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### Title

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### Author

Saliman, Aaron

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## An Environmentalist's Hesitant Support of Near-Term Carbon Capture

In general, environmentalists loath Carbon Capture and Sequestration (CCS) as a means of reducing greenhouse gas (GHG) emissions.<sup>1</sup> The process involves separating Carbon Dioxide from the waste stream of a power plant and putting it underground, in the ocean, or anywhere else it will stay for an indefinite period.<sup>2</sup> A tree-hugging hippy myself, I harbor more than my fair share of skepticism and derision toward the technology. And yet, I'm about to (hesitantly) suggest that its use is necessary in the near-term to meet California's goal of a carbon-free electric grid by 2045.<sup>3</sup>

The arguments against CCS are beyond reasonable: it is more expensive than renewable energy; it has higher emissions than renewable energy, due largely to imperfect and inefficient CO<sub>2</sub> capture; and it could use up vital economic resources needed to further develop renewables.<sup>4</sup> The fossil fuel industry also has vested interests in promoting CCS, which could allow coal- and gas-fired power plants to stay around much longer than would be ideal under a warming climate.<sup>5</sup> The storage of carbon also poses risks, such as leaks from poorly secured storage areas. The captured CO<sub>2</sub> can also be used to enhance oil mining in other locations, resulting in higher fossil fuel extraction and a net increase in emissions due to increased mining.<sup>6</sup>

Thus, I propose that CCS should be used not as a CO<sub>2</sub>-reducing panacea, but in minimal amounts to ensure the robustness of California's fully clean grid. This is in keeping with a December 2020 report from the Environmental Defense Fund, which indicated that, while theoretically possible, a 100% renewable California grid does not appear to be economically feasible due to the high costs of batteries, transmission lines, and the excess generation capacity that would be needed to ride out long periods of sunlessness and/or windlessness when conventional renewables cannot generate power.<sup>7</sup> While the report does not specifically call for CCS, it says that without clean firm power (i.e. power that can be turned off and on, like carbon-capture fossil fuels or nuclear), California's grid faces massive hurdles. These include the construction of 9 million miles of new transmission lines (compared to only 3 million using some clean firm power), the development of over 160 GW of battery storage (80 times current levels), and so much renewable generation that the solar panels and wind turbines might spill onto protected wilderness.<sup>8</sup>

The possibility of aiding the California grid with nuclear energy is compelling; it is 100% carbon free generation (unlike CCS)<sup>9</sup>, proven across decades, and can provide massive generation in a small footprint. But California's staunch anti-nuclear policy since 1979,

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<sup>1</sup> <https://www.greenpeace.org/usa/wp-content/uploads/legacy/Global/usa/planet3/PDFs/Carbon-Capture-Scam-Exec-Summary.pdf>

<sup>2</sup> <https://www.lse.ac.uk/granthaminstitute/explainers/what-is-carbon-capture-and-storage-and-what-role-can-it-play-in-tackling-climate-change/>

<sup>3</sup> <https://focus.senate.ca.gov/sb100/faqs>

<sup>4</sup> [https://www.dlr.de/tt/Portaldata/41/Resources/dokumente/institut/system/publications/Poster\\_CCS\\_Viebahn\\_SETAC\\_final.pdf](https://www.dlr.de/tt/Portaldata/41/Resources/dokumente/institut/system/publications/Poster_CCS_Viebahn_SETAC_final.pdf)

<sup>5</sup> <https://www.greenpeace.org/usa/wp-content/uploads/legacy/Global/usa/planet3/PDFs/Carbon-Capture-Scam-Exec-Summary.pdf>

<sup>6</sup> <https://www.sciencedirect.com/science/article/pii/S0360544204001562>

<sup>7</sup> <https://www.edf.org/sites/default/files/documents/SB100%20clean%20firm%20power%20report%20plus%20SI.pdf>

<sup>8</sup> *ibid*

<sup>9</sup> [https://www.dlr.de/tt/Portaldata/41/Resources/dokumente/institut/system/publications/Poster\\_CCS\\_Viebahn\\_SETAC\\_final.pdf](https://www.dlr.de/tt/Portaldata/41/Resources/dokumente/institut/system/publications/Poster_CCS_Viebahn_SETAC_final.pdf)

combined with nuclear decommissioning across the state, make me highly skeptical that the technology will play a large role in future energy policy.<sup>10</sup>

Other exciting power sources, such as Concentrated Solar Power, can continue producing renewable energy hours after the sun has gone down, but these technologies are still nascent and not economically available on the scales needed to reach decarbonization in less than 25 years.<sup>11</sup> Further, these technologies can only provide a few hours of energy buffering, which is not enough to ride out “energy doldrums” that often last days.<sup>12</sup>

CCS technology could be added to a growing number of fossil fuel plants, while still continuing the statewide policy of decommissioning as many of these plants as possible. Again, I only propose that this technology be used as a buffer to ensure a stable grid while research continues to drive battery prices down and renewable efficiencies up.<sup>13,14</sup> CCS can easily become a distraction and a tantalizing deus-ex-machina for our climate woes, and therefore it is critical that funding to fight climate change predominantly goes to the development of renewables and storage.

Carbon Capture and Sequestration technology, when applied in small, decreasing amounts to fossil fuel electricity generation could provide the boost California needs to maintain a dependable energy supply. The imperfect carbon capture, high cost, and risks described above all indicate why this technology should be approached cautiously and as a stepping stone to a grid that relies more and more on renewable generation, battery storage, and interconnection to balance out “energy doldrums,” a grid which will be feasible if battery and renewable technologies continue to decrease in price and increase in efficiency. Creative solutions on the demand side, such as helping consumers decrease demand during periods of low generation or building out microgrids of residential solar panels paired with residential batteries, could compliment a fully renewable future.<sup>15</sup> In the long-term, these strategies and technologies combined will help California arrive at an energy future devoid of fossil fuels; but for the challenging goal of grid carbon neutrality by 2045, CCS might need our grudging support in the near term.

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<sup>10</sup> <https://www.latimes.com/business/story/2021-05-18/california-climate-change-nuclear-power-plant>

<sup>11</sup> <https://www.nrel.gov/docs/fy12osti/52409-2.pdf>

<sup>12</sup> <https://www.edf.org/sites/default/files/documents/SB100%20clean%20firm%20power%20report%20plus%20SI.pdf>

<sup>13</sup> <https://www.nrel.gov/docs/fy12osti/52409-2.pdf>

<sup>14</sup> <https://www.nrel.gov/docs/fy19osti/73222.pdf>

<sup>15</sup>

[https://www.sciencedirect.com/science/article/pii/S0960148119309875?casa\\_token=ShLh9NTijBgAAAAA:qhwtDyYR LTZ-7VXQ\\_8K0dscV7q2wgpZZ7Up38tbu6SzytXKFbhl0gZucq14eMUHnpK15MfPVdl](https://www.sciencedirect.com/science/article/pii/S0960148119309875?casa_token=ShLh9NTijBgAAAAA:qhwtDyYR LTZ-7VXQ_8K0dscV7q2wgpZZ7Up38tbu6SzytXKFbhl0gZucq14eMUHnpK15MfPVdl)