Powers Engineering

October 9, 2009

California Energy Commission Dockets Office
MS-4 Re: Docket No. # 09-IEP-1
E 1516 Ninth Street
Sacramento, CA 95814-5512

Subject: Powers Engineering Comments on August 2009 Draft Staff Report "*Comparative Costs of California Central Station Electricity Generation*"

Dear California Energy Commission:

Powers Engineering has a number of recommended additions and modifications to the document based on a review of the August 2009 staff draft report. These recommended additions and modifications are provided below.

Include fixed thin-film PV source category

The final document should include fixed thin-film PV as a second PV source category. Fixed thin-film PV has played a pivotal role in California investor-owned utility solar procurements since the original December 2007 "*Comparative Costs of California Central Station Electricity Generation"* document was published. Also, the fixed thin-film PV category has been included in the CEC-funded Renewable Energy Transmission Initiative (RETI) proceeding since May 2008 and is included in the June 2009 CPUC preliminary assessment of the cost of achieving 33 percent renewable energy by 2020.[1,2]

Both RETI and the CPUC use a fixed thin-film PV cost of $3.70/We (a/c). RETI explains the genesis of the $3.70/W (a/c) thin-film PV capital cost value as:[3]

> An "alternate scenario" was proposed in the report (Section 3.8) to test lower future solar costs. Black & Veatch will run this scenario for thin film photovoltaic systems with a capital cost of $2,700/kWe to $3,500/kWe. This is based on module costs of $1,500/kWe to $1,700/kWe and "balance of system" costs of $1,200/kWe to $1,800/kWe. These module costs are based on First Solar's 2010 target production cost of $0.90/watt (dc). Balance of system includes inverters, installation, mounting systems and site costs."

First Solar states its average panel production cost is the second quarter of 2009 was $0.87/watt (dc),[4] slightly less then the $0.90/watt (dc) price basis used by Black & Veatch to establish a price range of $2,700/kWe to $3,500/kWe for thin-film PV in the RETI process. A $3.70/We ($3,700/kWe) capital cost is accurate for thin-film PV in 2009.

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[1] RETI Phase 1A Final Report, May 2008, p. 5-29 and Appendix B, p. 5-5.
[2] CPUC, *33% Renewables Portfolio Standard Implementation Analysis Preliminary Results*, June 2009, p. 31.
[3] RETI Phase 1A Final Report, May 2008, Appendix B, p. 5-5
[4] First Solar, *Fast Facts: Company Overview*, document MD-5-601 NA, August 2009. http://www.firstsolar.com/company_overview.php

The CPUC authorized a 20-year power purchase agreement (PPA) between PG&E and Sempra Generation for 10 MW of fixed thin-film PV output in May 2009. The Sempra PV system has been operational since December 2008. Sempra Generation states this PV installation produces the "lowest cost solar power in the world," and that this power is cheaper than power from solar thermal installations.[5] CEC staff can verify the sale price in the PG&E/Sempra PPA by communicating directly with CPUC staff. The PPA sale price will be a few cents per kWh higher than the COE for the 10 MW Sempra PV array. CEC staff can also readily verify the PPA terms that First Solar is currently offering for PV arrays up to 20 MW in size by communicating directly with First Solar.

A cost-of-energy (COE) range for thin-film PV arrays of $114/MWh to $176/MWh is identified by RETI in its March 2009 Phase 1B Final Report. This is somewhat lower than the $168/MWh value used by the CPUC in June 2009 for fixed thin-film PV.[6]

Recommendation 1: Include a fixed thin-film PV source category and utilize either: 1) the mid-range of the COE value identified by RETI in the Phase 1B Final Report of $145/MWh for fixed thin-film PV arrays, or 2) the $168/MWh figure used by the CPUC in its June 2009 analysis.

Revise the fixed O&M cost for PV

The August 2009 staff draft report estimates much higher PV fixed O&M costs, at $68/kW-yr, than other recent CPUC or CEC-funded estimates. See **Table 1**. That draft report states that the fixed O&M for PV is the same as the fixed O&M for solar trough. Other reports indicate considerably higher fixed O&M cost for solar trough.

The CEC needs to provide significantly more information in the final document than this single sentence (p. 56) regarding changes to fixed and variable O&M costs:

> "The changes in fixed and variable O&M are somewhat misleading as some of the variable costs were shifted to the fixed cost category to be more consistent with current practices of various other data collectors."

Recommendation 2: CEC staff should either provide a thorough explanation for the unexpectedly high cost of fixed O&M for PV or continue to utilize the fixed O&M value for single-axis tracking PV from the December 2007 "*Comparative Costs of California Central Station Electricity Generation Technologies"* final report. This fixed O&M cost estimate for single-axis tracking PV is supported by a study prepared by Navigant. No similar supporting study is included with the August 2009 draft staff report.

[5] GreenTechMedia, *Sempra Wants 300MW Plus of Solar in Arizona*, April 22, 2009.
[6] CPUC, *33% Renewables Portfolio Standard Implementation Analysis Preliminary Results*, June 2009, p. 31.

Recommendation 3: Staff should provide an explanation of why the fixed O&M cost for onshore wind is so low in the August draft staff report relative to the June 2009 CPUC estimate and the May 2008 CEC-funded RETI Phase 1A estimate.

Table 1. Comparative Fixed O&M Cost Estimates for Wind and Solar Resources

Report	Date	Fixed O&M ($/kW-yr)			
		single-axis PV	fixed PV	solar trough	wind (onshore)
CEC Comparative Costs - final	Dec 2007	24.87	NA	60	31.09
RETI Phase 1A	May 2008	35	25	66	50
CPUC 33% RPS Analysis[7]	June 2009	53.70	NA	80.55	73.49
CEC Comparative Costs - draft	Aug 2009	68	NA	68	13.70[a]

a) There is also a $5.50/MWh variable O&M cost included for wind power.

Clarify assumptions supporting PV and solar trough capital cost

CEC staff identify a capital cost for single-axis tracking PV in the draft staff report of $4,550/kW. This cost is one half the capital cost estimated by the CEC in the December 2007 "*Comparative Costs of California Central Station Electricity Generation Technologies"* final report. It is also considerably lower than the June 2009 CPUC estimate for the same technology. These capital costs are shown in **Table 2**. The $4,550/kW estimate is consistent with 2009 pricing for such systems. However, some explanation on single-axis tracking PV price trends should be provided in the text of the document, along with a discussion of difference in 2009 CPUC and CEC estimates. As noted earlier, fixed thin-film PV should be added as a separate source category.

Justification must be provided to support the unexpectedly low capital cost estimate for solar trough. The June 2009 CPUC report identifies a solar trough capital cost of $4,924/kW compared to the August CPUC draft staff report estimate of $3,687/kW. Obviously different assumptions are being used to estimate the solar trough capital cost. The type of cooling system assumed, either wet or dry, must be stated as that impacts capital cost, capacity factor, and COE.

Table 2. Comparative Capital Cost Estimates for Wind and Solar Resources

Report	Date	Capital Cost ($/kW)			
		single-axis PV	fixed thin-film PV	solar trough	wind (onshore)
CEC Comparative Costs - final	Dec 2007	9,678	NA	3,900	1,959
RETI Phase 1A	May 2008	6,500 – 7,500	2,700 – 3,700	3,800 - 4,800	1,900 - 2,400
CPUC 33% RPS Analysis[8]	June 2009	7,065	3,700	4,924	2,491
CEC Comparative Costs - draft	Aug 2009	4,550	NA	3,687	1,990

[7] CPUC, *Inputs and Assumptions to 33% Renewables Portfolio Standard Implementation Analysis*, June 2009, p. 12.
[8] Ibid, p. 12.

Recommendation 4: Provide an explanation of single-axis tracking PV price trends and reasons for the large difference between CPUC and CEC 2009 estimates of the current capital cost of single-axis tracking PV systems.

Recommendation 5: Clarify all assumptions behind the solar trough capital cost and explain why the draft staff report cost estimate of $3,687/kW is much lower than the June 2009 CPUC estimate of $4,924/kW.

Please feel free to contact me at (619) 295-2072 or bpowers@powersengineering.com if you have any questions about this comment letter.

Best regards,

Bill Powers, P.E.