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ENERGYECOLAB

Energy in Transition

Natalia Fabra

About myself

- I am an industrial organization economist
- Professor at Carlos III University

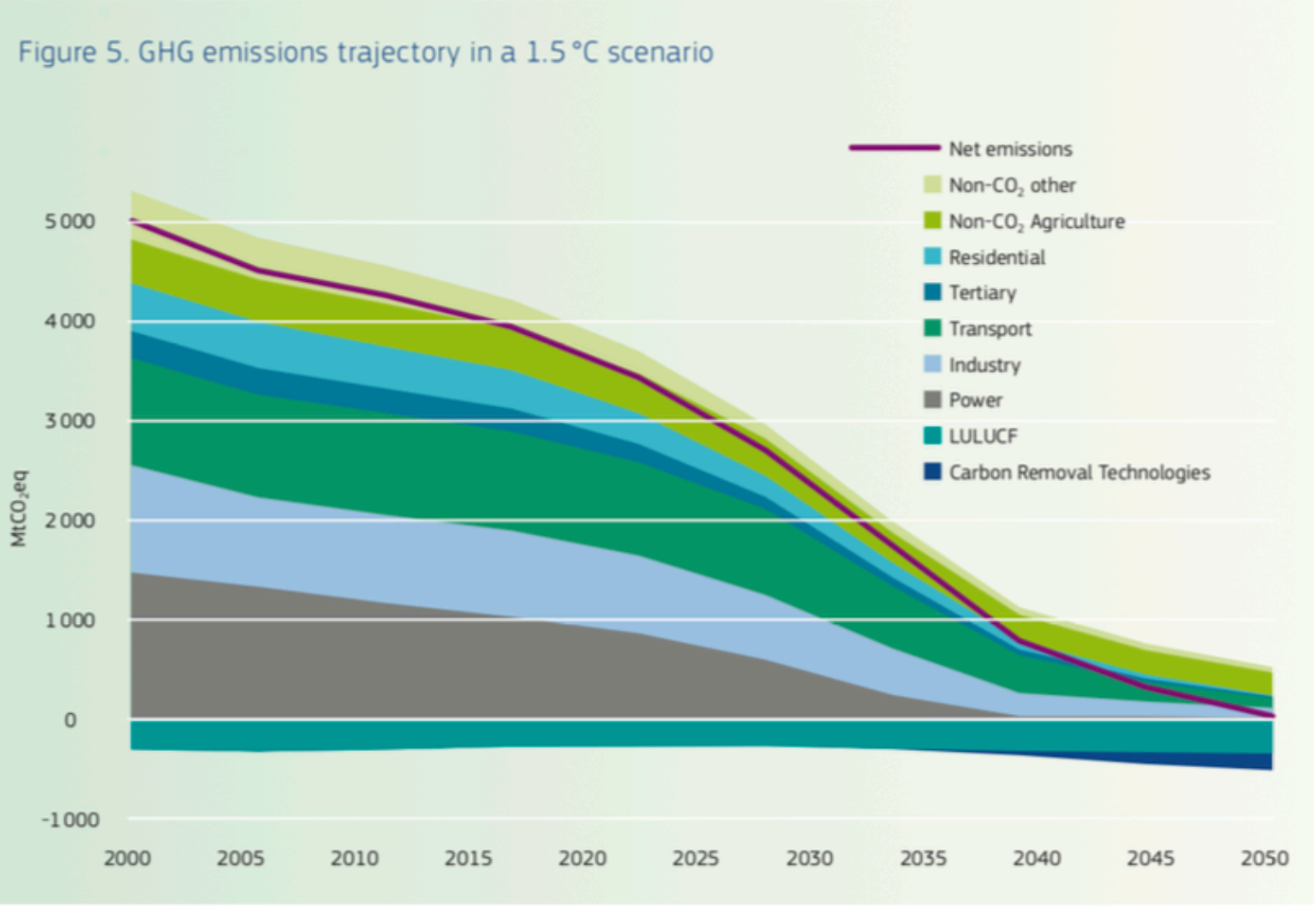
- My research focuses on energy and competition:
  - Market power in electricity markets
  - Electricity market design and policies
  - Emissions regulation
  - Storage

About this talk

Overview of the Energy Transition

- European and Spanish context
- Key role of the power sector
- Some stylized facts
- Key challenges for the energy transition
- Conclusions

The Energy Transition in Europe

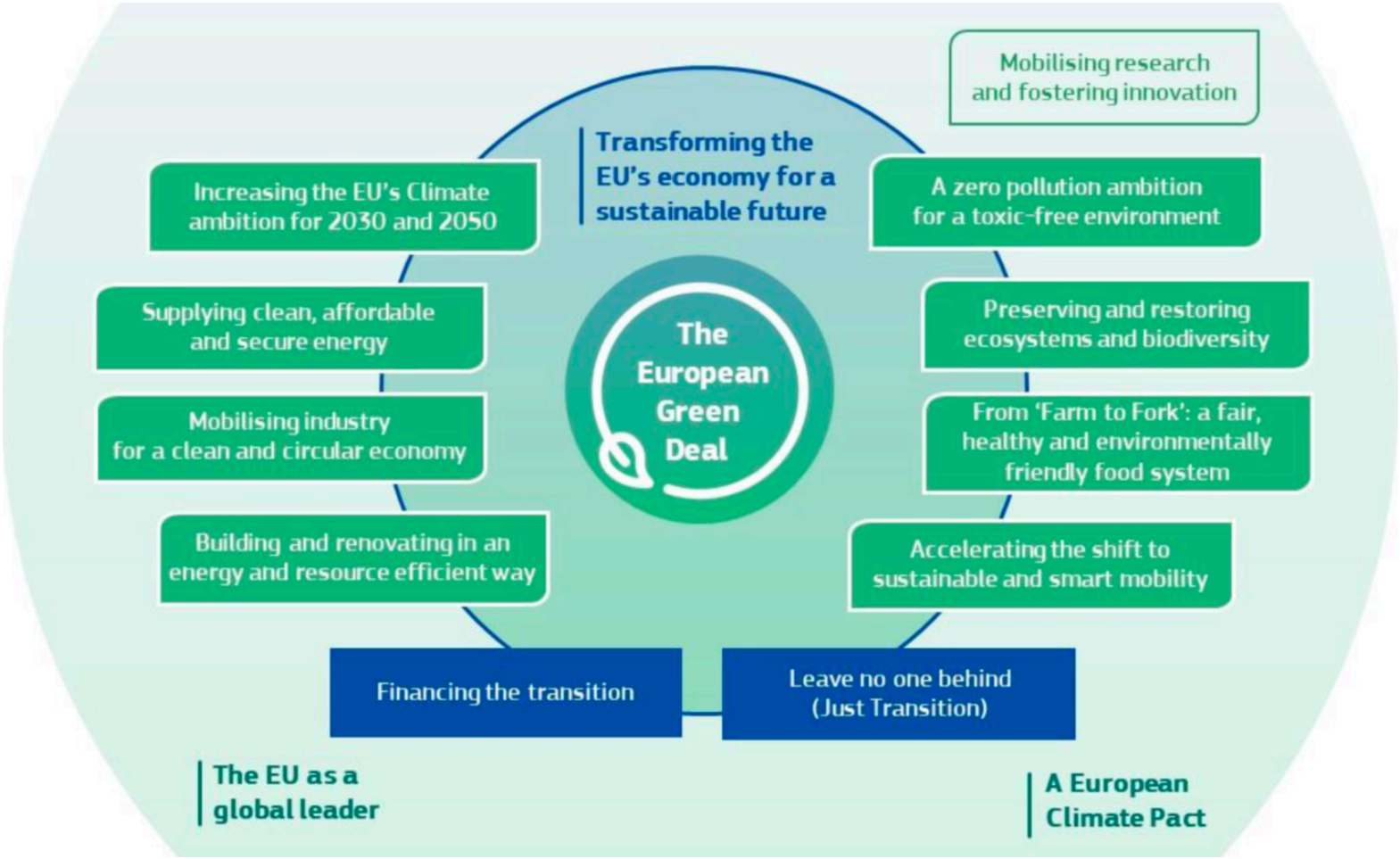


Source: EUROPEAN COMMISSION

Energy Union (2018)

Source: EUROPEAN COMMISSION

European Green Deal (2019)



Source: EUROPEAN COMMISSION

The EU recovery package (2020)

EU green recovery package sets a marker for the world

The bloc is showing the way in rebuilding coronavirus-ravaged economies to fight the climate emergency

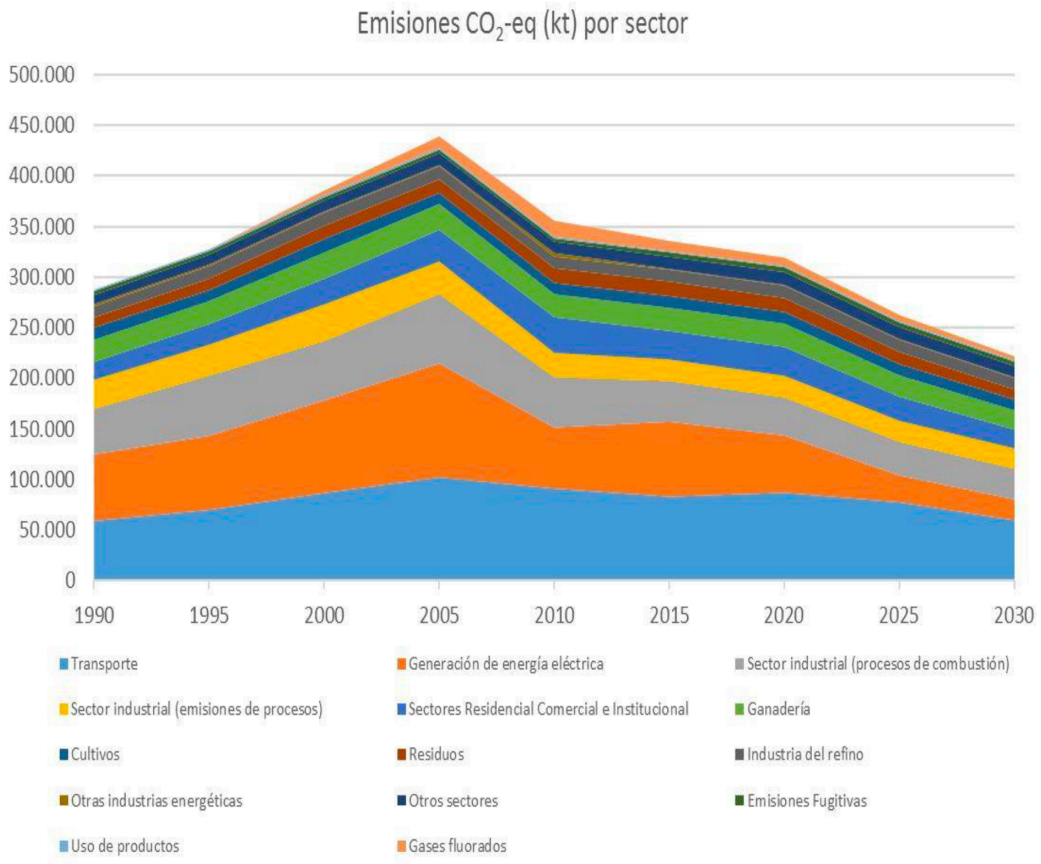
Coronavirus will not harm climate goals, EU promises

▲ Wind turbines contrast with coal power plants in Bergheim, Germany. EU money will help workers in coal-heavy industries into new roles. Photograph: Picturetom/Alamy

Source: THA GUARDIAN

The Energy Transition in Spain

Figura 2: Emisiones CO_2 equivalente por sector. Histórico y proyección a 2030 (kt)



Plan Nacional Integrado Energía y Clima (PNIEC)

Ley de Cambio Climático y Transición Energética

Emission reductions: -23%

Renewables: 42%

Renewables (power): 74%

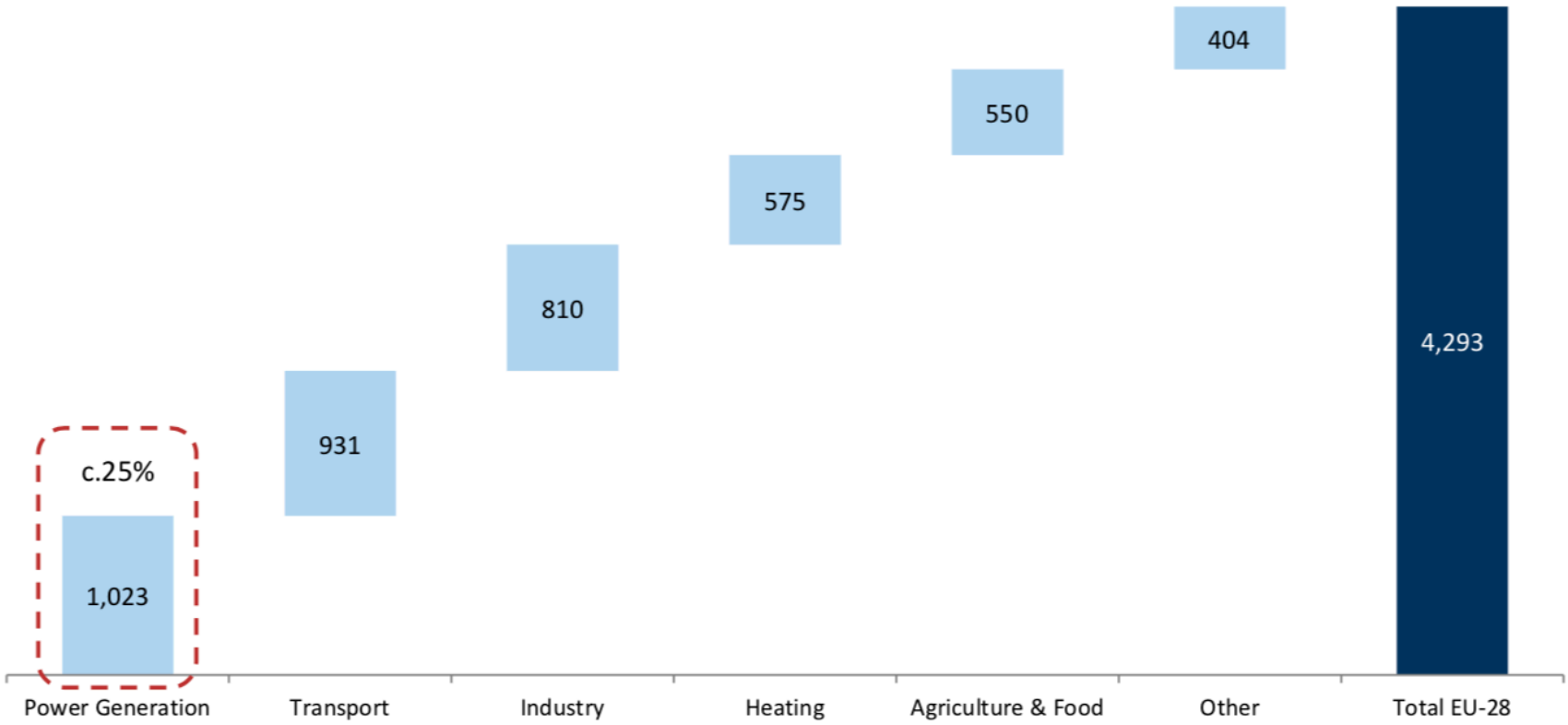
Energy efficiency: 39,5%

Source: PNIEC

Key role of the power sector

- Power sector plays a key role:
  - It is a particularly large emitter of CO2 (25%)
  - It has a greater decarbonisation potential thanks to **renewables**
  - Electricity demand will rise to decarbonise other sectors
- **Profound transformation** of the power sector

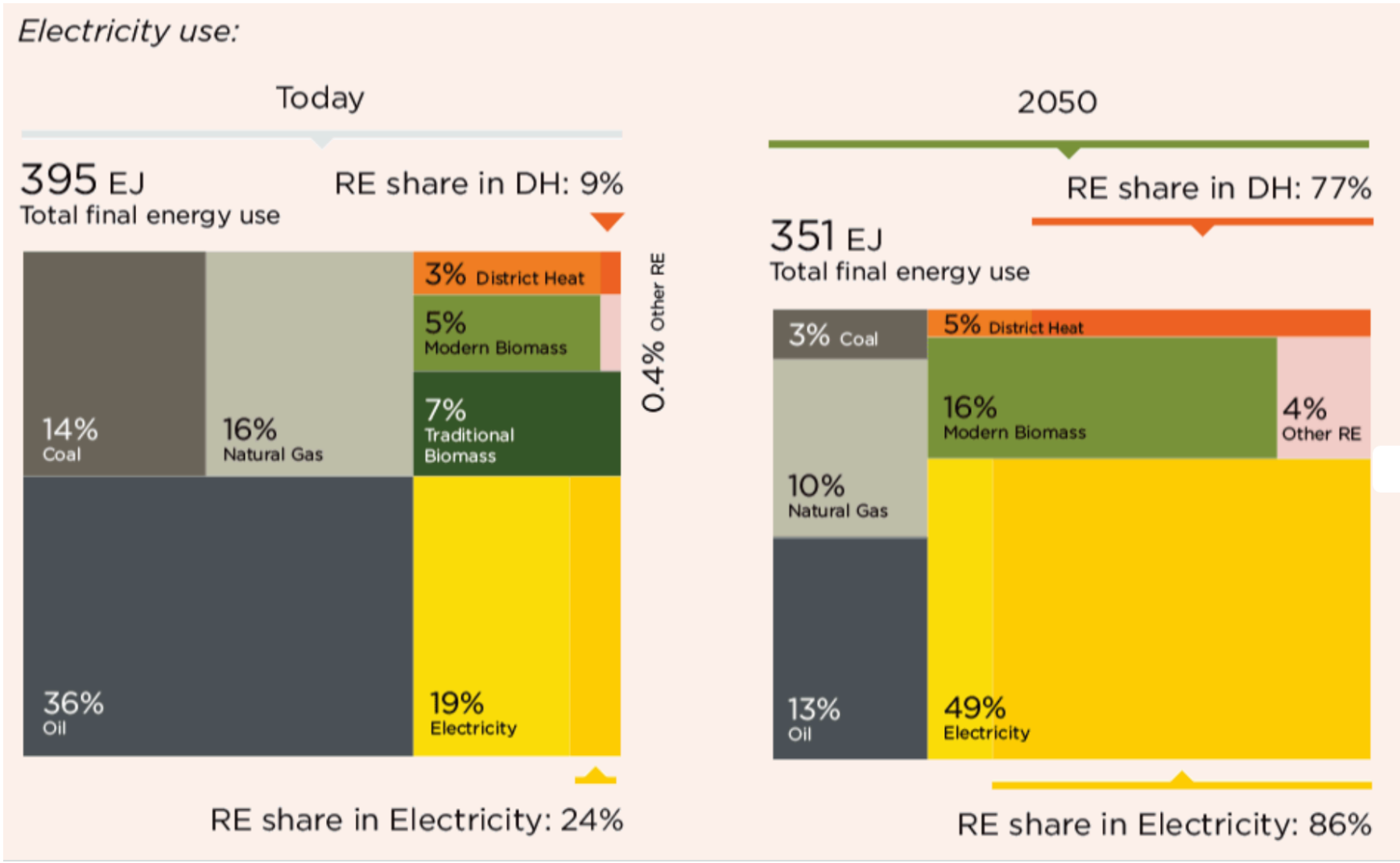
The power sector is still a large emitter



Power generation remains the largest contributor to European emissions
EU GHG Emissions breakdown (CO_2 mt, 2018)

Source: GOLDMAN SACHS

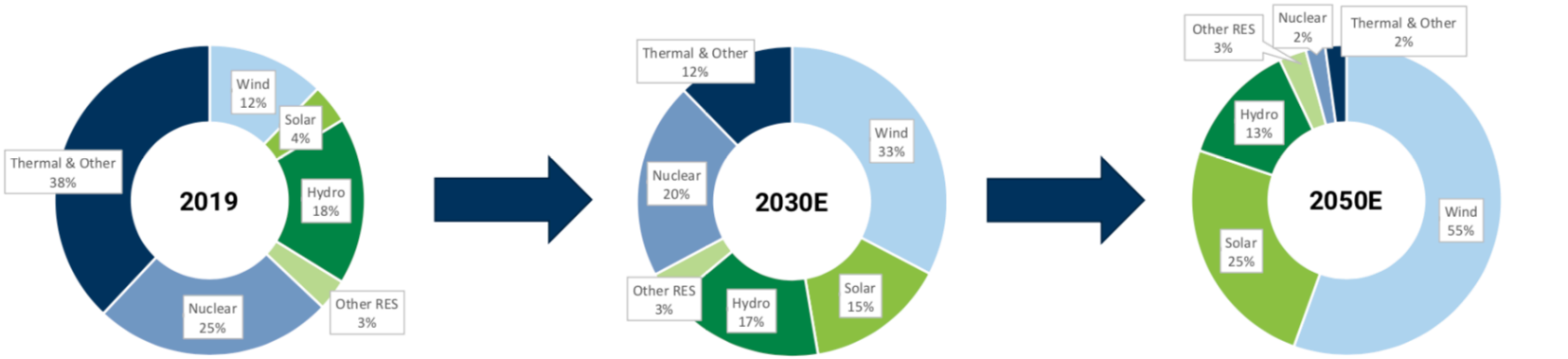
Electricity use will go up



Source: IRENA

Towards 100% renewables

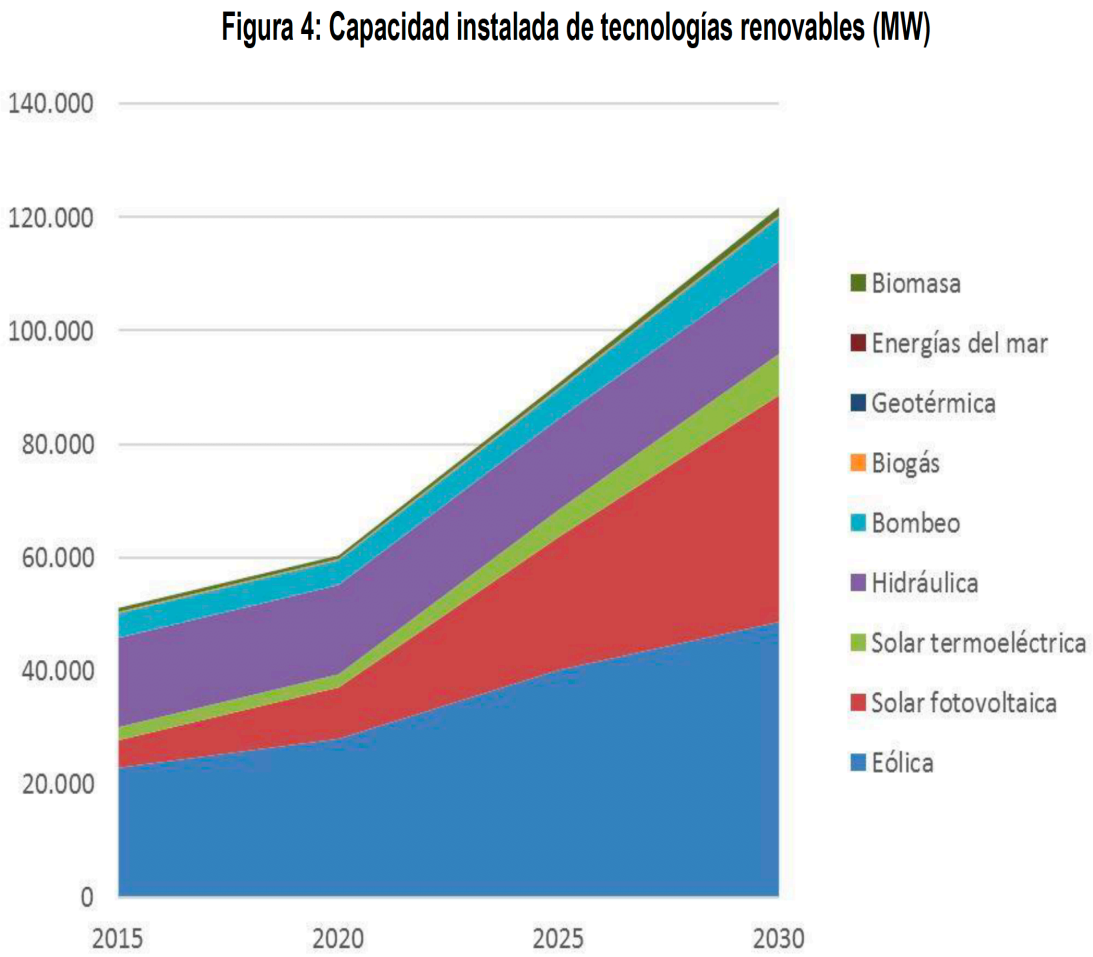
Exhibit 13: We still estimate a major transformation in power generation
Share of production from RES in the European mix



Source: Goldman Sachs Global Investment Research

Source: GOLDMAN SACHS

Renewables Expansion (Spain, 2030)



Electrification: 27%

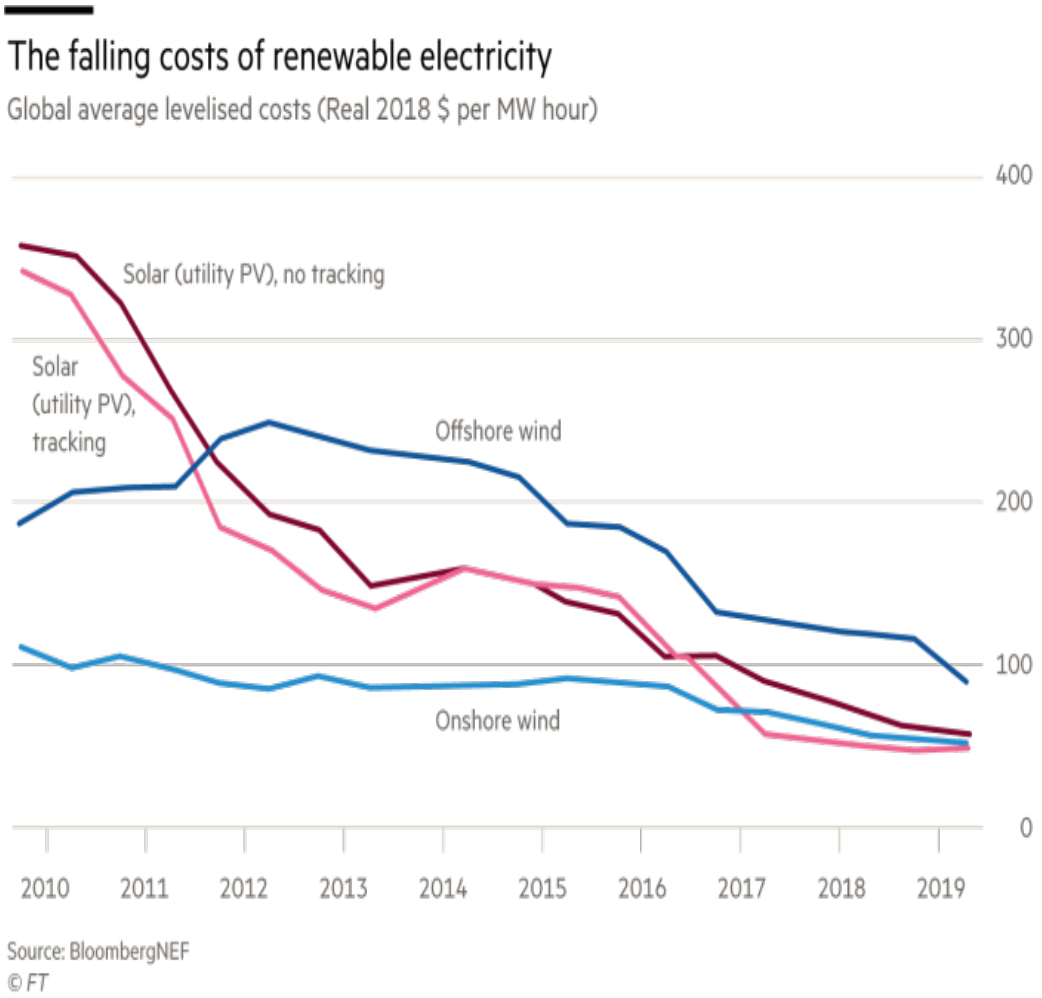
Renewable production: 74%

Investments in storage

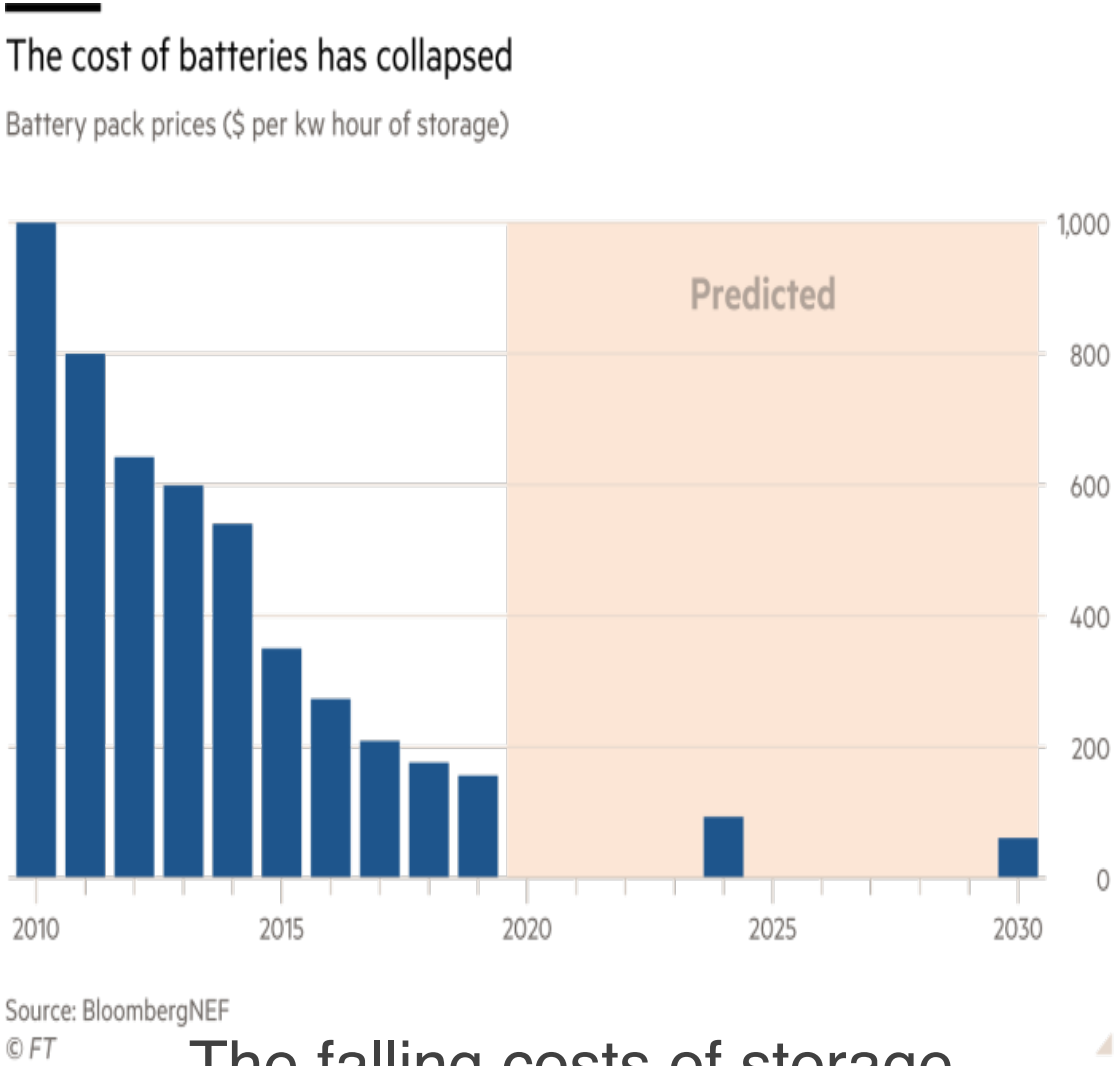
Source: PNIEC

13

Technology is making this easier…



Technology is making this easier…



The falling costs of storage

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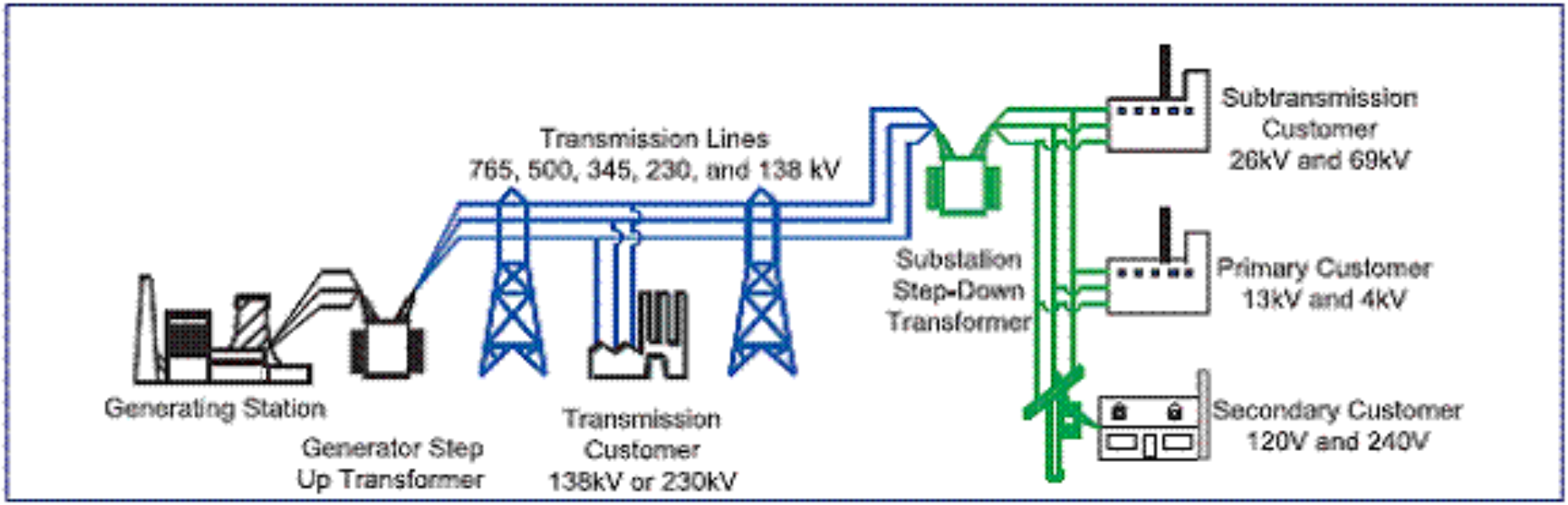
Some key facts about the power sector

- Structure of the sector
- Technologies
- Price setting in wholesale markets
- Price setting in retail markets

Structure of the power sector



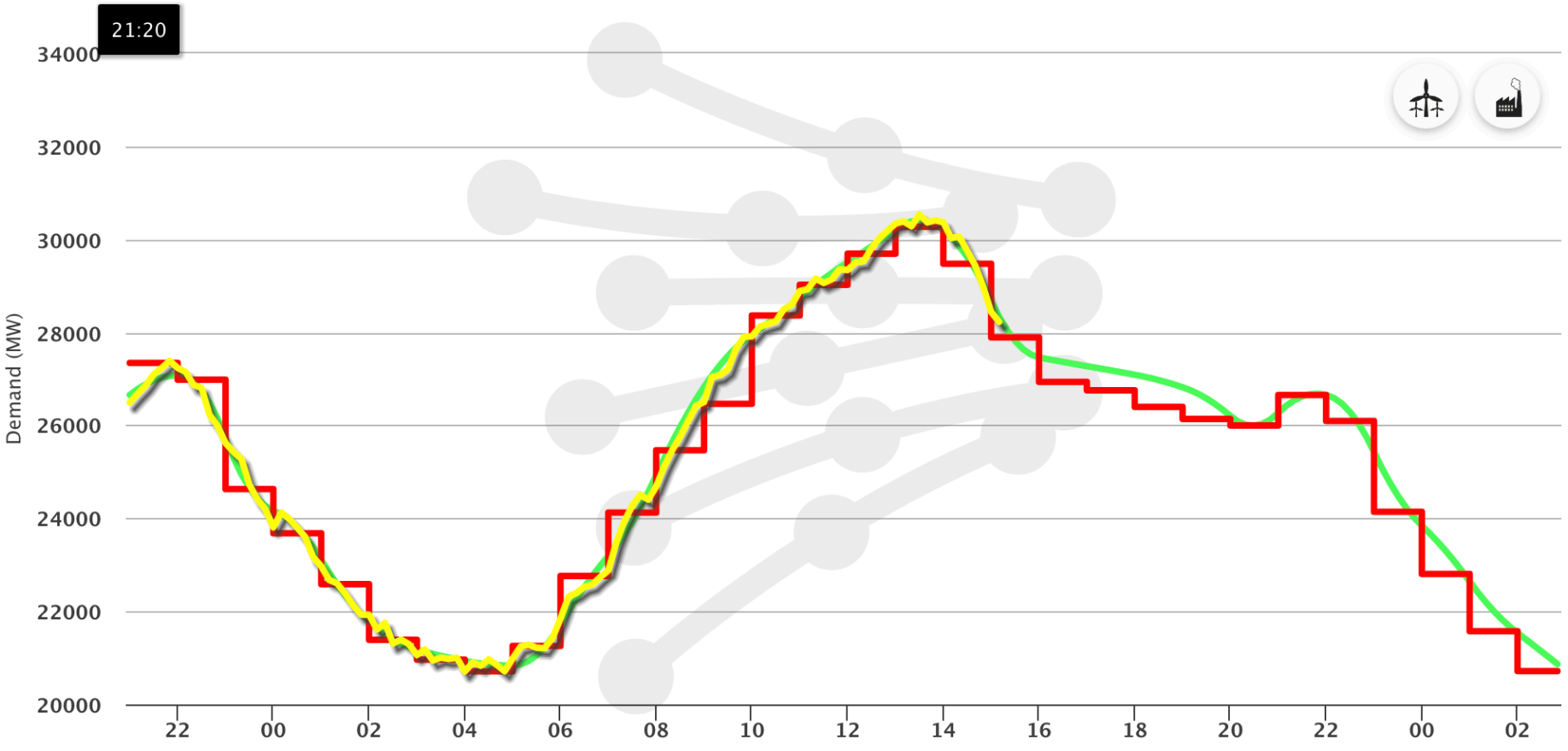
Source: www.nerc.com.

Black: Generation (Production)
Blue: Transmission (Transportation)
Green: Distribution
Also: Retailing

A Tour of Electricity Markets in Practice

- Website of the Spanish System Operator
- Website of the Iberian Market Operator

Electricity demand during the day

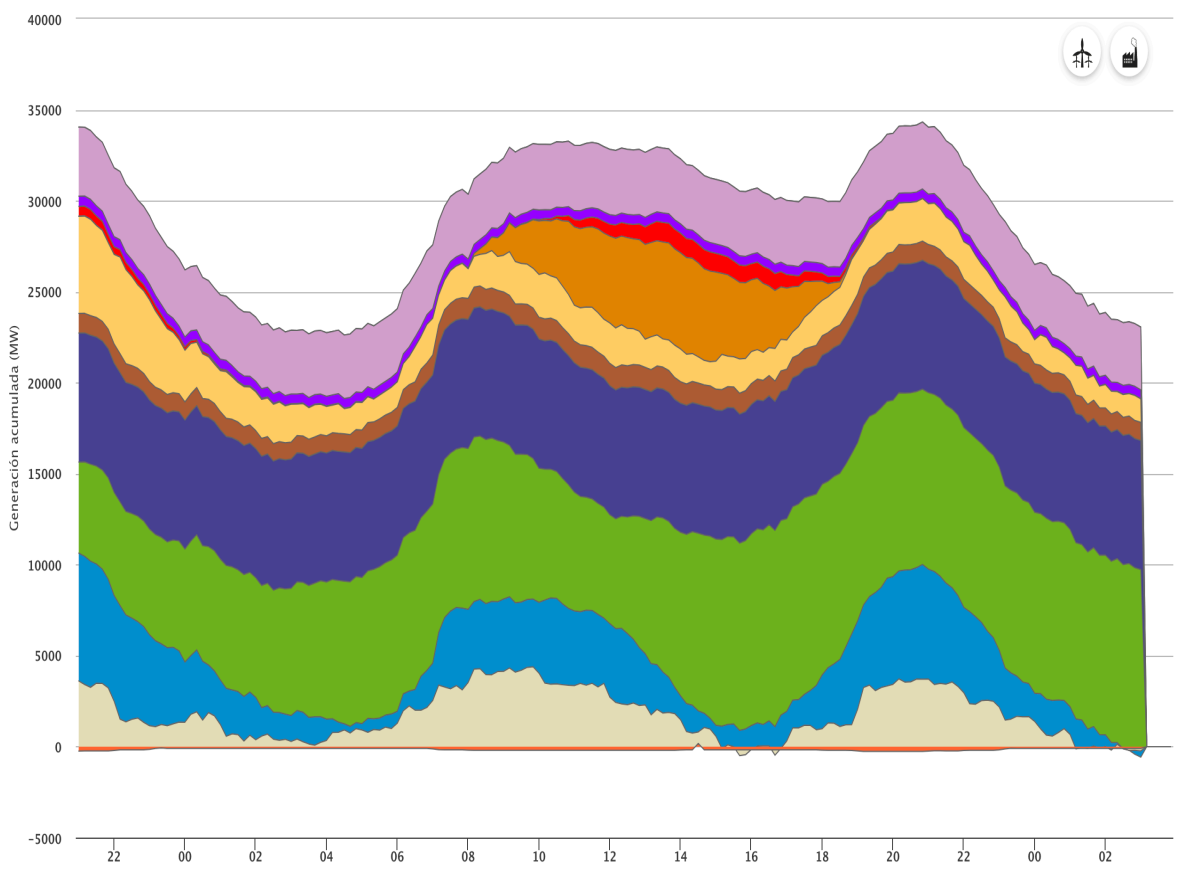


Generation technologies

Generation technologies

Estructura de generación (MW) a las 09:20 - 26/02/2020

Cogeneración y residuos	3.446	14,58 (%)
Térmica renovable	491	2,08 (%)
Solar térmica		0 (%)
Solar fotovoltaica	7	0,03 (%)
Ciclo combinado	1.289	5,45 (%)
Carbón	999	4,23 (%)
Nuclear	7.096	30,03 (%)
Eólica	10.305	43,6 (%)
Hidráulica	-345	0 (%)
Intercambios int	-133	0 (%)
Enlace balear	-100	0 (%)

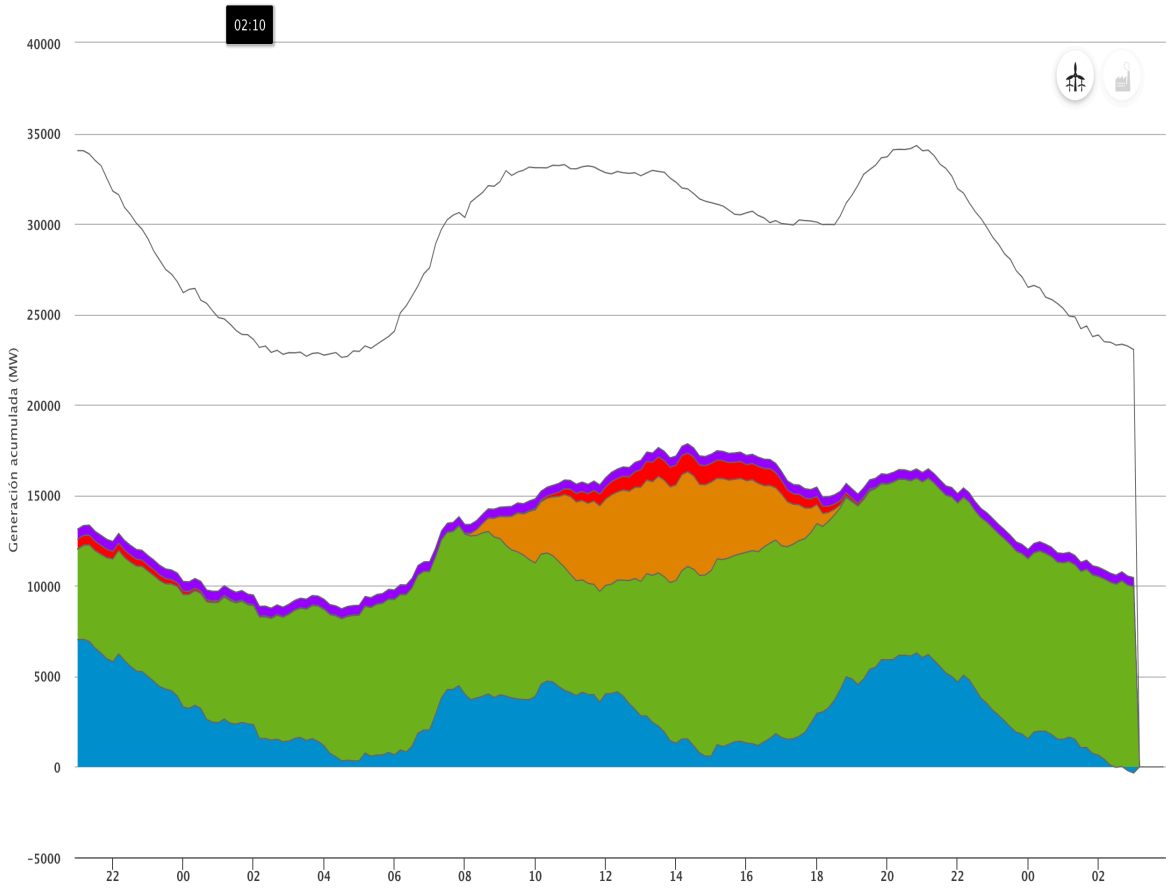


https://demanda.ree.es/visiona/peninsula/demanda/acumulada/2020-02-26

Green generation technologies

Estructura de generación (MW) a las 02:10 - 25/02/2020

Cogeneración y residuos	3448	27,07(%)
Térmica renovable	529	5,97(%)
Solar térmica	55	0,62(%)
Solar fotovoltaica	1	0,01(%)
Ciclo combinado	1195	9,38(%)
Carbón	1002	7,87(%)
Nuclear	7091	55,68(%)
Eólica	6718	75,78(%)
Hidráulica	1562	17,62(%)
Intercambios int	-133	0 (%)
Enlace balear	-100	0 (%)



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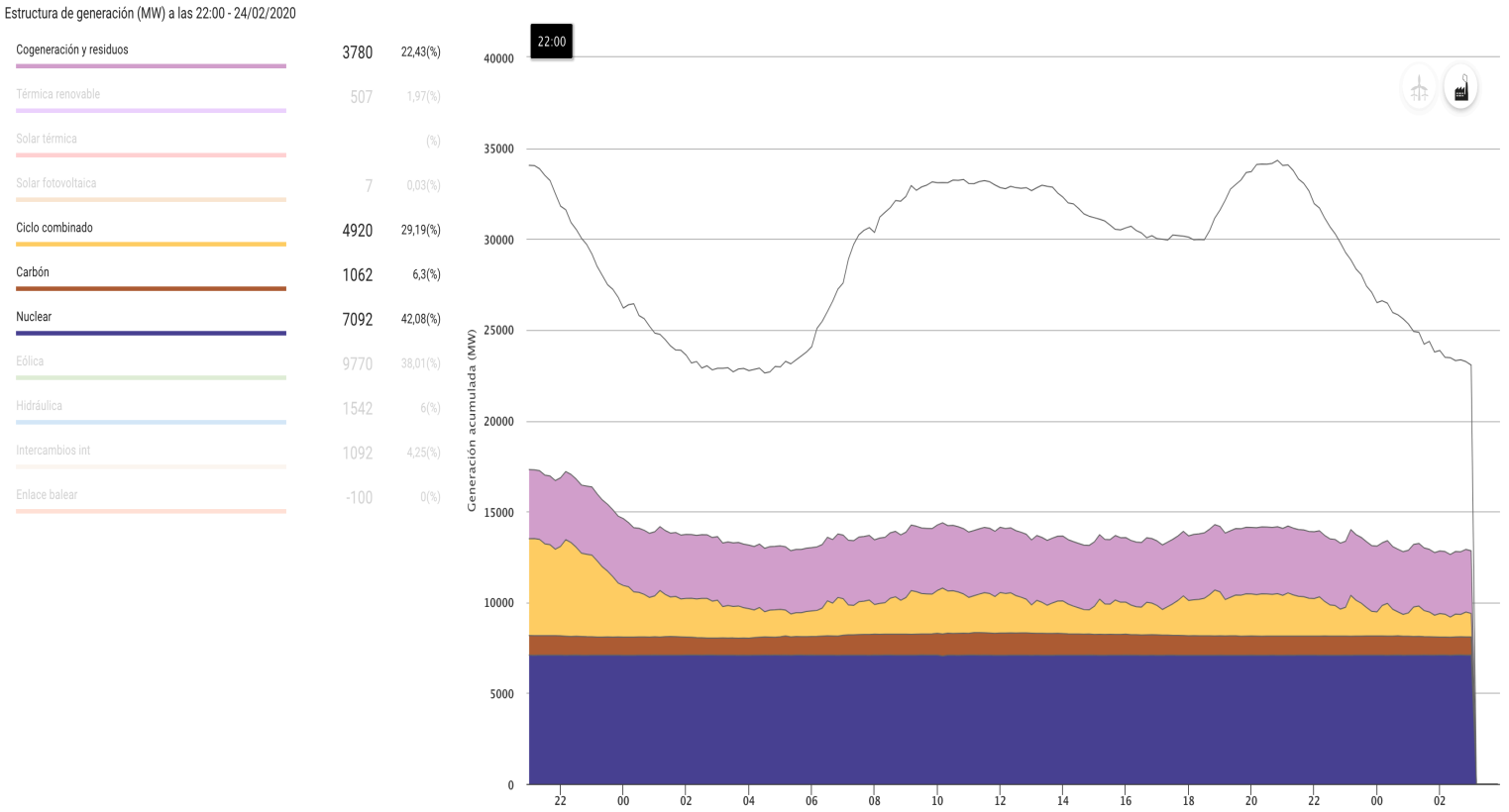
Brown generation technologies



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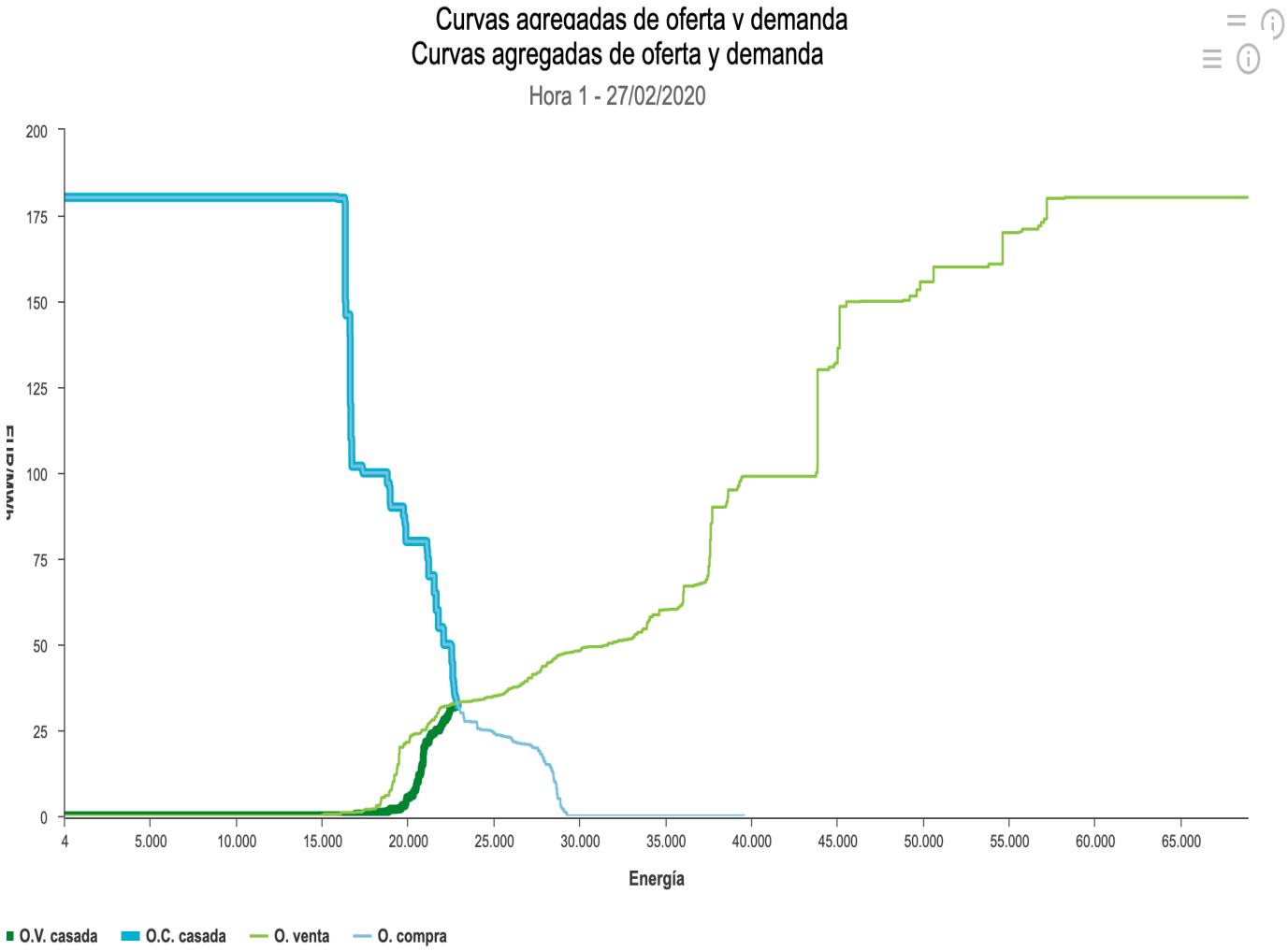
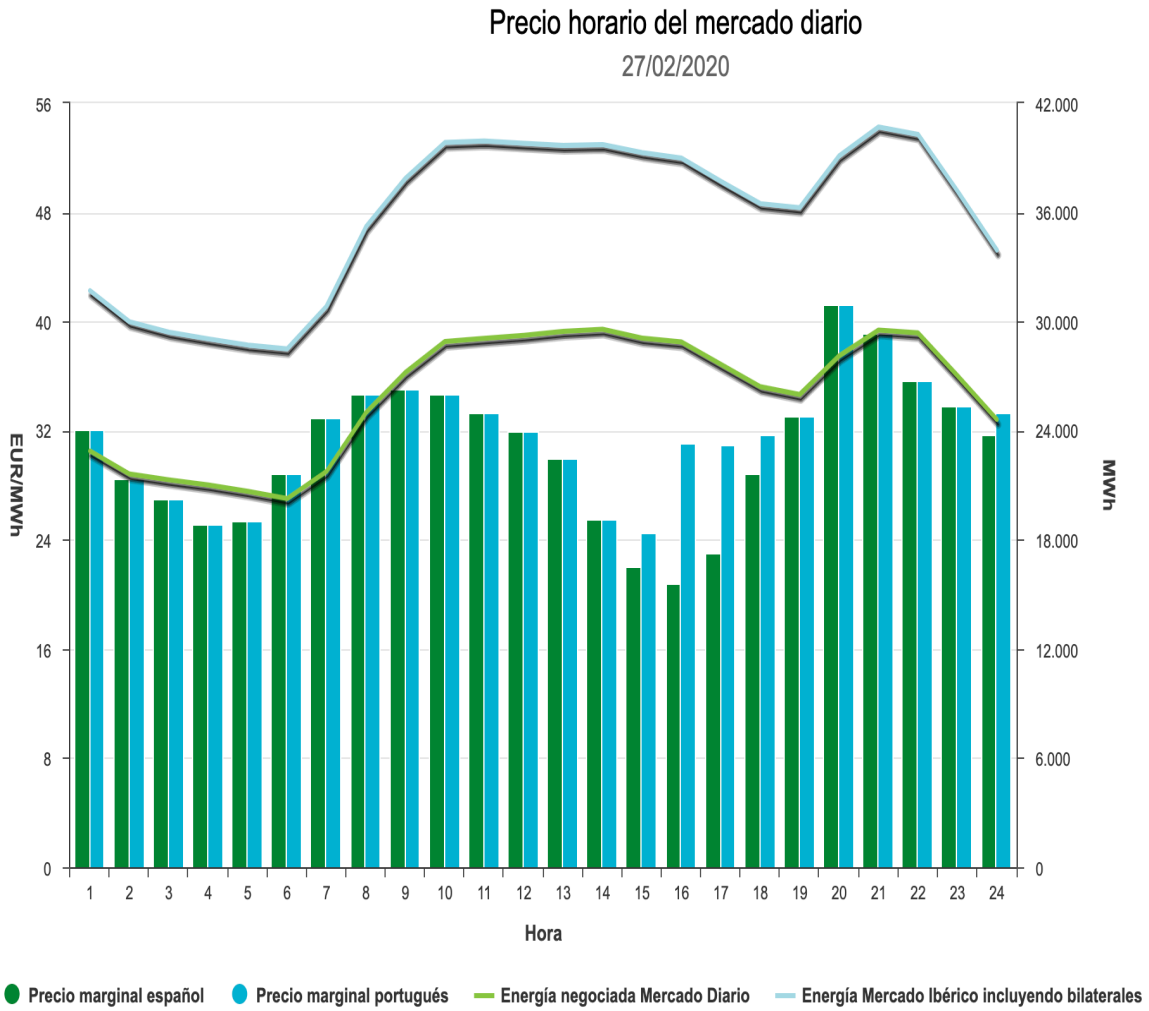
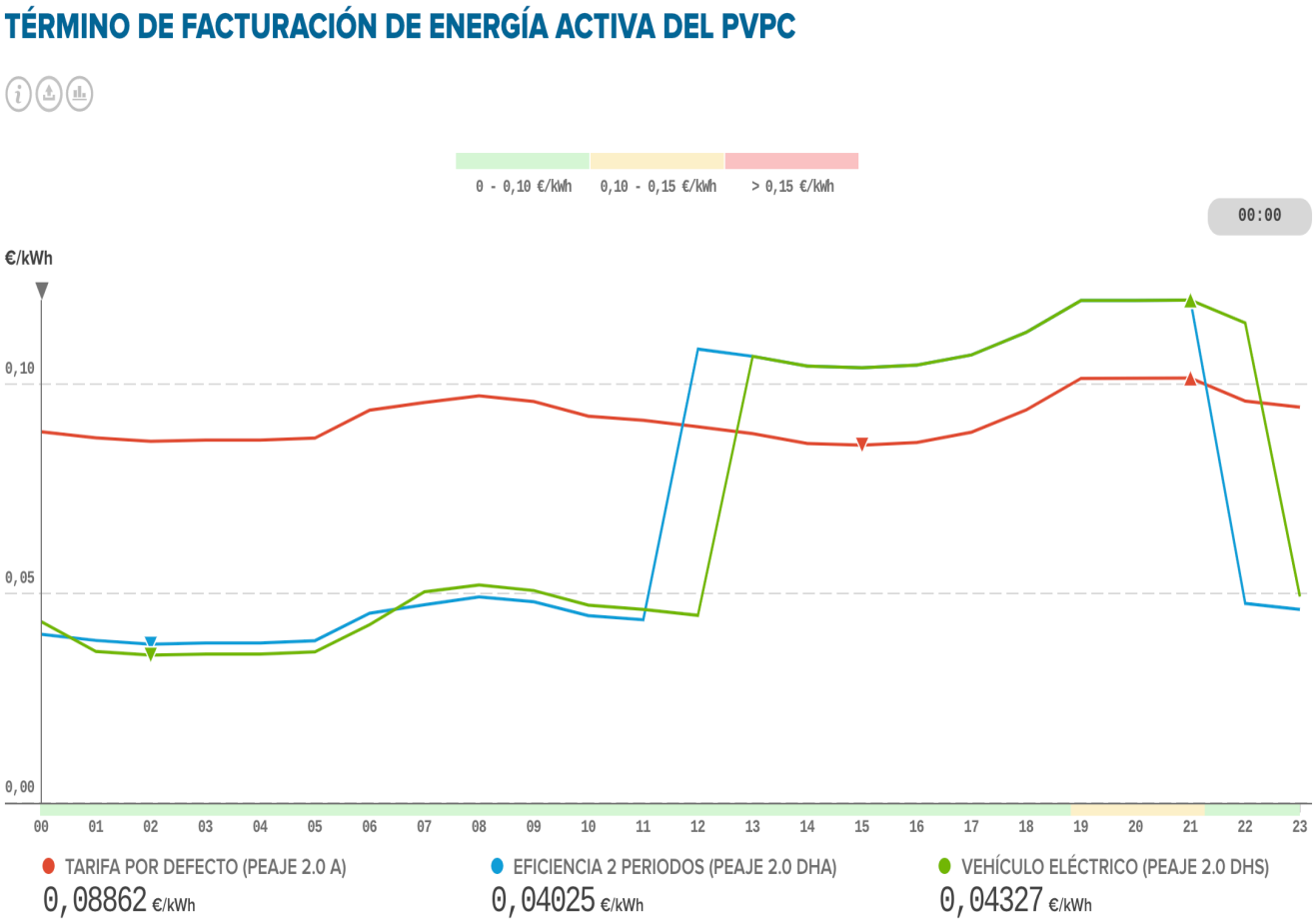
Price setting in wholesale electricity



As demand moves over the day, prices change



Electricity prices for households



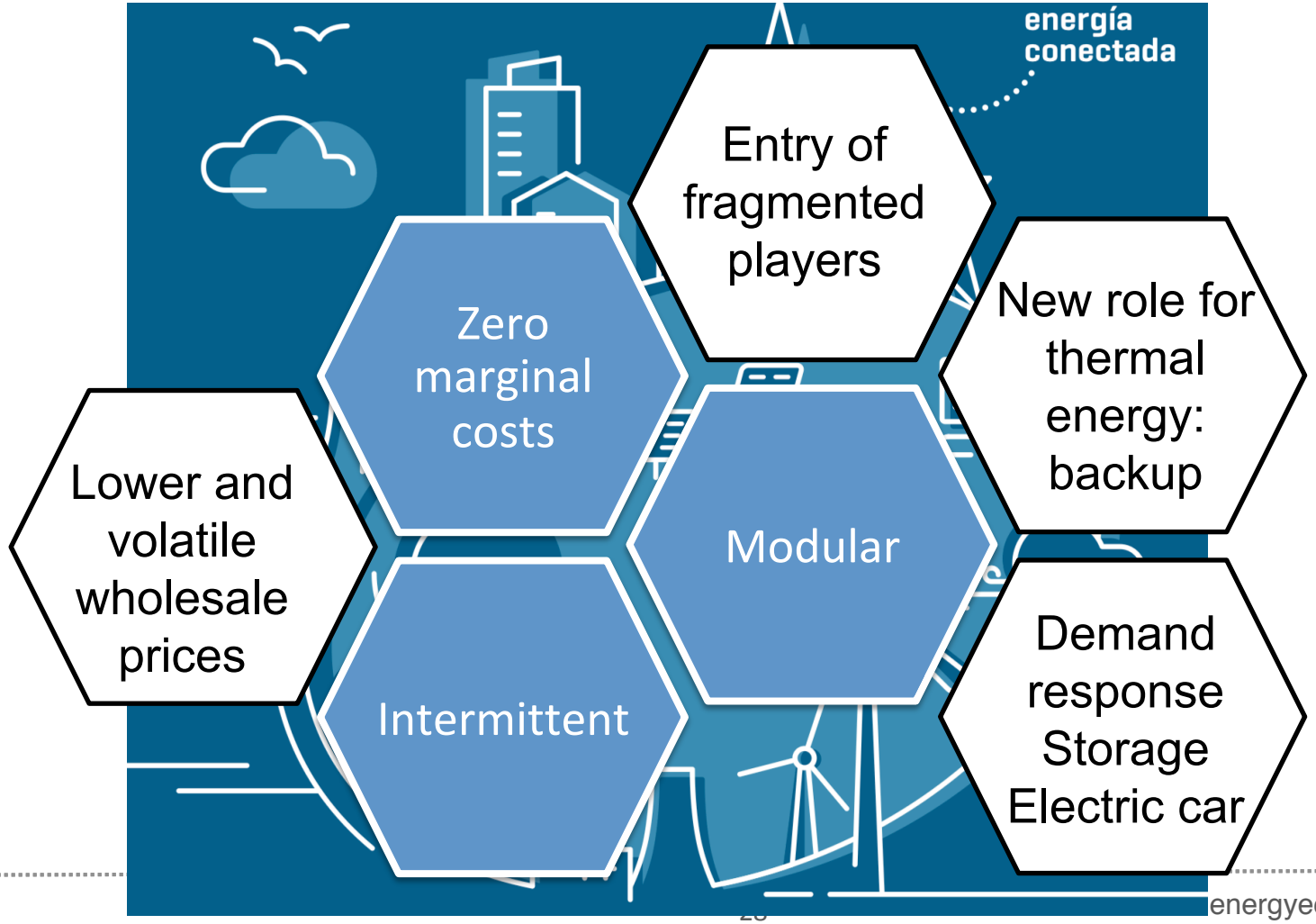
https://www.esios.ree.es/es/pvpc

Some key challenges for the power sector

Renewables: a game changer

- Investments in renewables
- Investments in back-up capacity
- Pricing for final consumers

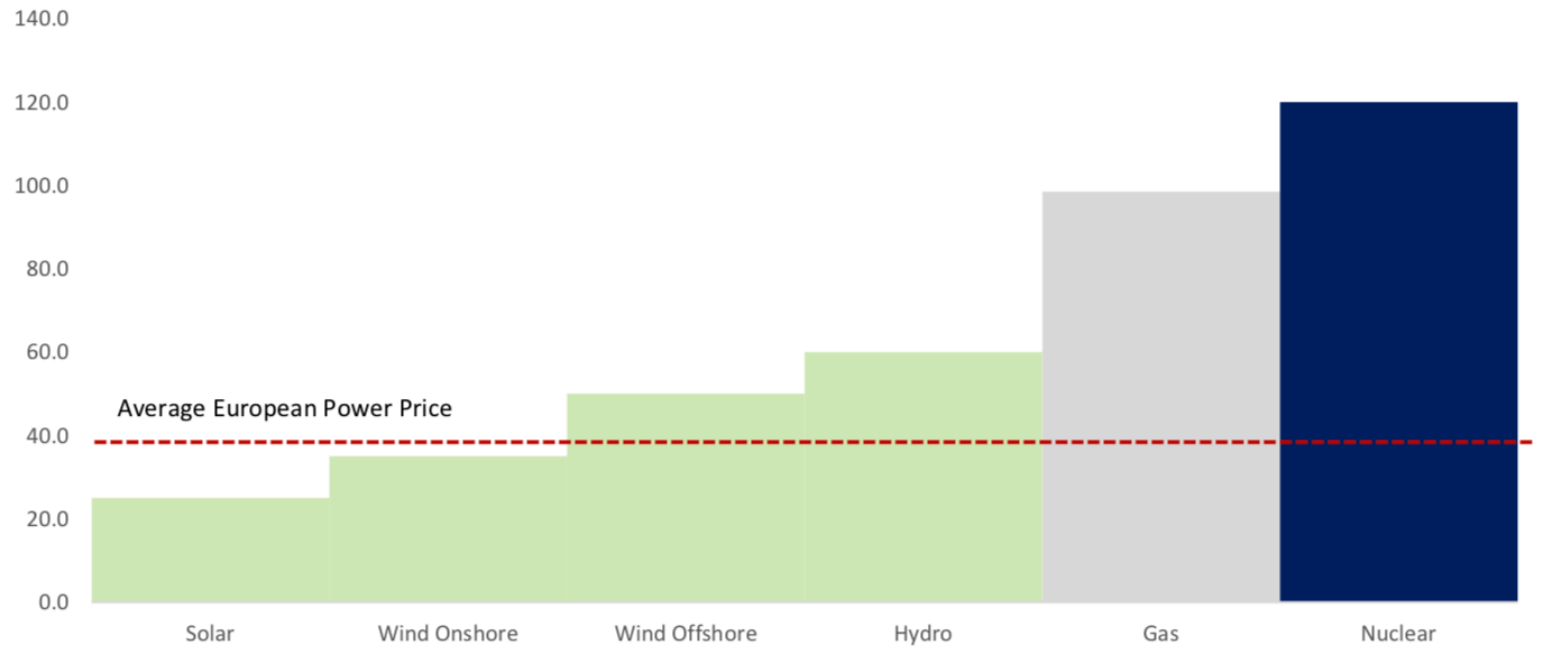
Renewables: a game changer



Renewables are competitive

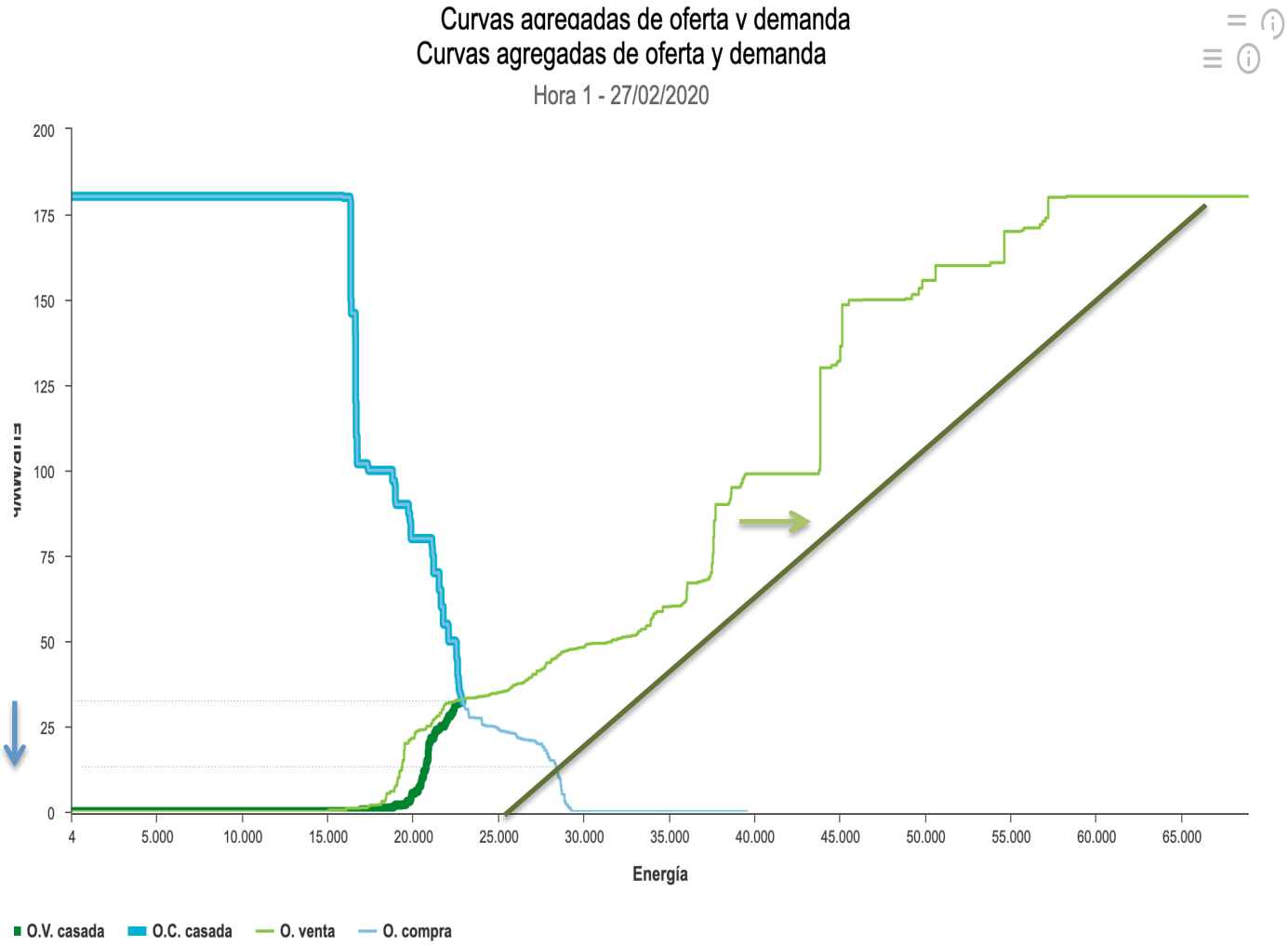
Exhibit 11: Renewable LCOEs are broadly below power prices and largely below any other competing (legacy) technologies

Levelised cost of electricity by technology (€/MWh)

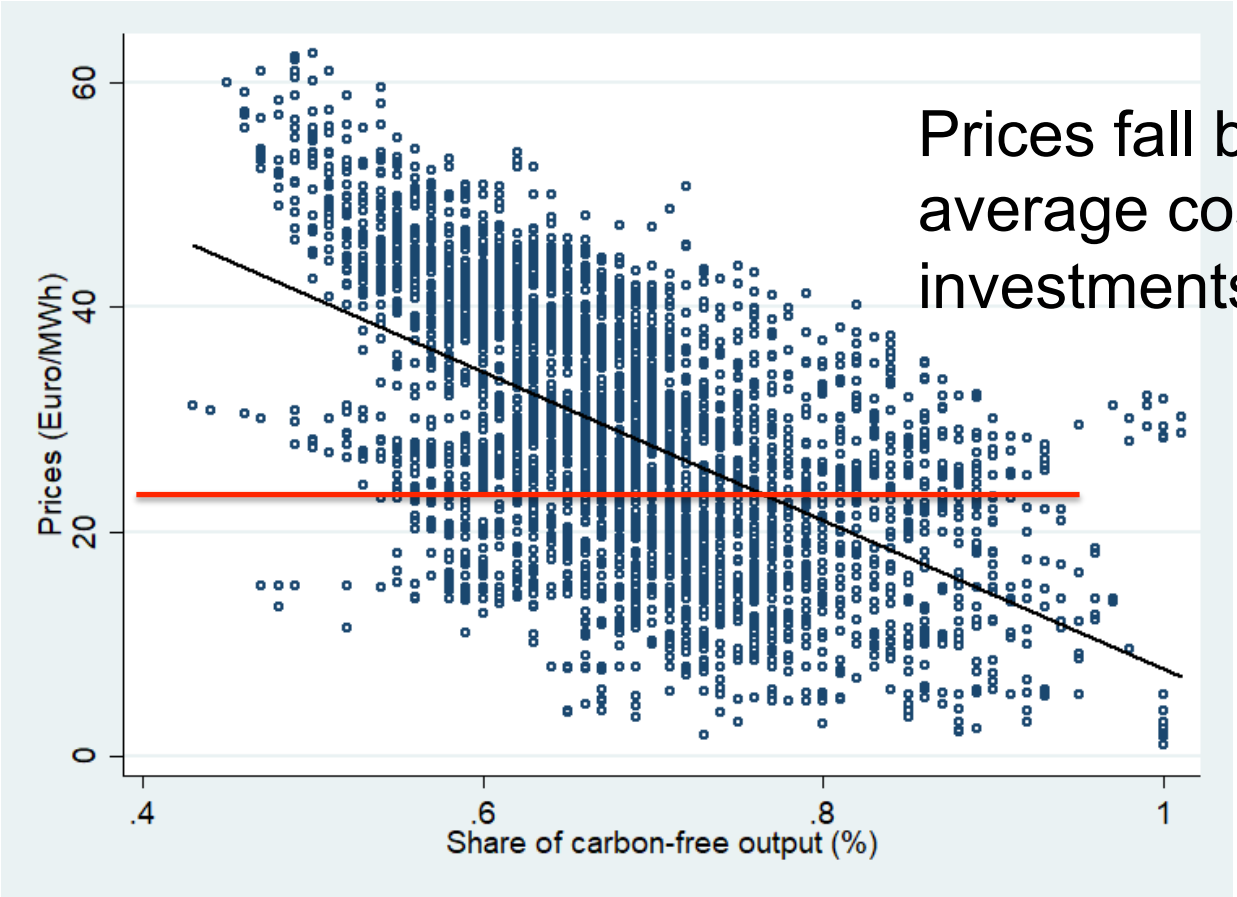


Source: Goldman Sachs Global Investment Research

What happens to prices with more renewables?



Renewables depress market prices….



Prices fall below the average cost of the investments

Correlation between prices and carbon free generation

March-May 2020, Iberian electricity market

The Renewables paradox

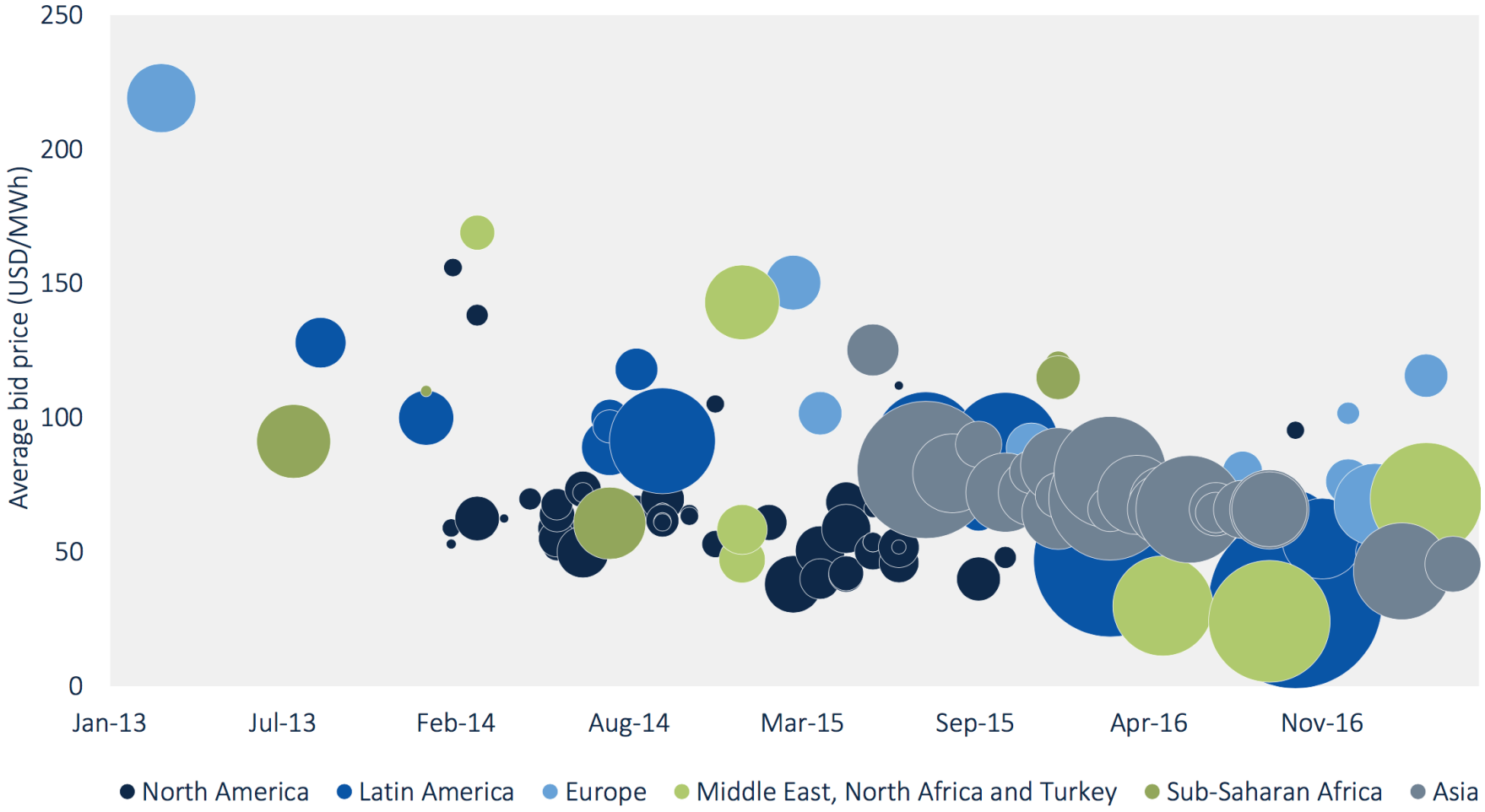
- Investments in renewables are good for society, but investors do not find it profitable to invest:
  - The variable costs of renewables are close to zero
  - Hence, price falls when renewables produce
  - Investors do not recover their investments

How to escape this paradox?

Pay renewable energy according to a **fixed price**

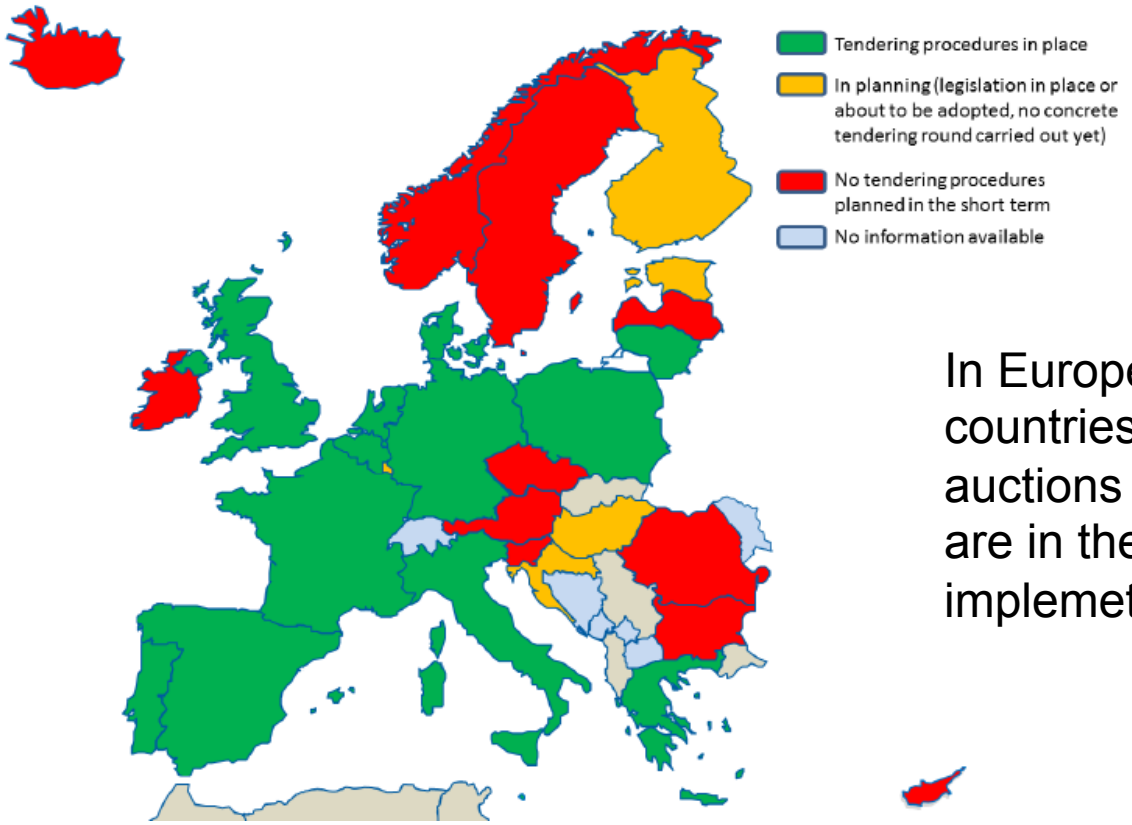
Make firms compete through **auctions** so as to set a competitive fixed price

The renewable auction revolution



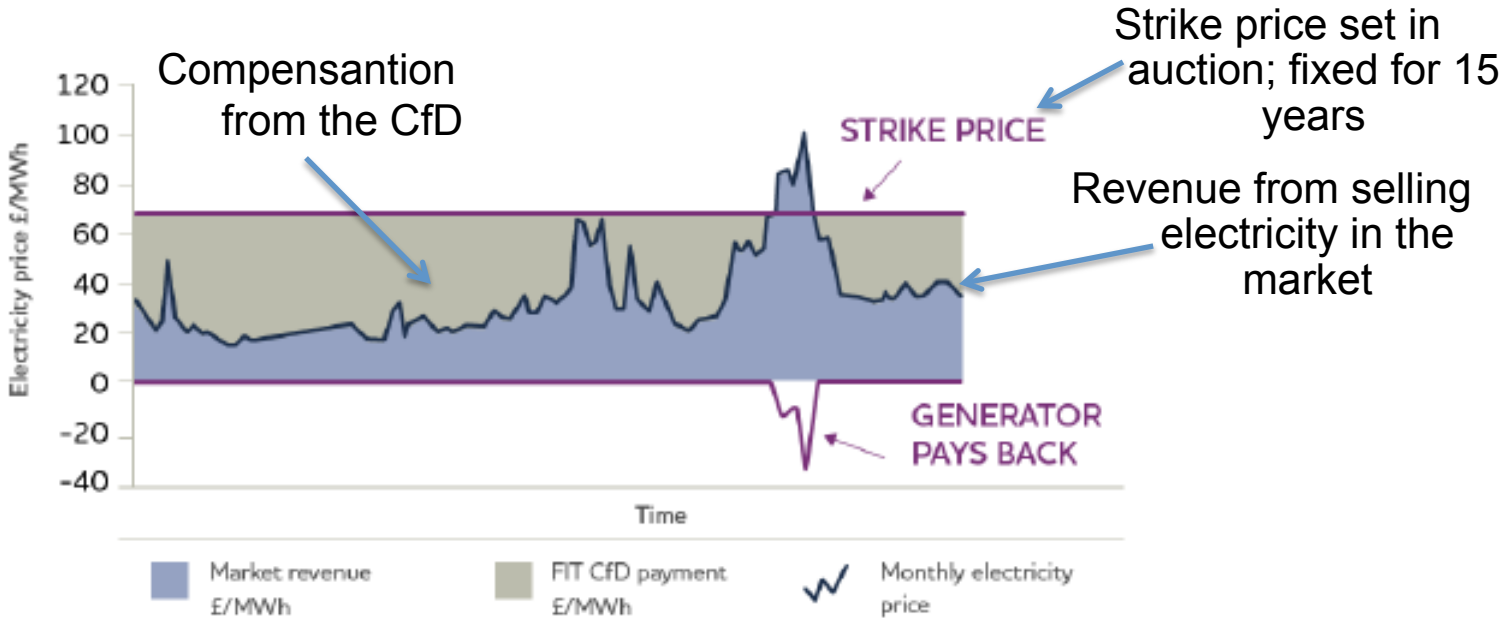
Global Tendered Projects by Bid Price and Capacity, 2014-2016

The renewable auction revolution



In Europe, 13 countries use auctions for RES, 5 are in the process of implemeting them

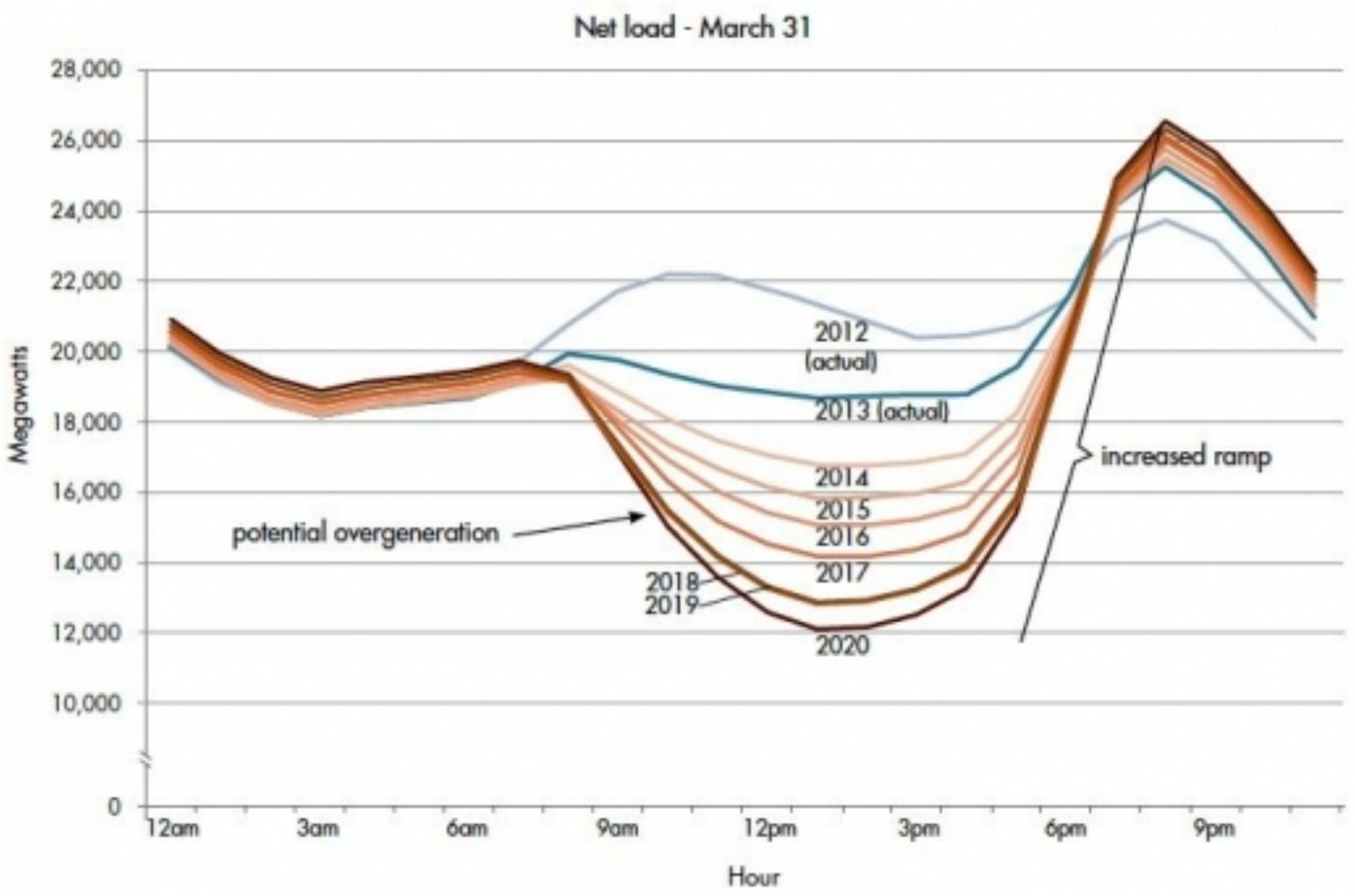
The UK case



FITs with Contracts for Differences (CfD)

- CfDs provide revenue certainty to RES investors
- Reduce the borrowing costs of financing RES projects
- Encourage competition both within and between generation technologies
- Improve affordability (generator pays back if high market price)

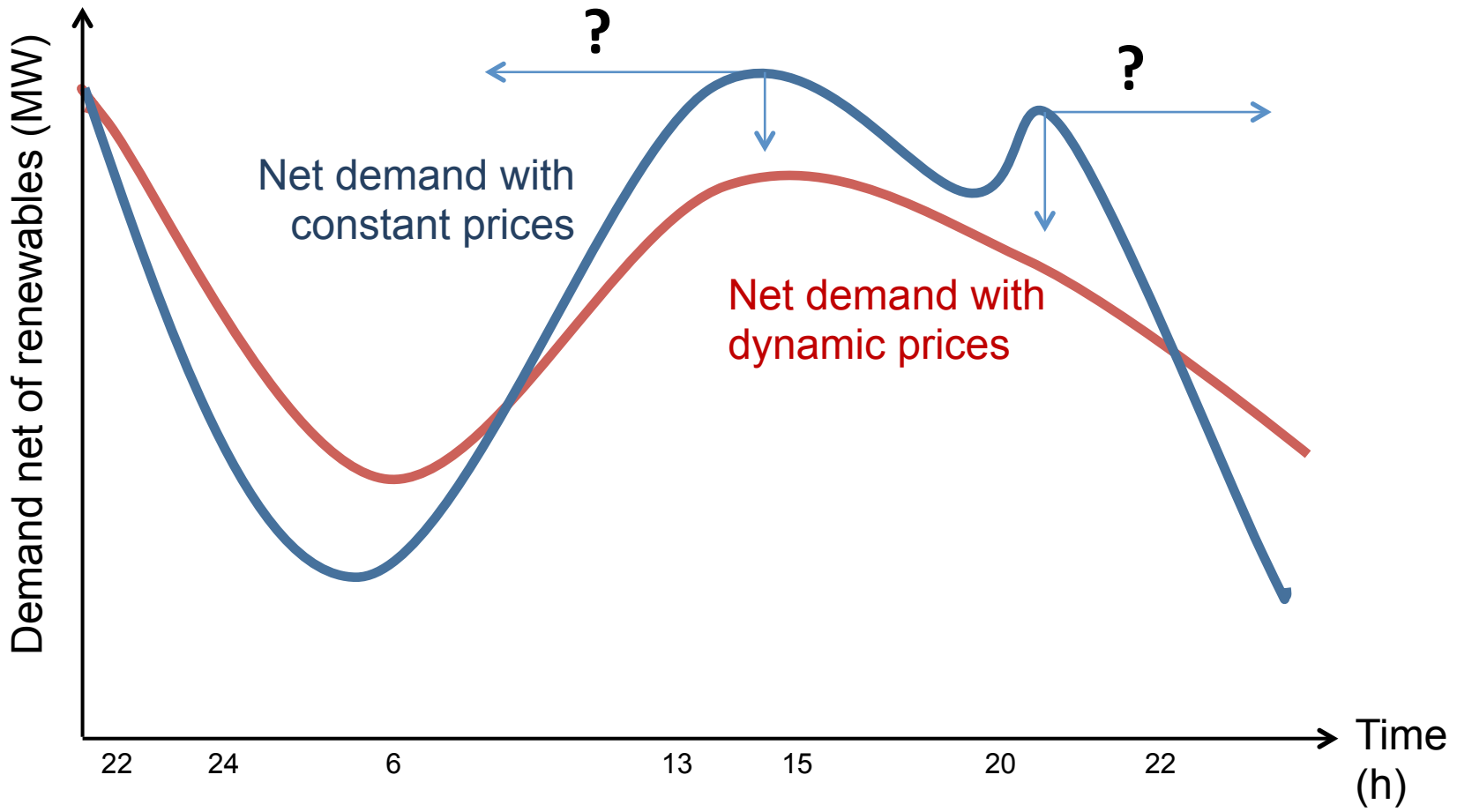
How to promote investments in flexible back-up capacity?



How to promote efficient pricing for consumers?

- In theory, optimal pricing:
  - prices equal to **marginal costs**
  - fixed fees to cover **fixed costs**
- This implies:
  - Price change hour-by-hour (**dynamic prices**)
    - Do consumers really respond?
    - Time-of-Use prices simpler, but they are a second-best
  - Weak incentives to invest in **energy efficiency**
  - Possibly **regressive effects**

How to promote efficient pricing for consumers?



Re-think market design and pricing

- Shift of focus from the short to the long-run
- Need to de-risk investments
- **Auctions for long-term contracts**
  - **Renewable energy**
  - Back up capacity
- Need to re-think price signals
- Liquid spot markets
- Important role for System Operators
- Market integration through interconnections

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Thank You!

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