



Regenerate California

October 24, 2022

Liane Randolph, Chair
California Air Resources Board
1001 "I" Street
Sacramento, CA 95814

SUBMITTED VIA ELECTRONIC SUBMISSION

RE: Regenerate California Comments on the Electric Sector Portion of the Recirculated Draft Environmental Analysis for the 2022 Draft Scoping Plan

Dear Chair Randolph, Board Members and Staff of the California Air Resources Board ("CARB"):

Regenerate California is a coalition of five environmental justice, social justice, and environmental organizations working to retire gas-fired power plants in frontline communities in California and replace them with truly clean, distributed, and reliable energy. Our organizations include the California Environmental Justice Alliance ("CEJA"), Center for Community Action and Environmental Justice ("CCA EJ"), Central Coast Alliance United for a Sustainable Economy ("CAUSE"), Communities for a Better Environment ("CBE"), and Sierra Club. We represent communities throughout the state that are suffering from the effects of air pollution caused by gas-fired power plants and the confluence of many other toxic industries. On behalf of these organizations and affected communities, we are grateful for the opportunity to submit public comments on the Recirculated Draft Environmental Analysis ("RDEA").

We recommend that CARB to make the following four changes to the final Scoping Plan:

1. Update the Environmental Analysis to reflect the removal of new gas capacity from the electric sector scenario;
2. Set an interim target for the electric sector of no greater than 30 MMT by 2030;
3. Prioritize direct emissions reductions by retiring gas-fired power plants in disadvantaged

- communities first;
4. Further develop the public health analysis; and
 5. Pursue direct emissions reductions from the electric sector rather than increasing reliance on carbon capture, use, and sequestration.
- 1. The RDEA must be updated to reflect the removal of new gas capacity from the electric sector scenario.**

We thank you for your work on the Scoping Plan (“the Plan”), and are particularly appreciative that you were responsive to our, the Governor’s, and others’ calls to remove new gas-fired electricity generation from the Plan. We are similarly relieved that the updated Plan will double vehicle miles traveled (“VMT”) reductions and commit CARB to an inter-agency planning process for a supply-side phasedown of oil refining in California. However, given that the RDEA was released before the updated Plan, we are left guessing as to whether these changes will be reflected in the next draft of the Plan. At the same time, neither the RDEA project description, impacts analysis, nor the mitigations and alternatives analysis indicate changes promised by recent legislation, the Governor’s mandates, and by CARB staff and Board members. These omissions are deeply concerning, given that it is unclear whether CARB has conducted the appropriate modeling to illustrate the impacts of these changes.

While the RDEA does reference “Further transition away from fossil fuel-based electricity generation, and toward increased renewable energy generation resources,”¹ the Project Description for electricity-sector specific changes does not reflect removal of the Draft Plan’s proposed 10 GW of new gas-fired electricity generation.² The removal of new gas capacity from the Plan was mandated by Governor Newsom in his July letter to CARB³, and was similarly echoed by CARB staff at the August 22-23 EJAC meeting.⁴ Unfortunately, the RDEA suggests that Scoping Plan compliance can be achieved with the use of Allam Cycle CCS technology, which is still in development, and is largely targeted towards natural gas combined cycle power plants.⁵ However, Allam Cycle technology cannot be used to retrofit existing facilities and requires the construction of entirely new gas-fired power plants.⁶ This suggestion is incongruous

¹ Recirculated Draft Environmental Analysis for the Draft 2022 Scoping Plan for Achieving Carbon Neutrality (“RDEA”), CARB, p. 11 (Sept. 9, 2022).

² RDEA, p. 17.

³ Office of the Governor, letter to Liane Randolph (July 22, 2022) <https://www.gov.ca.gov/wp-content/uploads/2022/07/07.22.2022-Governors-Letter-to-CARB.pdf?emrc=1054d6>

⁴ CARB, Proposed Changes for the Final 2022 Scoping Plan August 22-23, 2022 EJAC Meeting (Aug. 19, 2022)

https://ww2.arb.ca.gov/sites/default/files/2022-08/2022SP_changes_August2022.pdf.

⁵ RDEA, p. 20-21.

⁶ Amanda Doyle, *Process pioneer: Rodney Allam discusses the development of his CCS technology* (July 17, 2018)

<https://www.thechemicalengineer.com/features/process-pioneer-rodney-allam-discusses-the-development-of-his-ccs-technology/>.

with CARB’s promise to eliminate new gas-fired electricity generation from the Plan. We hope that reference to Allam Cycle in the RDEA was a residual drafting error, and request that it be removed from the document and that the RDEA explicitly echoes CARB’s intentions to remove new gas capacity from the Plan.

Furthermore, the Project Objectives list states that the Plan will, “Continue to increase electricity derived from renewable sources to 60 percent by 2030 and increase electricity derived from renewable and zero-carbon resources to 100 percent by 2045.”⁷ However, these objectives are contradicted by Table 4-12, which states that the Proposed Scenario aims for emissions from the electric sector to reach 31 MMT in 2045.⁸ CARB representatives have indicated that the remaining emissions from the electric sector in 2045 are solely derived from line losses. If California is to reach 100 percent renewable and zero-carbon electricity generation by 2045, there should theoretically be extremely few to no greenhouse gas (“GHG”) emissions associated with that generation. Even if the Scoping Plan electric sector goals are only relevant for a retail sales definition that excludes line losses, it is nonsensical to assume that the electricity included in line losses would be generated by a different resource or with a different process than the rest of retail sales. This would mean that line losses are derived from renewables and zero-carbon resources as well, with little or no associated emissions. As such, planning for 31 MMT of greenhouse gas emissions from the electric sector in 2045 contradicts both law and policy mandates.

As discussed below, we urge CARB to adopt an interim emissions limit of no more than 30 MMT by 2030 for the electric sector and that the current 2045 emissions target of 31 MMT in the RDEA be significantly lowered to reflect new modeling and a more accurate understanding of the electricity sector.

Overall, we are extremely supportive of the Board and Governor’s direction that the 10 GW of new gas-fired electricity should be removed from the Plan. Building 10 GW of new gas capacity would be inconsistent with the State’s climate, public health, and economic goals. Removing this from the Plan alleviates considerable potential impacts on frontline communities in terms of concentrated air pollutant emissions, in addition to resulting in decreased greenhouse gas emissions. We trust CARB will take swift corrective action and that the appropriate changes to the Plan will be included at the upcoming modeling update on October 28, 2022.

2. The Scoping Plan must be updated to more rapidly address existing electric sector emissions by setting an interim target of no greater than 30 MMT by 2030.

An interim greenhouse gas target for the electric sector is needed to meet our state, national, and international climate targets. CARB’s previous analysis shows the Draft Plan is

⁷ RDEA, p. 13.

⁸ RDEA, p. 140.

highly unlikely to achieve California’s climate goals,⁹ including the SB 100 requirement for California to achieve a zero-carbon electricity system by 2045.¹⁰ Further, the International Energy Agency has explained that all advanced economies must achieve a carbon-free electric sector by 2035,¹¹ and President Biden’s Executive Order has also set a goal of 100 percent carbon-free electricity for the United States by 2035.¹² Without revision, the Draft Plan will put our state behind national and international targets and will likely result in us failing to meet our own policies and mandates. By setting an interim target of no greater than 30 MMT GHGs by 2030, CARB will begin to set us on the path to meet the scale and speed of the climate crisis.

In addition to meeting our climate targets, an interim target is necessary to avoid increased harms for frontline communities. As multiple sectors electrify and the grid incorporates more new renewable resources, existing gas plants could potentially cycle more frequently to balance intermittent loads, meaning that existing plants could run more frequently and spew intense startup and shutdown emissions on a more frequent basis. This will have immediate impacts on frontline communities in terms of more frequent periods of intense concentrations of harmful air pollutants, which can trigger acute health crises such as asthma attacks, heart attacks, and strokes. To better protect frontline communities, CARB must evaluate the potential mitigation of a 2030 interim target for the electric sector.

To avoid the most destructive impacts of the climate crisis, and to improve air quality in our state’s most vulnerable communities, we need to be doing everything possible to safely and reliably transition off gas-fired generation as quickly as possible. The Scoping Plan plays a critical role in realizing this transition. The Board, via revisions to the Scoping Plan that reconcile with Governor Newsom’s direction, must adopt a just and ambitious interim target for the electric sector. This will not only help us move faster on our gas retirement and clean electricity goals, but will help prevent existing gas plants from running more frequently to meet increased demand from electrification of other sectors or for possible out-of-state exports, which

⁹ See CARB Achieving Carbon Neutrality in California Report, p. 4-6 (Oct. 2020), https://ww2.arb.ca.gov/sites/default/files/2020-10/e3_cn_final_report_oct2020_0.pdf (explaining that the High Carbon Dioxide Removal scenario, 15 MMT by 2045 scenario “represents the highest risk scenario, from a climate mitigation perspective, because it has the highest remaining direct GHG emissions, and relies on relatively untested [carbon dioxide removal] strategies which are not widely commercialized. The scenario also has the highest remaining quantity of fuel combustion, which means the air quality impacts, though far improved relative to today, will likely be highest among the three carbon neutral scenarios evaluated. Both the climate risks and the technology adoption and implementation risks of relying so significantly on [carbon dioxide removal] are high.”).

¹⁰ The 100 Percent Clean Energy Act of 2018, S.B. 100, (De León, 2018); Public Util. Code Section 454.53(a), (d)(2).

¹¹ *Pathway to Critical and Formidable Goal of Net-Zero Emissions by 2050 Is Narrow But Brings Huge Benefits*, International Energy Agency (May 18, 2021), <https://www.iea.org/news/pathway-to-critical-and-formidable-goal-of-net-zero-emissions-by-2050-is-narrow-but-brings-huge-benefits>.

¹² U.S. White House, *President Biden Sets 2030 Greenhouse Gas Pollution Reduction Target* (Apr. 22, 2021), <https://www.whitehouse.gov/briefing-room/statements-releases/2021/04/22/fact-sheet-president-biden-sets-2030-greenhouse-gas-pollution-reduction-target>.

would further increase emissions in frontline communities. Currently, the Draft Scoping Plan projects that the electric sector will emit 38 MMT of greenhouse gasses in 2030 and 30 MMT through 2050, both of which are unacceptable.

Fortunately, building new clean energy capacity and transitioning off gas-fired power generation is feasible, cost-effective, and can generate new high-road jobs. Building renewable energy projects is often more cost effective than running existing gas plants and maintaining aging gas infrastructure.¹³ The recently passed federal Inflation Reduction Act includes unprecedented levels of federal support for clean energy that will further spur renewable energy projects and enable their rapid buildout.¹⁴ The California legislature and multiple state agencies are actively coordinating on how to address siting, permitting, transmission, and interconnection bottlenecks for renewable energy projects.¹⁵ Thus, rather than relying on polluting fossil fuel power generation, the Scoping Plan should plan for additional distributed energy resources, energy efficiency, demand response, renewable energy, and storage technologies to power and empower our communities.

3. Prioritize direct emissions reductions by retiring gas-fired power plants in disadvantaged communities first.

Transitioning off gas-fired generation is critical not only for the sake of the climate, but also for the sake of equity and environmental justice. The vast majority of currently operating gas-fired power plants are located in or near disadvantaged communities,¹⁶ which means those communities are disproportionately burdened by the harmful pollutants that gas plants emit. Some of the highest-polluting gas-fired power plants emit over 100 tons of NO_x per year.¹⁷ NO_x pollution contributes to a range of public health impacts from asthma to lung cancer and premature death.¹⁸ The State's plan to address gas-fired power generation must therefore include a commitment to phase out the gas plants in disadvantaged communities first.

We recognize that retiring gas-fired power plants requires significant buildout of clean energy to ensure grid reliability. This only reinforces the importance of CARB setting a 30 MMT

¹³ Charles Teplin, Mark Dyson, Alex Engel, and Grant Glazer. *The Growing Market for Clean Energy Portfolios: Economic Opportunities for a Shift from New Gas-Fired Generation to Clean Energy Across the United States Electricity Industry*, Rocky Mountain Institute, p.15 (2019), <https://rmi.org/cep-reports>.

¹⁴ Inflation Reduction Act of 2022, H.R. 5376, 117th Cong. (2022).

¹⁵ See, e.g., California Public Utilities Commission Rulemaking 17-07-007: Order Instituting Rulemaking to Consider Streamlining Interconnection of Distributed Energy Resources and Improvements to Rule 21 (filed July 13, 2017).

¹⁶ PSE Health Energy, *Natural gas power plants in California's disadvantaged communities* (Apr. 2017) https://www.psehealthyenergy.org/wp-content/uploads/2017/04/CA.EJ_Gas_Plants.pdf.

¹⁷ CARB Facilities Search Results sorted by NO_x pollution, <https://www.arb.ca.gov/app/emsinv/facinfo/faccrit.php?sort=NOX>.

¹⁸ U.S. Environmental Protection Agency, *Integrated Science Assessment for Oxides of Nitrogen – Health Criteria*, EPA/600/R-15/068 (Jan. 2016), <https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=310879>.

by 2030 target, which will help catalyze other agencies and decision-makers to invest in or authorize procurement for renewable and zero-carbon energy projects such as wind, solar, geothermal, battery storage, and microgrids, especially for people who have historically been excluded from accessing the benefits of clean energy, including frontline, low-income, rural, and indigenous communities.

4. The RDEA and Scoping Plan’s public health analyses are incomplete.

The strength of the Scoping Plan ultimately will be judged in the continued health and the quality of life Californians will enjoy. It is for this reason that we are deeply concerned about the incomplete public health analysis. We know that California’s topographical features, proximity to water, fertility of land, proximity to transportation arteries, energy demands, and current air quality demand that we humanize the people of California and present an assessment that is reflective of families not corporations.

The Scoping Plan and RDEA’s public health analyses are calculated using a model that does not have the capability to evaluate regional impacts of proposed actions. This stops the public, regulatory agencies, and CARB itself from appropriately evaluating how the Scoping Plan will impact different communities throughout the state. Evaluating impacts on differently-situated communities is particularly crucial in order to understand the impact of the Scoping Plan proposals on California’s many diverse low-income communities of color. Due to California’s racist land use practices, most polluting industries are sited in or near communities of color, so any sector-specific, reasonably anticipated compliance activities associated with the Plan have the potential to disproportionately impact these communities. If the RDEA cannot evaluate the full scope of health impacts, the Plan will fail to protect communities from increased exposure to high levels of pollutants that result in detrimental degradation of physical and social development and ultimately lead to premature deaths that are akin to a slow suffocation.

5. The RDEA’s analysis, although incomplete, is clear that CCS will have negative implications on California’s water resources.

We appreciate the efforts to improve the Scoping Plan by eliminating all new gas plants, doubling VMT reductions, and a commitment to having an inter-agency plan to phase down oil refining, but the introduction of reliance on carbon capture and storage (“CCS”) unravels the newly introduced improvements. The CCS process has a heavy dependence on chemicals, membranes, and mixed salts. Based on the FY19 Carbon Capture Peer Review Overview Report produced by the National Energy Technology Laboratory, there is currently no complete analysis

on the correct concentrations for such chemicals, nor on the long-term health impacts these chemicals would have on communities, nor what their disposal process might be.¹⁹

CCS depends on a novel amine-based solvent technology. However, there are currently no Safety Data Sheets available to the public on this technology, and it appears that government agencies have not yet completed an assessment of the human toxicity of first-generation monoethanolamine (“MEA”).²⁰ An assessment conducted by Karin Veltman et al, indicates that amine-based scrubbing results in a 10-fold increase in toxic impacts on freshwater ecosystems.²¹ There is a maximum 40-fold increase in aldehyde emissions, which results in a maximum 4-fold increase in human health impacts. The increase in human health impacts is predominantly due to formaldehyde emissions,²² as formaldehyde is a recognized human carcinogen.^{23, 24}

As the RDEA correctly explains, carbon removal technologies require large quantities of water, and their operations may place additional strain on existing and future water resources.²⁵ Furthermore, CARB identified several additional concerns with the impacts of CCS on water quality, including seismic disturbances from storing brine, potential groundwater contamination risks, water demand challenges, and erosion of natural landscapes.²⁶

¹⁹ *FY19 Carbon Capture Peer Review Overview Report*, National Energy Technology Laboratory (Dec. 6, 2018), <https://netl.doe.gov/sites/default/files/2019-08/FY19-Carbon-Capture-Peer-Review-Overview-Report.pdf>.

²⁰ Karin Veltman et al., *Human and Environmental Impact Assessment of Postcombustion CO2 Capture Focusing on Emissions from Amine-Based Scrubbing Solvents to Air*, *Environ. Sci. Technol.*, 44, 4, 1496–1502 (Jan. 22, 2010), <https://doi.org/10.1021/es902116r>.

²¹ *Id.*

²² *Id.*

²³ Roberta Bronson Fitzpatrick, *CPDB: Carcinogenic Potency DataBase* (Oct. 11, 2008), <https://www.tandfonline.com/doi/abs/10.1080/02763860802198895>.

²⁴ Mark A J Huijbregts et al., *Human-toxicological effect and damage factors of carcinogenic and noncarcinogenic chemicals for life cycle impact assessment*, *Integr. Environ. Asses. Man.* 1 (3), 181-244 (July 2005), <https://doi.org/10.1897/2004-007r.1>.

²⁵ RDEA, p. 244-45.

²⁶ RDEA, p. 176.

The scientific literature supports the contention that CCS should not be implemented in water scarce regions.²⁷ California is currently in the driest three-year period on record.²⁸ Additionally, California is facing a unique climate crisis spurred by its unique geography, as droughts become more numerous and lengthier, while its precipitation patterns shift towards more extreme less frequent atmospheric rivers that increase the possibility of flooding.²⁹ This change in precipitation means that California will be unable to rely on snowpack to store and portion out its water through the dry summer months, and will need to overhaul its water storage procedures and strategy.³⁰ As such, CARB should listen to its own analysis and that of the scientific community and avoid the negative water impacts of CCS.

6. The Plan’s increased reliance on CDR and CCS technologies raises additional concerns relating to electricity generation that require more analysis.

a. The RDEA was updated to accelerate CDR and CCS.

One of the major changes to the RDEA is the reassessment of “potential atmospheric mechanical carbon dioxide removal projects and carbon capture and storage projects.”³¹ The RDEA includes a new goal for carbon dioxide removal (“CDR”) and carbon capture and sequestration (“CCS”) of 20 MMT CO₂e by 2030 and a 2045 target of 100 MMT CO₂e,³² with an additional focus on carbon removal in natural and working lands first.³³ And while the updated project description includes a discussion of recent legislation and how this might impact carbon removal technologies,³⁴ the RDEA ultimately concludes that none of the outcomes and actions are limited by any permitting or federal rulemaking processes.³⁵

²⁷ See Hihsham Eldardiry and Emad Habib, *Carbon Capture and Sequestration in power generation: review of impacts and opportunities for water sustainability*, Energy, Sustainability, and Society 8, 6 (2018), <https://doi.org/10.1186/s13705-018-0146-3> (concluding that adding CCS to power plants in the Southwest can have “significant impacts on the water system, especially in basins with relatively low water resources” and that CCS-equipped power plants can increase water consumption by “45 to 90%.”); See also Lorenzo Rosa et al., *Hydrological limits to carbon capture and storage*, Nature Sustainability 3, 658 (Aug. 2020), <https://doi.org/10.1038/s41893-020-0532-7> (finding that variability in water consumption at various power plants and the scarcity of water in a power plant’s region are most essential considerations when attempting to implement CCS).

²⁸ Ryan Endean, *New Water Year Begins Amid Preparations for Continued Drought*, California Department of Water Resources (Oct. 3, 2022), <https://water.ca.gov/News/News-Releases/2022/Oct-22/New-Water-Year-Begins-Amid-Preparations-for-Continued-Drought>.

²⁹ Alexander Gershunov et al., *Precipitation regime change in Western North America: The role of Atmospheric Rivers*, Scientific Reports 9, 9944 (2019), <https://doi.org/10.1038/s41598-019-46169-w>.

³⁰ Matt Moffitt, *California’s future weather will alternate between drought and atmospheric rivers, study says*, SFGATE (July 9, 2019), <https://www.sfgate.com/weather/article/Atmospheric-river-drought-Calif-weather-Scripps-14083031.php>.

³¹ RDEA, p. 1.

³² RDEA, p. 18.

³³ RDEA, p. 11.

³⁴ RDEA, p. 25.

³⁵ RDEA, p. 25.

b. The RDEA’s analysis of CDR and CCS as it pertains to electricity generation is incomplete and inadequate.

The RDEA, like the Draft Environmental Analysis, is silent on whether the reductions in GHG emissions from the electric sector are assumed to come from CCS and CDR or from retiring GHG-emitting generation. While the RDEA identifies goals and dates for CCS to be on petroleum refining, stone, clay, glass, and cement operations, no such goal exists for the electric sector.³⁶ The RDEA also fails to apply the 2030 and the 2045 CDR / CCS targets to specific sectors. This is problematic. While we understand that there is “inherent uncertainty in whether, when, or where many measures included in the 2022 Scoping Plan would occur,”³⁷ the California Environmental Quality Act (“CEQA”) requires the RDEA to include an accurate, stable project description, and a thorough assessment of significant impacts, mitigation measures and alternatives. CEQA’s core function is to ensure an informed decision making process. To engage in that process, the public must be privy to the Scoping Plan’s assumptions regarding these CDR and CCS targets. We look forward to additional CARB analysis pertaining to carbon removal and the electric sector in the modeling and updated Scoping Plan.

While, as noted above, we strongly support the commitment to planning for a future electric sector that does not include additional gas-fired generation, the RDEA includes a reference to the Allam Cycle as a “zero-carbon resource” and as a potentially foreseeable compliance response that would increase renewable energy capacity.³⁸ This is an error, as promotional materials, scientific analyses and the manufacturer itself all assert that the Allam Cycle is a “novel **natural gas power plant** design that can theoretically capture 100 percent of emissions.”³⁹ However, there is only one plant, a 50 MW test facility in Texas, that has currently operated with the Allam Cycle design, so whether it can capture 100 percent of emissions at a larger scale remains unknown.⁴⁰ Additionally, carbon capture through the Allam Cycle is not a “zero-carbon” resource, as it does not account for up-stream methane leakage during the production and transporting of natural gas to the power plant or the potential leakage of stored carbon after it has been captured.⁴¹ Further, the Allam Cycle is a power plant design, not a modification. According to its manufacturer, it involves an innovative technique of “burning

³⁶ RDEA, p. 17-18.

³⁷ RDEA, p. 44.

³⁸ RDEA, p. 20-21.

³⁹ David Yellen, *Carbon Capture and the Allam Cycle: The future of electricity or a carbon pipe(line) dream?*, Atlantic Council (May 21, 2020), (emphasis added), <https://www.atlanticcouncil.org/blogs/energysource/carbon-capture-and-the-allam-cycle-the-future-of-electricity-or-a-carbon-pipeline-dream/>; See also NET Power Technology, <https://netpower.com/technology/>.

⁴⁰ See Yellen, *Carbon Capture and the Allam Cycle: The future of electricity or a carbon pipe(line) dream?*.

⁴¹ See Raghav Chaturvedi et al., *CO2 Sequestration by Allam Cycle*, Senior Design Reports, University of Pennsylvania 123 (Apr. 20, 2021), https://repository.upenn.edu/cgi/viewcontent.cgi?article=1135&context=cbe_sdr.

natural gas with pure oxygen” (oxy-combustion), fed through a high-pressure system to a new, specially-sized turbine, and equipped with both a recuperative process and a CO₂ disposal method.⁴² Because it is an entirely new design, it requires the construction of new, complex gas-fired power plants and cannot be retrofitted onto existing power plants.⁴³ As described in section 1 above, Allam Cycle technology cannot be used to retrofit existing facilities and requires the construction of entirely new gas-fired power plants.⁴⁴ As such, the RDEA should delete any reference to the Allam Cycle, as it is not “zero-carbon” and its use would require the construction of new gas-fired generation in order to “theoretically” capture carbon, an unproven contention at the utility-scale.

c. The RDEA’s analysis is inadequate because it fails to analyze the additional energy needed to power all the CDR and CCS technologies.

As parties commented in June 2022, the draft Scoping Plan failed to account for the GHG impacts from powering CDR, direct air capture (“DAC”) and CCS that the draft Scoping Plan envisions as necessary to achieve statutory mandates.⁴⁵ The RDEA states that the energy needed to power the CDR and CCS technologies will be mitigated by “on-site energy generation . . . involving photovoltaic electricity generation, battery storage, and microgrid systems” as well as “increased generation, both on-site and off-site.”⁴⁶ The RDEA is silent on details, however, when it comes to how much power will be required and whether it is remotely feasible to build this level of off-grid renewables.

With respect to CCS on existing power plants, studies suggest that CCS technologies require an estimated 10-25 percent more energy to produce the same amount of power the plant would produce without the CCS.⁴⁷ This energy penalty is therefore not an insignificant, but rather a sizable amount of additional generation that will be needed to power such carbon removal technologies. As such, the use of CCS on existing power plants foreseeably leads to

⁴² NET Power Technology, <https://netpower.com/technology/>.

⁴³ Karl M. Bandilla, *Future Energy (Third Edition) – Improved, Sustainable and Clean Options for Our Planet*. Chapter 31 – Carbon Capture and Storage, 669, 688 (2020), <https://www.sciencedirect.com/science/article/pii/B9780081028865000311?via%3Dihub>.

⁴⁴ Amanda Doyle, *Process pioneer: Rodney Allam discusses the development of his CCS technology* (July 17, 2018), <https://www.thechemicalengineer.com/features/process-pioneer-rodney-allam-discusses-the-development-of-his-ccs-technology/>.

⁴⁵ See e.g. Michael Wara et al., Public Comment on the 2022 Scoping Plan – Stanford CEPP Comments on Scoping Plan (June 24, 2022), <https://www.arb.ca.gov/lists/com-attach/4433-scopingplan2022-UiFcLgdnUG0LawNs.pdf>.

⁴⁶ RDEA, p. 26.

⁴⁷ See *CAN Position: Carbon Capture, Storage, and Utilisation*, Climate Action Network Int’l., p. 9 (Jan. 2021), <https://climatenetwork.org/resource/can-position-carbon-capture-storage-and-utilisation/> (finding that pulverized coal stations fitted with CCS require 25% more energy); See also *Carbon Capture and Sequestration (CCS) in the United States*, Congressional Research Service (Oct. 5, 2022), <https://sgp.fas.org/crs/misc/R44902.pdf> (finding that the energy penalty has been reported at around 20% of a power plant’s capacity).

plants running harder, or longer, to deliver the same electricity to the grid in order to power the CCS. To envision a reliable grid, all calculations based on existing nameplate capacity of the gas fleet would have to be reduced by 25 percent. Even imagining CCS performed perfectly on existing plants, which no studies suggests it would, the increased power per MW delivered would result in more harmful non-CO₂ air pollutants, like NO_x and particulate matter, that are not captured by CCS.⁴⁸ For industries like refineries, the impacts to the electricity sector are even more extreme. For example, even if it were feasible to retrofit California refineries with CCS, the energy required to power that CCS would be vast. Based on data from 2020, the penalty would represent 5 percent of all energy used, or 7.2 percent of in-state production, in 2020.

For CDR like DACs, estimates of electricity per ton of captured CO₂ range from 2.43MWh to 3.89MWh.⁴⁹ To power 20 MMT of CO₂ removal would require 48,600,000 MWh.⁵⁰ According to the U.S. Energy Information Administration, as of July 2022, California had 20,425,000 MWh total net electricity generation, of which utility-scale solar, wind, and geothermal net electricity generation make up 6,731,000 MWh.⁵¹ The RDEA does not even begin to analyze impacts of building this scale of off-grid renewable power.

d. By prioritizing direct emission reductions, CARB can lessen its reliance on unproven carbon removal technologies to achieve its GHG reduction goals.

As earlier public comments have indicated,⁵² CCS is a costly, risky, and unproven form of CO₂ emission reduction. The first large U.S. power plant to implement CCS, the Petra Nova plant, shut indefinitely in January 2021, after only four years of operation, and remains shut down today due to lower oil prices than expected.⁵³ The world's largest DAC facility in the world, the Climeworks' Orca project, is also experiencing complications. After launching in

⁴⁸ See Mark Z. Jacobson, *The health and climate impacts of carbon capture and direct air capture*, Energy and Environmental Science 12, 3567-3574 (2019), <https://web.stanford.edu/group/efmh/jacobson/Articles/Other/19-CCS-DAC.pdf> (concluding that CCS are “not close to zero-carbon technologies” and that CCS does not capture “CO, NO_x, SO₂, organic gases, mercury, toxins, black and brown carbon, fly ash, and other aerosol components.”)

⁴⁹ Leigh Collins, *The amount of energy required by direct air carbon capture proves it is an exercise in futility*, Recharge (Sept. 14, 2021), <https://www.rechargenews.com/energy-transition/the-amount-of-energy-required-by-direct-air-carbon-capture-proves-it-is-an-exercise-in-futility/2-1-1067588>; see also Michael Wara et al., Public Comment on the 2022 Scoping Plan – Stanford CEPP Comments on Scoping Plan (June 24, 2022) (2000kWh per ton of CO₂ captured.).

⁵⁰ 2.43 x 20,000,000.

⁵¹ California State Energy Profile, U.S. Energy Information Administration, <https://www.eia.gov/state/print.php?sid=CA>.

⁵² See generally Michael Wara et al., Public Comment on the 2022 Scoping Plan – Stanford CEPP Comments on Scoping Plan (June 24, 2022); Chelsea Tu et al., Public California Environmental Justice Alliance, Comment on the 2022 Scoping Plan – CEJA Draft Scoping Plan Sector-Specific Comments (June 24, 2022), <https://www.arb.ca.gov/lists/com-attach/4459-scopingplan2022-UDMAY1Y9V2VQCQBk.pdf>.

⁵³ See *Carbon Capture and Sequestration (CCS) in the United States*, Congressional Research Service (Oct. 5, 2022), <https://sgp.fas.org/crs/misc/R44902.pdf>.

September 2021, it is running behind schedule after the Icelandic winter caused the technology to stop working.⁵⁴ Most major worldwide CCS projects have outright failed or captured significantly less than initially anticipated.⁵⁵ These examples demonstrate that getting large, utility-scale CDR and CCS technologies that operate as designed might take decades, in addition to the enormous additional burdens they would place on the electric sector, which is the key to decarbonizing the entire economy. If California is to achieve carbon neutrality by 2045,⁵⁶ CARB must act now to plan for retirement of gas-fired power plants and not increase the state's dependence on fossil fuels, while gambling on an unproven technology to develop.

Regenerate California appreciates the recent improvements to the Scoping Plan's RDEA as well as the opportunity to provide comments. We urge you to make the above additional improvements as well to reduce our reliance on gas-fired power plants in frontline communities and to replace them with truly clean, distributed, and reliable energy.

Sincerely,

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⁵⁴ Harry Cockburn, *World's biggest carbon removal machine 'freezes over' in Iceland*, Yahoo! News (Apr. 19, 2022), <https://nz.news.yahoo.com/world-biggest-carbon-removal-machine-114645741.html>.

⁵⁵ See Adam Vaughan, *Most major carbon capture and storage projects haven't met targets*, NewScientist (Sept. 1, 2022), <https://www.newscientist.com/article/2336018-most-major-carbon-capture-and-storage-projects-havent-met-targets/>.

⁵⁶ This goal is consistent with AB 1279, Muratsuchi, 2021-2022 legislative session.