Topical Conference on Renewable and Alternate Energy
Room 304 - Session EN-SuA

Renewable and Alternate Energy

Moderators: R. Ahrenkiel, University of Denver, G. Parsons, North Carolina State University

3:00pm **EN-SuA1 Scientific Challenges in Sustainable Energy Technology**, ***N.S. Lewis,*** California Institute of Technology **INVITED**

This presentation will describe and evaluate the challenges, both technical, political, and economic, involved with widespread adoption of renewable energy technologies. First, we estimate the available fossil fuel resources and reserves based on data from the World Energy Assessment and World Energy Council. In conjunction with the current and projected global primary power production rates, we then estimate the remaining years of supply of oil, gas, and coal for use in primary power production. We then compare the price per unit of energy of these sources to those of renewable energy technologies (wind, solar thermal, solar electric, biomass, hydroelectric, and geothermal) to evaluate the degree to which supply/demand forces stimulate a transition to renewable energy technologies in the next 20-50 years. Secondly, we evaluate the greenhouse gas buildup limitations on carbon-based power consumption as an unpriced externality to fossil-fuel consumption, considering global population growth, increased global gross domestic product, and increased energy efficiency per unit of globally averaged GDP, as produced by the Intergovernmental Panel on Climate Change (IPCC). A greenhouse gas constraint on total carbon emissions, in conjunction with global population growth, is projected to drive the demand for carbon-free power well beyond that produced by conventional supply/demand pricing tradeoffs, at potentially daunting levels relative to current renewable energy demand levels. Thirdly, we evaluate the level and timescale of R&D investment that is needed to produce the required quantity of carbon-free power by the 2050 timeframe, to support the expected global energy demand for carbon-free power. Fourth, we evaluate the energy potential of various renewable energy resources to ascertain which resources are adequately available globally to support the projected global carbon-free energy demand requirements. Fifth, we evaluate the challenges to the chemical sciences to enable the cost-effective production of carbon-free power on the needed scale by the 2050 timeframe. Finally, we discuss the effects of a change in primary power technology on the energy supply infrastructure and discuss the impact of such a change on the modes of energy consumption by the energy consumer and additional demands on the chemical sciences to support such a transition in energy supply.

3:40pm **EN-SuA3 Our Solar Power Future: The U.S. PV Industry Roadmap for 2030 and Beyond**, ***A.M. Barnett,*** University of Delaware; *R. Resch,* Solar Energy Industries Association **INVITED**

The next 10 years are critical for worldwide solar power development. Actions by industry and government will determine whether solar power is catapulted to a new level and whether the United States will regain its position at the forefront of solar power development. Investment decisions over the next decade for research, new manufacturing, and creating new markets will determine where solar power will thrive-and where it will merely survive. Solar power can provide great value in residential and commercial grid-connected applications, for individual consumers and businesses, as well as for utilities and the communities they serve. Our goals for 2030 are solar power system costs of $2.33 per watt, solar electricity prices of 3.8 cents per kilowatt-hour (kWh) delivered to the customer, installed solar power generation of 200 gigawatts (GW), and direct employment of 260,000 people.

4:20pm **EN-SuA5 Hydrogen and Chemicals from Fossil and Renewable Fuels by Autothermal Reforming**, ***L.D. Schmidt,*** University of Minnesota **INVITED**

Autothermal reactors have great promise for hydrogen and chemicals production because they have reactor residence times of 10-3 seconds and require very simple reactors. We describe the production of hydrogen and olefins from fossil fuels from methane to diesel and from renewable fuels such as ethanol and biodiesel in millisecond reactors. For successful vaporization and mixing of heavy fuels the use of fuel injectors for rapid vaporization and mixing is essential to suppress flames and carbon formation. For ethanol to hydrogen we obtain 80% selectivity to hydrogen at nearly 100% conversion of ethanol and oxygen for an ethanol-air feed. By adding water we obtain 110% (H2 from ethanol and water) in a single stage reactor and 130% H2 selectivity in a staged reactor where a cooler section undergoes the water gas shift reaction. For biodiesel (the methyl ester of C18 fatty acids from soy oil), we can obtain 80% H2 selectivity at C/O=0.8 and 80% selectivity to olefins at C/O=1.5. At higher C/O ratios the ester linkage also survives to produce olefinic esters. Modeling with detailed surface and homogeneous chemistry is used to simulate and understand these processes.

5:00pm **EN-SuA7 Fuel Cells from the Viewpoint of a Skeptical Optimist**, ***T. Zawodzinski,*** Case Western Reserve University **INVITED**

Fuel cells have been the subject of hype and backlash of late. The hype took various forms, including the 'We'll have a product next year' variety as well as inflated estimates system efficiency, simplicity, etc. Hopes have been dashed because of failure to adequately anticipate the difficulty of some technical and practical problems and from the short duration over which present-day configurations have been tested. The backlash has evolved from reaction to not meeting promises as well as from the realization of the aforementioned problems. Also, fuel cells are linked in many minds to the Hydrogen Economy, which has its own set of detractors. After reviewing these promises and pitfalls, this talk will discuss the current state of development of fuel cells, highlighting technical state of the art. Significant achievements and substantial activities to address some of the major challenges posed by the combination of cost, reliability and performance/functionality factors will be highlighted. By presenting a realistic assessment of these aspects, we hope to leave people with 'reasons to believe' in the promise of fuel cell technology in some applications

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