

BioFutures

A Biomass Energy Education Supplement to the **KEEP** *Energy Education* *Activity Guide*



Wisconsin K-12 Energy Education Program (KEEP)
College of Natural Resources
University of Wisconsin - Stevens Point



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BioFutures is a supplement to the KEEP Energy Education Activity Guide and Doable Renewables. The supplement can be used as a stand-alone unit, but will be enriched if used in conjunction with the KEEP Energy Education Activity Guide and Doable Renewables. References to the guide and suggested complementary activities are provided throughout this supplement. If you are interested in participating in a KEEP professional development opportunity, please contact the KEEP office at 715.346.4770 or Email keep@uwsp.edu for more information.

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What is the Wisconsin K–12 Energy Education Program?

The Wisconsin K-12 Energy Education Program (KEEP) was created to help promote energy education in Wisconsin. In 1993, the Wisconsin Center for Environmental Education (WCEE) proposed that a comprehensive guide to K–12 energy education in Wisconsin be developed. In 1995, the Energy Center of Wisconsin (ECW), a nonprofit energy efficiency research organization based in Madison, agreed to fund the project. The Wisconsin Environmental Education Board and the University of Wisconsin-Stevens Point also provided support.

In 2000, the ECW (now Seventhwave), worked with KEEP staff to ensure long-term financial support through Focus on Energy, Wisconsin's Public Benefits Program, a public-private partnership offering energy information and services to energy utility customers throughout Wisconsin. The partnership with Focus on Energy ended in May 2012. Recognizing KEEP's value, Wisconsin's six major utilities have continued their funding for KEEP on an annual basis.

For more than twenty years, the Wisconsin K–12 Energy Education Program (KEEP) has been working with teachers, administrators, and energy resource managers to increase and improve energy education in Wisconsin schools. The KEEP curriculum and other services and support materials provide Wisconsin students of every grade level the opportunity to receive a logically sequenced, comprehensive education about energy.

Vision

Communities making informed energy choices now and for a sustainable future.

Mission Statement

The mission of KEEP is to initiate and facilitate the development, dissemination, implementation, and evaluation of energy education programs within Wisconsin schools.

Goal

The goal of KEEP is to leverage teacher education to improve and increase energy literacy in Wisconsin's K-12 communities as a means of contributing to statewide energy savings.

KEEP Accomplishments

A Conceptual Guide to K–12 Energy Education in Wisconsin: Identifies important energy concepts that students should know and understand.

KEEP Energy Education Activity Guide and Supplemental Guides: Contain hands-on, interdisciplinary lessons that are aligned with Wisconsin's academic standards, Next Generation Science Standards and Common Core State Standards and make energy relevant to students' lives.

Professional Development Courses and Workshops for K–12 educators: Provide educators with hands-on experience teaching lessons from the KEEP *Energy Education Activity Guide* and supplements and introduce them to additional energy-related teaching resources. These offerings increase teachers' energy literacy and increase the likelihood that they will implement KEEP materials in their classrooms.

Web-based Energy Literacy Courses: Energy education via the Internet; the content of two interactive courses is available at no charge to teachers year-round via the KEEP website.

Renewable Energy Education: Activities, support materials, and inservice courses provide teachers with background information about renewable energy they can share with students.

Statewide Network of Energy Educators: KEEP provides continued support for teachers via online newsletters, the website, social media, and conferences, and through the lending of hands-on resources, tools, and take-home activities for students as they develop 21st century skills.

Partnerships in Energy Education: Working collaboratively with Focus on Energy, utilities, and various energy resource professionals, KEEP promotes energy education and efficiency in homes, schools, and communities.

Over 6,700 teachers throughout the state have participated in KEEP professional development offerings. These teachers are in turn increasing the quality and quantity of energy education for thousands of Wisconsin K–12 students. These teachers report that they now have the knowledge and experience to teach about energy, and that their classroom teaching includes more activities and lessons about energy.

A Rationale for Biomass Energy Education

Energy education can help students of today handle many of the energy resource issues and opportunities our nation faces. We have challenging energy decisions ahead of us, and the solutions will include a mix of energy efficiency measures, new technologies, and renewable resources. These decisions will need to be made by educated individuals who have a solid understanding of energy basics, including the pros and cons of both renewable and nonrenewable resources.

Understanding energy issues can help students prepare for the future in Wisconsin, the United States, and global communities. Wisconsin does not contain oil, coal, or natural gas reserves and thus, relies on other states and nations for our energy needs. As the shift to renewable energy increases, Wisconsin must take stock of the renewable resources that are available. The most utilized renewable energy resource in Wisconsin is wood burning in homes and industry.

Wisconsin is rich in biomass resources including closed landfills, animal manure, crops such as corn and soybeans, and forested land. Biogas is currently being produced at waste water treatment facilities, closed landfills, and large dairy farms. The use of ethanol, an alternative fuel made from corn, is increasing due to the increased cost of gasoline and pollution regulations placed on six southeastern counties in Wisconsin. Biodiesel is being made in large facilities and by motivated individuals throughout the state for their own use. The uses of more biomass energy forms are likely to increase as time passes.

Maria Boardman, the program coordinator for the Wisconsin Alternative Fuels Task Force, stated that, “development of a curriculum to educate our youth is a step forward in including everyone in the effort to increase awareness on our state’s energy, economic, environment, public health, and transportation needs.” Boardman is specifically interested in the development of activities that increase student awareness about biodiesel and the ethanol fuel blend E85.

Don Wichert, the Director of the Focus on Energy Renewable Energy Program, said, “it is important to educate students today about using this locally available resource.” Before working with Focus on Energy, Wichert was the Chief of the Energy Resources section of the Wisconsin Division of Energy and is considered one of the foremost experts on renewable energy in Wisconsin.

The Wisconsin Department of Administration (DOA), Division of Energy worked with KEEP to apply for a United States Department of Energy grant relating specifically to biomass. KEEP and the DOA proposed to develop a biomass activity guide along with a bookmark contest and public service announcement contest with a biomass theme. The grant was awarded to the DOA and KEEP.

Development of *BioFutures*

A Biomass Energy Education Supplement to the KEEP Activity Guide

In 1997, KEEP developed a conceptual framework for energy education. This framework identified key concepts in energy education that students should learn and understand to become energy literate. They were divided into four themes, with the first theme focusing on fundamental concepts and subsequent themes building on the first and each other toward effective energy resource management practices. For more information about the conceptual framework and its development, visit the KEEP Web site and select Resources.

In 2002, KEEP decided additional concepts addressing renewable energy were needed. Focus groups consisting of teachers and energy resource managers determined that while the first theme adequately covered concepts needed for renewable energy literacy, additional concepts were needed for the remaining three themes.

Using the Delphi process, energy resource managers from around the state helped identify and validate concepts for the revised conceptual framework. The process involved participants reviewing and ranking the proposed list of additional concepts. Their responses were used to prioritize and revise the concepts. The experts then reviewed the list again and agreed that the revised framework effectively addressed the needs of renewable energy education literacy.

The KEEP framework includes renewable energy education concepts in Themes II, III, and IV. This framework directed the development of *BioFutures*. To develop the supplement, teachers participated in a scope and sequence workshop and identified activities that addressed renewable energy concepts in the framework (for Themes II, III, and IV). Given the grade level emphasis appropriate for each of the themes (see below), the activity selection process resulted in activities geared mainly for middle and high school students. Understanding the details of biomass energy development, consumption, and management involves higher level skills more appropriate for older students. Therefore, while there are activities included for elementary students in the supplement, most of the activities are for secondary education teachers.

It is very important, however, that students experience activities related to concepts in Theme I to understand renewable energy and biomass energy concepts. Moreover, it is crucial that students gain an appreciation for renewable energy resources at an early age. This early awareness will support their further explorations of biomass energy resource development and use. *BioFutures* includes several activities that will support awareness of biomass energy resources. Finally, the *KEEP Activity Guide* contains a number of Theme I activities. Teachers can contact the KEEP office to learn how to obtain this guide if they would like a copy.

Following is a further explanation of the development of *BioFutures*.

The development of *BioFutures* occurred in six stages. Each of these stages included an evaluation process to ensure that the supplement successfully promotes renewable energy education.

Stage 1: Conceptual Framework. A review of the KEEP Conceptual Framework was conducted to assess if additional concepts were needed for the development of a biomass energy curriculum. The environmental educators and energy resource managers that reviewed the document determined that the existing framework had the necessary concepts for the development of a biomass energy curriculum.

Stage 2: Scope and Sequence. KEEP conducted a Biomass Energy Scope & Sequence Workshop, involving K–12 teachers. These educators expanded the conceptual framework into a scope and sequence, identifying the grade levels and subject areas in which the concepts should be introduced, developed, and mastered. These teachers also reviewed existing energy curriculum and activity guides to identify potential activities to fit within the scope and sequence.

Development of *BioFutures*

Stage 3: Activity Format. The activity format for *BioFutures* is based on the KEEP *Energy Education Activity Guide* and Doable Renewables format that was previously developed, reviewed, and evaluated.

Stage 4: Activities. *BioFutures* activities were selected based on reviews of published energy education resources. The reviews were conducted by Wisconsin K–12 teachers. KEEP staff drafted, reviewed, and revised activities.

Evaluation Process: Content Review. After activities were drafted, they were reviewed for content accuracy. Professionals in a field relevant to the concepts in the activity evaluated its Background and Procedure for content thoroughness and accuracy. Activities were revised based on these professionals' recommendations.

Piloting and Teacher Review. Each activity was given to two or three classroom teachers to pilot in a classroom. Teachers were given a review form that guided them in assessing the activity for grade-level appropriateness, ease of accomplishment, and success in achieving intended objectives. KEEP staff once again revised the activities based on the reviewers' suggestions.

Stage 5: Supplement Design. After the activities were revised, they were put in table of contents order. The KEEP staff then drafted the front and back matter for the supplement (Introduction and Appendix).

Evaluation Process. Biomass energy and educational professionals conducted a comprehensive review of the supplement. The purpose of this review was (1) to examine the extent to which important energy concepts were covered in the activities and (2) to assess the supplement's cohesiveness and level of organization. KEEP staff then made final revisions to the supplement.

Stage 6: Pilot and Revise. The first publication of *BioFutures* was piloted by K–12 teachers throughout Wisconsin.

Evaluation Process: *BioFutures* was piloted with Wisconsin K–12 educators to assess the effectiveness.

Dissemination of *BioFutures*

BioFutures is being disseminated through KEEP's Website: keepprogram.org. Select **Curriculum** for the link to *BioFutures*.

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Introduction

BioFutures, the KEEP biomass energy supplement provides K–12 teachers in a variety of subject areas with easy-to-use, hands-on, minds-on activities designed to promote energy literacy in Wisconsin students. The Wisconsin Department of Public Instruction's Academic Content and Performance Standards were referenced during the development of this supplement.

Grade Levels and Theme Emphasis

Concepts within all the themes from the KEEP *Conceptual Framework* are relevant to teachers at any grade level and in a variety of subject areas (see Cross-Reference Charts: Grade Levels and Subject Areas in Appendix). However, when building a K–12 renewable energy education program, certain themes can be stressed at different grade levels. For more information about the KEEP *Conceptual Framework*, visit the KEEP Web site and select *Resources*.

Participating in activities from **Theme I: We Need Energy** provides students with a fundamental knowledge about energy. The concepts within this theme are the foundation upon which concepts in the other three themes are built. Therefore, *We Need Energy* should be emphasized in grades K–5. The KEEP *Activity Guide* as well as KEEP's *Renewable Energy Web site* offer a variety of lessons and ideas for supporting student learning of Theme I energy concepts.

Activities and teaching ideas from **Theme II: Developing Energy Resources** have students identify and look at different sources of energy. These concepts are appropriate for the elementary grades, especially grades 3–5. However, other concepts within this theme require higher level thinking skills because students must interpret and examine the process of energy resource development. Therefore, many of the activities from this theme pertain to students in middle school.

Awareness of how renewable energy use positively and negatively affects quality of life, economic activity, and the environment can begin during the primary grades; however, because of the complexity of many issues, these concepts may be better introduced at a later stage. The majority of the activities within **Theme III: Effects of Energy Resource Development** are appropriate for the middle school years. High school students can take what they have learned earlier and use the knowledge and skills to conduct special projects (see Appendix). Educators can teach younger students the importance of renewable energy use. However, younger students may not comprehend the reasoning behind these efforts until they learn to think more abstractly.

The higher level thinking skills (such as linking economic activity and energy flows, linking environmental impacts and energy flows, and extrapolating how today's actions could affect the availability of energy resources tomorrow) are best suited for more mature students. Consequently, most of the activities from **Theme IV: Managing Energy Resource Use** are designed for middle and high school students. By the time students graduate from high school, they should have mastered the concepts and learned lessons from the world around them. These competencies will enable them to make wise decisions regarding energy choice, to understand the workplace and career opportunities and associated school-to-career elements, and to take actions that reflect their personal ethic and knowledge of energy.

Types of Activities

Activities in *BioFutures* are fully developed activities that provide educators with background information, explicit objectives, a detailed procedure, and assessment strategies. They are designed to be self-contained lessons. Background information is usually found within the activity; occasionally other sections of the guide may be referenced. Most activities require some preparation time to locate and set up materials; however, this time should decrease with successive uses. For the most part, the materials for the activity should be available in local stores or within the school.

Introduction

Integrating Energy Concepts

Concepts in *BioFutures* are applicable to teachers of Science, Mathematics (Math), Social Studies (SS), English/Language Arts (ELA), Technology Education (TE), Environmental Literacy & Sustainability (ES), and Family and Consumer Education (FCE), or to anyone who wants to promote energy as part of their curriculum. Educators can use KEEP Cross Reference Charts to identify activities relevant to a variety of their teaching needs, such as *Subject Areas* and *Grade Level*. KEEP activities can be used to address the Academic Content and Performance Standards developed by the Wisconsin Department of Public Instruction. These standards identify what students should understand and how they should demonstrate achieved learning. For more information about state standards, contact the

**Wisconsin Department of Public Instruction,
P.O. Box 7841, Madison, WI 53707-7841**
<https://dpi.wi.gov/>

In addition to the various Cross Reference Charts, educators and curriculum developers can refer to the *Suggested Scope and Sequence* in the Appendix that provides guidelines showing when and to what extent energy concepts could be integrated into school curricula. For example, teachers can use the Scope and Sequence to identify the concepts appropriate for their subject and grade level. The next step for educators is to determine which of these concepts are already included in and which are lacking from their curricula. Activities found within *BioFutures* provide teachers with opportunities to bring these energy concepts into their curricula.

Assessing Student Learning

BioFutures provides several approaches for assessing student learning. It is helpful to assess students' current understandings and misconceptions about energy. Orientation of each activity procedure provides suggestions for ascertaining what students know about the upcoming lesson. Formative and Summative Assessment ideas are located within each theme activity. Formative Assessment points out times during the activity when educators can check their students' achievement of the objectives. Summative Assessment takes place near the end of the activity or after the activity's completion. The aim of Summative Assessment is to determine if students can take what they have learned and apply it to a different experience.



Activity Format

Objectives

Knowledge and skills students will acquire as a result of doing the activity.

Materials

Items needed for the activity. Any necessary preparation of materials is described in *Getting Ready*.

Background

Description of energy topics and concepts addressed in the *Procedure*.

Procedure

Orientation

Discussion topics that can be used to relate forthcoming concepts to students' lives and to assess what students currently know about the concepts in the activity.

Steps

Suggested strategy for completing the activity. Written instructions and materials for students are found on separate *Student Activity Sheets* directly following the activity.

Closure

Discussion topics that can be used to conclude the activity and to assess what students have gained from participating in the activity.

Assessment

Formative

Questions about student actions that occurred during the activity.

Summative

Suggested activities that have students applying learned information or skills to new situations.

Extensions

Variations and additions to the activity.

Summary:

Briefly describes student learning and activity procedure.

Grade Level:

Suggested grade levels: K–4, 5–8, 9–12

Subject Areas:

Relevant subject areas.

Setting:

Recommended location.

Time:

Preparation: Approximate time needed to review background information and set up materials.

Activity: Average class time needed to conduct the activity.

Vocabulary:

Key terms introduced or used in the activity.

Major Concept Areas:

Lists the major concepts covered in this activity.

Getting Ready:

Directions for preparing materials or setting up demonstrations prior to conducting the activity with students.

Academic Standards:

A list of standards that can be tied to the activity.

Resources:

A list of books or Web sites that relate to the activity.

Related KEEP Activities:

Theme activities that can precede, supplement, or follow this activity.