# 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 today's 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 over 30%. 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 many more in carbon storage, again, see section 2.5):

Researchers at the Energy Center of the Netherlands (ECN, section 2.4.2) and Technical University of Delft (TU-Delft, section 2.4.3) are designing a combination of membranes, reactors and catalysts to form a membrane-reactor system. An integrated approach to carbon conversion and chemical separation may have both efficiency and cost advantages over separate unit operations.

Yuichi Fujioka is leading a team of scientists at The Research Institute of Innovative Technologies for the Earth (RITE) in 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.