

Chapter 22

Physics of Energy: A Sustainability–Themed University Travel Course

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ABSTRACT

A new physics course was offered at Pacific Lutheran University in Tacoma, Washington, which provides students with an understanding of the underlying physical principles of traditional and alternative energy production. The course was a travel course in the western United States, an ideal area to study practical use and research of hydroelectric, wind, nuclear, solar, ocean wave and geothermal energy sources. This sustainability-themed course was taught for the first time in January 2011 and traveled via the Amtrak Coast Starlight train, making stops in Washington, Oregon and California. Students studied the connection between resources, energy and surrounding communities. This chapter lists learning objectives, lecture and lab topics, energy sources and locations visited. Additionally, this chapter describes motivation for a sustainability-themed course in physics and contains a discussion of the unique experience of traveling with students.

INTRODUCTION

Given the limited natural resources and changing global climate, and noting our culture's tendency to ignore "behind the scenes" production of material products, food, water and energy, it is extremely important for all people to increase

their awareness of how our natural resources are used. The focus of this chapter is to describe a class that addresses this concern for energy. I provide one possible answer to this question for higher education instructors: How do we educate our students about sustainability and encourage energy production awareness?

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This chapter describes an example of a sustainability-themed college level course on energy, taught as a hybrid of on and off campus learning. The basic idea and framework of this course could be adapted to be taught by instructors in other fields of specialty (for example, geology, environmental science, public policy or business), adjusted to target various student levels and as a general or specialized topic. Justification for such a course is a need for renewable energy education, research and technology, as well as for scientists and future leaders who have interdisciplinary education. In an initial offering of *Physics of Energy* in January 2011, the major learning objective for the course was to increase awareness of energy production methods. While some challenges were faced (mostly stemming from logistics of traveling in a large group), student feedback was overwhelmingly positive.

ORGANIZATION BACKGROUND

Pacific Lutheran University (PLU) in Tacoma, WA is renowned for the number of its courses that offer international and study away opportunities. Over 40% of students graduating from PLU have incorporated study-away into their academic experience. PLU's Wang Center is called the center for global education. Their mission is to "Educate to achieve a just, healthy, sustainable and peaceful world, both locally and globally." In addition to semester and yearlong study-away opportunities, PLU offers a January term between fall and spring semesters, a month-long term during which many travel courses are typically offered. Destinations range from as close as the Olympic peninsula in our own Washington state to as far as Antarctica. More information can be found on Pacific Lutheran University's Wang Center for Global Education at <https://www.plu.edu/wang-center/>.

University education offers the flexibility and mathematics background appropriate for courses in energy. To appreciate the challenges

of sustainability, we must understand how our natural resources are used to meet our energy needs. To understand how energy is produced, we must understand some basic physics principles. Energy is an interdisciplinary subject and could be housed in many university departments. However, if you want to study conversion of natural resources into energy and eventually electricity, physics is a natural place to start. Also, in order to increase energy efficiency and optimize production, we must investigate the science behind the phenomena.

SETTING THE STAGE

One of the biggest challenges to sustainable use of our planet's resources is our great need for energy production. There are many methods of energy production, some simple, some complex. These methods use various types of resources. Most of our current energy needs in the United States are met by fossil fuels (oil, natural gas and coal) (EIA, 2013). These resources are finite and rate of world energy consumption is continually increasing. There is a need for renewable energy education, research and technology, as well as for scientists and future leaders who have interdisciplinary education. World leaders recognize the need for alternative energy. President Barack Obama, speaking in his 2012 State of the Union Address about developing energy technology, stated that the USA needs an "all-out, all-of-the-above strategy" (Obama, 2012).

The International Energy Agency defines renewable energy as energy derived from natural processes (*e.g.* sunlight and wind) that are replenished at a faster rate than they are consumed (OECD, 2013). Examples of renewable energy sources are solar, wind, geothermal, hydro, and some forms of biomass. According to the OECD Factbook (2013), renewable energy sources make up about 13.3% of total primary energy supply in the world, mostly from biofuels (10%) and hydro

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