Introduction to CO_2 Capture

The generation of carbon dioxide is a direct consequence of extracting the maximum energy possible from fossil fuels. However, emissions of CO_2 to the atmosphere can be avoided by returning the carbon to the lithosphere. At sufficient purity, CO_2 can be injected into the subsurface for permanent storage (see section 2.5 of this report). However, because fuel conversion requires oxygen from the environment, at least one chemical separation must be performed to achieve the CO_2 purity required.

Carbon dioxide capture and separation is a costly and inefficient process using present day technology. At thermodynamic efficiencies of 15% - 25%, these unit operations can consume 10% - 20% of a power plant's output, and their use is predicted to raise electricity generation costs by 50 to 100%. There is significant opportunity to exploit fundamental advances in chemistry and engineering to drive down the operational penalties that CO_2 capture imposes on power production.

GCEP has two projects in the area of carbon capture and separation and are in subcontract negotiations for two others at external institutions. The project in Japan is an extension of funding to allow the researchers to make further progress following on from their previous work. And the project at Stanford is newly awarded as of March 2012.

A team of scientists at The Research Institute of Innovative Technologies for the Earth (RITE) is developing CO_2-selective membranes. By engineering the chemistry and morphology of such membranes at the nanoscale, the group has made significant improvements to membrane performance. The technology described in the report uses a novel and effective supercritical CO_2 directing method.

A multi-disciplinary team lead by Jennifer Wilcox at Stanford is involved in the “Surface Functionalization of Mesoporous Silica-Based Sorbents for Capture”. This newly awarded work involves researchers from the departments of Energy Resources Engineering, Chemistry and Chemical Engineering. The researchers plan to develop high surface area carbon-based materials that have been functionalized with model complexes of carbonic anhydrases.