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California - Denmark Renewable Energy Summer Workshop

Abstract

The California - Denmark Renewable Energy Summer Workshop is a collaborative initiative between the University of California at Santa Cruz, the University of California at Davis and the Danish Universities, which students get academic course credit at their home institutions. This year the program is in its fourth year, the first and third years were held in Denmark, while the second and this fourth year in California. For the first three weeks in August, fifteen students and eight professors from Denmark and California came together to learn about and conduct research on the challenges of a rapid transition to a renewable energy society. The students come from a multitude of disciplines and the aim of the program is to train future policymakers, business leaders, scientists, and engineers in understanding renewable energy from a systems perspective that takes the technological, economic, environmental, and social aspects of climate change solutions. The first ten days of the program took place at the University of California at Santa Cruz and the last nine days were at the University of California at Davis. All students lived on campus except for a few local students whose residency was within few miles of campus.

The important aspect of the program is to give the students and researchers an insight into the ongoing research in Green Tech companies in Northern California. In order to meet such a goal, the students attended a two day workshop on “The Road to a 100% Renewable Energy System” held in Silicon Valley which consisted of participants from academia, industry, national laboratories, and several countries. In addition, the students participated in touring a variety of companies in the Bay area, such as, Solyndra, Makani Power, Tesla Motors, and Sustainability Base at NASA Ames in Mountain View. Additionally, the students attended lectures given by participating faculty and guest speakers, and participated in hands-on activities. In the beginning of the program, the students were assigned to work on a project of proposing a 100% Sustainable Energy Community. The choice of size and type of community was left to the students to decide. In groups of five, the students delivered proposals and made final presentations. At the end of the program, all the students were asked to answer a questionnaire and provide us with feedback.

More details about the program can be found at the following web-site: localrenew.soe.ucsc.edu. The first two authors of this paper are previous participants and coordinators who are committed to excellence of this program.

Introduction

The California - Denmark Renewable Energy Summer Program is a unique educational experience developed by researchers from Universities in California and Denmark. In 2008, twenty students from the University of California at Santa Cruz, the University of California at Davis, the University of California at Merced, and the Technical University of Denmark met in Lolland, the fourth largest island of Denmark for four weeks. In 2011, the students and researchers from the University of California at Santa Cruz, the University of California at Davis, the Technical University of Denmark and Aalborg University met for 3 weeks in California to attend this workshop. Participants of the workshop learned about the economics, politics, science, and technology behind renewable energy implementation from leading experts, while exploring communities and relevant energy sites where such technology is in place, or
currently being implemented. This interdisciplinary approach allowed students with various academic backgrounds to interact and develop concrete final project ideas while targeting today’s energy problems from different angles. The emphasis of this workshop is to engage the students in fieldwork to investigate and acquire knowledge that enables them to discover practical global solutions to renewable energy challenges.

The workshop was intended for students of all disciplines. The students were selected based on their academic qualifications, creativity, and commitment. In 2008, the very first year this program was offered, the participating student’s majors were from diverse disciplines, which included physics, business, marine biology, history, political studies, psychology, mechanical and electrical engineering. The workshop was also open to students of graduate and undergraduate populations, however, the majority of participants were students working on their graduate degrees. Lastly, students from both countries were equally encouraged to participate. Interestingly, when the program was held in California, the majority of participants were from Danish Universities and when the program was held in Denmark, the majority of the participating population of students were from the United States. Regardless of the discipline studied and the degree level pursued, the formed groups reflected examples in a diverse team that investigated the opportunities and challenges facing renewable energy implementation from many directions.

**Program Structure**

The California - Denmark Renewable Energy Summer Workshop consisted of three major components; lectures, field trips, and project work. All components varied from year to year based on the feedback received from the previous year participants. Generally, the first week of the workshop was filled with lectures and field trips, and during the last week the participants focused primarily on their projects. Additionally, the participants also had a choice of participating in social events, which were not mandatory and mostly held on the weekend.

In 2008 and 2010, the workshop was held in Denmark for four and three weeks respectively. In 2009 and 2011, the workshop was held in California, at the University of California at Santa Cruz and the University of California at Davis. At the beginning of the workshop, the participants spent time familiarizing themselves with the various disciplines of renewable energy technology, which included: solar, wind, biogas and biomass, central heating and power, and hydroelectric power. They also spent time learning about each other and their diverse academic backgrounds. In all four years of the workshop there were students from many fields of study. This academic diversity enabled groups to approach given problems from many angles. For example, a student of political studies can enlighten an electrical engineer about the various political restraints against implementing renewable technology that they would not have previously considered.
The structure of the summer school was designed to optimize the participants’ learning of the subject matter. Each day, a lecture was given on a subject by a professional that was working in that field. The lecturer would then take the students on a tour of their nearby facility and explain the procedure for how their company functioned. Over the course of a few days, the students would hear lectures and go on tours of various facilities that addressed a different stage of a technology. For example, a very prevalent renewable energy technology in Denmark is wind power. In 2009, according to Danish energy statistics, 26% of Denmark’s electricity was produced by wind power[1].

First, the students were given lectures on the important aspects of wind power by professors and professionals in the field. In addition, the students had discussions with local politicians of the Lolland Municipality, who explained what steps were necessary to make the public more conscientious about their energy usage. The students were then taken on a tour of Vestas, a wind turbine manufacturing company, where they learned about the various considerations on the manufacturing side. Next, the participants were shown around the insides of a functioning windmill. Finally, they took a tour of the Nysted Offshore Wind Farm, operated by Dong Energy, and were shown how wind energy is gathered on a massive scale. Overall, the students received in-depth explanations and tours of all stages of the technology being implemented. This procedure was repeated for several different renewable technologies. In 2011, the students attended a two day workshop on “The Road to a 100% Renewable Energy System” held in Silicon Valley, California. In addition, the students participated in touring a variety of companies in the San Francisco bay area, such as, Solyndra, Makani Power, Tesla Motors and Sustainability Base at NASA Ames in Mountain View. Figures 1, 2 and 3 demonstrate photographs from in-class lectures and the field trip to the Nysted Offshore Wind Farm in Denmark and the Dynegy Power Plant in Moss Landing, California.

Figure 1. The class listens to a lecture on the theory behind biomass energy production.
For the last component of the workshop, the idea of project learning was implemented. Every year participants were divided into groups and were evaluated based on their ability to generate projects with realistic results. In the first three years of the program, the project was left up to the students to decide. For the case of a project group in 2008, several participants were researchers and worked together as a group to evaluate the feasibility of turning the retired Castle Air Force Base into a business incubator for renewable start-up companies. Such incubator would
bring investment opportunities to the county and the university itself. The group consisted of
students with diverse majors and backgrounds. One of the group members with a business major
investigated the financial feasibility of start-up companies, while a science students investigated
solar and biomass resources sufficiency in that area for it to be a good location for those
technologies. The group also had several participants with politics majors who evaluated the kind
of procedures the Lolland municipality used to encourage businesses and investors to expand
such industries so that the same transformation could occur in their university. As a result of this
project, the participants returned to the community and started the company “Suntherm Energy
Inc.” They specialized in co-generation of solar electricity and heating. For the case of a project
group in 2009, five participants investigated and proposed solutions for future datacenters using
renewable solar energy while reducing electricity and consumption cost. In their proposal, they
discussed business models, pricing, sales and marketing strategies, market drivers, competing
technologies, and environmental concerns. In 2011, according to the feedback received from
the previous years, all the student groups were assigned a project with a specific task to propose
a 100% Sustainable Energy Community. The choice of the size and type of community was
left to the students to decide. Three groups of five participants each proposed solutions, and
made excellent presentations demonstrating the local and international 100% sustainable energy
communities.

Assessment and Student Feedback

The participants were assessed based on their final project presentation and the proposal. Each
group was graded based on how well they identified a problem and proposed a possible solution
from various angles based on the background of individual student within a group and provided a
list of recommendations.

On the last day of the program, when all the participants finished giving their project
presentations and submitted their final written work, they were asked to take an online survey
consisting of 60 questions all related to the summer workshop. Forty six of those questions asked
participants to rate individual components of the course on the scale from 1(poor) to 5(excellent).
A total of 11 students completed the online survey anonymously. In 2011, the overall satisfaction
with the course was rated 4.2 out of 5. Below are a few testimonials from students that came
from different Universities at different years.

“I had a great time, learned a lot and I’m going back to Denmark with renewable energy
and inspiration for my further studies. Thanks a lot!”

“I never thought I could learn as much as I did. Not only did my knowledge of renewable
energy grow exponentially during my time in Denmark, but the experiences I gained
from project-based learning and the benefits of international education are beyond anything I ever hoped to gain from the workshop. (…) All in all, I came out of the program with an amazing project that I feel very proud of, and an experience in which I learned to grow as a person, as well as a peer.”

“The CA-DK summer workshop was an eye-opening experience. As a business student, I deeply enjoyed the practical approach to learn about different clean technologies and how these were successfully implemented in various communities. The field trips to production facilities, manufacturers, and research centers were very useful in this regard. (…) I personally feel that this program has created powerful opportunities not only for its participants, but also the industries that alumni decide to focus on.”

"It was an amazing workshop! In our short time in Denmark, we were audience to some of the leading industry experts, researchers, and politicians in the field of renewable energy. It was awesome to be able to explore Denmark through our field trips. But the best part of the workshop was being able to meet with other students and professors from around the world who share a passion for renewable energy."

Based on the student feedback, the program coordinators are continuously finding new methods of improving the participants’ preparedness and enjoyment of the workshop. For instance, in the third year of this workshop, a series of introductory lectures were recorded and replaced with more advanced live lectures. The introductory online lectures were then made a mandatory component of the workshop where participants were required to watch prior to starting the workshop.

**Conclusion**

The California - Denmark Renewable Energy Summer Workshop is the first of its kind. It takes a dedicated team of faculty members and collaborators from the U.S. and Denmark to form and organize such a workshop on a yearly basis. The workshop is also improving and advancing yearly, based on the previous years’ feedback from the participants. Overall, the scientific committee and participating students across all four years feel that this workshop plays a valuable part in tackling bit by bit problems posed by global climate change and scarce natural resources by proposing viable solutions based on renewable energy resources.

**Acknowledgement**

The authors recognize the significant contributions of Anders Mueller, Bryan Jenkins, Kurt Kornbluth, Joel Kubby, Arne Remmen, Chresten Treholt, Morten Blarke, Brian Vad Mathiesen, Brenna Candelaria and William Kuhlman in making the California - Denmark Renewable Energy Workshop a successful one.
Bibliography