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RENEWABLE AND SUSTAINABLE ENERGY INSTITUTE

# BIG energy seminar series

Addressing global energy challenges in scale and complexity.

## *Environmental Carbon Dioxide Removal - An Electrifying Tale*


## *T. Alan Hatton*

***Ralph Landau Professor and Director of the David H. Koch School of Chemical Engineering Practice at the Massachusetts Institute of Technology***


Date: Tuesday April 18$^{TH}$, 1:30 PM-3:00 PM
Location: SEEC Building, C120


**Abstract:** **It is now well-established that reliance on fossil fuels for our energy needs is having a devastating effect on global climate patterns and our eco system. We can no longer rely simply on accelerated use of renewable energy resources to replace fossil fuels to avert this crisis, which is caused by the continuing atmospheric accumulation of $CO_2$ from industrial emissions; we must also deploy Negative Emissions Technologies (NETs) in which accumulated heat-trapping $CO_2$ is removed directly from the ambient environment itself. Indeed, there has been a recent surge of interest in exploiting direct air capture (DAC) for this purpose, a surge that has not yet been matched by a similar drive to reduce $CO_2$ in oceans, where increasing acidification has led to destruction of coral reefs, and reduced carbonate ion concentrations harm shellfish and other marine life. Since the total $CO_2$ accumulation rate by oceans rivals that in the atmosphere, effective means its removal from seawaters could augment the other NETs to reduce the environmental burden imposed by this greenhouse gas.**

**Traditional approaches for $CO_2$ capture and release generally rely on either chemical or physical interactions with sorbents with subsequent temperature or pressure changes to release the captured $CO_2$ and regenerate the sorbent. Isothermal operations that obviate or significantly reduce the heat integration requirements in these processes could potentially have significant advantages over the traditional methods in terms of complexity, energetics, and cost of the overall capture operation. Electrochemically based technologies that rely primarily on renewable energy resources for the capture and release of $CO_2$ under isothermal conditions may, therefore, offer effective alternative approaches for both point-of-use gas emissions mitigation, and for removal of $CO_2$ from the atmosphere and ocean waters. In this presentation, we will discuss the general principles underlying electrochemical processes, and the opportunities and challenges inherent in their implementation to address the pressing problems facing our world today (and tomorrow!).**


**Bio:** **T. Alan Hatton is the Ralph Landau Professor and Director of the David H. Koch School of Chemical Engineering Practice at the Massachusetts Institute of Technology. He obtained his BSc and MSc degrees in Chemical Engineering at the University of Natal, Durban, South Africa, and worked at the Council for Scientific and Industrial Research in Pretoria for three years before attending the University of Wisconsin, Madison, to obtain his PhD. He is currently Faculty Lead on Carbon Management in the Future Energy Systems Center of the MIT Energy Initiative. His research interests have encompassed self-assembly of surfactants and block copolymers, synthesis and functionalization of magnetic nanoparticles, and the exploitation of these stimuli-responsive materials for chemical, environmental and pharmaceutical processing applications. More recently, his group has pioneered a number of electrochemically mediated operations for water treatment and resource recovery, as well as for carbon dioxide removal from point sources, ambient air, and ocean waters. In addition, his laboratory has spun out two start-up companies: Verdox (2019), which is developing electrochemical swing processes for $CO_2$ capture from point sources and ambient air, was recently awarded a $1 million Elon Musk XPrize, while Mantel Capture (2022) is focused on exploiting molten salts for $CO_2$ capture at the high temperatures at which it is produced in many chemical industries.**

Link to campus map for SEEC Building


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