

# Renewable Energy Minor

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## ABSTRACT

In the Spring of 2007, the University of Wisconsin-Platteville started working on offering a renewable energy minor. After gauging students' and employers' level of interest, the goal and the objectives of a minor were formulated. The University of Wisconsin-Platteville has chosen to offer a university-wide interdisciplinary renewable energy minor, which was officially approved in the Spring of 2008 for implementation in the Fall of 2008. The minor has three required core courses and a set of carefully selected electives. The process of establishing a minor included a number of fundamental choices and decisions, some anticipated and some not. Depending on the questions asked and the answers given, the outcome could be different. The purpose of this paper is to summarize the experience and the insights gained during the process to help other engineering programs and educational institutions that may consider a similar offering in the future.

## INTRODUCTION

Currently renewable energy provides a small fraction of energy needs in the U.S. and worldwide. However, its share has been increasing at a rapid pace in the past decade. Environmental concerns and volatile fuel prices are the main forces behind this change. While its use has been increasing, wind energy still has a great deal of unrealized potential. Solar energy use is becoming more widespread but the cost of solar electric power generation is still relatively high. The intermittent nature of wind and solar energy does not make them suitable for baseload power generation until energy storage can be addressed in a cost effective manner; however, they can still play a significant role in a diverse power generation picture, especially in certain geographical areas. If a carbon tax became a reality, this would make wind and solar power more competitive. Several years ago, corn ethanol production was on the rise and many ethanol production plants were being built or planned. With declining oil prices, corn ethanol has seen difficult times more recently. Soaring prices for all grains due to corn ethanol production have also reduced its popularity. However, cellulosic ethanol made from switchgrass, wood chips, and other organic waste is still a promising idea for the future. Corn ethanol could be a bridge to cellulose-based ethanol.

There are many renewable energy programs of various types in the United States<sup>1,2</sup>. For example, John Brown University offers a B.S. degree in renewable energy with three options (design, management, and international development) in addition to offering a minor in renewable energy. Oregon Institute of Technology has a B.S. degree program in renewable energy engineering to prepare graduates for engineering careers in the energy sector in general and the renewable energy in particular<sup>3,4</sup>. The State University of New York in Canton and

Illinois State University also have four-year degree programs in renewable energy. Arizona State University has a program in alternative energy technologies.

University of Nevada at Reno<sup>5</sup> has an interdisciplinary minor program with two tracks in renewable energy open to all students. For engineering students, Track I is more suitable. For most students not majoring in engineering, Track II is more appropriate. New Mexico State University is working with the Institute for Energy and the Environment to offer a minor in renewable energy technologies.

It should be added that the spectrum of programs is much wider ranging from master's degree programs in some universities in Ohio and North Carolina to undergraduate and graduate concentrations in various engineering schools. Some community colleges offer one-year certificates and two-year associate degrees in renewable energy and related fields. The number of such programs under different names has been growing in recent years. Some universities are offering programs on energy or energy engineering as well.

In the Spring of 2007, the University of Wisconsin-Platteville started working on offering a renewable energy minor. An ad hoc faculty committee was formed with membership from the three colleges at the University of Wisconsin-Platteville. The following questions were given to the committee by the administration: "What does energy or renewable energy education mean at the University of Wisconsin-Platteville? What existing and new coursework is needed to accomplish this? Does this start as an emphasis or a minor, and does it progress to a major? What resources are needed to make this happen? What other relevant issues should we consider in this regard?" A university-wide interdisciplinary minor was officially approved in the Spring of 2008 for implementation in the Fall of 2008. The process of establishing a minor included a number of fundamental choices and decisions, some anticipated and some not. The purpose of this paper is to summarize the experience and the insights gained during the process to help other engineering programs and educational institutions that may consider a similar offering in the future.

## INITIAL PHASE

Naturally, many questions arose during the committee process that eventually resulted in offering a minor in renewable energy. Because of its diverse membership from all the university colleges, it started with the name of the committee, since at the outset it was not known what the outcome would be. After some months, it was called the Renewable Energy Committee, which at a later point became the Renewables Council.

The next issues were what our students are interested in and what potential employers need. In our contacts with regional industry, the following questions formulated by the committee were asked: "What is the level of your interest in a possible major or minor in renewable energy at the University of Wisconsin-Platteville? What skill sets in this area do you require most and what is missing? What attributes and knowledge base are on demand most? Are you in need of engineering and technical knowledge or economic and social knowledge? If a major or minor in renewable energy is in place at UWP, in what ways do you think you might want to interact with it? What aspect of your business is expected to grow in importance in the future?" There is a

degree of overlap in the above questions but they were selected to elicit most useful information. At the end, it was determined that regional industry is interested in some type of a university-level renewable energy program and that the university needed to take action.

There has been evidence for a long time that many students are excited about renewable energy. To gauge the nature and the level of interest, students were surveyed. According to the committee report, of the 456 students responding to the survey, 113 students (25 percent) were definitely interested in the first required course, which counts for social science credits, and an additional 176 students (39 percent) were possibly interested in it. Forty-seven students (10 percent) were definitely interested in a minor and additional 197 students (43 percent) were possibly interested in it. It was determined that there is strong university-wide student interest in renewable energy.

The main options to consider were a major, a minor, a certificate, and an emphasis or concentration within a program. A major has been considered by some in the university. Others have been of the opinion that, if a major is going to be in renewable energy engineering, all necessary coursework is built upon mechanical and electrical engineering principles. Their opinion is that renewable energy or renewable energy engineering does not have some unique elements that are not already a part of well-established disciplines. At the end, it was decided that the university would start a program at least at the minor level, which could after some time develop into a major, depending on how things may develop in the future. A minor in engineering only (i.e., renewable energy engineering minor) was an option, which could perhaps be considered if the university committee was unable to reach an agreement on a university-wide minor.

After some possible names for a minor (e.g., renewable energy, alternative energy, renewables) were considered, the committee thought that “renewable energy” is a good choice.

## GOAL AND OBJECTIVES

The committee formulated the goal and the objectives of the minor in a way that it balances technical, economic, social, political, and environmental aspects. It also balances the interests of diverse disciplines such as mechanical engineering, electrical engineering, chemistry, agriculture, industrial studies, and social sciences. This required a great deal of discussion. Another item of discussion was to what extent traditional energy sources and their impacts on environment and society should be included. The consensus was that it is necessary to cover these aspects so that students can have a more complete perspective.

The goal of the minor, as published by the university, is “to help undergraduate students develop and apply an in-depth understanding of issues related to energy, renewable energy, and bio-renewable products and associated markets.”

As published by the university, the objectives of the minor are:

1. Help the student understand the role of energy, energy sources, and energy usage patterns in society.

2. Develop basic knowledge in the student to understand social, economic, and environmental aspects of renewable energy and bio-renewable products.
3. Develop the student's abilities to assess the relative merits and potential impacts of different energy sources including but not limited to solar energy, wind energy, and bio-based fuels.
4. Develop the student's ability to assess the merit as well as potential social and economic impacts of replacing non-renewable goods with products manufactured from renewable resources.
5. Help the student understand how conservation fits into managing efficient use of energy resources.
6. Develop basic knowledge to understand renewable energy and bio-renewable products-related issues in the student's academic major.
7. Develop a multidisciplinary background in renewable energy and bio-renewable products.

#### REQUIRED AND ELECTIVE COURSES

A minor at the University of Wisconsin-Platteville, which is on a semester system, consists of 24 credits. Next, the committee dealt with the issues of how many courses should be required for this minor and what these courses should cover. It was agreed that there would be three required courses with a total of 9 credits. This section gives the descriptions for these three courses as approved by the university. The rest of the minor program has 15 credits of electives with no more than 12 credits from the student's major.

The first required course, ENERGY 2130, is a lecture course that counts as a social science course in the university's general education requirements. It is anticipated that this course will be offered every semester and may be team taught. The course was first offered in the Fall of 2008 with 26 students and is expected to have 17 students in the Spring of 2009.

##### ENERGY 2130 Energy, Environment, and Society (3 credits)

The course will provide the student with an overview of issues related to energy and renewable energy, including usage trends, historical patterns, social responses to energy changes, economic factors, market forces, geographical concerns, the various forms and sources of energy including renewable energy and bio-energy, how these sources may affect the environment, and recent developments in energy policies in the U.S. and the world. Energy, power, energy sources as well as usage patterns by societies over history will be presented. Prerequisite: Freshman Composition II.

The second required course, ENERGY 3240, delves into specific sources of energy and their impact. It has lecture and lab components. This course is anticipated to be offered every Spring

semester and may be team taught. It will be offered for the first time in the Spring of 2009 with about 15 students.

#### ENERGY 3240 Fundamentals of Energy Sources (4 credits)

Traditional, renewable, and bio-energy sources and their characteristics. Advantages and disadvantages of existing and future sources of energy and bio-products. Economic and environmental impact comparisons of various energy sources including wind, photovoltaic, hydrogen, geothermal, and biofuels. Prerequisite: ENERGY 2130.

The third course, ENERGY 4920, is expected to be team taught. It is planned to be offered for the first time in the Fall of 2009 and then every Fall semester in the future.

#### ENERGY 4920 Research or Design/Research on Renewables (2 credits)

An open-ended comprehensive research or design project will be done on renewable energy, bio-energy, or bio-products, by multi-disciplinary teams. Discussion and experiences in project management, team work, and ethics will be included. A written report and formal presentation are required. Prerequisite: ENERGY 3240 and senior standing.

In addressing the issue of elective courses, first a comprehensive list of all existing and relevant university courses was prepared. This list included many courses from a variety of programs at the University of Wisconsin-Platteville. At a later point, this list was pruned to obtain a final list of electives. Currently, there are 25 electives (six from Agriculture, five from Chemistry, four from Electrical Engineering, three from Industrial Studies, six from Mechanical Engineering, and one from Reclamation). For further information on the electives, see the Appendix section. In the future, it is anticipated that some university programs might develop new elective courses for this minor. Any new elective will need to be approved by the Renewables Council.

## CLOSURE

In the past two years, significant progress has been made in planning and implementing a Renewable Energy Minor at the University of Wisconsin-Platteville. This development has been welcomed by the university community and our external constituencies. Informal evidence to date is positive and encouraging. Since the first required course in social sciences has been just completed in December, 2008 and a second required course will be offered in the Spring of 2009, there is no formal assessment data at the present time. A future follow-up paper will report on educational assessment efforts for this minor and describe the experience gained during the implementation phase. It is also expected to address the possible future direction for this minor. Finally, it should be noted that the University of Wisconsin-Platteville has established a Renewable Energy Resource Center which will “serve as a regional teaching and information center providing the latest information on renewable energy sources and technologies”, as stated by the university administration<sup>6</sup>.

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## BIOGRAPHICAL AND CONTACT INFORMATION

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## APPENDIX

The names of approved elective courses (and the number of credits) for the Renewable Energy Minor are given below:

Agricultural Industries - Agricultural Prices and Risk Management (3), Agricultural Commodity Marketing (3), Materials Handling and Energy Seminar (3)

Agricultural Sciences - Grain and Seed Crops (2), Nutrient Management in Agriculture (3), Soil and Water Conservation (3)

Chemistry - Inorganic Chemistry (3), Analytical Chemistry (4), Organic Chemistry & Lab (5), Physical Chemistry & Lab (4), Biochemistry & Lab (4)

Electrical Engineering - Electric Power Engineering (4), Power Electronics and Electrical Machines (4), Electric Motor Drives (4), Power Systems Analysis and Design (4)

Industrial Studies - Biotechnology – the Opportunities and the Repercussions (3), Electrical Power (3), Building Systems Analysis (3)

Mechanical Engineering - Energy Systems Design (3), Power Plant Design (3), Internal Combustion Engine Design (3), Applied Thermodynamics (2), Thermal Systems Laboratory (2), Thermo-Fluid Systems Design (2)

Reclamation - Reclamation Revegetation (3)