Introduction to Exploratory Projects

In addition to deep research into high-risk, high-impact fundamental science and technology research, GCEP also funds smaller exploratory efforts. These exploratory projects can be funded for up to one year, and have budget limits of up to $100,000 each. The goal of these projects is to quickly evaluate the feasibility of a novel concept. If such an investigation proves successful, the investigators may apply for regular GCEP funding.

In 2006, three exploratory efforts were completed: Advanced Thermionic Energy Converters, Zero-Emissions Coal Power Plants, and Carbon Nanotube Networks for Transparent Conducting Electrodes.

This year, five more ideas are being investigated under the GCEP exploratory grant system.

Professor Mark Cappelli is determining whether the performance of PEM fuel cells can be enhanced by addition of plasma to the gas streams. While ionizing the fuel and air streams will require some energy input, the efficiency gains that might be achieved through plasma activation might offset the cost. This is especially true at high loads, where the losses are greatest.

The efficiency limits for single-bandgap solar cells could be surpassed using Multi-Electron Generation (MEG). MEG has been demonstrated in quantum dots and nanoparticles, but Professor Yi Cui is attempting to demonstrate MEG in nanowires. Nanowire MEG solar cells could enable entirely new architectures for capturing energy from sunlight.

Professor Fritz Prinz is evaluating solid-state materials that could act as electrolytes and could contain redox pairs in a photoelectrochemical conversion device. If proven feasible, this concept would combine the best aspects of dye-sensitized solar cells and silicon solar cells in an ultra-thin package.

Indium-Tin Oxide (ITO) is generally used as the transparent conducting electrode on thin-film solar cells, but the scarcity of indium may be a major roadblock to large-scale deployment. Very thin films of zinc oxide could replace ITO, but only if the morphology of the ZnO is well-controlled. Professor Alberto Salleo is studying the deposition of films of ZnO nanowires, and then laser-annealing them to achieve the desired functionality.

Managed wetlands have the capacity to fix enormous amounts of carbon. Generally, this carbon is cycled back to the atmosphere via the standard growth and decomposition routes. Professor Scott Fendorf is investigating whether or not decomposition and methanogenesis pathways can be suppressed via a combination of inundation control and targeted fertilization, thereby drastically increasing the net uptake of carbon.