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Senate Committee on Environmental Quality
Hearing on California's Climate Change Policies
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Chairman Allen, Vice Chair Bates, and members of the committee, thank you for giving me this opportunity to share Lawrence Livermore National Lab's insights into technologies that we believe California needs to pursue to reach the State's carbon goals. My name is Steve Bohlen, and I lead the Energy and Homeland Security Program at the Lawrence Livermore. Also, I am pleased to be testifying in front of this committee under considerably more positive circumstances than my previous meetings with you a few years ago when I was the State Oil and Gas Supervisor and the head of the Division of Oil, Gas and Geothermal Resources at a time of renewal, modern regulation development, and improvement of the agency's effectiveness.

California has made remarkable progress in using energy more efficiently, tapping renewable sources and getting electric vehicles on the road. But even with the most aggressive application of low-carbon technologies we can imagine, by 2045 the world will still be emitting far too much CO2 into the atmosphere. If the State is to achieve its goals in the next three decades and beyond, the State must seriously consider ways to remove CO2 from the atmosphere. This will almost certainly require some so-called negative emissions, even under more aggressive mitigations scenarios than we know and love today.

SB100 mandates that the state be powered by zero-carbon electricity by 2045. As challenging as this may seem, the path to a carbon-free electrical grid via renewables, storage, and carbon negative biogas, could allow attainment of the State's goals, both for 2030 and 2045. However, one area that deserves more attention is the security of the state's electric grid.

The challenge of a secure and carbon-free electric grid by 2045 pales in comparison with that of decarbonizing our transportation system by 2045. If the emissions from oil and gas production and refining are combined with the emissions from light- to heavy-duty vehicles, today fully half of the state's annual emissions of 450 MMT, come from transportation. There are nearly 25 million registered vehicles in the state, all of which are small, moving point sources of emissions.

Even by very optimistic projections, the use of gasoline and diesel fuel will be the prevailing transportation fuels in the state for most, if not all, of the next 25 years. This could change if there were a breakthrough in the weight, energy density, and cost of batteries or in fuel cells in the near term. But given the half-life of the automobile fleet in California of roughly 15 years, the state cannot rely solely on the rapid adoption of electric vehicles to address this huge emissions legacy. A more diverse set of approaches will be needed. Most important from a scientific perspective is to embrace the reality that there are no silver bullets or perfect solutions to the transportation emissions challenge.

Fortunately, the state has had the foresight to provide significant financial mechanisms for incentivizing new approaches to managing the carbon from transportation emissions via the Low Carbon Fuel Standard and the market that supports it. Currently the price of a LCFS credit is above $180 per ton of carbon eliminated from the transportation fuel system. This financial incentive is significant and may provide many decarbonization opportunities. However, even with the incentives, many challenges remain.

Our analysis, as well as those of others', suggests that the state needs to securely dispose of some of its current emissions, along with some CO2 from the atmosphere, deep underground, something commonly referred to as carbon capture and storage. Despite its low profile, the technology is mature and ready to be deployed widely today and holds significant unrealized potential to manage carbon emissions as a transition to a CO2-free economy. Today, 16 large-scale integrated CCS projects operate worldwide, and with six more planned, 22 will be operating by 2020. A broad suite of robust tools exists to predict and monitor injection of CO2 into geologic reservoirs and to manage any risks, including that of induced seismicity. Hence the technological stage has been set for the state to remove some of its transportation emissions by capturing CO2 from refineries, ethanol plants or directly from the air and sequester it securely underground.

In sequestering excess carbon deep underground, the state has the opportunity to transform its oil industry from a significant carbon emitting industry to carbon eliminating industry. Doing so could leverage the significant pool of nearly 150,00 high-paying, oil-industry jobs for the purpose of decarbonization. The oil industry's essential expertise in underground CO2 injection combined with the state's brand new and meticulous regulations approved recently by the Air Board that govern injection is the perfect combination for safe and secure carbon disposal.

CCS provides a mechanism to transform a carbon-intensive industry, preserve Central Valley jobs, and manage a portion of the state's transportation emissions. The state is blessed with excellent geology and studies indicate that the state's depleted hydrocarbon reservoirs alone could sequester over 2 billion tons of CO2 – twenty years at 50 million tons of CO2 per year. Fifty million tons a year is not a random number – it represents the carbon emissions of the production and burning of the petroleum produced in the state. Hence a near term goal could be for the state to make its own oil industry carbon neutral.

To reach this goal however, the incentives provided by the LCFS are not likely to be sufficient on their own. To grow a viable CO2 storage industry, the state needs to assess the regulatory path, and align and streamline the permitting requirements by the Air Resources Board, Division of Oil and Gas, State and Regional Water Boards, State Lands Commission, Air Districts, Counties and others. Even with a financial incentive provided by the LCFS, the perceived high regulatory risk and a several years uncertain slog through the permitting maze may prevent the building of much-needed projects.

50 million tons per year is, however, only 25% of the solution, though in itself a significant challenge. Sequestering the other 75% will require CCS beyond 50 million tons a year plus other solutions such as more rapid development of technologies for storage of carbon in soils. There is huge potential of agricultural soils for long-term carbon storage. For example, estimates indicate that return of the soil carbon of the agricultural soils of the state of Iowa to pre-Dust Bowl levels could sequester over 100 billion tons of carbon. This suggests that the agricultural soils of California also have promise for similar levels of storage. However, our scientific understanding and viable pathways for storage in soils are embryonic compared with CCS, and much work remains in this area. The state cannot afford to ignore it.

There are other emerging technologies – for example, pyrolytic conversion of forest waste to biofuels, direct air capture of CO2 and catalytic conversion of the CO2 to useful products including transportation fuels. All of these are making progress but are far from ready to address immediate needs. The state must immediately take on a proactive role in promoting further research and demonstration projects of meaningful scale to buy down the risk of carbon overshoot for itself as well as globally.

In summary, we see CCS as a proven, viable technology to help the state in both the short and long the term to deal with industrial and transportation emissions, as well as a critical enabler for carbon-neutral or carbon-negative solutions. We also have reason to believe that geologic disposal may hold the key to reducing the emissions of criteria and toxic pollutants and much needed air quality improvements for communities at risk. The stark reality of climate change and the extreme urgency to reduce emissions in California and globally demand that we include CCS in our portfolio and take proactive steps to deploy it alongside the many other tools.

Again, my thanks for the opportunity to address the committee and I look forward to your questions.