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November 8, 2019

California Energy Commission
California Public Utilities Commission
California Air Resources Board

Re: SB 100 Joint Agency Report: Charting a Path to a 100% Clean Energy Future, Docket. No. 19-SB-100

Dear Chair Hochschild, Chair Nichols and Commissioner Randolph:

Vote Solar and the Solar Energy Industries Association (“SEIA”) appreciate the opportunity to comment on your plans for the development of the first SB 100 Joint Agency Report (“SB 100 Report”). Vote Solar and SEIA are grateful for the leadership of the California Energy Commission (CEC), the California Public Utilities Commission (CPUC) and the California Air Resources Board (CARB) in the preparation of this report that will guide the State’s transition to a zero-carbon electric system.

Vote Solar is a 501(c)(3) organization with over 84,000 members across the United States and 18,000 in California. We are dedicated to advancing a clean energy future to minimize the impacts of climate change on future generations. We believe that a clean energy future will include substantial development of solar energy at all scales. Vote Solar is not a trade group and does not have corporate members.

SEIA is the national trade association of the United States solar industry. Through advocacy and education, SEIA and its 1,000 member companies work to make solar energy a mainstream and significant energy source by expanding markets, removing market barriers, strengthening the industry and educating the public on the benefits of solar energy. SEIA’s members have a strong interest in the adoption and implementation of policies and programs that will accelerate the movement to a low-carbon economy.



Since the passage of SB 100 in the 2018 Legislative session it is remarkable to observe the pace at which the mix of electrical generation is changing in California, across the West and throughout the United States. A cursory look at generator interconnection queues reveals an increasing amount of wind, solar coupled with storage getting prepared for development.¹ In that regard, SB 100 has already been a success in sending a message to investors worldwide that a sustained pathway to deep decarbonization is underway in the world's fifth largest economy - California.

Wind and solar generation are not only mainstream technologies now but are the lowest cost sources of electric energy throughout the Western United States and in many other parts of the world. Battery storage is not far behind in coming down the cost curve, with innovative developers already designing projects that couple storage with clean sources of generation both in-front-of and behind-the-meter, and that pair thermal and battery energy storage systems with automated demand response measures.

As these new sources of clean electricity come to dominate the generation portfolio in California, it is now well understood by energy system planners and operators that we need to improve their integration into the bulk energy system in order to minimize system costs. Procuring more hybrid energy storage systems coupled with solar and wind generation to assure system reliability deserves significant consideration in the SB 100 planning process. Likewise, shifting and matching flexible loads with low cost, as-available renewable generation through market compensation mechanisms and innovative rate design will be key strategies for rapid and deep decarbonization.

A major focus of the first SB 100 Report should be on near- and medium-term solutions that address both grid decarbonization and system reliability. By focusing on these important issues the first SB 100 Report can facilitate a better understanding of the possibility of

¹ The California Independent System Operator (CAISO) on July 18, 2019 issue a Hybrid Resources Issue Paper. It highlights that 41% of the capacity currently in the CAISO interconnection queue is comprised of hybrid resources, with 35,341 megawatts of hybrid resources out of a total of 85,643 megawatts of generating projects.



moving to a near-zero carbon emitting electric sector by 2030 and using that momentum to cost-effectively reach a zero-carbon electric system by 2045 or before.

The Integrated Resource Planning process authorized by SB 350 has already yielded important understandings about how to cost-effectively achieve at least 60% renewable energy integration by 2030. Rapid cost reductions in battery energy storage technologies suggest that even greater levels of clean energy integration could be achieved by 2030. It may actually be possible to serve on a net basis 85% to 95% of the state’s retail load from zero-carbon emitting resources by 2030 if hybrid solar-plus-storage are appropriately modeled and credited for the reliability services they can provide. The SB 100 Report, therefore, needs to investigate the opportunity to go above and beyond the 60% renewable energy target for 2030 contained in SB 100. Hybrid resources in California need to be implemented at scale over the next five years. The SB 100 Report should document the benefits that the near-term acceleration of solar plus storage procurement and integration can have on full decarbonization of the electric sector by 2045.

The California Public Utilities Commission (“CPUC”) initiated a comprehensive biennial integrated resource planning process (“IRP”) in 2016 in response to the passage of SB350. This innovative process focused on establishing future greenhouse gas (“GHG”) planning targets and periodically adopting a portfolio of resources that would meet those targets. The first iteration of the IRP (2017-18) resulted in the adoption of a GHG planning target of 42 million metric tons by 2030.²

The adopted Preferred System Portfolio called for approximately 12,000 megawatts of new renewable and storage resources to be developed by 2030. The modeling for the portfolio selected the bulk of new solar and wind generation for a 2022 on-line date so that ratepayers could benefit from the expiring federal tax credits and generate GHG-free power at a lower cost for the remainder of the decade and beyond. The portfolio deferred adding battery storage and pumped hydro storage until 2030 when costs were projected to be lower. After adopting the 2018

² When adjusted to account for combined heat and power systems the GHG target is 46 million metric tons for the electric sector.



Preferred System Portfolio at the beginning of 2019, the CPUC decided not to authorize any new procurement by load serving entities to implement the portfolio. However, some LSEs, particularly Community Choice Aggregators, have moved ahead with new long-term procurement to meet state requirements for long-term contracting.

Subsequent to the adoption of the Preferred System Portfolio, the CPUC staff determined that there was a need for procurement of system reliability resources that would be available beginning in the summer of 2021 with a continued growth in need through 2023. Analysis by the CPUC staff, the California Independent System Operator and Southern California Edison suggested that the need for incremental resource adequacy resources could be as much as 5,500 MW in 2023. After multiple public comments the CPUC decided to order load serving entities to procure an incremental 3,300 MW of system reliability resources by 2023. This magnitude of need was triggered by the retirement of once-through cooling thermal resources, changes in the availability of power from the Pacific Northwest and the migration of the net system peak to later in the evening and later in the year when stand-alone solar generation would produce less energy.

To meet that system reliability requirements, resources need to be available from 5 pm to 9 pm principally during the months of August and September. An ideal zero-carbon resource that can meet this reliability requirement is a hybrid solar plus storage project that captures excess solar power during the mid-day and stores it in a directly coupled battery for discharge later in the evening. Unfortunately, the CPUC resource adequacy counting rules for load serving entities do not yet allow for these hybrid systems to be credited for the reliability services they can provide. However, the CPUC has stated it intends to address this deficiency in their rules being considered in the extant Resource Adequacy proceeding.³

If the issue of crediting solar plus storage systems for the reliability value they can provide is promptly resolved, then there is the potential for one-third or even more of the GHG reductions

³ The CPUC has agreed accepted a motion submitted by Vote Solar and several other parties to establish a schedule and process for determining the capacity value of hybrid resources in Rulemaking 17-09-020.



envisioned in the 2018 Preferred System Portfolio to be secured by the summer of 2023. Significant additional progress in further reducing GHG emissions can be made in the subsequent seven years leading up to 2030.

In the 2019-2020 IRP process which is currently underway, the CPUC staff has set out three potential targets for GHG reductions. The most aggressive target would reduce the emissions in the electric sector for California down to 30 million metric tons, an additional one-third reduction beyond the target adopted by the CPUC in the 2017-18 plan. Significantly, the CPUC staff and its consultant E3 also have begun to model the full pathway to the SB 100 goals for 2045, including the years after 2030. This modeling shows that it may be wise to meet a more aggressive goal for 2030, given that the challenges of decarbonization become greater after 2030 as the required emission reductions increase and the electric sector also must support deep emission reductions in the building and transportation sectors. The modeling shows that the least-cost path to 2045 includes a 2020 to 2030 resource build-out that is similar to meeting a 2030 goal of 30 million metric tons.⁴

According to current CPUC modeling, reaching the more aggressive target could require the addition of nearly 50 gigawatts of new clean energy resources between 2020 and 2030.⁵ However, because the capacity expansion model (RESOLVE) that the CPUC is currently using does not yet consider solar-plus-storage or wind-plus-storage as discrete candidate resources, the model likely overestimates the cost of adding incremental clean energy resources. Targeting the procurement of stand-alone storage towards the latter part of the decade will result in much more renewable energy curtailment than would occur if hybrid renewable energy plus storage resources were procured together. Moreover, a sensitivity study which assumes that solar paired

⁴ See "2019-20 IRP: Proposed Reference System Plan" (2019-20 RSP), Attachment A to the Ruling in R. 16-02-007 issued November 6, 2019, at Slides 162-166.

⁵ 2019-20 Proposed Reference System Plan, Attachment A, CPUC Energy Division, November 6, 2019. Page 63



with storage allows the storage also to benefit from the federal ITC for solar is the least-cost case that staff has modeled, with costs that are \$400 to \$600 million lower than in the reference case.⁶

The RESOLVE model uses the most current forecast of battery storage costs provided by Lazard's Levelized Cost of Storage Analysis which is updated annually.⁷ However, the costs reductions of batteries have consistently outpaced forecasts. The most recent procurement by the Los Angeles Department of Water and Power demonstrates how quickly the costs of solar plus storage have declined in the marketplace.⁸

The combination of growing demand for electric vehicles and renewable energy integration have driven massive investments in both existing commercial and emerging battery technologies. Rapid improvements in lithium-ion technologies have made solar-plus-storage projects less costly than new fossil gas generation. Electric vehicles on a lifetime basis are more cost-effective than internal combustion engine vehicles. By the end of the decade, the Rocky Mountain Institute predicts that new clean energy portfolios will be less costly than continued operation of many existing fossil gas power plants and the sticker price of electric vehicles will be less than conventional vehicles.⁹

The rapid evolution of battery technologies both in cost reduction and performance improvement compels the Joint Agencies to examine how fast the cost-effective decarbonization of the electric system can proceed. The 30 million metric ton target under consideration for adoption in the 2019-2020 plant would result in renewable generation accounting for approximately 79% of retail sales by the end of the decade. When combined with hydroelectric and nuclear generation

⁶ *Ibid.*, at Slide 111.

⁷ Lazard's Levelized Cost of Storage Analysis, Version 4.0, November 8, 2018. Lithium ion batteries for utility-scale applications are value at \$104 to \$140 per megawatt hour of capacity.

⁸ A dispatchable 400 MW solar plus storage facility located in the Mojave desert by recently approved by the Los Angeles Department of Water and Power (LADWP) has an average energy price of \$31/MWH flat for 20 years. Meeting Agenda Board of Water and Power Commissioners, Sept 10, 2019, Item 21

⁹ Breakthrough Batteries: Powering the Era of Clean Electrification, Charles Bloch, James Newcomb, Samhita Shledar and Madeline Tyson, Rocky Mountain Institute (RMI). RMI forecasts battery costs



that is expected to be available the amount of zero-carbon resources could easily top 90% by 2030.

Such near- and medium term acceleration of hybrid system procurement in California could have significant benefits for GHG reductions across the Western United States by putting California on the road to becoming a net exporter of clean, zero-carbon electricity. It is even possible that California could exceed the 100% zero-carbon target envisioned in SB 100 much earlier than 2045 if new zero-carbon resources procured by California's load-serving entities allows for mutually beneficial interstate transactions of clean generation in a regional wholesale power market. This possibility of becoming a net exporter of clean energy is something that also needs to be studied in the SB 100 Report.

The SB 100 Report should use scenario planning to look at alternative pathways to reaching the 100% clean energy goal after 2030 with a focus on seasonal challenges.

Getting from 80% or 90% zero-carbon energy to 100% involves planning in the face of significant unknowns and uncertainties. The creation and modeling of alternative resource scenarios would be a useful tool to be used in the SB 100 Report to challenge the ways we conceptualize options about the more distant future and create a more creative approach to resource planning. There are many unknowns and uncertainties about how the last 10% to 20% of carbon-free electricity will be produced and delivered to retail load in California and throughout the Western United States. It has become increasingly clear that solar, wind and storage when combined with more flexible load will be able to provide sufficient energy for most of the hours during average weather years. Nonetheless, there will be some periods of time during unusual weather conditions when there will be a need for other sources of zero-carbon electricity. The magnitude and frequency of this need is still uncertain, as are the solutions for meeting it. The SB 100 Report should creatively explore multiple pathways for this last difficult incremental step to achieve full decarbonization of the electric system.



Scenario planning is a well-honed technique that has been used by both private and public organization to create possible future outcomes with a goal of improving decision making.¹⁰ Scenario planning would be an important tool for the Joint Agencies to use as you conceptualize the many possible futures for California’s electric power system. This planning process can stimulate debate about the choices facing the Legislature and other policy makers about possible futures using current and emerging carbon-free energy technologies.

The Joint Agencies could select three or four key dimensions of uncertainty along which future scenarios could be framed. The scenarios themselves should be developed in consultation with both energy experts and the many constituency groups interested in decarbonization of the energy sector and the economy. Vote Solar and SEIA suggest for consideration of the following dimensions of uncertainty for scenario development: 1) the amount of electrification that will occur across the economy; 2) the degree to which electric generation and storage in the Western Interconnect are subject to competitive market forces and are made available to serve California retail load; 3) the degree to which the desire for local resilience and consumer choice requires a more decentralized approach to electricity production and delivery; and 4) the amount of adaptation required by components of the electric system due to climate change.

Many interesting and useful scenarios could be developed along these dimensions. However, for the sake of understandability it is advised that from four to eight scenarios is optimal for long term planning.

It is in the scenario process that emerging zero-carbon technologies that could be available in the 2030 through 2045 time horizon can be assessed. Among the technologies that seem promising to evaluate are off-shore wind, long duration electrical energy storage (e.g. pumped hydroelectric, compressed air energy storage), thermal power plants fueled by zero carbon fuels such as hydrogen or ammonia, advanced dispatchable renewable energy technologies such a deep rock

¹⁰ See “Business: The Ultimate Resource” by Jonathan Law, ISBN 978 1-4081-2811-4 for a description of the scenario planning method that is widely taught in management programs and at business schools.



geothermal energy, tidal and ocean thermal technologies and perhaps even carbon capture and sequestration technologies. It should be recognized that the initial assessment of selected technologies in the first SB 100 Report would be a general characterization of the technologies along a limited set of criteria such as viability, risk, costs, benefits and fit into the larger system. Detailed quantification of system integration costs using these technologies need not be expected in this first iteration of the SB 100 Report. However, it should set the stage for future investigation and consideration in subsequent reports on SB 100 implementation.

Conclusion

California has been a world leader in bringing forward clean energy solutions for decades. Putting together this first SB 100 Report will be an important step in accelerating that leadership. Vote Solar and SEIA appreciate the work the state agencies and the many stakeholders have put into the formulation of this important report. We look forward to continuing to participate in the ongoing process that the Joint Agencies are leading.

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