March 28, 2025

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TO: California Air Resources Board
FR: Leilac, U.S., Inc.
RE: Public Workshop on Carbon Capture, Removal, Utilization, and Storage Program

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Leilac thanks the California Air Resources Board (CARB) for the opportunity to comment on its February 27th workshop on the planning and implementation considerations for the SB 905 program. Leilac aims to help CARB identify cost-effective, strategic pathways to reduce greenhouse gas emissions via carbon capture, removal, utilization, and storage (CCS) solutions, particularly for the cement and lime sectors.

Leilac aims to deliver a breakthrough decarbonization technology for the cement and lime industries. Unlike conventional carbon capture technologies that require an additional, energy intensive process to separate gases from gases, Leilac employs a "process modification" to cement and lime production to efficiently capture unavoidable process emissions. This modification simply prevents CO_2 emissions released from the raw material from being contaminated by exhaust gases and air, thereby enabling their capture as high-purity CO_2, without additional chemicals or solvents and for minimal energy penalty. It is also energy agnostic and fully compatible with alternative and clean fuels, including electrification.

Leilac is supportive of the steps California is taking to decarbonize its industrial and other hard-to-abate processes and appreciates the opportunity CARB is providing to coordinate with companies and other stakeholders through these workshops. Leilac encourages the agency to consider and implement strategies and targets that include consideration of emerging and innovative technologies with potential to significantly decarbonize the cement and lime sectors.

Leilac welcomes the chance to participate in additional conversations with the agency and all interested parties on this crucial topic to provide further information about our solutions and answer any questions that may arise.

Dr. Michael Walsh
GM, Corporate Affairs
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Permit and Project Portal

1. Considering it's voluntary to use, what features of the permit portal would increase the likelihood the portal is used by both project developers and permitting agencies?

Cost and knowledge sharing of large demonstration and/or near commercial units would be of substantial benefit. This is an approach Leilac has successfully implemented in Europe through the European Union-funded Leilac-1 and Leilac-2 projects, each of which involved a consortium of partners from industry, research institutes, and academia. As well as derisking early-stage projects, a consortium-based approach promotes knowledge sharing and the development of industry-wide solutions that all project developers can utilize.

4. Are there examples of existing public CCUS project databases that we should look to and/or emulate for public reporting on project deployment?

CARB should consider designing a database that allows CCUS technology to be identified by the manufacturer, including deployments across the globe. This step will help demonstrate the commercial availability and reliability of different technology options. By collecting and publishing this information, industry would be well equipped to identify technologies that have been deployed by industry. The system should also contain features to allow users to filter and sort by capture rates, local emissions, energy use, capture strategies (process vs. combustion emissions), carbon utilization strategies, etc. Developing a system that centralizes this information will also help increase public awareness of successful projects across the globe.

Examples of existing project databases for reference include:

- LeadIT's Green Cement Technology Tracker
- Mission Possible Partnership's Global Project Tracker for decarbonizing heavy-emitting industry and transport sectors

Criteria and Toxics Monitoring

The development and deployment of carbon capture technologies that are low-cost and do not introduce new chemicals or pollutants to the facility or local community are critical for widespread industrial decarbonization at the speed needed to meet climate and environmental goals. While industry will require an all-of-the-above approach to decarbonization, it is important to ensure there are no negative local impacts that could harm communities and stall climate projects.

Public acceptance is also one of the greatest sources of risk for CCUS projects, spurred on by concerns and questions regarding the variety of types of CCUS proposed, their costs and

technical viability, the perception that CCUS is deployed to prolong the use of fossil fuels, and public health and safety.

Leilac encourages CARB to ensure community benefits are embedded into every CCUS project to support broad public acceptance, including significant wealth creation and sharing with local economies. Additionally, embedding local community considerations into decarbonization projects can also help to deliver environmental and health benefits. When community benefits are considered as part of a holistic assessment of a project's merits, the chosen technical solution can deliver benefits beyond reducing greenhouse gas emissions.

For example, switching industrial heat sources from coal to renewably generated electricity can deliver improved air quality to the neighboring communities. Similarly, carbon capture projects that do not carry a real risk of negative local environmental or health impacts through the release of chemicals to the environment should be prioritized.

2. What specific criteria pollutants or toxics emissions should be prioritized for monitoring and where along CCUS/CDR project (i.e. capture, transport, injection/utilization)?

For all CCS and CDR projects with permanent sequestration goals, long-term monitoring of CO_2 storage and monitoring throughout the transportation process is important. Additionally, Leilac encourages CARB to implement measures to limit and monitor potential emissions at the point of capture. For conventional post-combustion capture technologies that employ amines as a solvent, the formation of nitrosamines emissions should be carefully monitored. Cryogenic capture solutions that involve freezing a mixed flue gas stream may create new sources of wastewater. Contaminants such as SO_x, NO_x, NH_3 and NH_4, CO_3, Ca, Mg, Na, and Cl, in both wastewater and air should be carefully monitored, along with other criteria pollutants and toxics that may present potential risk factors from some CCS solutions. Overall, Leilac encourages CARB to consider and implement safety measures and checks across the entire CCUS value chain.

4. Are there examples of existing regulatory monitoring efforts being conducted in other sectors/sources that may be instructive for SB 905?

The Scottish Environment Protection Agency (SEPA) introduced a maximum ambient air limit of just 10ng/m3 to prevent harm to local populations. A SEPA survey recently measured N-Nitrosodimethylamine (NDMA) and N-Nitrosodimethylamine (NDEA) emissions through 'slip' at various amine pilot plants, and recorded concentrations of up to 4.0mg/m3, a thousandfold breach of suggested ambient air limits.[1] Regulatory monitoring efforts, and data transparency, are essential to CCS programs.

[1] Scottish Environment Protection Agency: Review of amine emissions from carbon capture systems (pp.7-8)

Q&A Session

What are some market opportunities that CARB or the State of California should consider to help increase demand for CCS and CDR?

Leilac is encouraged by CARB's consideration of demand drivers for CCS and CDR solutions, as the adoption of new technologies and/or alternatives to traditional manufacturing processes represents a business risk for industrial facilities such as cement plants. One of the primary limiting factors facing the deployment of decarbonization technologies for U.S. industry is the lack of appropriate, industry-wide (i.e., non-competitive) incentives or penalties. While tax credits and other incentives provide significant and welcome upside for prospective decarbonization projects, they do not force adoption in the way a carbon price or emissions trading scheme would.

Tax credits, grant programs, and related forms of financial backing can be used to minimize – at least for a few early movers –associated risks and performance issues with both new technologies and new business cases. Full chain, integrated, multi-actor CCS developments are complex; factors for consideration include offtake agreements, timing and dependencies of the separate capture, transport, and storage developments, and financing of the relevant components.

In the absence of a carbon price or other regulatory measures that drive action in risk-averse, low-margin industries, downside cushioning to help derisk new technology adoption is essential. Given the complexity of many industrial decarbonization solutions, producers may understandably be reluctant to take a risk that could disrupt their production or impact their competitiveness. Upside incentives can be balanced by downside cushioning mechanisms that help derisk technology adoption and promote the establishment of first-of-a-kind projects. Mechanisms that CARB and the State of California could consider include production insurance schemes or similar guarantees of support. Procurement mandates to create real demand for low-carbon products would create an investable and bankable project that financial institutions would then be more willing to fund in the absence of grants, tax credits, or other such tools. Demand mechanisms will help to protect producers from the potential economic risks of adoption of new technology.

Additional Recommendations

Leilac encourages CARB in its implementation of SB 905 to promote and incentivize CO_2 avoidance equally with CO_2 capture. For example, while highly supportive of developing CCUS projects, the incentive available under the U.S. federal Section 45Q tax credit promotes capture of CO_2, rather than avoidance. For cement plants that require CCUS to abate their process emissions, this risks also locking in CCUS as the only solution for fuel emissions. Similar incentives to switch to low carbon fuels and avoid fuel-related emissions should be available to help promote flexible decarbonization pathways and ultimately lowest cost emissions avoidance.

Leilac also encourages CARB and the State of California to consider strongly supporting transport and storage considerations for industrial decarbonization and other carbon

capture projects. Supporting the full value chain of CCUS deployment is essential to project viability.

The Agency could take several approaches to supporting methods for disposition and sequestration/utilization of CO_2. Funding, permitting support, and other enabling solutions for CO_2 management infrastructure buildout would be highly beneficial. For more rapid deployment of projects in California, options for non-pipeline transport of CO_2 are available and viable today (e.g., rail or trucking), but will also require government support to meet costs.

Another tactic CARB and/or the State could consider would be capping the cost exposure of industrial decarbonization projects to transport and storage of CO_2, particularly those targeting hard-to-abate process emissions. To help reduce risks and drive adoption of CCUS, particularly for process emissions, and to promote industry-wide access to solutions, California could consider funding support that limits the exposure of individual projects or companies to highly variable costs associated with carbon management. As opposed to large-scale funding for selected individual projects, a cap on carbon transport and storage costs would promote equitable adoption of solutions, and derisk projects by removing a significant source of uncertainty and variability.