PV and CSP: Why Hybrids Make Sense (CSP-4)

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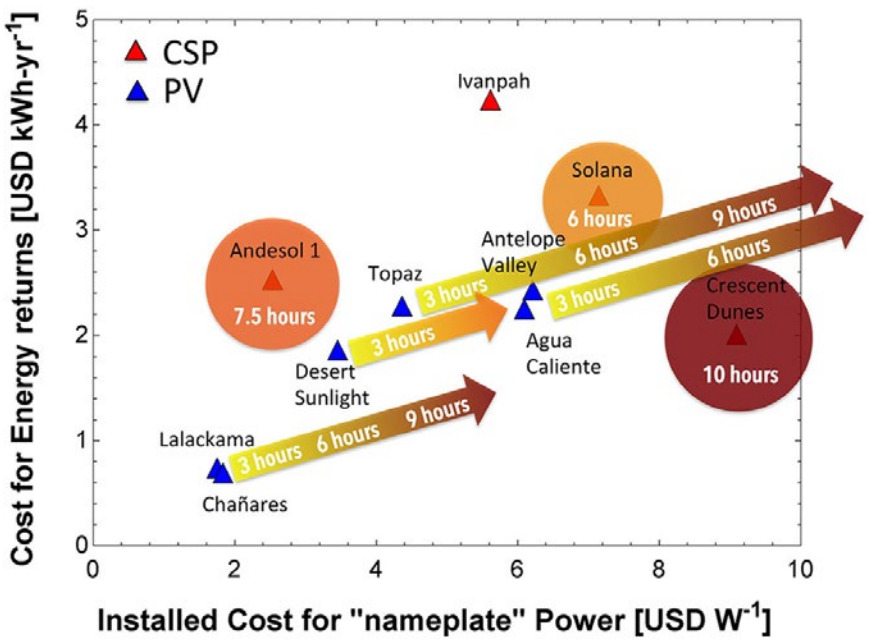
Scientific Achievement:

A comparative analysis of the strengths and weaknesses of photovoltaics (PV) and concentrating solar power (CSP) generation shows that a hybridization may be able to merge the best of both worlds by splitting the solar spectrum and sending the optimum wavelengths to PV and CSP.

Significance and Impact:

India has proposed 400 GW of new solar by 2022, meeting 25% of demand with renewables. Grid stability may be affected at this solar fraction (see "duck curve"). Hybridization with CSP including thermal energy storage (TES) can drive down costs while increasing dispatchability and enhancing grid reliability.



Research Details:

- We compared actual CSP and PV plants with and without storage for both specific "nameplate" costs [USD/W] and annualized levelized cost [USD/kWh-yr].
- PV outperforms CSP when storage is not considered; but if storage is needed, then the reverse is true: CSP with TES is more economical than PV plus batteries using current battery technology (Note: grid-scale storage with TES is more commercially mature than grid-scale battery storage).
- We explored the opportunity for hybridizing these technologies considering a spectral-splitting approach that directs the wavelengths usable by PV (generally Vis) to a CPV receiver with the balance of the solar spectrum (UV and IR) absorbed by a CSP heat-collection element, providing both direct conversion and storage in a single system with shared primary optics.

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