

June 11, 2013

California Energy Commission  
Dockets Office, MS-4  
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**Re: Docket No. 07-SB-1; Comments on the Cost Effectiveness of Rooftop Solar Photovoltaic Systems for Consideration in California's Building Efficiency Standards**

**A. INTRODUCTION**

The Solar Energy Industries Association (SEIA)<sup>1</sup>, the California Solar Energy Industries Association and the Vote Solar Initiative (Joint Parties) submit these joint comments in response to the California Energy Commission's (Commission) request for comment on the findings of the draft report *Cost Effectiveness of Rooftop Solar Photovoltaic Systems for Consideration in California's Building Efficiency Standards* (Draft Report) prepared by Energy and Environmental Economics, Inc. (E3). The Joint Parties are thankful to the Commission for its efforts to date related to the preparation of this important report and appreciates the opportunity to comment.

The Joint Parties agree with the main finding of the Draft Report that rooftop solar will be cost-effective in 2020 for a large portion of California's commercial and residential electricity customers. This finding affirms that the state's commitment to distributed solar generation is achieving the envisioned goals of lowered installation costs, and is further validation that solar has become an increasingly cost-effective and accessible deployment option for Californians.

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<sup>1</sup> The comments contained in these comments represent the position of the Solar Energy Industries Association as an organization, but not necessarily the views of any particular member with respect to any issue.

The Draft Report's conclusions also bode well for the achievement of Governor Brown's goal of 12,000 MW of in-state distributed generation (DG) by 2020, as well as the goal of this Commission that 100% of new residential construction be zero net energy (ZNE) by 2020 and 100% of commercial construction be ZNE by 2030. While continuing to be important contributors, energy efficiency and demand response alone will not achieve the laudable- and aggressive- ZNE goals. Because zero-emission DG will play an irreplaceable role in achieving these goals, it is absolutely critical to ensure that rooftop PV can be deployed on a wide-spread cost-effective basis. This report demonstrates that with the appropriate suite of supportive policies and rate structures in place, solar is well-positioned to do just that. Overall, the report provides a strong analytical basis for the Commission to seriously consider adoption of policies that will support increased deployment of solar technologies in an increasing number of circumstances and building contexts.

## **B. COMMENTS**

1. *The Model Underlying the Report Provides a Useful Tool to Assess the Implications of Potential Changes to Rate Design and Net Energy Metering (NEM) Policy*

The Draft Report includes a number of assumptions that E3 suggests are instrumental in shaping the final cost-effectiveness conclusions. Amongst these key assumptions is that the existing inclining block default residential rate design and net energy metering (NEM) structure will remain largely unchanged and continually available throughout the service lifetime of all rooftop PV systems installed through 2020. E3 stresses the importance that rate design and NEM policy play in the outcome of any cost-effectiveness analysis by noting that "If the structure of utility rates is changed [...] utility bill savings achieved installing PV could drop significantly.

Similarly, if NEM were replaced with a different policy [...] the cost-effectiveness of solar may decrease.”<sup>2</sup>

The Joint Parties agree that rate design and NEM are critical components to the value proposition of rooftop PV, and the conclusions of the Draft Report effectively highlight the need to continue sensible policies that align with, and do not harm, the state’s clean energy and GHG emissions reduction goals. We note that the California Public Utilities Commission (CPUC) is currently considering potential changes to residential rate design and NEM.<sup>3</sup> To the extent that significant changes are made to either NEM policy or electric rate structures, it is important that decision-makers understand the implications of those changes on the economic viability of solar, and by extension on the ability of the state to achieve its ZNE goals.

In this regard, the study provides a useful tool to help stakeholders and policy makers understand the practical impact of NEM and rate reform on the economics of solar from the participant perspective. As greater clarity emerges around the direction of rate and NEM reform, the Joint Parties encourage the CEC to use the model developed by E3 to assess the economic implications these reforms may have.

*2. The Assumptions in the Draft Report Regarding the Trajectory of Installed PV Costs on New Construction are Highly Conservative*

Like any complex analysis, the results of the E3 study are subject to uncertainty, particularly given the substantial number of assumptions and cost projections on which it necessarily relies. In general, we find that E3 has taken a reasonably conservative approach in assessing the future economics of solar. Given its centrality to E3’s analysis, we focus our comments here on the projection of installed PV costs.

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<sup>2</sup> See Draft Report at p. 40.

<sup>3</sup> See R.12-06-013 and R.10-05-004

From a methodological standpoint, there are a number of factors that collectively suggest that the cost of solar may be significantly lower than what E3 projects. Perhaps most significantly, the draft report's methodology for predicting future costs does not envision the fundamentally different business environment that would likely be engendered by including PV into building energy efficiency standards, and as such, the resulting cost predictions are higher than what might actually prevail.

The authors begin with data for residential retrofits (as 'self-reported' through the California Solar Initiative) for 2012, and make two adjustments. The first is a potential reduction of \$1.20/W, derived from data collected by the New Solar Homes Partnership between 2007 and 2009. The second is a 'progress ratio', derived from a 2007 NREL paper, estimating that future installed costs will come down 20% for every doubling of demand. However, incorporating PV into California's building energy efficiency standards would likely create a significantly different business environment from both the current residential retrofit market and the current New Solar Homes Partnership, making these benchmarking metrics less relevant.

For example, by including PV in all new construction, the costs associated with permitting, design, installation labor, and customer acquisition could be radically different relative to current conditions. Researchers at LBNL conducted an analysis into the differences in cost between residential installations in Germany and the United States.<sup>4</sup> Using data from 2011, they found an average delta of \$3.19/W. Much of the cost difference could be attributed to factors that would be effected by inclusion of PV into building codes, such as customer acquisition and design (\$0.62 more in the US) and permitting, inspection, and interconnection (~\$0.20/W), installation labor (\$0.36/W) and profit/overhead/residual (\$1.32/W).

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<sup>4</sup> <http://eetd.lbl.gov/ea/emp/reports/german-us-pv-price-ppt.pdf>

In addition to these methodological concerns, which suggest that E3's resulting cost projections may be high, we also compare E3's projections with other estimates that have been developed. Even though these estimates are not California specific we believe that as the solar market scales, both in California and globally, pricing will converge as best practices and winning technologies emerge and proliferate.

First, we note that E3's analysis projects the following approximate trajectory<sup>5</sup> for installed cost per watt of PV for systems under 10 kW and for systems 10 kW in size to 100 kW in size:

	2012	2013	2014	2015	2016	2017	2018	2019	2020
< 10 kW High	\$5.38	5.10	4.80	4.60	4.40	4.30	4.20	4.10	\$4.00
< 10 kW Low	\$4.18	4.00	3.80	3.60	3.50	3.40	3.30	3.20	\$3.10
>= 10 kW, < 100 kW High	\$4.52	4.30	4.20	4.10	3.90	3.80	3.60	3.50	\$3.40
>= 10 kW, < 100 kW Low	\$3.32	3.10	3.00	2.90	2.80	2.70	2.65	2.60	\$2.55

Thus, according to E3's low cost estimate for large projects, the installed cost of solar PV will, at most, decline to approximately \$2.55 per watt by 2020. According to data provided by the German Solar Energy Industry Association, the average cost of <10 kW systems in Germany for the 4th quarter of 2012 was 1.7 euro/W<sup>6</sup>. At today's exchange rate, this is equivalent to \$2.25/W.

Given the data that show what can be achieved today with best practices, the draft report's predictions for the future appear fairly conservative. A number of other studies also point to the reasonableness/conservativeness of E3's projection of solar installed costs:

A study evaluating the levelized cost of energy from solar in North Carolina estimated that installed cost for systems 10 kW and less in size will be \$3.84 per watt in 2020, and the cost

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<sup>5</sup> Values shown with the exception of those shown for 2012 are based on estimates relying on Figure 1, page 11 of the E3 study. We did not have access to the underlying numbers on which this figure was based.

<sup>6</sup> [http://www.solarwirtschaft.de/fileadmin/media/pdf/2013\\_2\\_BSW-Solar\\_fact\\_sheet\\_solar\\_power.pdf](http://www.solarwirtschaft.de/fileadmin/media/pdf/2013_2_BSW-Solar_fact_sheet_solar_power.pdf)

for systems sized between 10 kW and 500 kW will be \$2.58 per watt in 2020.<sup>7</sup> Both of these estimates are in line with E3's estimates. A study developed by the Department of Energy for the SunShot Initiative provides projections for the installed cost per watt in 2020 under a so-called "evolutionary" scenario, defined as the cost per watt assuming reasonably foreseeable incremental improvements.<sup>8</sup> Under this scenario, the authors predict that the installed cost per watt of solar PV will decline from \$5.71 per watt in 2010 to \$2.29 per watt in 2020 for residential systems, and from \$4.59 per watt in 2010 to \$1.99 per watt in 2020 for commercial systems. Notably, in the report, the SunShot Initiative established cost targets significantly below these 2020 levels. These cost projections, again, suggest that E3's estimates are not unduly aggressive. Finally, in a recent analysis, CitiGroup projects even more dramatic cost reductions by 2020, speculating that cost per installed watt could decline to between \$1.40 and \$1.12 per watt. Again, in comparison, E3's assessment appears quite conservative.<sup>9</sup>

The "Projections of Cost per Installed Watt- 2020" graph below compares the different estimates identified above. Collectively these studies' estimates suggest that E3's analysis is relatively conservative and thus, justified and reasonable for purposes of its cost-effectiveness analysis.

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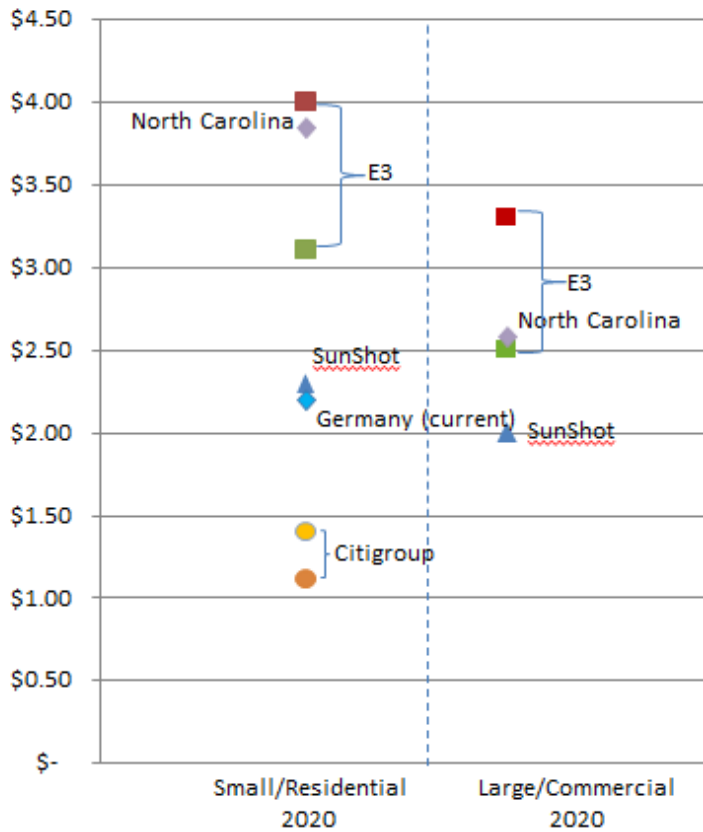
<sup>7</sup> "The Levelized Cost of Solar Photovoltaics in North Carolina" – February 2012, pg. 12;

<http://energync.org/assets/files/LCOE%20of%20Solar%20PV%20in%20North%20Carolina-FINAL.pdf>

<sup>8</sup> See SunShot Vision Study – February 2012, pg. 88; [http://www1.eere.energy.gov/solar/pdfs/47927\\_chapter4.pdf](http://www1.eere.energy.gov/solar/pdfs/47927_chapter4.pdf)

<sup>9</sup> See <http://cleantechnica.com/2013/04/02/citigroup-solar-modules-could-fall-to-25-centswatt-by-2020/>

## Projections of Cost per Installed Watt - 2020



### 3. *The Draft Report and E3's NEM Cost-Effectiveness Study Now Underway Under the Auspices of the CPUC Should be Supplemented to Include the Broad Societal Benefits of Rooftop PV Deployment*

From a methodological standpoint, this study is essentially a mirror-image of the NEM cost-effectiveness study that E3 is updating for the CPUC.<sup>10</sup> Where the CPUC's study looks only at the costs and benefits from the non-participant perspective, this study looks exclusively at the costs and benefits from the participant perspective. Thus, by design, both of these efforts limit full consideration of the comprehensive costs and benefits of rooftop solar and do not recognize

<sup>10</sup> See: [http://www.cpuc.ca.gov/PUC/energy/Solar/nem\\_cost\\_benefit\\_evaluation.htm](http://www.cpuc.ca.gov/PUC/energy/Solar/nem_cost_benefit_evaluation.htm)

the substantial environmental, health and economic benefits provided by widespread deployment of roof-top solar.

It is expected that the results of E3's upcoming NEM study could impact future NEM policy and because, by E3's own admission in this Draft Report, NEM is a critical component to the cost-effectiveness of rooftop PV, the Joint Parties encourage the Commission to grant the June 4, 2013 Petition by the American Lung Association and others requesting that this Commission perform analysis of the societal costs and benefits of NEM. By performing such a societal impacts analysis, the Commission would help fully inform policy decisions which could greatly impact the state's ability to meet its ZNE goals.

### **C. CONCLUSION**

The Joint Parties sincerely appreciate the Commission's efforts to assess the cost-effectiveness of solar PV for purposes of considering whether to include PV in the state's building code. The report demonstrates that solar is increasingly becoming a "no regrets" policy for a broad swath of California customers as the solar market scales. We also believe that the study underscores the importance of NEM and rate design issues in facilitating achievement of the state's ZNE goals, and that the model underlying its conclusions provides a tool that can and should be used going forward to help policy makers understand the implications of potential reforms to rates and to NEM on the economics of solar, and in turn, to assess the extent to which those reforms are likely to help or hinder achievement of the state's ZNE and distributed generation goals.

Although the study takes a relatively conservative approach to assessing the future cost trajectory of solar and is narrowly focused on cost and benefits from the participant perspective rather than considering a more comprehensive set of costs and benefits, both of these factors



suggest that the study's central findings are directionally sound, and thus provide a solid basis for the Commission to move forward.

Respectfully submitted,

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