

Where is CSP Currently and Where is it Heading

Market and Financing Outlook

The Role of CSP in the Evolving Energy Market in the Western US
Sacramento. February 18, 2020

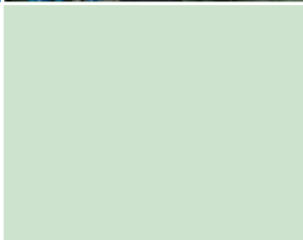
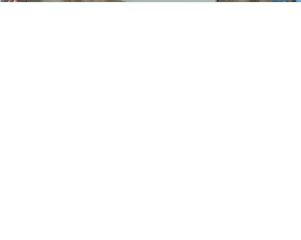
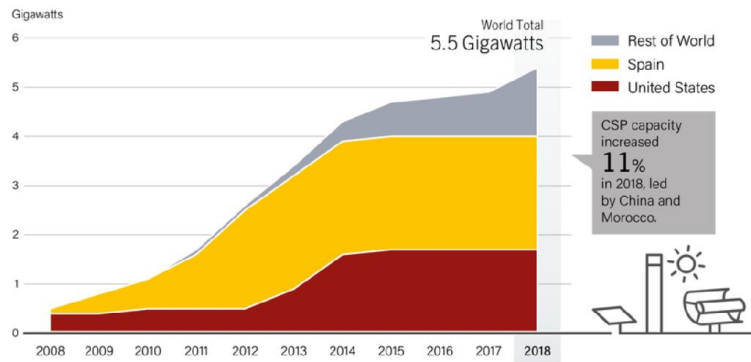


TABLE OF CONTENTS

- RENEWABLES MARKET INTRODUCTION
- WHERE IS CSP TODAY?
- WHERE IS CSP HEADING?
- FINANCING OUTLOOK

RENEWABLES MARKET

Concentrating Solar Thermal Power Global Capacity, by Country and Region, 2008-2018



Source: Renewables 2019 Global Status Report

FIGURE 25. Solar PV Global Capacity and Annual Additions, 2008-2018

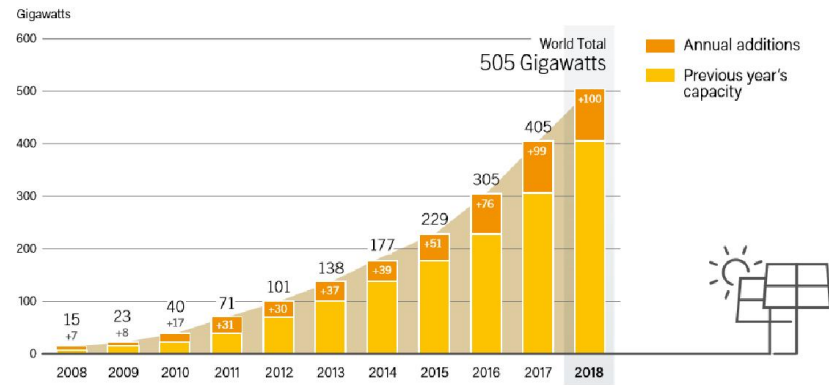
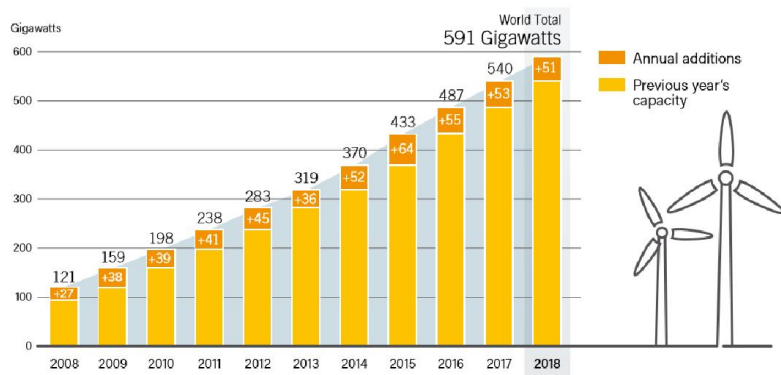
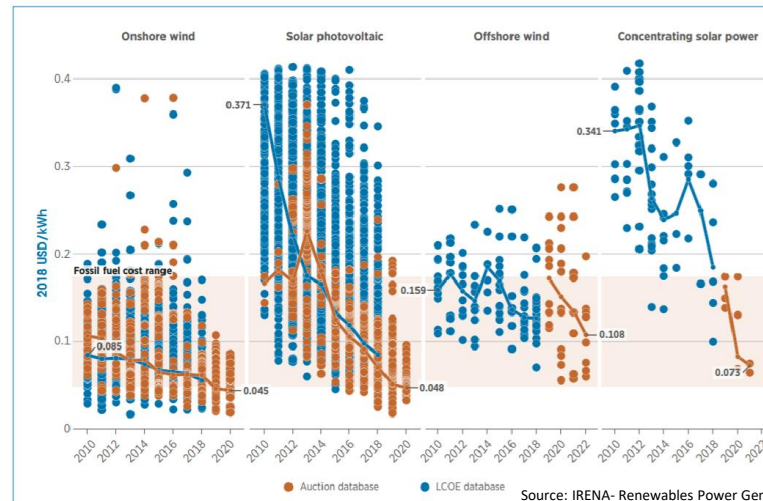


FIGURE 35. Wind Power Global Capacity and Annual Additions, 2008-2018



Source: Renewables 2019 Global Status Report



Source: IRENA- Renewables Power Generation Cost 2018

Where is CSP today?

- Latest ACWA Power CSP project under construction and our reference of CSP today **DEWA CSP project-Noor Energy 1**
- **7.3 USD cents / kWh** in a blended LCOE of the facility
- 950 MWe CSP+TES+PV around **4000 GWhe** of expected generation:
 - 3 x 200 MWe parabolic trough with 12.5h storage (75% approx.)
 - 1 x 100 MWe molten salts solar tower with 15h storage (12.5% approx.)
 - 250 MWe PV (12.5% approx.)
- Total investment **4300 MUSD**
- 35 years PPA
- PV covers auxiliary power consumption during day for CSP and dispatches at 2.5 cUSD/kWh
- CSP dispatches:
 - During day at PV tariff, only during summer months
 - During the night (from 4 pm to 10 am) for the full year



Where is CSP headed in the near future?

- **CSP+TES market in the future will be for the baseload solutions**, ideally integrated with PV and some battery storage if required to provide a dispatchable solar plant or solar baseload plant.
- **The key feature of CSP is cheap storage media**, which can provide very large scale bulk storage at a low cost, so it would be used for that purpose
- **Mature markets for renewables** which have seen a high penetration of variable renewables, particularly solar, are seeing now the need for dispatchable power solutions to take on the next wave of growth for renewables, and **CSP is well placed to address this challenge.**
- Old conventional projects decommissioning is offering a great opportunity for thermal storage technology to integrate their solution to the grid.
- While we clearly see future of the CSP to remain relevant to provide that dispatchable power solution in a system complementing PV and Wind and short duration batteries storage, we need to continue checking the cost
- **Long duration storage** and fast cycling which CSP in the locations with the required resource and land at low cost is able to offer.



Where is CSP headed in the near future?

Potential cost reduction through the following aspects:

- Overall expansion of the CSP market: US, Spain, Morocco and South Africa...
- And expansion of the CSP market in China: New technology providers, EPCs and OEMs
- Bigger sized CSP plants to reduce fixed costs (power block and BOP)
- Solar field, solar receiver and storage systems advanced designs and optimization
- Right hybridization with PV

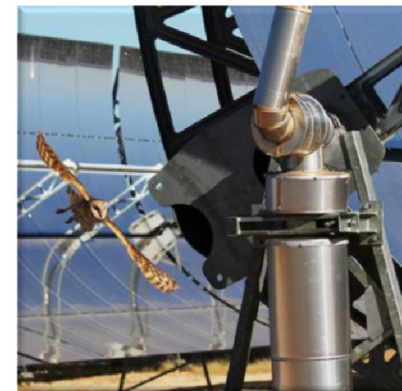
Other applications

- Heat process applications
- Solar desalination
- Hydrogen generation



Financing outlook

- ACWA Power did the financial close beginning 2019 for **the largest CSP and renewable project in the world.**
- **Redstone project in South Africa** is waiting for PPA extension and from financial part is ready to go forward.
- Although projects like **Crescent Dunes** with PPA cancellation are not good news to finance new CSP projects, we cannot base the development of a technology taking into account only one single project.
- Lack of track record especially in the molten salt towers is a handicap for the lenders, but despite of that we reached for two CSP towers last year
- **Parabolic trough is a mature technology**, normally is getting easily the financial close as so many good references have been achieved.
- **Lesson learnt from previous CSP** projects are key to improve and mitigate problems from that projects in new ones and based on that experiences, lenders can trust on the technology.
- Financing is a challenging process, but possible to be achieved as it has been demonstrated.





Je vous remercie Danke obrigado
 mihi koe рақмет сізге
 Teşekkürler شكرا
 謝謝 Asante மணி
 धन्यवाद Thank you
 Terima kasih Ngiyabonga Tak

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