COMPETITIVE SOLAR POWER TOWERS

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Policies to boost Concentrated Solar Power (CSP) in the global energy mix:

some recommendations

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Introduction - Public subsidies are required to boost storage, including CSP

Today, most electric systems have a medium-low share of variable renewables and medium-high share of carbon-intensive but dispatchable generation, thanks to which their need for massive storage is limited. Consequently, today, the value of storage is generally low.

However, we believe its value will go up in the medium term and that storage technologies will be widely deployed. R&D must be performed right now to meet this future need. Private investment in deployment is needed, too, but the returns are too uncertain today for investors to take the plunge. For this reason subsidy is needed to convince them of the business case. This is true of CSP that is technologically ready but needs further improvements to significantly lower its costs.

Message:

Ways to store large volumes of renewable energy will be needed by 2030. R&D is needed to develop them. Investors need to be convinced that an investment in storage soon will be profitable in the medium term.

Global challenges

The cheap price of the ton of carbon

Unless environmental externalities are seriously accounted for (e.g. through a significant pricing of the ton of carbon), it will be difficult to beat a gas-fired Combined Cycle Gas Turbine on LCOE.

Subsidies for RES differ between nations

There are countries/authorities that subsidise(d) renewables quite heavily. For example, they organise tenders to specifically build a CSP power plant, knowing that the chosen bid will be much costlier than a non-renewable power plant that would provide similar flexibility. See, for example, high feed-in tariffs (270 €/MWh) offered in Spain, where the maximum Direct Normal Irradiation is ~2100 kWh/m2.year. From a global standpoint, this is a very suboptimal way of spending taxpayers' money to boost CSP.

Europe's low Direct Normal Irradiation (DNI) and European funding

The bulk of CSP will not be built in Europe because its DNI is too low. Consequently, European research entities, technology providers, utilities, etc. want to develop CSP mostly as a technology to be exported outside Europe.

If the European Union decides to spend e.g. 100 M€ to enable the design, construction and operation of CSP plants, academia and industry of the CSP field think that it is more worthwhile to use said amount to help build 300 MWe in Chile rather than 150 MWe in Morocco or 80 MWe in Spain (order of magnitude figures). For this reason, subsidising European technology as a future export activity should not mean subsidising plants located in Europe. State Aid rules must allow this.

Message:

Build a CSP plant where its generation profile is most competitive with the local hourly unsubsidised electricity price (high DNI locations). Allow subsidies from Europe to that plant provided the value share of the European suppliers is above a given % threshold.

Recommendations to boost Concentrated Solar Power in the global energy mix

Boost investor's confidence

Given the current framework, direct incentives should be implemented where they will have the largest impact on fighting climate change. Governments tend to fund domestic installations. However, 1€ of subsidy (investment financing) is more efficient in areas with higher potential, i.e. solar resource in the case of CSP.

Nevertheless, some level of support to European projects remains relevant in order to create references that would help to reduce the perceived technological risk and showcase the European know-how.

Message:

Boost investors' confidence in the latest CSP technology with reference plants, built in Europe if needs be even though the sites with better resource are outside.

Favour technology-neutral calls for tenders

CSP may or may not be explicitly required but, choosing a site with high DNI and requiring (either explicitly or implicitly) a massive (e.g. 10 hour) storage narrows the choice down to CSP. However, if the area is suitable for other flexible renewables, why not letting the call open? This will be exceptional anyway.

Requiring expected services rather than a given technology is key. A good example is that most experts believed that the molten salt tower was the unbeatable benchmark. However, due to the ever-decreasing cost of PV, parabolic troughs enhanced with electric heaters fed by a PV farm appeared to be more competitive.

Message:

Allow CSP to participate in all tenders open to renewable energy generation that require dispatchability. Allow CSP plants owners freedom in the design of their plant, including to combine CSP with variable renewable energy technology.

How to meet these contradictory requirements?

- **Laying down a level playing field for all competing companies, technologies, etc.** Assessing technologies based on their levelised costs only conceals all market signals (notably price variation depending of time of day). On the other hand, using system-level indicators allows consistent and efficient decision-making at a greater scale.
- **Properly valuing the service provided to the grid.** All power production technologies do not provide the same service to the grid: dispatchability, ramping capability, spinning reserve, etc, if possible, **considering environmental (and others) externalities** such as water consumption, carbon content of the production, etc.
- **Subsidising the electricity generated with CSP** whilst upholding the abovementioned level playing field.

Recommendations on calls for tenders

Power Purchase Agreements (PPAs)

PPAs are a contract by the supplier to supply a set amount of electricity for a set price at a set time. They are usually of long duration (the economic lifetime of the plant). Because they

remove price-uncertainty (and therefore risk) for the supplier, the supplier can secure better financing terms, since revenue generated by the plant can be known with higher confidence.

Market price plus premium

Market price plus premium is a powerful tool that exposes any power plant to market needs. Innovative financing schemes are combining different types and sources of revenues (e.g. the Aurora project in Australia). However, such combined mechanisms may increase the uncertainty on long-term revenues.

Message:

Both Power-Purchase Agreements for a fixed price and the "market price plus premium" model (whereby the plant's revenues follow the hourly variations in electricity price on the open market) are good ways to fund CSP. The former offers certainty in revenues. The latter allows CSP to sell at moments when electricity prices are high.

What about hybridised fossil-fired power plants?

Electricity systems will retain a significant share of fossil-fired power plants (hopefully Combined Cycle Gas Turbines - CCGTs) for several decades if governments fail to take global heating seriously. CSP generation can be added to CCGT. This 'hybridisation' delivers significantly cheaper installed costs per MWe than greenfield, stand-alone CSP plants.

A power plant must meet several criteria to qualify for solar hybridisation: good DNI and available land next to the plant (for the solar field) are the main ones. Respecting these criteria, the marginal solar generation must be subsidised as if it were produced by a stand-alone CSP plant. Accurately identifying this solar generation can be easily performed using only a few measurements on the power cycle.

Message:

So long as CCGT remains an acceptable electricity generation source, extra power generation can be obtained thanks to a CSP field that provides solar steam to the CCGT. The cost of this supplementary solar power is significantly lower than that of a standalone CSP plant.

Lessons learnt: CAPTure's project experience

Although today's electric systems do not require massive storage, we know that in 10 years this will change and answering those needs will be possible thanks to EU funded research and development happening now. Incentives to deploy storage technology are needed, or a better market design that reveals the value of storage technology in the medium term.

CAPTure has worked on the conception of two innovative power plant layouts and in key technology components to optimise their efficiency. As a result, we can confirm that competitive CSP plants should be placed in the highest DNI locations to be viable without subsidy. To support the CSP supply chain, which is based in Europe, the EU should allow subsidies to flow to CSP projects outside Europe subject to conditions.

Hybridisation with CCGT plants allows for an optimal use of plant components and reduces the cost of the CSP-derived portion of electricity produced.