These short feedback comments are provided in relation to the Carbon Management Discussion Draft (DD) of the 2024 IEMAC Annual Report: https://calepa.ca.gov/wp-content/uploads/sites/6/2025/01/Chapter-6-Carbon-Management-in-Californias-Cap-and-Trade-Program.pdf. Author: Sam Uden, Net-Zero California (sam@netzerocalifornia.org).

- Two key discussion points in the DD relate to how point-source carbon capture and storage (CCS) and carbon dioxide removal (CDR) should be treated under the cap-and-trade program.

    - *CCS*: It seems clear that CCS, performed in accordance with the SB 905 regulation, should be considered an eligible emissions reduction action for covered entities under the cap-and-trade program. It also seems, in general, unreasonable that a capture entity could be held liable for a potential storage reversal, and face penalties for this reversal under cap-and-trade. In most cases, the capture entity is likely to offtake its CO_2 for storage to a separate operator. As part of that agreement, the storage operator would be liable for the CO_2. Therefore, similar to a forest carbon offset, it seems that the storage operator should have to meet a certain standard, likely defined in SB 905, that makes state regulators comfortable that there are sufficient safeguards in place to account for a potential reversal. In other words, storage would be available to prospective capture entities on that basis.

    - *CDR*: The potential role of CDR under cap-and-trade is uncertain and warrants further discussion. In peer-reviewed research, CDR is generally envisaged as compensating for “residual emissions” that are hard to eliminate from an economy on a midcentury timescale. The definition of “residual emissions” is subject to debate and will change across economies. In general, though, it is expected to include sources that are not currently covered by cap-and-trade (e.g. agriculture) and sources that may be covered by cap-and-trade (e.g. some industrial). As the DD notes, California may require large amounts of CDR to meet the AB 1279 mandate.

      To the extent that CDR is incorporated under cap-and-trade, such as in the form of a new “DAC protocol”, with presumably the main motivation being to create an additional incentive for CDR, it should be distinguished from conventional offsets. This is because CDR is meant to serve a different purpose than cost-containment for covered entities. The fact that CDR is, at present, so expensive, means it is unlikely to crowd-out achievable point-source emissions reductions.

      In an ideal setting, CDR would have its own separate inventory and strategic plan. In that scenario, cap-and-trade would be one policy, amongst many others, that are geared towards achieving the goal of 85% emissions reductions by 2045. Then, separately, there would be a set of new policies and programs geared towards achieving the goal of 15% carbon dioxide removal by 2045. To the extent certain covered cap-and-trade sources are deemed “residual emissions”, then those covered entities could purchase CDR to zero-out their

obligations by 2045. It is anticipated that CDR will become substantially cheaper in the coming decades.

This does not solve the near-term issue, though, which is: how does the state pay for, and scale, CDR over time? This is where, as a matter of practice, there may need to be some blending, whereby “emissions reduction” programs such as cap-and-trade and the Low Carbon Fuel Standard are leveraged to help pay for CDR.

One option could be to require cap-and-trade covered entities to pay an additional amount, on top of their current obligations, that would go directly towards the procurement of CDR. This would be an additional obligation and not be the same as a “DAC protocol”, contemplated above, which could be available to covered entities but is unlikely to be adopted to address residual emissions in the near- or even medium-term. A potential challenge with this mechanism, though, is that it could result in the leakage of covered sources that face competition from other states.

Another option would be to leverage GGRF revenues to support CDR procurement. This could be a cleaner strategy in that it would reduce, or even avoid, the blending of CDR into the cap-and-trade program. It would also reduce the burden to seek public funding for CDR. The GGRF mechanism could be cost-effective to the extent it is leveraged to ‘gap fill’ needed revenues only. That is, applicants could be required to obtain 45Q and LCFS incentives, and then the GGRF revenues could be deployed on a $/ton basis to bridge the gap. Although this revenue source would decline over time (as the state’s emissions decline), by that point in the future the goal is that CDR will be substantially lower-cost. At that stage there could also be more public support for CDR, which will require long-term (i.e. the year 2100+) deployment in order to help return global temperature back towards pre-industrial levels.

- Biomass: The role of biomass under cap-and-trade is not discussed in the DD, although it may be relevant for consideration. As background, California’s anthropogenic inventory accounts for, but does not include, biogenic emissions, on the basis that these emissions are a part of the ‘short’ carbon cycle and are carbon neutral. This assumption was established at the outset of AB 32 and has been consistent with other countries. However, due to establishing a new net-zero mandate, the state now maintains a Natural and Working Lands inventory to determine the annual carbon storage of the lands sector. This creates a potential double-counting issue, to the extent the anthropogenic inventory continues to assume biogenic emissions, such as bioenergy, are carbon neutral. The result is that arguably bioenergy should become a covered source under the cap-and-trade program.

  This is a difficult prospect to consider, given these entities have to date been exempt from cap-and-trade. There is also a need to substantially expand non-combustion biomass technologies, such as biomass-hydrogen, biomass-SAF and biomass-carbon removal, based upon the 2022 Scoping Plan. The state’s greenhouse gas inventory

identifies 50 Mt/yr of biogenic emissions in 2022, which would increase the anthropogenic inventory by roughly 15%. It may not be reasonable to just expand the state's inventory, given it is a product of accounting changes, and the state has followed recommended IPCC standards from the outset. Stakeholders should assess this potential issue in more detail, including the extent of the accounting overlap across the NWLs and anthropogenic inventories, and to the extent it is still shown to be an issue, discuss how to address it in a reasonable way.

- Business models: The DD contemplates the role of major existing programs, such as cap-and-trade, for enabling carbon management in California. It is possible, and indeed it may be optimal, that California look to adopt new programs outside of a carbon market paradigm to drive CCS and CDR. For example, in contrast to an incentive-based 45Q/LCFS approach, the UK has adopted a "business models" approach to deploy CCS and CDR. Specifically, it has established a regulated utility model for carbon transport and storage infrastructure. This is similar to the way transmission and distribution infrastructure is regulated in the power sector. It has adopted other business models for carbon capture and removal pathways. It may be worth highlighting this option in the Annual Report. For more information, see: https://www.netzerocalifornia.org/blog/the-challenges-of-carbon-capture-and-storage-in-california-commercial-frameworks.

- Minor points:

    - Page 1 separates CCS from CDR. This convention makes it difficult to categorize strategies like BECCS, which is not an emission reduction but is point-source capture. A diagram could potentially help here.

    - Page 2 summarizes the 2022 Scoping Plan. It is worth clarifying that the 75 Mt is for technological CDR only, and not nature-based CDR, which is found to have a limited potential for CDR in California on a 2045 time-scale. (It is important to provide meaningful investment into nature-based solutions, though, to *avoid* emissions that would otherwise undermine the state's 2030 and 2045 climate goals, as well as to provide greater resilience to natural disasters, such as wildfire.).

    - Page 2 states that the Scoping Plan assumes that technological CDR has no net energy consumption. The Scoping Plan does make an assumption of 64 GW of behind-the-meter solar to deliver 66 Mt of DAC in 2045. However, it is unclear if this also includes transport and storage energy needs.

    - Footnote 14 suggests that BECCS could be considered an emissions reduction vs. removal. This is not the approach adopted by the IPCC and in peer-reviewed literature, which determines BECCS pathways as a removal. (BECCS could result in net lifecycle emissions, but this typically depends on scenarios of energy crops. California's in-state biomass accumulation is almost, if not completely, in the form of waste. See: https://gs.llnl.gov/sites/gs/files/2021-08/getting_to_neutral.pdf).