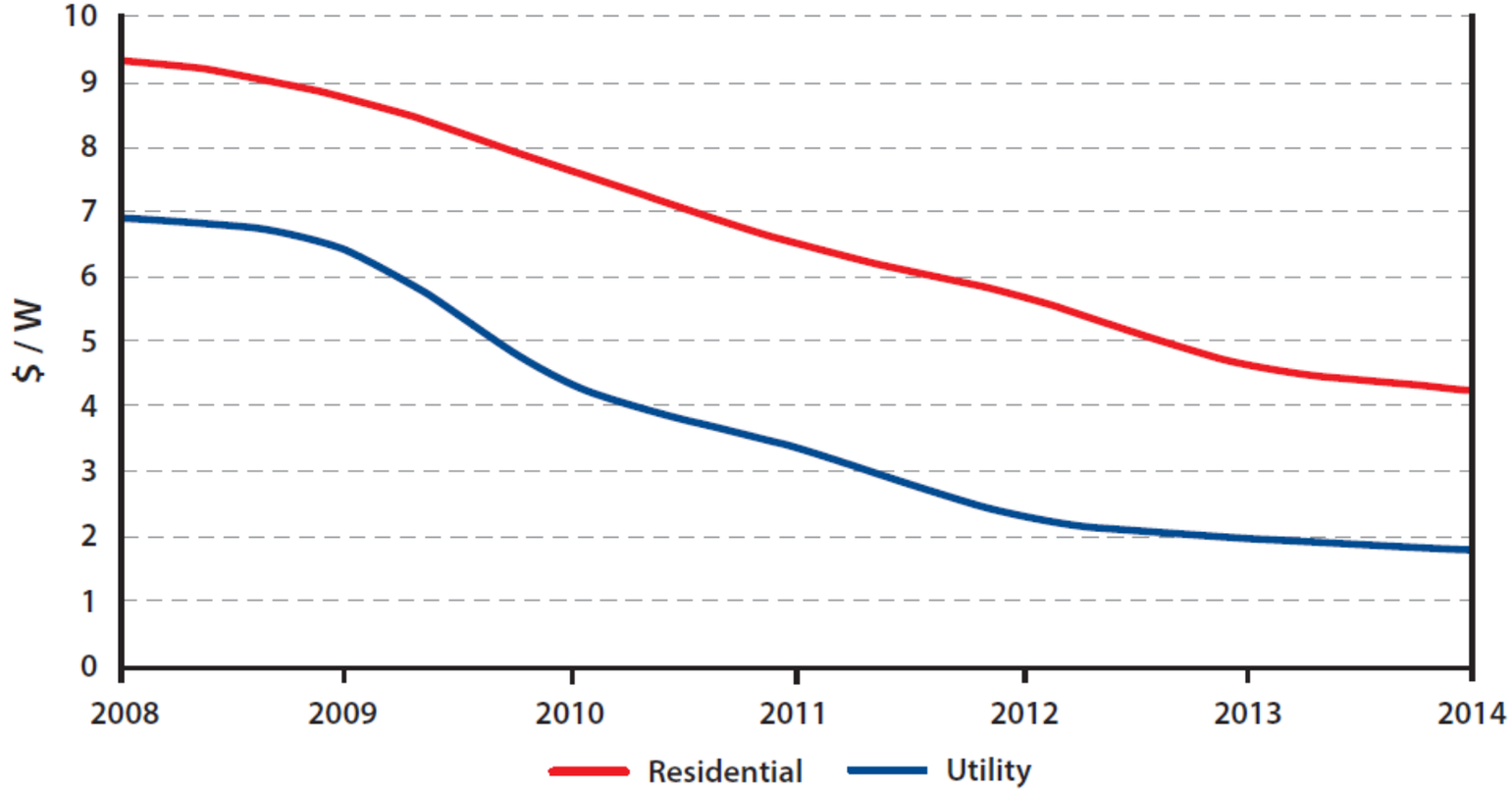


Sources: Red Eléctrica de España, www.ree.es

Distributed RES *market* integration
From wholesale to retailing

- **Statement 1: Contribution of RES-based, distributed generation (DG) will be needed in many jurisdictions to meet commitments made**
- **Statement 2: Support mechanisms for DG (this lacking economies of scale) are typically *implicit* (as opposed to *explicit* incentives for centralized resources), mostly in the form of exemptions to part of access tariffs, charges, taxes or levies.**

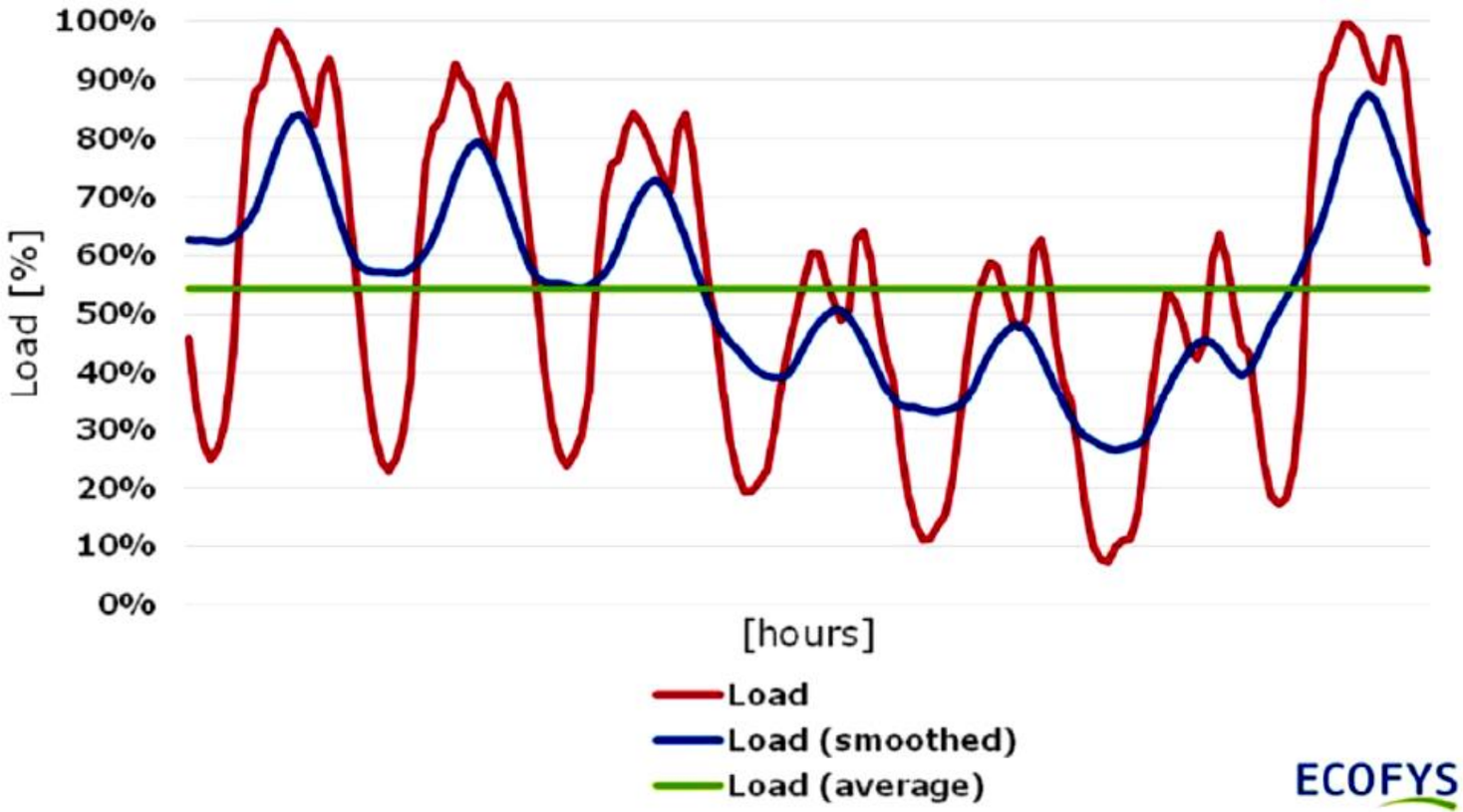
Average U.S. Prices for Residential and Utility-Scale PV Systems[ii]

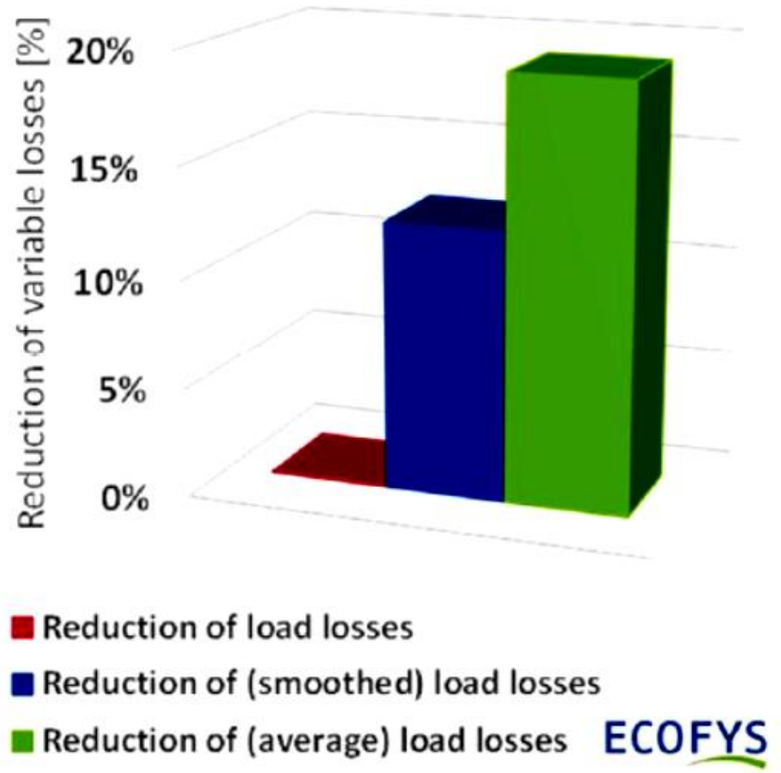


Source: MIT analysis based on data Solar Industry Association of America; https://mitei.mit.edu/futureofsolar

Distributed RES *market* integration
From wholesale to retailing

- **Marginal vs. Average losses — Impact of smoothing system loading on reduction of variable losses: there's a role to play for both distributed generation and storage**



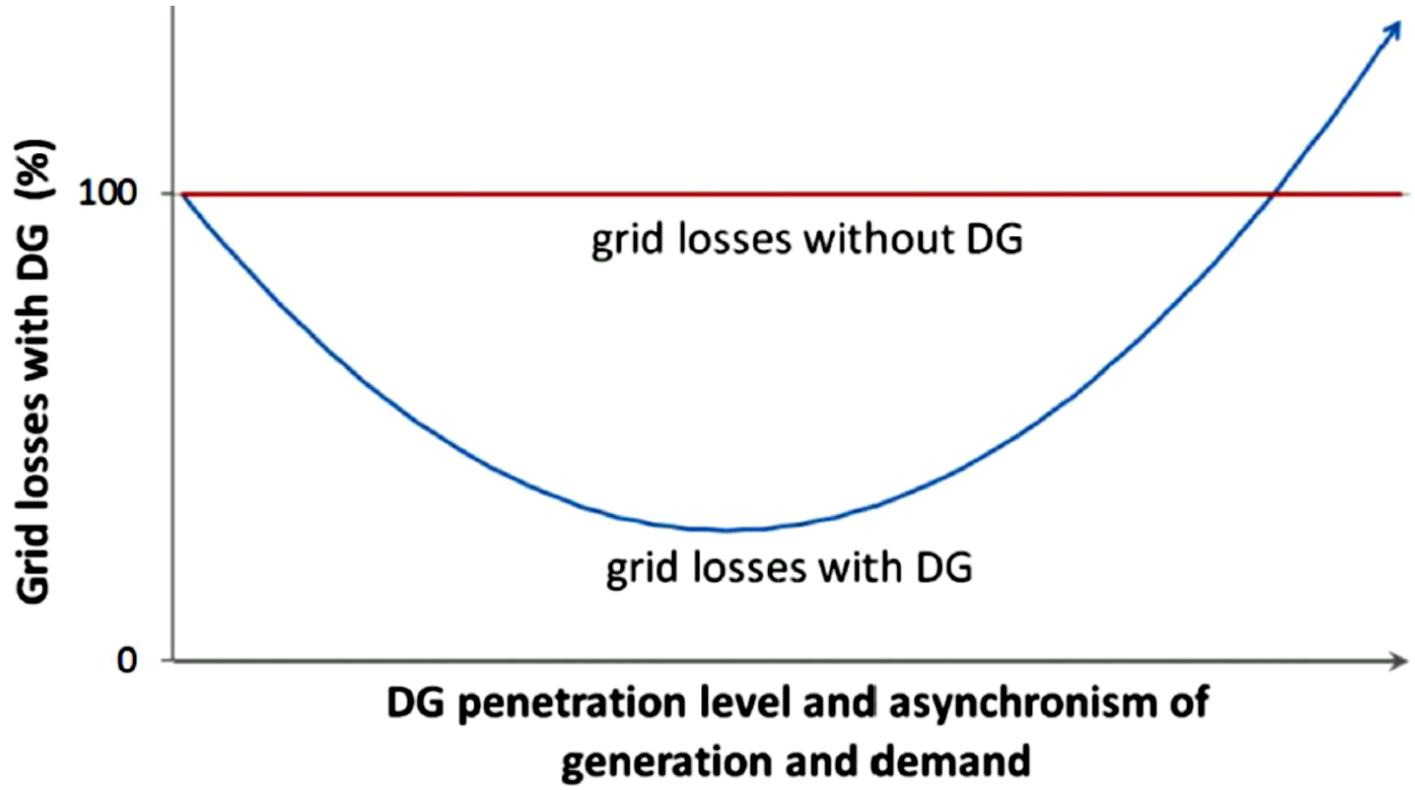


«Since variable losses are proportional to the square of the current, marginal losses have a much higher contribution to the total sum. This is shown as an example in [this figure] […] where the losses from 3 cases of system loading are presented. ***In all cases the same energy is transported, but the loading profiles present a different variability. Smoother loading profiles lead to significant losses reduction, up to 20% for a flat profile.»***

Source: Tractebel, Ecofys: 'Identifying Energy Efficiency improvements and saving potential in energy networks'; https://ec.europa.eu/energy/sites/ener/files/documents/GRIDEE_4NT_364174_000_01_TOTALDOC%20-%2018-1-2016.pdf

Distributed RES *market* integration
From wholesale to retailing

- **DG penetration level and grid losses: Domestic DG typically non-synchronized with adjacent load *(Johnnie Doe comes back home as the sun goes down)***



«[…] ***losses are expected to decrease for low penetration levels****, due to the fact that no significant reverse flows are expected* ***but after a certain level they increase due to the increased power flows they incur to the system****.* [This figure] *shows a study case in a LV grid in Switzerland where grid losses reach a maximum reduction of 20% at 25% PV penetration. At a penetration level of 50%, they are equivalent to the case when there was no PV and further increase if more PV panels are installed.»*

Source: Tractebel, Ecofys: 'Identifying Energy Efficiency improvements and saving potential in energy networks'; https://ec.europa.eu/energy/sites/ener/files/documents/GRIDEE_4NT_364174_000_01_TOTALDOC%20-%2018-1-2016.pdf

Distributed RES *market* integration
Regulating self -consumption/ -generation

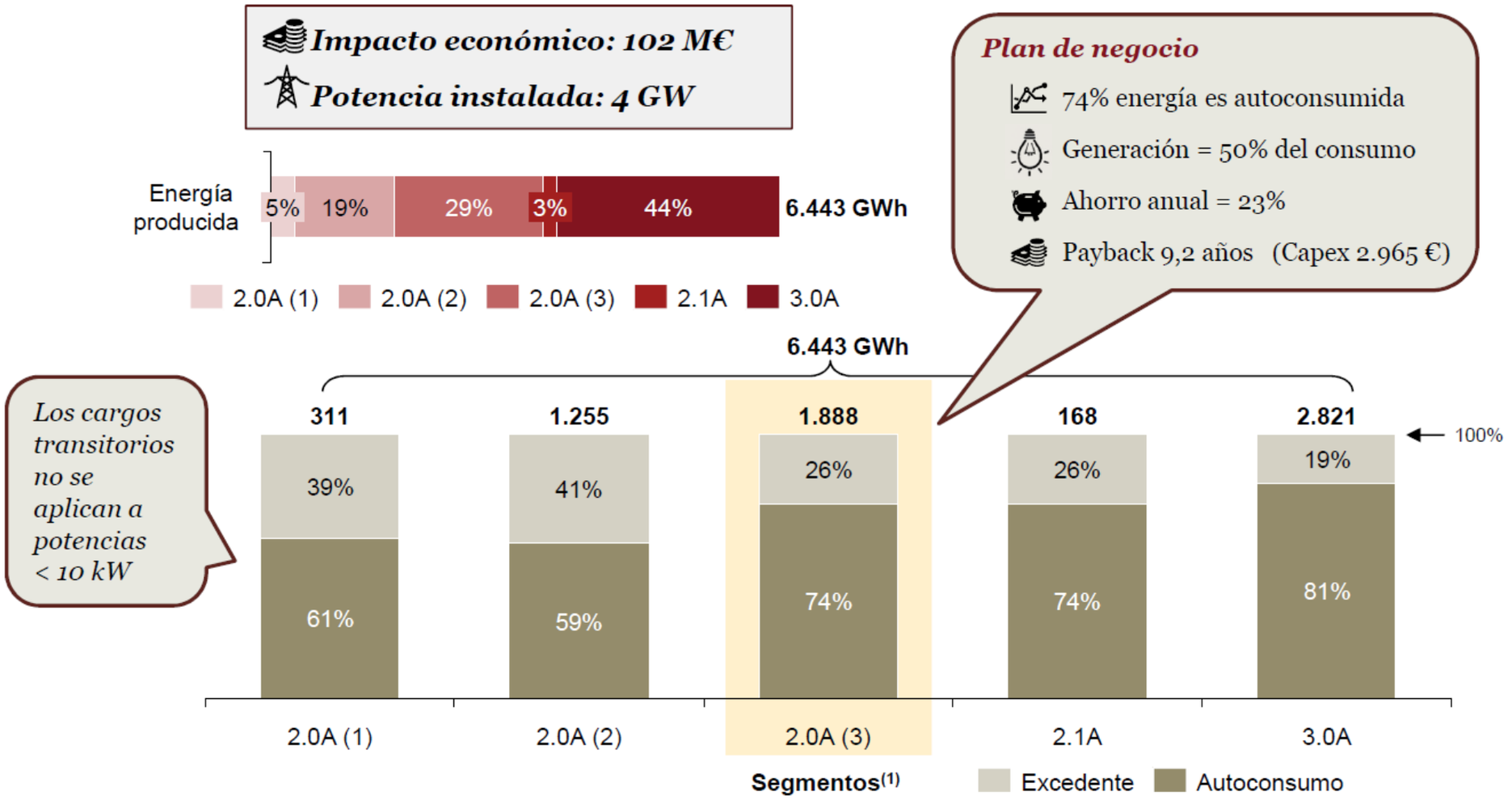
Picture gets more complicated as DG moves to self –consumption/ -generation, reinforces customer empowerment and impacts on how network and systems costs are shared.

- **Main aim: How best to leverage self consumption (SC) benefits whereas pre-empting its potential detrimental aspects, particularly the risk of socially retro-progressive cross-subsidies (‘unfair’ burden sharing of sunk costs)**

Distributed RES *market* integration

Regulating self -consumption/ -generation

From full charges to partial exemptions, not-so-large differences in tariff policy may push pay-back for SC facilities many years forward or backward.



PwC Nota 1: Potencia contratada por segmentos: 2.0A (1) P ≤ 4 Kw; 2.0A (2) P > 4 kW y ≤ 8 kW; 2.0A (3) P > 8 kW y ≤ 10 kW; 2.1A P >10 kW y ≤ 15 kW; 3.0A P> 15 kW

Source: Price Waterhouse Coopers España: 'El autoconsumo en España: Segmentos residencial y comercial' http://www.pwc.es/es/publicaciones/energia/informe-autoconsumo-pwc.html

Decarbonization via RES market integration: some upshots so far

- **Regulators to strive for a market-friendly low carbon generation mix…**
  - ►*Liable for its balance and sensitive to short-term price signals,*
  - ►*Where access to increasingly harmonized balancing markets is granted.*

- **Distributed Generation plays an undeniable role achieving these aims:**
  - ►*A new, 'smarter' way of operating distribution networks is needed*
  - ►*Eventual incentives to DG should undergo due cost-benefit analysis*

- **Self-generation should be ruled in a way everyone may afford it,**
  — Even the ones who *don't* intend to self-generate.

— Thanks for your attention!

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