The essential role of dispatchable renewables

The essential role of STE / CSP

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Can you guess the share of Renewables on the new capacity added last year at world level?

GLOBAL GROSS POWER GENERATION CAPACITY ADDITIONS, 2010–30 (GW)

Bloomberg NEW ENERGY FINANCE

FOSSIL FUEL	CLEAN ENERGY

RES technologies account for most of the new capacity additions in the last years at world level and this trend will increase exponentially in the near future.

Sooner than later the share of new yearly renewable capacity at world level will be above 95%

THE NEED OF POWER

❑ Industrialized countries

- Reduced power increase rates (small Δ GNP, reduction of energy intensity, stable population, …)
- Replacement needs
- Emission reduction commitments (Δ Renewable share)

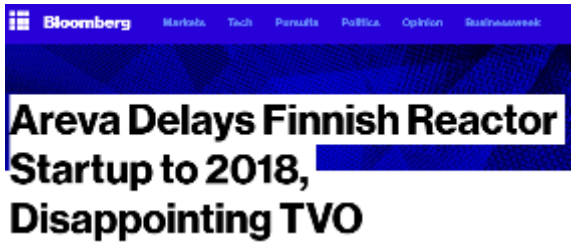
❑ Developing countries

- Relative large power increase requirements (Δ GNP, Δ Population, Δ standard of live, …)
- Replacement needs & technological change
- Firm power required

❑ Impact of distributed power and smart grids?

"It is the economy, stupid"

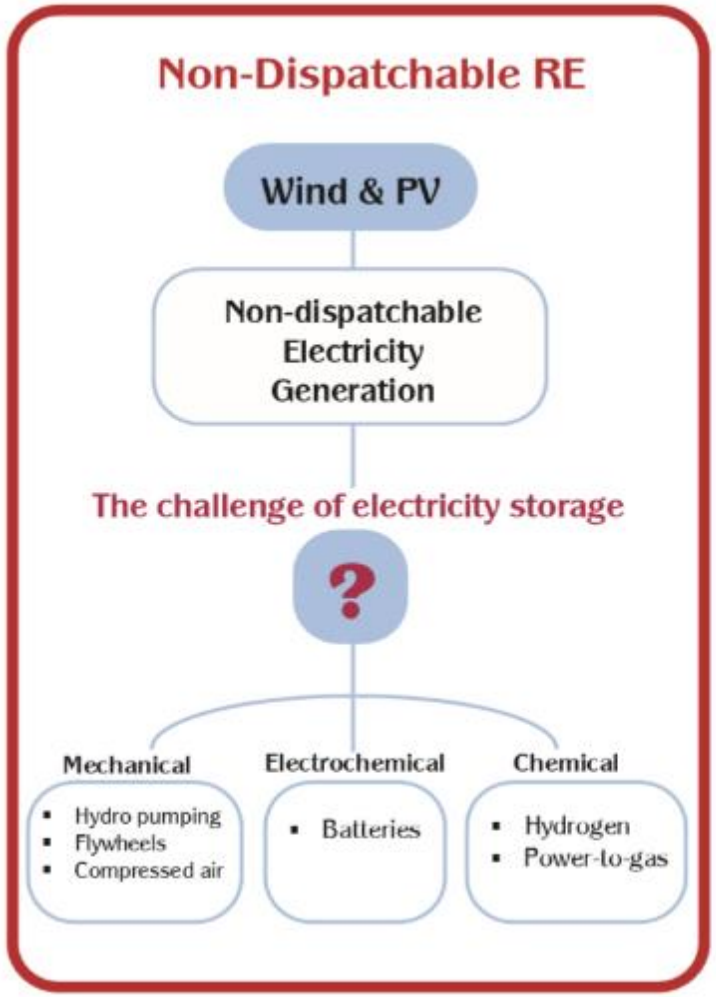
- Who can ever promote – on a pure commercial basis - a new coal or gas combined cycle plant in most countries in the world?
- Which financing organization could take the risk of uncertain carbon taxes or even strong operational restrictions during the payback time of the loans?

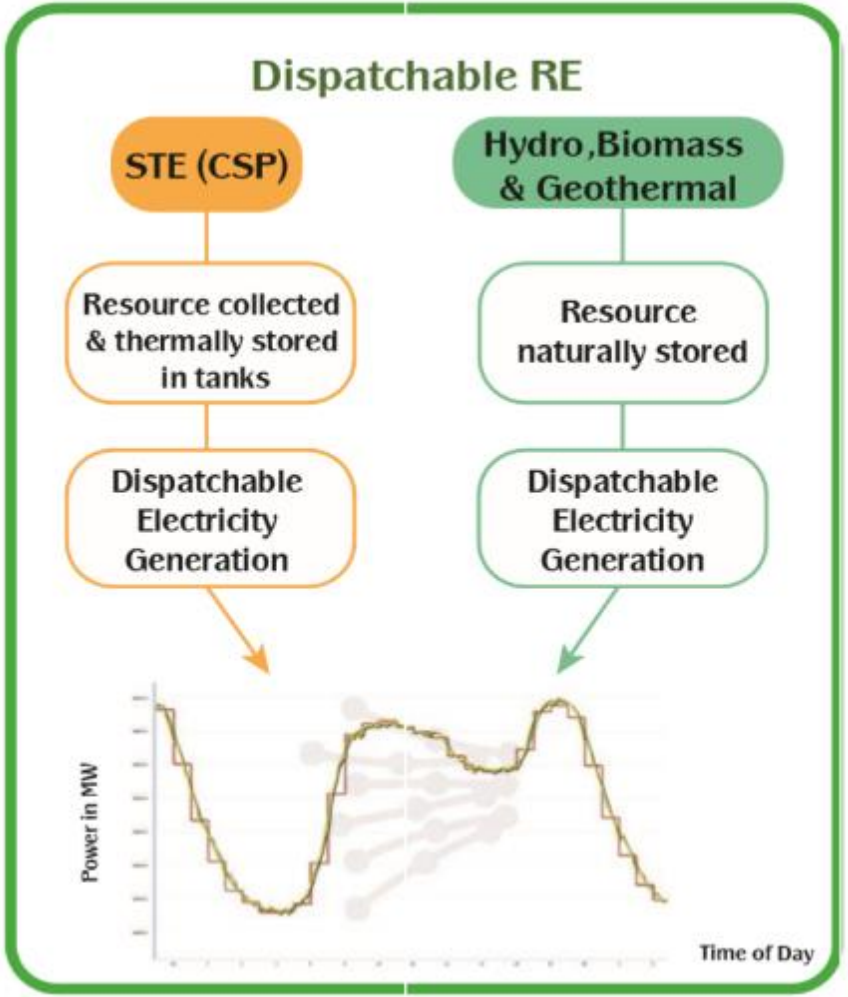


- Who knows how long will it take a new nuclear power plant to be constructed? How much would it have cost when finished? and even, once it is finished, whether it will operate during its whole life span or not.
- Who knows how much the decommissioning of the old nuclear plants and the radioactive waste management is going to cost to our grandson generation?

- Provided that new nuclear plants are neither competitive nor bankable, is electricity the only goal for the nuclear power under construction in China, Russia, India, Iran, Pakistan or the USA? Shouldn't the United Nations start thinking about some coincidences?

After the current the initial phase of RES deployment -reaching 450 GW of Wind and 250 GW of PV worldwide- time has come to face an **essential fact**





There are two types of renewables

- ✓ One, which is the cheapest but non-dispatchable
- ✓ The other one is the "still" more expensive but dispatchable technology - such as solar thermal electricity STE/CSP

Achieving a CO_2-free power system will be only possible with a larger share on dispatchable renewables

Regarding the issue of electrical storage,

why not prevent the causes of the problem instead of having to cure its effects?

Generation costs for a **STE system with 6 hours of storage is much cheaper than for an PV plant with batteries** and they will remain lower at least until 2030

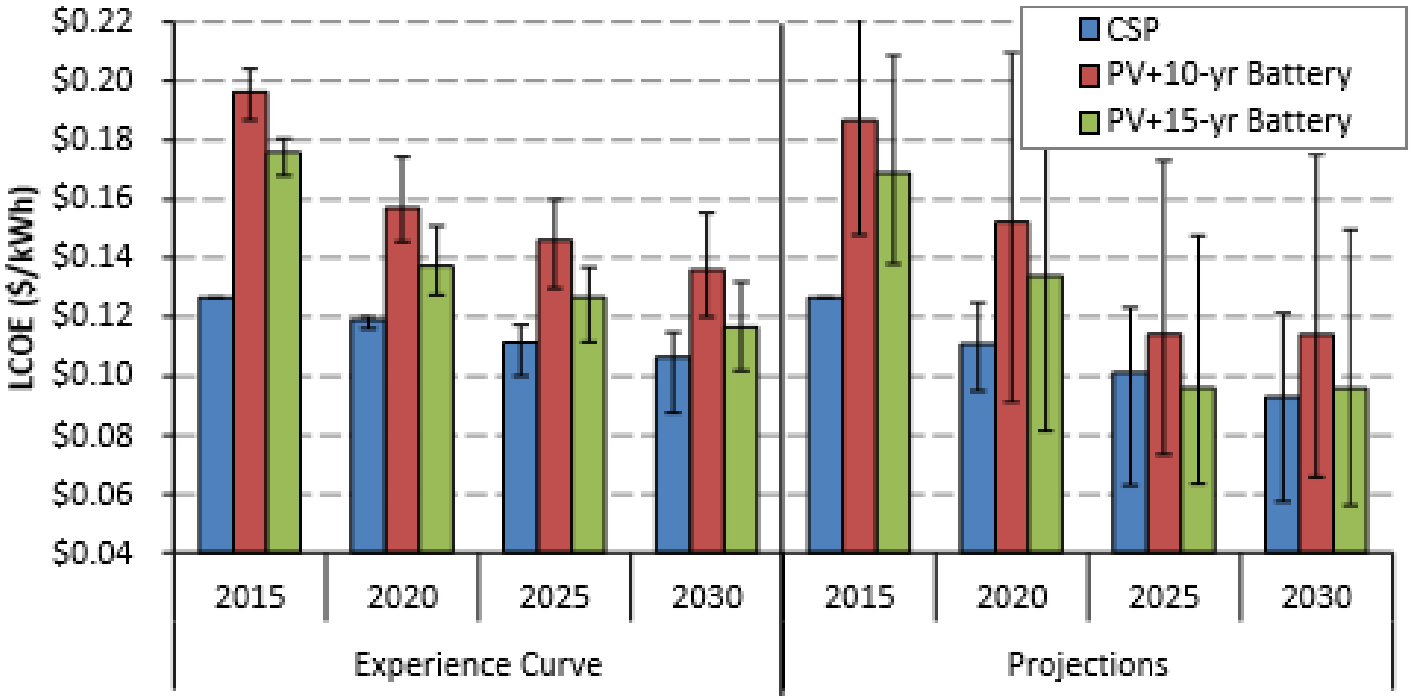
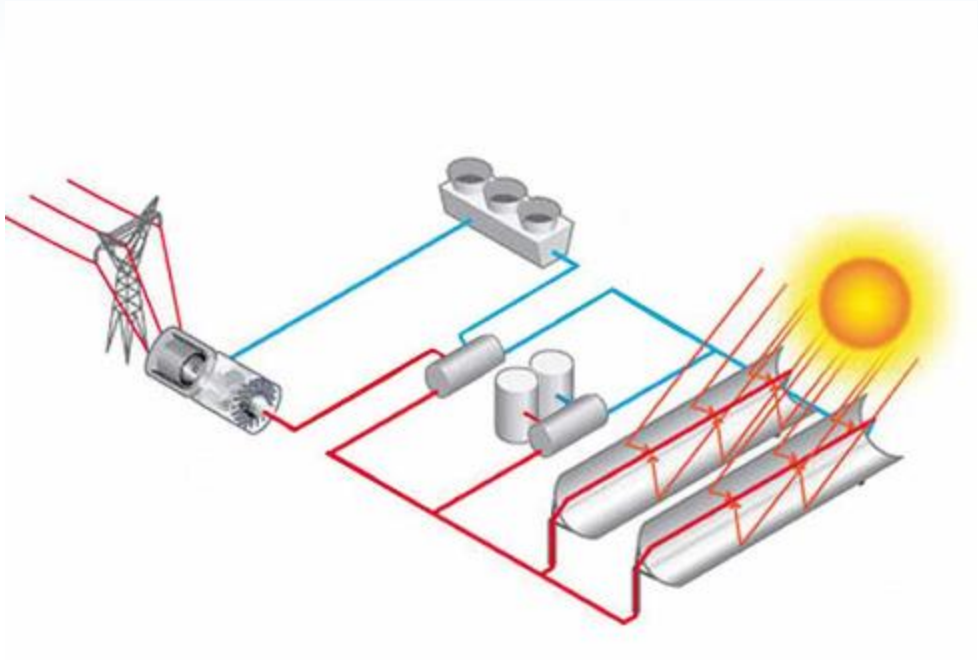


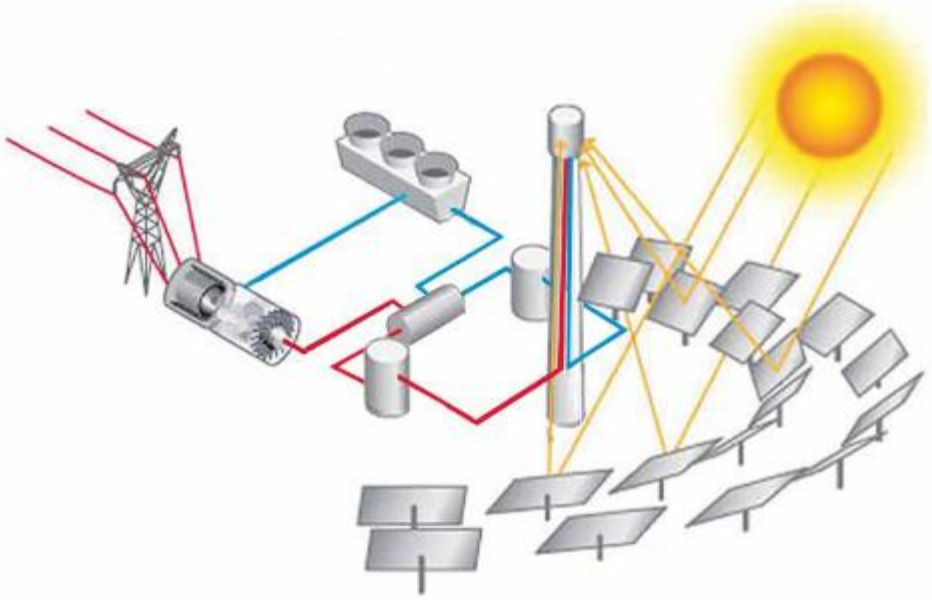
Figure 26. LCOE comparison: CSP versus PV (six hours of storage), 2015–2030

Mid case is shown with uncertainty bars representing the span of the low to high cases.

- Although batteries will continuously increase its role in electrical vehicles and distributed systems, it is not likely that they will be implemented in large power plants in the next 5 – 10 years
- **We mustn't forget that the generation fleet for 2030 have to start being constructed TODAY**

The current most efficient solution for Solar Energy Systems: Dispatchable Solar Thermal Electricity (STE/CSP)





The two tank molten salt storage system is working very efficiently since 2008
(One decade almost without degradation signs)

Molten salt tower plants require 3 time less volume of storage than the parabolic trough plants with thermal oil and no HTF/Salt heat exchanger

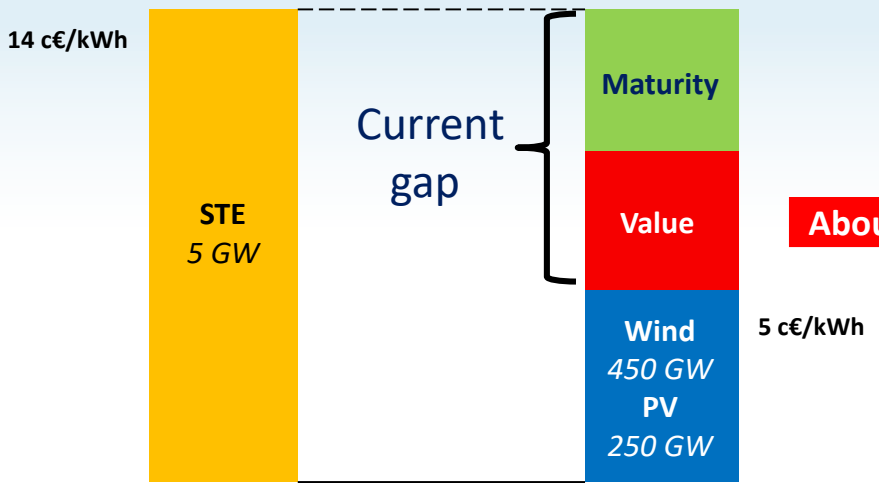
17 STE PT plants in Spain with 7,5 hours Storage

1 GWh_{th} equiv. 375 MWh_e

Cost 35 M€ aprox.
Ratio 90 €/kWh_e aprox.

Current prices for CSP storage systems for central receiver plants are already around 35 €/kWh_e

Explaining the current gap on costs between non dispatchable RE technologies and STE



About "Value"

About "Maturity"

$64/MWh has been offered by a STE plant in the last recent auction in Chile

- ✓ The PPAs for the two recently awarded STE plants in Morocco Noor 2 & 3 (200 MW PT & 150 MW T) were 15% lower than the previous one for Noor 1 awarded 2 years ago.

- ✓ A 110 MW STE plant with 17,5 hours of storage, partly hybridized with PV, was recently selected in Chile with a PPA of $110/MWh, in competition with all other generation technologies including Gas Combined Cycle.

- ✓ The tariff for the current "Expedited round" in South Africa is close to 20% less than the previous one for Round 3 established 18 months ago.

Understanding the value of solar power according to the Renewable Electricity penetration share

Example for 33% and 40% RE shares in California (NREL, May 2014)

http://www.nrel.gov/docs/fy14osti/61685.pdf

	33% renewables		40% renewables	
Value component	STE with storage value (USD/MWh)	PV Value (USD/MWh)	STE with storage value (USD/MWh)	PV Value (USD/MWh)
Operational	46.6	31.9	46.2	29.8
Capacity	47.9-60.8	15.2-26.3	49.8-63.1	2.4-17.6
Total	94.6-107	47.1-58.2	96.0-109	32.2-47.4

Conclusion:

It is equivalent -for the total cost of the system- to pay 50 USD/MWh to PV than 100 to STE

This difference will become larger as RE penetration increases

- **What does operational value means:**

  Operational value represents the avoided costs of conventional generation at their respective dispatching times along with related ancillary services costs, such as spinning reserve, etc. Savings on emission costs are also accounted

- **What does capacity value means:**

  Capacity value reflects the ability to avoid the costs of building new conventional generation in response to growing energy demands or plant retirements

THE REASONS FOR A BRILLIANT STE FUTURE

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1. Technical

STE is the only dispatchable and grid-friendly renewable technology with potential enough to firmly meet the electricity needs worldwide in order to achieve an almost carbon free generation system.
A wise mix with other R.E. technologies will be the right choice.

2. Local Economic Development

Local content of STE plants - and conversely its GDP contribution - should be one of the main drivers behind the coming supporting policies in most countries of the Sunbelt.

3. Affordable cost with higher value

STE plants are currently a cost competitive choice to supply the increasing power demand of emerging countries compared with “investing twice” as it would be the case regarding other fluent R.E. technologies + CC backup. Furthermore STE plants will show important reductions when approaching similar values of Wind (450 GW) and PV (250 GW) from their current 5 GW

Some recent data on STE production in Spain

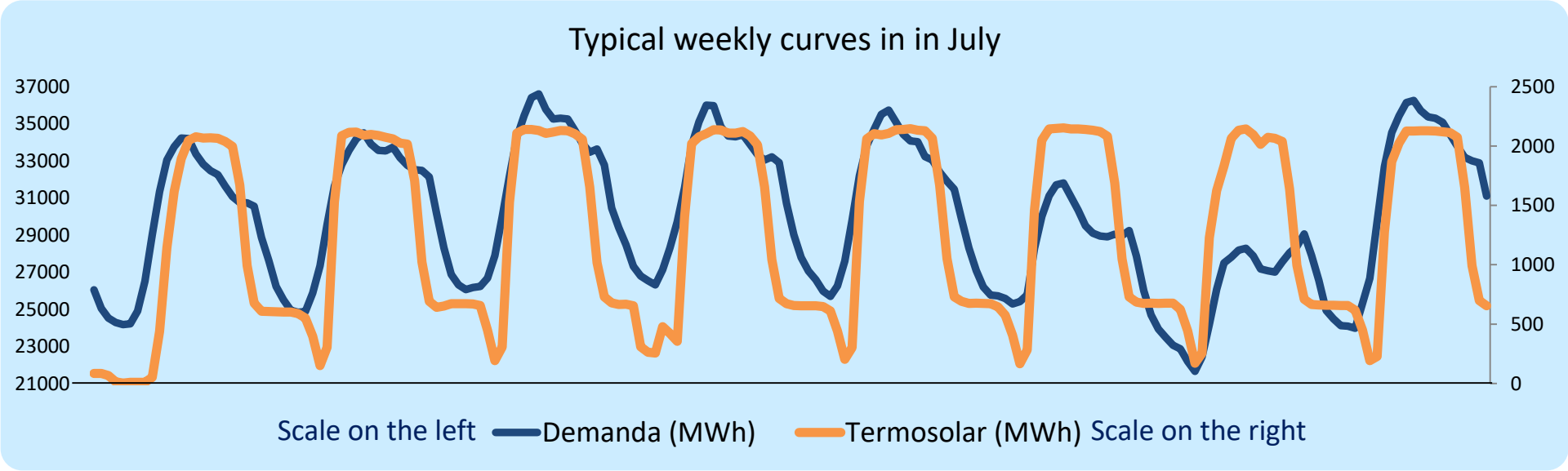
All the 50 STE Plants in Spain are performing according to the expectations

Improvements in operation and O&M cost reductions are still being applied

Important milestones in 2016

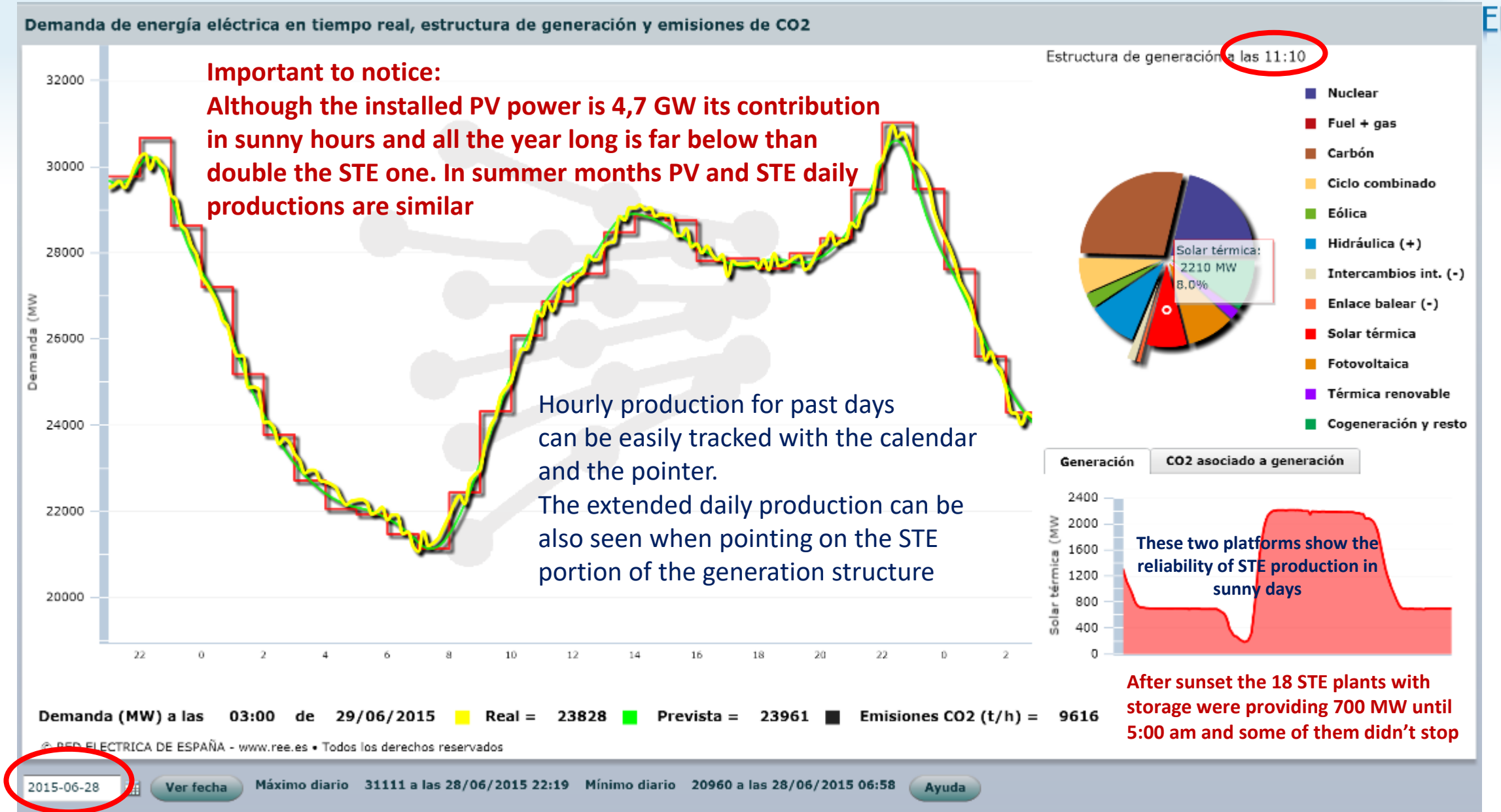
- ✓ Installed Power 2300 MW (50 plants)
- ✓ Same yearly record as in 2015 (5,1 TWh)
- ✓ Max. contribution > 9,4 %
  > 8% at many moments from May till September
- ✓ Max. daily contribution around 5%
  At many days in June, July and August
- ✓ Monthly production around 4 % in summer months

These curves show how good STE production matches naturally the demand



Typical production in a summer day

https://demanda.ree.es/demanda.html



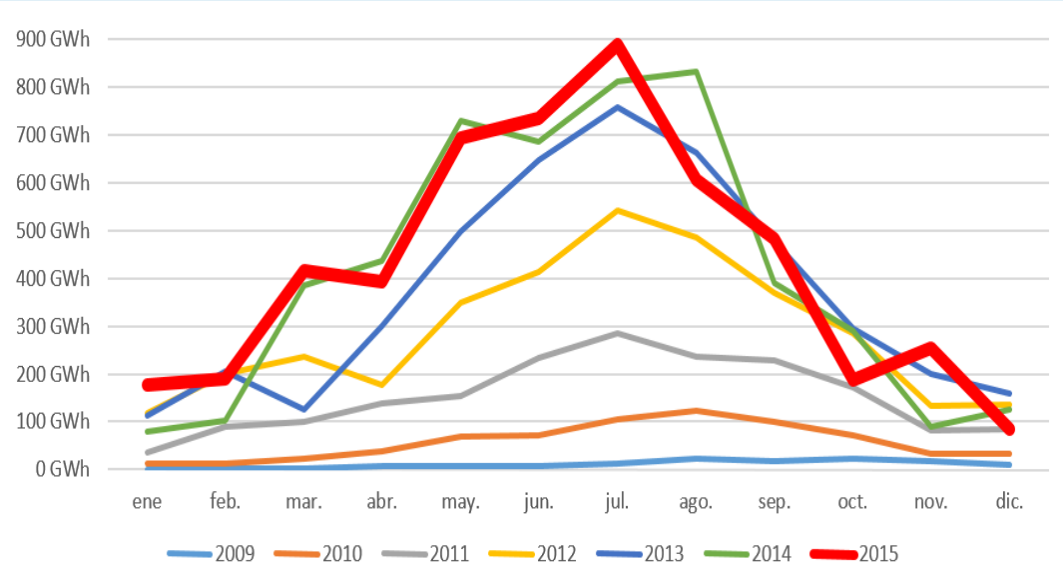
Important to notice:
Although the installed PV power is 4,7 GW its contribution in sunny hours and all the year long is far below than double the STE one. In summer months PV and STE daily productions are similar

Hourly production for past days can be easily tracked with the calendar and the pointer.
The extended daily production can be also seen when pointing on the STE portion of the generation structure

These two platforms show the reliability of STE production in sunny days

After sunset the 18 STE plants with storage were providing 700 MW until 5:00 am and some of them didn't stop

Historic production of STE plants in Spain



Macroeconomic Benefits for the country's economy

Comparison between premiums and returns of a STE deployment program

+ Industrial development

+ Re-balancing the generation mix

+ Reinforcement of the grid

+ Attraction of foreign investment

+ Regional economical convergence

Supports

Supporting STE was a wise decision for Spain and it will be so in all countries

Unemployment subsidies

Savings in CO2 rights

Savings from replacing imported fossil fuels

Fiscal contribution
(Social Security, Corporate, Personal and Local Taxes,)

Contribution to GDP

Solar Thermal Electricity:
The great opportunity for Sunbelt countries

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- ✓ The generation mix for 2030 must be planned today
- ✓ Most of the old fossil fired and nuclear power plants will be decommissioned sooner than later
- ✓ Dispatchable capacity from renewable sources will soon become a must
- ✓ The required support for STE plants is much more affordable today than 5 years ago
- ✓ Premiums to STE generation will start being payed 3 years after the program is launched, while the positive macroeconomic impact will be noticed from the beginning and will last forever

Sunny countries are loosing money every single day as long as they don't launch a specific STE support program

Final remarks

- ✓ LCOE of STE plants is - as of today - **much lower** than LCOE of PV plants with 6 hours battery storage. **And it will continue to be so at least in the next 10 years**

  Wherever you hear the simplistic argument that LCOE is much lower for PV than for STE, please raise your hand and say that it is not true, as STE will be always provided with thermal storage. Comparisons have to be made "apples to apples"

  We must amplify **this fact** and educate Policy Makers - and the general public - to make them understand that current PV systems and STE plants with storage are **two different products** with very much different value for the system

- ❑ Sooner than later Policy Makers and Planners will realize that it is not possible to continue decommissioning fossil fuel and nuclear plants and substituting them - while saturating the generation fleet - with "fluent" renewable technologies.

- ❑ Then, STE plant deployment will ramp up. **Market volume and fair competition on value bases will make the rest**

Thank you for your attention

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