Spanish wholesale electricity price dynamics

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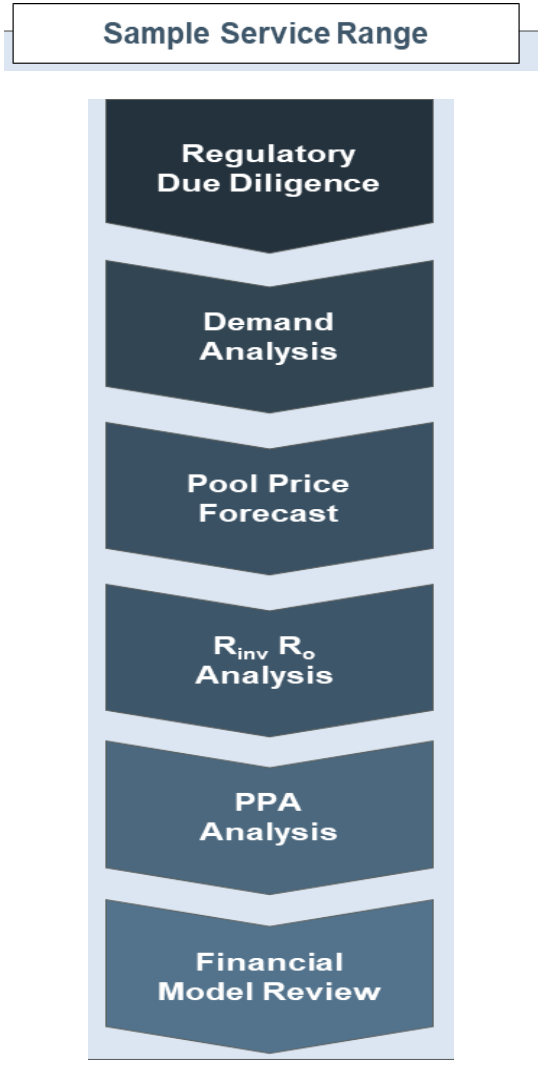
EKON'S SERVICE RANGE IN THE ENERGY SECTOR

- Broad range of services to financiers, utilities, IPPs and governmental agencies.
- Team background in energy consulting, strategic advisory and project development.
- Expert witness testimony in arbitration hearings of renewable arbitrations and commercial arbitrations between gas buyers and sellers.
- Regulatory and market due diligence reports that are relied upon by lenders.
- Supported successful completion of 52GW with a transaction value of US$35 billion.



Spanish Electricity Price Dynamics

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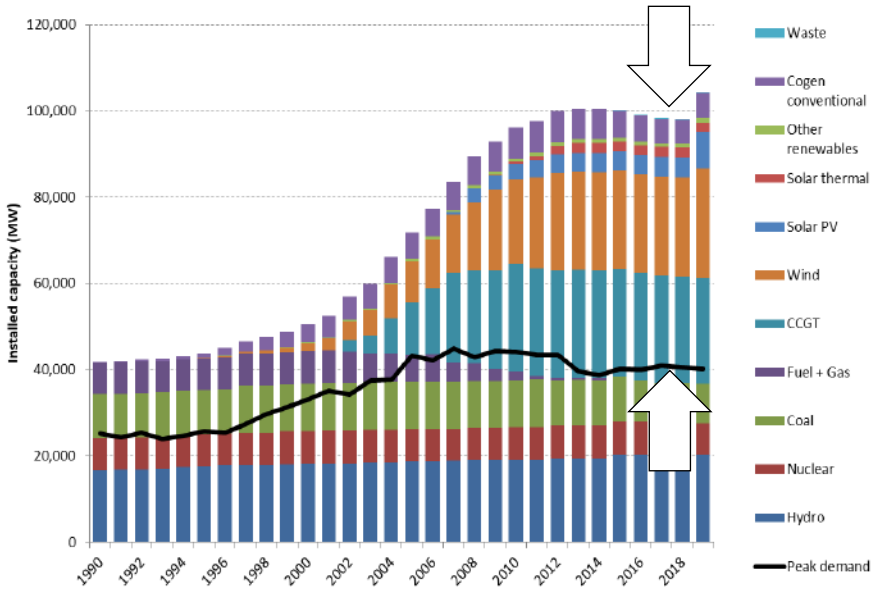
- Final comments

HISTORICAL CAPACITY MIX

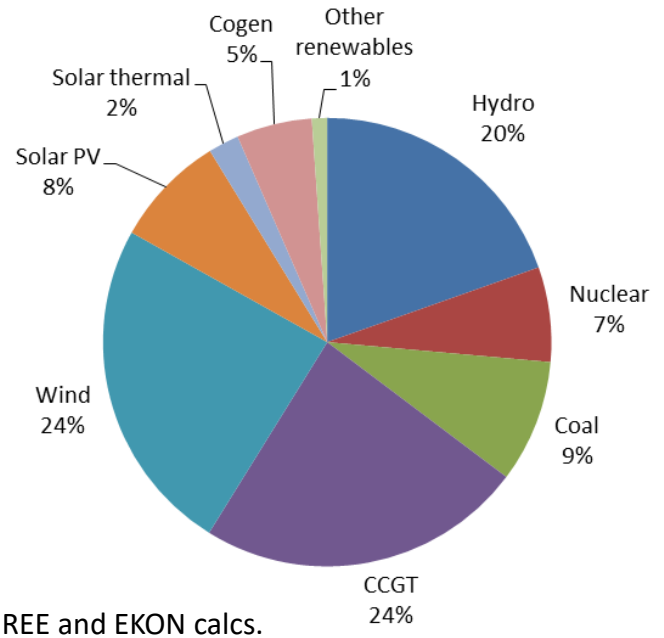
- We are not building renewables cause the lights are about to go out…

Evolution of installed capacity



Source: REE and EKON calcs.

Capacity mix (2019)



Source: REE and EKON calcs.

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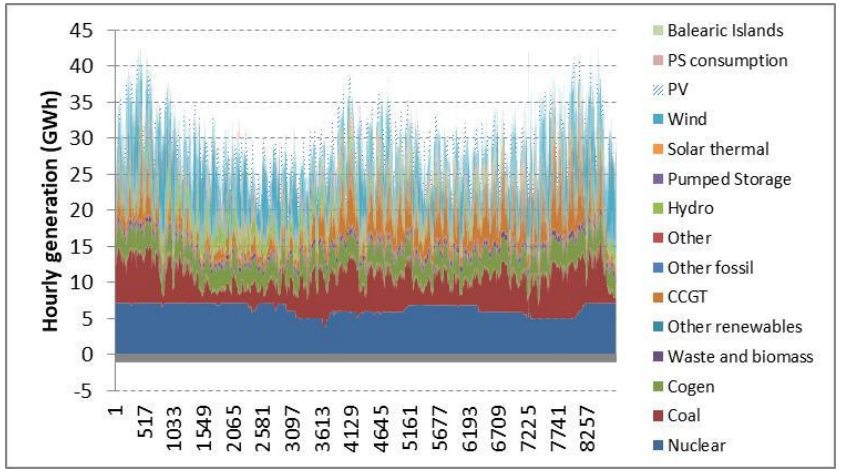
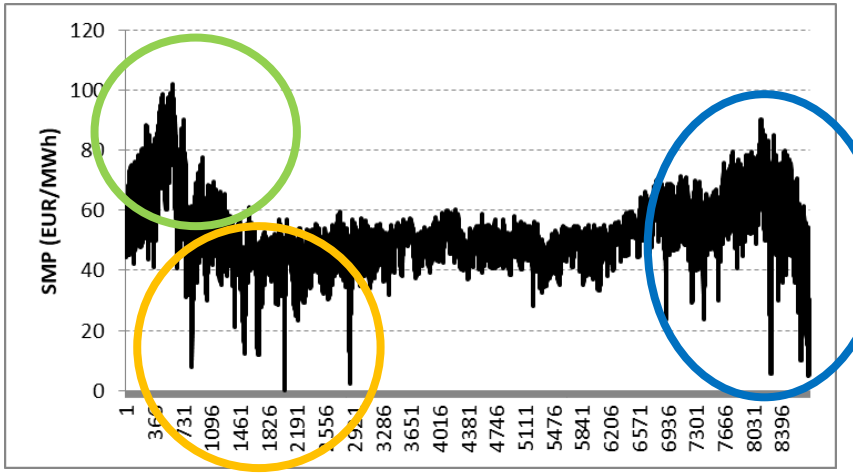
WHAT TO MAKE OF MARKET OUTCOMES?

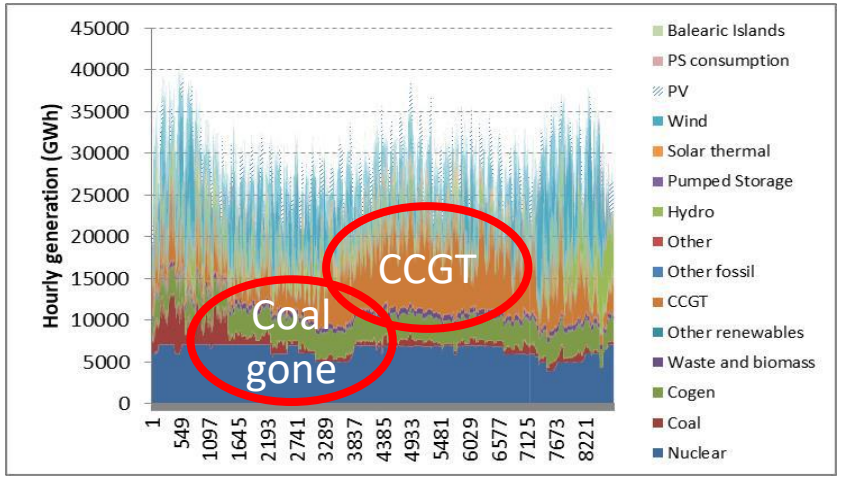
- Hourly data for 2017 and 2019 shows volatility of market prices and generation.

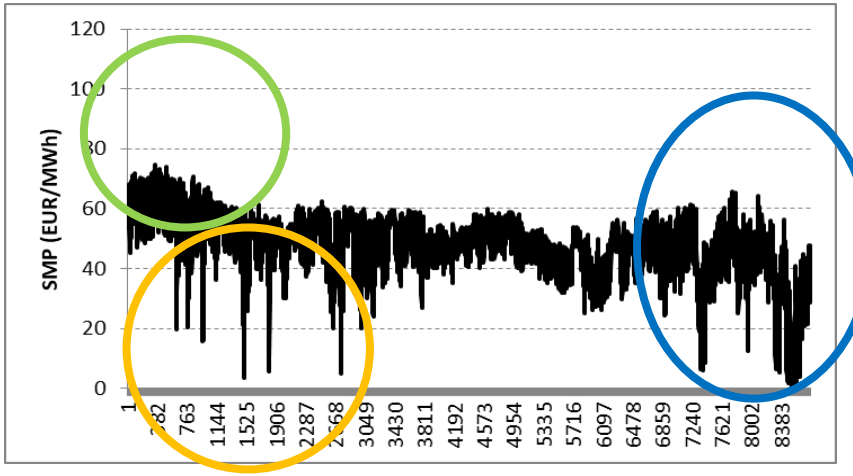
2017





2019

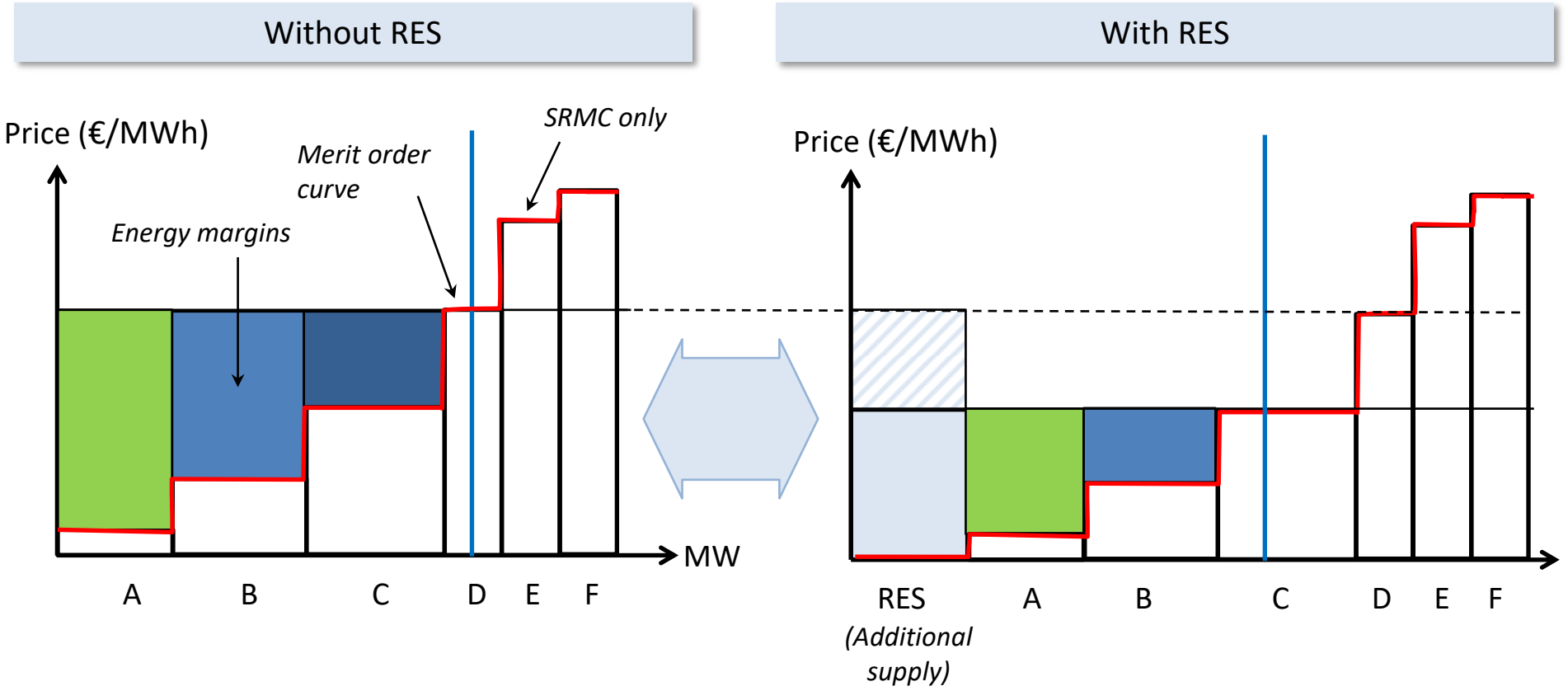




Source: REE ESIOS.

THE CHICKEN (DUCK?) AND EGG PROBLEM…

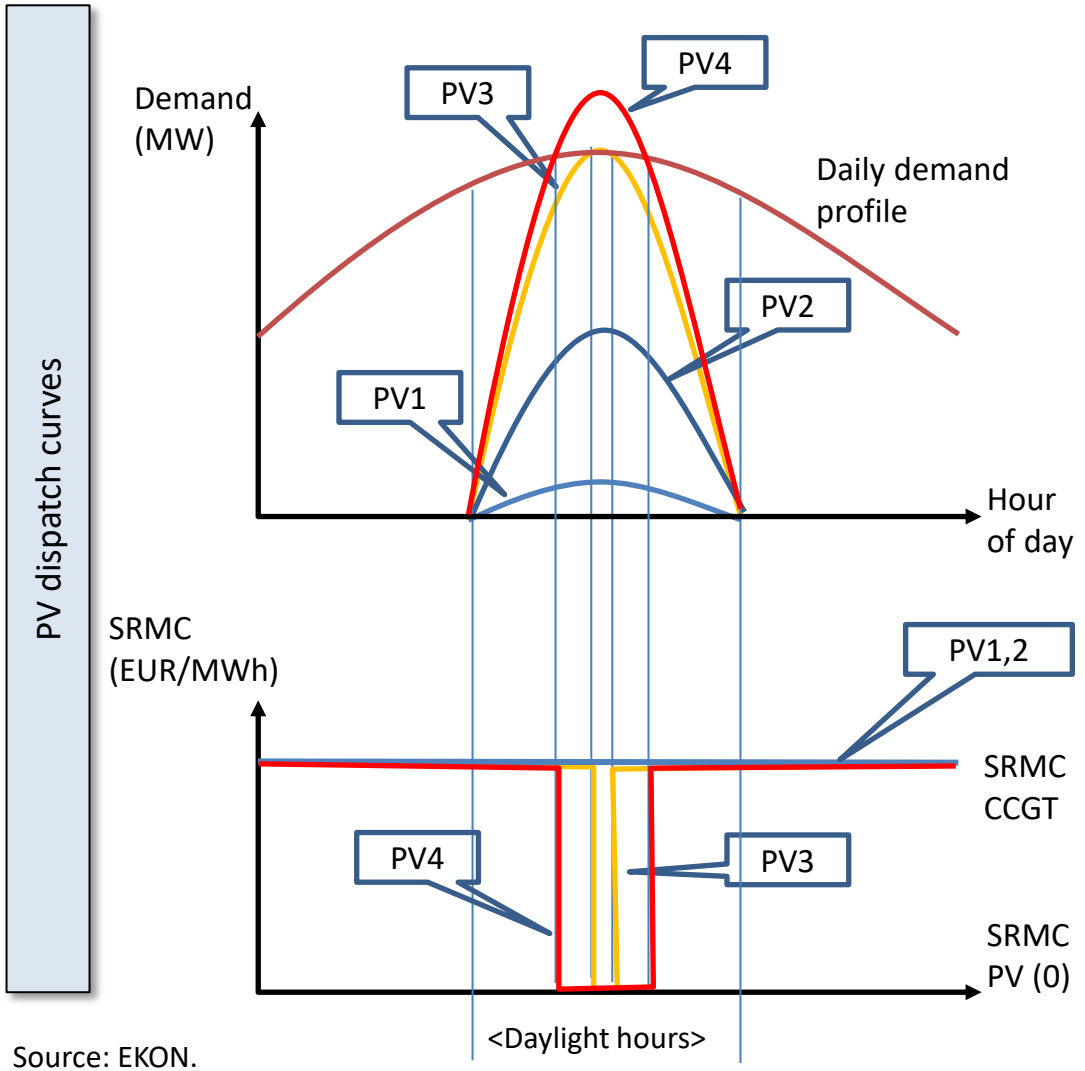
- Market participants make an assessment of profits from the energy market. Renewables energy sources ("RES") are price takers but will still affect market outcomes thereby reducing their remuneration the more they produce.



Source: EKON.

Recap https://www.youtube.com/watch?v=pHrUIGTlqt4&feature=youtu.be.

PV SATURATION REACHED WHEN REALISED PRICE OF PV = LCOE



Source: EKON.

- Consider simple 24-hour set-up with gas-fired CCGT. As you add PV capacity (PV1, PV2) prices will still be set by CCGT. After a point, the prices drop.
- After market reaches saturation point, there is no commercial incentive to build more PV. (Note that this point has no "missing money" problem, which happens when deployment is pushed beyond this limit .)

Recap https://www.youtube.com/watch?v=pHrUIGTlqt4&feature=youtu.be.

Impact of COVID-19

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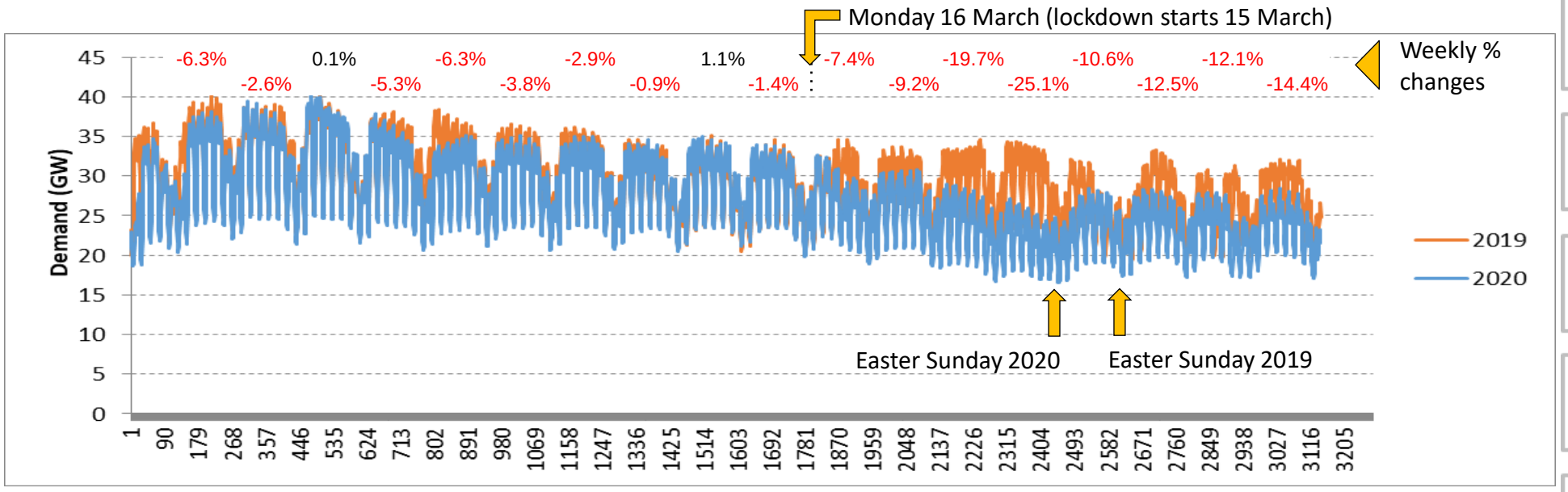
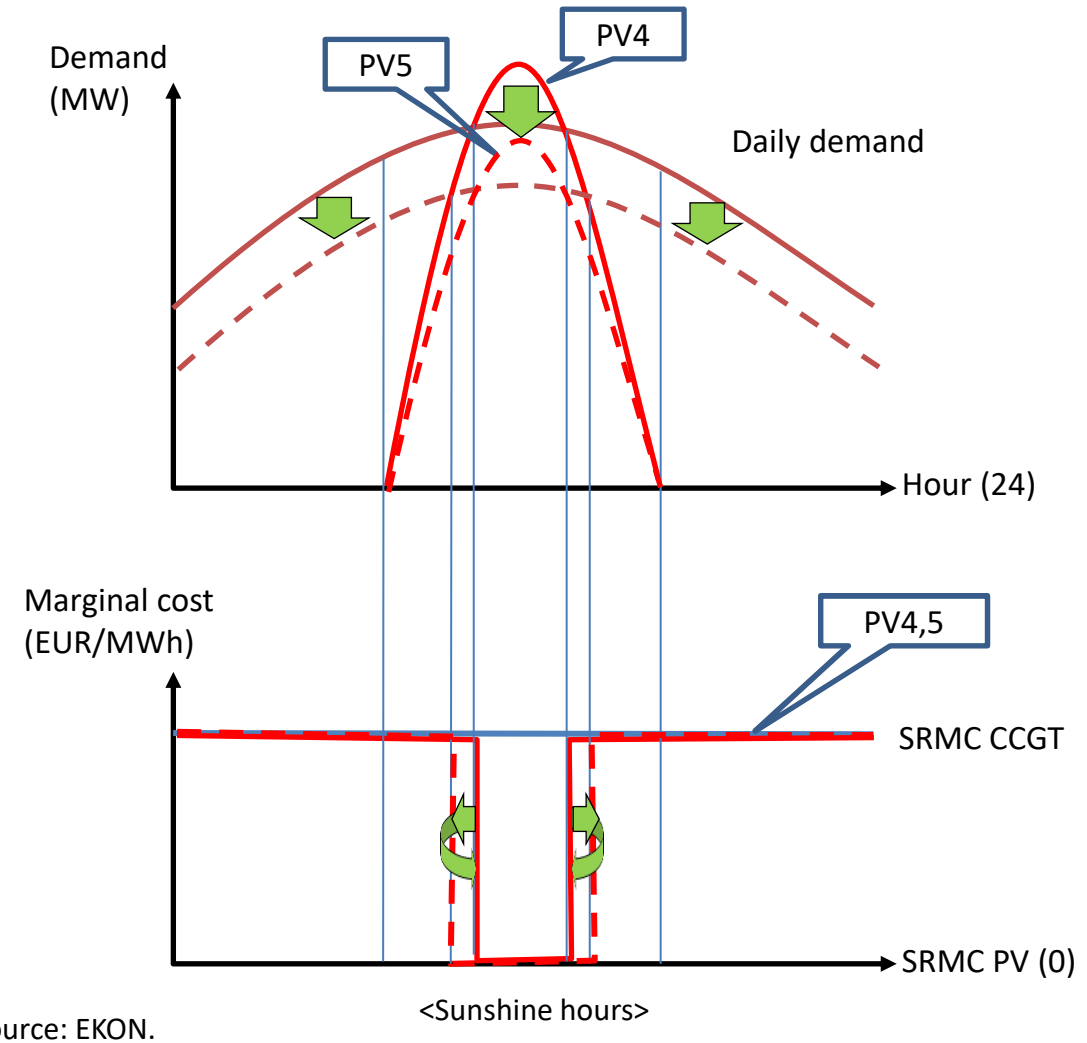
EVOLUTION OF DEMAND IN 2020

- Hourly demand profiles (synched by weekday) for Spain. If you see orange this indicates a drop in demand relative to the same period in 2019.
- But note that demand is affected by other things too: February had good weather. Beware weekly comparison: Easter Sunday was in mid April this year (12 April) and end of April last year (21 April).
- Pay attention to moving average/trend. Assuming demand reduction stabilises at say -12% for the rest of the year, looking at reduction in annual demand of 9%.
- IMF WEO April 2020 expects GDP growth of -8% in 2020 and 4.3% in 2021. Expect some recovery of demand in 2021…



Source: ENTSO-E.

WHAT HAPPENS WHEN DEMAND FALLS?



Source: EKON.

- If the demand falls and the capacity is equal to that of the starting point, there will be more hours with a low price.
- The solution is to decrease the penetration of PV so that the PV realised price does not fall below the Levelised Cost of Electricity ("LCOE").
- Notice that the distribution of prices (positive vs zero prices) is the same with CCGT retaining pivotal role!

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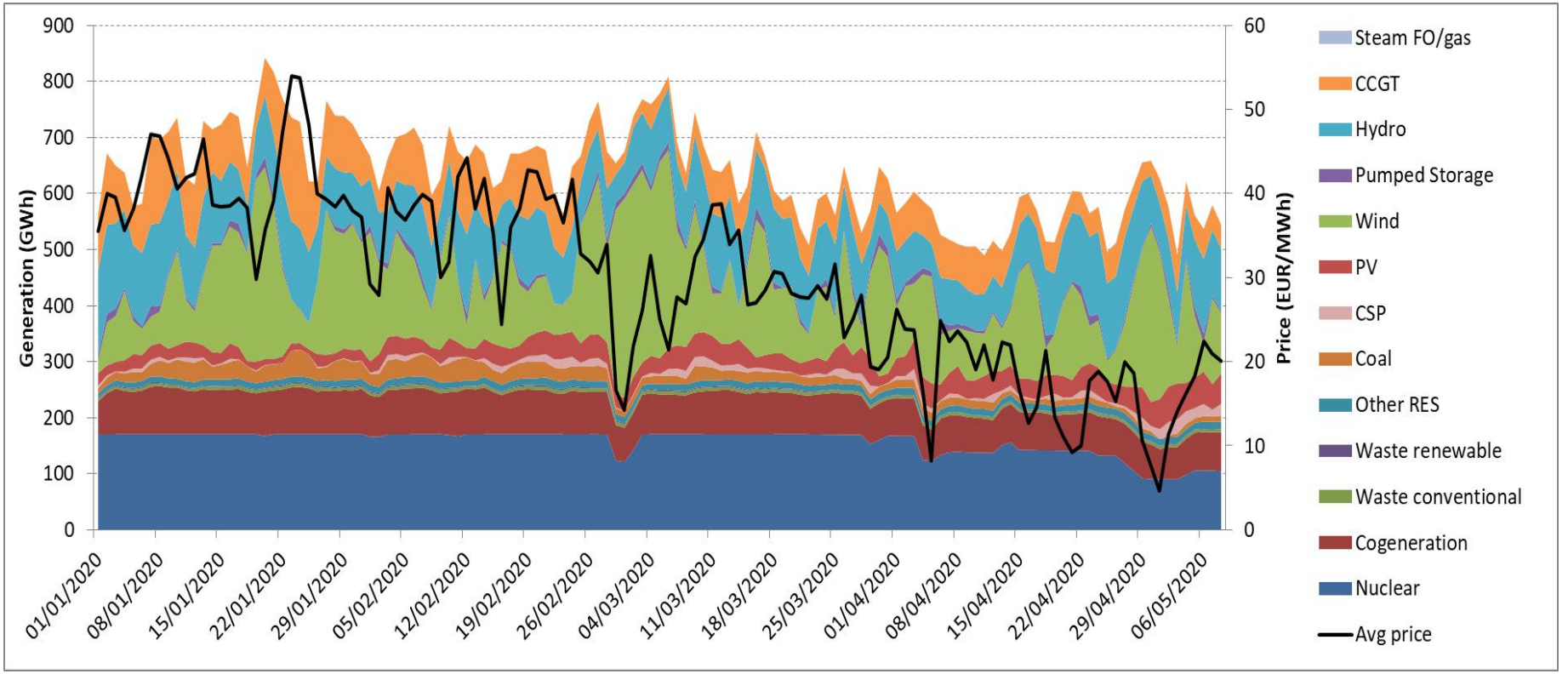
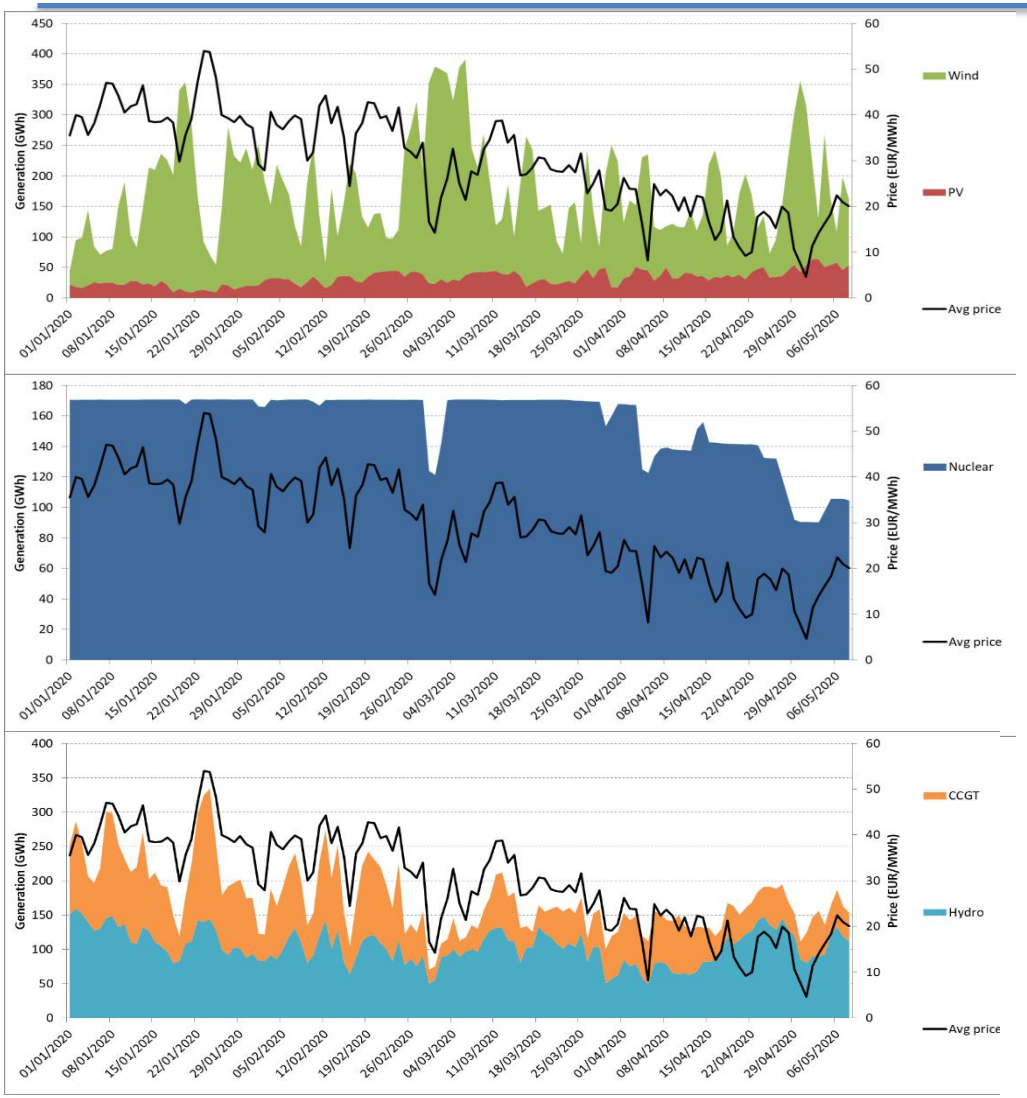
EVOLUTION OF GENERATION AND PRICES (1)

- Daily dispatch by technology and average daily spot prices for Spain in 2020. If you look carefully one can see how the market works…
- Note the large amount of wind, flexibility of nuclear, and continuing balancing role of gas-fired CCGT.



Source: REE and ENTSO-E.

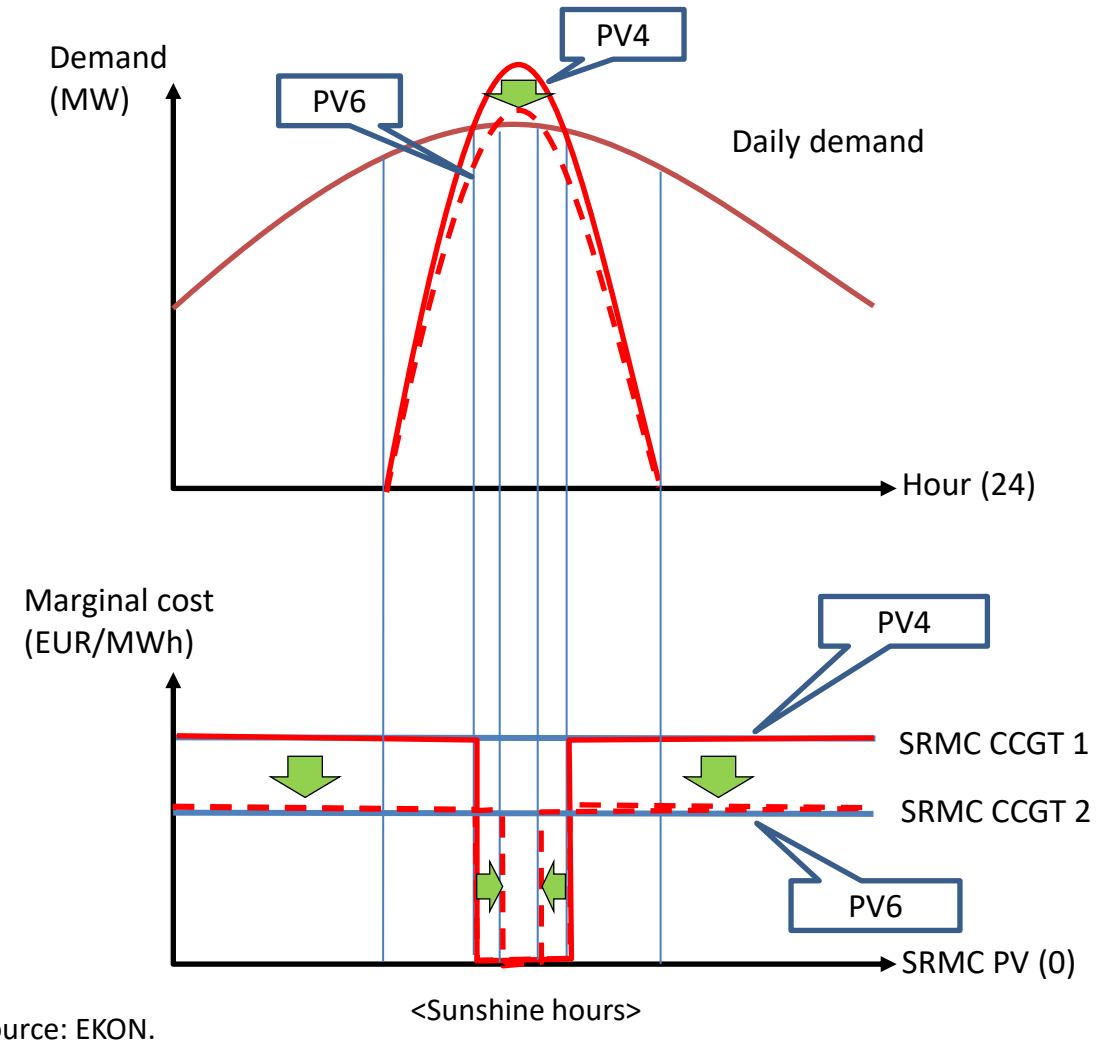
EVOLUTION OF GENERATION AND PRICES (2)



Source: REE and ENTSO-E.

- Renewable (especially wind) generation is inversely correlated with average spot prices. You can see the same thing at the hourly level.
- Programming of nuclear generation has proven to be flexible, even if this is less obvious at the hourly level. There is a price below which nuclear will reduce dispatch (~15€/MWh).
- CCGT retains balancing role with prices positively correlated with dispatch. Flexible hydro always tends to shadow price next most expensive flexible technology, i.e. CCGT, so dispatch positively correlated with prices as well. (Note Q2 is height of annual hydro generation.)

WHAT HAPPENS WHEN COST OF CONVENTIONAL GENERATION FALLS?



Source: EKON.

- If the cost of generating with a CCGT falls - caused by a decrease in the price of natural gas or the cost of CO2 - prices in all hours of PV operation will fall.
- The New PV cannot survive with the same number of very low priced hours, so the penetration of PV must be reduced so that the PV realised price does not fall below the LCOE.
- You have to "close the curtain": the percentage of low prices has to drop enough for the realised price to stabilise at the LCOE. Means market can absorb less PV than before!
- Do we need to reassess 2030 targets and levels of support?

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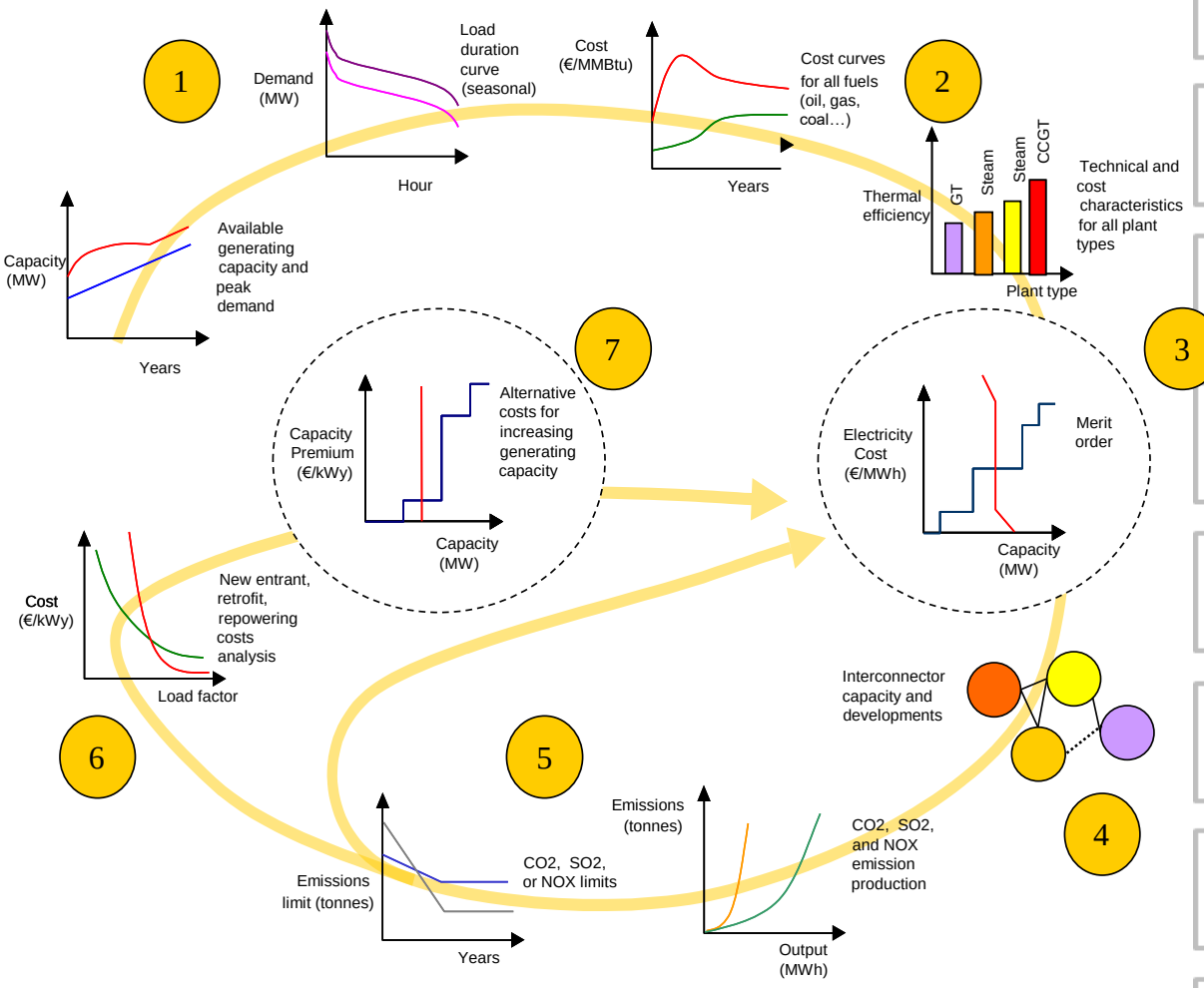
PMM IN A NUTSHELL

- PMM (Power Market Model) is designed to replicate the operations of the actual power system about which one is concerned.
- By including the economic and environmental constraints facing market participants in the real world, PMM replicates how actual decisions are made by stakeholders when subject to any slate of operational constraints, regardless of whether these constraints are physical, economic, or environmental.
- And everything in MS EXCEL.



OVERVIEW OF SENSITIVITIES

	Low Case *(Low1_20200507)*	Central Case *(Ref1_20200507)*	High Case *(High1_20200507)*
Demand growth	COVID+NECP BAU	COVID+NECP BAU	COVID+NECP Target
Fuel prices	World Bank (April 2020)	World Bank (April 2020)	WB+30%
CO2 (EUA prices)	25€/tCO2	25€/tCO2	IEA WEO 2018 NPS
Domestic coal surcharge	None	None	Applied
IED coal output cap	None	None	Annual output caps applied
Green Cent Tax	None	Applied to Coal	Applied to Coal
Generation Tax (7%)	None	Phasing out	Phasing out
Annual hours for New PV	2050	1739 (historical)	1739 (historical)
Annual hours for New Wind	3000	2500	2166 (historical)
TIC of New Wind and PV (EUR/KW)	-20%	1000 and 750	1000 and 750
Annual cap on New Wind and PV (from 2020)	5/4GW from 2020, uncapped from 2031	2.0/1.5GW from 2023	2.0/1.5GW from 2023

Most important

Note: Prices real 2020 €.

- NECP growth adjusted for COVID19 (-8pp/+4.3pp in 2020/21). Crude oil and international coal price forecasts based on World Bank (Apr 2020).
- CO2 prices set at 25EUR/tCO2 or IEA's WEO 2018 New Policies Scenario ("NPS").
- The High Case applies transportation surcharge for domestic coal and a more restrictive view of the implementation of the Industrial Emissions Directive ("IED").
- Existing auction (2016-2017) projects and 1.5GW of New PV in 2020 and 2021 as "firm". Apply annual caps on the deployment of other "economic" New Wind and PV until 2030 in the Low Case but forever in other cases.

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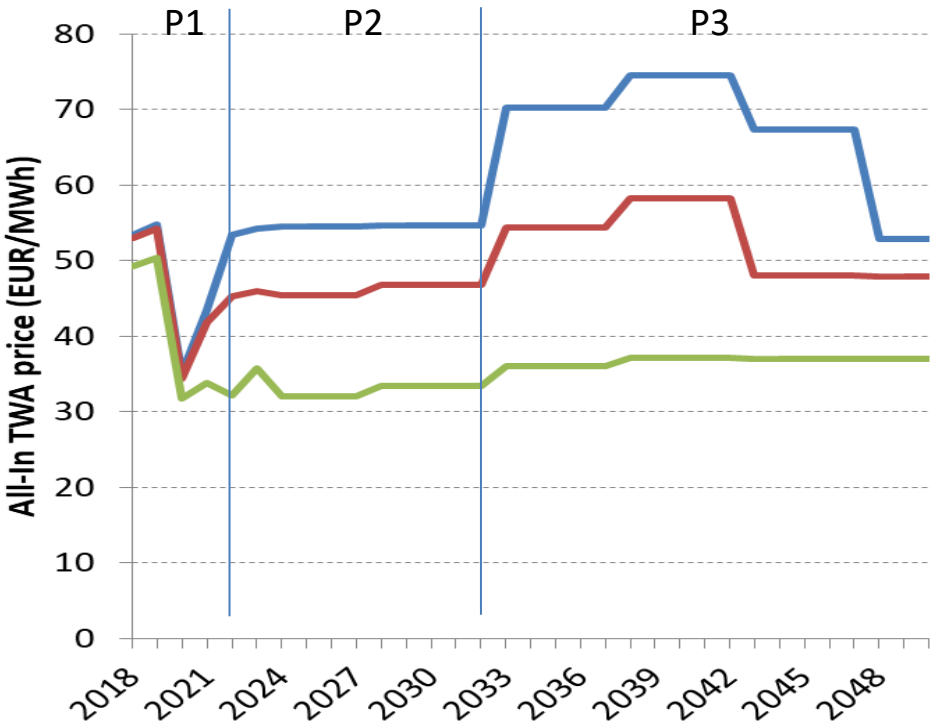
MARKET PRICE FORECASTS

Baseload price forecasts

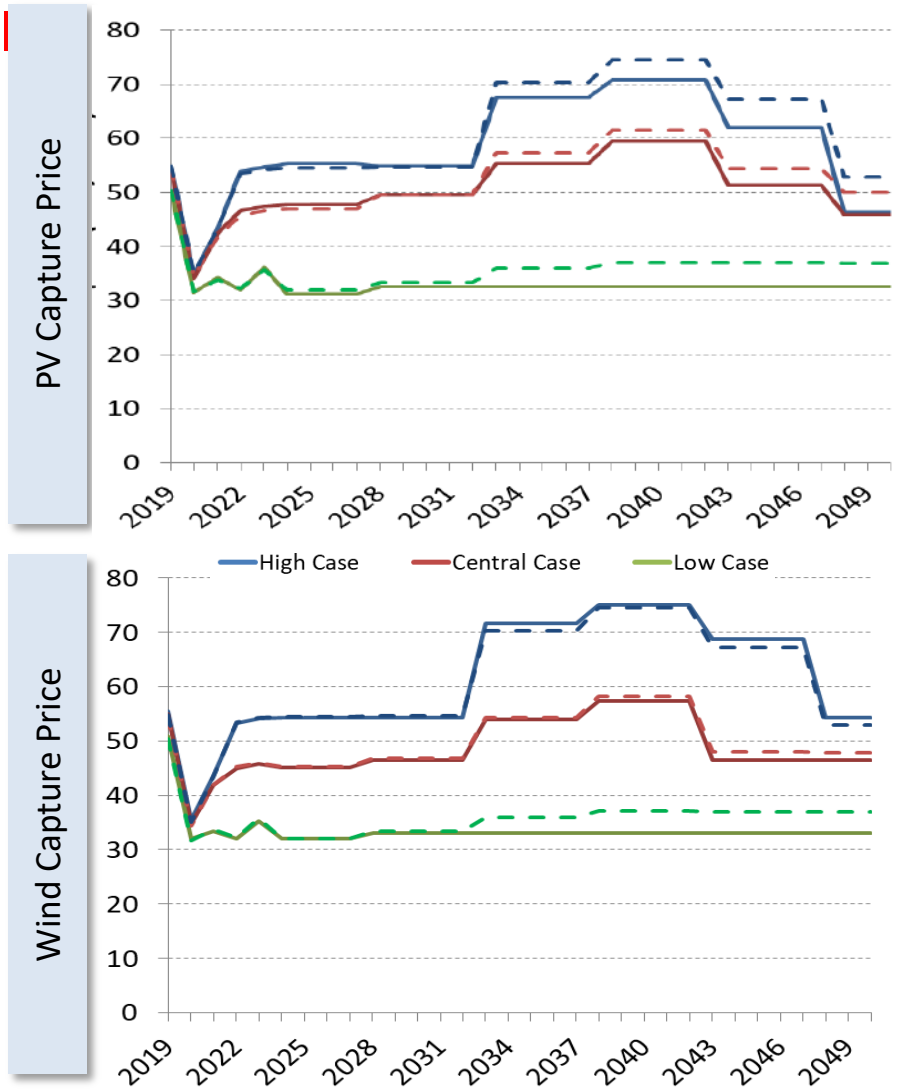


- Prices first move in line with commodity prices (P1) then plateau (P2).
- As a lot of thermal capacity retires in the 2030s, a step-up in prices is expected in the Central and High Cases (P3).
- But even in these cases, renewable capacity eventually catches up and prices drop.

Source: EKON 2020Q2. Prices real 2020 €.

REALISED PRICE FORECASTS

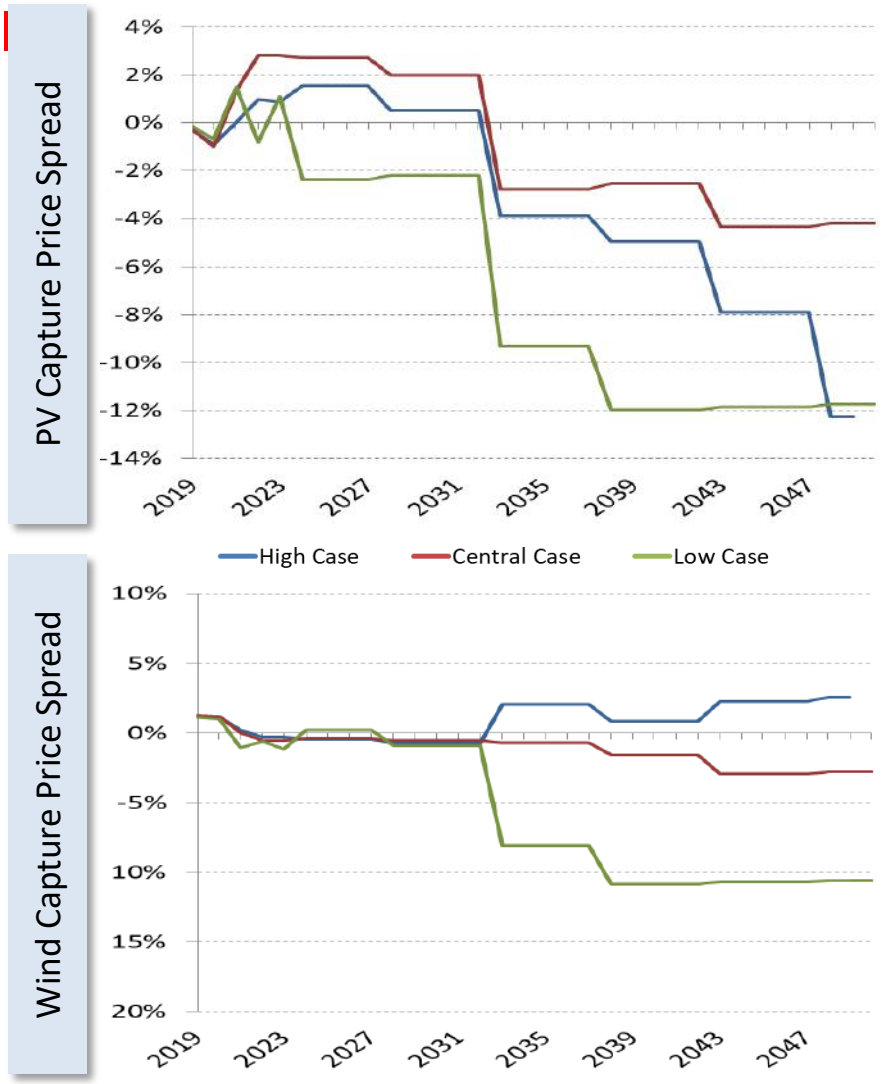
- The PV and Wind Capture Prices track the market price. But as more renewable capacity is introduced, the Capture Prices tend to drop below the baseload price.
- EKON remains optimistic that profitability of renewables will be satisfactory But we are also more pessimistic since we do not believe that market conditions (grid and planning constraints, project "bankability", liquidity of PPAs, etc.) are adequate to reach the government's aggressive capacity goals under the NECP.



Source: EKON 2020Q2. Prices real 2020 €. Dashed line = Baseload prices.

PV AND WIND CAPTURE PRICE SPREADS

- EKON predicts that the PV Capture Price Spread will go from positive to dropping to between -5% to -12% (on average). The Wind Capture Price Spread will fall less.
- When New PV and New Wind capacity are deployed until the Capture Prices converge on LCOE levels, since New Wind is "quasi-baseload" (since the wind blows both during the day and at night), then
  1. Wind Capture Price Spread = ~0
  2. PV Capture Price Spread = ~(LCOE PV – LCOE Wind) / LCOE Wind



Source: EKON 2020Q2.

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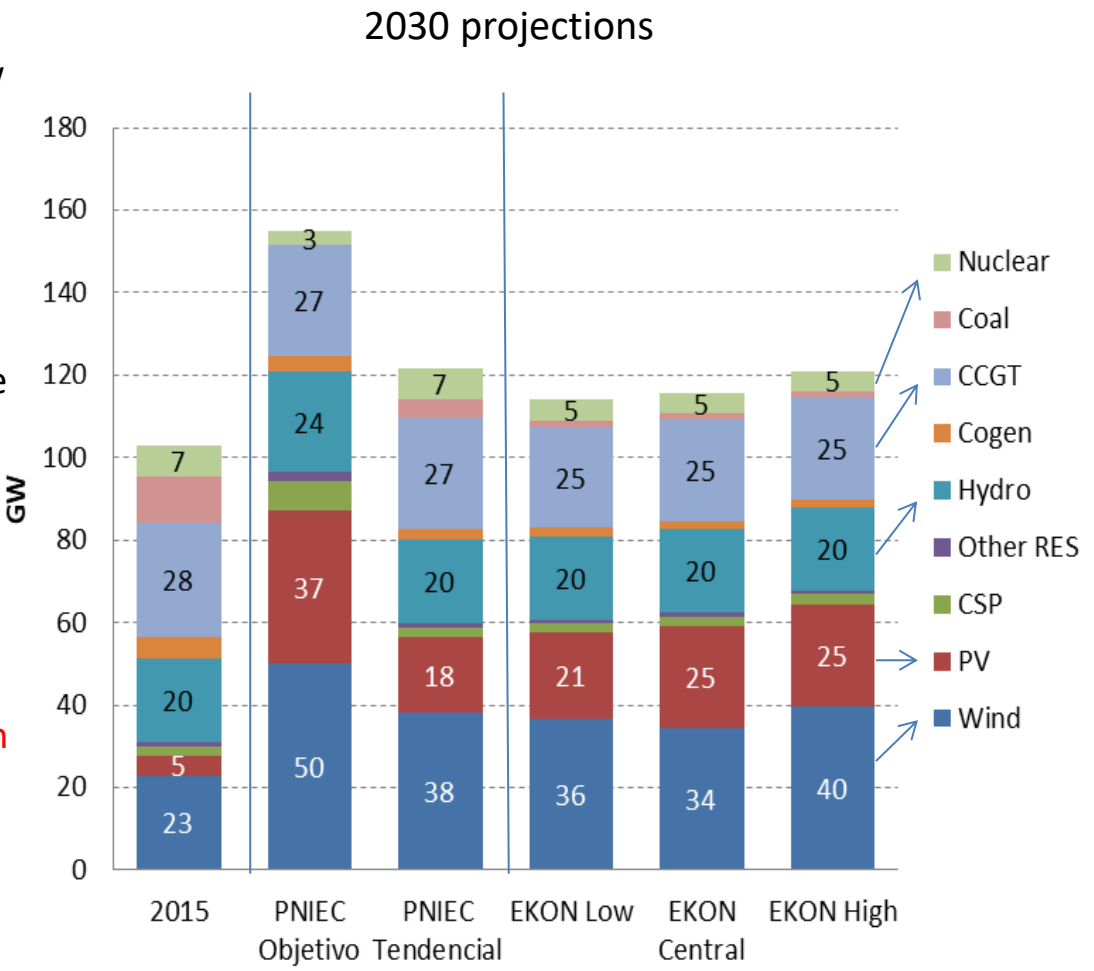
ACHIEVING THE NECP 2030 TARGETS

- Share of renewable generation in EKON Central Case is 67.4% and 71.8% in the Low Case (compared to 74% target in NECP).
- NECP capacity targets too aggressive since assume historical hours for renewables, and massive increase in exports (even to Portugal).
- What if the government pursues aggressive targets that exceed saturation point?
  - Auctions for new capacity only will undermine merchant market and be open to legal challenge for discrimination.
  - Better to use market for green certificates with firm targets and open to all. (With bonus of no "missing money" problem even if one exceeds saturation points.)



Source: Plan Nacional Integrado de Energía y Clima 2021-2030 ("PNIEC"), EKON 2020Q2.

AND BEWARE PNIEC ASSUMPTIONS

Figura D.7 Resultados escenario objetivo H2030

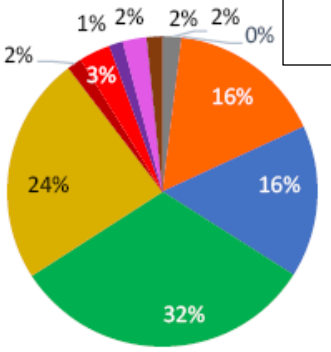
Escenario Objetivo H2030. Plan de Energía y Cambio Climático

España Peninsular | Generacion mínima síncrona: 5500 MW | *Cod 018*

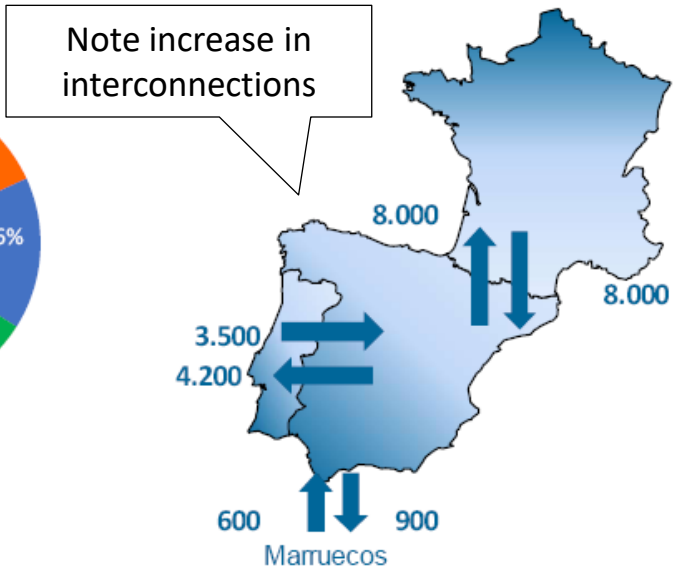
La demanda en ES (TWh):	268	Demanda punta (MW):	48.652

Capacidad instalada peninsular (MW)

	MW	%
Nuclear	3.050	2%
Carbón	0	0%
Ciclos	24.560	16%
Hidráulica (+ bombeo)	24.140	16%
Eólica	48.580	32%
Solar FV	36.134	24%
Termosolar	2.300	2%
Termosolar almacen. 9h	5.000	3%
Resto RES	2.220	1%
Cogeneración y otros	3.750	2%
Baterías	2.500	2%
Total sistema eléctrico	**152.234**	**100%**



Capacidad de intercambio (MW)



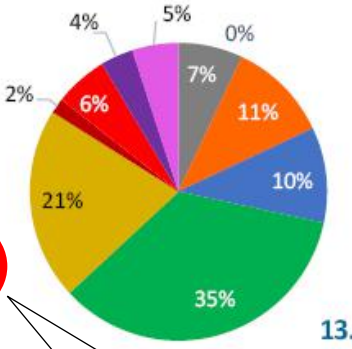
Source: PNIEC Annex D.

CAPACITY MAY NOT NEED TO BE THAT HIGH

Balance de generación (GWh). España peninsular

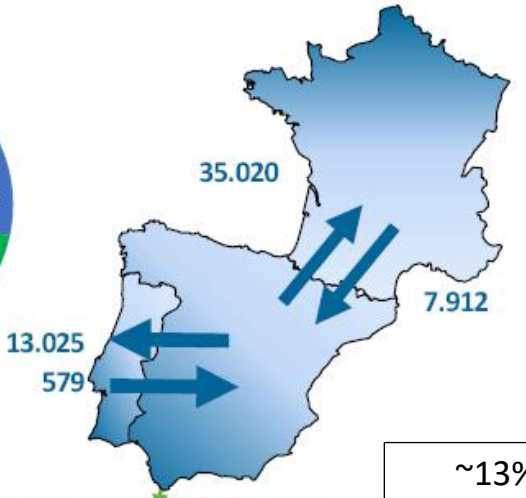
	GWh	%	Horas utilización
Nuclear	21.846	7%	7.162
Carbón	0	0%	0
Ciclos	34.043	11%	1.386
Hidráulica	32.257	10%	1.336
Eólica	108.013	35%	2.223
Solar FV	64.718	21%	1.791
Termosolar	5.160	2%	2.243
Termosolar almacen. 9h	17.887	6%	3.577
Resto RES	11.100	4%	5.000
Cogeneración y otros	15.658	5%	4.175
Generación	**310.683**	**100%**	

Balance almacenamiento	**-3.609**
Consumo almacenamiento	*18.611*
Producción bombeo	*8.900*
Producción baterías	*6.103*



Historical hours

Saldo de intercambios anual (GWh)



Perfil exportador con Marruecos: 0		
Saldo ES-FR	*27.108*	
Saldo ES-PT:	*12.445*	
Saldo Neto + Marruecos:	***39.554***	***ES EXPORT***
CONGESTIONES (% horas)	→	←
ES-FR	26,5%	2,9%
ES-PT	4,8%	0,1%
Spread ES-FR (€/MWh):	***10,5***	

~13% of generation for export?

Source: PNIEC Annex D.

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FINAL COMMENT

- What if government targets capacity that exceeds saturation points? Let's hope they don't discriminate between different cohorts of assets! Setting an aggressive green energy target (GWh) and backing this up with tradable green certificates would ensure that all investors - old and new - are protected from the inevitable electricity price crash.

- So get informed and if you want to take a view on realised prices for PV or wind, think about these:
  - Demand growth
  - Fuel prices
  - EUA prices
  - Taxes (Green Cent Tax, Generation Tax)
  - Industrial Emissions Directive ("IED") and coal closure
  - Lifetime limit for existing plants (cogeneration and renewables included)
  - Hydrology
  - Operational hours for New Wind and PV
  - Capex, leverage and cost of capital of New Wind and PV
  - Rate of deployment of New Wind and PV (including rooftop)
  - Measures to meet PNIEC targets

Especially these!