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NRDC Comments on SB100 Draft Results Workshop (September 2020)

Additional submitted attachment is included below.

Comments of the Natural Resources Defense Council (NRDC)
on the Joint Agency SB 100 Draft Results Workshop
Docket Number 19-SB-100, September 15, 2020

Submitted by: Rachel Fakhry (rfakhry@nrdc.org), Robbie Harding (rharding@nrdc.org), Alex Jackson (ajackson@nrdc.org), and Mohit Chhabra (mchhabra@nrdc.org)

I. Introduction and summary

The Natural Resources Defense Council ("NRDC") respectfully submits these comments on the SB 100 draft results ("SB 100 report"). The modeling conducted by E3 and Joint Agency staff provides valuable insight on the near-term policy actions and procurement required for California to achieve its clean energy goals in a timely, affordable, and equitable manner. This type of analysis will be critical to facilitate the types of investments required to run a zero-carbon grid reliably and cost-effectively.

Going forward, the joint agencies should convert the directional results presented in the draft SB 100 report into actionable recommendations. As Governor Newsom stated last week, California must raise its ambition and fast track implementation to confront the already catastrophic impacts of a changing climate. That work should begin by both accelerating the SB 100 timeline and ensuring the final report provides actionable policy guidance to rapidly deploy a diverse portfolio of clean energy resources.

NRDC's comments are categorized as recommendations for how these draft results should inform the final SB 100 report, and recommendations to improve future modelling and analysis.

Our recommendations to inform the final SB 100 report:

- The SB 100 core scenarios should include an accelerated timeline and expanded load coverage to align with the rate of decarbonization needed to attain California's carbon neutrality goals
- The SB 100 report should provide actionable policy guidance to guide near-term clean energy procurement
- The SB 100 report should recommend near-term policy actions necessary to facilitate timely deployment of long-lead time resources
- The SB 100 report should provide further guidance on zero-carbon firm resources
- The SB 100 report should analyze whether the state is on track to achieve the level of energy efficiency and demand response assumed in the core scenarios; the final report should also make policy recommendations necessary to attain those levels of energy efficiency and demand response

Our recommendations to update and refine SB 100 modeling and analysis:

- The SB 100 analysis should use electricity demand forecasts that represent the amount of electrification needed to achieve carbon neutrality
- The SB 100 analysis should update its modeling assumptions for green electrolytic hydrogen
- Future SB 100 analysis should model the impact of neighboring states' clean energy goals on import availability and the impact of climate change on hydropower availability
- Future SB 100 modelling should include reliability/loss of load analysis for interim milestone years
- The SB 100 analysis should apply the costs of methane leakage and health impacts of pollutants to evaluate all resources; staff should also work with stakeholders to develop a methodology to account for the impact of renewable buildout on our natural lands

II. Recommendations to inform the final SB 100 report

A. The SB 100 core scenarios should include accelerated timelines and expanded load coverage to align with the rate of decarbonization needed to achieve California's carbon neutrality goals

The SB 100 core scenarios constructed by the joint agencies should be aligned with the rate of decarbonization required to meet California's goal of achieving carbon neutrality as soon as possible, and no later than 2045.[1] To accomplish this, the joint agencies should incorporate accelerated timelines and expanded load coverage in the core scenarios as opposed to information-only study scenarios, as these scenarios better represent the pace of decarbonization California will need to maintain out to midcentury.

The joint agencies' new Accelerated Timeline scenarios appropriately analyze accelerated decarbonization schedules and less reliance on fossil gas. Decarbonizing the power sector is foundational to decarbonizing the larger economy because the most feasible and cost-effective pathways for economy-wide decarbonization involve electrifying other sectors. Therefore, the electricity sector must decarbonize further and on a faster timescale compared to the rest of the economy. The Accelerated Timeline scenarios better align with California's carbon neutrality goals than the current core scenarios and should be used as a core scenario in the final SB 100 report.

In addition, the joint agencies should include line losses in the loads subject to SB 100 as part of the SB 100 core scenarios. The joint agencies propose to exclude line losses (7% of in-state load, according to 2018 CEC estimates) from the loads subject to SB 100's zero-carbon requirement. As a

[1] https://www.ca.gov/archive/gov39/wp-content/uploads/2018/09/9.10.18-Executive-Order.pdf

result, the core SB 100 scenario has twice the amount of emissions (24 MMT) in 2045 compared to the SB 100 Study scenario with expanded load coverage that includes line losses (12 MMT).

As the agencies note, the statute requires "that eligible renewable energy resources and zero-carbon resources *supply* 100% of retail sales of electricity to California end-use customers and 100% of electricity procured to serve all state agencies by December 31, 2045." (emphasis added). Retail loads cannot be served without electricity travelling over the transmission and distribution systems. Line losses should thus be considered an essential component of "supplying" retail sales and covered as a load subject to SB 100. While that comports with a plain reading of the statute, the governor's recent directive to state agencies to accelerate existing climate strategies further weighs in favor of construing SB 100 to maximize emissions reductions from the electric sector. The joint agencies should not construct SB 100 compliant scenarios that produce electric sector emissions well-above the pathway needed to achieve carbon neutrality.

Finally, the agencies should compare the resource buildout required by an accelerated SB 100 core scenario and the No Combustion Study scenario. The difference in resource buildout between these scenarios, their societal costs and benefits, would be informative to determine what course the state should choose to achieve its economywide decarbonization goals.

B. The SB 100 report should provide actionable policy guidance to guide near-term clean energy procurement

The SB 100 report should inform the state's load serving entities' (LSE) near-term clean energy planning and procurement to ensure that LSEs comply with California's 2030 carbon reduction and clean energy procurement goals, while putting the state on the best path to comply with SB 100.

California's LSEs need to plan to reduce electric-sector emissions at least 40% below 1990 emissions levels by 2030 to comply with Senate Bill 350 (SB 350). This 2030 emissions reduction planning milestone should be informed by the path needed to get to SB 100's 2045 zero-carbon target as illustrated by the SB100 Study's core scenarios (See Section II.A). Separating planning to comply with the state's 2030 goals from the planning to meet the state's 2045 goals means that LSEs will likely under-procure clean energy resources in the near term. If this under-procurement of clean-energy resources required to comply with SB100's 2045 goals occurs, LSEs will have to ramp up resource procurement after 2030. Ramping up procurement in this way would likely put the LSEs and the state's energy agencies under undue strain to procure and integrate clean energy resources in a short amount of time (the

15 years between 2030 and 2045 as opposed to the 25 years between 2020 and 2045).[2] This scenario also comes with an environmental cost because climate change mitigation requires cumulative GHG emissions reductions. The need to reduce cumulative GHG emissions necessitates taking as much action as is feasible in the near-term.

Near-term clean energy resource procurement is driven by the state's Renewable Portfolio Standard (RPS) as modified by SB 100. SB 100 sets an RPS target of 60% by 2030. The study results should inform the mix of renewables procured to meet this RPS goal. This guidance will help LSEs invest in the right diversity of renewable resources to meet both interim and long-term targets.

C. The SB 100 report should recommend near-term policy and planning actions required to facilitate timely deployment of long-lead time resources

The SB 100 report identifies the need for multiple long-lead time resources necessary to meet our 2045 decarbonization goals. For each long-lead time resource picked by the model, the SB 100 report should provide recommendations on near term policy actions required to bring these resources online in a timely manner, such as providing the information necessary to conduct transmission planning as recommended by CAISO at the workshop.[3]

These long-lead resources include offshore wind, long duration storage, geothermal, and new out of state onshore wind. Bringing these resources online in time to meet our 2045 economy-wide decarbonization goals requires near term action. For example, developing offshore wind in a timely and environmentally responsible manner will require building out the requisite transmission infrastructure, conducting environmental analysis to ensure that our state's rich marine ecosystems are protected, upgrading the state's ports and streamlining the process to site and permit offshore wind in state and federal waters.

D. The SB 100 report should provide further guidance on zero-carbon firm and dispatchable resources

The SB 100 analysis does not meaningfully consider the potential for technological innovation to help achieve a zero-carbon power sector and carbon neutral economy. This includes the capacity for electrolytic renewable hydrogen to deliver both zero-carbon dispatchable power and long duration storage (as explained in Section III.B).

[2] The build rates required to meet our 2045 goals, per Staff presentation, already require solar and wind build rates that are twice as high as our historical renewable build rate, and storage build-rate that is 20 times the historical value. See Slide 42.

[3] California ISO, *SB100 Draft Results Workshop Presentation – Panel 2 – Grid Planning Implications from the CAISO Perspective,* (9/2/2020), at 2.

The Zero Carbon Firm Study scenarios, which include generic zero-carbon firm and dispatchable resources at different cost levels, attempt to explore this, but the final SB100 report should add specificity around the suite of technologies that could deliver those services. The joint agencies should incorporate the most recent research and cost estimates for these various technologies and include them in the model. The study results, as currently structured, may be too generic to produce market signals needed to further spur these technologies and inform actionable planning. Waiting for these technologies to first commercialize would put this analysis in jeopardy of being outdated, considering the speed at which both the technological landscape and decarbonization targets are evolving.

E. The SB 100 report should analyze whether the state is on track to achieve the energy efficiency and demand response assumed in the core scenarios; the final report should also make policy recommendations necessary to attain this amount of assumed energy efficiency and demand response

The High Electrification demand scenario, adopted from the California Energy Commission's Deep Decarbonization Study,[4] accounts for demand side resources, especially the levels of energy efficiency and demand response, modeled in the deep decarbonization study. These levels of energy efficiency, presented in Figure 1, are appropriately aggressive.

[4] Energy and Environmental Economics, *Deep Decarbonization in a High Renewables Future. California Energy Commission* (June 2018), at 17.

Figure 1. Energy Efficiency Assumptions in the E3 Deep Decarbonization Study's High Electrification Scenario

Pillar of GHG Reductions	Sector & Strategy	High Electrification Scenario, 2050 assumptions
Efficiency	Building electric & natural gas efficiency	34% reduction in total (natural gas and electric) building energy demand, relative to 2015. Savings are achieved via conventional efficiency and building electrification.
	Transportation smart growth and fuel economy	24% reduction in per capita light-duty vehicle miles traveled relative to 2015, plus shipping, harbor-craft & aviation energy demand 2030 measures
	Industrial efficiency	20% reduction in total industrial, non-petroleum sector energy demand relative to 2015, 90% reduction in refinery and oil & gas extraction energy demand
Electrification	Building electrification	100% new sales of water heaters and HVAC are electric heat pumps; 91% of building energy is electric (no building electrification is possible, but requires higher biofuels or power-to-gas), Moderate electrification of agriculture HVAC
	Zero-emission light-duty vehicles	35 million ZEVs (96% of total): 19 million BEVs, 11 million PHEVs, 5 million FCEVs, 100% of new sales are ZEVs
	Zero-emission and alternative fueled trucks	47% of trucks are BEVs or FCEVs (31% of trucks are hybrid & CNG); 88% electrification of buses, 75% of rail, 80% of ports; 77% of harbor craft electric or hybrid

Pillar of GHG Reductions	Sector & Strategy	High Electrification Scenario, 2030 assumptions
Efficiency	Building electric & natural gas efficiency	10% reduction in total building energy demand relative to 2015. Same level of non-fuel substitution energy efficiency as the SB 350 Scenario in non-heating sub-sectors. Additional efficiency is achieved through electrification of space heating and water heating.
	Transportation smart growth and fuel economy	New gasoline ICE light-duty autos average 45 mpg, 12% reduction in light-duty vehicle miles traveled relative to 2015, 5-6% reduction in shipping, harbor-craft & aviation energy demand relative to Reference
	Industrial efficiency	20% reduction in total industrial, non-petroleum sector energy demand relative to 2015, additional 14% reduction in refinery output relative to 2015

The final SB 100 report should compare these assumptions of demand-side resources included in the report with the current trajectory of energy efficiency and demand response deployment to ensure that the state is on track to meet these resource forecasts. The SB 100 report should then make recommendations necessary to ensure that the California Public Utilities' Commission and the California Energy Commission are working with the state's LSEs to procure this amount of energy efficiency and demand response.

III. Recommendations to update SB 100 modelling and analysis

A. Electricity demand forecasts should align with the electrification needed to achieve carbon neutrality

To better align the SB 100 report with California's goal of getting to a carbon neutral economy by no later than 2045, future analysis should (1) extract electric demand forecasts from E3's recent study "Achieving Carbon Neutrality in California," commissioned by the California Air Resources Board, and (2) apply this updated electric demand estimate as the basis for future capacity expansion modeling. The "High Electrification" demand scenario applied in the SB 100 core scenarios represents the electric demand calibrated to reduce economy-wide GHG emissions 80% below 1990 levels by 2050.[5] This undercounts the amount of electrification needed to achieve economy-wide decarbonization by 2045. In E3's recent modelling, for instance, the "balanced" scenario reduced direct emissions 87% from 1990 levels by 2045.[6] The California Energy Commission should use the results of this E3 study to develop an electric demand forecast for economy-wide decarbonization by 2045 through the next Integrated Energy Policy Report and then apply that demand forecast in the next SB100 study to develop the an accurate resource procurement estimate to meet our state's 2045 goals.

B. The joint agencies should update their analysis of green electrolytic hydrogen

The current SB 100 analysis falls short of recognizing the potential of green hydrogen[7] to decarbonize the power sector and broader economy. Results of all scenarios modeled confirm the need for long duration storage and the potential benefits of zero-carbon dispatchable power. The SB 100 analysis should also recognize that green hydrogen is poised to deliver both services. As discussed below, hydrogen combustion turbine projects are commercially viable, and hydrogen is increasingly being recognized as one of the leading options for long duration storage.[8] The analysis currently omits these recent technological developments and thus falls short of providing meaningful market and policy signals needed to unlock the potential of electrolytic hydrogen. Green electrolytic hydrogen could have a key role

[5] Energy and Environmental Economics, *Deep Decarbonization in a High Renewables Future. California Energy Commission* (June 2018), at 1 and 15.
[6] https://ww2.arb.ca.gov/sites/default/files/2020-08/e3_cn_report_aug2020.pdf, slide 7.
[7] Green hydrogen is hydrogen produced through electrolysis powered by clean electricity.
[8] https://ieefa.org/conversion-of-1800mw-intermountain-coal-plant-in-utah-to-840mw-gas-hydrogen-facility-moving-forward/; https://www.greentechmedia.com/articles/read/nextera-energy-to-build-its-first-green-hydrogen-plant-in-florida ; https://pv-magazine-usa.com/2020/07/03/nrel-study-backs-hydrogen-for-long-duration-storage/#:~:text=A%20National%20Renewable%20Energy%20Laboratory,to%20be%20cost%2Deffective.%E2%80%9D&text=The%20power%20equipment%20begins%20with,with%20solar%20or%20wind%20power.

in cost-effectively decarbonizing the power sector and the economy; the agencies should not wait until 2025 to recognize and better explore this technology.

i. The final SB 100 report should update its electrolyzer cost estimates

The draft report relies on electrolysis cost projections reaching back as far as 2014. In the past five years, electrolysis costs have fallen by 40%.[9] The final report should reflect these cost reductions. The analysis assumes $600/kW capital costs for electrolyzers in 2030; however, Bloomberg New Energy Finance (BNEF) reports electrolyzer costs as low as $135/kW, even in its conservative scenario[10]. In addition, the recently released European Union hydrogen strategy includes a substantial electrolyzer deployment target which, if met, will put the green hydrogen industry on the path to scale and further reduce electrolyzer costs. BNEF estimates that this level of deployment could potentially drive electrolyzer costs down to as low as $100/kW by 2030.[11] These EU developments could have a large impact on electrolyzer costs in the U.S. In fact, Mitsubishi Hitachi Power Systems Americas recently stated that the targets in the EU strategy will get green hydrogen to a cost-competitive place in the U.S. in the near-term[12]. We encourage the agencies to use the most recent BNEF electrolyzer cost projections of $135/kW by 2030 to accurately model the potential for future green hydrogen deployment.

ii. Turbines compatible with green hydrogen are commercially available

As noted above, the generic qualification of "zero-carbon dispatchable resources" does not recognize the advancements in hydrogen technology. Mitsubishi already produces turbines that can burn fuel blends with up to 30% hydrogen and is working on turbines that could burn 100% hydrogen fuel.[13] BNEF's Hydrogen Economy Outlook report assumes that all new turbines in 2030 onwards would be hydrogen-compatible.[14] LADWP has announced plans to replace coal-fired generation at the Intermountain Power Project with combined-cycle gas turbines capable of running on 100% green hydrogen by 2045. NextEra is planning a pilot plant that runs on green hydrogen.[15] And the EU hydrogen strategy specifically plans for hydrogen to start playing a balancing role in a high renewable grid in the late 2020s.[16] We thus encourage the agencies to reflect those developments in future SB 100 analysis by

[9] https://in.reuters.com/article/us-hydrogen-investment-study/carbon-free-hydrogen-production-needs-multi-billion-dollar-subsidies-to-make-it-cost-effective-research-idINKBN21H1SC
[10] Bloomberg New Energy Finance, Hydrogen Economy Outlook, March 30, 2020
[11] Bloomberg New Energy Finance, Europe's $500 Billion Plan Will Scale Up Green Hydrogen, July 13, 2020
[12] Statement by Paul Browning from MHPS during a webinar on the Advanced Clean Energy Storage project on August 21st, 2020
[13] ETN Global, "The Path Towards a Zero-Carbon Gas Turbine," January 2020, www.etn.global
[14] Bloomberg New Energy Finance, Hydrogen Economy Outlook, March 30, 2020
[15] https://www.greentechmedia.com/articles/read/nextera-energy-to-build-its-first-green-hydrogen-plant-in-florida
[16] https://ec.europa.eu/energy/sites/ener/files/hydrogen_strategy.pdf

modeling how hydrogen turbines could reduce and possibly even eliminate reliance on fossil gas for reliability and renewable integration.

iii. Green hydrogen offers cross-sectoral benefits necessary for economy-wide decarbonization

Green hydrogen is a decarbonization option for multiple sectors, including long-distance freight transport, heavy industry, aviation and maritime shipping. Green hydrogen thus has valuable cross-sectoral benefits that could lower the costs of decarbonizing the economy, because improvements in one sector's hydrogen infrastructure would make green hydrogen cheaper for all other sectors. For example, increased demand in one sector could drive economies of scale that other sectors could benefit from, while costs for infrastructure to transport and store hydrogen could be shared across sectors. We encourage the agencies at a minimum to recognize those synergies when forecasting green hydrogen costs. While SB 100 is focused on the power sector, decarbonizing the economy remains the ultimate climate imperative, and the agencies need to treat this analysis as part of a whole, and not in isolation.

C. Future SB 100 analysis should investigate modeling the impact of neighboring states' clean energy goals on import availability and update assumptions regarding northwest hydropower imports and climate change impact on northwest hydropower availability

Oregon[17] and Washington[18] have both established clean energy goals, and Nevada and Arizona are expanding their respective Renewable Portfolio Standards. Accordingly, all these western states will be building additional renewable capacity that can provide resource diversity to the western grid that each state can benefit from. Future SB 100 reports should analyze the benefits of enhanced regional cooperation to meet carbon reduction goals more cost-effectively.

Further, these developments also mean that California LSEs may not be able to rely on clean hydropower imports to meet our energy needs to the same extent going forward. The SB 100 analysis currently assumes a constant amount of northwest hydropower imports in all scenarios.[19] Future iterations of this analysis should better understand and forecast future availability of Northwest hydropower imports.

[17] https://www.oregon.gov/gov/Documents/executive_orders/eo_20-04.pdf
[18] https://www.governor.wa.gov/sites/default/files/documents/clean-electricity-policy-brief-bill-signing.pdf
[19] California Energy Commission, SB 100 Joint Agency Report: Charting a path to a 100% Clean Energy Future. Presentation – SB100 Draft Results (August 2020), at 16.

Northwest hydropower availability will also be impacted by climate change. The Northwest Power Council[20] has already started a forward looking process[21] to understand how climate change will impact energy efficiency, wind, and hydro energy availability,[22] and how these changes in energy availability interact with climate change modified customer demand. The joint agencies should consider these forecasts of hydropower availability going forward.

D. The joint agencies should conduct reliability analysis for interim milestone years

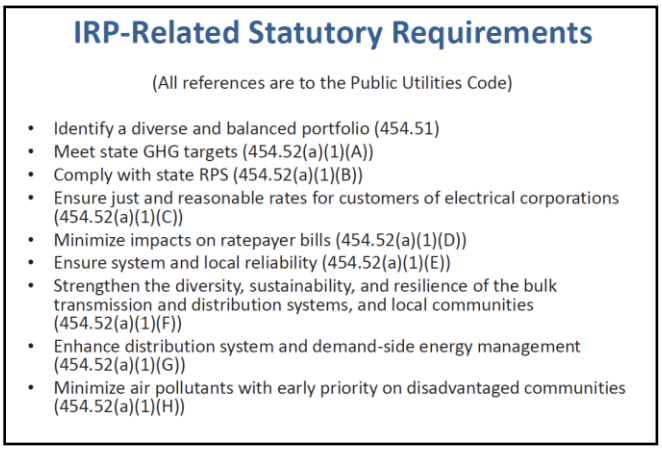
The joint agencies should complement the SB 100 report's capacity expansion analysis with reliability analysis for milestone years to ensure that the selected resource mix is capable of meeting future electricity demand. RESOLVE is a capacity expansion model and it procures resources to meet future demand, while accounting for a peak demand planning reserve margin. However, as the electric grid integrates more variable capacity renewable resources, it is important to ensure that this mix of renewable resources can meet reliability requirements at all hours, not just during peak demand. For SB 100 to facilitate actionable planning and policy guidance, future analysis will need to integrate more closely with the state's reliability analysis and requirements.

E. The SB 100 analysis should apply the costs of methane leakage and health impacts of pollutants to evaluate all resources; staff should also work with stakeholders to develop a methodology to account for the impact of renewable buildout on our natural lands

The SB 100 analysis should evaluate all resources, demand and supply side, consistently and accurately by accounting for all relevant costs and benefits. This resource valuation methodology should guide planners, through RESOLVE, to select a mix of resources that meet energy system needs and California's environmental policy goals equitably and affordably. Figure 2 presents the statutory requirements that the California Public Utilities Commission must follow in its integrated resource planning proceeding (IRP), which should be the template for evaluating all resources in RESOLVE.

[20] https://www.nwcouncil.org/news/accounting-climate-change-2021-power-plan
[21] https://www.nwcouncil.org/meeting/sif-climate-change-and-2021-power-plan-workshop-may-1-2019
[22] https://nwcouncil.app.box.com/s/nla2zip91dx9efw5swwnxzg2ckxmdh6b

Figure 2 IRP Related Statutory Requirements[23]



The resource selection criteria applied in the draft SB 100 report do not match these IRP statutory requirements. To rectify this and develop an accurate methodology, the joint agencies should, at a minimum, make the following updates to their resource selection criteria:

i. Account for methane leakage associated with all gas resources.

Staff should include benefits of incremental reduction in methane leakage due to clean energy adoption. Clean energy adoption reduces natural gas throughput through pipelines which in turn means less methane leakage. One way to determine this benefit is to calculate methane leakage and then apply the carbon dioxide equivalent of methane's global warming potential.[24] An accurate assessment of the true scope of methane leakage from various resources is necessary to guide procurement and plant retirement. Incremental methane leakage is a significant contributor to a resource's lifecycle GHG emissions, particularly in the case of natural gas.[25] Methane leakage during drilling, extraction, transportation, and storage of natural gas presents significant threats to our climate.[26] The effects of methane leakage are felt most deeply in California's disadvantaged communities.

ii. Account for the health impacts of criteria pollutants from all electricity generation

[23] California Public Utilities Commission, "Attachment A," in *Administrative Law Judge's Ruling Seeking Comment on Proposed Reference System Plan and Related Commission Policy Actions,* (September 9th, 2017), at 112.

[24] Per the California Air Resources Board, methane has 25 times the global warming potential as carbon dioxide. This means that every ton of methane leakage should count as 25 tons of carbon emissions towards the IRP's emissions reduction goal.

[25] Union of Concerned Scientists, *Environmental Impacts of Natural Gas*, https://ucsusa.org/resources/environmental-impacts-natural-gas.

[26] See, e.g., EPA, Understanding Global Warming Potentials, https://www.epa.gov/ghgemissions/understanding-global-warming-potentials.

Commission staff conducted a preliminary analysis to develop a statewide average estimate of health impact from criteria pollutants emitted from gas generation through the CPUC's Integrated Distributed Energy Resources (IDER) proceeding.[27] This average health impact estimate is a conservative lower limit because gas-fired power plants in populated areas have an outsized impact on the health of residents of nearby communities. This outsized impact, which disproportionally affects disadvantaged communities, is obscured by the statewide average estimate. While staff develops more detailed analysis to better understand the health impacts of these gas-fired power plants, they should at minimum apply the analysis conducted in the IDER proceeding as a starting point. In addition, more analysis is needed to identify impacts from other types of resources, including biofuels.

Finally, the joint agencies should continue refining their initial estimates of the land use impacts of SB 100 compliant scenarios to determine which resource mix appropriately balances energy system and community needs with the impacts on our ecosystems and natural lands.

[27] California Public Utilities Commission, *Distributed Energy Resource Cost - Effectiveness Evaluation: Further Recommendations on the Societal Cost Test An Energy Division Staff Proposal Addendum #2* (March 2018), at 12.