Introduction to Renewable Energy - Solar

The solar energy flow reaching the surface of the Earth is sufficiently large for solar energy to have the potential of becoming an important fraction of the future low GHG global energy portfolio.

Research in solar energy seeks to develop technologies to efficiently harvest solar radiation and convert it into electricity at sufficiently low cost for them to become competitive in the energy market and be deployed at a large scale. Thin-film solar cells are regarded as promising routes for low-cost energy conversion. Inorganic thin films are relatively mature technologies with record efficiencies above 15%. Organic solar cells are at an earlier stage of development with efficiencies currently ranging from ~6% for polymeric heterojunctions to 10% for dye-sensitized cells. Further research in thin-film technologies is required to enhance photon absorption and charge transport processes to increase the efficiency up to the thermodynamic limits.

Solar thermal technologies are appropriate for large-scale energy production and can be combined with thermal energy storage systems, allowing to address the issue of supply intermittency common to other renewable sources. The conversion of solar energy into chemical fuels, and particularly hydrogen, is another way of circumventing this limitation.

GCEP currently has two projects in solar energy and is in the process of selecting additional projects that will start in the current of this year.

Professor McGehee is developing nanostructured photovoltaic materials that could be deposited in reel-to-reel coating machines. This research will lead to devices that will efficiently split excitons and carry charge to electrodes, that will have improved packing of the molecules in the organic semiconductor to enhance its ability to carry charge, and that will have a modified organic-inorganic interface to prevent recombination of electrons and holes.

Professor Prinz is exploring the possibility of capturing electricity directly from living biological cells by inserting nano-scale electrodes into their chloroplasts. Generation of bioelectricity will occur by placing the anodic electrode in the stroma of the chloroplast and the cathodic electrode in the lumen and exploiting the electrical potential difference created by the photosynthetic process in the chloroplast.