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Comments of Calpine Corp on the November 18th SB 100 technical workshop

Additional submitted attachment is included below.

Comments of Calpine Corp. on the November 18th SB 100 technical workshop

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Calpine welcomes the opportunity to comment on the November 18th technical workshop as well as the SB 100 Report process more generally. Calpine fully supports the SB 100 goals but recognizes that they will be difficult to meet. Calpine believes that in order to ensure that the goals can be met at reasonable cost and with acceptable reliability, all options should be on the table. In particular, the agencies should interpret SB 100 in a manner that permits some limited reliance on gas generation. In addition, the agencies should not unduly restrict technologies that will count towards SB 100 goals, e.g., they should not limit reliance on technologies that utilize combustion.

Calpine owns and operates approximately 6 GW of capacity in California including the 725 MW Geysers geothermal plant and a fleet of modern, flexible, efficient gas-fired generation. Calpine commissioned the study presented by E3 at the technical workshop to understand how our portfolio might complement the state's goals as well as evolve to facilitate the goals.

As the workshop highlighted, achieving those goals at reasonable cost while maintaining reliability appears feasible but challenging. While it is relatively easy up to a point to displace emissions from gas generation with intermittent renewables, such as wind and solar (potentially paired with battery storage), at very high penetrations of renewables, it is increasingly difficult to meet the demand for electricity reliably using these technologies alone. Some of the biggest challenges relate to the temporal mismatch between the production from intermittent renewables and the demand for electricity. For example, the electrification of end uses such as transportation and space heating is expected to lead to significantly higher demand for electricity in the winter, when solar generation is lower and more variable due to cloud cover. Multi-day periods of low solar generation in the winter due to storms could be particularly problematic.¹ There are multiple strategies to address this issue. For example, some oversizing of solar generation (and batteries) so that it is sufficient to meet demand even under poor solar conditions (but yields excess power under other conditions) might be economic, but the strategy becomes prohibitively expensive at very high penetrations of solar and batteries. Relatedly, battery storage can be used to shift solar generation to evening and overnight hours, but it is not currently economic for shifting solar generation by multiple days or seasonally, for example from the spring or summer when solar generation is higher to the winter when it might be most needed.

Consequently, studies such as the ones presented at the workshop generally conclude that some continued reliance on gas generation with its attendant emissions is economic. The Calpine/E3 study shows that the state can reduce emissions in the electricity sector by ~90% even as it grows by 60% to accommodate the electrification of other sectors with an approximate doubling of electricity sector costs while retaining most of the state's gas generation capacity but operating it at significantly lower

¹ In Germany, these winter periods of low renewable generation are called dunkelflaute, i.e., dark doldrums.

capacity factors. Further, the study demonstrates that portfolios that meet aggressive GHG goals cost-effectively are consistent with the interpretation of SB 100 offered by the CPUC at the workshop, i.e., that SB 100 requires procurement of clean electricity equal to retail sales but not the complete elimination of gas generation.² The Calpine/E3 study finds that eliminating gas generation from the electricity sector entirely would increase electricity sector costs by \$65 billion/year.

The study that SCE presented at the workshop similarly concludes that the cost-effective decarbonization of the electricity sector entails some continued reliance on gas generation, noting:

...if the remaining 10 GW of natural gas capacity was eliminated from the electric system, average annual resource costs would rise nearly 40% post-2030...Until alternative cost-effective technologies are available to provide grid services and energy during infrequent but expected weather patterns, natural gas generation capacity provides a crucial role in keeping the grid reliable and affordable.³

Regardless of whether the agencies stop short of eliminating all GHG emissions from the electricity sector, the agencies should not preclude any technologies. In particular, the agencies should consider carbon capture and sequestration (CCS) retrofits to existing gas-fired generation or new plants that utilize CCS. CCS is an established and cost-effective technology and California is uniquely well-suited to its deployment due to its existing gas and gas generation infrastructure as well as the presence of geologic formations that are well-suited to permanent sequestration. Studies of other regions suggest that a combination of renewables and resources such as CCS could reduce the overall cost of decarbonizing electricity, particularly for targets as ambitious as California's.⁴ In addition, the development of CCS infrastructure, including CO₂ pipelines and storage facilities, could accelerate the decarbonization of other hard to decarbonize sectors, such as heavy industry, through the application of CCS to those sectors.

In particular, the agencies should not adopt a definition of Eligible Electricity Resources to count towards the SB 100 goals that would limit reliance on CCS, such as a definition that restricts reliance on technologies that use combustion. At the workshop, CARB suggested that limits on combustion might be warranted to address emissions of criteria pollutants. Calpine notes that there are technologies that involve combustion but produce no emissions of criteria pollutants, including the Noble Thermodynamics technology discussed at the workshop and CCS generation technologies that utilize the Allam Cycle.⁵ In addition, while the most common post-combustion CCS retrofits to existing gas-fired generation do not address emissions of criteria pollutants, emissions of criteria pollutants from power

² See slide 10 of <https://efiling.energy.ca.gov/GetDocument.aspx?tn=230751>. SB 100 entails an obligation to procure clean energy equal to retail sales. The gap between wholesale generation and retail sales due to transmission and distribution losses allows emissions associated with wholesale generation in excess of retail sales. In addition, LSEs could satisfy the SB 100 clean electricity requirement by procuring electricity in addition to the electricity needed to meet clean energy requirements and exporting the excess. SCE used the same interpretation of SB 100 in the report that they summarized at the workshop. (See pp. 7-8 of <https://www.edison.com/content/dam/eix/documents/our-perspective/201911-pathway-to-2045-white-paper-appendices.pdf>.)

³ *Ibid.*, 8.

⁴ See <https://www.congress.gov/116/meeting/house/108973/documents/HHRG-116-IF18-20190228-SD004.pdf>, especially pp. 10-11.

⁵ <https://www.netpower.com/technology/>

plants are a very small share of the state's overall emissions of criteria pollutants,⁶ in part because modern combined cycle and combustion turbine plants already have extensive emissions controls.⁷ Even if they continue to operate, emissions from gas power plants would decline as their output (but not necessarily their capacity) would be displaced by renewables and other types of clean energy.

Relatedly, the agencies should not preclude the combustion of renewable natural gas and/or hydrogen to meet the SB 100 goals. The combustion of RNG would yield the same low emissions of criteria pollutants as the combustion of conventional gas and the combustion of hydrogen entails no emissions of criteria pollutants.

In addition, the agencies should craft rules that allow at least partial crediting of energy that is mostly if not completely clean. For example, common CCS technologies are capable of eliminating ~90% of the emissions from gas-fired generation. The agencies should not preclude 90% clean resources from counting towards the SB 100 goals.

Calpine appreciates the opportunity to offer these comments and looks forward to further participation in the SB 100 process.

⁶ For example, Electric Utilities and Cogeneration accounted for the less than 2% of the state's NOx emissions. (https://www.arb.ca.gov/app/emsmv/2017/emssumcat_query.php?F_YR=2012&F_DIV=-4&F_SEASON=A&SP=SIP105ADJ&F_AREA=CA.)

⁷ See the discussion of this issue at slides 36-40 of https://www.cpuc.ca.gov/uploadedFiles/CPUCWebsite/Content/UtilitiesIndustries/Energy/EnergyPrograms/ElectPowerProcurementGeneration/irp/2018/ServmResolveResults_20191106.pdf.