Stories and Bragging Points for the Center for Sustainable Energy at Notre Dame (cSEND)

Below is a collection of stories and bragging points on cSEND research, education and outreach.

Research

SEI Seed Funding:

The Sustainable Energy Initiative (SEI), a Strategic Research Investment managed through Center for Sustainable Energy at Notre Dame (cSEND), provides seed grants for new, energy related research collaborations. **Professor Seth Brown** from the Department of Chemistry and Biochemistry and **Professor Thomas Albrecht-Schmitt** from Civil Engineering and Geological Sciences received one of the first of these grants to fund a graduate student on a project entitled "O_2 Activation and Production via High-Coordinate Complexes of Redox-Active Ligands." A direct result of this seed grant was Professor Brown's proposal and subsequent award of almost half of a million dollars from the National Science Foundation to study "Nonclassical Oxygenation Reactions." The seed grant effectively leveraged $50,000 to develop 3 years of external funding for three undergrad researchers, a graduate student, a postdoctoral fellow, and summer salary for the principal investigator.

Multiple Awards from the Advanced Research Projects Agency - Energy:

DOE's new Advanced Research Projects Agency, Energy (ARPAe) awarded cSEND faculty with 2 competitive research grants totaling more than $5M in funding. Of the 121 awards made by ARPAe, only 9 organizations earned multiple awards, and our peers in this distinguished group include Massachusetts Institute of Technology, Georgia Tech Research Corporation, United Technologies Research Center, GE Global Research, Lawrence Berkeley National Laboratory, Arizona State University, CUNY Energy Institute and Virginia Tech. The two awards to Notre Dame are both related to carbon dioxide: the first will provide materials and techniques to make CO_2 capture from electricity generation much more affordable; the second uses CO_2 to make air conditioning and refrigeration more sustainable.

Undergraduate Energy Research Expo:

In January 2011, Center for Sustainable Energy at Notre Dame (cSEND) sponsored its first annual Undergraduate Energy Research Expo. This event was designed to help match undergraduate students interested in participating in energy-related research with research groups with available projects during summer 2011 and the 2011-2012 academic year. In addition, this event was used to encourage students selected to fill research slots to apply for fellowships through the ***Vincent P. Slatt Endowment for Undergraduate Research in Energy Systems and Processes*** to support their work. The event was well-received by students and faculty, and thirty-five students completed applications, with twenty-seven of

these students new to undergraduate research. As a result, applications for Slatt Fellowships increased by almost 60% over 2010. This event will continue to be a cornerstone activity for increasing undergraduate participation in research.

Education

Micro-Hydropower for Rural Nepal:

Margaret Bellon ('13 Civil Engineering student) conducted a research project in Nepal to identify opportunities for providing clean energy and water for a rural village. The project was funded with a fellowship from the *Vincent P. Slatt Endowment for Undergraduate Research in Energy Systems and Processes* Under the guidance of **Professor Joe Fernando** (Wayne and Diana Murdy Professor of Engineering and Geosciences), **Professor Ann-Marie Conrado** (Industrial Design) and **Charles Rettalack** (Environmental Fluid Dynamics Post-Doctoral fellow), Ms. Bellon traveled to Chitepani, Nepal to initiate the project. Professor Conrado's "Hope for Nepal" charity has been working in the region for some time, offering a foundation for this effort. Chitepani is a forty-household village located outside of Nepal's trekking base, Pokhara. The village gets only four hours of electrical service a day in the dry season. Ms. Bellon developed recommendations for a community charging station that would use available water resources to provide power for lighting and small electronics for residents, and computers for the local school. Locally generated power will help overcome the energy shortage, without requiring overhaul of the electric grid. In coming years, the team will design, deliver and install the micro-hydroelectric generation and charging facility, and expand it to provide additional power a water purification system.

Establishment of an Energy Studies Minor:

Beginning in fall 2011 the Center for Sustainable Energy at Notre Dame (cSEND) offers a minor in Energy Studies which is open to undergraduate students in all majors and colleges. This minor will prepare students to become successful leaders who understand the complexity of the energy challenge and who can direct our country and the world in finding solutions for more sustainable energy practices. Both technical and non-technical tracks are offered, and each participating student will complete a capstone project in addition to coursework. Additional information is available at http://energystudiesminor.nd.edu.

Fannie and John Hertz Foundation:

Patrick Brown, a sophomore in the Department of Chemistry and Biochemistry, received a Slatt Fellowship in 2007. In collaboration with his adviser, **Dr. Prashant Kamat**, Patrick studied single-wall carbon nanotube based photochemical solar cells, focusing on the desired properties for harvesting light energy. Patrick is now a second-year graduate student in the Physics Department at MIT and was recently among the 15 new recipients of the prestigious fellowships from the Fannie and John Hertz Foundation. This no-strings-attached fellowship is worth $250,000 for up to five years for each recipient and allows exceptional scientists and engineers the freedom to innovate as part of their graduate studies in the applied sciences.

Fulbright Scholarship:

Yamil Colón, then a Junior in Chemical and Biomolecular Engineering, received a Slatt Fellowship in 2008. Studying under the direction of **Professor Joan Brennecke**, Yamil focused his research on evaluating the potential use of specific ionic liquids based on the thermophysical properties of each liquid in different compositions of ethanol. Yamil graduated from Notre Dame in 2009. He received a Fulbright Scholarship for graduate study from the Fulbright Program, which is our government's premier scholarship program, designed to foster mutual understanding among nations through educational and cultural exchanges. Yamil is currently studying separation processes and phase equilibra at the University of Santiago de Compostela in Spain.

Student Energy Audit Supporting National Parks:

The University-National Park Energy Partnership Program (UNPEPP) partnered with the Center for Sustainable Energy at Notre Dame (formerly the Notre Dame Energy Center) during the summer of 2008 to improve the Indiana Dunes National Lakeshore facilities. Funding for the project allowed for three undergraduate students from Notre Dame to work with park officials to conduct energy audits and make recommendations for capital improvements. Under the direction of **Professor Joan Brennecke**, the Keating-Crawford Professor of Chemical and Biomolecular Engineering and director of the Center for Sustainable Energy at Notre Dame, **Thomas Furlong**, a junior in aerospace and mechanical engineering; **Brian Klein**, a senior political science major; and **Jackie Mirandola Mullen**, a sophomore pursuing degrees in German and history, focused their research on energy conservation and savings and projected payback in terms energy use reduction and lower greenhouse gas emissions. These students also designed a geothermal heat pump system and a grass roof system for two of the facilities, as well educational materials for park guests. Our undergraduate students were able to put their formal training into practice in a real-world setting, using project management and leadership skills to promote discussion on realistic and responsible uses of resources, while the National Park gained the knowledge from our students to implement new practices and ways to operate more efficiently and cost-effectively.

Outreach

Solar Microgrid for the The Université Notre Dame du Kaseya in Tshumbe, Congo.

Tshumbe is a city of almost 700,000 people in remote eastern Democratic Republic of the Congo. While a population of this size would normally indicate a metropolis, its remoteness and dire lack of infrastructure mean that Tshumbe is actually a very large—and very impoverished—village. Water, sanitation, and electricity are scarce and only intermittently available. Fuel comes in the form of expensive ($20/gallon) diesel, which must be flown in by seaplane. The Université Notre Dame du Kaseya is a small college in Tshumbe consisting of several simple mud houses that serve 250 students. Tshumbe offers an abbreviated, but highly relevant, menu of educational programs in computer science, management and economics, psychology and educational sciences, and medicine. A key challenge to for the college is the lack of reliable, affordable energy. The University of Notre Dame, guided by experts in the Center for Sustainable Energy at Notre Dame (cSEND), will design, construct and install a solar hybrid microgrid,

complete with battery storage and diesel backup to help meet the energy needs of their sister school in the Congo. A donation from **Keith (ND '81) and Janet Sherin** with matching funds provided **by General Electric** underwrite this effort. Their generous support will allow us to have the system up and running in January 2012, allowing the school to cut fuel costs, and increase enrollment.

cSEND Awarded an NSF Research Experience for Teachers (RET): *Engineering a More Sustainable Energy Future:*

The Center for Sustainable Energy at Notre Dame (cSEND) received a grant award this fall from the National Science Foundation designed to connect high school science and math teachers with Notre Dame engineering and science faculty involved in sustainable energy research. This *Engineering a More Sustainable Energy Future* project aims to improve science education for a new generation of students by providing its teachers meaningful lab-based experiences on energy related topics. These topics will focus on the issues and current approaches surrounding energy use and sustainability. In addition, this project will build research communities consisting of participating Center faculty and teachers, both from local schools and from the Notre Dame's **Alliance for Catholic Education (ACE)** program. The addition of ACE teachers to this project expands its impact to schools with large minority populations, including many under-resourced Catholic schools across the U.S.

Fifth Annual Energy Week:

Energy Week originated in 2007 through a small group of energetic undergraduate students who were passionate about energy conservation issues and energy inefficiencies that adversely affected the environment. Energy Week continues today in its 5th iteration, still led by a group of our students yet the group size and program magnitude have changed dramatically. Now, both undergraduate and graduate students from all disciplines at Notre Dame are involved in structuring this week-long event made up of education and outreach programs that focus on strengthening our students' knowledge and enthusiasm to take part in the action to create a more sustainable energy future. By raising awareness and drawing upon the expertise of renowned researchers in the field and representatives from prestigious energy related companies and organizations, Energy Week has become the annual forum for addressing the most critical energy related issues facing our nation today and understanding the latest technologies and scientific and industrial developments that will lead us to a more sustainable energy future.

Faculty Honors

Brennecke wins Lawrence Award:

Professor Joan Brennecke was presented The Ernest Orlando Lawrence Award by U.S. Secretary of Energy, Steven Chu. This award is given by the United States Department of Energy and honors scientists and engineers at mid-career for their exceptional contributions in research and development and supporting DOE's mission to advance the national, economic and energy security of the United States.

Multiple cSEND Faculty listed in the Top 100 Chemists:

Being listed as a Top 100 Chemist means that a researcher achieved the highest citation impact scores for chemistry papers published since January 2000. Two cSEND faculty **Professor Joan Brennecke** (Keating-Crawford Professor of Chemical and Biomolecular Engineering and director of cSEND) and **Professor Prashant Kamat** (Rev. John A. Zahm Professor of Science in the Department of Chemistry and Biochemistry and Radiation Lab, and Concurrent Professor of Chemical and Biomolecular Engineering) are included in a new ranking of the top chemists of the past decade, recently published by the Times Higher Education group.