Alternative Energy Center

Final Scientific/ Technical Report

Date: September 7, 2007
Award Number: DE-FC36-04GO14218
Project Title: Alternative Energy Center
Project Director/Principal Investigator: Howard Dillman
(Former Principal Investigator - Ruth Borger)

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No Limitations on Distribution

I. Executive Summary

The Lansing Community College Alternative Energy Center was created with several purposes in mind. The first purpose was the development of educational curricula designed to meet the growing needs of advanced energy companies that would allow students to articulate to other educational institutions or enter this growing workforce. A second purpose was the professional development of faculty and teachers to prepare them to train tomorrow's workforce and scholars. Still another purpose was to design, construct, and equip an alternative energy laboratory that could be used for education, demonstration, and public outreach. Last, the Center was to engage in community outreach and education to enhance industry partnerships, inform decision makers, and increase awareness and general knowledge of hydrogen and other alternative energy technologies and their beneficial impacts on society. This project has enabled us to accomplish all of our goals, including greater faculty understanding of advanced energy concepts, who are now able to convey this knowledge to students through a comprehensive alternative energy curriculum, in a facility well-equipped with advanced technologies, which is also being used to better educate the public on the advantages to society of exploring alternative energy technologies.

II. Public Benefit

America's dependence on foreign oil has been rising since the 1970's when we reached our national peak oil production. At the same time, with only minor exceptions, the United States has experienced an ever increasing demand for oil. In more recent years, this American trend has been mirrored by developing nations and the world at large resulting in an ever increasing demand for energy while the world oil production approaches its peak. Political and economic instability in some oil rich areas of the world brings into question the long term availability of inexpensive energy produced from oil. In addition, evidence continues to mount suggesting that the world is experiencing a warming trend which is being augmented by human consumption of fossil fuels including oil as the largest source of energy today. The combination of an uncertain energy future based on oil alone, and the environmental effects of its continued consumption, requires that we look at advanced alternative energy sources. Several of these sources have been identified, including wind, photovoltaic, geothermal, and alternative fuels such as ethanol, CNG (compressed natural gas), propane, and hydrogen. Each of these energy sources has great potential as well as great challenges, not the least of which is the necessary infrastructure to produce, distribute, store, and utilize this energy. Additional challenges include the ability to educate the public on the viability of these energy sources in order to facilitate early adoption of this emerging technology. Another constraint to early adoption is the development of a highly trained and educated workforce, not only to assist in the research and development needed to overcome the challenges of this new technology, but also to operate and maintain the equipment necessary to put it into practical use. A necessary prerequisite to the education of this workforce is the expansion of the knowledge base of the nations' educators related to these new and exciting

technologies. With knowledgeable educators and an informed public, two other ingredients are necessary in order to assist in the full development of the needed workforce. These are 1) having a fully developed curriculum of study to educate the workforce and public as well as 2) having the equipment and facilities needed to do so. Thus, with faculty development, public outreach and education, a properly equipped energy lab, and a fully developed curriculum, a community college is ready to help eliminate a critical infrastructure constraint in the adoption of emerging energy technologies. The present project was created in order to bring this benefit to the public at large.

III. Goals, Objectives and Accomplishments

The goals and objectives of this project can be divided into four specific areas. These are; Curriculum Development, Faculty Development and Teacher Preparation, Community Education and Outreach, and Equipping an Alternative Education Technology Lab/Facility. We will address each of these in the paragraphs that follow.

A. Goal/Objective – Curriculum Development

Task #1 -- Curriculum Development

Lansing Community College will develop and integrated, multi-level hydrogen/alternative energy curriculum with a practical, hands-on, applications-based approach.

Deliverables

- Hydrogen and Alternative Energy continuing education curriculum.
- Hydrogen retraining for current technicians transitioning from automotive applications to hydrogen/alternative energy areas.
- Update current alternative fuels certificate of completion.

Accomplishments:

A comprehensive Alternative Energy Engineering Technology Curriculum has been developed, piloted and is now being offered to students on a regular basis. The curricula guides and syllabi are attached for your ready reference in Appendix A. Additionally, these courses have been designed to be completed individually by students as a part of their own continuing education. Likewise, the automotive alternative fuels curriculum has been revised to better reflect the needs of the community and to address the specific needs of technicians transitioning to areas that involve advanced alternative energy. This curriculum and the syllabi of those courses are also attached for your ready reference as Appendix B. Finally, because of much of the faculty development which has taken place, these courses and curricula will continue to be updated as developments occur in this emerging field.

B. Goal/Objective - Faculty Development and Teacher Preparation

Task #2 -- Faculty Development and Teacher Preparation

Lansing community College will team with industry and business leaders to provide a variety of opportunities for faculty members to grow in their knowledge and ability to teach hydrogen/alternative energy curricula. Lansing Community college will offer a variety of training to allow faculty in diverse fields to teach the curricula noted above.

Deliverables

- Develop and maintain online teaching resources linked to new curricula resources that will be tailored to the needs of faculty members.
- Offer an annual daylong faculty advancement opportunity related to hydrogen/alternative energy teaching issues, as well as regular, small-group opportunities throughout the course of the academic year.
- Identify specific faculty members for intensive exposure to hydrogen/alternative energy content areas and professional growth.
- In addition to the providing the learning opportunities above, LCC will also share resources with colleague colleges in Michigan and across the nation through the college's website, conference presentations, and regional workshops.

The following are accomplishments based on the above deliverables:

During August 1, 2004 – December 31, 2004of this project, faculty members met with and assisted in the planning of a campus-wide faculty day focused on hydrogen and alternative energy. Due to the delay in equipment installation, faculty requested hosting this event later in the academic year. From January 2, 2005 – March 31, 2005, faculty members participated in several national and local conferences in order to educate themselves about hydrogen/alternative energy. These conferences included:

1. Clean Heavy Duty Vehicles Conference, Palm Springs, CA
2. The Economics of Green Building Conference, Pontiac, MI
3. Performance Racing Industry Conference, Indianapolis, IN
4. Specialty Equipment Manufacturers Association Conference, Las Vegas, NV

During April 1, 2005 – June 30, 2005, faculty members were involved in several faculty development activities. They included:

1. Fuel Cell 2005 Conference, Minneapolis, MN
   A full-time faculty from our electrical program attended this conference in June to assist in the course development for HVAC and Electrical courses.

2. Several "brown-bag" sessions during our Fall Kick-off program were used as a method for disseminating information to other college staff and faculty. The presenters were those who have had the opportunity to attend conferences and workshops to share what they have heard.

3. SBIC/LCC Green Building Guidelines Seminar-LCC and the Sustainable Buildings Industry Council hosted a seminar designed to introduce the concepts of sustainable or green home design. This was housed at LCC's West Campus facility where architects, designers, contractors, students and governmental policy makers were invited. Over 18 LCC faculty, staff, and students had the opportunity to attend.

4. National Hydrogen Association Conference 2005, Washington, DC

The task of researching and coordinating the attendance at conferences and workshops was assigned to one individual. This was done to ensure we had a comprehensive approach to selecting the appropriate workshops/conferences, as well as the appropriate faculty/staff to attend. This individual was be responsible for creating a coordinated approach to reporting out to the rest of the college.

The quarter beginning July 1, 2005 and ending September 30, 2005 proved to be an extremely active one with faculty members participating in several international, national, regional, and local conferences. Faculty members presented at several of these conferences in addition to sharing the hydrogen/alternative energy developments at Lansing Community College including the following:

1. International Colloquium on Environmentally Preferred Advanced Power Generation (ICEPAG), Irvine, CA

In the next quarter (October 1, 2005 – December 31, 2005), faculty members were involved in another round of training and development, participating in the following events:

1. Fuel Cell Durability Conference
2. Reinvention Symposium 2005, Miami, FL
3. Specialty Equipment Manufacturer's Association Conference, Las Vegas, NV
4. Sustainable Curriculum Development Meeting, Grand Rapids, MI
5. Great Lakes Renewable Energy Association (GLREA) Energy, Lansing, MI
6. Energy & Environmental Building Association (EEBA) Houses that Work (this involved faculty and students enrolled in alternative energy classes). This event is one of the first events where students enrolled in the Lansing Community College's Alternative Energy Engineering Technology (AEET) program are simultaneously learning and teaching others about alternative energy. Lansing, MI
7. Housing Education and Research Association (HERA) Conference, Golden, CO

Faculty members continued to work with industry and business leaders by actively participating in conferences across the nation. With continued exposure to the hydrogen/Alternative energy efforts at Lansing Community College, faculty members are now being actively recruited to share their growing expertise. First quarter events 2006 (January 1, 2006 – March 31, 2006) included the following faculty/staff development:

1. NFL Environmental Program for Students
2. Hydrogen & Fuels Event for Teachers & Students, Southfield, MI
3. Leadership in Energy and Environmental Design (LEED) for Homes Pilot Program, Grand Rapids, MI

From April 1, 2006 – June 30, 2006, we continued to encourage faculty/staff development in key areas:

1. Fuel Cell & Energy Storage Seminar
2. WINDPOWER Conference, Pittsburgh, PA
3. Great Lakes Renewable Energy Association (GLREA) Conference, Onekama, MI
4. HAAS Racing Center Visit, Canton, OH
5. Haas CNC Racing & Hendricks Racing, Charlotte, NC
6. NEOCon GreenLife Conference, Chicago, IL
7. SUNY Delhi College of Technology Faculty Exchange May 2006. The event was hosted by SUNY in New York. Below is the attendee list:

During July 1, 2006 – September 30, 2006, faculty members continued to be involved in meeting the goals of this grant award. In this last quarter, we sent faculty to several conferences and made plans to attend some others during the remaining quarter:

1. International Straw Bale Building Conference, Ontario, Canada
2. West Coast Green Residential Building Conference, San Francisco, CA

In our January 31, 2007 report, which covered the October 1, 2006 – December 31, 2006 quarter, the following activities were completed by faculty members:

1. Specialty Equipment Market Association (SEMA), Las Vegas, NV
2. Energy & Environmental Building Association Excellence In Building, Norfolk, VA
3. Housing Education and Research Association, Ithaca, NY
4. Refrigeration Service Engineers Society **(**RSES) 2006 Convention, Atlanta, GA
5. Greenbuild International Conference and Expo, Denver, CO

Faculty and staff continued to attend conferences through the end of this project. Those conferences attended during the last two quarters included:

1. Affordable Comfort Institute (ACI), Cleveland, OH
2. National Renewable Energy Laboratory (NREL) Conference, Denver, CO
3. WINDPOWER Conference, Los Angeles, CA
4. AGRI-ENERGY Conference, Lansing, MI
5. MI Energy Fair, Onekama, MI

C. Goal/Objective – Community Education and Outreach

Task #3 – Community Education and Outreach

Lansing Community College conducted a public awareness campaign in the community, and among local and state decision and law makers to increase the general knowledge and understanding of hydrogen/alternative energy technologies their benefits, and their potential impact on society.

Deliverables

- Community Outreach Plan
  - A comprehensive hydrogen awareness plan was developed to enhance the public's awareness of hydrogen and alternative energies and viable choices.
- Assessment of Public Opinion
  - Using LCC survey research programs, and mirroring the national survey assessing public opinion on hydrogen and alternative energies, LCC explored opportunities to leverage partnerships to assess the state-wide knowledge of the opinion toward hydrogen as an energy source.
- Decision Maker Outreach
  - Specific activities to educate local, regional, and state decision makers will continue throughout the project. These will include presentations at key conventions and gatherings.
- Print Collateral/Website
  - Use LCC website to distribute information to other community college, K-12, and post secondary, and community based organizations. Produce paper-based, "leave behind" materials for educational settings.

Accomplishments for the August 1, 2004 – December 31, 2004 quarter are listed below:

1. Additional personnel resources were identified and contracts offered.

2. The West Campus Grand Opening was on November 8, 2004 and showcased the Alternative Energy Program and proposed laboratory.

3. LCC presented *Implementing the Alternative Energy Technology Curriculum* at the NextEnergy Conference for educators in November 2004.

4. A panel presentation was on the agenda and well attended for the **Subtask:** Decision Maker Outreach.

5. Attended Association of Community College Trustee (ACCT) Annual Meeting, New Orleans, LA

During the next quarter January 1, 2005 – March 31, 2005 the team accomplished the following tasks:

The College hired an outside agency to assist in the creation and dissemination of information related to our alternative energy initiative. Here is a sampling of what has been accomplished to date:

1. A public awareness plan is complete.
2. We are in the process of developing a press kit which will explain the College's involvement in alternative energy and also offer the media a list of contacts within LCC and their areas of expertise.
3. We have developed a newspaper ad with an Earth Day theme promoting the College's commitment to alternative energy in its curriculum.

On March 23, 2005 LCC co-hosted a Geothermal Forum with the Michigan Geothermal Energy Association. About 30 participants attended to learn more about geothermal energy hear about LCC's curriculum, and take a tour of the College's geothermal heat pump system. The participants were comprised of the general public, LCC faculty and local heating and cooling contractors and home builders. Invitations to this event were sent to the following organizations: Greater Lansing Home Builders Association, Greater Lansing Realtors Association, The Nature Conservancy, Michigan Association of Home Builders, Michigan Nursery and Landscape Association, Michigan Plumbing and Mechanical Contractors, Air Conditioning Contractors of America (Michigan Chapter), and the Michigan Society of Professional Engineers.

Key contact meetings have been held with the University of Michigan, the Michigan Economic Development Corporation and other alternative energy companies.

Attended Detroit (DTE) Energy Conference, Livonia MI

For further education and community outreach. staff from LCC attended the International Society of Automotive Engineer's annual congress.

During this next quarter, April 1, 2005 – June 30, 2005 a lot of activity occurred related to Community Education and Outreach. The following accomplishments were achieved:

- Collateral materials and the website were completed.

- LCC had a grand opening of its greenhouse in May 2005. It will be used by the Agriculture Technologies, Horticulture, Landscape Architecture, and Precision Agriculture programs for classes starting Fall Semester. It was designed using the same geothermal technologies as the rest of the West Campus building. This was another avenue the College used to educate the general public.

- LCC was involved in a big meeting at Michigan's NextEnergy's new facility in Detroit with all community colleges and some universities to build one education consortium for the State of Michigan. Evaluation of the meeting from those attending indicated LCC's hydrogen/alternative energy curriculum design and projects were well advanced in relation to projects of the other community colleges/universities in attendance.

- LCC met with the leadership of the new energy initiative to explore possible partnerships and collaborations.

Key decision-maker connections included:

- Lansing Rotary-hosted 200 decision makers of the Lansing Rotary Club who toured the West Campus facility and learned about our alternative energy initiative
- State of Michigan alternative energy program and DEQ
- Truckee Meadows CC in Reno, Nevada
- University of Michigan Engineering and Energy Center
- General Motors Knowledge Center
- Ongoing meetings with Collaboration LLC
- Central Michigan Sustainable Business Forum
- Society of Automotive Engineers Conference
- Monroe County Community College

Key Awareness Activities

- Presentation at DOE hydrogen conference
- Two Clean Cities events
    - held a press conference to announce establishing a partnership with Clean Cities and LCC; a natural synergies between our programs and how that will promote the public awareness of advanced and alternative fuels in our community.
    - supported the community college one-day conference at LCC that educated fleet supervisors, and others on use of alternative fuels in busses and vehicle fleets and announced the donation of an ethanol fuel fleet vehicle (an SUV) from General Motors to the State of Michigan.
- Hosted Sustainable Business Forum

LCC worked with key individuals from the State of Michigan involved with alternative energy technologies, including the Central Michigan Sustainable Business Forum, to explore partnership options on Green Energy and Technology.

The Quarter beginning July 1, 2005 and ending September 30, 2005 allowed LCC to make significant progress regarding Community Education and Outreach. LCC in cooperation with the University of Michigan created a Fall Advanced Energy Conference held at the State Capitol on September 21, 2005. This provided us with yet another opportunity to educate the public on what LCC is doing as well as introduce them to hydrogen/alternative energy technologies.

Some collateral materials were developed and the website is operational at www.lcc.edu/energy.

We completed two brochures–one for the general public and one for policy makers–and have printed them in sufficient quantities to serve our immediate needs. Those brochures are being distributed at speaking engagements and community events. They are designed and written to

provide basic information and to engage the audiences in such a way that prompts a response, such as a visit to the Web site or a call for more information.

Materials for community education events – In addition to the brochures, we have developed a variety of materials to be used or distributed at community education events or presentations:

1. Portable display units: We designed and had produced three eye-catching portable banners showcasing alternative energy that can work together or separately to draw people to informational presentations at trade shows, meetings or speaking engagements.
2. We have magnets advertising LCC's alternative energy program; the magnets prompt viewers to visit the Web site for more information.
3. Information sheet on educational opportunities and curriculum: This is designed for people interested in knowing more about how they can study alternative energy. A list of courses may be printed on the back of the single sheet.

Events

- LCC was the key organizer at a special community education event at the state Capitol on Sept. 21. **(See separate attached report and photographs about this event.)**
- LCC sponsored a renewable energy conference at the Radisson, joining such diverse entities as the Michigan Corn Growers, the state Department of Environmental Quality, the local Board of Water, and Light and various other organizations, in providing educational displays and information. LCC's booth drew requests from parents of potential students, potential industry partners, and others who are intrigued by the Alternative Energy Initiative and want to know more. We used the event to continue to build the e-newsletter contact list as well as to disseminate information.

Speakers Bureau

- Lezott Miller Osburn arranged for LCC to be involved in or sponsor a major Economic Club speaker on the topic of alternative energy in the upcoming year. Economic Club speakers typically are high-profile experts on topics of importance to the state and region.
- LCC faculty member and department chair Howard Dillman spoke at the Golden K Kiwanis Club on alternative energy.
- LCC Vice President for Advancement Ruth Borger and Dillman presented to the Lansing Rotary – a group of 200-plus business leaders in the Capitol region – on the topic of alternative energy.

Media Relations

- A media training session has been developed for key faculty and administrators involved in the initiative; such training is essential to ensure that media interviews help advance the DOE's mission and LCC's programs. The session will include message development, interview strategies and tactics, and on-camera practice sessions.
- We placed the MET Department Chair, Annette Parker, on a Sunday morning business show to discuss current developments in alternative energy technologies.
- We have developed media tips and pitches for National Public Radio and several other regional and national media outlets.

Additional Activities

- We nominated the Alternative Energy Initiative for the Automation Alley Fifth Annual Awards Gala recognition in the education category. Automation Alley is a consortium of more than 500 businesses, educational institutions, and government entities that works to enhance the growth of the technology economy in southeast Michigan. While the Alternative Energy Initiative (AEI) did not win the award, the nomination process enhanced the AEI's visibility to this important group.

- We drafted an education- and usage-focused resolution for Michigan Governor Jennifer Granholm to present to the state legislature proclaiming September 21 as Alternative Energy Day in Michigan.
- Attended NextEnergy/DEQ Meeting, Detroit, MI

For the reporting period October 1, 2005 – December 31, 2005, the website has been redesigned and the materials updated to reflect new information. A staff member has been designated to keep the site fresh and populated with current data, events, and new initiatives. The website can be viewed at: www.lcc.edu/energy.

Below is a summary of outreach activities during this quarter.

Materials for community education events – We have added to the materials previously created by focusing more on curriculum and particular courses available. All materials are available on both campuses for faculty, staff, and administrative use.

Events

- LCC formed a partnership with "The Energy Store" to plan, develop, market, and host an educators' conference in June.
- LCC linked with the local "Clean Cities" group to plan for a public display on alternative energy technologies to be held at the Capitol later in 2006. The display drew capitol visitors as well as lawmakers and their staffs to information on the benefits and availability of alternative energy technologies.

Media Relations

- Key faculty participated in a two-part media training session to help prepare them to conduct interviews that can help advance the DOE's mission and LCC's programs. The session included message development, interview strategies and tactics, and on-camera practice sessions. We developed a pitch on the students' efforts to build a hydrogen-powered race car and will place the story on PR Newswire and conduct specific media outreach related to the story as soon as the engine has been tested.

During January 1, 2006 – March 31, 2006, the New Energy Education **(NEEW) Conference** working group was formed to enhance and supplement marketing initiatives already in place for the New Energy Education Conference, scheduled for June 22-23, 2006 on Lansing Community College's West Campus. Lansing Community College, a conference co-host with the Fuel Cell Store, had planned a statewide event. The conference was intended to help science, math and technology teachers find new and innovative ways to integrate and teach alternative energy in their classroom. The timing of this conference caused it to be cancelled.

Activities of the working group this quarter included:

- Wrote, designed, and printed an informational flyer that was distributed at a statewide science teacher's conference and then mailed to intermediate school districts.
- Wrote, designed, and printed a marketing postcard to be distributed to teachers throughout the state and the Midwest.
- E-mailed information and a news release about the conference to all members of the Michigan/Ohio region of the National Science Teachers Foundation.
- E-mailed information to members of the Michigan Science Teachers Association.
- Determined several appropriate potential keynote speakers, including Michigan State University President Lou Anna K. Simon, and made initial contact to invite them to speak.

- Updated the LCC Web site to include a link that takes people who want to register for the conference directly to the Fuel Cell Store's online registration materials. Go to this website for additional information about this conference http://www.h2conference.com.
- Purchased a half-page ad promoting the conference in the May issue of the Michigan Science Teacher newsletter.
- Attended Detroit (DTE) Energy Conference, Novi, MI

Speaking Engagements

- Continued coordinating upcoming speakers' panel for Economic Club for the purpose of informing the community about LCC's alternative energy initiatives.

Educational Materials

- Developed a template for an e-newsletter about alternative energy for review.
- Developed and constructed informational tabletop display that promotes learning about and utilizing alternative energy technologies and informs people of the potential benefits.

Events

- LCC hosted an informational booth at a statewide science teachers' conference that drew 2,500 attendees. Staff at the booth distributed informational brochures related to alternative energy technologies and to the essential need for K-12 teachers to incorporate information about alternative energy into the curriculum.
- LCC joined Clean Cities in an informational event for legislators at the state Capitol, staffing an informational booth in an area frequented by visitors as well as lawmakers. LCC invited legislative staff members to visit the booth and also distributed informational brochures.

Media Relations

- Revised media relations plan for the first six months of 2006 to reflect changes in media priorities and in alternative energy policies at the national level.
- Contacted Crain's Detroit Business about LCC's DOE-funded alternative energy work and provided them with background information, resulting in inclusion in a story about the state's alternative energy plans.
- Contacted National Public Ratio and other national and regional media to pitch alternative energy as a story topic.
- Drafted feature story on hydrogen engine development at LCC.
- Discussed possible story with the Associated Press.
- Created a media relations plan specifically related to the upcoming fuel cell conference. Had an article published in the "Great Lakes IT Report" about LCC's work in the development of a hydrogen engine (see attached copy of the article).

LCC continued to make significant progress during the April 1, 2006 – June 30, 2006 quarter regarding awareness, education, and outreach**:**

- A two-day workshop for educators in hydrogen fuel cell technology and alternative energy was postponed due to low enrollment. The majority of planning work was completed in the second quarter of 2006 and was the primary focus of advancement activities during this period.
- LCC networked with Keith Etheridge, with NEED, to host their H2 Educate Workshop for teachers in May at the College's West Campus. The timing did not work for NEED, but they are considering partnering with LCC in the future.
- The College, with Lezotte Miller Osburn, has designed an Alternative Energy Lecture series for the academic year 2006-2007.

- Attended and presented at DOE Conference

Media relations:

- Significant regional and national coverage was produced on the College's hydrogen internal combustion engine developed in LCC's automotive technologies division (see separate attachment).

Materials for community education events:

- A free standing display was replaced as some materials were ragged from wear and tear.

Advancement:

- Spearheaded the development of a proposal for an alternative energy knowledge incubator for funding from the State of Michigan's 21st Century Jobs Fund. The program would reach out to small and medium businesses that potentially could develop alternative energy product lines, and provide awareness, education, and technical support. While the proposal made it through a number of stages, we recently received word that it did not advance to the final round in a very competitive process.

During July 1, 2006 – September 30, 2006, not much activity happened regarding Community Education and Outreach. We completed a list of all external contacts that we continued to network with and received a proposal for a capstone public relations program and participation in an informational website that would provide access and linkages to Michigan's alternative energy educational resources. We unfortunately were not selected for a 21st Century Jobs Fund grant but remain hopeful in resubmitting a proposal for incubator business services. We continued to network with National Education Energy Development Project to be the site of an educator's workshop in November 2006.

During October 1, 2006 through December 31, 2006, we accomplished the following:

1. Sponsored Greater Lansing Chamber economic club with General Motors Vice President, Dr. Byron McCormick
2. Continued to promote LCC Alt Energy program
3. Completed Kiosk at West Campus
4. Continued displays at West Campus
5. Continued conversations about sponsorship of a web portal with Kettering University
6. Opted to not pursue K-16 educator's conference

D. Goal/Objective – Equipping an Alternative Education Technology Lab/Facility

Task #4 – Equipping an Alternative Education Technology Lab/Facility

This task focuses on designing, constructing and equipping a hydrogen/alternative energy laboratory and facility that will be use for education, demonstration and various pilot programs.

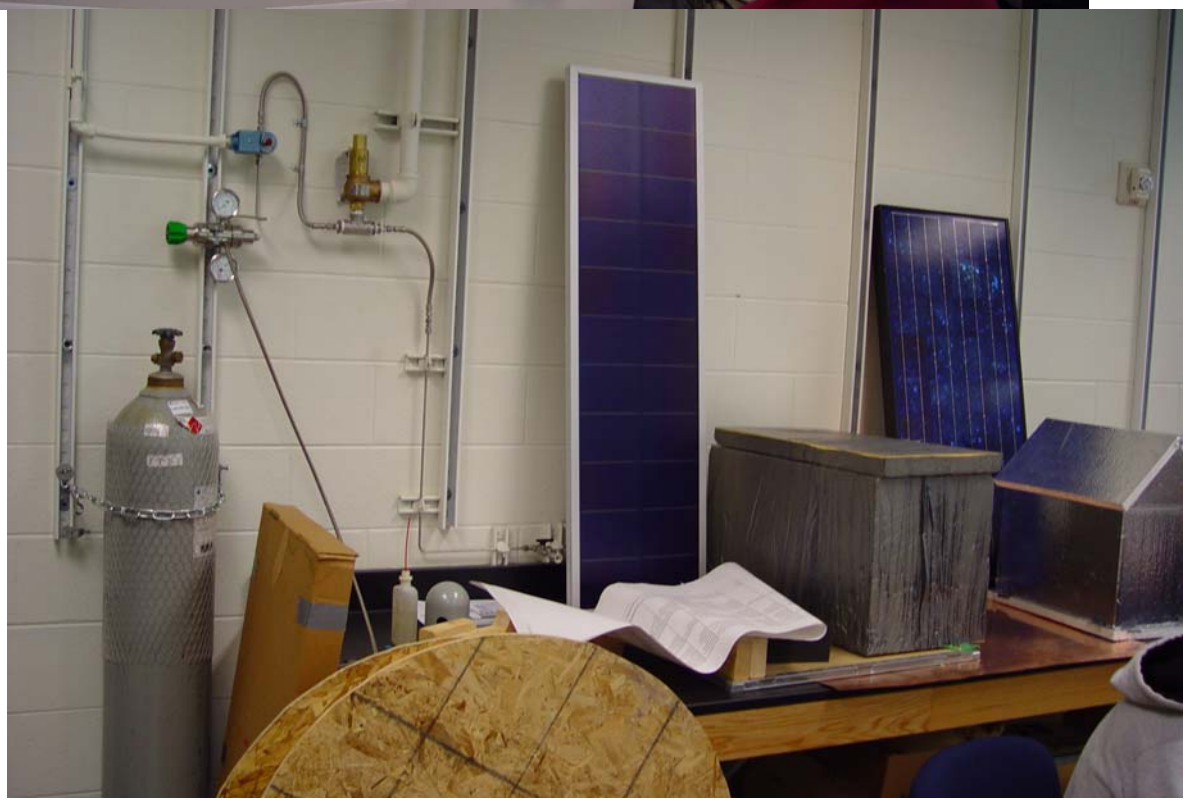
Deliverables

- Equip an energy laboratory with hydrogen/alternative energy equipment, develop a hydrogen safety plan using DOE guidelines, and conduct a safety readiness review with DOE, prior to initial operation of the laboratory facility.
- Provide access to the students, public, business and governmental decision maker to experience how hydrogen/alternative energy applications operate.
- An operating instructional laboratory equipped with hydrogen fuel cells and other equipment that illustrates how hydrogen is used in automotive applications.

Accomplishments

A hydrogen safety plan based upon DOE guidelines was prepared and presented to DOE for their review. After some revisions, this plan was approved and adopted. The plan has now been implemented and is attached at Appendix C. Further, all installations of the labs discussed below were reviewed and approved by the Delta Township Fire Marshall and were inspected and approved by Delta Township building inspectors. One aspect of the safety plan included the outdoor security cage utilized for the storage of hydrogen cylinders and other fuels used in the Alternative Energy Laboratories.

There are many other components of the Alternative Energy Lab. These include lab classrooms that contain hydrogen detection systems, hydrogen fuel cell demonstration boards, and hydrogen fuel cells.

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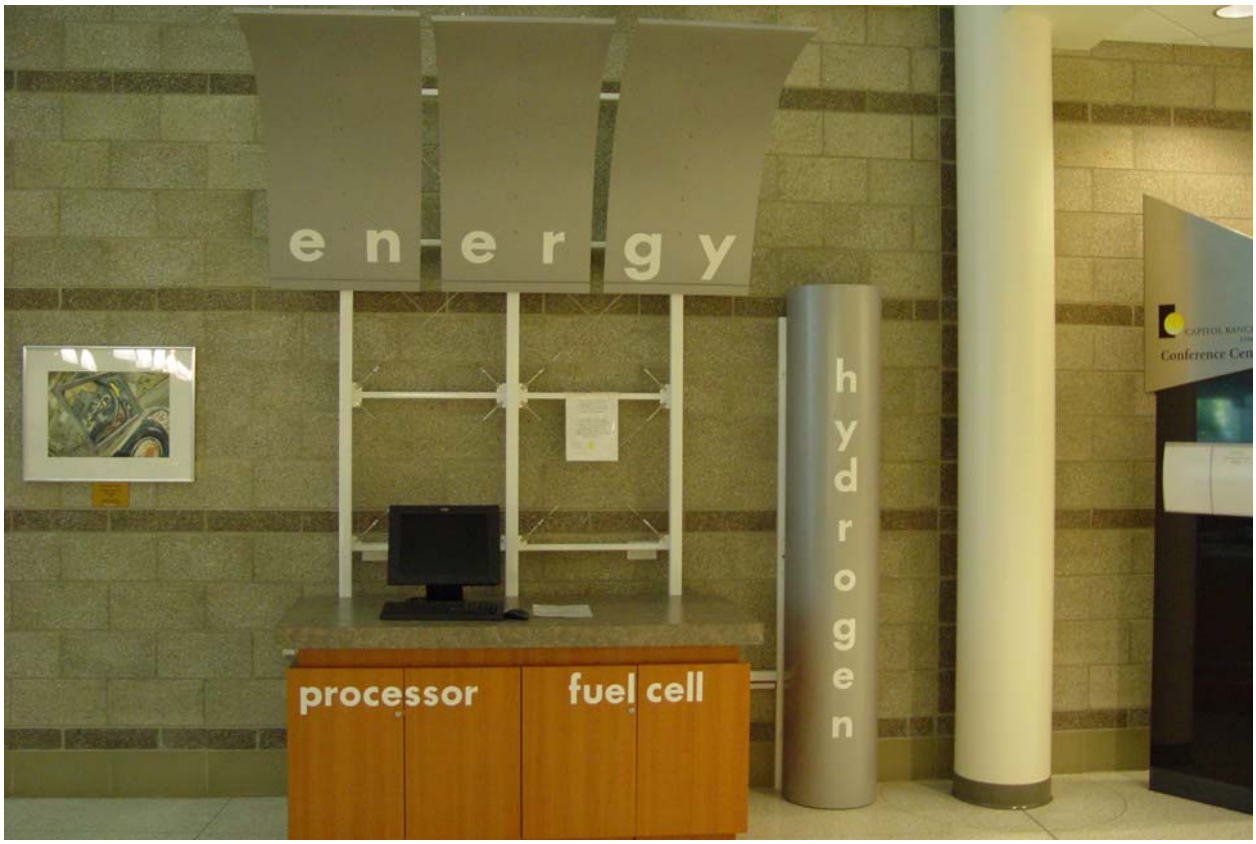
The lab also includes a Wind Turbine together with the associated inverter and batteries.

A hydrogen powered kiosk which allows students to explore websites with information on alternative energy or register for Alternative Energy Engineering courses is located at our West Campus Alternative Energy Center.



Still other aspects of our lab include a mobile public outreach trailer which is used to transport alternative fuel vehicles to public gatherings.

Other aspects of the alternative energy lab related to the automotive field include and engine and vehicle test facility which is being used to test engines and vehicles operating on a variety of alternative fuels such as biodiesel, ethanol, CNG and others.

An integral part of the alternative energy laboratory, faculty development, and public outreach included the development of a hydrogen powered internal combustion engine which is utilized for teaching, experimentation, tuning, and public demonstration.

Yet other examples of lab equipment which is used for student instruction, faculty development and public outreach is our hydrogen Fuel Cell powered golf cart and Toyota Prius Hybrid vehicle which is shown at the education and outreach event held at the Michigan State Capitol building.

In short, all of the goals and objectives of developing an effective Alternative Energy Center capable of educating the workforce, public, and decision makers have been met.

IV. Project Activities

The original idea was to create an Alternative Energy Center where the necessary equipment and trained personnel would be available to educate the workforce, public, and decision makers about energy alternatives. While this was accomplished, it was done after overcoming many obstacles. Each of the four main objectives of curriculum, teacher education, public outreach, and equipping an energy lab presented their own challenges which will be discussed individually.

Developing the content of curricula was arguably the largest challenge. First, identifying the actual tasks students needed to be able to do was particularly challenging given the developing nature of this emerging technology. Identifying the technology most likely to come to market first was difficult since most of this new technology has not yet been universally adopted. Ultimately, since various technologies are being incrementally adopted the approach was to create broad based curricula that would prepare students for a fairly large variety of technologies while at the same time take more specialized approaches in curricula directed at specific industries such as transportation. Likewise, obtaining qualified individuals with content knowledge in these areas was also difficult considering that most individuals who have the specialized knowledge work for private sector organizations that have proprietary interests to protect. Finally, developing a curriculum that also creates seamless opportunities for students to

progress from high school, through an associate's degree and on to a Bachelors or graduate degree presented the usual challenges of working through several organizations policies and procedures to obtain the necessary articulation agreements. The use of advisory committees and the DACUM (design a curriculum) process was used to develop the curricula. Collaboration with other educational institutions helped to identify content experts, and numerous meetings with partner institutions facilitated the development of articulation agreements.

Teacher and faculty development also presented its own challenges. These included the ability to locate valuable and relevant professional development opportunities specifically geared to each teacher's content area and interest. Another constraint was the ability to attract interest from the K-12 community in this type of professional development. While the workshop approach failed to generate the necessary interest, individual contact with K-12 institutions resulted in significant professional development.

Developing an effective outreach approach was problematic. The services of a public relations firm resulted in several effective publications and events. These included numerous presentations by faculty and administrators to civic organizations, technical educators, and legislators. Partnerships with OEM's also enhanced the outreach activities by generating significant press opportunities. These outreach activities continue even after the end of these grant activities and will result in additional outreach opportunities for the indefinite future.

The creation of the alternative energy lab also posed numerous challenges. First, the cost and availability of necessary equipment became an issue. Much of the equipment was more costly than anticipated given it had not yet been fully adopted. Likewise, some equipment such as the hydrogen refueling station was simply too expensive to be within the scope of these grant activities. Also, certain equipment was simply not available to educational institutions such as lightweight composite hydrogen fuel tanks. Nevertheless, the acquisition of most of the equipment necessary was ultimately obtained through diligent effort, and a supply of hydrogen was obtained without a refueling station from industrial suppliers. Another issue was the ability to obtain necessary permits to install a hydrogen capable engine dynamometer. Despite efforts to educate the local municipality this remained a constraint limiting use of this part of the lab to other types of alternative fuels such as E-85 and Bio-diesel. While some of these constraints were insurmountable, the remaining efforts have resulted in and effective lab which will support a broad range of alternative energy education and outreach activities.

V. Products Developed

6. **Products developed** under the award and technology transfer activities, such as:

    a. **Publications (see Appendix D)**

    b. **Web site: www.lcc.edu/energy**

Alternative Energy Center

Scientific/Technical Report

Appendix “A”

LANSING COMMUNITY COLLEGE

CURRICULUM GUIDE

Energy Management Technology
Associate in Applied Science Degree

Curriculum Code: 1293 (Effective Fall 2007 – Summer 2012)

Technicians work on systems that control temperature, humidity, and air quality of enclosed spaces. They are required to evaluate, recommend, install, service, and maintain the various types of equipment used to control human comfort in residential, commercial, industrial and institutional environments. They are also involved in the planning, design, installation and maintenance of a wide variety of energy producing systems, such as solar, wind or fuel cells. This technician will need a working knowledge of "green" building concepts and energy efficient design principles. **Not all courses in this program transfer to all colleges.** Students planning to transfer should see an academic advisor or counselor before enrolling in any course.

PREREQUISITES

Students should see *Course Descriptions* or *Course Offerings* for course prerequisite information. See the *Assessment and Placement Testing* section for skills assessment and advising information.

INFORMATION

Contact the Manufacturing Engineering Technologies Department, West Campus, Room M103, telephone number (517) 483-1339 (Website: http://www.lcc.edu/manufacturing/) or Student Services West Campus, West Campus Building, Room M106, telephone number (517) 267-5510.

REQUIREMENTS — TOTAL: 67 CREDITS

CODE	TITLE	CREDIT HOURS
ADMN275	Diversity in Business	3
AEET102	Prin of Alternative/Renewable Energies	3
AEET215	Geothermal Technology	3
AEET216	Solar Energy Technologies	3
AEET218	Fuel Cell and Hydrogen Technologies	3
AEET250	Alternative Energy Analysis I	3
BLDT103	Structural Blueprint Reading	4
HVAC100	Fundamentals of HVAC	3
HVAC101	HVAC/R Piping	2
HVAC105	Sheet Metal Fabrication & Installation	2
HVAC110	Applied Electricity I	3
HVAC111	Applied Electricity II	3
HVAC120	Heating I	3
HVAC130	Air Conditioning I	3
HVAC201	Mechanical Code	4
HVAC230	Air Conditioning II	3
HVAC231	Heat Pump	3
HVAC251	Fundamentals of Direct Digital Controls	3
MATH119	Investigations with Math	3
PHYS120	The Art of Physics	4
SPCH110	Oral Communications in the Workplace	3
WRIT124	Technical Writing	3

LIMITED CHOICE REQUIREMENTS **TOTAL: 0 CREDITS**

Complete the indicated number of credits from **EACH CHOICE** listed below.

CHOICE 1: General Education Core Areas **0 Credits**

(See *General Education Core Requirements* for information on how to fulfill these requirements. Core area proficiency exams, where appropriate, are available for each core area.)

Communication Core Area (See Note 1)	0
Global Perspectives and Diversity Core Area (See Note 1)	0
Mathematics Core Area (See Note 1)	0
Science Core Area (See Note 1)	0
Writing Core Area (See Note 1)	0
MINIMUM TOTAL	**67**

NOTE:

1. Students completing "REQUIREMENTS" have fulfilled the requirements for this core area.

SUGGESTED COURSE SEQUENCE

Students should see course descriptions to find out when departments plan to offer courses. Students who for any reason are unable to follow the course sequence suggested below (for example, those who are part-time, have transferred in courses from another school, or have prerequisites to fulfill) should contact an academic advisor or counselor for help with adjustments.

I	II	III	IV
AEET 102	AEET 216	AEET 215	ADMN275
HVAC100	AEET 250	AEET 218	BLDT 103
HVAC 101	HVAC 111	HVAC201	PHYS120
HVAC 105	HVAC 120	HVAC 230	SPCH110
HVAC 110	HVAC 130		
WRIT124	MATH 119		

V
HVAC231
HVAC251

LANSING COMMUNITY COLLEGE

CURRICULUM GUIDE

Alternative Energy Technology
Associate in Applied Science Degree

Curriculum Code: 1229 (Effective Fall 2007 – Summer 2012)

Professional Energy Specialists are involved in the inventory, evaluation, planning, design, installation, and maintenance of a wide variety of energy producing systems. Specialists will deal with the integration of current energy courses along with newly developing alternative energy distribution systems. The energy specialist will need a working knowledge of "green" building concepts and energy efficient design principles. **Not all courses in this program transfer to all colleges.** Students planning to transfer should see an academic advisor or counselor before enrolling in any course.

PREREQUISITES

Students should see *Course Descriptions* or *Course Offerings* for course prerequisite information. See the *Assessment and Placement Testing* section for skills assessment and advising information.

INFORMATION

Contact the Manufacturing Engineering Technologies Department, West Campus Building, Room M103, telephone number (517) 483-1339 (Website: http://www.lcc.edu/manufacturing/alternative_energy/) or Student Services West Campus, West Campus Building, Room M106, telephone number (517) 267-5510.

REQUIREMENTS — TOTAL: 61 CREDITS

CODE	TITLE	CREDIT HOURS
AEET102	Prin of Alternative/Renewable Energies	3
AEET110	Energy Site Evaluation	3
AEET120	Conventional Energy Sources and Use	3
AEET215	Geothermal Technology	3
AEET216	Solar Energy Technologies	3
AEET217	Biomass, Biogas and Microturbine Tech	3
AEET218	Fuel Cell and Hydrogen Technologies	3
AEET219	Wind Energies	3
AEET250	Alternative Energy Analysis I	3
AEET255	Alternative Energy Analysis II	3
AEET260	Codes, Regulations and Standards	3
CHEM135	Chemistry in Society	4
ELTE100	Electrical Safety Practices	1
ELTE110	Practical Electricity	3
MATH121	College Algebra I	4
MATH122	College Algebra II and Trigonometry	3
MGMT234	Diversity in the Workplace	3
PHYS200	Introductory Physics With Applications	4
SPCH110	Oral Communication in the Workplace	3
WRIT124	Technical Writing	3

LIMITED CHOICE REQUIREMENTS **TOTAL: 0 CREDITS**

Complete the indicated number of credits from **EACH CHOICE** listed below.

CHOICE 1: General Education Core Areas **0 Credits**

(See *General Education Core Requirements* for information on how to fulfill these requirements. Core area proficiency exams, where appropriate, are available for each core area.)

Communication Core Area (See Note 1)	0
Global Perspectives and Diversity Core Area (See Note 1)	0
Mathematics Core Area (See Note 1)	0
Science Core Area (See Note 1)	0
Writing Core Area (See Note 1)	0
MINIMUM TOTAL	**61**

NOTE:

1. Students completing REQUIREMENTS have fulfilled the requirements for this Core area.

SUGGESTED COURSE SEQUENCE

Students should see course descriptions to find out when departments plan to offer courses. Students who for any reason are unable to follow the course sequence suggested below (for example, those who are part-time, have transferred in courses from another school, or have prerequisites to fulfill) should contact an academic advisor or counselor for help with adjustments.

I Fall	II Spring	III Fall	IV Spring
AEET102	AEET120	AEET215	AEET217
AEET110	CHEM135	AEET216	AEET219
ELTE100	MATH121	AEET218	AEET255
ELTE110	MGMT234	AEET250	AEET260
SPCH110		MATH122	PHYS200
WRIT124			

LANSING COMMUNITY COLLEGE

CURRICULUM GUIDE

Stationary Energy Technology
Certificate of Achievement

Curriculum Code: 1228 (Effective Fall 2007 – Summer 2012)

This certificate is intended for the entry-level technician as well as the professional involved in the heating, ventilation and air conditioning field to add a specialization in energy to their credentials. Stationary energy technicians will be involved in various aspects of the inventory, evaluation, planning, design, installation, and maintenance of a wide variety of energy producing systems. Technicians will deal with the integration of current energy sources along with newly developing energy distribution systems. The stationary energy technician will need a working knowledge of "green" building concepts and energy efficient design principles.

PREREQUISITES

Students should see *Course Descriptions* or *Course Offerings* for course prerequisite information. See the *Assessment and Placement Testing* section for skills assessment and advising information.

INFORMATION

Contact the Manufacturing Engineering Technologies Department, West Campus Building, Room M103, telephone number (517) 483-1339 (Website: http://www.lcc.edu/manufacturing/alternative_energy/) or Student Services West Campus, West Campus Building, Room M106, telephone (517) 267-5510.

REQUIREMENTS — TOTAL: 34 CREDITS

CODE	TITLE	CREDIT HOURS
AEET102	Prin of Alternative/Renewable Energies	3
AEET120	Conventional Energy Sources and Use	3
AEET215	Geothermal Technology	3
AEET250	Alternative Energy Analysis I	3
AEET255	Alternative Energy Analysis II	3
ELTE100	Electrical Safety Practices	1
HVAC100	Fundamentals of HVAC	3
HVAC110	Applied Electricity I	3
HVAC111	Applied Electricity II	3
HVAC120	Heating I	3
HVAC130	Air Conditioning I	3
HVAC220	Heating II	3
	MINIMUM TOTAL	**34**

SUGGESTED COURSE SEQUENCE

Students should see course descriptions to find out when departments plan to offer courses. Students who for any reason are unable to follow the course sequence suggested below (for example, those who are part-time, have transferred in courses from another school, or have prerequisites to fulfill) should contact an academic advisor or counselor for help with adjustments.

I	II	III
AEET102	AEET120	AEET215
ELTE100	AEET250	AEET255
HVAC100	HVAC111	HVAC130
HVAC110	HVAC120	HVAC220

Lansing Community College

Manufacturing Engineering Technologies
Official Course Syllabus Effective
from Summer 2005 **Semester**

Course Code: AEET 102 Title: Prin of Alternative/Renewable Energies

I.	Course Code	Credit	Lecture	Lab
	AEET 102	3	32	32

II. Prerequisite: Reading Level 3 and Writing Level 4

Restriction: None

Co-requisite Course: None

Recommended: None

III. COURSE DESCRIPTION:

This course will cover basic principles and history of alternative energy sources. Industry and government status of geothermal, wind, solar, biomass, fuel cells and other energy sources will be highlighted. Alternative and traditional energies will be defined and compared in terms of today's use. The evolving energy career areas will be discussed.

IV. INSTRUCTIONAL MATERIALS:

A. Textbooks *This information is provided by the Section instructor or in XII Other Course Information*

B. Other Materials/Resources: May be Used

C. Tools, Equipment or Apparel (required May be Used

of the student):

V. STUDENT LEARNING OUTCOMES (Department Specified):

Based upon established textbook or other resource standards, industry standards, and/or professional practices, the successful student will be able to:

Identify and evaluate basic sources of alternative energies
Identify and track the development of alternative energies
Identify key operational components of geothermal, wind, solar, biomass and fuel cell technologies
Define current use of traditional and alternative energies
Identify career paths in energy technology
Describe the functions of an energy specialist and energy engineer
Identify the relationships between energy, infrastructure, architecture, land planning and building construction

VI. METHODS OF INSTRUCTION

This information is provided on the Section Syllabus

VII. METHODS OF EVALUATING STUDENT ACHIEVEMENT/ PROGRESS:

A. The following methods are used in this class.

Method		Department Range (specify when required)
Class Attendance:	May be Used	0-15%
Class Participation:	May be Used	Combined with Attendance
Paper(s):	May be Used	0-15%
Portfolios:	May be Used	0-15%
Assignments	Required	20-30%
Projects	Required	30-40%

Report(s)/Presentations	May be Used	0-15%
Quizzes		
May be Used		0-30%
Exams or Tests	Required	20-30%
Final Exam	May be Used	0-30%

Additional Information (By Department)

Extra Credit: "Extra credit may be available for this course. This information is provided by the section instructor."

B. Grading Scale:

The grading scale used in this course is as follows:

College Standard

College Grading Standards	Recommended Guidelines For Student Grades
4.0 --- Excellent	4.0 --- 91 -100%
3.5 --- ----------	3.5 --- 86 - 90%
3.0 --- Good	3.0 --- 81 - 85%
2.5 --- ----------	2.5 --- 76 - 80%
2.0 --- Satisfactory	2.0 --- 71 - 75%
1.5 --- ----------	1.5 --- 66 - 70%
1.0 --- Poor	1.0 --- 60 - 65%

0.0	---	----------	0.0	---	0 - 59%

VIII. COURSE PRACTICES

College-wide policies are stated in the Lansing Community College Catalog and include those on attendance, withdrawals and incomplete grades. The catalog is available on the internet at http://www.lcc.edu/catalog/

IX. DETAILED OUTLINE OF COURSE CONTENT AND SEQUENCING

The Detailed Course Outline is provided by the section instructor or, if present, is subject to change by the section instructor.

X. TRANSFER POTENTIAL

For transferability information, please consult the Transfer Equivalency List located on the internet at http:// www.lcc.edu/transfer. For additional transferability information contact the LCC Counseling Services Department, (517) 483-1255.

The MACRAO Transfer Agreement simplifies the transfer of students from one Michigan institution to another. It appears in the catalog.

XI. STUDENT ACADEMIC INTEGRITY

The very nature of higher education requires that students adhere to accepted standards of academic integrity. Therefore, Lansing Community College has adopted a code of academic conduct and a statement of student academic integrity. These may be found in the Lansing Community College Catalog. The violations of academic integrity listed and defined are cheating and plagiarism. It is the student's responsibility to be aware of behaviors that constitute academic dishonesty.

Classroom behavior that interferes with the instructional process is not tolerated. The consequences are addressed in the catalog under Administrative Withdrawal.

Additional Information (By Department):

N.A.

XII. OTHER COURSE INFORMATION

By Department:

OFFICE OF DISABILITY SUPPORT SERVICES
Students with disabilities who believe that they may need accommodations in this class are encouraged to contact the Office of Disability Support Services, Gannon Building, Room 204 or by calling 517-483-1904 as soon as possible to better ensure that such accommodations are implemented in a timely fashion.

Last Date Syllabus Revised: 03/27/2007 02:59:05 PM

END OF SYLLABUS

Lansing Community College

Manufacturing Engineering Technologies

Official Course Syllabus Effective
from Summer 2005 **Semester**

Course Code: AEET 110 Title: Energy Site Evaluation

I. Course Code	Credit	Lecture	Lab
AEET 110	3	32	32

II. Prerequisite: Minimum 2.0 in AEET102 or concurrently

Restriction: None

Co-requisite Course: None

Recommended: None

III. COURSE DESCRIPTION:

This course will cover how to evaluate a site for the most efficient energy usage in terms of site geography, topography, availability of energy and resources, and age of building. Evaluation of a building style and materials for energy usage will be included. Site design features will be redesigned for efficiency/management concerns.

IV. INSTRUCTIONAL MATERIALS:

A. Textbooks *This information is provided by the Section instructor or in XII Other Course Information*

B. Other Materials/Resources: May be Used

C. Tools, Equipment or Apparel (required May be Used

of the student):

V. STUDENT LEARNING OUTCOMES (Department Specified):

Based upon established textbook or other resource standards, industry standards, and/or professional practices, the successful student will be able to:

Evaluate a site or location for geography, topography and existing features
Evaluate a site or location for energy availability and resources
Evaluate building structure style and materials for energy usage
Complete an energy site evaluation
Design and construct a site specific project
Analyze a residential site for energy efficiency
Analyze a commercial site for energy efficiency
Design an energy efficient landscape design

VI. METHODS OF INSTRUCTION

This information is provided on the Section Syllabus

VII. METHODS OF EVALUATING STUDENT ACHIEVEMENT/ PROGRESS:

A. The following methods are used in this class.

Method		Department Range (specify when required)
Class Attendance:	May be Used	0-15%
Class Participation:	May be Used	Combined with Attendance
Paper(s):	May be Used	0-15%
Portfolios:	May be Used	0-15%
Assignments	Required	20-30%
Projects	Required	30-40%
Report(s)/Presentati	May be Used	0-15%

ons		
Quizzes		
May be Used		0-30%
Exams or Tests	Required	20-30%
Final Exam	May be Used	0-30%

Additional Information (By Department)

Extra Credit: "Extra credit may be available for this course. This information is provided by the section instructor."

B. Grading Scale:

The grading scale used in this course is as follows:

College Standard

College Grading Standards			Recommended Guidelines For Student Grades
4.0	---	Excellent	4.0 --- 91 -100%
3.5	---	----------	3.5 --- 86 - 90%
3.0	---	Good	3.0 --- 81 - 85%
2.5	---	----------	2.5 --- 76 - 80%
2.0	---	Satisfactory	2.0 --- 71 - 75%
1.5	---	----------	1.5 --- 66 - 70%
1.0	---	Poor	1.0 --- 60 - 65%

0.0	---	----------	0.0	---	0 - 59%

VIII. COURSE PRACTICES

College-wide policies are stated in the Lansing Community College Catalog and include those on attendance, withdrawals and incomplete grades. The catalog is available on the internet at http://www.lcc.edu/catalog/

IX. DETAILED OUTLINE OF COURSE CONTENT AND SEQUENCING

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X. TRANSFER POTENTIAL

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XI. STUDENT ACADEMIC INTEGRITY

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Additional Information (By Department):

N.A.

XII. OTHER COURSE INFORMATION

By Department:

OFFICE OF DISABILITY SUPPORT SERVICES
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Last Date Syllabus Revised: 03/27/2007 03:10:34 PM

END OF SYLLABUS

Lansing Community College

Manufacturing Engineering Technologies

Official Course Syllabus Effective
from Summer 2005 **Semester**

Course Code: **AEET 120** **Title:** **Conventional Energy Sources and Use**

I.	Course Code	Credit	Lecture	Lab
	AEET 120	3	32	32

II. Prerequisite: Reading Level 3 and Writing Level 4

Restriction: None

Co-requisite Course: None

Recommended: None

III. COURSE DESCRIPTION:

The focus of this course will be on the history of traditional energy sources and reasons why government, business, and industry are turning to alternative and renewable energy sources. Topics include how to reduce fossil fuel usage and how to convert from traditional energy sources to alternative and renewable energy sources.

IV. INSTRUCTIONAL MATERIALS:

A. Textbooks *This information is provided by the Section instructor or in XII Other Course Information*

B. Other Materials/Resources: May be Used

C. Tools, Equipment or Apparel (required May be Used

of the student):

V. STUDENT LEARNING OUTCOMES (Department Specified):

Based upon established textbook or other resource standards, industry standards, and/or professional practices, the successful student will be able to:

- Analyze the history of conventional energy sources and use
- Analyze conventional energy source technologies
- Evaluate conventional energy applications
- Evaluate conventional energy efficiency options
- Identify conventional energy manufacturing issues
- Identify conventional energy system integration issues
- Identify conventional energy policy issues
- Analyze the economics of conventional energies
- Identify alternatives to traditional energies
- Construct conversion scenarios for alternative and renewable energies
- Complete an energy analysis and evaluation project
- Identify the environmental impacts of current conventional energy

VI. METHODS OF INSTRUCTION

This information is provided on the Section Syllabus

VII. METHODS OF EVALUATING STUDENT ACHIEVEMENT/ PROGRESS:

A. The following methods are used in this class.

Method		Department Range (specify when required)
Class Attendance:	May be Used	0-15%
Class Participation:	May be Used	Combined with Attendance
Paper(s):	May be Used	0-15%
Portfolios:	May be Used	0-15%
Assignments	Required	20-30%

Projects	Required	30-40%
Report(s)/Presentations	May be Used	0-15%
Quizzes		
May be Used		0-30%
Exams or Tests	Required	20-30%
Final Exam	May be Used	0-30%

Additional Information (By Department)

Extra Credit: "Extra credit may be available for this course. This information is provided by the section instructor."

B. Grading Scale:

The grading scale used in this course is as follows:

College Standard

College Grading Standards			Recommended Guidelines For Student Grades		
4.0	---	Excellent	4.0	---	91 -100%
3.5	---	----------	3.5	---	86 - 90%
3.0	---	Good	3.0	---	81 - 85%
2.5	---	----------	2.5	---	76 - 80%
2.0	---	Satisfactory	2.0	---	71 - 75%
1.5	---	----------	1.5	---	66 - 70%

1.0	---	Poor	1.0	---	60 - 65%
0.0	---	----------	0.0	---	0 - 59%

VIII. COURSE PRACTICES

College-wide policies are stated in the Lansing Community College Catalog and include those on attendance, withdrawals and incomplete grades. The catalog is available on the internet at http://www.lcc.edu/catalog/

IX. DETAILED OUTLINE OF COURSE CONTENT AND SEQUENCING

The Detailed Course Outline is provided by the section instructor or, if present, is subject to change by the section instructor.

X. TRANSFER POTENTIAL

For transferability information, please consult the Transfer Equivalency List located on the internet at http:// www.lcc.edu/transfer. For additional transferability information contact the LCC Counseling Services Department, (517) 483-1255.

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XI. STUDENT ACADEMIC INTEGRITY

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Classroom behavior that interferes with the instructional process is not tolerated. The consequences are addressed in the catalog under Administrative Withdrawal.

Additional Information (By Department):

N.A.

XII. OTHER COURSE INFORMATION

By Department:

OFFICE OF DISABILITY SUPPORT SERVICES
Students with disabilities who believe that they may need accommodations in this class are encouraged to contact the Office of Disability Support Services, Gannon Building, Room 204 or by calling 517-483-1904 as soon as possible to better ensure that such accommodations are implemented in a timely fashion.

Last Date Syllabus Revised: 03/27/2007 03:32:45 PM

END OF SYLLABUS

Lansing Community College

Manufacturing Engineering Technologies

Official Course Syllabus Effective from Summer 2007 **Semester**

Course Code: AEET 215 Title: Geothermal Technology

I. Course Code	Credit	Lecture	Lab
AEET 215	3	32	32

II. Prerequisite: Reading Level 3 and Writing Level 4

Restriction: None

Co-requisite Course: None

Recommended: None

III. COURSE DESCRIPTION:

This course will cover the basics of geothermal energy production and technology. Essentials on how to utilize and integrate geothermal technology as an energy source will be analyzed and demonstrated. Examples of residential and commercial applications will be shown and reviewed.

IV. INSTRUCTIONAL MATERIALS:

A. Textbooks *This information is provided by the Section instructor or in XII Other Course Information*

B. Other Materials/Resources: May be Used

C. Tools, Equipment or Apparel (required of the student): May be Used

V. STUDENT LEARNING OUTCOMES (Department Specified):

Based upon established textbook or other resource standards, industry standards, and/or professional practices, the successful student will be able to:

Explain heat transfer technologies
Explain earth core energy extraction
Identify geothermal energy applications
Determine geothermal energy efficiency of a project site
Analyze geothermal distribution issues
Analyze geothermal manufacturing process
Analyze geothermal systems integration issues
Discuss geothermal policy issues
Analyze the economics of geothermal energy
Identify geothermal energy career opportunities
Integrate geothermal technology with other energy sources
Complete a geothermal energy audit and analysis project
Identify and demonstrate geothermal equipment usage and maintenance

VI. METHODS OF INSTRUCTION

This information is provided on the Section Syllabus

VII. METHODS OF EVALUATING STUDENT ACHIEVEMENT/ PROGRESS:

A. The following methods are used in this class.

Method		Department Range (specify when required)
Class Attendance:	May be Used	0-15%
Class Participation:	May be Used	Combined with Attendance
Paper(s):	May be Used	0-15%
Portfolios:	May be Used	0-15%
Assignments	Required	20-30%

Projects	Required	30-40%
Report(s)/Presentations	May be Used	0-15%
Quizzes		
May be Used		0-30%
Exams or Tests	Required	20-30%
Final Exam	May be Used	0-30%
Other (specify)	May be Used	

Additional Information (By Department)

Extra Credit: "Extra credit may be available for this course. This information is provided by the section instructor."

B. Grading Scale:

The grading scale used in this course is as follows:

College Standard

College Grading Standards			Recommended Guidelines For Student Grades
4.0	---	Excellent	4.0 --- 91 -100%
3.5	---	----------	3.5 --- 86 - 90%
3.0	---	Good	3.0 --- 81 - 85%
2.5	---	----------	2.5 --- 76 - 80%
2.0	---	Satisfactory	2.0 --- 71 - 75%

1.5	---	----------	1.5	---	66 - 70%
1.0	---	Poor	1.0	---	60 - 65%
0.0	---	----------	0.0	---	0 - 59%

VIII. COURSE PRACTICES

College-wide policies are stated in the Lansing Community College Catalog and include those on attendance, withdrawals and incomplete grades. The catalog is available on the internet at http://www.lcc.edu/catalog/

IX. DETAILED OUTLINE OF COURSE CONTENT AND SEQUENCING

The Detailed Course Outline is provided by the section instructor or, if present, is subject to change by the section instructor.

X. TRANSFER POTENTIAL

For transferability information, please consult the Transfer Equivalency List located on the internet at http:// www.lcc.edu/transfer. For additional transferability information contact the LCC Counseling Services Department, (517) 483-1255.

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XI. STUDENT ACADEMIC INTEGRITY

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Classroom behavior that interferes with the instructional process is not tolerated. The consequences

are addressed in the catalog under Administrative Withdrawal.

Additional Information (By Department):

N.A.

XII. OTHER COURSE INFORMATION

By Department:

OFFICE OF DISABILITY SUPPORT SERVICES
Students with disabilities who believe that they may need accommodations in this class are encouraged to contact the Office of Disability Support Services, Gannon Building, Room 204 or by calling 517-483-1904 as soon as possible to better ensure that such accommodations are implemented in a timely fashion.

Last Date Syllabus Revised: 10/11/2006 09:58:21 AM

END OF SYLLABUS

Lansing Community College

Manufacturing Engineering Technologies

Official Course Syllabus Effective from Summer 2007 **Semester**

Course Code: AEET 216 Title: Solar Energy Technologies

I. Course Code	Credit	Lecture	Lab
AEET 216	3	32	32

II. Prerequisite: Reading Level 3 and Writing Level 4

Restriction: None

Co-requisite Course: None

Recommended: None

III. COURSE DESCRIPTION:

This course will cover the basics of solar energy generation including energy collection and storage. Solar power ranging from the heat of the day to solar electric conversion technologies will be covered including Solar Electric (Photovoltaic); Thermal; and Heating, Cooling and Lighting (Active and Passive). A brief history of solar powered energies will be included.

IV. INSTRUCTIONAL MATERIALS:

A. Textbooks *This information is provided by the Section instructor or in XII Other Course Information*

B. Other Materials/Resources: May be Used

C. Tools, Equipment or Apparel (required May be Used

of the student):

V. STUDENT LEARNING OUTCOMES (Department Specified):

Based upon established textbook or other resource standards, industry standards, and/or professional practices, the successful student will be able to:

Analyze a site or location and evaluate it for solar applications
Describe passive heating and cooling building designs
Design a solar water heating system
Design a solar cooking device
Diagram a solar thermal electric system
Design a solar energy efficiency model
Analyze solar manufacturing issues including equipment evaluation and types of collectors/filters
Create a cost analysis for a solar powered project
Complete a solar energy project

VI. METHODS OF INSTRUCTION

This information is provided on the Section Syllabus

VII. METHODS OF EVALUATING STUDENT ACHIEVEMENT/ PROGRESS:

A. The following methods are used in this class.

Method		Department Range (specify when required)
Class Attendance:	May be Used	0-15%
Class Participation:	May be Used	Combined with Attendance
Paper(s):	May be Used	0-15%
Portfolios:	May be Used	0-15%
Assignments	Required	20-30%
Projects	Required	30-40%

Report(s)/Presentations	May be Used	0-15%
Quizzes		
May be Used		0-30%
Exams or Tests	Required	20-30%
Final Exam	May be Used	0-30%

Additional Information (By Department)

Successful completion of this course does not guarantee a passing score on the Certification of Solar Practitioners Exam.

Extra Credit: "Extra credit may be available for this course. This information is provided by the section instructor."

B. Grading Scale:

The grading scale used in this course is as follows:

College Standard

College Grading Standards			Recommended Guidelines For Student Grades
4.0	---	Excellent	4.0 --- 91 -100%
3.5	---	----------	3.5 --- 86 - 90%
3.0	---	Good	3.0 --- 81 - 85%
2.5	---	----------	2.5 --- 76 - 80%
2.0	---	Satisfactory	2.0 --- 71 - 75%

1.5	---	----------	1.5	---	66 - 70%
1.0	---	Poor	1.0	---	60 - 65%
0.0	---	----------	0.0	---	0 - 59%

VIII. COURSE PRACTICES

College-wide policies are stated in the Lansing Community College Catalog and include those on attendance, withdrawals and incomplete grades. The catalog is available on the internet at http://www.lcc.edu/catalog/

IX. DETAILED OUTLINE OF COURSE CONTENT AND SEQUENCING

The Detailed Course Outline is provided by the section instructor or, if present, is subject to change by the section instructor.

X. TRANSFER POTENTIAL

For transferability information, please consult the Transfer Equivalency List located on the internet at http:// www.lcc.edu/transfer. For additional transferability information contact the LCC Counseling Services Department, (517) 483-1255.

The MACRAO Transfer Agreement simplifies the transfer of students from one Michigan institution to another. It appears in the catalog.

XI. STUDENT ACADEMIC INTEGRITY

The very nature of higher education requires that students adhere to accepted standards of academic integrity. Therefore, Lansing Community College has adopted a code of academic conduct and a statement of student academic integrity. These may be found in the Lansing Community College Catalog. The violations of academic integrity listed and defined are cheating and plagiarism. It is the student's responsibility to be aware of behaviors that constitute academic dishonesty.

Classroom behavior that interferes with the instructional process is not tolerated. The consequences

are addressed in the catalog under Administrative Withdrawal.

Additional Information (By Department):

N.A.

XII. OTHER COURSE INFORMATION

By Department:

OFFICE OF DISABILITY SUPPORT SERVICES
Students with disabilities who believe that they may need accommodations in this class are encouraged to contact the Office of Disability Support Services, Gannon Building, Room 204 or by calling 517-483-1904 as soon as possible to better ensure that such accommodations are implemented in a timely fashion.

Last Date Syllabus Revised: 10/11/2006 10:00:36 AM

END OF SYLLABUS

Lansing Community College

Manufacturing Engineering Technologies

Official Course Syllabus Effective from Summer 2007 **Semester**

Course Code: AEET 217 Title: Biomass, Biogas and Microturbine Tech

I. Course Code	Credit	Lecture	Lab
AEET 117	3	32	32

II. Prerequisite: Reading Level 3 and Writing Level 4

Restriction: None

Co-requisite Course: None

Recommended: None

III. COURSE DESCRIPTION:

This course will focus on the release of chemical energy by accelerating the naturally occurring carbon dioxide cycle and the use of this energy to power engines and generators. Natural fuels and fuels made from plant materials and garbage will be discussed. Engine efficiency and its impact on lower emissions will also be discussed.

IV. INSTRUCTIONAL MATERIALS:

A. Textbooks *This information is provided by the Section instructor or in XII Other Course Information*

B. Other Materials/Resources: May be Used

C. Tools, Equipment or Apparel (required May be Used

of the student):

V. STUDENT LEARNING OUTCOMES (Department Specified):

Based upon established textbook or other resource standards, industry standards, and/or professional practices, the successful student will be able to:

Identify biomass fuel sources (organic matter)
Describe biomass technologies
Describe biomass applications
Determine biomass energy efficiency
Analyze biomass distribution issues
Analyze biomass manufacturing issues
Analyze biomass systems integration issues
Evaluate biogas and its sources and site location
Design a biomass system and its related components
Identify various microturbines and their components

VI. METHODS OF INSTRUCTION

This information is provided on the Section Syllabus

VII. METHODS OF EVALUATING STUDENT ACHIEVEMENT/ PROGRESS:

A. The following methods are used in this class.

Method		Department Range (specify when required)
Class Attendance:	May be Used	0-15%
Class Participation:	May be Used	Combined with Attendance
Paper(s):	May be Used	0-15%
Portfolios:	May be Used	0-15%
Assignments	Required	20-30%
Projects	Required	30-40%

Report(s)/Presentations	May be Used	0-15%
Quizzes		
May be Used		0-30%
Exams or Tests	Required	20-30%
Final Exam	May be Used	0-30%

Additional Information (By Department)

Extra Credit: "Extra credit may be available for this course. This information is provided by the section instructor."

B. Grading Scale:

The grading scale used in this course is as follows:

College Standard

College Grading Standards			Recommended Guidelines For Student Grades		
4.0	---	Excellent	4.0	---	91 -100%
3.5	---	----------	3.5	---	86 - 90%
3.0	---	Good	3.0	---	81 - 85%
2.5	---	----------	2.5	---	76 - 80%
2.0	---	Satisfactory	2.0	---	71 - 75%
1.5	---	----------	1.5	---	66 - 70%

1.0	---	Poor	1.0	---	60 - 65%
0.0	---	----------	0.0	---	0 - 59%

VIII. COURSE PRACTICES

College-wide policies are stated in the Lansing Community College Catalog and include those on attendance, withdrawals and incomplete grades. The catalog is available on the internet at http://www.lcc.edu/catalog/

IX. DETAILED OUTLINE OF COURSE CONTENT AND SEQUENCING

The Detailed Course Outline is provided by the section instructor or, if present, is subject to change by the section instructor.

X. TRANSFER POTENTIAL

For transferability information, please consult the Transfer Equivalency List located on the internet at http:// www.lcc.edu/transfer. For additional transferability information contact the LCC Counseling Services Department, (517) 483-1255.

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XI. STUDENT ACADEMIC INTEGRITY

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Classroom behavior that interferes with the instructional process is not tolerated. The consequences are addressed in the catalog under Administrative Withdrawal.

Additional Information (By Department):

N.A.

XII. OTHER COURSE INFORMATION

By Department:

OFFICE OF DISABILITY SUPPORT SERVICES
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Last Date Syllabus Revised: 11/29/2006 02:12:04 PM

END OF SYLLABUS

Lansing Community College

Manufacturing Engineering Technologies

Official Course Syllabus Effective from Summer 2007 **Semester**

Course Code: AEET 218 Title: Fuel Cell and Hydrogen Technologies

I. Course Code	Credit	Lecture	Lab
AEET 218	3	32	32

II. Prerequisite: Reading Level 3 and Writing Level 4

Restriction: None

Co-requisite Course: None

Recommended: None

III. COURSE DESCRIPTION:

This course will focus on fuel cell conversion devices and other hydrogen based technologies. The history of hydrogen and fuel cell technologies, their application, instrumentation, specifications, codes, system designs and materials will be covered. Basic thermodynamics and heat/mass transfer technology will be discussed. Specific licensing, permits, and safety issues will be covered.

IV. INSTRUCTIONAL MATERIALS:

A. Textbooks	*This information is provided by the Section instructor or in XII Other Course Information*
B. Other Materials/Resources:	May be Used
C. Tools, Equipment or Apparel (required	May be Used

of the student):

V. STUDENT LEARNING OUTCOMES (Department Specified):

Based upon established textbook or other resource standards, industry standards, and/or professional practices, the successful student will be able to:

Identify fuel cell types
Describe fuel cell applications
Identify fuel cell components
Demonstrate heat/mass transfer technology
Describe fuel cell stack materials
Determine fuel cell system performance indicators
Explain basic energy conversion principles
Identify applications and requirements for stationary and mobile fuel cells
Design and build a fuel cell system
Identify hydrogen production requirements
Analyze hydrogen energy storage systems
Determine hydrogen energy efficiency of a stationary fuel cell system
Analyze hydrogen distribution issues
Analyze systems integration issues
Complete a project using fuel cell and hydrogen technology

VI. METHODS OF INSTRUCTION

This information is provided on the Section Syllabus

VII. METHODS OF EVALUATING STUDENT ACHIEVEMENT/ PROGRESS:

A. The following methods are used in this class.

Method		Department Range (specify when required)
Class Attendance:	May be Used	0-15%
Class Participation:	May be Used	Combined with Attendance
Paper(s):	May be Used	0-15%
Portfolios:		

	May be Used	0-15%
Assignments	Required	20-30%
Projects	Required	30-40%
Report(s)/Presentations	May be Used	0-15%
Quizzes		
May be Used		0-30%
Exams or Tests	Required	20-30%
Final Exam	May be Used	0-30%

Additional Information (By Department)

Extra Credit: "Extra credit may be available for this course. This information is provided by the section instructor."

B. Grading Scale:

The grading scale used in this course is as follows:

College Standard

College Grading Standards	Recommended Guidelines For Student Grades
4.0 --- Excellent	4.0 --- 91 -100%
3.5 --- ----------	3.5 --- 86 - 90%
3.0 --- Good	3.0 --- 81 - 85%
2.5 --- ----------	2.5 --- 76 - 80%

2.0	---	Satisfactory	2.0	---	71 - 75%
1.5	---	----------	1.5	---	66 - 70%
1.0	---	Poor	1.0	---	60 - 65%
0.0	---	----------	0.0	---	0 - 59%

VIII. COURSE PRACTICES

College-wide policies are stated in the Lansing Community College Catalog and include those on attendance, withdrawals and incomplete grades. The catalog is available on the internet at http://www.lcc.edu/catalog/

IX. DETAILED OUTLINE OF COURSE CONTENT AND SEQUENCING

The Detailed Course Outline is provided by the section instructor or, if present, is subject to change by the section instructor.

X. TRANSFER POTENTIAL

For transferability information, please consult the Transfer Equivalency List located on the internet at http:// www.lcc.edu/transfer. For additional transferability information contact the LCC Counseling Services Department, (517) 483-1255.

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XI. STUDENT ACADEMIC INTEGRITY

The very nature of higher education requires that students adhere to accepted standards of academic integrity. Therefore, Lansing Community College has adopted a code of academic conduct and a statement of student academic integrity. These may be found in the Lansing Community College Catalog. The violations of academic integrity listed and defined are cheating and plagiarism. It is the student's responsibility to be aware of behaviors that constitute academic dishonesty.

Classroom behavior that interferes with the instructional process is not tolerated. The consequences are addressed in the catalog under Administrative Withdrawal.

Additional Information (By Department):

N.A.

XII. OTHER COURSE INFORMATION

By Department:

OFFICE OF DISABILITY SUPPORT SERVICES
Students with disabilities who believe that they may need accommodations in this class are encouraged to contact the Office of Disability Support Services, Gannon Building, Room 204 or by calling 517-483-1904 as soon as possible to better ensure that such accommodations are implemented in a timely fashion.

Last Date Syllabus Revised: 10/11/2006 10:02:28 AM

END OF SYLLABUS

Lansing Community College

Manufacturing Engineering Technologies

Official Course Syllabus Effective from Summer 2007 **Semester**

Course Code: AEET 219 Title: Wind Energies

I. Course Code	Credit	Lecture	Lab
AEET 219	3	32	32

II. Prerequisite: Reading Level 3 and Writing Level 4

Restriction: None

Co-requisite Course: None

Recommended: None

III. COURSE DESCRIPTION:

This course will cover the use of naturally occurring winds to create electricity. Wind farms, collection devices and current status of wind energy will be discussed. Horizontal Axis and Vertical Axis Turbines systems will be covered. A brief history of wind energy will be included.

IV. INSTRUCTIONAL MATERIALS:

A. Textbooks *This information is provided by the Section instructor or in XII Other Course Information*

B. Other Materials/Resources: May be Used

C. Tools, Equipment or Apparel (required of the student): May be Used

V. STUDENT LEARNING OUTCOMES (Department Specified):

Based upon established textbook or other resource standards, industry standards, and/or professional practices, the successful student will be able to:

Analyze a site or location for history, geography, resources and restrictions for wind energy
Discuss wind-power materials technology
Demonstrate wind-power energy efficiency
Analyze wind-power distribution issues
Analyze wind-power manufacturing issues
Analyze wind-power systems integration issues
Design and construct a wind energy project

VI. METHODS OF INSTRUCTION

This information is provided on the Section Syllabus

VII. METHODS OF EVALUATING STUDENT ACHIEVEMENT/ PROGRESS:

A. The following methods are used in this class.

Method		Department Range (specify when required)
Class Attendance:	May be Used	0-15%
Class Participation:	May be Used	Combined with Attendance
Paper(s):	May be Used	0-15%
Portfolios:	May be Used	0-15%
Assignments	Required	20-30%
Projects	Required	30-40%
Report(s)/Presentations	May be Used	0-15%
Quizzes		

May be Used		0-30%
Exams or Tests	Required	20-30%
Final Exam	May be Used	0-30%

Additional Information (By Department)

Extra Credit: "Extra credit may be available for this course. This information is provided by the section instructor."

B. Grading Scale:

The grading scale used in this course is as follows:

College Standard

College Grading Standards			Recommended Guidelines For Student Grades		
4.0	---	Excellent	4.0	---	91 -100%
3.5	---	----------	3.5	---	86 - 90%
3.0	---	Good	3.0	---	81 - 85%
2.5	---	----------	2.5	---	76 - 80%
2.0	---	Satisfactory	2.0	---	71 - 75%
1.5	---	----------	1.5	---	66 - 70%
1.0	---	Poor	1.0	---	60 - 65%
0.0	---	----------	0.0	---	0 - 59%

VIII. COURSE PRACTICES

College-wide policies are stated in the Lansing Community College Catalog and include those on attendance, withdrawals and incomplete grades. The catalog is available on the internet at http://www.lcc.edu/catalog/

IX. DETAILED OUTLINE OF COURSE CONTENT AND SEQUENCING

The Detailed Course Outline is provided by the section instructor or, if present, is subject to change by the section instructor.

X. TRANSFER POTENTIAL

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XI. STUDENT ACADEMIC INTEGRITY

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Classroom behavior that interferes with the instructional process is not tolerated. The consequences are addressed in the catalog under Administrative Withdrawal.

Additional Information (By Department):

N.A.

XII. OTHER COURSE INFORMATION

By Department:

OFFICE OF DISABILITY SUPPORT SERVICES
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Last Date Syllabus Revised: 10/11/2006 10:04:04 AM

END OF SYLLABUS

Lansing Community College

Manufacturing Engineering Technologies

Official Course Syllabus Effective from Summer 2007 **Semester**

Course Code: AEET 250 Title: Alternative Energy Analysis I

I. Course Code	Credit	Lecture	Lab
AEET 250	3	32	32

II. Prerequisite: Minimum 2.0 in AEET102

Restriction: None

Co-requisite Course: None

Recommended: None

III. COURSE DESCRIPTION:

This course will analyze current energy systems, their applications and status. The process will include project recommendations based on the site, structures and both existing and proposed features. Analysis will be project-based and require cost comparison of various energy solutions.

IV. INSTRUCTIONAL MATERIALS:

A. Textbooks *This information is provided by the Section instructor or in XII Other Course Information*

B. Other Materials/Resources: May be Used

C. Tools, Equipment or Apparel (required of the student): May be Used

V. STUDENT LEARNING OUTCOMES (Department Specified):

Based upon established textbook or other resource standards, industry standards, and/or professional practices, the successful student will be able to:

List the system components necessary in the current energy inventory process
Inventory a current energy system
Evaluate cost and energy efficiency of a current energy system
Create alternative energy scenarios based on the analysis of a current energy system
Complete an energy inventory and analysis project
Analyze and inventory a residential site
Analyze and inventory a commercial site

VI. METHODS OF INSTRUCTION

This information is provided on the Section Syllabus

VII. METHODS OF EVALUATING STUDENT ACHIEVEMENT/ PROGRESS:

A. The following methods are used in this class.

Method		Department Range (specify when required)
Class Attendance:	May be Used	0-15%
Class Participation:	May be Used	Combined with Attendance
Paper(s):	May be Used	0-15%
Portfolios:	May be Used	0-15%
Assignments	Required	20-30%
Projects	Required	30-40%
Report(s)/Presentations	May be Used	0-15%
Quizzes		

May be Used		0-30%
Exams or Tests	Required	20-30%
Final Exam	May be Used	0-30%

Additional Information (By Department)

Extra Credit: "Extra credit may be available for this course. This information is provided by the section instructor."

B. Grading Scale:

The grading scale used in this course is as follows:

College Standard

College Grading Standards			Recommended Guidelines For Student Grades		
4.0	---	Excellent	4.0	---	91 -100%
3.5	---	----------	3.5	---	86 - 90%
3.0	---	Good	3.0	---	81 - 85%
2.5	---	----------	2.5	---	76 - 80%
2.0	---	Satisfactory	2.0	---	71 - 75%
1.5	---	----------	1.5	---	66 - 70%
1.0	---	Poor	1.0	---	60 - 65%
0.0	---	----------	0.0	---	0 - 59%

VIII. COURSE PRACTICES

College-wide policies are stated in the Lansing Community College Catalog and include those on attendance, withdrawals and incomplete grades. The catalog is available on the internet at http://www.lcc.edu/catalog/

IX. DETAILED OUTLINE OF COURSE CONTENT AND SEQUENCING

The Detailed Course Outline is provided by the section instructor or, if present, is subject to change by the section instructor.

X. TRANSFER POTENTIAL

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XI. STUDENT ACADEMIC INTEGRITY

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Classroom behavior that interferes with the instructional process is not tolerated. The consequences are addressed in the catalog under Administrative Withdrawal.

Additional Information (By Department):

N.A.

XII. OTHER COURSE INFORMATION

By Department:

OFFICE OF DISABILITY SUPPORT SERVICES
Students with disabilities who believe that they may need accommodations in this class are encouraged to contact the Office of Disability Support Services, Gannon Building, Room 204 or by calling 517-483-1904 as soon as possible to better ensure that such accommodations are implemented in a timely fashion.

Last Date Syllabus Revised: 03/21/2007 11:05:31 AM

END OF SYLLABUS

Lansing Community College

Manufacturing Engineering Technologies

Official Course Syllabus Effective
from Summer 2007 **Semester**

Course Code: AEET 255 Title: Alternative Energy Analysis II

I.	Course Code	Credit	Lecture	Lab
	AEET 255	3	32	32

II. Prerequisite: Minimum 2.0 in AEET102

Restriction: None

Co-requisite Course: None

Recommended: None

III. COURSE DESCRIPTION:

This course will analyze current energy management systems and technologies for the most efficient energy usage in terms of site geography, topography, availability of energy and resources. Site design features will include energy efficiency/management concerns. The Energy Star Program guidelines from the U.S. Department of Energy for energy efficient solutions will be covered.

IV. INSTRUCTIONAL MATERIALS:

A. Textbooks *This information is provided by the Section instructor or in XII Other Course Information*

B. Other Materials/Resources: May be Used

C. Tools, Equipment or Apparel (required May be Used

of the student):

V. STUDENT LEARNING OUTCOMES (Department Specified):

Based upon established textbook or other resource standards, industry standards, and/or professional practices, the successful student will be able to:

Describe energy efficiency principles and guidelines
Identify key concepts of the energy STAR program
Describe U.S. Department of Energy guidelines for building efficiency
Describe categories of the U.S. Green Building Council Leadership in Energy and Environmental Design (LEED) Certification
Design an energy management plan for a residential site
Design an energy management plan for a commercial site
List the principles of efficient land site design
Design an energy recycling efficiency plan
Demonstrate the use of evaluation equipment for efficiency design

VI. METHODS OF INSTRUCTION

This information is provided on the Section Syllabus

VII. METHODS OF EVALUATING STUDENT ACHIEVEMENT/ PROGRESS:

A. The following methods are used in this class.

Method		Department Range (specify when required)
Class Attendance:	May be Used	0-15%
Class Participation:	May be Used	Combined with Attendance
Paper(s):	May be Used	0-15%
Portfolios:	May be Used	0-15%
Assignments	Required	20-30%
Projects	Required	30-40%

Report(s)/Presentations	May be Used	0-15%
Quizzes		
May be Used		0-30%
Exams or Tests	Required	20-30%
Final Exam	May be Used	0-30%

Additional Information (By Department)

Extra Credit: "Extra credit may be available for this course. This information is provided by the section instructor."

B. Grading Scale:

The grading scale used in this course is as follows:

College Standard

College Grading Standards			Recommended Guidelines For Student Grades		
4.0	---	Excellent	4.0	---	91 -100%
3.5	---	----------	3.5	---	86 - 90%
3.0	---	Good	3.0	---	81 - 85%
2.5	---	----------	2.5	---	76 - 80%
2.0	---	Satisfactory	2.0	---	71 - 75%
1.5	---	----------	1.5	---	66 - 70%

1.0	---	Poor	1.0	---	60 - 65%
0.0	---	----------	0.0	---	0 - 59%

VIII. COURSE PRACTICES

College-wide policies are stated in the Lansing Community College Catalog and include those on attendance, withdrawals and incomplete grades. The catalog is available on the internet at http://www.lcc.edu/catalog/

IX. DETAILED OUTLINE OF COURSE CONTENT AND SEQUENCING

The Detailed Course Outline is provided by the section instructor or, if present, is subject to change by the section instructor.

X. TRANSFER POTENTIAL

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XI. STUDENT ACADEMIC INTEGRITY

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Classroom behavior that interferes with the instructional process is not tolerated. The consequences are addressed in the catalog under Administrative Withdrawal.

Additional Information (By Department):

N.A.

XII. OTHER COURSE INFORMATION

By Department:

OFFICE OF DISABILITY SUPPORT SERVICES
Students with disabilities who believe that they may need accommodations in this class are encouraged to contact the Office of Disability Support Services, Gannon Building, Room 204 or by calling 517-483-1904 as soon as possible to better ensure that such accommodations are implemented in a timely fashion.

Last Date Syllabus Revised: 03/27/2007 03:47:09 PM

END OF SYLLABUS

Lansing Community College

Manufacturing Engineering Technologies

Official Course Syllabus Effective from Summer 2007 **Semester**

Course Code: AEET 260 Title: Codes, Regulations & Standards

I. Course Code	Credit	Lecture	Lab
AEET 260	3	32	32

II. Prerequisite: Reading Level 5 and Writing Level 6

Restriction: None

Co-requisite Course: None

Recommended: None

III. COURSE DESCRIPTION:

This course will cover the codes, regulations, and industry standards that are currently in place for sustainable energy buildings and Green Buildings. Evaluation of a building style and the energy efficient materials used in its construction will be included.

IV. INSTRUCTIONAL MATERIALS:

A. Textbooks *This information is provided by the Section instructor or in XII Other Course Information*

B. Other Materials/Resources: May be Used

C. Tools, Equipment or Apparel (required of the student): May be Used

V. STUDENT LEARNING OUTCOMES (Department Specified):

Based upon established textbook or other resource standards, industry standards, and/or professional practices, the successful student will be able to:

Identify resources for sustainable building codes, regulations and industry standards
Evaluate industry standards for sustainable buildings
Identify Green Building standards
Design and implement a Green Building plan
Complete a project documenting codes, regulations and Leadership in Energy and Environmental Design (LEED) standards
Identify Electrical code specifications related to alternative energy equipment
Identify hydrogen transport and handling standards
Complete a checklist of codes and regulations for a residential project
Complete a checklist of codes and regulations for a commercial project

VI. METHODS OF INSTRUCTION

This information is provided on the Section Syllabus

VII. METHODS OF EVALUATING STUDENT ACHIEVEMENT/ PROGRESS:

A. The following methods are used in this class.

Method		Department Range (specify when required)
Class Attendance:	May be Used	0-15%
Class Participation:	May be Used	Combined with Attendance
Paper(s):	May be Used	0-15%
Portfolios:	May be Used	0-15%
Assignments	Required	20-30%
Projects	Required	30-40%
Report(s)/Presentati	May be Used	0-15%

ons		
Quizzes		
May be Used		0-30%
Exams or Tests	Required	20-30%
Final Exam	May be Used	0-30%

Additional Information (By Department)

Extra Credit: "Extra credit may be available for this course. This information is provided by the section instructor."

B. Grading Scale:

The grading scale used in this course is as follows:

College Standard

College Grading Standards			Recommended Guidelines For Student Grades
4.0	---	Excellent	4.0 --- 91 -100%
3.5	---	----------	3.5 --- 86 - 90%
3.0	---	Good	3.0 --- 81 - 85%
2.5	---	----------	2.5 --- 76 - 80%
2.0	---	Satisfactory	2.0 --- 71 - 75%
1.5	---	----------	1.5 --- 66 - 70%
1.0	---	Poor	1.0 --- 60 - 65%

0.0	---	----------	0.0	---	0 - 59%

VIII. COURSE PRACTICES

College-wide policies are stated in the Lansing Community College Catalog and include those on attendance, withdrawals and incomplete grades. The catalog is available on the internet at http://www.lcc.edu/catalog/

IX. DETAILED OUTLINE OF COURSE CONTENT AND SEQUENCING

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X. TRANSFER POTENTIAL

For transferability information, please consult the Transfer Equivalency List located on the internet at http:// www.lcc.edu/transfer. For additional transferability information contact the LCC Counseling Services Department, (517) 483-1255.

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XI. STUDENT ACADEMIC INTEGRITY

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Additional Information (By Department):

N.A.

XII. OTHER COURSE INFORMATION

By Department:

OFFICE OF DISABILITY SUPPORT SERVICES
Students with disabilities who believe that they may need accommodations in this class are encouraged to contact the Office of Disability Support Services, Gannon Building, Room 204 or by calling 517-483-1904 as soon as possible to better ensure that such accommodations are implemented in a timely fashion.

Last Date Syllabus Revised: 03/27/2007 03:51:15 PM

END OF SYLLABUS

LANSING COMMUNITY COLLEGE
Where Success Begins

Alternative Energy Center

Scientific/Technical Report

Appendix “B”

CERTIFICATE OF ACHIEVEMENT - ALTERNATIVE FUELS

.AUTO 100	3 CR	GENERAL AUTOMOTIVE
.AUTO 110	5 CR	AUTOMOTIVE ELECTRICITY
.AEET 118	3 CR	FUEL CELL& HYDROGEN TECHNOLOGY
.AUTO 210	3 CR	ADVANCED AUTO ELECTRICAL/ELECTRONIC
.AUTO 215	5 CR	ENGINE TUNE-UP
.AUTO 225	5 CR	AUTOMOTIVE COMPUTERS
.AUTO 266	2 CR	HYDROGEN APPLICATIONS AND SAFETY
.AUTO 260	3 CR	INTRODUCTION TO ALTERNATIVE FUELS
.AUTO 265	2 CR	HYBRID VEHICLE TECHNOLOGY
.AUTO 263	2 CR	ELECTRIC AND FUEL CELL APPLICATIONS
.AUTO 264	3 CR	GASEOUS FUELS (PROPANE, CNG, HYDROGEN)

TOTAL CREDITS = 34

Lansing Community College

Transportation Technologies Department

Official Course Syllabus

Course Code: AUTO 265 Title: Hybrid Vehicle Technology

I.	Course Code	Credit	Lecture	Lab
	AUTO 265	2	40	8

II.	**Prerequisite:**	Minimum 2.0 in AUTO 260 or concurrently
	Restriction:	None
	Co-requisite Course:	None
	Recommended:	None

III. COURSE DESCRIPTION:

This course covers the fundamentals of hybrid vehicle technology. The course is intended to give the student an understanding of the types of hybrid vehicles, hybrid vehicle components, how hybrid vehicles operate and basic service procedures; which will enable the student to obtain employment as an alternative fuel vehicle technician.

IV. INSTRUCTIONAL MATERIALS:

A. Textbooks	*This information is provided by the Section instructor or in XII Other Course Information*	
B. Other Materials/Resources:	Required	Manufacturer's and Comprehensive Service Manuals for vehicles being serviced
C. Tools, Equipment or Apparel (required of the student):	Required	Safety glasses (leather shoes are strongly encouraged)

V. STUDENT LEARNING OUTCOMES (Department Specified):

Based upon established textbook or other resource standards, and other relevant industry standards and/or professional practices, the successful student will be able to:

BASICS OF HYBRID ELECTRIC VEHICLES

1. Define what a Hybrid Electric Vehicle (HEV) is.
2. Develop a list of hybrid vehicles based on information using internet web search techniques.
3. Identify the benefits of a HEV
4. Identify interior and exterior characteristics.
5. Summarize the types of HEV's.
6. Describe the technologies used in a HEV. (Operating Characteristics)
7. Explain the operation of mild and assist hybrid vehicles.
8. Explain the operation of full hybrid vehicles.

BATTERIES

1. Summarize basic battery operation.
2. List the different methods of rating batteries.
3. Differentiate between the different types of batteries and explain how they operate.
4. Explain battery cooling techniques.

MOTOR AND GENERATOR BASICS

1. Define basic motor types.
2. Explain basic motor and generator operation.
3. Describe how direct current motors operate.
4. Describe how alternating current motors operate.
5. Describe controller operation.

POWERTRAIN

1. Engine
    a. Internal Combustion Engine (ICE).
    b. Variable valve timing.
2. Transmission/transaxle

TECHNOLOGIES

1. Explain module communication.
2. Stop-start features.
3. Regenerative braking.
4. Electrical management.
5. Battery charging.

ACCESSORIES

1. Identify heating, ventilation and air conditioning systems.
2. Illustrate various power brake systems.
3. Describe how hybrid power steering systems operate.

HYDRAULIC AND PLUG-IN HYBRIDS

1. Identify the benefits of hydraulic and plug-in hybrids vehicles.
2. Describe the technologies used in hydraulic and plug-in hybrids vehicles (Operating Characteristics).

3. Explain the operation of hydraulic and plug-in hybrid vehicles.

HYBRID MAINTENANCE AND SERVICE

1. Explain safety procedures to be followed when servicing hybrids.
2. List safety equipment and procedures that should be used when servicing hybrid vehicles.
3. List special service tools required for hybrid vehicle service.
4. Demonstrate how to de-power the high voltage system.
5. Describe how to service the low and hi voltage batteries.
6. Demonstrate how to jump-start a hybrid vehicle.
7. Identify electronic diagnostic procedures used for hybrid vehicles
8. List basic internal combustion engine (ICE) service procedures for hybrid vehicles.
9. Describe cooling system service procedures for hybrid vehicles.
10. Summarize transaxle service procedures for hybrid vehicles.
11. Describe basic brake service procedures for hybrid vehicles.
12. Describe steering system service procedures for hybrid vehicles.
13. Describe air conditioning service procedures for hybrid vehicles.

VI. METHODS OF INSTRUCTION

This information is provided on the Section Syllabus

Attendance Policy

This attendance policy has been adopted and is intended to motivate students to maintain regular class attendance while participating in the Automotive Technology Program.

Three Credit Classes	Five Credit Classes
2-classes missed: 3.0 grade maximum	4-classes missed: 3.0 grade maximum
3-classes missed: 2.0 grade maximum	5-classes missed: 2.0 grade maximum
4-classes missed: 1.0 grade maximum	6-classes missed: 1.0 grade maximum
5-classes missed: Drop from class	7-classes missed: Drop from class

This Policy pertains to unexcused absences only. The individual instructor and the student will determine if the absence is excused or unexcused.

VII. METHODS OF EVALUATING STUDENT ACHIEVEMENT/ PROGRESS:

A. The following methods are used in this class.

Method		Department Range (specify when required)
Class Attendance:	Required	Up to 20%
Quizzes	Required	35%
Final Exam	Required	45%

Additional Information (By Department)

Extra Credit: Extra Credit may be available for this course. This information is provided by the instructor.

B. Grading Scale:

College Standard

College Grading Standards			Recommended Guidelines For Student Grades		
4.0	---	Excellent	4.0	---	91 -100%
3.5	---	----------	3.5	---	86 - 90%
3.0	---	Good	3.0	---	81 - 85%
2.5	---	----------	2.5	---	76 - 80%
2.0	---	Satisfactory	2.0	---	71 - 75%
1.5	---	----------	1.5	---	66 - 70%
1.0	---	Poor	1.0	---	60 - 65%
0.0	---	----------	0.0	---	0 - 59%

VIII. COURSE PRACTICES

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IX. DETAILED OUTLINE OF COURSE CONTENT AND SEQUENCING

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X. TRANSFER POTENTIAL

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Additional Information (By Department):

N.A.

XII. OTHER COURSE INFORMATION

By Department:

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Last Date Syllabus Revised: Not applicable – New Course

END OF SYLLABUS

Lansing Community College

Transportation Technologies Department

Official Course Syllabus Effective from XXXXXXSemester

Course Code: AUTO 266 Title: Hydrogen Application and Safety

I.	Course Code	Credit	Lecture	Lab
	AUTO 266	2	36	12

II.	**Prerequisite:**	Minimum 2.0 in AUTO 260, AUTO 265 or concurrently
	Restriction:	None
	Co-requisite Course:	None
	Recommended:	None

III. COURSE DESCRIPTION:

This course will give the student an understanding of the properties of hydrogen, its use as a fuel for internal combustion engines and fuel cells; and the storage, transportation and safety considerations; enabling the student to obtain employment as an alternative fuel vehicle technician.

IV. INSTRUCTIONAL MATERIALS:

A. Textbooks	*This information is provided by the Section instructor or in XII Other Course Information*	
B. Other Materials/Resources:	Required	Manufacturer's and Comprehensive Service Manuals for vehicles being serviced
C. Tools, Equipment or Apparel (required of the student):	Required	Safety glasses (leather shoes are strongly encouraged)

V. STUDENT LEARNING OUTCOMES (Department Specified):

Based upon established textbook or other resource standards, and other relevant industry standards and/or professional practices, the successful student will be able to:

USES OF HYDROGEN FOR TRANSPORTATION

1. List the reasons to use hydrogen as a fuel (Why Hydrogen?).
1. List the uses of hydrogen in transportation systems.
2. List hydrogen fueling station locations.

PROPERTIES OF HYDROGEN

1. Describe the atomic structure of hydrogen.
2. List the physical properties of hydrogen.
3. List the chemical properties of hydrogen.
4. List the gas laws that apply to hydrogen.
5. Describe key engineering parameters and their measurement (pressure, temperature, volume, capacity, mass weight and air flow).

CHARACTERISTICS PERTAINING TO THE USE OF HYDROGEN

1. Describe the ways of manufacturing or producing hydrogen.
2. Describe hydrogen storage methods.
3. Define hydrogen transportation methods.

HYDROGEN USE IN INTERNAL COMBUSTION ENGINES (ICE)

1. Describe the current use of hydrogen in ICEs.
2. Describe the combustive properties of hydrogen.
3. Explain crankcase ventilation, thermal emissions, exhaust emissions, gas mixtures and air/fuel ratio for hydrogen.
4. Define pre-ignition problems and solutions.
5. Describe hydrogen fuel delivery systems.
6. Describe thermal dilution.
7. Define engine designs for hydrogen engines.
8. Describe ignition systems used in hydrogen engines.
9. Explain power output for hydrogen engines.
10. List safety considerations for use of hydrogen in ICE's.

HYDROGEN USE IN FUEL CELL VEHICLES

1. Describe the history of fuel cells.
2. List the advantages and disadvantages of fuel cells.
3. Define fuel cell applications.
4. Explain the principles of operation of different types of fuel cells (molten carbonate, solid oxide, alkaline, phosphoric acid, and proton exchange membrane.
5. Describe how stoichiometry applies to hydrogen fuel cells.
6. Explain how humidity affects fuel cell operation.

SYSTEM DESCRIPTIONS

1. Describe how the listed systems operate with reference to fuel cell engines:
    a. Air system.
    b. Fuel storage system.
    c. Fuel delivery system.
    d. Humidification system.
    e. Stack cooling system.
    f. Heating, ventilating and cooling (HVAC) system.
    g. Electronic control system.
    h. Electrical system.
    i. Leak detection system.
    j. Fire suppression system.

GENERAL HYDROGEN SAFETY

1. List hydrogen characteristics that that must be considered as safety factors in the transportation and storage of hydrogen.
2. Describe safety guidelines for the use of hydrogen with reference to the hydrogen characteristics including Material Safety Data Sheets (MSDS) and emergency resource procedures.
3. Describe various hydrogen Safety Sensors and safety test equipment.

FUEL CELL ENGINE SAFETY

1. Describe the procedures for responding to hydrogen leaks and fires to include chemicals used to respond to fires.
2. Describe low and high temperature hazards that pertain to hydrogen.
3. Describe safety procedures that pertain to electrical shock.
4. Describe safety procedures that are followed when responding to high pressures.
5. Describe procedures for using de-ionizing resins and filters.
6. Describe safety procedures when handling ethylene glycol.
7. Describe the physical characteristics of a fuel cell stack and how they can be dealt with safely.

FUEL CELL VEHICLE MAINTENANCE

1. Explain fire suppression system inspections and tests.
2. List mechanical inspection procedures.
3. Describe filter inspection and replacement procedures.
4. Explain how to perform electronic diagnostic procedures.
5. Describe warning alarms that may be used on fuel cell vehicles.

FUEL CELL HYBRID ELECTRIC VEHICLES

1. Describe what a hybrid electric vehicle (HEV) is.
2. Discuss the various types of HEV's.
3. List the components of hybrid electric vehicles.
4. Explain how regenerative braking works.
5. Explain energy storage systems used in HEV's.
6. Describe HEV control systems.

CODES AND STANDARDS

1. List Federal Policy Acts that apply to hydrogen.
1. Describe codes and standards for storage of solid, liquid, metal hydride and gaseous hydrogen on board a vehicle.
2. Describe procedures for industrial and non-industrial stationary storage of solid, liquid, metal hydride and gaseous hydrogen.
3. List the codes and standards that apply to the transportation of liquid and gaseous hydrogen.
4. List reference publications for hydrogen.
5. Identify United States regulatory organizations that pertain to use of hydrogen.
6. Describe information on a Material Safety Data Sheet (MSDS) that pertains to hydrogen.

MAINTENANCE AND FUELING FACILITY GUIDELINES

1. Describe the following maintenance facility guidelines to be considered when developing a gaseous hydrogen repair facility.
    a. Leak detection systems.
    b. Fire detection systems.
    c. Electrical classification for hazardous locations.
    d. Positive ventilation.
    e. Emergency stop equipment.
    f. Designated parking and storage.
    g. Heating equipment.

2. Describe the following fueling facility guidelines to be considered when developing a gaseous hydrogen fueling facility.
    a. Mechanical design.
    b. Electrical Design.
    c. Clearances.
    d. Safety provisions.
    e. Materials.
    f. Security.
    g. Maintenance.
3. Discussthe special considerations for establishing a liquid hydrogen fueling facility.

FIRST RESPONDER PROCEDURES

1. List the information contained in first responder training for hydrogen.
2. Describe personal safety considerations.
3. List safety equipment needed for first responders.
4. List electrical and electronic safety cutoff equipment used by various manufacturers.
5. List hazards that first responders must be aware of when approaching hydrogen fueled vehicles.
6. Describe steps to follow when approaching a hydrogen vehicle at an accident.
7. Describe how to find the latest Emergency Response Guides for vehicles.

VI. METHODS OF INSTRUCTION

This information is provided on the Section Syllabus

Attendance Policy

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Class Attendance:	Required	Up to 20%
Quizzes	Required	35%
Final Exam	Required	45%

Additional Information (By Department)

Extra Credit: Extra Credit may be available for this course. This information is provided by the instructor.

B. Grading Scale:

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2.5 --- ----------	2.5 --- 76 - 80%
2.0 --- Satisfactory	2.0 --- 71 - 75%
1.5 --- ----------	1.5 --- 66 - 70%
1.0 --- Poor	1.0 --- 60 - 65%
0.0 --- ----------	0.0 --- 0 - 59%

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By Department:

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Last Date Syllabus Revised: Not applicable - New Course

END OF SYLLABUS

Lansing Community College

Transportation Technologies Department

Official Course Syllabus

Course Code: AUTO 263: Electric and Fuel Cell Technology

I.	Course Code	Credit	Lecture	Lab
	AUTO 263	2	40	8

II.	**Prerequisite:**	Minimum 2.0 in AUTO 100, 110,215, 225, 260
	Restriction:	None
	Co-requisite Course:	None
	Recommended:	None

III. COURSE DESCRIPTION:

This course is designed to help prepare the student to enter the auto repair and service industry in the area of alternative fuels. It is an intensive study of vehicle electric and fuel cell theory, application, installation, diagnosis, service and safety regulations will be covered.

IV. INSTRUCTIONAL MATERIALS:

A. Textbooks	*This information is provided by the Section instructor or in XII Other Course Information*	
B. Other Materials/Resources:	Required	Instructor handouts, manufacturer publications and internet references will be used.
C. Tools, Equipment or Apparel (required of the student):	Required	Safety glasses (leather shoes are strongly encouraged)

V. STUDENT LEARNING OUTCOMES (Department Specified):

Outcomes

Based on instructional guidelines included in West Virginia University training material, and current industry standards pertaining to electric and fuel cell vehicles, the successful student will be able to:

ELECTRIC VEHICLES

1. Describe what a battery electric vehicle is.
2. Describe the differences between vehicles that are powered by electricity and those fueled by fossil fuels.
3. Describe enabling technologies (high power batteries, ultra-capacitor, flywheel, hydraulic, solar).
4. Explain the advantages of having electric driven vehicles available to the public.
5. Describe the basic components of electric drive vehicles.
6. Discuss the evolution of electric drive vehicles.
7. List how electric vehicles are being used today.

BASICS OF ELECTRICITY

1. List and define common electrical terms.
2. Illustrate electrical circuit components.
3. Identify the basics of magnetism.
4. Differentiate between high and low voltage electrical systems,
5. Explain basic motor types.
6. Identify the components of AC motors.
7. Identify the components of DC motors.
8. Explain how generators work.
9. Explain how motor/generators work.
10. Describe how electric vehicle controllers operate.
11. Describe power meter.

COMPONENTS

1. Describe the basic components of electric drive vehicles.
2. Discuss basic battery theory.
3. Explain methods of rating batteries.
4. List the common types of batteries and how they store electricity.
5. Describe the basic components of a battery operated electric vehicle and how they are installed in the vehicle.
6. List the accessories available for battery powered electric vehicles and how they operate.
7. Describe battery diagnosis procedure for batteries used in battery powered electric vehicles.

HYDROGEN

1. Identify the properties of hydrogen.
2. Identify the sources of hydrogen.
3. Discuss the heating value, energy density, flammability and flash point of hydrogen.
4. Describe hydrogen shipping and storage challenges.
5. Describe properties of hydrogen-based fires.

FUEL CELL VEHICLES

1. Describe what a fuel cell vehicle is.
2. Describe the differences between vehicles that are powered by fuel cells and those fueled by fossil fuels.
3. Explain the advantages of having fuel cell driven vehicles available to the public.
4. Describe the basic components of fuel cell vehicles.
5. Discuss the evolution of fuel cell vehicles.
6. List the types of fuel cells.
7. Identify on-board reformers.
8. Describe how proton exchange membrane fuel cells work.
9. List the fuel cell vehicles being driven on the road today.

10. Describe possible emissions from a fuel cell vehicle (water, heat, carbon monoxide, hydrogen, NOx,
11. Identify potential environmental and human impacts.

FUEL CELL SAFETY

1. Describe hydrogen monitoring and detection techniques.
2. Describe high pressure gas compression safety.
3. Describe storage and transportation procedures.
4. Identify potential electrical dangers (fuel cell stack, high voltage, inverter, wiring).
5. Identify potential ignition sources (fuel cell stack, test equipment, ambient sources).
6. Identify critical temperature (fuel stack, motor).
7. List types of failures (surge, over-current, hydrogen leak, short circuit, gas crossover).
8. Describe hydrogen monitor.
9. Identify hazardous waste produced by fuel cell material.
10. Describe spray distinguishing procedures (manual and automatic).
11. Describe ventilation systems.
12. Describe spark resistant equipment.
13. Describe notification procedures.
14. Describe emergency response procedures.

VI. METHODS OF INSTRUCTION

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VII. METHODS OF EVALUATING STUDENT ACHIEVEMENT/ PROGRESS:

A. The following methods are used in this class.

Method		Department Range (specify when required)
Class Attendance:	Required	Up to 20%
Lab, Assignments	Required	40%
Quizzes	Required	25%
Final Exam	Required	15%

Additional Information (By Department)

Extra Credit: Extra Credit may be available for this course. This information is provided by the instructor.

B. Grading Scale:

College Standard

College Grading Standards			Recommended Guidelines For Student Grades		
4.0	---	Excellent	4.0	---	91 -100%
3.5	---	----------	3.5	---	86 - 90%
3.0	---	Good	3.0	---	81 - 85%
2.5	---	----------	2.5	---	76 - 80%
2.0	---	Satisfactory	2.0	---	71 - 75%
1.5	---	----------	1.5	---	66 - 70%
1.0	---	Poor	1.0	---	60 - 65%
0.0	---	----------	0.0	---	0 - 59%

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Additional Information (By Department):

N.A.

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By Department:

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Last Date Syllabus Revised:

END OF SYLLABUS

Lansing Community College

Transportation Technologies Department

Official Course Syllabus

Course Code: AUTO 264: Gaseous Fuels

I.	Course Code	Credit	Lecture	Lab
	AUTO 264	3	32	32

II.	**Prerequisite:**	Minimum 2.0 in AUTO 100, 110,215, 225, 260
	Restriction:	None
	Co-requisite Course:	None
	Recommended:	None

III. COURSE DESCRIPTION:

This course is designed to help prepare the student to enter the auto repair and service industry in the area of alternative fuels. It is an intensive study of three gaseous fuels, natural gas, propane and hydrogen. Theory, application, installation, diagnosis and safety regulations will be covered.

IV. INSTRUCTIONAL MATERIALS:

A. Textbooks	*This information is provided by the Section instructor or in XII Other Course Information*	
B. Other Materials/Resources:	Required	Instructor handouts, manufacturer publications and internet references will be used.
C. Tools, Equipment or Apparel (required of the student):	Required	Safety glasses (leather shoes are strongly encouraged)

V. STUDENT LEARNING OUTCOMES (Department Specified):

Outcomes

Based on instructional guidelines included in West Virginia University training material, NATEF standards and current industry standards pertaining to alternative fuel vehicles, the successful student will be able to:

COMPRESSED NATURAL GAS

1. Describe the characteristics of natural gas as a fuel.
2 List the legislative and regulatory policies pertaining to the use of natural gas as a fuel.
3. Describe the safety guidelines pertaining to natural gas.
4. Identify NGV vehicle compatibility and learn system selection techniques.
5. Illustrate NGV dedicated vehicle components, layout and installation.
6. Illustrate NGV conversion system components, layout and installation.
7. Identify the various NGV Fuel Cylinder types and describe how to install the cylinders properly.
8. Identify electrical, electronic control system components and wiring.
9. Examine driver orientation guidelines and learn vehicle fueling procedures.
10. Discuss diagnostic methods and troubleshooting procedures that may be used to solve vehicle drivability problems.
11. Describe CNG cylinder defects and define proper inspection procedures.

PROPANE

1. Describe the characteristics of propane as a fuel.
2. List the legislative and regulatory policies pertaining to the use of propane as a fuel.
3. Describe the safety guidelines pertaining to propane.
4. Identify propane vehicle compatibility and learn system selection techniques.
5. Illustrate propane dedicated vehicle components, layout and installation.
6. Illustrate propane conversion system components, layout and installation.
7. Demonstrate how to install propane cylinders properly.
8. Identify electrical, electronic control system components and wiring.
9. Examine driver orientation guidelines and learn vehicle fueling procedures.
10. Discuss diagnostic methods and troubleshooting procedures that may be used to solve drivability problems.
11. Describe propane cylinder defects and define proper inspection procedures.

HYDROGEN

1. Describe the characteristics of using liquid and gaseous hydrogen as a fuel.
2. List the legislative and regulatory policies pertaining to the use of hydrogen as a fuel.
3. Describe the storage and shipping requirements for gaseous and liquid hydrogen.
3. Define the safety guidelines pertaining to hydrogen
4. Describe the various types and designs of fuel cells that might be used in vehicles.
5. Identify hydrogen vehicle engine design characteristics.
6. Illustrate liquid and gaseous hydrogen components used on dedicated vehicles. Illustrate layout and installation guidelines.
7. Describe how to install fuel cell and hydrogen components properly.
8. Identify electrical, electronic control system components and wiring.
9. List driver orientation guidelines and explain vehicle fueling procedures.
10. Discuss diagnostic methods and troubleshooting procedures that may be used to solve drivability problems.

NATIONAL FIRE PROTECTION ACTS

1. NFPA 52: Compressed Natural Gas and Hydrogen.
2. NFPA 58 Propane (LPG).

ELECTRONIC DIAGNOSTIC AND INTEGRATION METHODS

1. Discuss the importance of electronics and diagnostics using the given reference manuals.
2. Describe the use of electronics and computer control in CNG vehicles.
3. Review diagnostic and troubleshooting procedures to follow when solving problems.
4. Explain the fundamentals of electricity pertaining to CNG vehicles.
5. Review computer fundamentals pertaining to CNG vehicles, such as logic gates, truth tables, temperature sensors, pressure sensors, throttle position sensor, spark monitoring and control, hall effect switch, oxygen sensor, electronic spark timing, and computer control of fuel induction.
6. Learn the difference between open and closed loop operation and the effects on engine operation.
7. Discuss various types of CNG control systems including ANGI, IMPCO, GFI, Baytech, MESA GEM, MODAS, DAI/Synchro-Start, and SPI injectors.
8. Learn how electronic control systems interact using the given reference manuals.
9. Demonstrate different types of NGV systems (adaptive learn, speed density, programmable compu-valve, stand alone engine controls, oxygen sensor driven feedback, and high pressure gaseous injector).

SYSTEM SPECIFIC ELECTRONICS

1. Identify systems that demonstrate two control philosophies using the given reference manuals.
2. Identify two conversion systems that demonstrate speed density calculations using different methods.
3. Identify the values that ECO FMS monitors.
4. Learn how ECO FMS performs diagnostic procedures.
5. Discuss timing optimizers for ECO systems.
6. Discuss how the MESA GEM system monitors various parameters in the vehicle.
7. Identify the values that the GEM system monitors.
8. Discuss how the GEM system performs diagnostic procedures.

EMISSIONS

1. Define emissions.
2. Identify the major causes of emissions.
3. Explain the effects of exhaust emissions on human health and the environment.
4. Discuss the chemistry of combustion: ideal versus reality.
5. Describe the chemical reaction associated with combustion using the given reference manual.
6. Describe the reaction between exhaust gasses and the catalytic converter.
7. Describe the difference between gaseous fuel injection and mixers.
8. Perform emission tests on gaseous and liquid fuel vehicles.

CYLINDER INSPECTION

1. Discuss cylinder background and history using the given reference manual.
2. Describe and discuss pressure vessel design and features.
3. Describe the four different types of cylinders.
4. Explain how cylinders are made and where safety features are designed into cylinders.
5. Explain how cylinders are labeled.
6. Identify and explain the standards that apply to different types of cylinders.
7. Complete a general visual inspection.
8. Complete a detailed visual inspection.
9. Discuss other types of testing available using the given reference manual.
10. Demonstrate how cylinders are mounted, shielded and vented.
11. List the requirements of the National Fire Protection Act-52 (NFPA 52AND NFPA 58) and what the act covers.
12. Identify different types of cylinder damage, such as surface corrosion, fatigue cracking, abrasion damage, cuts, impact damage, stress corrosion, fire or heat damage and ultra-violet ray damage.
13. Perform a cylinder inspection, identify types and severity of damage and recommend repair or disposition.

14. Complete cylinder inspection report.
15. De-fuel a cylinder.

VEHICLE CONVERSION

1. Perform a vehicle conversion on a CNG or propane vehicle.

*Students will be responsible for meeting current NATEF and industry standards, which may not be reflected in this syllabus.

VI. METHODS OF INSTRUCTION

This information is provided on the Section Syllabus

Attendance Policy

This attendance policy has been adopted and is intended to motivate students to maintain regular class attendance while participating in the Automotive Technology Program.

Three Credit Classes	Five Credit Classes
2-classes missed: 3.0 grade maximum	4-classes missed: 3.0 grade maximum
3-classes missed: 2.0 grade maximum	5-classes missed: 2.0 grade maximum
4-classes missed: 1.0 grade maximum	6-classes missed: 1.0 grade maximum
5-classes missed: Drop from class	7-classes missed: Drop from class

This Policy pertains to unexcused absences only. The individual instructor and the student will determine if the absence is excused or unexcused.

VII. METHODS OF EVALUATING STUDENT ACHIEVEMENT/ PROGRESS:

A. The following methods are used in this class.

Method		Department Range (specify when required)
Class Attendance:	Required	Up to 20%
Lab, Assignments	Required	40%
Quizzes	Required	25%
Final Exam	Required	15%

Additional Information (By Department)

Extra Credit: Extra credit may be available for this course. This information is provided by section instructor.

B. Grading Scale:

College Standard

College Grading Standards			Recommended Guidelines For Student Grades		
4.0	---	Excellent	4.0	---	91 -100%
3.5	---	----------	3.5	---	86 - 90%
3.0	---	Good	3.0	---	81 - 85%
2.5	---	----------	2.5	---	76 - 80%
2.0	---	Satisfactory	2.0	---	71 - 75%
1.5	---	----------	1.5	---	66 - 70%
1.0	---	Poor	1.0	---	60 - 65%
0.0	---	----------	0.0	---	0 - 59%

VIII. COURSE PRACTICES

College-wide policies are stated in the Lansing Community College Catalog and include those on attendance, withdrawals and incomplete grades. The catalog is available on the internet at http://www.lcc.edu/catalog/

IX. DETAILED OUTLINE OF COURSE CONTENT AND SEQUENCING

The Detailed Course Outline is provided by the section instructor or, if present, is subject to change by the section instructor.

X. TRANSFER POTENTIAL

For transferability information, please consult the Transfer Equivalency List located on the internet at http:// www.lcc.edu/transfer. For additional transferability information contact the LCC Counseling Services Department, (517) 483-1255.

The MACRAO Transfer Agreement simplifies the transfer of students from one Michigan institution to another. It appears in the catalog.

XI. STUDENT ACADEMIC INTEGRITY

The very nature of higher education requires that students adhere to accepted standards of academic integrity. Therefore, Lansing Community College has adopted a code of academic conduct and a statement of student academic integrity. These may be found in the Lansing Community College Catalog. The violations of academic integrity listed and defined are cheating and plagiarism. It is the student's responsibility to be aware of behaviors that constitute academic dishonesty.

Classroom behavior that interferes with the instructional process is not tolerated. The consequences are addressed in the catalog under Administrative Withdrawal.

Additional Information (By Department):

N.A.

XII. OTHER COURSE INFORMATION

By Department:

OFFICE OF DISABILITY SUPPORT SERVICES
Students with disabilities who believe that they may need accommodations in this class are encouraged to contact the Office of Disability Support Services, Gannon Vocational-Technical Building, Room 204 or by calling 517-483-1904 as soon as possible to better ensure that such accommodations are implemented in a timely fashion.

Last Date Syllabus Revised:

END OF SYLLABUS

Alternative Energy Center

Scientific/Technical Report

Appendix “C”

LCC Safety Statement

The safety of each employee and student of the Lansing Community College (LCC) is of primary importance. Lansing Community College has every desire to provide a safe work and educational environment and will make every effort to eliminate and/or control all accidents, fires, and occupational hazards to its employees and students. To accomplish this, LCC will provide reasonable safeguards necessary to one's personal protection.

Employees and students are expected to follow safe procedures and take an active part in protecting themselves and their colleagues. Available safety equipment will be properly used and will not be destroyed or abused. Safety rules shall be followed at all times.

Instructors and lecturers will be accountable for the safety of the students under their supervision and will be expected to conduct operations in a safe manner at all times. They will give leadership and direction to the education and training of their students in the safety requirements of LCC.

Our goals …

- To establish and maintain a safe environment for employees and students
- To eliminate hazards
- To practice accident prevention
- To promote and recognize safety consciousness and responsibility
- To involve administration, instructors, lecturers, and staff in safety planning and prevention
- To improve channels of communication

Responsibilities: Administrators

1. Set objectives and policy.
2. Ensure that safety and health information is included as an integral part of instructional curricula, methods, materials and operations.
3. Ensure that effective fire prevention and protection controls exist.
4. Guarantee a system where hazard control is considered an important part of equipment purchase and process design, preventive maintenance, and shop layout and design.
5. Recognize that the College's maximum efficiency and effectiveness cannot be achieved without complying with the State and College occupational safety regulations.

Responsibilities: Instructors

1. Train and educate students in work methods and techniques which are free from recognized hazards.
2. Demonstrate an active interest in and comply with school safety and health policy and regulations.

Responsibilities: Instructors (cont'd)

3. Supervise and evaluate student performance with consideration given to safe behavior and work methods.
4. Inspect and monitor the shop/lab for human, situational, and environmental factors that can cause accidents and injuries.
5. Make sure that tools, equipment, and machinery are ordered and purchased with adequate consideration for student and safety and with adequate protective devices.
6. Obtain adequate information on the health hazards associated with substances and materials used in the shop operations.
7. Keep machinery, tools, and equipment in safe working conditions. Unsafe or malfunctioning equipment shall be tagged out and shall not be used until repaired.
8. Correct hazards detected in their monitoring and report such hazards to the College Safety Officer.
9. Report immediately all accidents occurring within their shops/labs to DPS.

Responsibilities: Safety Officer

1. Assist instructors on facility survey/inspection for safety and health hazards.
2. Advise administration of safety and health hazards found and offer recommendations for their correction.
3. Evaluate shop/lab health and safety rules/programs.
4. Be familiar with the shop/lab safety and health practices and the safety information contained in materials and curricula.
5. Assist instructors on the selection of appropriate safety devices, personal protective equipment and emergency response materials.
6. Provide administrators, instructors and staff with information on how to comply with Michigan (MIOSHA) Standards.
7. Review accident/injury records, identify problem areas, and develop effective control methods to reduce/eliminate accidents/injuries.
8. Review the College Safety and Health Program on an annual basis to ensure that the program is effective and in compliance with the current safety standards. Provide adequate training to administrators, faculty, and staff on relevant safety issues.

Responsibilities: Students

1. Obey school safety and health rules and regulations and work according to standard shop practices.
2. Recognize and report immediately to the instructor hazardous conditions or work practices in the shop.
3. Use protective equipment, tools, and machinery as they were assigned.
4. Report all injuries or exposure to toxic material to the instructor immediately.

General Safety and Health Rules

The following Safety and Health Rules are applied to all faculty members, staff, administrators, students, and visitors.

1. Instructors shall set a good example in promoting occupational health and safety by following all safety rules.
2. All students involved in activities that pose potential exposures to chemical, physical hazards in the classroom, laboratory, or shop must be trained on the hazards and safe practices. All formal health and safety training must be documented. Health and safety rules will be strictly enforced by the instructor. Students who violate the rules will not be allowed to attend or continue the class until such actions are corrected. Repeated violation of safety rules may result in dismissal from the class.
3. General safety rules which apply at all times in the classrooms, shops, and laboratories should be posted.
4. Specific safety procedures for specific equipment, tools and machinery shall be posted at the locations of activities. The requirement to use personal protective equipment, for example, safety glasses, gloves, ear plugs, must be posted at the locations as well.
5. An adequate first aid kit shall be maintained in each designated location. Instructors are not allowed to distribute internally-taken medicine, including pain killers such as aspirin or acetaminophen.
6. All equipment, tools, and machinery must be kept in good operating condition. The instructor must ensure that periodic inspection and preventive maintenance are conducted and that the equipment operates to manufacturer's specifications.
7. All accidents, whether with or without an injury, must be reported to DPS immediately.
8. Instructors should be aware of the fire safety procedures and communicate the procedures to the students in the classroom.

LANSING COMMUNITY COLLEGE
HYDROGEN SAFETY PLAN

Section 1

Lansing Community College will be using hydrogen in several demonstration projects at our West Campus Facility over the next few years. What follows is a detailed process of how the hydrogen will be used, equipment used and safety procedures to be used with the demonstrations and classroom use. This document has been divided up into two sections. The first section details the Hydrogen cell kiosk on the first floor of West Campus and the second part details the energy lab room

EQUIPMENT TO BE USED:

Three Ballard Power System – Airgen Fuel Cell Generators (item # 1)

IDENTIFICATION OF SAFETY VULNERABILITIES

The College will be using one generator to run a computer kiosk on the first floor of our West Campus Facility. The kiosk will be in our foyer on the South side of the building (See item # 2) Vulnerabilities in this system would include:

1. leak of hydrogen from tank, fuel cell or piping system.
2. fire/explosion in kiosk caused by malfunction fuel cell or computer unit.
3. deliberate vandalism to the kiosk resulting in fire or explosion.

All vulnerabilities above could result in death or serious injury to faculty, staff, students or the general public.

RISK MITIGATION PLAN

Physical Controls:

1. The Airgen Fuel Cell has auto shutdown. In the event of a hydrogen leak, an alarm would sound throughout the building. This alarm would be sent to both campus police departments, at West and Main Campus.

2. Cabinet where Airgen is located has explosion proof vent fan to vent any Hydrogen (See item #3)

3. Cabinet also has vent to help airflow in Airgen area. (See item #4)

4. Area where Hydrogen tank is located has a Hydrogen sensor at top of the tank. This sensor would send an alarm and also shutdown fuel system to the unit.

5. All sensors alarms are sent via fire system to the Campus Police dept. which monitor all alarms 24/7. The College has one police sub station directly across from the kiosk where alarms will come to. In addition alarms also go to Main Campus Police dispatch which is also manned 24/7. (See item #5 – West Campus substation and item #6 Main Campus Dispatch)

6. It was thought that placing the kiosk close to the police substation would dissuade anyone from tampering with the unit.

7. Local fire authority will be advised of special hazard and be given a copy of this document as a prefire plan.

8. Area where kiosk is located is fully sprinkle red and also has a VESDA smoke detector system.

9. Kiosk shall have only one tank of Hydrogen at 2400 psi.

MEASURING SAFETY PREFORMANCE

Every month the sensor system shall be checked by the College Safety Officer. Written documentation of these inspections shall be maintained by the Safety Officer. Safety reports and any safety related inspections from outside agencies will also be kept by the safety officer. Should changes be made in any part of this kiosk, the College Safety Officer will be notified first.

STANDARD OPERATING PROCEDURES

1. Kiosk will have a timer the on unit to activate and turn on unit at 8:00 A.M. Monday through Friday. Unit will automatically be turned off at 9:00 P.M. Monday through Friday.

2. Once a month, the College Safety Officer will check kiosk and check for Hydrogen leaks that automatic system did not pick up. If any unusual condition or leaks are discovered, the Safety Officer will deactivate the unit and report problem to the Physical Plant Dept.

3. Upon the activation of a Hydrogen sensor, the system will shut down automatically. The alarm will also be transmitted to the Campus Police Dept. at both West Campus and Main Campus locations.

EMPLOYEE TRAINING

1. All employees of the Campus Police Dept. and employees working on the Hydrogen Kiosk project will be trained on the following:

   a. Procedures for replacing hydrogen tank at kiosk

   b. Location and operation of Hydrogen sensors on the unit and operational procedures should sensors detect a possible Hydrogen leak.

   c. Campus Police and kiosk employees will review emergency procedures once every six months. A training log shall be kept of all employee training on this kiosk. This log shall be kept by the College Safety Officer.

ENSURING EQUIPMENT INTEGRITY

1. As stated in the measuring safety performance section, the College Safety Officer will make monthly inspections of the kiosk to insure safe operation of unit and inspect fuel cell, piping and ventilation systems.

EMERGENCY RESPONSE PLAN

FIRE:

1. Heat from a possible Hydrogen fire would most probably set the kiosk itself on fire. The VESDA smoke detector system would pick up the smoke and turn in the alarm. Automatic shutdowns on the hydrogen tank and on Airgen fuel cell would shut off the Hydrogen and shut off Airgen unit.

2. Fire alarms will sound in the building; Campus Police will respond; note fire location and direct building occupants away from the area of the fire and out exit doors.

3. Sprinkler system would activate and control any fire spread.

4. Campus Police would take the added precaution to turn off electrical breaker to Airgen unit.

5. Delta Fire Dept. would be contacted and respond to the scene Campus Police would communicate to Delta that hydrogen was involved in the fire.

6. Delta Fire Dept. will extinguish any remaining fire . Both Delta Fire and the College Safety Officer will investigate the fire scene.

7. Occupants will not be allowed in the building until Delta Fire Dept. and College

Safety Officer are both satisfied that no further danger exists from the kiosk and That the Hydrogen tank powering the fuel cell is removed from the building.

8. A fire report will be written by both the College Safety Officer and Delta Fire Dept. A copy of the fire reports will be submitted to D.O.E. for review. The kiosk will not be used again until Delta Fire, College Safety Officer and D.O.E. have given their permission to resume operations.

HYDROGEN LEAK:

1. Hydrogen sensors will activate indicating a possible leak in piping, tank or fuel cell unit.

2. Alarms will be sent to both the West and Main Campus Police Depts. Officers will respond to the scene. Delta Fire will also be called and respond to the scene.

3. Area 500 feet around the unit will be evacuated and all power to the unit will be shut down.

4. Safety Officer and Delta Fire will use metering and observation to determine leak location. After insuring all Hydrogen has been shut down and the area free of any possible danger, the storage tank will be unhooked and the fuel cell taken out of service.

5. A report will be written by the Safety Officer reference to the incident and submitted to College Administration for review.

6. Kiosk will not be placed back into operation again until leak is repaired and fault analysis has taken place to determine the caused of the incident. Corrective actions will be taken to insure the leak will not reoccur

VANDALISM PREVENTION

The Kiosk is in the main hallway of the West Campus. This area is under video surveillance. The Kiosk is also directly across the hallway from the West Campus Police substation.

HYDROGEN SAFETY PLAN

Section 2

Lansing Community College will be using two fuel cells in its Alternative Energy Lab at the West Campus Facility. Several classes will be involved with this project. What follows are the physical safety items, safety procedures and emergency procedures that will be used in the management of these classes.

EQUIPMENT TO BE USED:

Ballard Power System – Airgen Fuel Cell Generators.

IDENTIFICATION OF SAFETY VULNERABILITIES

The College will have two Airgen Fuel Cells in the lab, room W164 at the West Campus. (See item # 7 for photo of lab.) The possible vulnerabilities to this lab include:

1. leak of Hydrogen from the two 250 cubic feet capacity tanks used to power cells.
2. fire / explosion in lab caused by malfunctioning fuel cell or piping.
3. deliberate vandalism to lab area resulting in fire or explosion.

All vulnerabilities above could result in death or serious injury to faculty, staff, students or general public.

RISK MITIGATION PLAN

Physical Controls:

1. Both Airgen Fuel Cells have auto shutdown. In the event of a Hydrogen leak, an alarm would sound in the lab and throughout the building. This alarm would also be sent to the Campus Police at both West and Main Campus.

2. Two Hydrogen sensors are located above fuel cell work area and also two below. This will insure no leaks will travel blow or above bench area. (See item # 8 for photo of detectors used.)

3. Emergency power shutoffs are also installed by workbench and by exit door. Upon activation, these shutoffs will stop Hydrogen flow, turn off all power to systems in the room, and send a trouble alarm to Campus Police. (see items # 9 & 10)

4. Since Hydrogen burns with a clean flame, the College has installed a flame detector in the lab. This detector scans the work area where hydrogen tanks, fuel cells, work stations and piping are installed. Should any fire start in the lab from hydrogen source or other ignition sources, this detector will give immediate detection of the problem. This detector is hooked up to the fire alarm system for the building and to the Campus Police. (See item # 11 for photo of detector)

5. In the event of a Hydrogen leak alarms will sound throughout the building. Evacuation will be accomplished with the assistance of the Camps Police. The Delta Fire Dept will be contacted. Should the Alternative Energy Lab be the source of the alarm, a special vent system will be activated. This vent is run by an explosion proof motor and will vent out all residual Hydrogen vapors in the lab.

6. Upon the arrival of Delta Fire Dept. the Alternative Energy Lab should be relatively free of Hydrogen vapors. At the entrance to the lab area, there is a reset button. This button can be activated to remotely reset all hydrogen detection devices in the room. After reset, the detection devices will again check the room for any flammable gas. If the alarm activates the fire officer will know there is still flammable vapors in the room. (see item # 12 for photo of button location)

7. Alternative Energy Lab is 100% fire sprinklered.

MEASURING SAFETY PREFORMANCE

Every month all safety systems will be checked by the College Safety Officer. Written documentation of these inspections shall be maintained by the safety officer. Safety reports and any safety related inspections from outside agencies will also be kept by the Safety Officer. Should changes be made to any part of this lab, the College Safety Officer will be notified first.

EMPLOYEE TRAINING

1. All employees of the Campus Police Dept. and employees working in the lab will be trained on the following:

    a. procedures for replacing Hydrogen tanks in lab.

    b. location and operation of Hydrogen sensors and emergency manual shutoffs in the lab. Procedures in the event sensors detect Hydrogen leak.

c. Campus Police and employees working in lab will review emergency procedures once every six months. A training log shall be kept of all employees training as it relates to this lab.

ENSURING EQUIPMENT INTEGRITY

1. As stated in the measuring safety performance section, the College Safety Officer will make monthly inspections of lab area to insure safe operation of the lab.

EMERGENCY RESPONSE PLAN

FIRE:

1. Heat from possible fire would set off heat detector in room. All systems would shut down, including supply tanks and Airgen fuel cell.

2. Fire alarms would sound in the building, Campus Police will respond, note fire location, and direct building occupants away from the area of the fire and out exit doors.

3. Sprinkler system in lab would activate and control any fire spread.

4. Delta Fire Dept. would be contacted and respond to the scene. Campus Police would communicate to Delta Fire Dept. that Hydrogen was involved in the fire.

5. Delta Fire will extinguish any remaining fire. Both Delta Fire and College Safety Officer will investigate the fire scene.

6. Occupants will not be allowed in the building until Delta Fire and College Safety Officer is both satisfied that no danger exits in the lab area, and that Hydrogen tanks are removed from the building.

7. A fire report will be written by both the College Safety Officer and Delta Fire Dept. a copy of the fire reports will be submitted to D.O.E. for review.

HYDROGEN LEAK

1. Hydrogen sensors will activate indicating a possible leak in piping, tank or fuel cell unit.

2. Alarms will be sent to both Campus Police Departments, at West Campus and Main Campus. Delta Fire Dept. will also be contacted and respond to the scene.

3. Lab area and entire building will be evacuated and all power to the lab area for experimentation will be shut off.

4. Safety Officer and Delta Fire will use metering and observation to determine leak location. After insuring all Hydrogen has been shut down and area free of any danger, the hydrogen storage tanks will be unhooked and fuel cells taken out of service.

5. A report will be written by the Safety Officer reference to the incident and submitted to the College Administration for review. The lab will be taken out of use and not put back into operation again until leak is repaired and fault analysis has taken place to determine the cause of the incident. Corrective actions will be taken to insure leak will not reoccur

STUDENT AND INSTRUCTOR SAFETY PROGRAM

Instructors in this program take a high degree of responsibility for the safety of their students and safety of the general public. See item # 13 for safety policy for Hydrogen class.

VANDALISM PREVENTION

The lab area which houses the Alternative Energy Program is protected with special Best “Peaks” system locks. This series of locks can not be picked or opened without a special key. All equipment inside law will be locked in cabinets when not in use.

Area is patrolled by Campus Police and area around lab is under video surveillance 27/7.


BALLARD
airGEN
ON/AUTO
MANUAL

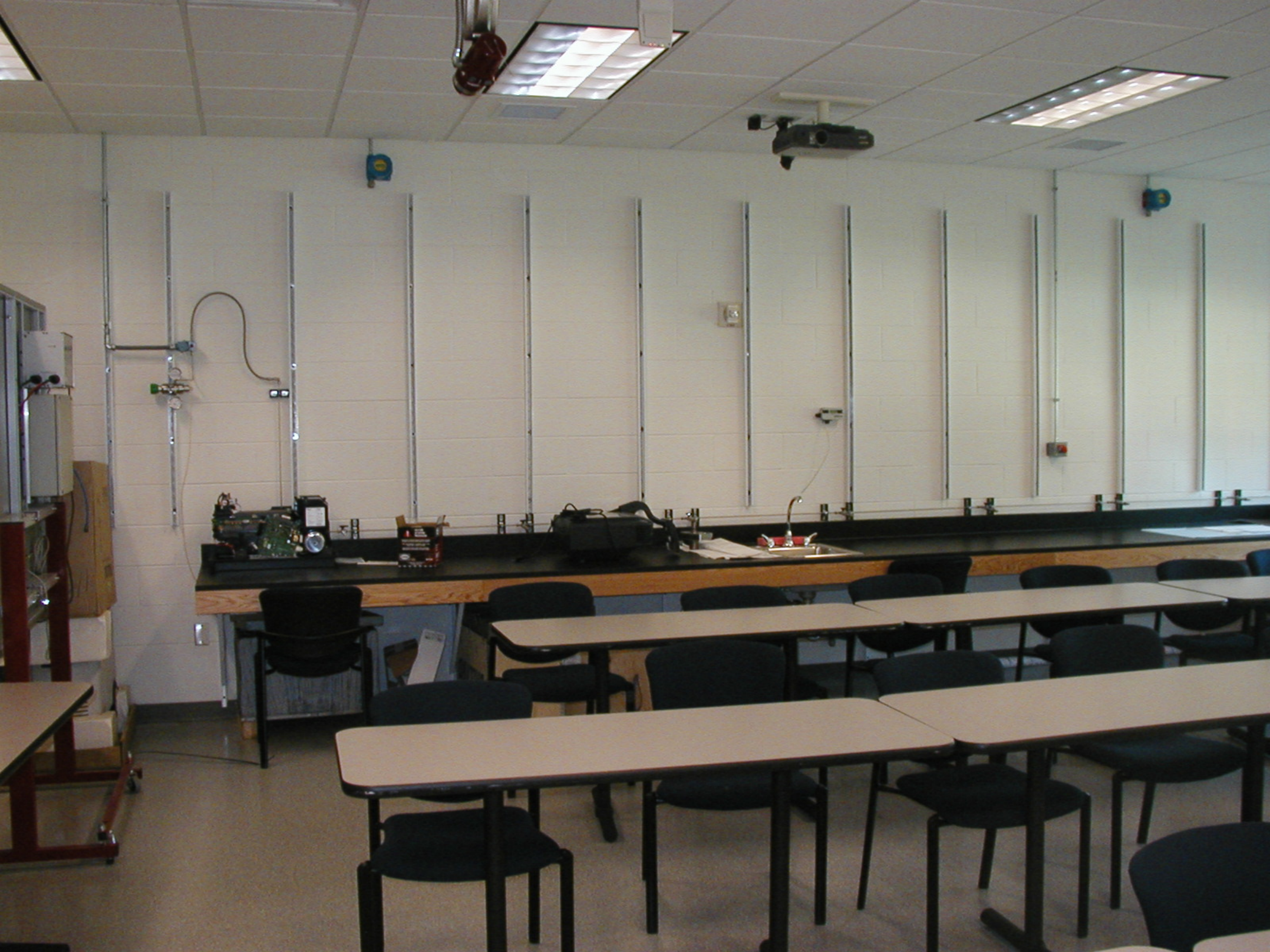
energy

hydrogen

processor

fuel cell


NORTH
Police
HEARTSTART




73°F
HP-46 3.3.16
SIEMENS
EMERG. STOP


009008-002

H2 Safety policy for instructors and students in the **Alternative Energy Program.**

1. Prior to any activities involving H2, all must view the video on Hydrogen safety. No exceptions.

2. Prior to any activities involving H2, all must pass a ten question test with 100% score on Hydrogen Safety, the test is available by contacting the AEET program director or the College safety officer. Failure to pass the test will require re-viewing the video on Hydrogen safety, there will be a limit of one test per person per day.

The following guide lines must be followed at all times.

1. No Hydrogen cylinders of greater than 250 cubic feet capacity will be permitted inside any LCC buildings. NFPA requirement.

2. No more than one cylinder of less than 250 cubic feet capacity shall be in any one wing of the West Campus Technical Center building.

3. Public Safety will be notified before a cylinder containing hydrogen is moved from outside storage to the interior of the building, and when it is removed.

4. The safety cap will remain on the cylinder, and the valve seal plug installed, at all times when it is being moved by any method. Exception: when cylinder is secured to a vehicle powered by hydrogen.

5. Before making any connections to any component in any Hydrogen system the user will insure that a working Hydrogen detector is operational in the area. That the door to that class room is blocked open and that the ventilation system is turned on. Currently this limits Hydrogen use to West Campus classroom WC164 and the kiosk located in the front lobby. The use of the Hydrogen fuel cell powered golf cart is permitted in all areas except small classrooms, since it has an integral shutdown that is triggered by a H2 sensor.

6. When making any gas connections to any Hydrogen system or component a soap bubble leak test will be preformed. The smallest leak is a leak that must be corrected, no exceptions.

7. All lines containing Hydrogen shall be purged with dry Nitrogen or Hydrogen to insure that all oxygen is removed from the line before it is pressurized.

8. Conventional firefighting equipment such as A-B-C dry chemical extinguishers may have little effect on a H2 fire. SHUT OFF THE GAS AT THE CYLINDER AT ONCE.

9. If a fire is ignited by accident and is not immediately extinguished by closing a valve to stop the flow of gas, it is assumed to be out of control and the fire alarm must be pulled. All accidental ignition, no matter how harmless, of H2 shall be reported to the Public Safety Department, which will create a report of the incident and take action to prevent a recurrence.

10. No one person alone shall operate any H2 system. There will be a minimum of two (2) or more people present when the H2 system is in use.

11. Although H2 is non-toxic it can displace oxygen in poorly vented areas and can cause a person to lose consciousness, if you are in the room with the unconscious person remove the person and all others from the room at once. Do not attempt to enter an area where a person is unconscious, sound alarm and get help. Treatment is to move all affected persons to fresh air.

Policy Developed August 21, 2006
John M. Hanley
Professor
Lansing Community College

Alternative Energy Center

Scientific/Technical Report

Appendix “D”

Thinking globally... working locally

The U.S. Department of Energy is working with institutions like Lansing Community College so that we are prepared for the future. The DOE has provided $1 million in funding for LCC's Alternative Energy Initiative, which includes education, curriculum development and the training of tomorrow's workforce to succeed in a new energy economy. That's essential – because the future is here.

Michigan's future depends on new energy. And there's a whole world of opportunity.

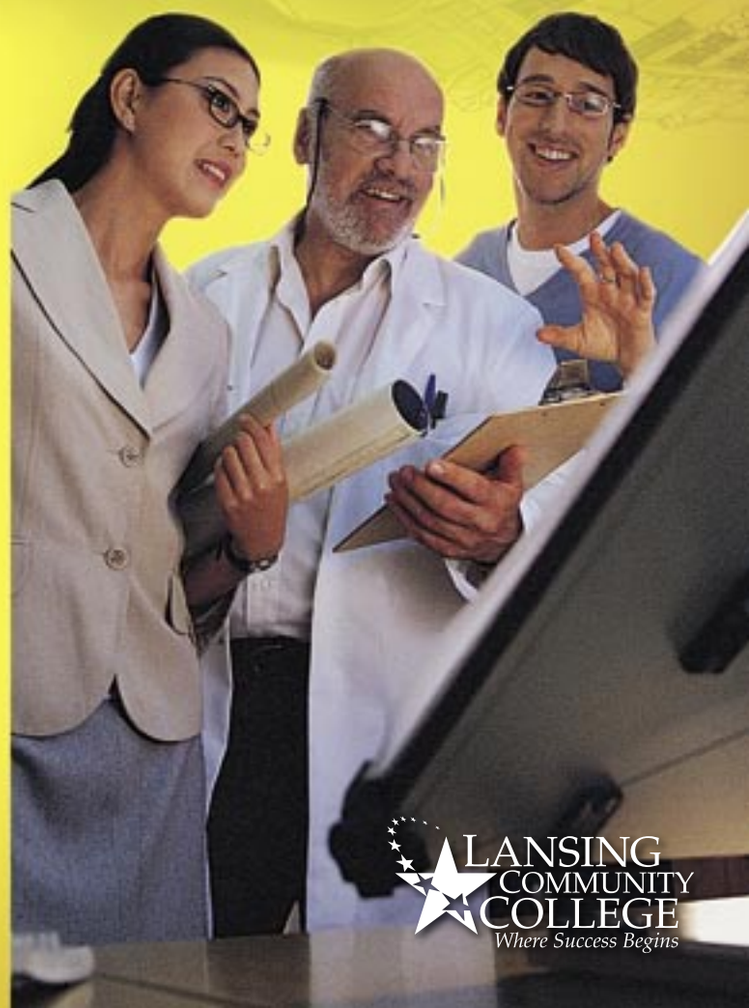
LCC exists so that the people it serves have learning and enrichment opportunities to improve their quality of life and standard of living.

-mission statement, Lansing Community College

For more information on LCC's Alternative Energy Initiative, call (517) 483-1924 or connect at www.lcc.edu/energy

LANSING COMMUNITY COLLEGE
Where Success Begins

Leadership, partnership and bold vision will power the alternative energy economy



LANSING COMMUNITY COLLEGE
Where Success Begins

LANSING COMMUNITY COLLEGE
Where Success Begins

New partnerships will drive us to energy diversity.

Michigan's future depends on new energy. Public and private partnerships can make the bold vision a reality.

Fossil fuels have driven our economy for a century, but now the United States is exploring new energy technologies to reduce dependence on foreign oil, protect the environment and diversify the energy supply. Strong partnerships among leaders in corporate, industry and governmental settings as well as educational institutions are essential if we are to tap into the energy sources that will move our economy from one based on fossil fuels to one that fosters energy diversity.

- Corporations know a highly trained workforce, knowledgeable about new technologies, must be ready.
- Policy makers know economic success lies in our ability to envision the future and provide the right environment in which to reach it.
- Educational institutions provide the research, training and outreach that serve business, policy makers and the public at large.

Business and policy leaders can lead the way.

Since the 1970s, business and policy leaders have called on the nation's top scientists, educators and industry leaders to address the nation's energy needs.

The time is now.

The nation still needs affordable, renewable alternative energy sources. Automakers are stepping to the plate with initiatives for hydrogen and hybrid vehicles. Other industries are testing technologies for "green" buildings and more efficient production processes. Business leaders and policy makers recognize the need to form partnerships with educational institutions and with each other as they work to meet future energy needs.

The place is here.

In Michigan, a century of automotive production keeps us focused on the links between energy and transportation. To help us maintain our leadership in automotive manufacturing and research, Lansing Community College has developed a diverse set of programs and initiatives that integrate reliable, affordable, and environmentally sound energy for America's future. LCC's efforts are linked with those of the auto industry, software providers, research universities and high-tech manufacturers and suppliers. The goal: to create an integrated educational program that will promote comprehensive training for all alternative energy applications – geothermal, wind, solar, biomass and fuel cell – thus increasing the viability and deployment of renewable energy technology.

Alternative energy will accelerate Michigan's economy.

As America embraces alternative energy, research and technology will drive the economy. Michigan is uniquely poised to become a leader in alternative energy. We must be ready with a trained workforce, a bold entrepreneurial mindset and with the willingness to forge non-traditional partnerships to reach our goals.

Education that powers the future

www.lcc.edu

Lansing Community College can help.

In 2004, the Department of Energy awarded Lansing Community College $1 million in funding for its Alternative Energy Initiative, making it one of the first colleges in the nation to incorporate alternative energy into its curriculum. In addition, LCC instructors were tapped to create alternative energy curricula for colleges and universities nationwide.

LCC students can earn a degree in alternative energy management. LCC also weaves alternative energy into many other degree programs, including manufacturing, automotive technology and construction. Classes are taught at LCC's state-of-the-art West Campus, which houses an energy lab, a fuel cell lab and is heated and cooled by a geothermal system.

LCC is also committed to keeping the general public informed about alternative energy through its website, seminars, conferences and community events. Learn more at www.lcc.edu/energy

Michigan's future depends on new energy.
You can depend on it, too.

LCC exists so that the people it serves have learning and enrichment opportunities to improve their quality of life and standard of living.

-mission statement, Lansing Community College

Get ready. The power of alternative energy is here.

For more information on LCC's Alternative Energy Initiative, call (517) 483-1924 or connect at www.lcc.edu/energy

Photo courtesy of General Motors.

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Alternative energy will power our future

Alternative energy sources are abundant – and renewable. Energy can be harnessed from the sun, the wind, from soybeans and other food crops, and even from the natural heat below the earth's surface. Using such energy sources is good for the environment – and for the economy.

Alternative energy means new jobs for Michigan.

At the heart of the world's automotive industry, Michigan is in an ideal position to lead this transition to a new energy economy. New industries and jobs are emerging. To land these new jobs, Michigan must be ready with a pool of workers trained in alternative energy technologies.

New energy works for you.

Advances in technology are making alternative energy more practical and economical for mass use.

How can renewable energy sources work for you?

- **Hydrogen Fuel Cell:** Hydrogen fuel cells can transform the way the world uses energy. Fuel cells generate electricity by combining hydrogen and oxygen with only water as a by-product. They can power everything from laptop computers to automobiles. While at least a decade remains before they can easily be incorporated into everyday life, the promise of zero emissions and increased fuel efficiency makes fuel cells worth the wait.

- **Geothermal:** Geothermal technology uses natural heat from the earth to heat and cool buildings. This clean and sustainable technology reduces emissions and operating costs. In Michigan, numerous homes, businesses and educational buildings use geothermal heat pumps.

Lansing Community College students help design and build an internal combustion engine powered by a fuel cell.

- **Biomass:** Biomass energy is derived from plant matter and animal waste. It's been around since our ancient ancestors started burning wood to keep their caves warm. Today, wood is still our largest biomass resource. Other sources include plants, residues from agriculture and forestry, and the organic component of municipal and industrial wastes.

The Granger Company produces electricity from methane gas produced in its landfill near Lansing, Michigan.

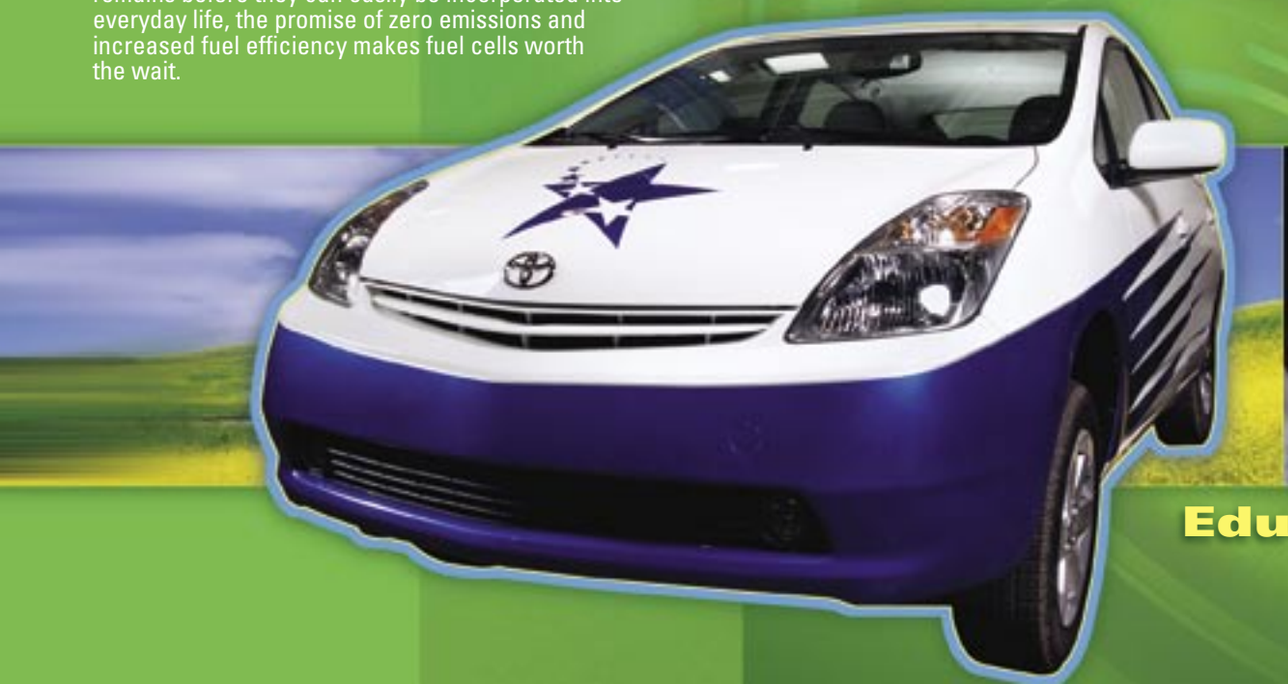
- **Biodiesel:** Biodiesel is produced by mixing fat or vegetable oil with petroleum diesel to create a biodiesel blend. It can be used in diesel engines with few or no modifications.

St. Johns Public School District runs its buses on biodiesel fuel. The school district says the buses get better gas mileage and emit less smoke and diesel smell.

- **Wind:** Wind can be harnessed to generate electricity, charge batteries, pump water or grind grain. Wind turbines convert the kinetic energy of the wind into electricity.

- **Solar:** Photovoltaic cells convert sunlight directly into electricity and can provide tiny amounts of power for watches, large amounts for an entire electric grid, and everything in between.

More than 60 percent of the heating and cooling at Lansing Community College's West Campus is provided by a geothermal system, which extracts heat from the earth. The system saves the college about $100,000 in energy costs per year.



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