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Testimony of
MARK B. GLICK, Chief Energy Officer

before the
SENATE COMMITTEES ON ENERGY, ECONOMIC DEVELOPMENT, AND TOURISM AND AGRICULTURE AND ENVIRONMENT

Tuesday, January 30, 2024
1:01 PM
State Capitol, Conference Room 229 and Videoconference

Providing Comments on
SB 2451

RELATING TO AN ATMOSPHERIC CARBON CAPTURE PLANT.

Chairs DeCoite and Gabbard, Vice Chairs Wakai and Richards, and Members of the Committees, the Hawai‘i State Energy Office (HSEO) provides comments on SB 2451, which directs HSEO, in conjunction with the Hawai‘i Natural Energy Institute (HNEI), to develop and submit a strategy interim report and final report no later than forty days before the convening of the regular sessions of 2025 and 2026, respectively, for the construction of at least one atmospheric carbon capture plant in the State by 2029.

HSEO’s comments are guided by its mission to promote energy efficiency, renewable energy, and clean transportation to help achieve a resilient, clean energy, decarbonized economy.

HSEO appreciates the opportunity to investigate and pursue the use of atmospheric carbon capture and sequestration technologies activities further and supports the intent of SB 2451. However, HSEO notes before the construction of any atmospheric carbon capture plant, the facility and technology chosen must undergo not only a thorough environmental review but should also undergo robust lifecycle emissions analysis to determine the efficacy of the plant itself due to the substantial energy requirements of atmospheric carbon capture, also known as

direct air capture (DAC) technology. Further, if geological sequestration is paired with the atmospheric carbon capture plant, the selected site's geological substrate must be adequately studied and researched.

HSEO notes a few technical definitions that should be used when referring to both direct air capture and carbon sequestration technologies.

(a) Carbon Capture and Storage (CCS) is the process by which carbon dioxide is captured from a smokestack or flue from a power plant or factory and then sequestered underground. This industrial process captures emissions from a point source GHG emitter and not the atmosphere. It is a mitigative action aimed at reducing emissions from point source facilities such as factories, refineries, or energy production facilities.

(b) Carbon Capture and Utilization (CCU) is the process by which carbon dioxide (CO_2) is captured and converted into useful products including sustainable aviation fuel, carbon-negative concrete, or carbon dioxide for industrial and commercial use, such as use in beverages.

(c) Carbon Dioxide Removal (CDR) is the process by which CO_2 gas is removed from the atmosphere and sequestered. Sequestration is the process of capturing and removing CO_2 from the atmosphere for long-term storage in the following ways:

   a. The Biological type stores CO_2 in vegetation, soils, and oceans.
   b. The Geological type stores CO_2 in geological formations (underground rocks).
   c. The technological type refers to the storage in engineered molecules.

(d) Direct Air Capture (DAC) is the process by which carbon dioxide is removed from the ambient air into a form in which it can be stored or utilized.

(e) Direct Air Capture with Carbon Storage (DACCS) is a CO_2 removal method in which carbon dioxide is captured from the ambient air via a contractor and is compressed into a pure stream to be injected into a geological reservoir for long-term storage.

(f) Geological Sequestration is a technology in which captured carbon is mixed with water and injected into an appropriate substrate, such as basalt, where it creates a carbonate rock and is stored for millennia.

(g) Negative Emissions Technology (NET) is a technology that removes more carbon out of the air than it emits during its full life cycle, also known as greenhouse gas removal technology. NETs include DACCS and CCS.

Notably, a DAC facility alone does not include a permanent storage mechanism for the captured atmospheric carbon. Geological sequestration provides the promise of long-term storage; however, some critical challenges and concerns must be addressed before its safe implementation in Hawai‘i. As with any industrial facility before the adoption of the technology adequate community engagement and environmental analysis must occur. Further, understanding the geological substrate for permanent storage should be prioritized before substantially investing in DAC technology.

Per Act 238, Session Laws of Hawai‘i 2022, HSEO worked with the University of Hawai‘i (UH) Climate Resilience Collaborative (CRC) on evaluating carbon sequestration and carbon utilization opportunities for the state of Hawai‘i. As a part of this work, HSEO and UH CRC collaborated on a white paper, which HSEO submitted as an appendix to the Act 238 legislative report.[1] As a part of the white paper, HSEO evaluated the space, energy, regulatory, and other requirements of a facility similar to the Orca facility in Iceland. The facility in Iceland was chosen for comparison due to Hawai‘i’s similar basalt geology required for the sequestration of CO_2 after DAC.

The energy requirements for a DAC facility can generally be divided into two categories: 1) the energy required for mechanical components such as the fans to collect the CO_2 from the air and 2) the energy required to adequately heat the CO_2 collected and desorb it from the surface of the collection adsorbents (carbon filters). Regarding the latter, studies have indicated that the climatic benefits of DAC are highly dependent on the energy source used to power the associated capture

[1] Hawai‘i State Energy Office (2023). Hawai‘i Pathways to Decarbonization. Appendix D, pages 333-357.

facility.[2] For an autonomous system (not attached to the utility grid), that is entirely powered by photovoltaic electricity (including a high-temperature heat pump (HTHP) operated with electricity from the grid), energy requirements increase, as there is no direct heat source.[3]

Estimated energy requirements for CO_2 capture using the DAC technology used by the first net-negative facility Orca in Hellisheiði, are about 500 kilowatt-hours (kWh) per ton CO_2 for electricity, not including the electricity consumption for CO_2 compression, and 1,500 kWh per ton CO_2 for heat (for temperatures around 100 degrees Celsius).[2] This equates to approximately 2,000 megawatt-hours (MWh) per year of mechanical energy, excluding the energy used for compression, and approximately 6,000 MWh of energy annually for heating.

Various CO_2 removal technologies, such as the DAC, are a critical component to achieving Hawai‘i’s net negative goals; however, they should not be construed as the fix-all solution for various reasons. Firsthand, the DAC has lower energy efficiency when compared to CCS – another technology utilized for greenhouse gas abatement, but the incentives at the federal level are not as high. Inflation Reduction Act 45Q tax credits authorized by the Inflation Reduction Act (IRA) specify credit values of $85 and $180 for both point source capture and direct air capture, respectively. Conversely, at the low end of the cost spectrum DACCS systems have estimated costs of $134-342 per metric ton.[4] Yet some research still suggests that reasonable expectations place costs substantially higher in the range of $600-1,000 per net metric ton removed.[5] At this point, federal tax provisions and carbon markets are not adequate to fund this type of facility.

Considering DAC’s substantial energy requirements that make its viability highly sensitive to the cost of the energy source, substantial subsidies would likely be necessary to support the viability of DAC in the current market. It is also

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[2] Terlouw, T., Treyer, K., Bauer, C., & Mazzotti, M. (2021). Life cycle assessment of direct air carbon capture and storage with low-carbon energy sources. Environmental Science & Technology, 55(16), 11397-11411
[3] Hawai‘i State Energy Office (2023). Hawai‘i Pathways to Decarbonization. Appendix D, pages 333-357.
[4] Herzog, H. (2022). Direct Air Capture. Greenhouse Gas Removal Technologies, 31, 115. https://doi.org/10.1039/9781839165245-00115
[5] Herzog, H. (2022). Direct Air Capture. Greenhouse Gas Removal Technologies, 31, 115. https://doi.org/10.1039/9781839165245-00115

important to keep in mind that CO_2 removal is not currently a cost-effective alternative to reducing emissions through first-order solutions such as energy efficiency, renewable energy development, electric vehicle adoption, prioritizing infill and transit-oriented development, and alternative and active transportation mechanisms. Furthermore, carbon removal technology is not an alternative to maintaining and increasing natural sinks through measures such as reforestation and afforestation, and soil carbon sequestration or regenerative agriculture.

As additional background information, HSEO notes that annual emissions from Hawai‘i’s energy sector (excluding international bunker fuels) were the equivalent of approximately 19.4 million metric tons of CO_2 annually.[6] Comparatively, the annual amount of atmospheric carbon dioxide captured and sequestered in Iceland was 4,000 metric tons, less than one percent of Hawai‘i’s energy sector emissions.

HSEO recommends that, while general research and attention to carbon capture continue, the specific tasks envisioned in this bill be delayed to a future time when Hawai‘i’s grids have an excess of zero-carbon energy available and when there is the necessary understanding of the geological substrate needed for carbon capture. Currently, it is not clear whether the act of geologic sequestration would affect geologic resources including minerals and state land, doing appropriate geological investigations should be prioritized to determine if the physical geological substrate is appropriate for carbon storage. The University of Hawai‘i Groundwater and Geothermal Resources Center is a better-suited entity to complete this type of research.

HSEO believes that mandating construction by a specific date is not appropriate at this time because the technology is still relatively nascent and this type of project requires substantial environmental review, energy resources, and complex lifecycle emissions analysis.

However, if the Committee does decide to proceed with this measure, HSEO requests the following revisions to clarify the intent of SB 2451:

[6] State Department of Health (2023). Hawai‘i Greenhouse Gas Emissions Report for 2005, 2018, and 2019

1) Section 1 should clarify whether the Hawai‘i State Energy Office will be evaluating a DAC facility only, or if the strategy should also be inclusive of the DACCS - a facility that sequesters and/or geologically stores CO_2 after it is captured. Storage and/or utilization after direct air capture are technologies separate from atmospheric carbon capture and the pathways for CO_2 utilization or storage after collection differ and require varying levels of analysis, environmental review, and permitting dependent upon the chosen pathway.
2) Removing or extending construction date requirements to ensure adequate environmental analysis, community engagement, and economic analysis can commence.

Thank you for the opportunity to testify.

UNIVERSITY OF HAWAIʻI SYSTEM
ʻŌNAEHANA KULANUI O HAWAIʻI

Legislative Testimony
Hōʻike Manaʻo I Mua O Ka ʻAhaʻōlelo

Testimony Presented Before the
Senate Committee on Energy, Economic Development, and Tourism
Senate Committee on Agriculture and Environment
Tuesday, January 30, 2024 at 1:01 p.m.
By
Richard Rocheleau, Director
Hawaiʻi Natural Energy Institute
School of Ocean and Earth Science and Technology
And
Michael Bruno, PhD
Provost
University of Hawaiʻi at Mānoa

SB 2451 – RELATING TO AN ATMOSPHERIC CARBON CAPTURE PLANT

Chairs DeCoite and Gabbard, Vice Chairs Wakai and Richards, and members of the Committees:

The Hawaiʻi Natural Energy Institute (HNEI), offers comments on SB 2451 that directs the Hawaii State Energy Office (HSEO), in conjunction with HNEI, to develop and submit a strategy report for the construction of at least one atmospheric carbon capture plant in the State by 2029. HSEO, in their testimony, provides definitions of a number of carbon capture strategies each involving some methodology for the removal and concentration of CO2 from its source, and some method for utilization or long term storage. HSEO also discusses the significant energy inputs required for current Direct Air Capture (DAC) technology.

While carbon capture may eventually be a critical component of any carbon reduction scheme it is not, at this time, as effective or as cost effective for Hawaiʻi as continued efforts to reduce our use of fossil fuels and to increase efficiency in all the energy sectors. Reports regarding carbon capture, and in particular, Direct Air Capture indicate significant energy consumption for operation. To have a significant impact these plants will need to have very high capacity (i.e. be large), and be located where low-cost renewable energy is plentiful. We believe this may be a significant barrier for deployment in Hawaiʻi . Additionally, overall success of any strategy for CO2 removal from the air will require local solutions for long-term sequestration. While geologic or ocean sequestration may be possible in HI, neither the technology, the cost nor the assurance of success exists today.

In summary, HNEI believes that it is premature to develop a strategy for development of a carbon removal plant in the timeframe proposed for both technical and cost reasons.

However, given the local interest and ongoing global effort to improve these technologies, HNEI would willingly participate in developing a more detailed assessment of current removal technologies including, state-of-readiness for commercial deployment, energy requirements, and full life-cycle emissions (or reductions); and working with a consortium of relevant partners to identify and assess the various opportunities for long-term sequestration in Hawai‘i .

Thank you for the opportunity to provide this testimony on SB 2451

Environmental Caucus of
The Democratic Party of Hawai'i

Energy & Climate Action Committee

Tuesday, January 30, 2024, 1:01 pm

Senate Committee on Energy, Economic Development, and Tourism
SENATE BILL 2451 – RELATING TO AN ATMOSPHERIC CARBON CAPTURE PLANT
Position: Strongly Oppose

Me ke Aloha Chair DeCoite, Vice-Chair Wakai, and members of the Senate Committee on Energy, Economic Development, and Tourism:

SB2451 Directs the Hawai'i State Energy Office and the Hawai'i Natural Energy Institute to develop a strategy for the construction of an atmospheric carbon capture plant by 2029.

Energy and Climate Action Committee strongly opposes this measure as a misguided effort to capture not atmospheric carbon but federal research dollars for a technology widely recognized as being far too expensive and far less effective than cheaper and more direct means of sequestering atmospheric carbon. A number of studies have explored this technology at relatively small scale, all of them quite expensive but none producing significant results at scale. Reviewers conclude that only eager technologists seeking to continue their professional careers pursue such technologies. It is being advocated by giant technology contractors seeking new pastures, with large advertising budgets, producing glossy spreads, riding the wave of interest in reducing greenhouse gases, and by fossil fuel companies eager to produce the technologies with more fossil fuel use. Decision-makers are gulled by optimistic grand promises and fancy promotions that are not met by real-life demonstrations.

Real progress, on the other hand, has continued to produce startling results from proper land management, in altering agricultural and pastoral practices, finding that soils can be managed not only to halt the depletion of soil health and carbon depletion from industrial agricultural and pastoral practices, but to accelerate soil health and crop or grassland productivity and nutritional content, and to accelerate carbon sequestering. These land management innovations are riding the same wave of interest and are far cheaper, but not as glossy as their high-tech competitors. Dirt seems not to inspire as much attention as shiny metal, but it happens to be proven, very effective, and much cheaper.

Hawaii should not be squandering precious dollars pursuing false promises when solid technologies are achieving real and encouraging results by other means. Such taxpayer money is far better spent on proven and promising technologies that are far cheaper and proven effective. Moreover, these technologies are more labor-intensive and more directly economically productive by rehabilitating useful land, providing more jobs, still cheaper than flashy high-tech enterprise. Hawaii should be forging ahead with regenerative agriculture, which restores and enhances soil and food productivity and food nutrition, as well as providing more atmospheric carbon recapture than anything but old growth forest and plankton-rich ocean environments. In the wake of the 2023 Lāhainā disaster and its previous 2018 wildfire reducing the ground cover to gravel, along with a century of depleting soil under sugar, we should be on the ground with both feet along proven lines.

Mahalo for providing the oppoortunity to address this matter.

/s/ Charley Ice, Chair, Energy and Climate Action Committee
Environmental Caucus of the Democratic Party

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COMMITTEE ON ENERGY, ECONOMIC DEVELOPMENT, AND TOURISM
Senator Lynn DeCoite, Chair
Senator Glenn Wakai, Vice Chair

COMMITTEE ON AGRICULTURE AND ENVIRONMENT
Senator Mike Gabbard, Chair
Senator Herbert M. "Tim" Richards, III, Vice Chair

DATE: Tuesday, January 30, 2024
TIME: 1:01 PM
PLACE: Conference Room 229 & Videoconference

SB 2451 Greenhouse Gas Emissions COMMENTS

Life of the Land is Hawai`i's own energy, environmental and community action group advocating for the people and `aina for 54 years. Our mission is to preserve and protect the life of the land through sound energy and land use policies and to promote open government through research, education, advocacy and, when necessary, litigation.

There is federal money being offered for clean energy projects. Hawaii is seeking to tap into the money. Like the hydrogen proposal, the focus appears to emphasize getting federal funds more than considering whether the idea makes sense.

The concept behind direct air capture is that fossil fuel plants can continue to emit dangerous toxins into the air. These toxins include greenhouse gases, particulates, and a wide variety of other poisons.

Money can then be spent removing the toxins. Like not brushing one`s teeth because one can always go to the dentist to repair the damages.

The largest facility of its kind on earth,[1] the Climeworks-Carbfix Orca carbon capture plant uses direct air capture (DAR) to remove carbon dioxide from the atmosphere. The plant is located next to the Hellisheidi Geothermal Power Station some 13 miles from Hólmvað homes. (Google Maps) The plant cost $10-15M,[2] and started operations in 2021.

Climeworks states that the plant can capture 4000 tons of CO2 per year.[3] According to the US Environmental Protection Agency, the carbon captured equates to the emissions from about 870 cars.[4] Carbon dioxide emissions from all operations within the Icelandic economy were 5,244 kilotonnes in 2022.[5]

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[1] https://en.wikipedia.org/wiki/Orca_(carbon_capture_plant)
[2] https://www.bloomberg.com/news/features/2021-09-08/inside-the-world-s-largest-direct-carbon-capture-plant
[3] https://climeworks.com/subscriptions#:~:text=Direct%20air%20capture%20supports%20nature%20by%20scaling%20CO%E2%82%82%20removal&text=However%2C%20as%20land%20space%20is,the%20same%20land%20(source).
[4] https://www.theguardian.com/environment/2021/sep/09/worlds-biggest-plant-to-turn-carbon-dioxide-into-rock-opens-in-iceland-orca
[5] https://www.statice.is/publications/news-archive/environment/air-emission-account-updated-to-2022/#:~:text=CO2%20emissions%20from%20the%20economy%20increases%20by%2021%25%20between%202021%20and%202022&text=Preliminary%20figures%20suggest%20that%20carbon,when%20they%20were%204%2C328%20kilotonnes.

Thus, Orca is removing just under 0.08% of the total Islandic GHG emissions. Future plants may remove some of the remaining 99.92% of the greenhouse gases currently not being removed.

Hawai`i law requires that net emissions in the state be zero or less in 2045. If the state is still using fossil fuels in 2045, then a variety of local offsets is required, and DAR may be one of them. But incrementally adding greenhouse gases every year for the next two decades will incrementally or exponentially increase extreme weather events that will severely damage the local economy.

Prevention is superior to repair.

Mahalo

Henry Curtis
Executive Director

SB-2451
Submitted on: 1/27/2024 11:43:14 AM
Testimony for EET on 1/30/2024 1:01:00 PM

Submitted By	Organization	Testifier Position	Testify
Sunny Savage	Individual	Support	Written Testimony Only

Comments:

In support

SB-2451
Submitted on: 1/27/2024 2:37:24 PM
Testimony for EET on 1/30/2024 1:01:00 PM

Submitted By	Organization	Testifier Position	Testify
Victor K. Ramos	Individual	Oppose	Written Testimony Only

Comments:

I strongly oppose. Plant life thrives and converts CO2 into Oxygen. How is this bad?

SB-2451
Submitted on: 1/27/2024 9:32:32 PM
Testimony for EET on 1/30/2024 1:01:00 PM

Submitted By	Organization	Testifier Position	Testify
Andrew Crossland	Individual	Oppose	Written Testimony Only

Comments:

I **oppose** this Bill.

SB-2451
Submitted on: 1/28/2024 10:05:50 AM
Testimony for EET on 1/30/2024 1:01:00 PM

Submitted By	Organization	Testifier Position	Testify
Ben Robinson	Individual	Oppose	Written Testimony Only

Comments:

I understand the intent of this measure and do not discount carbon capture, but don't think Hawai'i is the best place for this or best use of funds at this time.

SB-2451
Submitted on: 1/28/2024 10:19:03 AM
Testimony for EET on 1/30/2024 1:01:00 PM

Submitted By	Organization	Testifier Position	Testify
Regina Gregory	Individual	Oppose	Written Testimony Only

Comments:

This technology will be expensive, requires energy, and requires underground storage sites.

SB-2451
Submitted on: 1/28/2024 3:21:12 PM
Testimony for EET on 1/30/2024 1:01:00 PM

Submitted By	Organization	Testifier Position	Testify
Keith Neal	Individual	Oppose	Written Testimony Only

Comments:

Aloha Chair DeCoite, Chair Gabbard, and members of the EET and AEN committees.

I oppose public policy that enables or funds atmospheric carbon capture. It is far better that public and private resources pursue renewable energies and emissions prevention. Once carbon is in the atmosphere it's too late. Furthermore, atmospheric carbon capture is expensive, resource and energy intensive. Atmospheric carbon capture technology is too nascent and too risky for Hawaii.

Far better Hawaii pursue polices that prevent carbon emissions in the first place.

Mahalo,

Keith Neal