Renewable Energy Engineering
2010-11 Assessment Report

Department of Electrical Engineering and Renewable Energy

F I N A L R E P O R T

October 14th, 2011

Editing Faculty

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REE 453	√		√		√					√	√	√		
REE 454	√		√		√	√				√	√	√		
REE 455	√	√	√	√	√	√	√			√	√		√	
REE 459	√	√	√	√	√	√	√	√	√	√	√	√	√	√
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1 Introduction

1.1 Program Goals

1.2 Program History

In 2005, the Oregon Institute of Technology (OIT) began offering its new Bachelors of Science in Renewable Energy Systems program (BSRES) at its satellite campus in Portland, Oregon. The BSRES degree was the first of its kind in North America, and it was created to prepare graduates for careers in various fields associated with renewable energy. These included, but were not limited to, energy management, energy auditing, energy systems planning, energy economics, energy policy and development, carbon accounting and reduction, and energy-related research, as stated in OIT's 2005-06 catalogue.

In 2008, however, the BSRES degree was discontinued and replaced by the Bachelors of Science in Renewable Energy Engineering (BSREE). Analysis of the market place and observed growth in career options across the renewable energy fields revealed significant opportunities for graduates with a solid energy engineering education. By design, the original BSRES program was built atop a firm engineering foundation, and the curriculum could generally be described as near engineering-level. But the title of the degree, Renewable Energy Systems, a dearth of 300-level mathematics coursework and the absence of several key engineering fundamentals courses prevented the degree from being considered a full engineering degree, particularly one that could be accredited as an ABET EAC program. By stating engineering as a principle programmatic focus, the career potential for graduates expanded beyond those previously stated to also include engineering-related career paths such as electrochemical systems engineering, energy systems design engineering, building systems engineering and modeling, hydronics engineering, power electronics engineering, HVAC engineering, and power systems engineering.

We anticipate BSREE graduates will enter energy engineering careers as power engineers, PV/semiconductor processing engineers, facilities and energy managers, energy system integration engineers, HVAC and hydronics engineers, design and modeling engineers for net-zero energy buildings, LEED accredited professionals (AP), biofuels plant and operations engineers, energy systems control engineers, power electronics engineers, utility program managers, as well as renewable energy planners and policy makers. Graduates of the program will be able to pursue a wide range of career opportunities, not only within the emerging fields of renewable energy, but within more traditional areas of energy engineering as well. Without a mechanism for obtaining professional licensure, these graduates would either not be able to advance in their careers or they would not find employment in these fields to begin with. Our survey of the renewable energy industry cluster in the Pacific Northwest convinced us that an engineering degree, the BSREE degree, was the only suitable option for our students.

1.3 Industry Relationships

The BSREE program has strong relationships with industry, particularly through its program-level Industry Advisory Council (IAC) and REE alumni. These relationships with our constituents allow the BSREE program to meet another institutional mission objective, "5. Develop and maintain partnerships with public and private institutions, business and industry, and government agencies to ensure quality programs that meet the needs of students and the organizations that employ them."

The IAC has been instrumental in the success of the REE program. Twenty representatives from corporations, government institutions and non-profit organizations comprise the IAC, giving the BSREE a broad constituent audience. The IAC provides advice and counsel to the REE program with respect to the areas of curriculum content advisement, instructional resources review, career guidance and placement activities, program accreditation reviews, and professional development advisement and assistance. In addition, each advisory committee member serves as a vehicle for public relations information and potentially provides a point of contact for the development of specific opportunities with industries for students and faculty.

1.4 Program Locations

Among the advantages that make OIT an ideal institution for offering the BSREE program is the benefit of having campuses in two distinctive locations – one in urban Portland in proximity to the Pacific Northwest's energy industry cluster, and the second in rural Southern Oregon with exceptional natural energy resources. The Portland campus allows students to leverage their classroom experience within internships at the Northwest's world-class energy and power companies. The Klamath Falls campus has unique energy advantages and is already a leading geothermal research facility. In addition, the climate makes it ideally suited to applied research in the field of solar energy.

1.5 Enrollment

Enrollment in the program at both the Portland and Klamath Falls campuses has been increasing since the inception of the program. Winter 2011 headcount enrollment was 137 students at the Portland campus (114 BSREE, 23 PREE) and 89 in Klamath Falls (56 BSREE, 33 PREE), for a total headcount of 226.

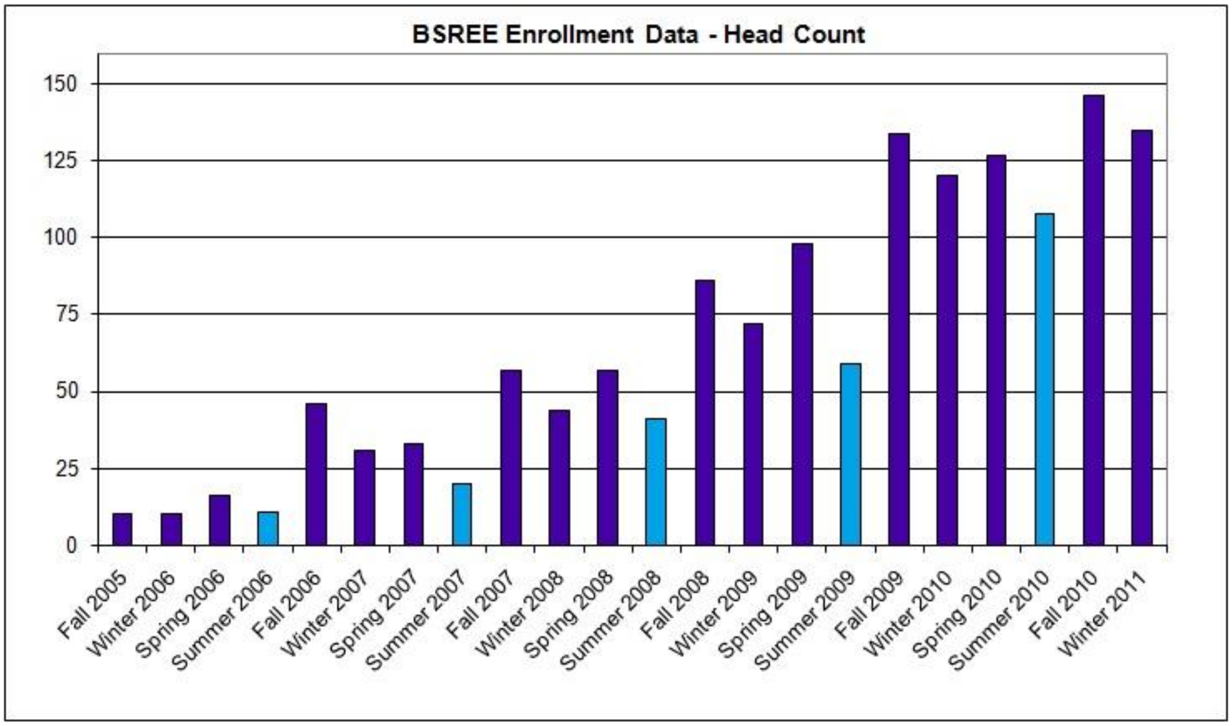

Figure 1 Enrollment growth for the Portland BSREE location, Fall 2005 to Winter 2011

1.6 Graduates

Graduation rates have been climbing; 27 BSREE students have graduated as of Winter 2011. By end of Summer 2011, an additional 28 students are expected to have graduated. Graduate employment status is summarized in Table 1.

Table 1 - BSREE Program Graduates

Numerical Identifier	Matriculation Term		Graduation date	Certification/ Licensure	Initial or Current Employment/Job Title
1	F	2006	8/15/2008	FE (NM)	Solar Design Engineer, Atlasta Solar Center
2	F	2006	12/12/2008	FE (OR)	Design Engineer, Stantec Consulting Services
3	F	2006	6/13/2009		Wind Energy Developer, Enerfin
4	Sp	2006	6/13/2009	BPI Energy Analyst	Owner, Parker Energy Solutions
5	W	2006	6/13/2009		Energy Engineer, Imagine Energy
6	F	2006	6/13/2009	FE (OR)	Planning Engineer, Energy Trust of Oregon
7	W	2006	8/14/2009		Development Engineer - Test, Clear Edge Power
8	Sp	2006	8/14/2009	FE (OR)	Solar Program Coordinator, Energy Trust of Oregon
9	F	2006	8/14/2009	Planning FE (petition)	Wind Energy Analyst, Garrad-Hassan
10	Sp	2006	12/11/2009	Planning FE (petition)	Development Engineer - Test, Clear Edge Power
11	Sp	2006	3/19/2010	FE (OR)	Energy Analyst, Conservation Services Group
12	F	2007	3/19/2010	FE (OR)	Electrical Engineer, Elcon Associates
13	Sp	2007	6/12/2010		Test Engineer, PV Powered
14	F	2007	6/12/2010		Diffusion Process Engineer, Fairchild Semiconductor
15	F	2007	6/12/2010	Planning FE (petition)	Control Room Engineering Intern, Iberdrola Renewables
16	Sp	2008	8/13/2010		Energy Engineer, Imagine Energy
17	W	2006	8/13/2010	CEM, Planning FE (petition)	Energy Analyst, Glumac
18	Sp	2008	8/13/2010	Planning FE (petition)	Electrical Engineer, Power Engineers
19	Sp	2007	8/13/2010	Planning FE (petition)	Energy Program Manager, Portland Public Schools
20	Su	2006	12/10/2010	Planning FE (petition)	Energy Analyst, Hodai Engineering
21	Su	2006	12/10/2010	Planning FE (petition)	Design Engineer, Stantec Consulting Services
22	F	2006	12/10/2010		Engineer/Owner, Imagine Energy
23	F	2008	12/10/2010		Development Engineer, Clear Edge Power
24	Su	2008	12/10/2010		
25	Sp	2007	Spring 2011	Planning FE (petition)	Wind Energy Coordinator, Native Village of Eyak
26	Sp	2009	Winter 2011		Engineering Manager, PVPowered/Advanced Energy
27	F	2007	Winter 2011		

2 Program Mission, Educational Objectives and Outcomes

2.1 Program Mission

The mission of the Renewable Energy Engineering degree program is to prepare students for the challenges of designing, promoting and implementing renewable energy solutions within society's rapidly-changing energy-related industry cluster, particularly within Oregon and the Pacific Northwest. Graduates will have a fundamental understanding of energy engineering and a sense of social responsibility for the implementation of sustainable energy solutions. The department will be a leader in providing career ready engineering graduates for various renewable energy engineering fields. Faculty and students will engage in applied research in emerging technologies and provide professional services to their communities.

2.2 Program Educational Objectives

Program educational objectives are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve. The Program Educational Objectives (PEOs) of OIT's Bachelor of Science in Renewable Energy Engineering program are:

- BSREE graduates will excel as professionals in the various fields of energy engineering.
- BSREE graduates will be known for their commitment to lifelong learning, social responsibility, and professional and ethical responsibilities in implementing sustainable engineering solutions.
- BSREE graduates will excel in critical thinking, problem solving and effective communication.

2.3 Relationship Between Program Objectives and Institutional Objectives

These program objectives map strongly to two of the six objectives in OIT's institutional mission statement, particularly the central objectives "1. Provide degree programs that enable graduates to obtain the knowledge and skills necessary for immediate employment," and "2. Enable students to be effective communicators, responsible citizens, and lifelong learners by assisting them in the development of critical thinking and problem solving skills, and ethical and cultural awareness."

2.4 Program Outcomes

The BSREE Program Outcomes include ABET's EAC a - k outcomes as well as the program-specific outcomes l – n. All of these are listed here:

(a) an ability to apply knowledge of mathematics, science, and engineering

(b) an ability to design and conduct experiments, as well as to analyze and interpret data

(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

(d) an ability to function on multi-disciplinary teams

(e) an ability to identify, formulate, and solve engineering problems

(f) an understanding of professional and ethical responsibility

(g) an ability to communicate effectively

(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

(i) an ability to engage in independent learning and recognize the need for continual professional development[1]

(j) a knowledge of contemporary issues

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

(l) an ability to apply the fundamentals of energy conversion and applications

(m) an understanding of the obligations for implementing sustainable engineering solutions

(n) an appreciation for the influence of energy in the history of modern societies

The BSREE Program Outcomes are mapped to courses as shown in Table 18 in the Appendix.

[1] During Convocation in Fall 2010, the EERE faculty agreed to change outcome (i). Previously, the faculty had adopted the outcome (i) developed by ABET: "a recognition of the need for, and an ability to engage in life-long learning".

3 Cycle of Assessment for Program Outcomes

3.1 Introduction and Method

Table 2 shows the minimum outcomes assessed during each academic year. Assessment of the program outcomes will be conducted over a three year-cycle, following the pattern starting in 2010-11 (during the 2009-10 academic year, all outcomes were assessed in order to establish a baseline). In addition to program assessment, faculty members participate in assessment of Institutional Student Learning Outcomes (ISLOs).

3.2 Assessment Cycle

Table 2 – BSREE Outcome Assessment Cycle

		2008-09	2009-10	2010-11	2011-12	2012-13	2013-14
(a)	Fundamentals	√	√		√		
(b)	Experimentaiton		√			√	
(c)	Design	√	√		√		
(d)	Teamwork	√	√		√		
(e)	Engineering Problems		√	√			√
(f)	Ethics		√			√	
(g)	Communication		√	ISLO		√	
(h)	Impact of Solutions		√			√	
(i)	Life-long Learning		√	√ ISLO	√*		√
(j)	Contemporary Issues		√	√			√
(k)	Engineering Tools		√	√			√
(l)	Energy Conversion	√	√		√		
(m)	Sustainable Engineering		√			√	
(n)	History		√	√			√
* indicates the outcome from the previous year has been selected to be reassessed as part of the continuous improvement process							

3.3 Summary of Assessment Activities & Evidence of Student Learning

3.3.1 Introduction

The BSREE faculty conducted formal assessment during the 2010-11 academic year using direct measures, such as comprehensive ABET Projects and ABET Assignments.[2] Additionally, the program outcomes were assessed using indirect measures, namely results from student evaluations based on methods developed by the IDEA Center[3], and data from NCEES regarding passing rates for the Fundamentals of Engineering Exam (FE).

[2] ABET Projects and ABET Assignments refer to projects and assignments especially designed by OIT BSREE faculty to go beyond the assessment of course outcomes in order to assess more general program-level outcomes including the ABET a-through-k outcomes.

[3] The IDEA Center, www.theideacenter.org

3.3.2 Background of Assessment of Program Educational Objectives

Because BSREE graduates have not been in the field for longer than three years, the faculty has not yet conducted assessment of the Program Educational Objectives (PEOs). The BSREE faculty designed the PEOs using broader statements describing career and professional accomplishments that the graduates can expect to achieve.

Table 3 shows the minimum outcomes assessed during each academic year. Assessment of the program outcomes will be conducted over a three year-cycle, beginning in 2013-14. For the 2012-13 academic year, all three PEOs will be assessed in order to establish a baseline[4]. Future appendices of the annual REE program assessment report will include detailed alumni and employer's surveys designed to assess these PEOs.

Table 3 – BSREE Program Educational Objectives Assessment Cycle

Educational Objective	2012-13	2013-14	2014-15	2015-16	2016-17
EO1	√	√		√	√
EO2	√	√	√		√
EO3	√		√	√	

3.3.3 Methods for Assessment of Program Outcomes

The BSREE conducts direct and indirect assessments. The direct assessment process using assignments specifically designed to measure ABET-style outcomes. The indirect assessment process derives assessment data from course evaluations.

Direct Measure: ABET Assignments

This direct assessment process links specific tasks within engineering course assignments to ABET program outcomes and then on to program educational objectives in a systematic way based on ABET rubrics.[5] The program outcomes are evaluated as part of the course curriculum primarily by means of comprehensive ABET assignments specifically designed to measure program-level outcomes in addition to course-level outcomes. These assignments typically involve a project or lab requiring the student to apply math, science, and engineering principles learned in the course to solve a particular problem requiring the use of modern CAD tools and engineering equipment, working in teams, and writing a project report or giving an oral presentation. ABET assignments are designed to assess several fundamental program outcomes at once.

An ABET multi-outcome rubric is used to perform direct assessment of these assignments. A systematic, rubric-based process is then used to quickly assess tasks within assignments and link them directly to a group of program outcomes. Evaluations of these outcomes are then gathered and accounted in outcome-specific tables, analyzed and then individually summarized. Summaries for all outcomes are then compiled into a comprehensive program outcome summary for each course. The outcome summary is then evaluated for relevance with respect to the program objectives. The summary of outcomes is formatted and organized such that it is suitable for inclusion in an ABET review document.

[4] The original assessment PEO assessment plan was to begin by establishing a baseline in 2011-12 with an assessment of all three PEOs, however, with only two graduates and two employers to survey, the faculty decided that this would not provide enough statistics and deferment until 2012-13 was appropriate.

[5] "ABET rubrics" refer to rubrics especially designed by OIT BSREE faculty to assess ABET projects based on program-level outcomes.

The mapping process aims to systemize the assessment of engineering coursework, and to provide a mechanism that facilitates the design of engineering assignments that meet the ABET-relevant ("a" through "k") outcomes, particularly those that are more distant from traditional engineering coursework. Rather than considering how the outcomes match the assignment, the assignment is designed to map to the program outcomes.

By assessing multiple outcomes per assignment, the number of assessed assignments may be reduced and assignments become more relevant to the program outcomes, since the assignments are designed with the general program outcomes in mind. Additionally, incorporating multiple outcomes in a single assignment provides for a richer assignment, one that takes into account a wider range of engineering issues.

Direct Measure: NCEES Fundamentals of Engineering (FE) Scores

The BSREE faculty strongly encourages graduates to take the Fundamentals of Engineering (FE) exam. The BSREE program has only recently been accredited by ABET's EAC, so the graduating seniors did not meet the educational requirements set forth in ORS 820-010-0225(3) parts (a), (b) and (c) for taking the Fundamentals of Engineering (FE) Exam. However, students have successfully petitioned the board for the right to register and sit for the exam under ORS 820-010-0225(3) part (f)[6].

Indirect Measure: KSU IDEA Evaluations

At OIT, course evaluations are conducted using the course evaluation form developed by the IDEA Center[7], an organization originating from Kansas State University. From collected student evaluation forms, an IDEA Center diagnostic report is generated and returned to the instructor.

Methods for this indirect assessment are detailed in Criteria 3 of the 2009-10 BSREE ABET Self-Study. The sections below describe the 2010-11 targeted indirect assessment activities based on the IDEA Center diagnostic reports.

3.3.4 2010-11 Targeted Assessment Activities

The sections below describe the 2010-11 targeted assessment activities and detail the performance of students for each of the assessed outcomes. Unless otherwise noted, the tables report the percentage of students performing at a developing level, accomplished level, and exemplary level for each performance criteria, as well as the percentage of students performing at an accomplished level or above.

The minimum acceptable performance level for all outcomes was to have 80% or above of the students performing at the accomplished or exemplary level for all performance criteria. The summary data presented in this section represent cumulative averages for multiple course-specific evaluation criteria, not percentages of students. The percentages of students meeting course-specific criteria may be found in course notebooks.

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[6] OSBEELS – Oregon State Board of Examiners for Engineering and Land Surveying, www.oregon.gov/OSBEELS/
[7] The IDEA Center, www.theideacenter.org

3.3.4.1 Targeted Assessment of Outcome (e)

An ability to identify, formulate, and solve engineering problems

Performance Criteria:

E1	Identify and define an engineering problem
E2	Articulate the problem in engineering terms
E3	Develop solutions appropriate for the problem

Assessment e1: Petrovic, REE 331 – Fuel Cells, Fall 2010

The outcome was assessed using a group laboratory project and one final exam question. The objective was to engage the class in a team-based project on a new technology for them, but with elements of much of the class material. The teams chose a topic, identified three research publications closely dealing with the subject; and made attempt to reproduce the results from the papers first and then consider improvements. The following aspects studied in the class were addressed in the proposal: understanding of the most important scientific and technical issues, thorough literature search, use of basic electrochemical and fuel cell principles, multidisciplinary thinking, proposed components and assembly methods. Finally, this was an experimental project with use of a variety of lab equipment.

The students were required to demonstrate reading, writing, listening and speaking skills; identifying a technical problem, developing a plan to solve it in a group, executing experimental methods for solving the problem, and producing a reasoned report on their project.

Eleven students divided into three teams were assessed using the performance criteria listed below. The group and individual efforts were evaluated based on the reports and group presentations. The group projects were evaluated for the following: Identify and define an engineering problem (e.g., selection of an engineering problem from literature), (max. 15 points); management of team, delegation of responsibilities (e.g., division of task within team) (max. 15 points); develop solutions appropriate for the problem (e.g., adaptation of methods, development of novel procedures) , (max. 15%); and Final Report (max. 15%).

The exam question was worth 40% and included a comprehensive engineering problem relative to fuel consumption in different fuel cells and under different conditions.

Table 4 summarizes the results of this targeted assessment. The results indicate that the performance level higher than 80% was met on both performance criteria for this program outcome, demonstrating that the students in the evaluated class have the ability to identify, formulate and solve engineering problems.

Table 4 Targeted Assessment for Outcome (e).

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students >= 2
(e) an ability to identify, formulate, and solve engineering problems				
e1: Identify engineering problem, manage teams, develop solutions, and adapt methods	0%	26%	74%	100%
e2: Solve conceptual and numerical engineering problem	10%	54%	36%	90%

Assessment e2: Stevens, REE 412 – Photovoltaic Systems, Winter 2011

This outcome was assessed using an ABET Project. The project required students to define an application (of interest to them and of their choosing) where a photovoltaic system could be used to generate electricity for some useful purpose. The students then designed an integrated photovoltaic system to satisfy the specific needs of their applications using principles introduced in REE412. Students worked together in groups of three or four and presented their projects to the class and submitted a written report describing their photovoltaic system designs.

For this assessment, students were asked to formulate an engineering description of their systems using solar resource data, load profiles, and sizing calculations for system components. In addition, they were required to articulate the various elements of their systems using computer generated schematics, bills of materials, and life cycle cost analysis. Finally, students were required to develop conclusions based on their results and findings.

Nineteen students were assessed in Winter 2010 in the course using the performance criteria listed below. The minimum acceptable performance level was to have above 80% of the students performing at the accomplished or exemplary level in all performance criteria. The summary data presented below represents cumulative averages for multiple course-specific criteria, not percentages of students. Percentages of students meeting course-specific criteria may be found in the course notebook.

Table 5 summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met on all performance criteria for this program outcome. Students generally met or exceeded expectations, although several groups formed weak conclusions. The presentations and papers clearly demonstrated the students' ability to identify, formulate, and solve a specific engineering problem.

Table 5 Targeted Assessment for Outcome (e).

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students >= 2
(e) an ability to identify, formulate, and solve engineering problems				
E1: Identify and define an engineering problem	0%	79%	21%	100%
E2: Articulate the problem in engineering terms	0%	79%	21%	100%
E3: Develop solutions appropriate for the problem	0%	79%	21%	100%

3.3.4.2 Targeted Assessment of Outcome (g)

An ability to communicate effectively

Performance Criteria:

G1	Oral communication
G2	Written communication
G3	Acquisition and application of information sources

The Communications ISLO assessed during the 2010-11 academic year aligns with program outcome (g). The outcome was assessed using an institution-prescribe assignment and rubric.

Assessment g1: Rytkonen, EE 321 – Electronics I, Fall 2010

This outcome was assessed using a project presentation. The project required students to discuss the design process they went through to create, build, and test an electronic circuit. The assessment is designed to assess students' ability to deliver technical material in an oral presentation.

Thirteen students were assessed in Fall 2010 using the performance criteria listed below. The minimum acceptable performance level is set at 80%; it is expected that 80% of the students perform at the 'accomplished' or 'exemplary' level in all performance criteria. The summary data presented below represents percentages of students meeting course-specific criteria.

Since outcome (g) aligned with an ISLO in academic year 2010-11, the performance criteria from the OIT Public Speaking Rubric, and the OIT Visuals Rubric were used as the basis against which to assess student accomplishment. For current purposes, the "No/Limited Proficiency" and "Some Proficiency" categories from the OIT rubrics have been blended and are represented herein as "Developing." The categories "Proficiency" and "High Proficiency" are represented herein as "Accomplished" and "Exemplary" respectively.

Table 6 summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met for the performance criteria for this program outcome. This assessment demonstrates that students are able to prepare and deliver oral presentations focusing on technical material that inform the audience.

Table 6 Targeted Assessment for Outcome (g).

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% >= 2
(n) an ability to communicate effectively				
G1: Oral communication	8%	54%	38%	92%

<u>Assessment g2: Stevens, MECH 318 – Fluid Mechanics, Winter 2011</u>

This outcome was assessed using an ABET Project. Projects from two separate sections of MECH318 students were assessed. The project required each student to design a residential solar hot water heating system using principles introduced in MECH318. For this assessment, students were asked to prepare and deliver a 5 - 10 minute oral presentation to the class with accompanying Power Point slides, as well as prepare and submit a written report on the results of their specific projects.

Twenty students were assessed in Winter 2010 in the course using the performance criteria listed below. The minimum acceptable performance level was to have above 80% of the students performing at the accomplished or exemplary level in all performance criteria. The summary data presented below represents cumulative averages for multiple course-specific criteria, not percentages of students. Percentages of students meeting course-specific criteria may be found in the course notebook.

Since outcome (g) aligned with an ISLO in academic year 2010-2011, the performance criteria from the OIT Technical and Research Writing Rubric, the OIT Public Speaking Rubric, and the OIT Visuals Rubric were used as the basis against which to assess student accomplishment. For current purposes, the "No/Limited Proficiency" and "Some Proficiency" categories from the OIT rubrics have been blended and are represented herein as "Developing." The categories "Proficiency" and "High Proficiency" are represented herein as "Accomplished" and "Exemplary" respectively.

Table 7 summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met on all performance criteria for this program outcome. Students generally met or exceeded expectations, although several students were uncomfortably nervous presenting their projects to the class. The presentations and papers clearly demonstrated the students' abilities to communicate effectively.

Table 7 Targeted Assessment for Outcome (g).

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students >= 2
(g) an ability to communicate effectively				
G1: Oral communication	15%	65%	20%	85%
G2: Written communication	5%	65%	30%	95%
G3: Acquisition and application of information sources	20%	60%	20%	80%

3.3.4.3 Targeted Assessment of Outcome (i)[8]

An ability to engage in independent learning and recognize the need for continual professional development

Performance Criteria:

I1	Demonstrate an awareness that knowledge must be gained
I2	Identify, gather and analyze information
I3	Recognize the acquisition of knowledge is a continuous process

The Communications ISLO assessed during the 2010-11 academic year aligns with program outcome (i), though faculty members are free to assess this ISLO using their own assignments and rubrics.

Assessment i1: Petrovic, REE 335 – Hydrogen, Fall 2010

The outcome was assessed using an ABET Project. The objective was to engage the class in a team-based project on a completely new technology for them, but with elements of much of the class material. The teams were asked to choose an experimental project and develop a method to reproduce the work by assembling their own instrumentation and learning on their own to conduct a research project. The following aspects studied in the class were addressed in the proposal: understanding of the most important scientific and technical issues, thorough literature search, use of basic electrochemical principles, critical thinking, multidisciplinary thinking, learning hydrogen production, storage and use techniques.

The students were required to demonstrate reading, writing, listening and speaking skills; awareness of what they need to learn; following a learning plan; identifying, retrieving, and organizing information; understanding and remembering new information; critical thinking skills; experimental ability, understanding instrumentation; and demonstrate ability to reflect on own understanding.

The second criterion was an exam question which included an implied reference to life-long learning outcome.

Nine students divided into three teams were assessed using the performance criteria listed below. The group and individual efforts were evaluated based on reports and group presentations. The reports were evaluated for the following: willingness to learn new material on their own and to reflect on the learning process, reading engineering articles and accessing information effectively and efficiently outside of class and from variety of sources, reading critically and assessing the quality of information available (e.g., question the validity of information, including that from textbooks or teachers), synthesizing new concepts by making connections, transferring prior knowledge, and generalizing, and reason by predicting, inferring, using inductions, questioning assumptions, using lateral thinking, and inquiring.

Table 8 summarizes the results of this targeted assessment. The results indicate that the performance level higher than 80% was met on both performance criteria for this program outcome. All groups accomplished the goals of the project and generated proposals; they demonstrated their abilities to apply math, science and engineering principles to conduct research on previously unknown technology and showed capacity to engage in life-long learning.

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[8] The wording of outcome (i) was changed by the EERE faculty in Fall 2010.

Table 8 Targeted Assessment for Outcome (i).

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students >= 2
(i) an ability to engage in independent learning and recognize the need for continual professional development				
i1: willingness to learn new material on their own and to reflect on the learning process, using lateral thinking, and inquiring.	0%	33%	67%	100%
i2: Exam question with implied life-long learning concept	11%	33%	56%	89%

Assessment i2: Crespo, EE 321 – Electronics I, Fall 2010[9]

This outcome was assessed by means of an ABET project. The project consisted of designing, simulating, implementing, and experimentally testing an AC-to-DC power supply and linear regulator with current boosting to provide an adjustable regulated output voltage with short-circuit/overload protection. Principles of AC-to-DC conversion were covered as part of the class, but no specific linear regulators were included in the curriculum. Students were therefore required to individually research the concept of linear regulation, as well as an adequate topology for their design that would meet the specifications while staying within the design constraints given as part of the project definition.

Fourteen students were assessed in the course EE 321 Electronics I in the 2010-11 academic year. The project allowed the ability of students to engage in independent learning to be assessed, as well as their understanding that learning is a lifelong process and that as future engineers they will be expected to be resourceful researchers and independent learners. The minimum acceptable performance level was to have above 80% of the students performing at the accomplished or exemplary level in all performance criteria.

Table 9 summarizes the assessment results. The results indicate that the minimum acceptable performance level of 80% was met on all performance criteria, that is, over 80% of students were able to recognize the need for and display the ability to engage in lifelong learning.

Table 9 Targeted Assessment for Outcome (i).

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students >= 2
(i) an ability to engage in independent learning and recognize the need for continual professional development				
i1:ability to engage in independent learning	14%	36%	50%	86%
i2: recognize the need for continual professional development	0%	50%	50%	100%

[9] This assessment was performed using criteria established for our BEET program. However, a significant number of the students in the EE 321 course are BSREE students, so the faculty feel it is important to include this assessment in our report.

Assessment i3: Torres Garibay, REE 307 – Energy Storage Systems, Winter 2011

An ability to engage in independent learning and recognize the need for continual professional development

This outcome was assessed using an ABET Project. The project involved a 1000 words essay on the topic of future career and professional lifelong learning after graduation, focusing in the following four areas: lifelong learning, professional societies and organizations, credentials and continuing education, and short- and long-term career plans. This outcome is aligned with the one of the Institutional Student Learning Outcomes (ISLO) for OIT. Therefore, the assignment was given to the students in accordance to the institutional guidelines.

Eight students were assessed in Winter 2011 in the course using the performance criteria listed below. The assignment was graded using the institutional lifelong learning rubric. The performance criteria listed in this rubric was aligned with the performance criteria for outcome I as follows: 1. Lifelong learning (I1), 2. Professional Societies and Organizations (I2), 3a. Credentials (I2), 3b. Continuing education (I3), and 4. Short- and long-term career plans (I3). The minimum acceptable performance level was to have above 80% of the students performing at the accomplished or exemplary level in all performance criteria.

This assignment revealed that although most students, 7 out of 8, were aware that learning is a continuous process (I3). Some of them, 3 of 8, focused mostly in their current learning and did not fully present a realistic, sustainable manner of embracing a life of "lifelong learning" (I1). In some cases, 2 out of 8, it was not fully evident for them how professional resources could benefit them in this process (I2). Although the current results are not above the minimum acceptable performance level in two performance criteria, it is worth mentioning that further conversations with some of these students revealed that they valued the opportunity for self reflection given by this assignment.

A recommendation for next time this outcome is evaluated is to have an in-class discussion of the essays submitted by the students, to allow those with no work experience to be exposed to different ideas in the context of lifelong learning. A broader recommendation is to expose students earlier in the program to professional societies and to encourage them to think about their professional paths in every class they take.

Table 10 summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was only met on one performance criteria for this program outcome.

Table 10 Targeted Assessment for Outcome (i).

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students >= 2
(i) an ability to engage in independent learning and recognize the need for continual professional development				
I1: Demonstrate an awareness that knowledge must be gained	38%	38%	25%	63%
I2: Identify, gather and analyze information	25%	38%	38%	75%
I3: Recognize the acquisition of knowledge is a continuous process	13%	50%	38%	88%

3.3.4.4 Targeted Assessment of Outcome (j)

A knowledge of contemporary issues

Performance Criteria:

J1	Demonstrate knowledge of contemporary issues
J2	Recognize the temporal nature of contemporary issues
J3	Recognize the historical pretext of contemporary issues

Assessment j1: Torres Garibay, REE 346 – Biofuels and Biomass, Fall 2010

This outcome was assessed through an assignment. The students were asked to select a contemporary issue related to the topic of biofuels or biomass. They were required to describe and explain the issue in their own words to demonstrate knowledge of the contemporary issue (J1) and to describe the current conditions that contribute to the current existence of this issue, as a way to recognize the temporal nature of the contemporary issue (J2).

Three students were assessed in Fall 2010 using the performance criteria listed below. The minimum acceptable performance level was to have above 80% of the students performing at the accomplished or exemplary level in all performance criteria.

Table 11 summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met on both performance criteria for this program outcome. All students identified a contemporary issue related to the class topic and recognize current factors that contribute to its existence.

Table 11 Targeted Assessment for Outcome (j).

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students >= 2
(j) a knowledge of contemporary issues				
J1: Demonstrate knowledge of contemporary issues	0%	0%	100%	100%
J2: Recognize the temporal nature of contemporary issues	0%	0%	100%	100%

3.3.4.5 Targeted Assessment of Outcome (k)

An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Performance Criteria:

K1	Demonstrate proficiency with engineering software: CAD, FEA, programming, data analysis, etc
K2	Demonstrate proficiency with engineering hardware: test/measurement equipment, prototyping, etc
K3	Apply communications tools and skills within engineering practice

<u>Assessment k1: Rytkonen, EE 456 – Control Systems Design, Winter 2011</u>

This outcome was assessed using an ABET Project. The project required students to use measurement hardware to test the performance of a system and then use engineering software to develop a model of the system. The students then had to produce engineering construction drawings, a written report, and give an oral presentation on the results of their experimentation and modeling. The assessment is designed to assess students' ability to use modern engineering tools.

Thirty-four students were assessed in Winter 2011 using the performance criteria listed below. The minimum acceptable performance level is set at 80%; it is expected that 80% of the students perform at the 'accomplished' or 'exemplary' level in all performance criteria.

Table 12 summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met for the performance criteria for this program outcome. This assessment demonstrates that students are able to use modern engineering tools.

Table 12 Targeted Assessment for Outcome (k).

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% >= 2
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice				
K1: Demonstrate proficiency with engineering software: CAD, FEA, programming, data analysis, etc.	0%	59%	41%	100%
K2: Demonstrate proficiency with engineering hardware: test/measurement equipment, prototyping, etc.	0%	65%	35%	100%
K3: Apply communications tools and skills within engineering practice	18%	71%	12%	82%

3.3.4.6 Targeted Assessment of Outcome (n)

An appreciation for the influence of energy in the history of modern societies

Performance Criteria:

N1	Understand the historical development of energy systems
N2	Correlate historical events and resource conflicts - not assessed
N3	Recognize the consequences of energy systems on the development of modern societies

Assessment n1: REE 453 – Power Systems Analysis, Fall 2010

This outcome was assessed using an ABET Project. The project required students to discuss the historical development of regulatory framework within the U.S power sector, the consequences this framework has had on the power grids and the societal consequences this framework facilitates. The assessment is designed to assess students' appreciation for the historical context of energy systems and the influences energy systems have had on modern societies.

Twenty students were assessed in Fall 2010 using the performance criteria listed below. The minimum acceptable performance level is set at 80%; it is expected that 80% of the students perform at the 'accomplished' or 'exemplary' level in all performance criteria. The summary data presented below represents cumulative averages for multiple course-specific criteria, not percentages of students. Percentages of students meeting course-specific criteria may be found in the course notebook.

Outcome (n) is also assessed in REE 201, Introduction to Renewable Energy. Assessments of outcome (n) in the 201 courses have always failed to meet the 80% performance level. Repeating the assessment within a 400-level course and seeing the performance level increase significantly suggests students develop their appreciation of energy systems in an historical context between their sophomore and senior years. Likely, this may be attributed to the requirement that all BSREE majors take HIST 356, History of Energy.

Table 13 summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met for both performance criteria for this program outcome. This assessment demonstrates that students are able to appreciate the influences power systems have on society within an historical context.

Table 13 Targeted Assessment for Outcome (n).

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% >= 2
(n) an appreciation for the influence of energy in the history of modern societies				
N1: Understand the historical development of energy systems	0%	42%	58%	100%
N3: Recognize the consequences of energy systems on the development of modern societies	0%	27.5%	72.5%	100%

Summary of Direct Measure Assessment for 2010-11

Strengths

The results indicate that students in the REE program will be strong in the areas of engineering problem solving, including use of modern engineering tools and techniques. This is expected with the application and hands-on engineering focus of the program. The students were also strong in some of the soft skills, especially in communication. The strength in communication is not surprising as the courses assessed were upper division, and students have been repeatedly exposed to written and oral communication assignments throughout the lower division coursework and in other upper division courses.

Weaknesses

The results indicate that some weakness may exist in outcome (i), an ability to engage in independent learning and recognize the need for continual professional development.

Recommendations

A direct reassessment of outcome (i) is recommended for the 2011-12 assessment cycle.

Outcome-Specific Strengths, Weaknesses and Recommendations

(e) an ability to identify, formulate, and solve engineering problems

Assessment of this outcome indicated overall success in the areas of articulating a problem in engineering terms and developing appropriate solutions. Both assessments of these two criteria indicate at least 80% of the students demonstrated either accomplished or exemplary results. The assessment methods appear suitable for evaluating this outcome, so no recommendations are suggested at this time.

(g) an ability to communicate effectively

The assessment results indicate that students do fairly well with both written and oral communication. For oral communication, with two assessments, 100% of the students were either accomplished or exemplary. For written communication, with one assessment, 95% of the students were either accomplished or exemplary. Finally for acquisition and application of information sources, with one assessment, the level of accomplished and exemplary was at 80%. The assessment methods appear suitable for evaluating this outcome, so no recommendations are suggested at this time.

(i) an ability to engage in independent learning and recognize the need for continual professional development

This outcome shows mixed results, in part due to the fact that the performance criteria used was different for each of the three assessments conducted. Overall, students have developed good skills in the areas of "independent learning," "recognizing the acquisition of knowledge is a continual process/the need for continual professional development," and the ability to "identify, gather and analyze information." However, students appear to falter in "demonstrating an awareness that knowledge must be gained," with 38% showing only a developing ability in this skill area. The assessment methods appear suitable for evaluating this outcome, but due differences in the assessment performance criteria used, it is recommended that this outcome be revisited in the 2011-12 assessment cycle with a revised assignment and rubric as a continuing improvement item.

(j) a knowledge of contemporary issues

This assessment has excellent results, but with only one assessment that was not comprehensive, it is difficult to draw conclusions. The assessment for the ability to "demonstrate knowledge of contemporary issues" and to "recognize the temporal nature of contemporary issues" showed that 100% of all students were at the exemplary level. The assessment methods appear suitable for evaluating this outcome based on two out of the three criteria, so no immediate recommendations are suggested at this time. However, more than one assessment should be conducted of this outcome in future assessment cycles where it is targeted, and all of the criteria should be assessed at those times.

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Based on the results of one assessment for this outcome, 100% of students assessed have the ability to use the techniques, skills, and modern engineering tools necessary for engineering practice. This is consistent with results from the 2009-10 assessment. Though only one assessment was conducted in the 2010-11 cycle, the assessment methods appear suitable for evaluating this outcome, so no recommendations are suggested at this time.

(n) an appreciation for the influence of energy in the history of modern societies

Assessment of this outcome indicated overall success in the two criteria targeted. However, with only one assessment that was not comprehensive, it is difficult to draw conclusions. For the assessment of these two criteria, 100% of the students demonstrated either accomplished or exemplary results. This could be attributed to assessing upper division students, as assessment of lower division students has, in the past, indicated a lower level of accomplishment. The assessment methods appear suitable for evaluating this outcome based on two out of the three criteria, so no immediate recommendations are suggested at this time. However, more than one assessment should be conducted of this outcome in future assessment cycles where it is targeted, and all of the criteria should be assessed at those times.

Summary of FE Exam Direct Measure Assessment for 2010-11

As a result of their successful petition to the Oregon State Board of Examiners for Engineering and Land Surveying, four BSREE students took the October 2010 exam. Table 14 shows the October 2010 FE exam results.

Two other BSREE students took the FE exam in October 2009. One has a BSEET degree from an ABET TAC-accredited program and over a dozen years of work experience. The other student took the exam in New Mexico, which permits students to take the FE without having graduated from an accredited program. Table 15 shows the October 2009 FE exam results.

NCEES does not provide an option for students to select "Renewable Energy Engineering" as their major when they register for the FE exam. Consequently, BSREE students must select "Other" as their major. This leads to the possibility that students from other majors (such as BEET, BMET, etc.) may also appear in the "Others" data, clouding the assessment of BSREE graduates.

Table 14 October 2010 FE exam results for OIT graduates and enrollees who claimed "Other" as their major

October 2010									
Data Set	**# taken**	**# passed**	**Major**	**PM**	**AM Ave (/120)**	**AM %**	**PM Ave (/60)**	**PM %**	**Total (/240)**
Enrolled	---	---	---	---	---	---	---	---	---
Graduate	1	1	Other	Elect	98.0	82%	40.0	67%	178.0
	3	3	Other	Gen	83.0	69%	40.3	67%	163.6

Table 15 October 2009 FE exam results for OIT graduates and enrollees who claimed "Other" as their major

October 2009									
Data Set	**# taken**	**# passed**	**Major**	**PM**	**AM Ave (/120)**	**AM %**	**PM Ave (/60)**	**PM %**	**Total (/240)**
Enrolled	---	---	---	---	---	---	---	---	---
Graduate	2	2	Other	Gen	84.9	71%	36.1	60%	157.1

The results indicate that students in the BSREE program are successful when attempting to take the Fundamentals of Engineering exam. However, the students attempting the exam are still few in number.

Recommendations

The faculty should recommend to all students that they attempt the FE exam at their earliest opportunity.

The faculty should develop a more specific method to use the FE as a direct assessment tool. NCEES provides a white paper on using the FE for assessment effectively.

Indirect Assessments

<u>IDEA Center Indirect Assessment of Bass, EE 221, Circuits I, Fall 2010</u>

Table 16Table 13 summarizes the results of this indirect assessment

Table 16 – IDEA Center Assessment, EE 221

	EE 221, Circuits I: DC and 1st-Order Transient Analysis					
	Fall 2010					
	IDEA Center Relevant Objectives	Related a-n Outcomes	IDEA Objective for this course?	Average	Standard Deviation	a-n Outcome met (>3.5)
21	Gaining factual knowledge	i	**Essential**	4.7	0.6	yes
22	Learning fundamental principles, generalizations, or theories	e	**Essential**	4.8	0.4	yes
23	Learning to *apply* course material	a, k	**Essential**	4.5	0.6	yes
24	Developing specific skills, competencies and points of view needed by professionals	k	Minor/None	4.4	0.6	yes
25	Acquiring skills in working with others as a team	d	Minor/None	4.3	0.9	yes
26	Developing creative capacities (writing, etc.)	g	Minor/None	2.9	1.5	no
28	Developing skills in expressing myself orally or in writing	g	Minor/None	3.2	1.5	no
29	Learning how to find and use resources for answering questions or solving problems	i	Minor/None	4	1.1	yes
32	Acquiring an interest in learning more by asking my own questions and seeking answers	i	Minor/None	4.1	1.2	yes
		16	***students responded to this course evaluation.***			

For all IDEA Center Relevant Objectives rated as 'essential' or 'important,' the average score rated above 3.5, the targeted score for determining whether the associated program outcomes were satisfied.

This indirect assessment indicates students believe progress has been made on the following program outcomes:

(a) an ability to apply knowledge of mathematics, science, and engineering
(d) an ability to function on multi-disciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(i) a recognition of the need for, and an ability to engage in life-long learning
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Relevant Objectives deemed 'essential' of 'important' to this course all scored above the 3.5 threshold, indicating substantial progress has been made on program outcomes (a), (e), (i) and (k). Students also reported progress in developing teamwork skills, (d), even though that Relevant Objective was not deemed essential.

IDEA Center Indirect Assessment: Bass, REE 453, Power Systems Analysis, Fall 2010

Table 17Table 13 summarizes the results of this indirect assessment

Table 17 - IDEA Center Assessment, REE 453

	REE 453, Power Systems Analysis					
	Fall 2010					
	IDEA Center Relevant Objectives	Related a-n Outcomes	IDEA Objective for this course?	Average	Standard Deviation	a-n Outcome met (>3.5)
21	Gaining factual knowledge	i	Important	4.8	0.4	yes
22	Learning fundamental principles, generalizations, or theories	e	Important	4.7	0.5	yes
23	Learning to *apply* course material	a, k	**Essential**	4.7	0.6	yes
24	Developing specific skills, competencies and points of view needed by professionals	k	**Essential**	4.8	0.4	yes
25	Acquiring skills in working with others as a team	d	Minor/None	4.5	0.7	yes
26	Developing creative capacities (writing, etc.)	g	Minor/None	4.1	0.9	yes
28	Developing skills in expressing myself orally or in writing	g	Minor/None	4.4	0.5	yes
29	Learning how to find and use resources for answering questions or solving problems	i	**Essential**	4.8	0.4	yes
32	Acquiring an interest in learning more by asking my own questions and seeking answers	i	Important	4.7	0.6	yes
		18	***students responded to this course evaluation.***			

For all IDEA Center Relevant Objectives rated as 'essential' or 'important,' the average score rated above 3.5, the targeted score for determining whether the associated program outcomes were satisfied.

This indirect assessment indicates students believe progress has been made on the following program outcomes:

(a) an ability to apply knowledge of mathematics, science, and engineering
(d) an ability to function on multi-disciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(g) an ability to communicate effectively
(i) a recognition of the need for, and an ability to engage in life-long learning
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Relevant Objectives deemed 'essential' of 'important' to this course all scored above the 3.5 threshold, indicating substantial progress has been made on program outcomes (a), (e), (i) and (k). In addition, students reported significant progress in developing teamwork skills (d) and communications skills (g), even though both those Relevant Objectives were deemed Minor.

Summary of IDEA Center Indirect Measure Assessment for 2010-11

Strengths

The results indicate that students in the REE program believe that they have strengths in outcomes (a), (d), (e), (i) and (k).

Weaknesses

In the IDEA Center indirect assessment in EE 221, the students did not meet the threshold of > 3.5 for outcome (g), however that outcome was rated by the assessor to be of minor or no importance. It is possible for sophomore-level students to misinterpret the questions asked related to this outcome, as engineering students often do not see performing engineering design as a creative effort or keeping a laboratory notebook as expressing themselves in writing.

Recommendations

The faculty should consider including more indirect assessments from the IDEA Center evaluations.

4 Changes Resulting from Assessment

This section describes the changes resulting from the assessment activities carried out during the 2009-10 academic year and recommended changes identified during the 2010-11 academic year. It includes any changes that have been implemented based on assessment in previous assessment cycles, from this or last year, as well as considerations for future assessment cycles.

4.1 Changes to Assessment Methods Resulting from the 2009-10 Assessment

During the 2009-10 academic year an attempt was made to assess all (a)-through-(n) Program Outcomes. This was done in order to build a solid body of assessment for ABET review and program improvement. Upon completion of the assessment activities, the faculty decided that targeting specific outcomes each year (i.e., a subset of outcomes not exceeding 10 program outcomes) would result in improved assessment data and decisions over the 3-year cycle of assessment. Following this decision, during the 2010-11 academic year five program outcomes were targeted for assessment.

During Convocation in Fall 2010, the EERE faculty agreed to change outcome (i). Previously, the faculty had adopted the outcome (i) developed by ABET: "a recognition of the need for, and an ability to engage in life-long learning." The faculty felt that the outcome was not assessable given the "life-long" nature of the outcome, and could only truly be assessed by querying our alumni. The long-term nature of the burden of proof requires assessment more typical of a PEO rather than that of a program outcome; a characteristic exhibited by our alumni rather than one exhibited by our recent graduates. By recasting the outcome in terms of shorter-term criteria, the assessment becomes measurable within the time frame of a class or senior project while still revealing the same desired values, particularly independent learning and professional development. The faculty agreed that the REE outcome (i) achieves the same goal as the ABET outcome (i); encourage the faculty to develop curricula that cause BSREE students to recognize the need for continuous professional development and independent learning.

The assessments conducted during the 2009-10 academic year revealed the following areas of recommended improvement (shown in italics). The 2010-11 actions taken are shown following each recommendation.

1. *There is a need for better coordination among the faculty to define outcomes and methods for performing relevant outcome evaluations. This need is especially important for new faculty joining so we can ensure consistency in our evaluation approach.*

   To establish better coordination among the faculty to define outcomes and methods for performing relevant outcome evaluations, assessment training was conducted with all EERE faculty during Fall 2011 convocation. In the training, a program assessment committee of three faculty at the two campuses was established to improve communications and coordination between the campuses.

2. *Where there are not enough assessments available to draw clear conclusions, assessments could be broadened to other classes and assessment methods.*

   In the fall of 2011 the number of FT faculty in the REE program increased from seven to nine. This increase in staffing will allow the program to add more assessed courses by more varied instructors in the normal three-year assessment cycle.

3. *Assessment of several of the outcomes and outcome performance criteria should be broadened to different classes and different instructors. This approach will net us larger assessment samples and also result in variation in methods. Consequently, the assessment results should be more representative of how the ABET outcomes are likely to be applied in professional practice.*

   Same as #2.

4. *There is a distinction between the hard and soft skills represented by the several ABET outcomes. We need to find methods to assess both types of skills in a range of courses, rather than just concentrate soft skills assessments in project-based classes and assessments of hard skills in classes that emphasize engineering fundamentals and problem solving.*

   The program used rubrics from the institutional student learning outcome (ISLO) to assess the soft skills in various upper division classes other than the capstone senior project class.

5. *It would be helpful for faculty to reinforce the kinds of circumstances and performance expectations that students will encounter in industry. There is an attitude among some students, although it might not be universal, that calculations and technical problems are the primary focus of working engineers. Although it is certainly true that engineers are singularly qualified to deal with technology problems, some students discount the need to develop communication, teamwork, and other soft skills, which are essential for successful careers.*

   The faculty reinforced the kinds of circumstances and performance expectations that students will encounter in industry by providing more real-world assignments that showed the students that they need to develop communication, teamwork, and other soft skills to function as effective engineers.

6. *To emphasize the mechanics and processes of teamwork, we need to find ways to make all team members accountable. Perhaps SPE 321 should be a prerequisite for any course that requires teamwork, since teamwork is the hallmark of many of our upper division courses.*

   There has been assessment on teamwork in other upper division classes. The expectations and deliverables of the team are stressed and students have done well (after some explanation). For the future, the 2011-12 assessment coordinators agreed that making SPE 321 a prerequisite infringes on academic freedom. Many instructors change the methods used to teach courses as they attempt to improve student learning, and may or may not include teamwork problems as desired to meet the objectives of their courses.

7. *To address the need for using information sources, it is important to educate students on the array of sources available for the kinds of information they are expected to locate, and also to instruct them on how to go about identifying and validating useful information.*

   Faculty has reinforced research concepts in their classes, and directed students to work with library faculty to learn to properly perform research. Some faculty limit the references allowed from internet sources to encourage use of other information sources.

8. *Assessments should be emphasized later on in the program, in upper division classes – more so than in the lower division classes – after students have had ample opportunity to learn and develop knowledge and capabilities that demonstrate competence with the program outcomes.*

   During the program rollout phase, only lower division courses were available for assessment. In the 2010-11 academic year, the program was more mature, and assessments were conducted in upper division courses.

9. *To address the apparent disparity between the students early in the program and those in upper division status, it is important that the faculty concur what kind of assessment is most appropriate and what to expect of students at different levels.*

   Outcome (n) was assessed in this fashion as a pilot program. The faculty will consider changing the expected level of performance for outcomes to allow a lower standard for lower division courses than for upper division courses. This proposed change will be forwarded to the faculty for adoption for the 2012-13 assessment.

10. *Consider tighter integration of software tools within the curriculum, identifying which software tools should be recommended or used as standard. For example, a CAD course is not required in the REE curriculum, yet students are expected to use CAD in some courses, and CAD software packages are fundamental tools for design and technical documentation.*

    Certain software tools were used as standard. To address the need that a CAD course is not required in the REE curriculum, students and faculty developed and gave tutorials on the use of AutoCAD, the selected software package. Other tutorials will be developed in the future. Faculty will discuss more standardization in the future, however, means and methods of achieving course objectives still fall within the bounds of faculty academic freedom.

11. *There is a need for better resolution in assessing the skills and abilities that apply to outcome (g), an ability to communicate effectively. In future assessments, we will identify more appropriate performance criteria to separate assessment of writing, speaking, presentation, and intra-team communication skills. To accomplish this change, we can take advantage of the separate rubrics developed by our Communication Department, at http://www.oit.edu/faculty-staff/provost/assessment/rubrics.*

    Outcome (g) was separated into subcategories for assessment. The faculty will examine the possibility of changing the performance criteria for outcome (g) to become more targeted in future assessment cycles.

12. *Given the wide variation in the types of communications required by the assessments, such as memos, lab reports, senior project, design documentation, presentations, proposals, and so on, one recommendation is to identify written documentation requirements more explicitly, perhaps using examples or templates so students have a better idea of the structure, organization, and content of such written documentation.*

    Not addressed this year as it really impinges on the concept of academic freedom. Some faculty provide templates or examples, others do not.

13. *For a more focused assessment of outcome (d) an ability to function on multi-disciplinary teams, we will adapt the Communication Department's teamwork rubric and tools available at: http://www.oit.edu/faculty-staff/provost/institutional-student-learning-outcomes/tools.*

    Outcome (d) was not assessed this cycle. The recommendation proposed during the 2009-10 cycle will be forwarded to the 2014-15 assessment cycle for consideration by the faculty, as that is the next cycle in which outcome (d) will be assessed.

4.3 Recommended Changes Resulting from the 2010-11 Assessment

The assessments conducted during the 2010-11 academic year revealed the following areas needing improvement:

1. The performance criteria used to assess outcomes must be the same throughout the program, and the faculty members must be in agreement as to the meaning of each performance criteria. This must be resolved through training in assessment and faculty discussion as well as the development of common rubrics so that a consensus is reached.

2. The faculty should consider including more indirect assessments from the IDEA Center evaluations and student exit surveys. The method for conducting such assessments must be formalized so that it can be applied uniformly throughout the program.

3. The faculty should recommend to all students that they attempt the FE exam at their earliest opportunity to increase the indirect assessment opportunity.

4. As the faculty has grown, consider increasing the amount of direct assessments conducted to improve the opportunity to assess each targeted outcome at each location.

Appendix A - Mapping Between SLOs and the BSREE Curriculum

Table 18 - Mapping between BSREE engineering courses and the Program Outcomes. Check marks indicate the faculty has identified the outcome as assessable in a particular class.

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)
CHE 260	√	√		√	√		√			√		√		
ECO 357	√					√	√	√	√	√			√	√
EE 221	√	√		√	√		√				√			
EE 223	√	√		√	√		√				√			
EE 225	√	√		√	√		√				√			
EE 321	√	√	√	√	√		√		√		√			
EE 343	√			√	√	√	√	√	√	√		√		
EE 419	√	√	√	√	√		√	√			√	√		
EE 456	√	√	√	√	√	√	√				√			
ENGR 211	√				√		√				√			
ENGR 266	√	√			√						√			
ENGR 355	√				√		√				√	√		
ENV 427	√					√	√		√	√			√	
HIST 356							√							√
MECH 318	√	√		√	√		√				√	√		
MECH 323	√				√						√	√		
MECH 433	√	√		√	√		√			√	√	√		
REE 201	√					√	√	√		√			√	√
REE 243	√	√		√	√		√		√	√	√	√		
REE 253	√	√	√	√	√		√				√	√		
REE 331	√	√	√	√	√		√	√	√	√	√	√	√	√
REE 333	√	√	√	√	√	√	√	√	√	√	√	√	√	
REE 335	√	√	√	√	√	√	√	√	√	√	√	√	√	
REE 339	√	√	√	√	√	√	√	√	√	√	√	√	√	√
REE 344	√			√	√	√	√	√		√	√	√		
REE 345	√				√	√		√		√	√	√		
REE 346	√	√	√	√	√		√	√		√	√			
REE 347	√				√	√		√		√	√	√		√
REE 348	√		√		√	√	√	√		√	√	√		
REE 412	√		√		√	√	√	√		√	√	√		
REE 413	√		√		√		√				√	√		
REE 439	√	√	√	√	√		√				√	√	√	
REE 449	√	√	√	√	√	√	√	√	√	√	√	√	√	√
REE 451	√		√		√						√	√		
REE 453	√		√		√					√	√	√		
REE 454	√		√		√	√				√	√	√		
REE 455	√	√	√	√	√	√	√			√	√		√	
REE 459	√	√	√	√	√	√	√	√	√	√	√	√	√	√
REE 463	√	√	√	√	√		√				√			