

APS ENERGY RESEARCH WORKSHOP PROGRAM
Boston Convention Center
Boston, MA
Rooms 160B

Sunday, February 26, 2012

*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

Jill Dahlberg, Past Chair, Mike Campbell (Workshop Organizer)
APS Topical Group on Energy Research and Applications (GERA)

8:35 WORKSHOP OVERVIEW

George Crabtree *Argonne National Lab*

The dependence on oil and other fossil fuels for over 80% of our energy and the continued emission of carbon dioxide threatening stable climate are captured in a single term: sustainability. Although we generally agree that sustainability is valuable, there is less agreement on how much sustainability is necessary or desirable. In this talk, three criteria describing increasingly strict features of sustainability will be presented and applied to evaluate the alternatives to oil and carbon dioxide emission, such as tapping unused energy flows in sunlight and wind, producing electricity without carbon emissions from clean coal and high efficiency nuclear power plants, and replacing oil with biofuel or electricity. Implementing these more sustainable alternatives requires new materials of increasing complexity and functionality that control the transformation of energy between light, electrons and chemical bonds at the nanoscale. Challenges and opportunities for developing the complex materials and controlling the chemical changes that enable greater sustainability will be presented.

SESSION 1: NUCLEAR ENERGY

9:05 A Strategy for U.S. Nuclear Power: Changing the Game with Small Modular Reactors- is this a “Sputnik Moment?”

Speaker: Victor Reis *Office of Science, Department of Energy*

Does the present confluence of events (climate change and the need for abundant clean energy, the recent nuclear disaster at Fukushima, the closing of the Yucca Mt. geologic storage site for spent fuel, the present ongoing global economic crisis) place the previous nuclear energy strategy and the hope for a nuclear Renaissance in turmoil or does it lead to a potential “Sputnik moment” where innovation and a new vision for nuclear power take form from the chaos? In this presentation such a strategic vision for change featuring the small nuclear module reactor (SMR) will be discussed. The presentation will include the opportunities and challenges of making this vision become a reality. If successful this strategy

can provide a foundation for a rational U.S. and global nuclear energy policy and offer an opportunity for new and innovation driven companies.

10:15 COFFEE BREAK

SESSION 2: EMERGING ENERGY TECHNOLOGIES-BIOFUELS AND CRITICAL ELEMENTS

10:30 Biofuels: Addressing the Transportation Energy Challenge

Speaker: Gregg Deluga – Director Biofuels, Logos Technologies

In 2009 the US consumed over 5Billion barrels (5BB) of oil of which over 3.3 BB were imported. Of this amount, over 70% is used in the transportation sector which constitutes about 27% of our total energy use. While the recent economic downturn has impacted US consumption and imports, the dependence on oil and other fossil fuels for over 80% of our energy and the continued emission of carbon dioxide threatening stable climate remain a major challenge for the 21st century. While numerous approaches are being explored to reduce our dependence on fossil fuels, particularly in electricity generation, energy for transportation, despite the efforts for increased fuel efficiency and electrification will still rely heavily on liquid hydrocarbon fuels. The energy density (>40 MJ/kg) and environmental robustness of such fuels will not be replaced in the foreseeable future. Recognizing these features, significant efforts are now underway to replace the “petroleum feedstock” of these fuels with renewable and sustainable sources such as algae and cellulosic (non-food) biomass. Numerous approaches for conversion of this biomass into transportation fuel are being actively developed with the goal of demonstrating large scale (billions of gallons per year), economic (cost competitive with present petroleum feedstock) processes with greenhouse gas emission integrated over the process Life Cycle (LCA) significantly reduced over petroleum based fuel. In this presentation an overview of the approaches and their challenges and opportunities will be discussed.

11:15 Life Cycle Assessment of Climate Change Mitigation Strategies – Applications to the Passenger Transportation Sector

Speaker: Alissa Kendall – UC, Davis

The mitigation of climate change emissions in the United States and worldwide requires the adoption of new technologies and investment in new infrastructure. Life cycle assessment (LCA) has emerged as an important tool for evaluating the performance of technologies and policies to serve in climate change mitigation strategies, and has even been codified in California’s Low Carbon Fuel Standard, which requires an estimation of a life cycle greenhouse gas emissions for passenger transportation fuels.

This talk will describe typical and enhanced LCA methods and how they have been implemented for analyzing biofuels and other technologies relevant to the passenger transportation system. Results from LCAs of transportation-related

systems such as biofuels, advanced vehicle technology, high-speed rail, and highway asset management, will be discussed along with recommendations for how LCAs should be conducted in light of the complexity of these systems.

12:00 Critical Elements and New Energy Technologies

Speaker: Robert Jaffe – MIT

The twin pressures of increasing demand for energy and increasing concern about anthropogenic climate change have stimulated research into new sources of energy and novel ways to harvest, transmit, store, transform or conserve it. At the same time, advances in physics, chemistry, and material science have enabled researchers to identify chemical elements with properties that can be finely tuned to their specific needs and to employ them in new energy-related technologies. Elements that were once laboratory curiosities, like neodymium, tellurium, and terbium, now figure centrally when novel energy systems are discussed. Many of these elements are not at present mined, refined, or traded in large quantities.

New technologies can only impact our energy needs, however, if they can be scaled from laboratory, to demonstration, to massive implementation. As a result, some previously unfamiliar elements will be needed in great quantities. Although every element has its unique story, these Energy Critical Elements have many features in common. I will describe the shared characteristics of these elements, their roles in emerging technologies, potential constraints on their availability, and government actions that can help avoid disruptive shortages. Research, both basic and applied, is an essential ingredient in a coherent approach to constraints on critical materials. Ingredients in a coherent research strategy include work on geological deposit modeling, mineral extraction and processing, material characterization and substitution especially focused on earth-abundant materials, materials utilization, recycling technologies, and life cycle analysis. If appropriate, I will briefly summarize the state of relevant legislation under consideration in Congress.

12:30 – 1:15 LUNCH

ROOM 160C

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.

SESSION 3: ROLE OF INDUSTRY IN INNOVATIVE & EMERGING ENERGY TECHNOLOGIES

1:15 Startups Innovating for a Sustainable-Energy Future

Speaker: Noubar Afeyan – Managing Partner and CEO, Flagship Ventures

Alternatives to crude oil derived liquid fuels gain in urgency each time the price of oil rises significantly. As in the late 70's, the last decade has seen a renewed interest in replacing our national dependence on imported oil, this time with the

added impetus provided by the increased awareness of environmental damage from CO2 emissions. Alternatives to the status quo inevitably imply innovation and commercialization, activities increasingly dominated by startup companies rather than incumbents. Arguably the most economically significant innovation of the past decades is the “Startup Company” itself, the process by which ideas get combined with resources to produce innovative products/services disrupt markets and shift or create enormous economic value. Based on successes in IT and Life Sciences, the venture capital community is actively engaged in catalyzing the formation and development of the Apple, Genentech or Google of the alternative energy or cleantech industry. Using as examples four new ventures, Mascoma, LS9, Joule and Midori, the challenges and opportunities faced by a new breed of startups will be presented.

1:50 How to take a good idea and make it real – the Amyris Experience
Speaker: Neil Renninger – Cofounder & Chief Technology Officer, Amyris

2:25 The winding road from researcher to entrepreneur

Speaker; Jim Carey – Co-Founder, SiOnyx

The path that any new technology must take to go from a laboratory idea to a viable product is steep and circuitous. Market dynamics and unforeseen technology hurdles can result in dramatic changes in direction and go-to-market strategy. For innovations that are aimed at the energy market, the importance of every decision is further amplified by the sheer size of capital requirements and the challenge of displacing well-entrenched incumbents. These hurdles can be discouraging and slow the development or implementation of emerging energy solutions. However, it is critical for researchers and entrepreneurs to fight through the resistance in order to ultimately solve our future energy needs. We will discuss experiences and lessons learned while nurturing a startup company (SiOnyx) with solar aspirations and the unique challenges that the current market conditions and investment sentiment has created. In addition we will discuss how one can begin down the path to a photovoltaic venture with minimal capital outlays.

2:50 The Challenge of Starting a Nuclear Company

Speaker: Jose N. Reyes, Jr. – NuScale Power

NuScale Power is commercializing a scalable modular reactor that offers a new level of safety and novel deployment and operating characteristics that significantly reduce commercial risks. It is aimed at a global community that is actively seeking new sources of economic, carbon emission free, base-load power. This presentation examines the many challenges in creating a world class nuclear power company. Discussion topics include creating a new paradigm for nuclear plant deployment, assessing the market, building the business case, finding the right investors, strategic partners, and suppliers, building the right

leadership team, the role of entrepreneur engineers, creating a workforce within a nuclear safety culture, and the international competition.

3:30 BREAK

3:45 PANEL DISCUSSION:

Moderator: Mike Campbell

Focus of Discussion:

1. What is the role of the US in addressing the Global Energy Challenge
2. How does one enter the Energy Field?
3. What does Industry want?

Panelists:

Vic Reis
Nubar Afeyan
Gregg Deluga
Jose Reyes
Jill Dahlburg

5:00 – 6:15 RECEPTION

Room : 160C

For registered participants.

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

Program Committee

E. Mike Campbell (*Chair*)

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