



Powering the Planet: The Challenge for Science in the 21st Century

Daniel G. Nocera

Department of Chemistry; Massachusetts Institute of Technology (MIT),

The supply of secure, clean, sustainable energy is arguably the most important scientific and technical challenge facing humanity in the 21st century. Rising living standards of a growing world population will cause global energy consumption to increase dramatically over the next half century. Within our lifetimes, energy consumption will increase at least two-fold, from our current burn rate of 12.8 TW to 28

– 35 TW by 2050 (TW = 10^{12} watts). This additional energy needed, over the current 12.8 TW energy base, is simply not attainable from long discussed sources – these include nuclear, biomass, wind, geothermal and hydroelectric. The global appetite for energy is simply too much. Petroleum-based fuel sources (i.e., coal, oil and gas) could be increased. However, deleterious consequences resulting from external drivers of economy, the environment, and global security dictate that this energy need be met by renewable and sustainable sources.

Of the possible sustainable and renewable carbon-neutral energy sources, sunlight is preeminent. If photosynthesis can be duplicated outside of the leaf – an artificial photosynthesis if you will – then the sun's energy can be harnessed as a fuel. The combination of water and light from the sun can be used to produce hydrogen and oxygen. The hydrogen can then be combined with the oxygen in a fuel cell to give back water and energy. In the overall cycle, sunlight is converted to useful energy.

This talk will place the scale of the global energy issue in perspective and then discuss how an artificial photosynthesis to power our planet might be achieved.