MBSE SEMINAR SERIES

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CLSSRM 263

Getting to Neutral

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About Dr. Aines: Roger Aines is the Energy Program Chief Scientist in E Program, which conducts government and private sector research in clean energy technology. He holds a Bachelor of Arts degree in Chemistry from Carleton College, and Doctor of Philosophy in geochemistry from the California Institute of Technology.
Roger leads the Carbon Initiative at LLNL, which aims to understand, develop, and implement technologies for the removal of carbon dioxide from the atmosphere, so-called *negative emissions technologies.* He has been at LLNL since 1984 working on nuclear waste disposal, environmental remediation, application of stochastic methods to inversion and data fusion, management of carbon emissions including separation technology, and monitoring and verification methods for sequestration.

Abstract: We conducted a study to map out the ways in which California can achieve its mid-century carbon neutrality climate goal by supplementing emissions reductions with negative emissions, including natural and technological pathways. We found that 125 million tons of true negative emissions can readily be achieved through a mix of natural, biomass conversion, and direct air capture approaches and that, under the best circumstances, the total system cost could be less than $10B in 2045, which is about 0.2% of California's projected GDP in that year. Natural solutions can provide about 14 million tons per year at an average cost of $48/ton. Biomass-to-fuel with CO2 process capture can provide 80 million tons per year at an average of $54/ton (mostly using human-generated waste and waste biomass to produce valuable hydrogen, which offsets much of the cost). Geologic storage of more than 100 million tons of CO2 per year will be required; we have evaluated the geology in California's oil fields and similar saline aquifer areas to identify more than 17 billion tons of available, safe storage that meets all regulatory and safety requirements.
The relatively low total system costs we observe are due to extensive use of natural solutions and biomass-based CO2collection, coupled with revenue generation from the production of valuable fuels (particularly H2 – liquid fuels cost slightly more as they are not carbon-free), and the relatively easy compressed CO2 transportation problems presented by California's rich endowment of good geologic storage sites.

Zoom link: https://ucmerced.zoom.us/j/84771125941