# ESTELA comments to the Public Consultation Paper "Underwriting New Generation Investments"

Brussels, 6 November 2018

ESTELA appreciates the open invitation to submit written comments on the Public Consultation Paper "Underwriting New Generation Investments". ESTELA remains at the disposal of Australian authorities to provide more information regarding the aspects addressed in the following comments – all understood as a constructive contribution to properly reflect the real, specific role of CSP.

## Answers to questions for stakeholders

**1. Which option, or combination of options, will best achieve the program objectives?**

- We understand "option" both in the sense of potential support mechanism and in the sense of technology options.
- Related to **support mechanisms**, we consider any single of the enumerated options (floor price, contract for difference, etc..) as well as a blend of these, would be helpful to achieve the program objectives.
- Related to **technology options** we underline that a deployment program for CSP technologies:
    - Would substantially contribute to provide **new firm capacity for Australia**
    - Would substantially contribute to **decrease the emissions of the Australian electricity sector**
    - Already achieved a **competitive cost level (especially when hybridized with PV)** allowing to **reduce the overall system costs** in Australia;
    - Would strengthen the supply chain in the country and increase the local job creation and industrial development

**2. Are there any alternative options, eligibility/merit criteria, and requirements that should be considered?**

- Planning priorities should be consistent with political priorities, which means that system planning serving a transition towards a decarbonized electricity system would need to meet three principles jointly, but assessing the various possible answers to these priorities in the right order:

1. Decarbonization
2. Reliability of supply
3. Affordable costs

3. What are the key risks in relation to energy markets and investment associated with the various options?

- The main risk of discarding CSP is to achieve additional firm capacity only via fossil generation at higher costs than via a high solar, smart generation mix (PV + CSP), which would also negatively impact the emission level compared to 2005
- The development of a program that includes CSP capacity does not pose special risk related to energy markets/investments. On the contrary, the effects have proven to be beneficial.

4. **Please provide additional feedback that may impact the Government's program**

- Should the least cost capacity system development approach be further used in Australia, two essential points should be considered:
  - Introducing specific hourly dispatch profile with seasonal differences;
  - Using updated costs (incl. cost forecasts) for CSP plants, i.e. tracking the auction and tendering processes which are currently going on in different countries, with due considerations regarding DNI and other local specific conditions.

## Additional information

We think that the least cost approach – which was useful when the generation costs were primarily driven by variable fuel costs – are no longer appropriate to assess ways and means for achieving the most adequate new generation investments and their impacts on system costs.

This is essentially because renewables do have different dispatch profile capabilities and roles to play in the power system of a given country, that can be combined and shared at interregional level or even system level, which are not usually considered by these models; doing so, options that can contribute to better decarbonization results with even lower total system costs are often discarded.

Furthermore, such an approach does not consider decarbonization as the main driver provided that an affordable cost is reached; they just rely on the minimum cost approach to deliver some decarbonization effects. They also stick to fossil backup although current prices in tendering processes and international references (such as SunShot/DOE, IRENA and others) forecast lower cost for CSP than for fossil fuels in the short term.

Finally, in the wider context of decarbonization, renewables progressively *shall* and *will* ultimately replace all conventional sources due to technological, political/environmental or competitiveness reasons

The specific dispatch approach that we suggest in this document also refers to the conclusions of the ISEA Institute in Aachen, carried out for SolarPACES (provided as annex).

This report states that the role of CSP becomes obvious when all possible synergies achievable with CSP are duly considered. In combination with storage and co-firing, it has enough potential to be part of an economic and low GHG future for the South African power system.

This study points at several drivers for CSP's competitiveness: on one hand, **external** factors like gas price uncertainties and the challenge of integrating high shares of non-manageable renewables; on the other hand, **internal** factors like low cost of capital. Each driver alone can make CSP the best economic option. Most critical are gas prices: if Australia would manage to develop a secure and low-cost gas supply, this would probably be an obstacle to CSP deployment enduringly. High costs of capital would have a similar effect, while high shares of non-manageable renewables are unlikely to be detrimental to CSP deployment.

**All measures** towards minimizing costs of capital are supportive to renewables in general and to CSP particularly. If this coincides with insecure and costly imports as sole source of natural gas, a large deployment of CSP turns to be the most economic case. In case of tight GHG reduction obligations, CSP would become one of the major shares in power generation in Australia.

Conversely, if the lowest cost approach would remain the *top* priority in the planning exercise, the effect on decarbonization level will be much weaker.

- A recent study using real operational records by REE (*Red Eléctrica de España*) over a 4-year period, shows that a further increase of RES penetration towards the decarbonization target is achievable (at least in Spain) with very low backup capacities in fossil fuel plants *and* at *affordable* costs, *i.e. either similar or even lower costs* compared to the least cost models

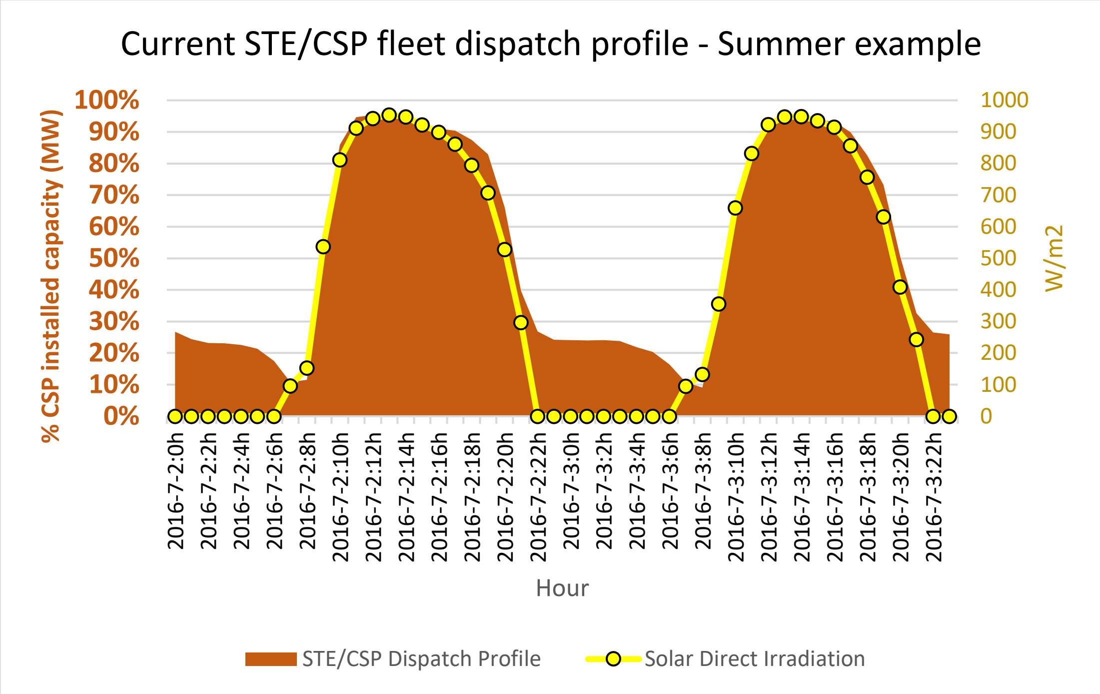
  (https://www.protermosolar.com/wp-content/uploads/2018/06/Protermosolar-Transition-Report.pdf).

- Although the current fleet in Spain is different as compared to the Australian one, the methodological approach and the main conclusions can be perfectly be applicable in Australia as well.

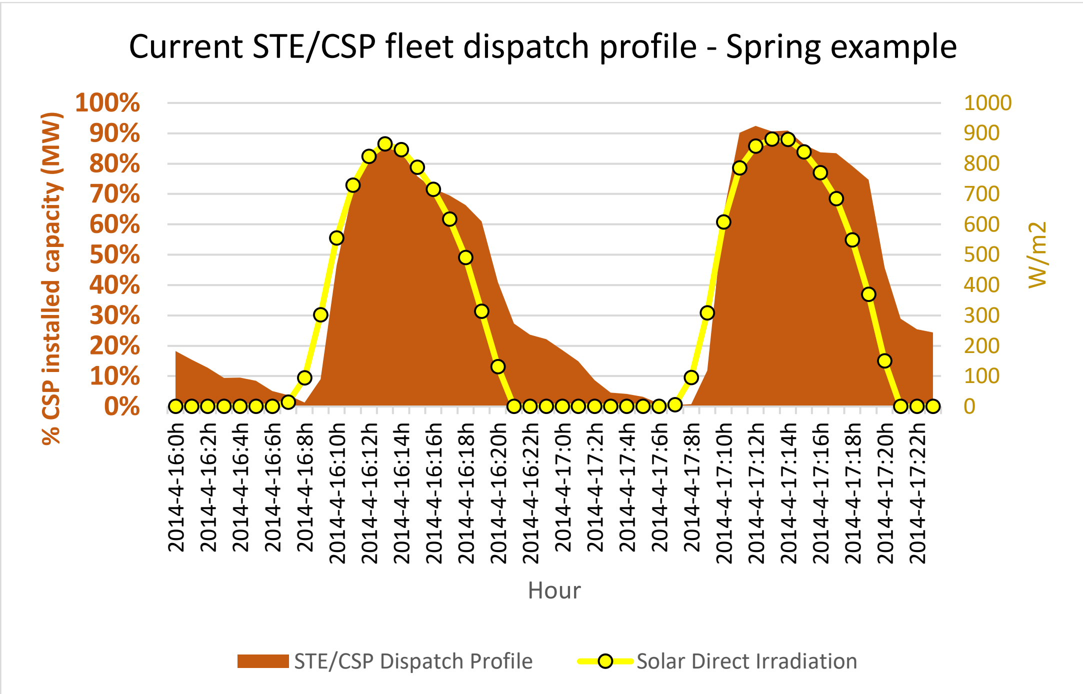
## Understanding the role of CSP in planning new capacity

- Least cost approach should consider the different dispatch profile capabilities of each specific RES and their respective specific seasonal operational profiles.
- Regarding CSP, all future CSP plants will be equipped with thermal storage up to 15h at nominal electric capacity. The capacity factor of future CSP plants will most likely go beyond 45%, running more than 4000 equivalent operating hours per year.
- This means that CSP does NOT compete with PV plus batteries (since battery technology stores energy at much lower capacity and at higher costs).
- However, it would replace conventional back up such as combines cycles or coal plants after sunset with the major effect on decarbonization.

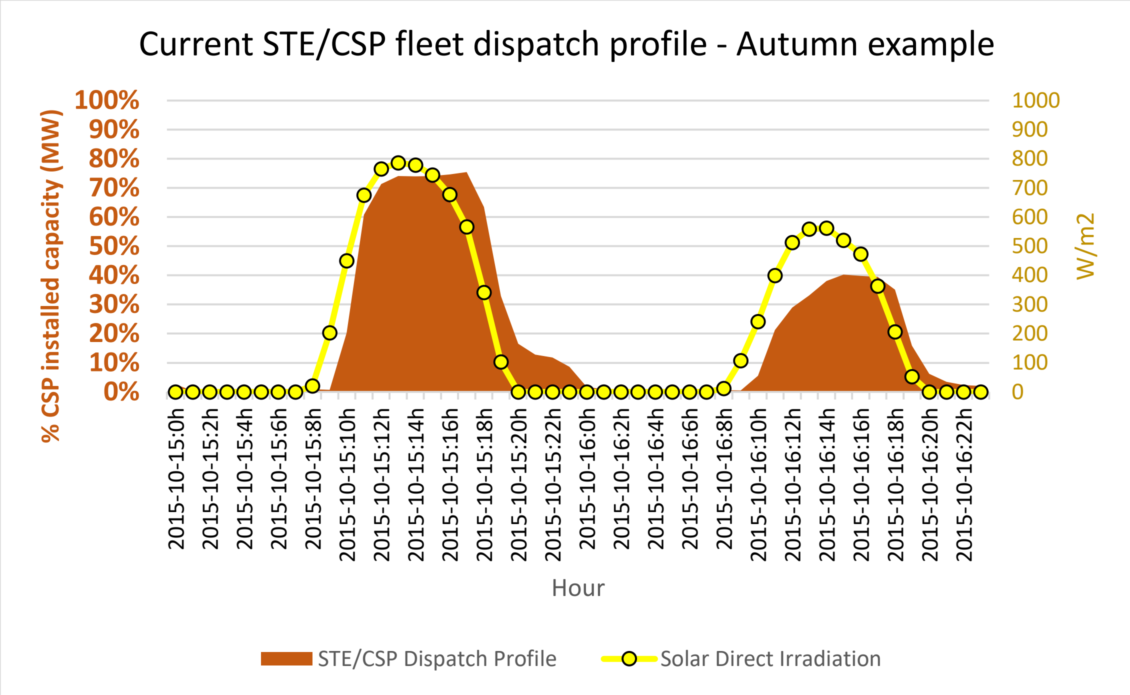
- As illustration of the above said, please find below examples of operational profiles on selected sunny days in July, April, October and January – in the northern hemisphere – from different years under review.



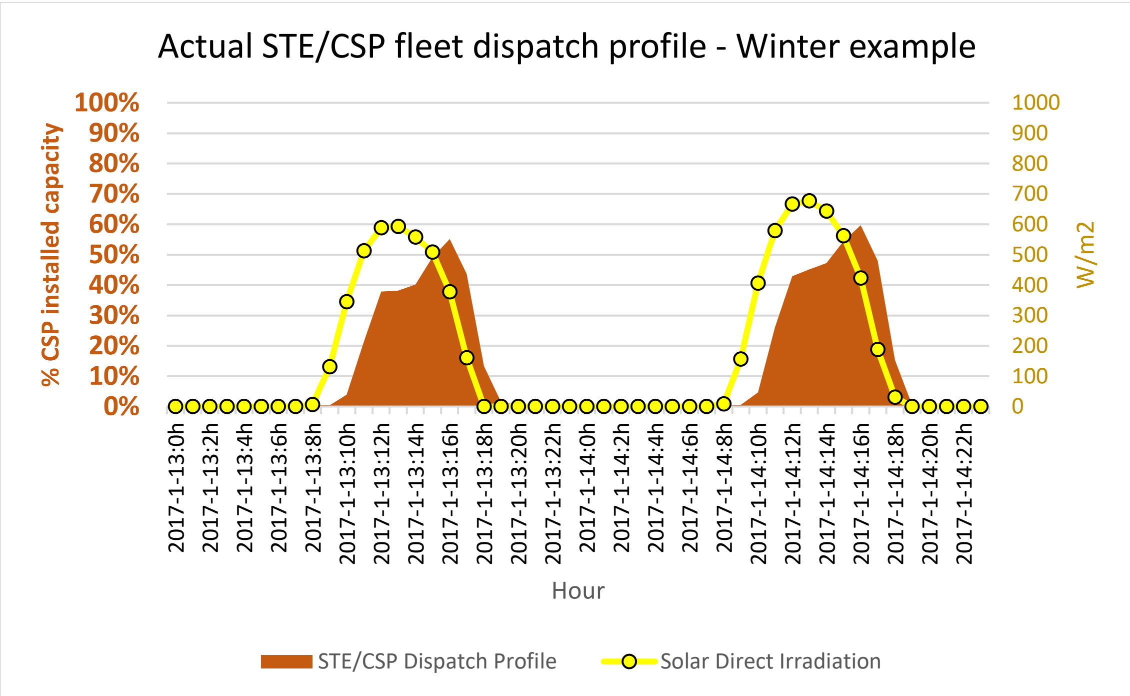

Dispatch profile of CSP Spanish fleet on 2 and 3 July 2016




Dispatch profile of CSP Spanish fleet on 16 and 17 April 2014



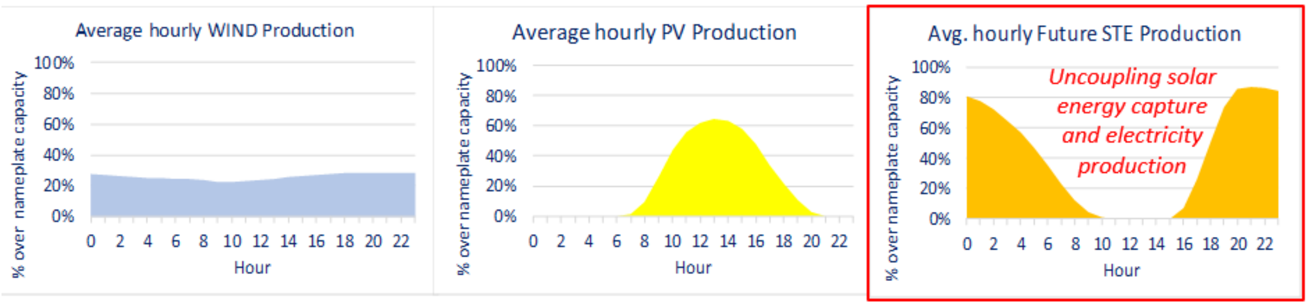

Dispatch profile of CSP Spanish fleet on 15 and 16 October 2015




Dispatch profile of CSP Spanish fleet on 13 and 14 January 2017

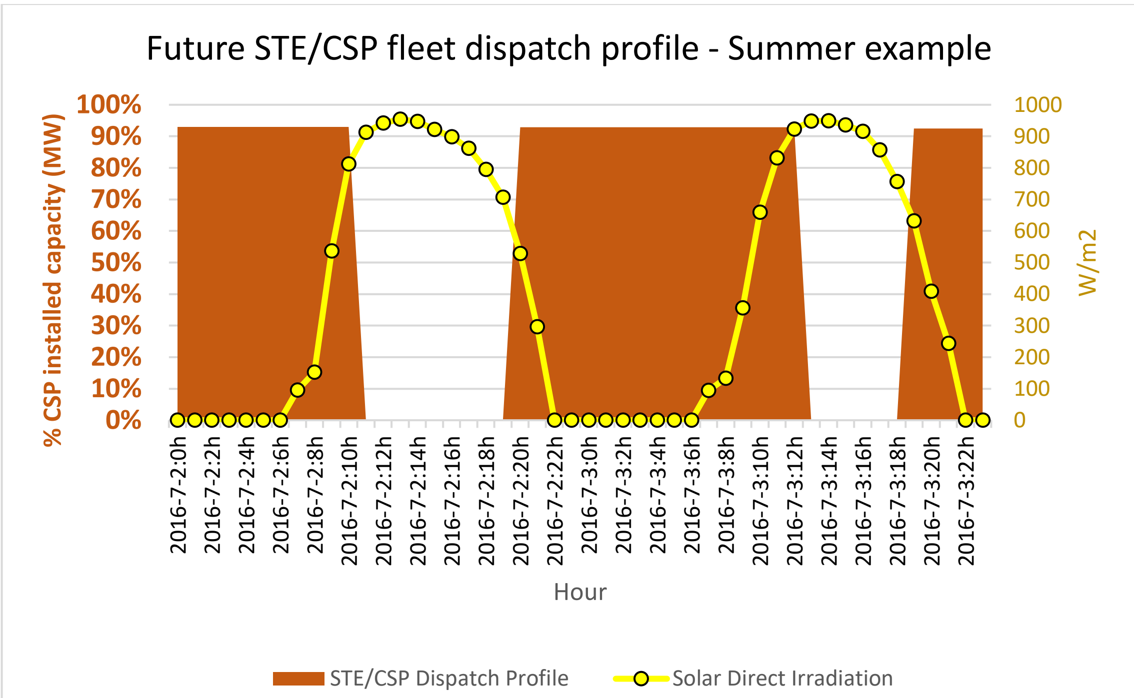
- In Spain, only 1/3 of the total installed 2.3 GW capacity in CSP plants has storage facilities (7.5h) due to historical, legal regulatory constraints. This means that 2/3 of the CSP fleet in Spain generates electricity only during sunny hours. There are neither regulatory provisions nor market incentives for the current Spanish plants to change their usual dispatch profile.

- Those plants equipped with storage facilities are in fact reducing their capacity at night just to avoid stopping the turbine until sunrise on the next day.
- From now on, CSP plants will find their place in system development models if their most important feature (the possibility to uncouple solar energy capture and electricity generation) is integrated in the models' algorithms.

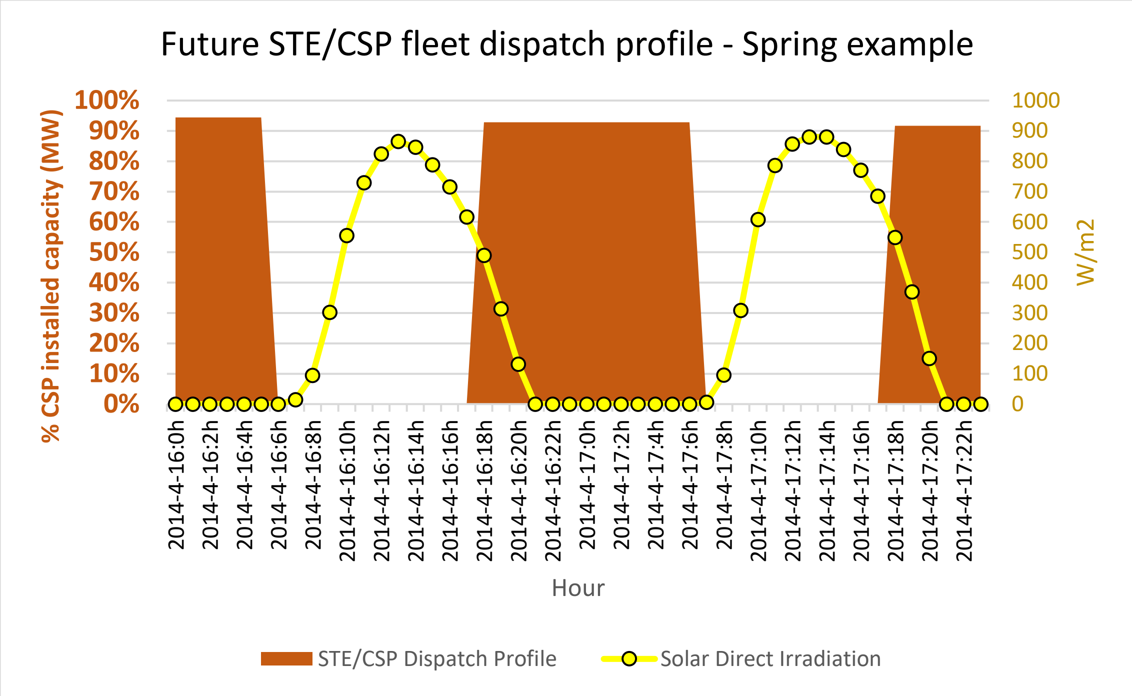



Yearly average hourly dispatch profiles - PV & Wind values over the period 2014 – 2017

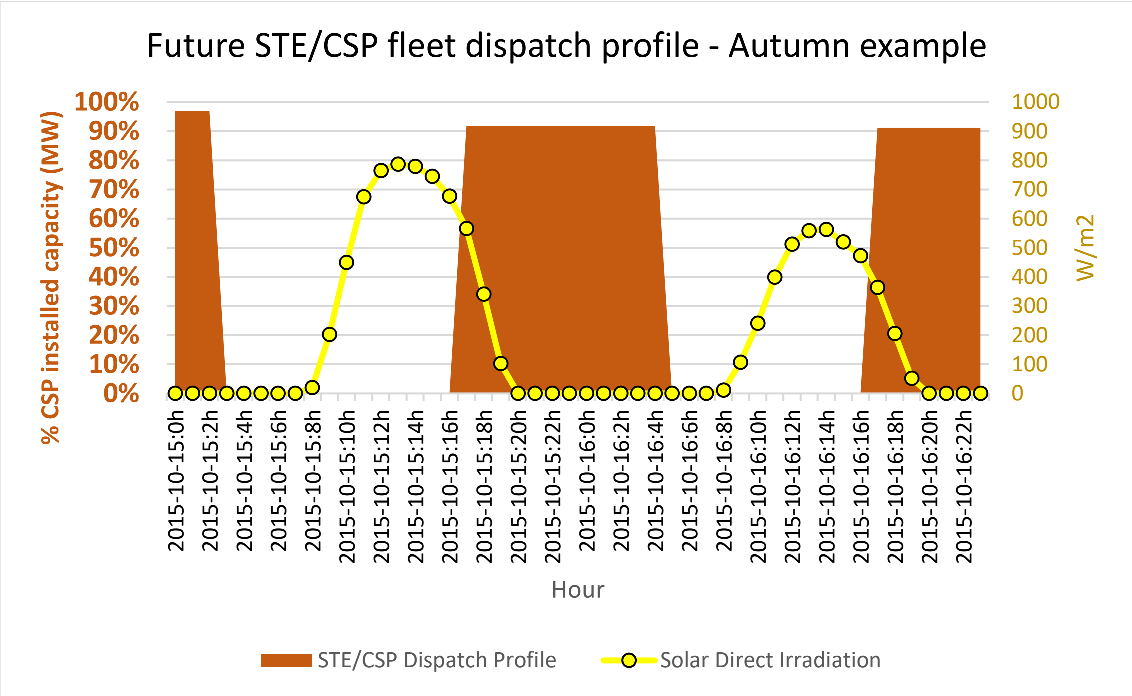
This means that future CSP/STE plants are well able to deliver the following dispatch profiles:



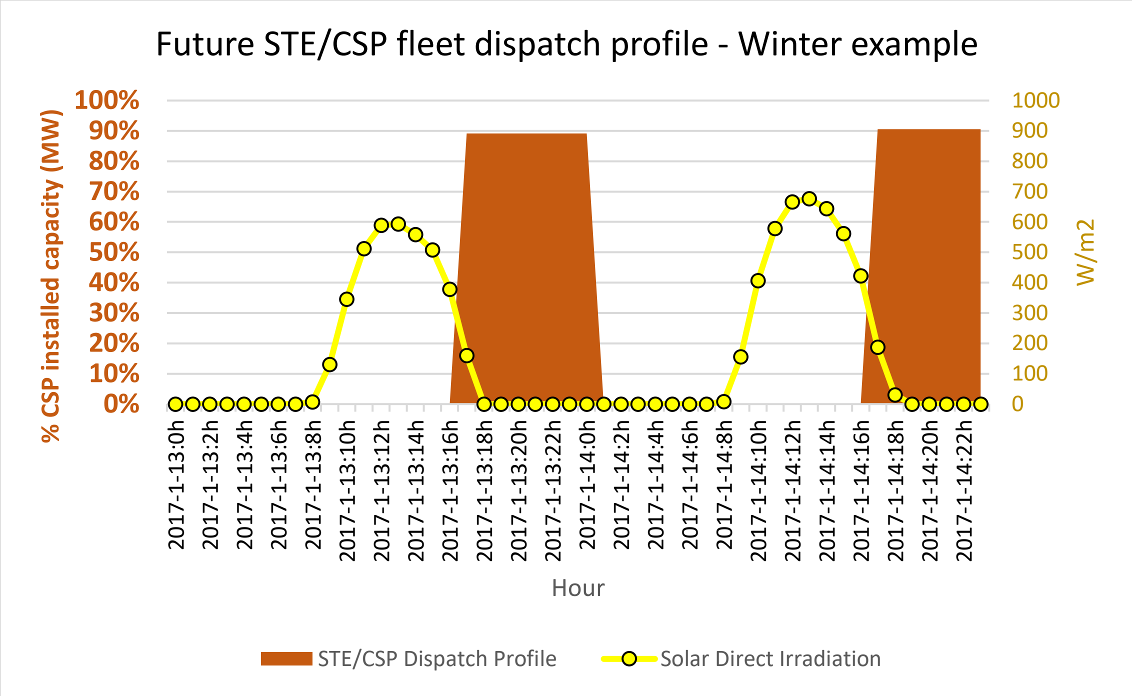

Target dispatch profile of new CSP Spanish fleet on the same 2 and 3 July 2016




Target dispatch profile of new CSP Spanish fleet on the same 16 and 17 April 2014

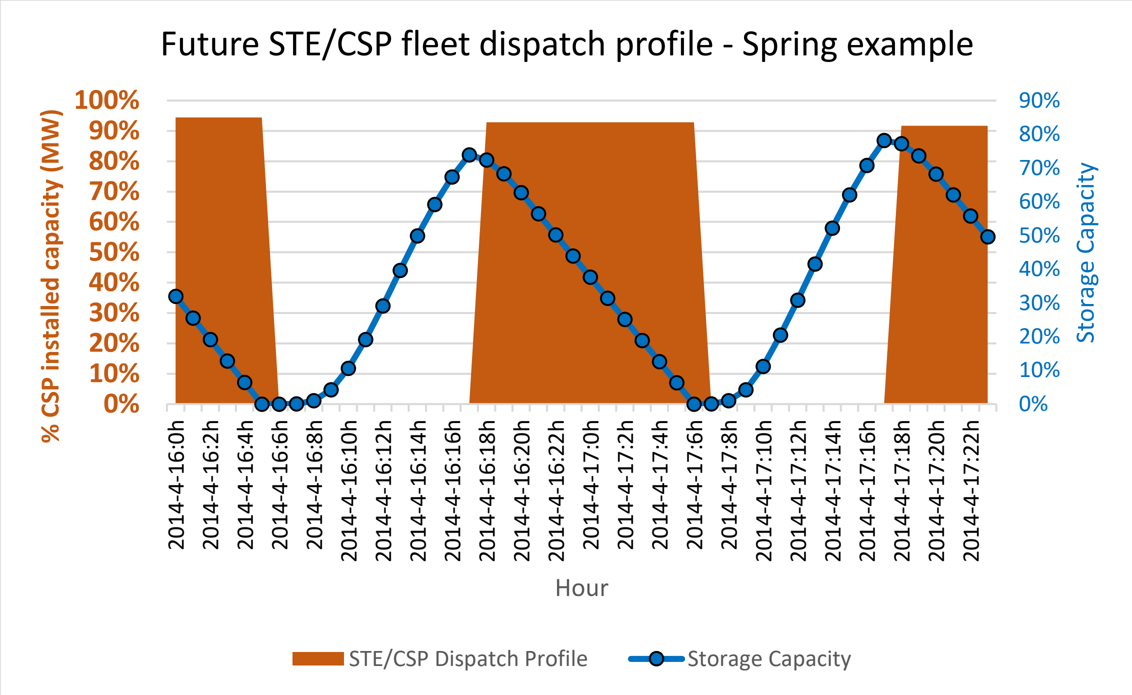



Target dispatch profile of new CSP Spanish fleet on the same 15 and 16 October 2015




Target dispatch profile of new CSP Spanish fleet on the same 13 and 14 January 2017

- During **cloudy days**, demand should be covered by other generation sources but the impact on $CO_2$ reduction of the a.m. dispatch profiles would be very important.
- The complementarity of given natural resources across the system shall be duly addressed in assessing the future electricity mix.
- Future CSP plants in Spain shall be designed for approximatively 3500 equivalent operation hours, corresponding to approximatively a 40% capacity factor. This appears today feasible or could even be surpassed by current CSP projects. This suggested capacity factor matches perfectly any strategy taking advantage from the complementary between CSP and PV. In Australia, CSP plants can easily run more than 4000 equivalent operation hours, thus the benefit for the system would be higher in Australia than in Europe (Spain).
- Storage tanks would be charged during the day hours. This dispatch profile leads to an almost 100%- firm synchronous power delivery for the day-ahead market (i.e. with minimal deviations from the contracted values).




Example of storage tanks behaviour on 16 and 17 April 2014

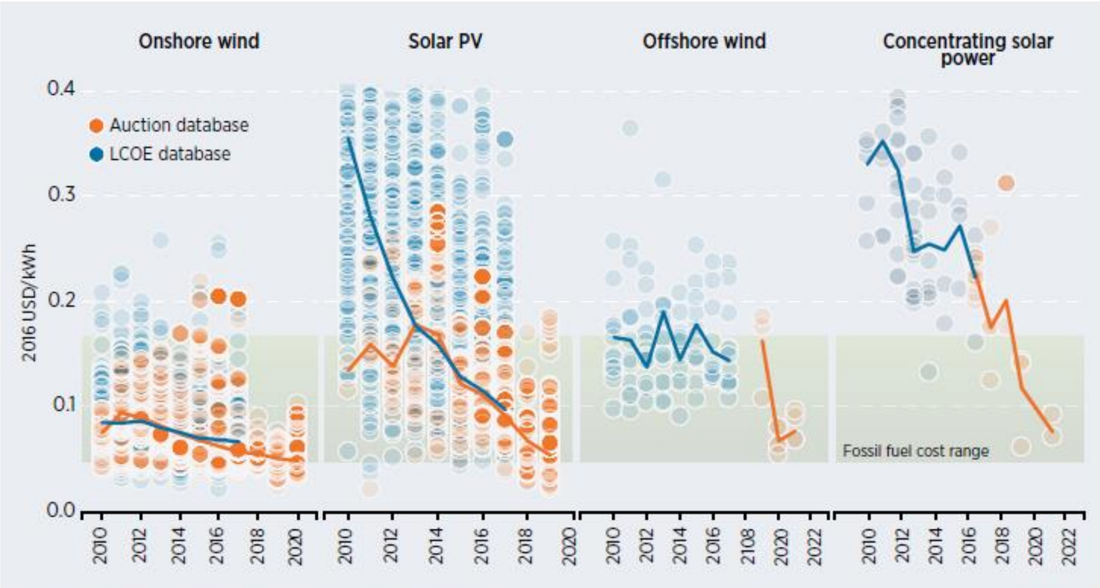
**Introducing these dispatch profiles and the correct CSP costs** – as of today and respectively corresponding to the expected learning curve till 2030 – in the least cost system development models **would lead to a different result showing the important role that CSP plants can play also in Australia** at the 2030 horizon and beyond.

## Costs

According to IRENA – Renewable Power Generation Costs in 2017, the CSP cost forecasts can be summarized as follows:

- "Recently, very low bids for CSP projects have been announced. Examples include the USD 0.073/kWh (± 0.061 €/kWh) bid announced by the Dubai Electricity and Water Authority (DEWA) for a 700 MW plant at the Mohammed bin Rashid Al Maktoum Solar Park (DEWA, 2017) and the Port Augusta CSP project in Australia, at around USD 0.06/kWh (± 0.049 €/kWh).
- If the auction results for Dubai and South Australia are factored in, then for the period 2010-2022 the learning rate could reach 30%"
- Learning rates for technologies are the average percentage cost or price reduction that occurs for every doubling in cumulative installed capacity of that technology

**Figure ES.2** The levelised cost of electricity for projects and global weighted average values for CSP, solar PV, onshore and offshore wind, 2010-2022




*Source: IRENA Renewable Cost Database and Auctions Database.*

*Note: Each circle represents an individual project or an auction result where there was a single clearing price at auction. The centre of the circle is the value for the cost of each project on the Y axis. The thick lines are the global weighted average LCOE, or auction values, by year. For the LCOE data, the real WACC is 7.5% for OECD countries and China, and 10% for the rest of the world. The band represents the fossil fuel-fired power generation cost range.*

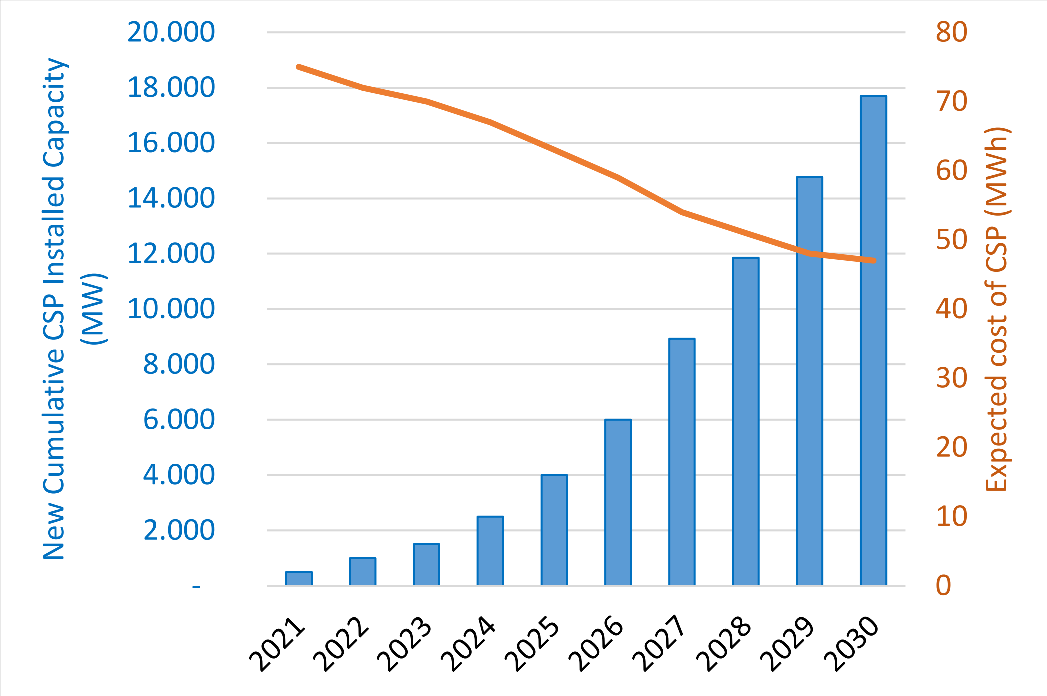
This is consistent with the ESTELA cost forecasts.

The graph below shows the estimated cost evolution curve for new installed CSP capacity in Spain according to the a.m. Protermosolar's transition report. The cost reduction curve is based not only on the new capacity in CSP to be added in Spain, but also on the impact on costs of the ongoing CSP deployment worldwide.

As of today, CSP worldwide installed capacity is approximatively 5 GW – which means 100 times less than PV. Therefore, the remaining room for performance improvements and further cost reductions is very high. There are 1.35 GW under construction/development in China. It's also expected that China will release a second batch of CSP projects in a range between 3.5 GW and 5 GW).

Moreover, Kuwait may include in the phase 3 of its "Shagaya RES Plan" additional CSP capacity on top of the recently commissioned. Besides, Morocco is set to announce in the coming weeks cost figures for the Midelt Project (including a CSP capacity between 300 – 390 MW).

The a.m. examples show that the solar resource can be more efficiently captured for electricity generation purposes. Doing so, a smart combination of CSP and PV avoids the overlapping of production during the central hours of the day. This is what should be from now on considered in the system development models, since the resulting average costs for 2030 (S. above) – and even before – would place CSP as a more competitive choice than gas combined cycles after sunset.




The graph above shows the proposed new CSP capacity added to the electrical system in Spain and the expected cost over the years under review. Although the capacity recommended for Australia would be lower, the cost trend over the years could be considered the same, as both Australia and Spain will take advantage from the cost reduction curve of the technology at world level.

| | STE / CSP | | Solar PV | |
|---|---|---|---|---|
| | €/MWh | New Inst. Capacity (MW) | €/MWh | New Inst. Capacity (MW) |
| **2021** | 75 | 500 | 40 | 2.700 |
| **2022** | 72 | 500 | 38 | 2.700 |
| **2023** | 70 | 500 | 37 | 2.700 |
| **2024** | 67 | 1.000 | 35 | 2.000 |
| **2025** | 63 | 1.500 | 32 | 1.500 |
| **2026** | 59 | 2.000 | 31 | 1.000 |
| **2027** | 54 | 2.925 | 30 | 701 |
| **2028** | 51 | 2.925 | 29 | 701 |
| **2029** | 48 | 2.925 | 28 | 701 |
| **2030** | 47 | 2.925 | 27 | 701 |
| **Weighted average by Technology in 2025** | **67** | | **37** | |
| **Weighted average by Technology in 2030** | **55** | | **35** | |

We underline that this cost forecast is rather conservative since costs outside EU in 2017 (DEWA, 73 $/MWh) are already lower than the assumed cost in 2021 in Spain – even if the available solar resource (Direct Normal Irradiation - DNI) in Spain is better than in the UAE. The argument would apply even better to Australia since the solar resource is than in the Arab Emirates or Europe.

## Questioning least-cost system development models (so far known to us)

- They clearly do not target decarbonization as the primary objective – discarding the overall political objectives in Europe and worldwide (Paris Agreement and the recent UN's Intergovernmental Panel on Climate Change (IPCC) Special Report on Global Warming of 1.5°C).
- A very high penetration of intermittent renewables in the system does not appear compatible with the goal of optimizing the generation fleet as the total value of the non-dispatchable new plants – operational and capacity – decreases dramatically with their penetration share. (s. NREL reference https://www.nrel.gov/docs/fy14osti/61685.pdf)
- The input data on the models regarding CAPEX and OPEX and capacity factors used until now, do not correspond in most cases to the current PPAs resulting from the competitive tendering and auction processes. The impact of this input on the results is high and correspondently, the conclusions of the model very doubtful.
- The increase of balancing costs also resulting from the high renewable penetration does not seem to be properly considered. Expert studies already pointed out that, the dysfunctionalities of the resulting generation mix, will have consequences that must be paid by the system.
- In addition, meeting the demand at any time – under real hourly meteorological conditions – has constraints and implications which must be technically solved and paid by 'somebody else'. This generates also more emissions. The inertia and synchronous generation that CSP provides is always needed by the power system. The costs for fossil backup increase exponentially from a certain renewable penetration share upwards. The results of the least cost capacity expansion models point neither at these 'hidden' costs and externalities, nor at the impact of curtailments on the cost of non-dispatchable renewables from a given penetration level on.

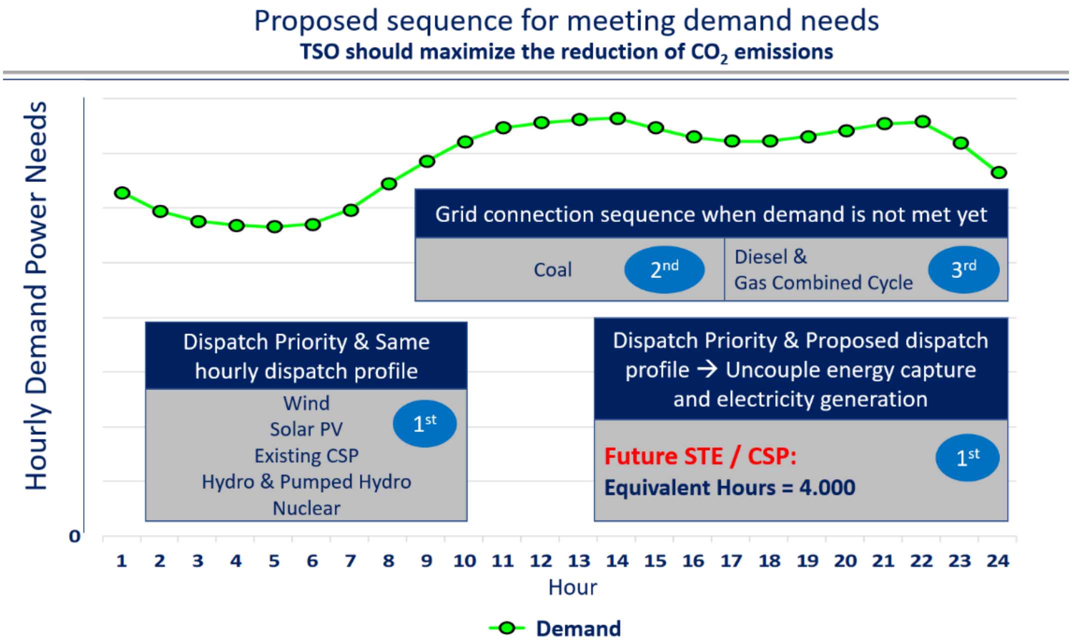
## Macroeconomic impact

CSP plants provide higher benefits to a country's economy than any other renewable generation technology. For example, in South Africa, the local content has been continuously increasing from KaXu Solar One to Illanga I. KaXu Solar One (100 MW) created 4500 jobs during the construction period and 80 permanent jobs.

CSP plants have fulfilled – and mostly largely surpassed – the requirements regarding added value in local content in those countries where this has been specifically requested (e.g. in Morocco and South Africa).

Especially, the industrial localization (the progressive complete or partial transfer of the supply chain into a given country/region, due to a deployment CSP program beyond a single CSP project) has two essential effects: it strengthens the supply chain (i.e. it brings down costs of components, logistics, labour and subsequently the total cost of energy produced) and it creates additional jobs.

Other data resulting from our experience in Europe show for example, that more than 500 people are working at the plant location during a 2-year construction time. Once the plant is finished there will be more than 50 people – permanent jobs – per plant directly employed. The number of indirect jobs is very high as well.




ESTELA kindly offers to the relevant Australian entities its inductive projection planning model to perform comparisons on an hourly operational basis. ESTELA could also possibly finetune its recommended generation structure to further optimize the results.