[*CAN HYBRID SOLAR PROJECTS PAVE THE WAY FOR CSP DEVELOPMENT*]

[Ahmed Albalawi, KAPSARC, +966509716252, Ahmed.balawi@kapsarc.org]

Overview

Hybrid renewable energy systems are a combination of two or more technologies that complement each other to result in clean and more stable power output. They offer flexibility and dispatchability. Hybrid systems, especially the combination of concentrated solar power and photovoltaic systems (CSP-PV), have been investigated for many years to try and address the challenges the electricity system faces with high penetration of renewables. A hybrid system with CSP-PV could provide a baseload generation well into the night hours. Recently, China's rapid renewable energy development through their "base projects" initiatives has paved the way for the development and deployment of many technologies including CSP-PV hybrids. The CSP technology featured in several winning tenders to be part of a large hybrid complex, typically collocated with 9-times larger PV system to cover peak demand more reliably. This study reviews the progress of CSP technology worldwide and explore how the hybrid renewable energy projects could pave the way for accelerated development of CSP.

Methods

We examine the status of CSP projects through a dataset maintained and updated annually by CSP Guru (https://csp.guru). The database present information on 124 operational and under construction projects of CSP technologies worldwide. CSP deployment has been characterised by separate phases of policy incentives in different countries. Recently, the technological and financial development is driven by China's hybrid renewable energy projects that look to add 1 GW of CSP capacity to the grid. We review and analyse the recent advancement of CSP as part of a hybrid solar projects and extrapolate how these projects will accelerate the learning curve especially in terms of levelized cost of energy. We then assess the cost competitiveness of the technology to try and examine at which point will its levelized cost of electricity (LCOE) makes it competitive in the market as a standalone system. Similarly, we assess the future market of hybrid solar projects.

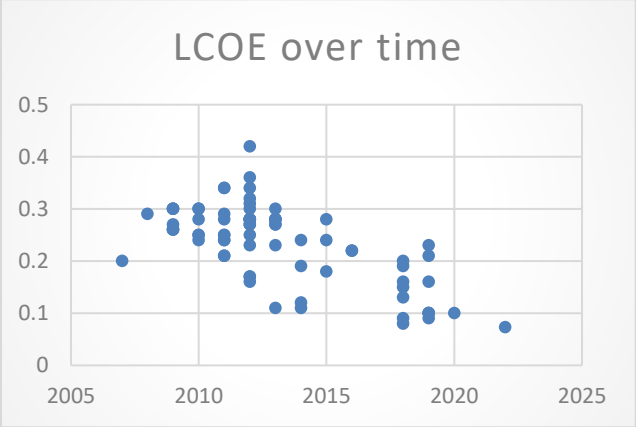
Results

There is a growing trend of deploying CSP co-located with PV as a hybrid renewable energy project since CSP technologies have the energy storage inherent in the system, which makes them a flexible and dispatchable source of renewable energy. Some recent examples of the CSP-PV hybrid include the Noor Energy 1 project in Mohammed Bin Rashid Al Maktoum Solar Park, Dubai. The project includes a 700 MW CSP (100MW Tower and 3x200 MW parabolic trough systems) + 250 PV system. The development is led by ACWA Power and is following the example of the Noor project in Morocco by having CSP and PV co-located in a single site.

Recently, China's rapid renewable energy development through their "base projects" initiatives has paved the way for the development and deployment of many technologies including CSP-PV hybrids. The CSP technology featured in several winning tenders to be part of a large hybrid complex, typically a 100 MW CSP component as part of a GW system. The move towards hybrid renewable energy projects comes to address the challenges associated with the integration of new energy resources while maintaining power system stability and reliability.

Hybrid energy projects aim to combine the characteristics of different technology in a way that provides smooth output and reliable power that covers the daily fluctuations in demand including peak demand. This would give the hybrid renewable energy projects a big advantage and better financing prospects. The Chinese demonstration initiative hope to build their experience in this field in order to position themselves well for the international market. The key aspect to demonstrate is the reliability of the energy management system of these hybrid solutions to provide peaking power. CSP is viewed as one of the promising solutions in these configurations.

In terms of the LCOE, it has been decreasing at reasonable rate from an average of 0.27 $/kWh in 2012 to an average of 0.15 $/kWh in 2019. The costs are being driven to below 0.1 $/kWh range by the recent developments in China and UAE.



Conclusions

The increased deployment of intermittent resources brings into attention the importance of regulation the power during peak demand. Storage solutions, especially batteries, are all solutions that are being investigated and each has its own advantages and shortcomings. As for the CSP, it is a technology that brings the renewable energy capacity along with the benefits of flexibility and controllability that storage solutions offer. With the right level of operational experience and cost reductions, the technology can become financially competitive.

The cost of finance is a crucial element of the systems costs. Although CSP technology is not complicated, the system complexity arises from performance management of distinct different components that are usually manufactured and supplied by different specialized companies. In addition, the different type of CSP technologies and different applications makes it challenging for developers to identify the “winning” technology.

Currently, no active support mechanism is available for CSP developers, which creates a challenge to grow the market and continue innovations in the field. The recent incentivized large-scale projects were mostly in China with high localization focus under the incentive scheme that expired by the end of 2021. The accumulated expertise of developers from Europe and elsewhere are at risk of losing their advantage. The cost reductions of the technology may not be enough in its own to drive the industry forward. The hope for CSP industry is that the new hybrid model will unlock a new wave of projects for CSP that will help to accelerate the development and cost reductions. A new wave of CSP projects can continue to drive the costs down to around 0.05 $/kWh by 2026 at the current learning rate, at which point the technology is expected to be cost competitive with other generation resources.

References

All information, data and previous conclusions reflected in this paper will be sufficiently referenced.