DOCKETED

Docket Number:	09-AFC-07C
Project Title:	Palen Solar Power Project - Compliance
TN #:	202966
Document Title:	Susan Kraemer Comments: Refuting the claim that batteries are a cheaper substitute for CSP storage
Description:	N/A
Filer:	System
Organization:	Susan Kraemer
Submitter Role:	Public
Submission Date:	8/20/2014 4:53:29 PM
Docketed Date:	8/20/2014

Comment Received From: Susan Kraemer
Submitted On: 8/20/2014
Docket Number: 09-AFC-07C

Refuting the claim that batteries are a cheaper substitute for CSP storage

I am in a position to refute one of the many bogus and unfounded claims I read in the transcripts - that it would be cheaper to use batteries for storage.

This is not true.â€¨
In my work in the past I have interviewed experts in batteries and CSP storage.

I interviewed Dr Pitchumani who heads up the SUNSHOT Program at the US department of Energy. He told me that when the DOE SUNSHOT Initiative began in 2010, the cost of thermal energy storage was about $27 a kilowatt hour.

He told me â€œThe essential goal is to drive that down to $15 a kilowatt hour. The batteries that I have seen are anywhere from $500 a kilowatt hour and up anywhere up into the thousands.â€

Please understand that these figures he gave me were for the onetime cost of building the actual storage: so it is per kilowatt-hour of storage capacity - not what it costs to ship every kilowatt-hour out! When the $15 goal is reached, then the costs of CSP per kilowatt-hour can meet the SUNSHOT goal of 6 cents a kilowatt-hour for CSP, only a cent more than its goal for PV.

(Of course getting those costs down depends on getting enough CSP power towers with storage built to reduce the costs - just as building lots of PV has driven those costs down)

But given the $15 versus $500 comparison - and this is when lots of batteries have been built over many decades - it seems intuitively obvious that CSP storage is a more promising option, even with just one or two projects in work so far. To achieve this $15 goal with batteries for storage would be impossible.

I also spoke to an ARPA-E awardee who is working on cutting edge CSP thermal storage to get to that $15 using perovskites, Anoop Mathur. He told me that the thermal storage of CSP could also be used, not only attached to a CSP plant, but as a standalone storage medium. Utility-scale tanks of a thermal storage medium are cheaper to build than utility-scale batteries. Surplus electricity from wind at 3AM or solar at 1PM could be used to heat up the liquid in the tanks to cover the actual peaks that utilities have - which is now evenings in California, due to the increase in daytime generation from rooftop PV.

I also interviewed Charles Barnhart of Stanford who is studying the ESOI of batteries - the amount of energy that can be stored by a technology, divided by the amount of energy required to build it (Energy Stored On Invested). His point was that cycle life inherently limits batteries, in a way that it doesnâ€™t for storage in natural formations like CAES or pumped storage in reservoirs.

Over a 30-year timescale, for example, CAES for example, delivers 240 times its energy cost compared with Li-on batteries that returned merely 10 times, and only 6,000 cycles compared with 25,000. (Li-on because they are the best batteries so far) He also told another reporter that in thermal storage like with CSP the round trip efficiency is very high.

http://pubs.rsc.org/en/content/articlepdf/2013/ee/c3ee41973h

I also have spoken to SolarReserve CEO Kevin Smith many times. He has a long history in energy development, and

California regulators earlier approved SolarReserveâ€™s power tower CSP with storage Rice project near the Palen site.

SolarReserve is building CSP with storage both here (Crescent Dunes power tower with storage) and internationally, and in the meantime, also building the three biggest PV plants in the South African market, so he is familiar with the storage side both for PV and CSP.

I asked him about batteries versus CSP storage. He said that like pumped hydro storage, there is really no cycle limit in CSP storage.

â€œThe storage side of CSP is probably five to ten times cheaper than batteries. And at large scale you practically need a football field of a battery. One key difference is cycle life. Basically weâ€™re just filling a tank with hot molten salt, and we can do that as much as we want. No limit. Itâ€™s expected that the cycling will be every single day for the full life of each project. By contrast, batteries still face limits to the number of cycles.â€