APS ENERGY RESEARCH WORKSHOP PROGRAM
Oregon Convention Center
Portland, Oregon
Rooms B-114 & B-115

Sunday, March 14, 2010

Workshop made possible in part by a grant provided by the US Department of Energy and organized by the APS Topical Group on Energy Research and Applications.
Reception sponsored by the Journal of Renewable & Sustainable Energy.

8:30 WELCOME
Alex King, Acting Chair
APS Topical Group on Energy Research and Applications (GERA)

8:35 WORKSHOP OVERVIEW
George Crabtree ***Argonne National Lab***
The transition from fossil fuels to secure and sustainable alternative energies has many possible routes, including, among others, solar and wind electricity, carbon sequestration and plug-in hybrid vehicles. Sustainable alternatives to fossil fuel will be introduced and compared for the degree of their sustainability and for the roadblocks to their implementation. Overcoming the roadblocks requires controlling energy conversion among photons, electrons and chemical bonds at the nanoscale in the materials and chemistry of sustainable energy, a scientific challenge that is now within reach.

9:20 SESSION 1
The Status and Future of the Photovoltaics Industry
Speaker: Dave Carlson ***BP - Solar***
The photovoltaics (PV) industry has been one of the fastest growing industries in the world over the last decade with a compound annual growth rate of 45%. While growth has slowed in 2009, this has been accompanied by a rapid drop in the price of solar cells and PV systems, which should set the stage for future rapid growth of the industry. Crystalline silicon is currently the dominant PV technology with 87% of the total market in 2008, but a large number of companies are developing solar cells based on other materials such as cadmium telluride, amorphous silicon, microcrystalline silicon, copper-indium-gallium diselenide (CIGS), dye-sensitized titanium oxide and compound semiconductors such as gallium arsenide. Crystalline silicon solar cells are being commercially produced with efficiencies as high as 22% while CIGS solar cells have exhibited efficiencies as high as 19.9% in the lab. A number of companies are commercializing concentrating PV systems and efficiencies as high as 41.6% have been obtained in the lab using a triple-junction structure under concentrated sunlight. While thin film PV technologies have recently been challenging crystalline silicon solar cells in the marketplace, we may see new generations of

low-cost, high performance solar cells based on organic or nanostructured materials emerge in the next decade or two.

10:05 COFFEE BREAK

10:20 SESSION 2

Thin Film PV Challenges for Terawatt Production – Emerging Technologies

Speaker: Dave Ginley – *National Renewable Energy Laboratory*

As society grows towards using 20 terawatts of energy a year replacing a meaningful fraction of this with renewable energy sources will depend on being able to produce systems at low cost and a very large scale. To meet grid parity at this scale may not be possible with existing technologies. There are some baseline criteria for any of these technologies they must be elementally abundant, processing temperatures must be low and processing time must be short. A number of new technologies are emerging that have the potential to achieve these goals. This includes organic photovoltaics, thin film Si on glass and technologies that promise to be much more efficient using physical phenomenon at the nanoscale. In addition, there is an increasing interest in solar fuels or solar systems with imbedded storage which will be needed for large scale deployment. The technological readiness of these approaches vary widely from the near commercialization of OPV and the dye cell to some approaches that are 20 years out. The talk will provide a snapshot of the current state of the art in these scientific areas and present some of the key basic and applied challenges needed for these technologies to make a substantial contribution worldwide.

11:15 SESSION 3

Energy Storage:

Speaker: Yet-Ming Chiang - *MIT*

This talk will discuss the metrics by which energy storage technologies are evaluated by end users, and the recent advances in lithium ion batteries that have led to accelerated development of hybrid and all-electric vehicles (HEVs, PHEVs, and BEVs) worldwide. In much the same way that energy storage has enabled the electrification of vehicles, it is now emerging as a critical technology for improving the stability and efficiency of the electric grid, and enabling the expansion of renewable energy. The scientific challenges that lie ahead in both these areas of opportunity will be highlighted.

12:10 LUNCH Room B-113

Box lunches will be provided for all registered participants. This is an opportunity to sit at a table with session speakers for informal discussion and networking.

1:15 SESSION 4

Fuel cells: Research opportunities and applications:

Speaker: Karen Swider-Lyons – *Naval Research Laboratory*

Proton exchange membrane fuel cells (PEMFCs) are being developed worldwide as clean, efficient energy conversion devices to replace combustion engines. These polymer-based fuel cells are efficient because the fuel (hydrogen) and oxidizer (oxygen in air) react by electrochemical catalysis, rather than by combustion. I will describe the Naval Research Laboratory's fuel-cell powered Ion Tiger unmanned airvehicle, and show how the science, technology and engineering blend together in the creation of a high performance system. Success of this new energy efficient system is due to advanced in materials, electronics, thermal management, and optics, integrated into an aerodynamically efficient package. The resulting fuel-cell unmanned airvehicles are relatively lightweight (35 to 100 lbs) but they are quiet and efficient, allowing them to do "big airplane" missions. The full system offers a significant fuel and energy savings and demonstrates that a systems approach can be critical to the adaptation of new energy technologies.

2:10 SESSION 5:

Carbon Dioxide Capture and Sequestration in Deep Geological Formations

Speaker: Sally Benson – *Stanford University*

In little more than a decade, carbon dioxide (CO_2) capture from point source emissions and sequestration in deep geological formations has emerged as one of the most important options for reducing CO_2 emissions. Two major challenges stand in the way of realizing this potential: the high cost of capturing CO_2 and gaining confidence in the capacity, safety, and permanence of sequestration in deep geological formations. First, we review available and prospective technology for capturing CO_2 from industrial sources such as power plants, refineries and chemical manufacturing plants. What are the fundamental thermodynamic limits on the efficiency of capture? How does this compare to the actual performance? What are the advantages and limitations of alternative approaches to capture? Second, building on examples from fundamental laboratory and field based studies of multiphase flow of CO_2 in porous rocks we will review current prospects for carbon dioxide sequestration in deep geological formations. What are the physical mechanisms by which CO_2 remains trapped underground and how well do we understand them? Which formations can provide safe and secure sequestration? At what scale will this be practical and is this scale sufficient to significantly reduce emissions? What monitoring methods can be used to provide assurance that CO_2 remains trapped underground? What can be done if a leak develops? What are the potential impacts to groundwater resources and how can these be avoided? The status of each these questions will be discussed, along with emerging research questions.

3:05 BREAK

3:20 SESSION 6

Energy Technology and Policy:

Speaker: Ernie Moniz – *MIT*

Abstract to be inserted

4:15 PANEL DISCUSSION:

Moderator: Debra Rolison - *NRL*

Focus of Discussion:

1. How does one enter the field of energy research? What are the prerequisites?
2. What is the funding outlook for energy research?

Panelists:

Harriet Kung – Department of Energy
Dave Carlson – BP Solar
Yet-Ming Chiang – MIT
George Crabtree – Argonne National Laboratory
Garry Rumbles – NREL
Ernie Moniz - MIT

5:15 – 6:30 RECEPTION Room B-113

For registered participants.

Open beer, wine, and soft drink bar with light appetizers.

Program Committee

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