Savannah River National Laboratory

Renewable Energy in a Sustainable Environment

The most commonly quoted definition of sustainability is "… development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987). Sustainability has become a watchword within government, the military, and industry, which refers to this concept as the "triple bottom line" of financial, social and environmental responsibility. Thus, the overall goal of SRNL will be to integrate economic activities with natural systems in a way that preserves existing resources for future needs.

SRNL is proposing to establish a research center in South Carolina that will partner with government, industry and academia to address sustainable solutions from a perspective of local, regional, and national priorities. SRNL will lead collaborative research teams that:

- Help entrepreneurs and enterprises create jobs and generate revenue for the region by:
    - Developing clean and sustainable energy resources.
    - Understanding and mitigating the environmental impacts of new approaches in energy generation and building construction.
    - Assuring clean and abundant water resources.
    - Developing risk management methodologies and understanding to ensure the protection of human health.
- Foster the rapid transition from R&D to industrial development.
- Prepare the workforce of the future through educational outreach programs.

Renewable Energy Initiatives

The future vision for energy production in the US requires both the utilization of multiple innovative sources of fuel and the ability to provide an "intelligent" power distribution approach. The power grid of the future is going to depend on rapid semi autonomous control of the grid especially at the edges of the existing infrastructure. The grid of the future will depend on distributed power generation systems linked to an intelligent control system that can rapidly call up remote resources to respond to voltage excursions or loss of the main power feed. Alternative and renewable power sources are ideal for these applications.

SRNL Activities

1. **Project Description**: SRNL is currently working with the Department of Energy (DOE) Office of Electricity Delivery and Energy Reliability to install a demonstration back up power system at the Center for Hydrogen Research (CHR), an Aiken County owned research laboratory. Hydrogen is an ideal energy storage medium and coupled with SRNL Hydrogen storage technologies, it can create a robust source of standby power. The demonstration system will use off peak power from the grid to drive an electrolyzer to separate the hydrogen. The hydrogen will be stored on a metal hydride bed coupled to a large stationary fuel cell. When the unit senses demand from the grid,

it will switch to batteries to act as a bridge power source until the fuel cell is up to full capacity. This demonstration unit is installed and undergoing initial testing.

Funding: $1,000,000 (FY 08, DOE)
Research Location: SRNL, Aiken, South Carolina
Research Entities: SRNL

2. Project Description: SRNL is working with CHR to select a wind turbine that will be installed as an alternative power source to the demonstration back up power system. Coupling a wind turbine to the electrolyzer instead of grid power will demonstrate renewable distributed power. Future plans include the installation of a large solar panel that will work in conjunction with the wind turbine as a power source.

Funding: $75,000 (FY 09, Economic Development Council of Aiken County)
Research Location: SRNL, Aiken, South Carolina
Research Entities: SRNL

3. Project Description: SRS has its own micro grid for power distribution. SRNL is currently working with site engineering to evaluate the potential to conduct smart grid testing on a micro scale that will not disrupt normal power distribution in the South East. Initial discussions indicate that this would be easily implementable and could be very valuable infrastructure for grid testing.

Funding: TBD
Research Location: SRNL, Aiken, South Carolina
Research Entities: SRNL

4. Project Description: The University of South Carolina and the University of Arkansas have been selected as finalists for the NSF competition to be named a center for "Smart Grid" studies. SRNL is working with the Universities to determine how ultra secure wireless controllers currently being developed by SRNL, for the automotive industry, could assist in developing a robust and secure grid infrastructure.

Funding: TBD
Research Location: SRNL, Aiken, South Carolina
Research Entities: SRNL, University of South Carolina, University of Arkansas

5. **Project Description**: Complex hydride systems can increase the capacity of batteries or fuel cells by an order of magnitude or more than existing batteries. A novel electrolytic method to store energy using proton and electron transfer in non-aqueous solution will be developed under this project. The process presented is based on driving a chemical reaction using electrochemical cells to form high capacity hydrides that can be reversed to act as a battery or fuel cell. The proposed work has the potential to be a break-through technology. At this time no other group world wide has disclosed their work on electrolytic charging of hydrogen storage materials. If successful, a whole new method of storing and discharging hydrogen in hydrogen batteries will have been created.

   Funding: $100,000 (FY08, DOE)
   Research Location: SRNL, Aiken, South Carolina
   Research Entities: SRNL

6. Project Description: The goal of this project is to develop and utilize system-level molecular biological techniques to investigate the interactions between H2 producing cyanobacteria and their commonly associated bacterial flora. Cyanobacteria are photosynthetic microorganisms that utilize energy harvested from sunlight to convert CO2 into biomass. Cyanobacteria may also help our nation transition from fossil fuel dependency to more sustainable and secure sources of energy through biotechnological applications including carbon sequestration, biodiesel and bioethanol production, and H2 production.

Funding: $250,000 (FY07, $100,000; FY 08, $150,000 DOE)
Research Location: SRNL, Aiken, South Carolina
Research Entities: SRNL

7. **Project Description**: High-strength alloys are needed for pressure vessels for the hydrogen economy. This research will investigate the compatibility of ultrapure high-strength alloy steel for service in high-pressure hydrogen environments. This work will test the hypothesis that alloy steels can be made much more resistant to hydrogen embrittlement by modifying alloy element composition so as to reduce grain boundary impurity segregation. This would be a significant contribution to the scientific understanding of the hydrogen embrittlement phenomena. If we can demonstrate that ultra-pure high strength alloys can be made with greatly improved resistance to hydrogen-induced intergranular fracture, then the results will have an immediate impact on the selection of materials of construction for the hydrogen economy.

Funding: $100,000 (FY 08, DOE)
Research Location: SRNL, Aiken, South Carolina
Research Entities: SRNL