Published on *CSP Today* (http://social.csptoday.com)

Which CSP technology is best for a given project size?

Posted by Heba Hashem [1] on Mar 14, 2014

Discussion over which technologies might best serve different sizes of CSP project has been fanned with the publication of a new report.

By Jason Deign [2]

The longstanding debate [3] over project sizes in CSP has been given a further twist with a report from the US advisory firm Lux Research.

The report, titled 'Turning Up the Heat on Advanced Concentrating Solar Components', predicts power towers and linear Fresnel technologies will end up being the most cost effective concepts for very large and small projects, respectively.

While forecasting a welcome reduction in levelised cost of electricity (LCOE), to a level competitive with multi-crystalline silicon (mc-Si), the study appears to hint at a reduced role for parabolic trough at both ends of the project size spectrum.

"Advanced power towers will win for large projects," said Lux in a press release last month. "Supercritical steam systems are the most likely to come to fruition by 2020.

"The next step for power towers will likely be toward air Brayton and supercritical CO2 systems that can beat mc-Si's LCOE by 31% and 33%, respectively."

The company added: "Fresnel reflector systems are best for small projects.

"Linear Fresnel reflectors with molten salt heat transfer fluid can undercut mc-Si's LCOE by 6% and have the most potential to dominate smaller CSP projects and alternative applications like integrated solar combined cycle, industrial heat, enhanced oil recovery, and water purification."

However, Jayesh Goyal, global vice president of sales for the linear Fresnel plant developer AREVA Solar, says it would be a mistake to assume the technology cannot compete in larger projects.

Small projects

"We are targeting power plants of up to 250MWe and 17 hours of storage with our technology," he points out.

“It’s one thing to say that Fresnel is the best CSP solution for small projects, which is likely a true statement as it is very cost effective and modular, but quite another to say that it is not suitable for large projects, which we definitely disagree with.”

Goyal also doubts whether linear Fresnel will be able to beat mc-Si on LCOE, unless the former is equipped with molten salt storage and the latter employs batteries.

“Regarding the LCOE projections, I’d say that if we compare systems with storage we can definitely beat out mc-Si. But for projects without storage it will take quite a while before any CSP technology can beat the LCOE of mc-Si.

“I don’t see a clear roadmap for that development at this time.”

Linear Fresnel proponents maintain that the technology has lower costs compared to other CSP variants because it uses flat mirrors with fewer moving parts.

But Kelly Beninga, chief commercial officer at SkyFuel, is keen to emphasise that parabolic trough, CSP’s most established technology, still offers unbeatable value across projects of all sizes.

As a parabolic trough developer itself, it is understandable that SkyFuel should defend its corner. However, says Beninga: “SkyFuel has developed a linear Fresnel system in the past.

“We went through building a prototype and our conclusion was that the lower optical efficiency of linear Fresnel didn’t offset any cost savings by having less structure.

Operational efficiency

“It takes a pretty big hit in optical efficiency so you have to have a bigger area, and the cost for that is more than the savings in structure.”

Beninga says SkyFuel’s comparative findings have been backed up by independent studies in Europe. “We’re not just saying this because we are building troughs and not just because we sell troughs. We had the option of doing both systems.”

He also disputes whether power towers will turn out to be more cost-efficient than parabolic troughs for large projects in the future.

The accepted wisdom [4] is that power tower technology could gradually edge out parabolic trough because it can achieve higher temperatures, which results in greater efficiency and thus potentially a lower LCOE. Power towers also tend to be more economical at larger sizes.

However, some of these assumptions might not stand up to close scrutiny, Beninga argues. In particular, the point about higher temperatures is generally based on a comparison of parabolic trough with a synthetic oil heat transfer fluid and power tower with molten salt.

While such a comparison may apply to most existing plants, many parabolic trough (and, indeed, linear Fresnel [5]) projects now under development also use molten salt, making it possible to achieve temperatures of 500ºC and more across the board.

“There is some argument that for very large plants the piping for very large troughs becomes oppressive,” admits Beninga. “That may be a balancing point in 10 or 20 years from now. But it is

still a ‘what if’.”

In the meantime, he adds, power towers have yet to outperform parabolic trough on LCOE and the promise that their costs will come down as the technology matures has still not come true.

“Power towers are using the same laws of thermodynamics that we are,” he says. “The jury is still out on them.”

To respond to this article, please write to the author Jason Deign [2].

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