No show stoppers for concentrating solar power

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Parabolic trough collectors at the PSA, Plataforma Solar de Almeria, experimental facilities in Spain. Concentrated sunlight heats up a synthetic oil in the pipes at the focus of the troughs. Photo: Erik Pihl

(Phys.org) -- A recently published study confirms that solar thermal power is largely unrestricted by materials availability. There are, however, some issues that the industry needs to look into soon, like replacing silver in mirrors.

In the wake of Chinese export restrictions on rare earth metals, the dependence of some renewable technologies on scarce materials has gained attention. Several players in the wind and PV industry are struggling to get away from excessive use of restricted elements, such as indium or rare earth metals. Meanwhile, there has been a shared notion amongst solar scientists and industry that Concentrating Solar Power (CSP) should "probably" be less restricted, being built mainly on commonplace commodities like steel and glass.

A recently published study from Chalmers University of Technology has gone into the details on material issues for CSP. The main conclusion is that CSP does indeed seem to be largely unrestricted, viewing the material requirements compared to the global reserves. In theory, enough solar plants could be built to cover – at the very least – five times the current global electricity demand.

However, the report also highlights some issues that are likely to pose challenges to the industry. The main point of concern is that silver, today extensively used for reflecting surfaces, will most likely be in short supply in the coming decades even without demand from a booming CSP industry. CSP mirror manufacturers might have to look at other reflective surface materials, such as aluminium, to secure cost competitiveness.

“The prospects for strong growth for CSP over the next few decades seem good, but would cause a stir on the global commodity markets”, says Dr Erik Pihl, lead author of the scientific article.

Following a Greenpeace/IEA SolarPACES/ESTELA growth scenario where CSP reaches 8000 TWh/year in 2050, the solar plants would consume up to 50-120% of today’s yearly nitrate salt production, and 5-15% of several common materials such as glass, nickel, magnesium and molybdenum.

The report has used data directly from plant manufacturers Cobra and eSolar for trough and tower plants. These plants have somewhat different characteristics when it comes to material use.

“Parabolic trough plants tend to use a lot of concrete and iron, while the concept of small heliostat tower plants has a higher use of aluminium and stainless steel,” says Erik Pihl. “The common design of a parabolic trough plant also requires more molten salt per MW than a salt-receiver

tower plant, even when the former has fewer storage hours. That means that trough plants appear slightly more sensitive than tower plants to possible salt production bottlenecks, unless other storage techniques can be employed."

Erik Pihl believes that we can expect to see material demands for plants decreasing as we go for higher steam temperatures and increased plant efficiency.

"We see that clearly when comparing a mature design to a novel concept. That does not automatically mean that all material restriction problems will be solved. We might trade a large use of common materials for small quantities of scarce elements. It comes down to what alloys we use in pipes, receivers and turbines."

Higher temperatures means more use of high quality steels, but alloy materials such as molybdenum and niobium have restrictions in both stock and production.

"There might be enough for CSP alone, but there are many other uses", says Erik Pihl. "That could be a problem in the more distant future. In the short term, substituting silver and increasing nitrate salt production should be the first priority."

The full article "Material Constraints for Concentrating Solar Thermal Power" has been published in *Energy*.

Provided by Chalmers University of Technology

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