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Form Energy Comments on SB 100 Analytical Framework

Please find our comment letter attached. Thank you.

Additional submitted attachment is included below.

November 14, 2023

Liz Gill
California Energy Commission (CEC)
Docket Unit, MS-4
Docket No. 23-SB-100
715 P Street
Sacramento, California 95814

Re: Comments on the Senate Bill 100 Analytical Framework Workshop

Dear Ms. Gill:

Form Energy appreciates the opportunity to comment on California's planning for its transition to clean energy and the October 31, 2023, SB 100 Analytical Framework Workshop. We urge CEC to plan for and implement steps to achieve a truly clean, reliable – and zero emissions – electricity grid. This means prioritizing scenarios in the SB 100 analysis that are not limited to the least decarbonization required under SB 100, but that actually achieve zero greenhouse gas emissions (i.e., 0 $MMTCO_2$) in the power sector by no later than 2045, and preferably by 2035, in-line with the U.S. commitment pursuant to the Paris Climate Accords. We hope CEC will fully evaluate the technologies needed to cost-effectively achieve a reliable, completely zero-carbon electricity grid in the next SB 100 Joint Agency Report.

In particular, we offer the following specific recommendations, which are elaborated on below:

- SB 100 scenarios should plan for decarbonizing the electricity sector at rates similar to other sectors, which would result in emissions of 20-30 $MMTCO_2$ in the sector by 2030.
- SB 100 scenarios should account for the requirements of AB 1279 and:
    - Cap total emissions from the sector in all scenarios at <8.6 $MMTCO_2$ in 2045,
    - Evaluate and prioritize scenarios that achieve 0 $MMTCO_2$ in the 2035-2045 timeframe, and
    - Include in the costs of greenhouse gas emitting resources the costs associated with direct air capture to remove associated emissions from the atmosphere.

In addition, we offer several specific comments on the workshop slides, and additional suggestions for agency actions through relevant forums to achieve a 100% clean and reliable electricity grid.

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About Form Energy – Enabling a Fully Renewable, Cost-Effective, and Reliable Electrical Grid

Form Energy is developing, manufacturing, and commercializing a new class of multi-day energy storage system that will enable a fully renewable electrical grid that is reliable and cost-effective year-round, even in the face of multi-day weather events. Our first commercial product is a rechargeable iron-air battery capable of continuously discharging electricity for 100 hours at a system cost competitive with legacy power plants. With over 600 employees, Form Energy is headquartered in Somerville, MA, with offices in Berkeley, CA and the Greater Pittsburgh area. Our first commercial manufacturing facility is under construction in Weirton, WV, and will begin operations mid-to-late 2024, ultimately employing over 750 employees and producing 500 MW of capacity per year.

Form Energy has over 5 GWh of projects under contract and development, with our first project expected to come online in 2024 with utility Great River Energy in Minnesota. Other announced projects include two with Xcel Energy – one a 10 MW/1,000 MWh system at the Sherburne County Generating Station in Becker, Minnesota, and the other, a 10 MW/1,000 MWh system at the Comanche Generating Station in Pueblo, Colorado – both expected to come online as early as 2025; a 10 MW/1,000 MWh project in New York, supported by a grant from NYSERDA, which will come online as early as 2025; a 15 MW/1,500 MWh project with Georgia Power to come online as early as 2026; and a 5 MW/500 MWh project with Dominion Energy in Virginia to come online as early as 2026. Form Energy is in discussions with the CEC regarding a grant-funded 5 MW/500 MWh project with Pacific Gas & Electric that could come online in Mendocino, California as soon as 2025.

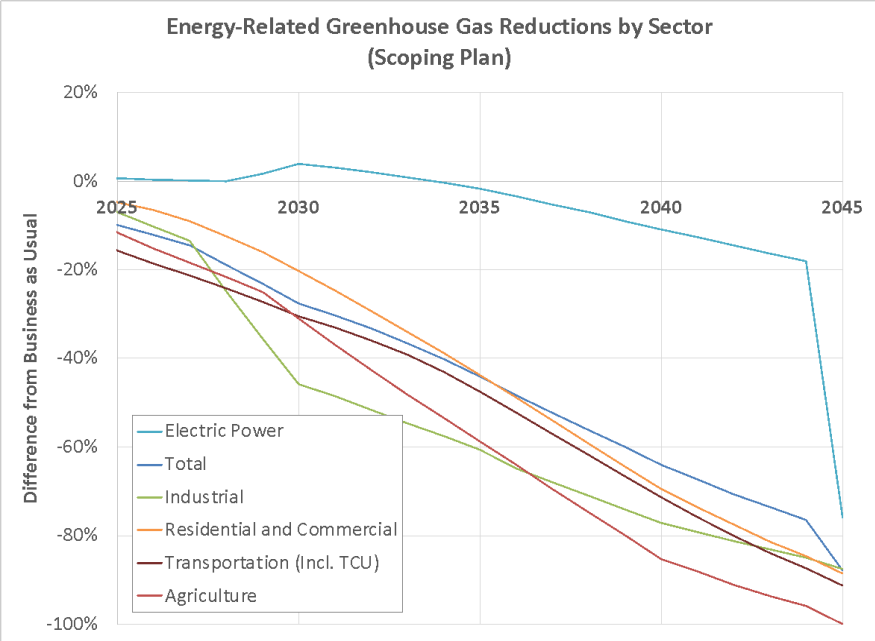
The Electric Sector Is a Key Sector to Completely Decarbonize, and Doing So Has Other Decarbonization Benefits for the Broader Economy

Decarbonizing electricity is foundational to achieving carbon neutrality. As California aims to electrify a wide array of end uses – from transportation to buildings – quickly decarbonizing the electricity sector will be key to ensuring that the State realizes the greatest level of climate benefit from these efforts.

Traditionally, decarbonizing the electricity sector has been a top priority for early climate action, and the sector long has been understood to be one of the sectors most able to be completely decarbonized. Accordingly, as part of the U.S. Nationally Determined Contribution submitted at the COP26 climate conference in Glasgow, the Biden Administration set a goal of achieving zero carbon in the power sector, nationwide, by 2035.[1] The California Air Resources Board (CARB), in originally scoping scenarios for the 2022 Scoping Plan Update modeling, envisioned ongoing, rapid and deep greenhouse gas reductions in the electricity sector, including 23-30 MMT by 2030

[1] https://unfccc.int/sites/default/files/NDC/2022-06/United%20States%20NDC%20April%2021%202021%20Final.pdf

and 0 MMT by 2035-2045.[2] Several studies,[3] including the State's 2021 SB 100 Joint Agency Report,[4] have shown that these levels of greenhouse gas reductions at the state and national level are feasible and can be achieved at low or no cost.



Yet the "Core" scenario in the 2021 SB 100 Joint Agency Report is one with higher costs and higher emissions than those that utilize firm zero carbon resources, like Form Energy's 100-hour iron-air batteries, to reduce the reliance on existing natural gas power plants. According to the State's most recent climate planning, in the 2022 Scoping Plan Update, the electricity sector is incorrectly represented as the hardest to decarbonize, and no efforts appear to be made to reduce electricity sector emissions below business-as-usual levels until around 2035 (see Figure above). In the final Scoping Plan scenario, electricity sector emissions actually *increase* in 2030 compared to business as usual, whereas all other sectors see a reduction of 20-45 percent in energy-related

[2] https://ww2.arb.ca.gov/sites/default/files/2021-09/Draft_2022SP_ScenarioAssumptions_30Sept.pdf

[3] For example, see the following:

- https://www.nrel.gov/analysis/100-percent-clean-electricity-by-2035-study.html
- https://www.edf.org/sites/default/files/documents/SB100%20clean%20firm%20power%20report%20plus%20SI.pdf
- https://energyinnovation.org/wp-content/uploads/2020/09/Pathways-to-100-Zero-Carbon-Power-by-2035-Without-Increasing-Customer-Costs.pdf
- https://www.wartsila.com/energy/learn-more/downloads/white-papers/path-to-100-renewables-for-california

[4] Various scenarios demonstrated that SB 100 goals could be achieved as soon as 2030 at costs that are likely less than the benefits associated with doing so, based on prevailing social cost of carbon estimates and avoided cap-and-trade compliance costs, and that deploying firm zero carbon resources reduced both costs and emissions associated with meeting the goals of SB 100. https://www.energy.ca.gov/sb100

greenhouse gas emissions.[5] If similar levels of greenhouse gas reductions were applied to the electricity sector (that is, 20-45% below business as usual levels), electricity sector emissions would be 20-29 MMT in 2030.

SB 100 Scenarios Should include Those that Achieve 20-30 MMTCO_2 in 2030, 0 MMTCO_2 in 2035-2045

The next SB 100 Joint Agency Report provides an opportunity for the CEC and the other joint agencies to establish a vision for decarbonizing the electricity sector at least in-line with other sectors, and perhaps as a leading sector to decarbonize, as long envisioned in climate change planning and in-line with the U.S. Nationally Determined Contribution pursuant to the Paris Climate Accord. Specifically, we encourage CEC to evaluate SB 100 scenarios that would achieve electricity sector emissions of 20-30 MMTCO_2 in 2030, and 0 MMTCO_2 in the 2035-2045 timeframe. This would reflect emissions reductions in the electricity sector that span those achieved by the next slowest-to-decarbonize sector in the 2022 Scoping Plan Update (which would result in 29 MMTCO_2 in the electricity sector in 2030) and the industrial sector (which would result in less than 20 MMT in 2030).

These levels of emissions reductions are achievable in the electricity sector. Conceptually, the same strategies that can be deployed to decarbonize industry, which sees its emissions nearly halved by 2030 compared to business as usual according to the 2022 Scoping Plan Update, can be deployed to decarbonize the power sector (e.g., a range of firm zero carbon resources). Indeed, these are the same strategies ultimately applied to decarbonize the electricity sector in the 2022 Scoping Plan Update, but for electricity, the plan assumes these strategies are not deployed until 2045, whereas they are assumed to come online at scale in 2028 for the industrial sector. In fact, the electricity sector should be even less difficult to decarbonize than industry, because a broader array of technologies – including long duration and multi-day storage – is available to decarbonize electricity than exists in the industrial sector. For example, Form Energy will deploy a 100-hour iron air energy storage system in California as soon as 2025.

As noted above, several research items suggest these levels of emissions reductions can be achieved cost effectively. Indeed, the 2021 SB 100 Joint Agency report laid out a scenario that would reduce electricity sector greenhouse gas emissions by 15 MMT in 2030 at an added total resource cost of about $3 billion in 2030.[6] This accelerated greenhouse gas reduction scenario did not include firm zero carbon resources, which other scenarios in the report showed could reduce costs associated with meeting SB 100 goals by billions of dollars per year. Nor does it include incentives from the Inflation Reduction Act, which will significantly reduce costs associated with technologies needed to decarbonize the electricity sector, including multi-day

[5] See 'AB 32 GHG Inventory Sectors Modeling Data Spreadsheet' at https://ww2.arb.ca.gov/our-work/programs/ab-32-climate-change-scoping-plan/2022-scoping-plan-documents
[6] Comparison of the SB 100 Core scenario to the SB 100 in 2030 scenario. https://www.energy.ca.gov/sb100

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storage, hydrogen, or carbon capture and sequestration. Still, even as modeled, total incremental costs in 2030 are less than the avoided costs based on the most recent estimates of the social cost of carbon from U.S. EPA and avoided cap-and-trade compliance costs.[7,8]

Finally, we note that many of the State's largest electric utilities, including the Los Angeles Department of Water and Power[9] and Sacramento Municipal Utilities District,[10] most of the state's other largest cities and counties, including San Diego,[11] San Jose,[12] San Francisco,[13] many community choice aggregators, and others – have already committed to achieving zero or near-zero greenhouse gas emissions by 2030. We encourage CEC to incorporate the wide array of existing goals and commitments at a local, regional, and utility level into its SB 100 scenario modeling.

SB 100 Scenarios Must Reflect Emissions Constraints Imposed by AB 1279 (Muratsuchi)

If nothing else, all SB 100 scenarios must reflect constraints imposed by AB 1279, which in addition to codifying the State's carbon neutrality goal, requires greenhouse gas emissions from sources to be reduced by at least 85% below 1990 levels by 2045.[14] Greenhouse gas emissions seem to be an output in the proposed scenarios; however, given that these constraints are in state law, emissions outcomes that at least achieve AB 1279 outcomes should be a constraint in the modeling and included as part of the fixed assumptions that apply to all scenarios.

Emissions from some sources – including agricultural and landfill methane, N_2O emissions, refrigerant emissions, and other non-CO_2 greenhouse gases – are challenging to eliminate or significantly reduce, meaning that energy-related CO_2 emissions must be reduced by more than 85% on average. According to the 2022 Scoping Plan Update, energy-related emissions across sectors are reduced by about 90% below current levels in 2045. For the electricity sector, the 2022 Scoping Plan Update suggests that emissions must be no greater than about 8.6 $MMTCO_2$ in 2045. All SB 100 scenarios should include this as a minimum constraint to ensure electricity sector emissions are compliant with the requirements of AB 1279, in addition to those of SB 100 and SB 1020.

[7] Assuming a social cost of carbon of $190/MT and cap-and-trade allowance prices of $35/MT, greenhouse avoided costs from accelerated electricity decarbonization in the SB 100 scenarios would exceed $3 billion and the incremental costs modeled in the SB 100 by 2030 scenario.
[8] https://www.epa.gov/system/files/documents/2022-11/epa_scghg_report_draft_0.pdf
[9] https://www.ladwpnews.com/100-percent-carbon-neutral-power-by-035-los-angeles-city-council-approves-landmark-initiative/
[10] https://www.smud.org/en/Corporate/Environmental-Leadership/2030-Clean-Energy-Vision
[11] https://www.sandiegocounty.gov/content/dam/sdc/dgs/Doc/Energy_ZeroCarbonPP.pdf
[12] https://www.sanjoseca.gov/Home/Components/News/News/3546/4699
[13] https://sfmayor.org/article/san-francisco-adopts-new-climate-action-goals
[14] https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202120220AB1279

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While the 2022 Scoping Plan Update achieves this objective through the widespread use of carbon capture on existing natural gas power plants in 2045 as a stand in for the broader firm zero carbon resource class, we encourage the SB 100 scenarios to explore a wider array of technologies that can achieve these goals, and explore the costs and co-benefits of each, including reduced criteria air pollutants.

Costs Associated with Natural Gas Generation should Include Direct Air Capture Costs in the 2035-2045 Timeframe

Incorporating AB 1279 as a fixed assumption in the SB 100 scenarios requires not just constraining overall emissions from the sector in 2045, but also accounting for the realistic cost of natural gas generation. This includes both high operations and maintenance costs for the aging fleet, as well as costs associated with carbon dioxide removal to net out remaining emissions. It is essential to account for these costs so that non-emitting reliability assets, such as multi-day storage, are appropriately valued in long-term decarbonization planning.

In addition to limiting emissions from sources to 85% below 1990 levels by 2045, AB 1279 requires the state to "Achieve net zero greenhouse gas emissions as soon as possible, but no later than 2045, and to achieve and maintain net negative greenhouse gas emissions thereafter." Accordingly, any remaining greenhouse gas emissions from sources must be netted out with carbon removals from the atmosphere by no later than 2045 to be minimally compliant with the law. AB 1279 charges the state to net out remaining greenhouse gas emissions with carbon removals as soon as possible.

According to the 2022 Scoping Plan, 96% of carbon dioxide removals through 2045 are expected to come from direct air capture, including 98% of carbon dioxide removal in 2045.[15] This implies that any remaining emissions from the power sector will be offset with an equal amount of carbon dioxide removal via direct air capture, which is currently – and expected to remain – a costly technology and, additionally, one that would impose enormous additional electricity demands on the system. This dynamic further reinforces the importance of directly planning to achieve zero greenhouse gas emissions in the electricity sector to comply with state law, and also to include a wide range of firm zero carbon resources, like multi-day storage, among the resources available to achieve a reliable, zero carbon grid.

At a minimum, SB 100 scenarios should account for the added cost of direct air capture as a cost associated with unabated emissions from legacy power plants. We urge CEC to include costs for direct air capture in costs for any technology with remaining emissions in its analysis. Due to the direction in AB 1279 to achieve carbon neutrality "as soon as possible" and the U.S. Climate

[15] See 'AB 32 GHG Inventory Sectors Modeling Data Spreadsheet' at https://ww2.arb.ca.gov/our-work/programs/ab-32-climate-change-scoping-plan/2022-scoping-plan-documents

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Commitment under the Paris Climate Accord, we urge the scenario analysis to begin applying these costs to natural gas power plants immediately, but no later than 2030 portfolios.

Comments on Workshop Slides

We appreciate the detailed presentation and opportunity to weigh in early on the analytical framework for the next SB 100 Joint Agency Report. In addition to the high level comments and observations provided above, we offer the following comments on the workshop slides and questions:

- **Slide 8:** As described in detail above, we hope the next SB 100 Joint Agency Report will take the opportunity to advance the conversation related to decarbonizing the electricity sector, the technologies necessary to do so, and the potential and imperative to rapidly achieve a zero carbon power sector.

- **Slide 9:** Decarbonizing the electricity sector will require the increased deployment of firm zero carbon resources. We appreciate the upcoming workshop on SB 423 implementation, where this topic will be explored in further detail. In order to track progress towards not just the SB 100 goals, but the ultimate goal of achieving a zero carbon, reliable electricity grid – we encourage the SB 100 report to specifically identify the level of firm zero carbon resources – including long duration and multi-day storage – needed to achieve that objective, and specifically track progress in deploying firm zero carbon resources as a metric of progress towards achieving 100% zero carbon electricity.

- **Slide 10:** We encourage the CEC to take stock of, and report on, all load-serving entities and publicly owned utilities with accelerated and/or expanded clean electricity goals, compared to SB 100 and SB 1020 requirements, and incorporate those plans into the fixed assumptions of the SB 100 scenarios.

- **Slide 13:** We appreciate the exploration of different scenarios and technology portfolios. We recommend including a scenario designed to achieve a zero carbon (i.e., 0 $MMTCO_2$) electricity grid as quickly as possible (this is implied in the "Combustion Resource Retirement" scenario, but it should be modeled explicitly as a goal no later than 2045 and ideally also in earlier years to inform policy decisions). One of the key findings in a CEC-funded study about long-duration storage portfolios in California that Form Energy conducted in partnership with E3, is that true zero carbon portfolios can be achieved at cost-parity with existing SB 100 goals[16] Additionally, we urge the CEC to co-optimize electric resource needs over a range of weather years, rather than plan for an average

[16] *See* E3, Form Energy, UCSD presentation for CEC EPC-19-056: Assessing the Value of Long Duration Energy Storage, Final Public Workshop, May 9, 2023, p. 20-22, available at https://efiling.energy.ca.gov/GetDocument.aspx?tn=250157

year. The use of a single average weather year does not accurately reflect true resource needs or costs, and it also tends to understate the value of firm zero carbon resources, a finding highlighted in the study referenced above. Additionally, given the range of scenarios presented, we encourage the CEC to produce a single co-optimized resource portfolio that reflects the least-cost portfolio under a range of different technology costs, weather years, and resource availability. Perhaps this could be addressed through the addition of another, "all of the above" scenario.

- **Slide 18:** We strongly urge the CEC to ensure that scenarios of long-duration energy storage include diverse technologies, including those in the multi-day energy storage class like Form Energy's 100-hour iron air battery. Isolating certain variables among scenarios may be helpful for identifying specific implications of deploying more or less of one technology, but may be less helpful for identifying optimal scenarios overall, unless these scenarios are co-optimized. We encourage more scenarios to include clearly promising technologies, such as increasing levels long-duration and multi-day storage. Notably, many of these scenarios have interactive effects: When low cost-multi-day storage is included as a candidate resource, models tend to select more wind in the least-cost portfolio, for example.

- **Slides 25-26:** In addition to accounting for SB 100 and SB 1020, baseline demand assumptions should account for the state's climate change goals under SB 32 and AB 1279. According to the 2022 Climate Change Scoping Plan Update, this includes significant additional electricity loads for hydrogen production and direct air capture, which should be accounted for in the fixed assumptions.

- **Slide 27:** Economic retirements for existing power plants with unmitigated emissions should be based on the costs of those facilities plus the added cost of direct air capture to remove remaining emissions. CARB has estimated the costs for direct air capture technologies through 2045 in the 2022 Scoping Plan Update and subsequently in the context of Low Carbon Fuel Standard amendments.

- **Slide 32:** The Resource Diversification scenario is especially important to explore alongside scenarios including expanded load coverage or that achieve zero greenhouse gas emissions in the electricity sector. The resources identified in this scenario are primarily firm zero carbon resources needed to reduce reliance on existing natural gas power plants. Without capturing the additional value of emissions reduction potential associated with these scenarios, the analysis may underestimate their appropriate role in achieving the state's clean energy and climate change goals.

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- **Slide 34:** We encourage the analysis of increased offshore wind resources to specifically consider opportunities to pair increased offshore deployments with long duration and multi-day storage to create fully dispatchable, firm zero carbon power plants.

- **Slide 35:** In response to the stakeholder question posed, "What assessments, reports, policies and/or programs should the joint agencies consider when determining what level of long duration energy storage to include in the Resource Diversification Scenario? (e.g. CEC's Long Duration Energy Storage program)," we encourage the CEC to leverage studies of long-duration storage that it has funded. In particular, the CEC supported recent research by E3, Form and UCSD on long duration storage, which found that the inclusion of 37 GW of long-duration and multi-day energy storage by 2045 can support a zero carbon power sector at costs similar to SB 100 goals.[17] Additionally, the inclusion of long-duration storage and multi-day storage can significantly lower overall resource needs to achieve a zero carbon grid, ensuring reliability during a wide range of realistic weather conditions. We encourage the CEC to rely on this work, as well as numerous other studies related to firm zero carbon resources that show similar outcomes. Additionally, we emphasize that first and foremost, the joint agencies should consider AB 1279, and the implication that the state needs to either replace unmitigated natural gas power plants as soon as possible, and no later than 2045, or otherwise account for the costs of direct air capture to remove emitted greenhouse gas emissions from these plants in its energy planning.

- **Slide 39:** We support consideration of a combustion retirement scenario, and encourage that scenario (as well as others) to consider retirement of all existing natural gas power plants and strategies needed to achieve a 0 $MMTCO_2$ electricity grid by no later than 2045.

- **Slides 40-41:** We strongly support consideration of expanded load coverage, which is necessary to achieve the State's climate change goals. We believe this should be a baseline assumption, as part of the fixed assumptions. Alternatively, the SB 100 analytical framework should apply expanded load coverage as an option for each scenario, to better understand the costs and benefits associated with decarbonizing the electricity sector using different strategies and technologies.

- **Slides 43-48:** We are concerned that the modeling tools and methods that the CEC is using may not be capable of accurately modeling long-duration and multi-day energy storage. We encourage the CEC to ensure that its capacity expansion modeling optimizes resource needs using a chronology that can capture seasonal energy capabilities of storage. (i.e., optimizing over 8,760-hours of grid operations or tracking storage state of charge across representative weeks, rather than modeling a sample days or sample weeks in isolation.) Numerous academic studies have demonstrated that the capacity

[17] https://efiling.energy.ca.gov/GetDocument.aspx?tn=250157&DocumentContentId=84879

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expansion chronology significantly influences the selection of renewables and storage resources in an optimal portfolio. Capacity expansion models which are designed to implement such chronologies include RESOLVE and RIO. Additionally, when conducting production cost modeling, it is essential that models accurately preserve hourly grid operations using perfect foresight, rather than using truncated look-ahead periods, which will miss opportunities for resources like multi-day storage to seasonally shift renewable energy.

- **Slide 49:** In California's modeling to date, virtually all of the remaining natural gas generation in California is anticipated to remain primarily to serve local reliability areas. As a result, we strongly encourage SB 100 modeling, and all future long-term planning studies, to directly model optimal resource portfolios to address local capacity requirements. It is imperative to direct the development of new firm zero carbon resources to local reliability areas so that the resources developed to achieve SB 100 goals meaningfully reduce emissions and create a pathway to achieving a reliable zero carbon grid. Toward that end, we encourage the CEC to replicate the modeling approach that Form Energy and E3 demonstrated in the CEC-funded study of long-duration storage portfolios, referenced above. This study included a capacity optimization of the LA Basin Local Capacity Area to identify firm zero caron resource needs to support grid reliability if natural gas generation in disadvantaged communities were to retire. This approach could be replicated in all local capacity areas to inform California's understanding about optimal resource needs at the local and system level.

Achieving a 100% Clean Electricity Grid

Finally, while a critical piece of the state's clean energy and climate change planning, we recognize that the SB 100 Joint Agency Report is only one element, and several other active forums are underway that will influence the ability of the state to transition to a zero-carbon, reliable and affordable electricity system. Accordingly, we encourage CEC to work with the other energy agencies and take the steps to enable the state's transition to a 100% clean electricity grid. In particular, we encourage the joint agencies to:

- **Develop a timely and thorough evaluation of firm zero carbon resources pursuant to SB 423 (Stern), including multiday storage.** We are excited by the announced SB 423 workshop and see this effort as a critical complement to the SB 100 Report and to achieving a clean, reliable electricity grid. Per SB 423, CEC will evaluate resources capable of delivering zero carbon electricity reliably during multiday weather events. These are exactly the resources needed to replace fossil fueled power plants and deliver a truly zero carbon, reliable electricity grid. We encourage CEC to fully evaluate the role these resources can play to accelerate electricity sector decarbonization and achieve the targets and outcomes identified above.

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- **Update the SB 350 electricity sector planning targets to 20-30 $MMTCO_2$ by 2030 and evaluate scenarios and plan for achieving 0 $MMTCO_2$ in the electricity sector in the Cap-and-Trade program.** CARB has timely processes underway, related to greenhouse gas emissions in the electricity sector, through its SB 350 planning targets and upcoming amendments to the Cap-and-Trade program. It should update its SB 350 planning targets to support decarbonizing the electricity sector at similar rates as other sectors, and should plan for achieving 0 $MMTCO_2$ in the electricity sector in the 2035-2045 timeframe in its analysis and amendments related to the Cap-and-Trade program.

- **Coordinate with energy agencies to incorporate climate change and multiday weather events into energy planning.** In order to achieve a reliable, zero carbon electricity grid, we have to plan for it. Current planning based on example 24-hour periods is insufficient for fully modeling reliability requirements in a decarbonized future, including needs to seasonally shift renewable energy, accommodate new reliability constraints like extended cold and cloudy periods during winter weeks, or to fully account for climate impacts and multi-day extreme weather events. We encourage the state to update planning to design for reliability in an entirely renewably powered grid. This requires coordinating demand and renewable generation profiles, hourly modeling over 8,760 hours in a year, and planning for climate-induced extreme weather that may have historically occurred only once every 10, 20 or 40 years.

- **Advance firm-zero carbon resources capable of decarbonizing the electricity grid.** The 2021 SB 100 Joint Agency Report and the 2022 Scoping Plan Update both highlight the role that firm-zero carbon resources, including emerging technologies, can play in reducing solar and battery build rates, electricity sector emissions, and costs.[18] It follows that, if commercialization of new, zero-carbon technologies can reduce build rates, it is likely that such commercialization would also improve the feasibility and reduce the portfolio costs of more aggressive decarbonization goals in the electricity sector. We encourage CEC to work with CARB and other agencies through the processes identified above, as well as upcoming incentive programs, to rapidly deploy firm zero carbon resources necessary to decarbonize the electricity grid at low cost.

[18] See pg. 202. https://ww2.arb.ca.gov/sites/default/files/2023-04/2022-sp.pdf

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Thank you again for the opportunity to comment on the Senate Bill 100 Analytical Framework Workshop, and for all your work to deliberately and effectively advance California's clean energy goals. Please do not hesitate to reach out with any questions or follow up items.

Sincerely,

Mark Thompson
Senior Director, State Affairs
Form Energy
mthompson@formenergy.com