Before the California Air Resource Board
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Thank you for this opportunity to comment on the development of the Quantification Methodology for CCS projects in California. Clean Air Task Force is a nonprofit environmental organization with offices in the U.S. and in China. CATF works to help safeguard against the worst impacts of climate change by catalyzing the rapid global development and deployment of low carbon energy through research and analysis, public advocacy leadership, and partnership with the private sector. For more information, please visit www.catf.us.

Carbon capture and storage (CCS) is a necessary technology for decarbonizing the fossil electric sector in order to mitigate the worst impacts of climate change. In order for CCS to effectively demonstrate the real and quantifiable permanent carbon emissions reductions it has the potential to achieve, storage projects must meet robust but cost–effective and achievable operational standards.

My comments briefly summarize our views on the fundamentals of a rigorous but pragmatic approach to monitoring, reporting and verification (MRV) that can form the cornerstone of California's Quantitative Methodology, meeting the specific needs of California CCS projects, while at the same time satisfying the Federal Greenhouse Gas Reporting Rules, Subpart RR, which is a condition for fossil-fueled power plants under U.S. EPA's carbon dioxide new source performance standards and eventually also the Clean Power Plan for retrofit CCS projects. We look forward to working with ARB in the development of the Quantitative Methodology.

An effective MRV will identify and address identified risk, rather than take a “kitchen sink” approach to carbon surveillance and quantification that could pose unnecessary barriers to commercialization of CCS technology. As an example, while surface soil gas monitoring arrays may give the public confidence, research suggests that identification and quantification of leakage outside of the noise of seasonal soil variability may be nearly impossible at the surface, and moreover, by the time a leak is identified, it could be late to remediate. Instead, ARB should develop and adopt an effective surveillance methodology based on the characteristics of each site aiming to identify deviations from expected subsurface CO2 behavior that pose increased leakage risk early. Deviations should trigger attendant remediation steps, if needed, and a practical approach to quantification of any atmospheric leakage.

In developing its methodology, California should give consideration to the differing needs of CO2 storage in saline brines, depleted oil fields (including incidental storage during and storage subsequent to production), and in related stacked saline formations. While there will be many common elements to MRV plans in saline and depleted oil field settings, risk elements will require different approaches. For example, storage in saline formations will generally be accompanied by less subsurface knowledge, and lack pressure management (unless specifically planned for) and therefore have very different requirements than a MRV plan in an oil field, with well known geology and inherent pressure management through production, but commonly legacy well leakage risk in older fields. MRV programs should focus first on site screening and assessment and attendant development of a risk model which then focuses monitoring resources where there is greatest potential for storage failure, accompanied by a plan of action if monitoring suggests unexpected behavior of the subsurface CO2 that could lead to leakage if unaddressed.

In short, the essential components of secure storage in California's methodology must include:

1. **Site Selection and Screening.** Selecting an appropriate site—whether it be a saline brine aquifer or a depleted oil field-- is a key step toward *prevention* of leakage. For a variety of reasons, not all sites will be appropriate for subsurface storage. Therefore, operators should demonstrate a knowledge of the subsurface, risk factors and the predicted behavior of injected CO2 in the potentially impacted storage volume. Leakage risks will vary with location, storage type, knowledge of the subsurface and prior history of the resource. Risk factors may include induced seismicity potential, nearby environmental sensitivity, water resources, legacy wells, fractured caprock or monitoring being infeasible.
2. **Identify an Area of Study and Surveillance.** The area/ subsurface volume for subsurface characterization, risk analysis, and monitoring, prior to approval of a project should be established based on reservoir knowledge, predicted subsurface CO2 behavior and risk factors, rather than the presumptive radius prescribed in the UIC Class II rules, and updated as new data suggests is necessary in order to protect air and groundwater resources.
3. **Well integrity.** Identification and evaluation of legacy wells, robust well construction requirements, and routine mechanical integrity testing are, perhaps, the most essential components of secure storage in depleted oil fields. The plan should include surveillance of wells that have been plugged and abandoned for subsurface blow outs at horizons above the injection zone.
4. **Monitoring.** Surveillance of geologic resources and surface operations for evidence of unexpected behavior of injected CO2 that poses risk based on a

specification—i.e. adverse CO_2 migration/leakage at a given horizon which could be monitored, for example, "above zone." Monitoring should not be "kitchen sink," but, instead, targeted at vulnerabilities and accompanied by action steps that would be triggered in the event of unexpected CO_2 behavior resulting in higher risk of leakage to the atmosphere or to water resources. In the event of leakage to the atmosphere, injection should be suspended until the leakage is contained and source of leakage repaired/remediated.

5. **Quantification of Storage.** Accounting for the quantity of CO_2 remaining in the subsurface has been addressed in several efforts (See, e.g., the Pew (C2ES) quantitative methodology at http://www.c2es.org/docUploads/CCS-framework.pdf). Quantitative storage assessment is also partly addressed in EPA's Greenhouse Gas Reporting Rules Subpart RR. The tricky step is the quantification of leakage— the CO_2 actually reaching the atmosphere. Leakage estimates should take an approach that is pragmatic given the difficulties of measuring subsurface CO_2 flux. One solution would be to estimate and subtract a "maximum expected loss" of CO_2 from storage to the atmosphere from the net injected and creditable CO_2.
6. **Well closure requirements.** Injection wells must be robustly plugged and abandoned and the wells and subsurface CO_2 plume monitored post-injection until there is confidence that CO_2 is not expected to migrate so as to pose a leakage risk.

Thank you for this opportunity to present our views. Clean Air Task Force looks forward to working with ARB as a helpful resource as it develops its Quantitative Methodology.