Electrochemically Mediated Separation for Carbon Capture and Mitigation

T. Alan Hatton[1], Howard J. Herzog[2], Fritz Simeon[1], Thomas Hammer[3], Harald Landes[3]

[1]Department of Chemical Engineering, **Massachusetts Institute of Technology**, 77 Massachusetts Avenue, Cambridge, MA02139.
[2]MIT Energy Initiative, **Massachusetts Institute of Technology**, 77 Massachusetts Avenue, Cambridge, MA02139.
[3]**Siemens AG**, Corporate Research & Technology, CT T DE HW4, Günther-Scharowsky-Str. 1, 91058 Erlangen, Germany.

Technology Summary

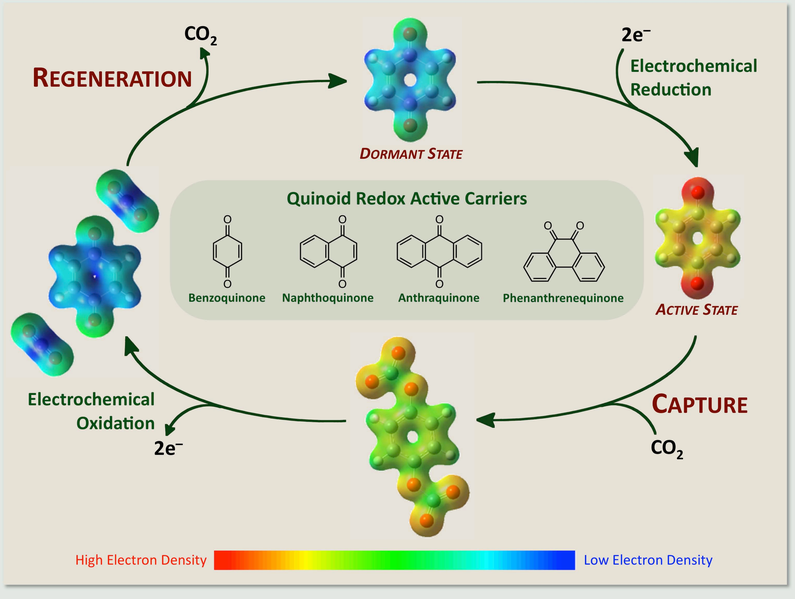
Electrochemically mediated separation (ECMS) processes are to be developed and assessed for post-combustion CO_2 capture at coal-fired power generators.

Significant changes in the binding affinity of robust redox-active carriers with the desired selectivity and capacity for CO_2 on changes in their redox state will be exploited.

Electrical energy is to be utilized to facilitate effective CO_2 capture under more benign, isothermal conditions of sorption and desorption than in traditional continuous chemical-scrubbing operations.

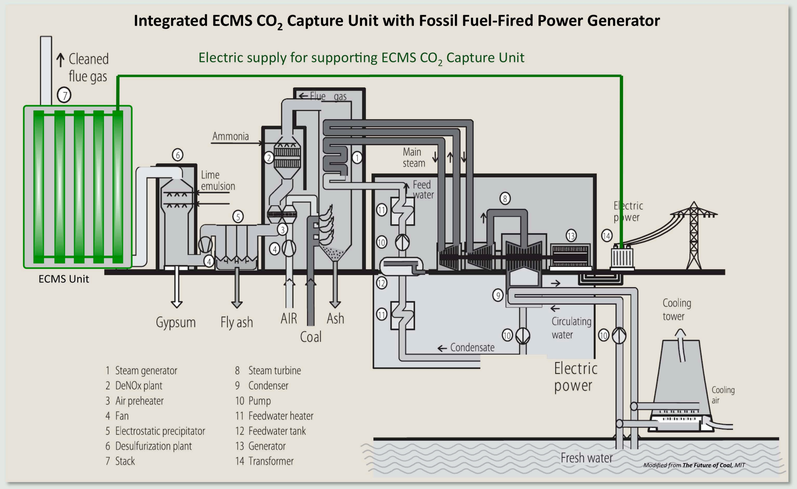
The project will entail molecular modeling and experimental optimization of carrier structure, fabrication and evaluation of prototype separation units, and techno-economic evaluation of this potentially transformative technology for carbon mitigation at coal-fired power plants and other carbon emitters.

Chemistry of Redox Active Carriers



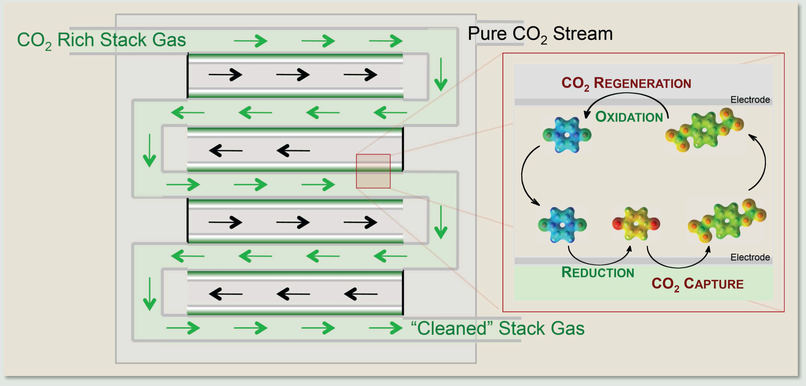
Technological Impact

The potential impact of this technology, compared to today's post-combustion capture processes, is to increase energy efficiency, to ease the task of retrofitting CO_2 capture systems at fossil fuel-fired power generators, and to widen the application to other industrial carbon emitters.



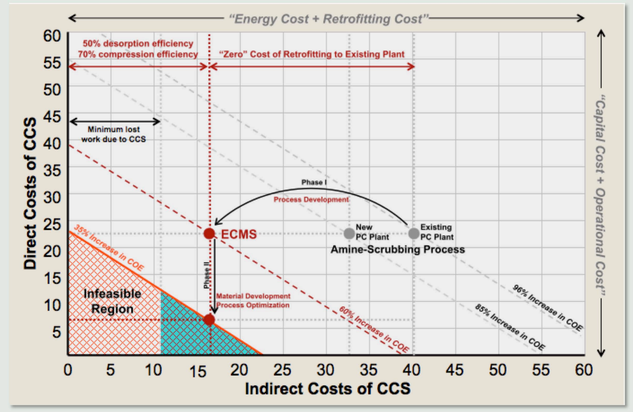
ECMS Capture Unit

Isothermal electrochemically-modulated CO_2 capture system using quinoid-based redox active carrier.



Economical Impact

Estimates of Cost of Electricity (COE) increases of 35%, \$31/tonne CO_2 avoided compare favorably with baseline amine processes, which have COE increases of 86% and \$78/tonne CO_2 avoided.



ECMS Program Summary

Key Milestones & Deliverables

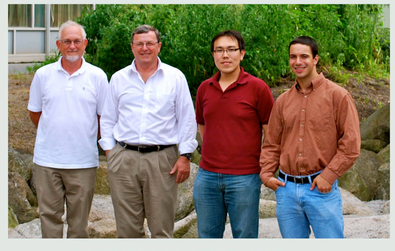
Year 1

- Synthesis and optimization of carriers
- Initial ECMS CO_2 cell design/construction
- Computer simulation of ECMS cell

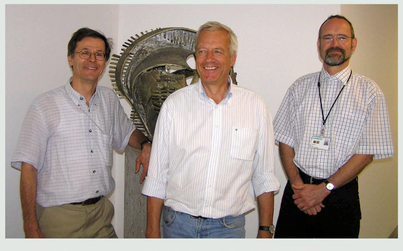
Year 2

- Prototype ECMS CO_2 cell tests
- Techno-economic assessment of ECMS
- Cycle analysis of ECMS system

MIT-Siemens ECMS Project Team



MIT ECMS ARPA-E Team



Siemens ECMS ARPA-E Team

Organizations:

Massachusetts Institute of Technology

SIEMENS

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