The Creation and Evolution of an Energy Engineering and Education Outreach Model

Lynn A. Albers

ABSTRACT

The Energy Engineering and Education Outreach Model is a new model to introduce undergraduates to the field of energy engineering and engage them in engineering education through K-12 outreach programs to promote ST(EE)2M: Science, Technology, Energy Engineering, Engineering Education, and Math. The model places students with mentors in the university's facilities management department or energy center where they gain valuable experience in assessing energy usage, needs and areas of potential savings thereby helping the institution save energy. The model utilizes undergraduates as university ambassadors of the institution who can disseminate their intellectual knowledge and help raise awareness of ST(EE)2M to the local community through K-12 engineering education outreach avenues such as Family STEM Nights and energy clubs.

This article details the impetus for this model, its creation and evolution. It is unique because it is a collaboration between the College of Engineering and the College of Education thereby giving students interdisciplinary educational experiences with a focus on energy. The model is also flexible and can be applied at any institution.

Keywords: energy, engineering, efficiency, STEM, outreach, education, interdisciplinary

INTRODUCTION

The Energy Engineering and Education Outreach Model ("The Model") is a model to expose undergraduates to the field of energy engineering to help fill the demand for energy engineers [8] and to engage un-

dergraduates in engineering education through K-12 outreach programs to promote ST(EE)2M. This acronym takes the familiar STEM acronym and modifies it to include energy engineering and engineering education. Students likely to major in engineering are significantly more likely than others to want to address energy (supply or demand), climate change, environmental degradation, water supply (shortages, pollution), terrorism and war, and opportunities for future generations. [10] To expose undergraduates to energy engineering, the Model places students with mentors in the university's facilities management department or energy center where they can gain valuable experience in assessing energy usage, needs and areas of potential savings thereby helping the institution save energy and achieve the goals of the sustainability policy that mandates a university-wide goal of 30% reduction in energy usage by 2015 [9]. While some universities such as James Madison University have implemented programs in sustainable engineering [10], most universities have not. The Model affords students the opportunity to supplement a traditional engineering education with energy engineering experience.

Students with sustainability-related outcome expectations are underrepresented in engineering. [10] Therefore it is not only important to raise awareness of engineering but to also show that engineers are needed to address energy and sustainability challenges. It is never too soon to introduce a child to energy engineering. Therefore, the Model also utilizes undergraduates as ambassadors of the university to act as engineering role models and disseminate their intellectual knowledge to the local community through K-12 engineering education outreach avenues such as Family STEM Nights and Energy Clubs. The undergraduates can simultaneously raise energy engineering awareness while educating and inspiring K-12 students to pursue careers in engineering. Figure 1 shows the three focus areas: Energy Engineering, K-12 Engineering Education Outreach, and Academics and how they intersect to give the student multiple educational experiences related to energy.

THE ENERGY ENGINEERING AND EDUCATION OUTREACH MODEL

The Model is designed to give students the opportunity to learn about energy engineering, efficiency and conservation from professionals in the facilities management departments and/or energy centers at

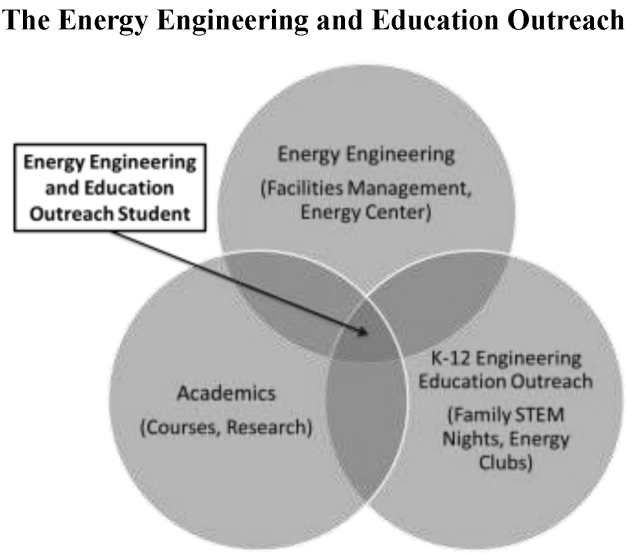

Figure 1: The Model—Energy Engineering and Engineering Education Outreach Student

their respective institutions. Because of budget cuts and the increasing size of campuses, additional resources are needed, and undergraduates are valuable resources for the facilities management teams. The knowledge they gain can then, in turn, be used to help the institution reduce energy usage (and consequently greenhouse gases) thereby helping achieve the target goal of 30% reduction in energy by 2015. By helping the institution save energy, the student is also helping it save money. Helping their institution instills a sense of pride and creates a stronger, lifelong bond between the student and their alma mater. The student can also take the skills learned back to their home community where they can help local schools, government, non-profit, and faith-based organizations save energy.

By working with K-12 Engineering Education Outreach, they are not only able to disseminate their knowledge to the community, promote ST(EE)2M, but also improve communication skills [7] and learn their value as ambassadors of the university and mentors to the children while simultaneously gaining confidence in their academic fields. [5]. K-12 students are highly motivated by and respond very positively to college students. [11] Therefore, undergraduates can play a significant role towards inspiring young scholars to study ST(EE)2M disciplines.

By gaining experience in these sectors, the undergraduates are able to make better decisions about their academic career. Having experiences outside their academic bubble may give them better insight into why they are learning what they are learning and can have a positive influence on their studies.

To experience each focus area, undergraduates should have the opportunity to work 8-10 hours per week with the institution's facilities management department or energy center and 2-5 hours per week working Family STEM Nights or assisting with energy clubs as part of K-12 Engineering Education Outreach. Based on experience from the two programs, one can generally expect undergraduates to work 10-15 hours per week while taking classes.

The Model Evolution

The Model evolved from two successfully implemented programs at North Carolina State University. The State Energy Internship Program [7] is an example of the impact that undergraduates can have on assessing areas of energy savings in the energy efficiency and conservation sector. Sixty-two undergraduates were placed with mentors in both the private and public sectors. Participating companies included Stantec, Fluor Enterprises, RTI and Brady Trane to name a few. The public sector participants included nearby towns and other institutions within the university system. Overall, the 62 interns were able to perform 240 energy audits covering 8+ million square feet, recognizing 19+ million kWh in electric savings and 147 MW in demand savings over a 21-month period. All academic institutions have a facilities management department that, due to economic cutbacks and limited resources, can utilize undergraduates to perform such energy saving measures as lighting audits, net metering projects and checking that VAV boxes are operating according to design [12].

In addition, an average of ten interns helped at thirteen Family STEM Nights by running engineering-related activities with the K-8 students. Several of these activities were energy related such as the "lightbulb activity" which demonstrates the energy saving characteristics of a CFL versus an incandescent lightbulb by melting chocolate as shown in Figure 2. Family STEM Nights and energy clubs are successful outgrowths of the university's National Science Foundation GK-12 Outreach program called RAMP-UP (Recognizing Accelerated Math Potential in Underrepresented People). [2,7] According to 2010 data,

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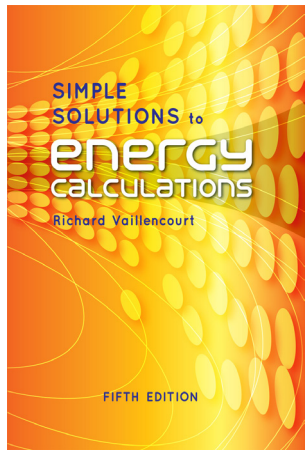

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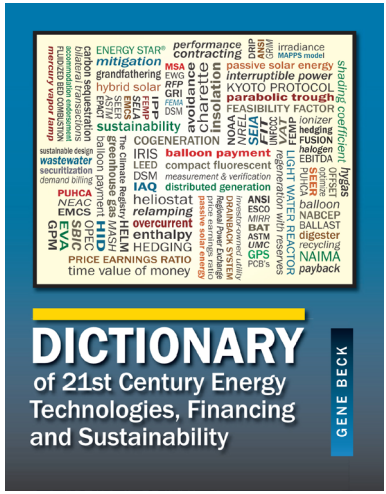

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NSF has funded over 299 programs at 182 institutions [1] throughout the country. Family STEM Nights have been shown to increase awareness of engineering and improve popularity of STEM disciplines among elementary and middle school students. [3] Energy clubs have raised awareness in elementary school students as to what engineers do, what technology is, and the engineering design process. [4].

Below are some of the observations and lessons learned from each program.

- It is feasible to hire undergraduate and graduate students as biweekly temporary employees of the university and place them outside the university in both private and public organizations and institutions. They can reliably work 10-15 hours per week.
- To place undergraduates at institutions outside of their academic institution, a Memorandum of Understanding (MOU) was required and created by the university legal team to establish ownership of intellectual property, address safety concerns and other legal requirements.
- Energy interns enjoyed supplementing their academics and energy internship with engineering education outreach opportunities such as Family STEM Nights.
- There is a great demand for Family STEM Nights and Energy Clubs [4]. Undergraduates are the perfect resource to help run these programs.

Figure 2: Family STEM Night Lightbulb Activity—melting chocolate on an incandescent lightbulb

- There is a great need for additional resources to help with energy conservation efforts across campuses through facilities management departments or energy centers. Undergraduates can fill this need while simultaneously gaining valuable experience.
- K-12 students are highly motivated by and respond very positively to college students. [11]
- By utilizing undergraduates, one can cost-effectively disseminate intellectual property to the community and impact a greater number of K-12 students. [2]

CONCLUSION

The Energy Engineering and Education Outreach Model uses interdisciplinary educational experiences to give undergraduates the opportunity to learn about energy engineering and K-12 engineering education outreach while helping the university save energy, promote energy careers and inspire K-12 students to pursue ST(EE)2M disciplines. There is a great need to promote ST(EE)2M in order to replenish the energy engineering workforce. It is not only important to make undergraduates aware of this field but also to promote the field to K-12 students. The Model is flexible and can be applied at other academic institutions. Ultimately, the Model has the potential to infuse new energy into university programs and help develop a much needed supply of energy engineers to meet the demands of society.

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Lynn A. Albers, Department of Mechanical and Aerospace Engineering, North Carolina State University, based the Model on her personal graduate experience. As a graduate student in mechanical engineering, she was the project coordinator for the SEIP program and a program manager for the RAMP-UP program. As project coordinator for SEIP, she helped place and mentor the 62 interns in the program. As a RAMP-UP program manager, she oversaw a team of undergraduates that worked in local, public, inner city elementary and middle schools teaching STEM through hands-on activities through energy clubs and Family STEM Nights. Prior to returning for graduate work, the author worked at Nortel Networks as a systems application engineer and project manager. For further inquiries, please feel free to email the author at laalbers@ncsu.edu.