Renewable Energy Engineering
2011-12 Assessment Report

Department of Electrical Engineering and Renewable Energy

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Editing Faculty

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1 Introduction

1.1 Program Design and Goals

The Bachelor of Science in Renewable Energy Engineering (REE) program at Oregon Institute of Technology (Oregon Tech) has been designed to provide interdisciplinary education in mechanical, electrical, and chemical engineering topics as they apply to renewable energy. Students take coursework in communications, natural sciences, mathematics, and the humanities and social sciences to support their engineering coursework.

The REE program goal is to provide graduates for careers in areas of renewable energy engineering such as but not limited to: solar, solar thermal, wind power, wave power, geothermal energy, transportation, energy storage, hydroelectric and traditional energy fields such as power systems, smart grid, energy management, energy auditing, energy systems planning, energy economics, energy policy and development, carbon accounting and reduction, and controls and instrumentation. BSREE graduates will enter renewable energy engineering careers as design, site analysis, product, application, test, quality control, and sales engineers.

1.2 Program History

In 2005, the Oregon Institute of Technology (Oregon Tech) began offering its new Bachelor of Science degree 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 Oregon Tech's 2005-06 catalogue.

In 2008, however, the BSRES degree was discontinued and replaced by the Bachelor of Science degree 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 program, particularly one that could be accredited as by the Engineering Accreditation Commission of ABET, Inc. 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. 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 Oregon Tech 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 started to level off for the first time since the inception of the program. Fall 2011 headcount enrollment was 131 students at the Portland campus (79 BSREE, 52 PREE) and 97 in Klamath Falls (47 BSREE, 50 PREE), for a total headcount of 228.

1.6 Graduates

Graduation rates have been climbing, as indicated in Table 1.

Table 1 – Renewable Energy Baccalaureate Degrees Awarded

Academic Year	Number of Graduates
2008-09	7[1]
2009-10	9
2010-11	29
2011-12	35

[1] Six graduates received the BSREE degree; one graduate received the BSRES degree.

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 Oregon Tech'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 educational objectives map to the Oregon Tech's institutional mission statement and core themes by offering statewide educational opportunity in an innovative and rigorous applied degree program in engineering oriented toward graduate success and an appreciation for the role of the engineer in public service.

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[2]

(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

[2] 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 Assessment of 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		√			√	
(h)	Impact of Solutions		√			√	
(i)	Life-long Learning		√	√	√*		√
(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 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.[3] Additionally, the program outcomes were assessed using indirect measures, namely results from student evaluations based on methods developed by the IDEA Center[4].While data from NCEES regarding passing rates for the Fundamentals of Engineering Exam (FE) has previously been used in the assessment process, the lack of ability to explicitly identify REE students in the NCEES reported results has led to the decision to exclude its use as an assessment tool.

[3] ABET Projects and ABET Assignments refer to projects and assignments especially designed by Oregon Tech 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.

[4] 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 2 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[5]. 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.[6] 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.

[5] 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.

[6] "ABET rubrics" refer to rubrics especially designed by Oregon Tech 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.

Indirect Measure: KSU IDEA Evaluations

At Oregon Tech, 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 2011-12 targeted indirect assessment activities based on the IDEA Center diagnostic reports.

3.3.4 2011-12 Targeted Direct Assessment Activities

The sections below describe the 2011-12 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 the percentages of students meeting course-specific criteria.

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

3.3.4.1 Targeted Assessment of Outcome (a)

An ability to apply knowledge of mathematics, science, and engineering

Performance Criteria:

A1	Apply knowledge of mathematics
A2	Apply knowledge of science, engineering

Assessment a1: [REE 253, Fall 2011 – Klamath Falls]

This outcome was assessed using a homework and lab assignment. The objective was to engage the class in a homework on applying the knowledge of mathematics, science and engineering to address problems in the field of electrical machinery. Students are required to work out homework problems independently and finish the lab assignment in groups. The lab project involves building synchronous generators with lab electrical machinery (dissectable motors). Measurements are also required to be taken to plot the characteristic curves. The students are required to demonstrate reading, writing and speaking skills, identify the technical problem; develop a plan to solve it with a group of five people, execute the experimental method for problem solving and produce a report on the lab project.

Twenty students were assessed in fall term of 2011 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 4 below 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 met or exceeded expectations; they demonstrated their abilities to apply math, science and engineering principles to predict and analyze experimental results and solve technical problems.

Table 4 Targeted Assessment for Outcome (a).

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students ≥ 2
(a) an ability to apply knowledge of mathematics, science, and engineering				
A1: Apply knowledge of mathematics	0%	10%	90%	100%
A2: Apply knowledge of science, engineering	0%	15%	85%	100%

Assessment a2: [ENGR211, Fall 2011 – Wilsonville]

This outcome was assessed using a term-long truss bridge building and analysis project. Students worked in teams to design, analyze and construct a bridge from basswood and wood glue, which was tested at the end of the term for strength and for its strength to weight ratio. Students generated ideas, analyzed multiple options for their hypothetical strengths, and built the bridge that they felt was the best design.

Seventeen students were assessed in Fall, 2011 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 5 below 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 met or exceeded expectations; they demonstrated their abilities to apply math, science and engineering principles to predict and analyze experimental results and solve technical problems. The results of this assessment may be positively skewed by the fact that students worked in teams on this project. Team projects should reflect the combined abilities of the group: if a student who is exemplary at applying knowledge of mathematics works on the same team as another student who is exemplary at applying engineering skills, then the project documentation and presentation would reflect an exemplary skill level for both performance criteria for both students. Thus success at teamwork may obscure the level of success for individual students for this criterion. The faculty will perform subsequent assessments in a manner that more fully reflects individual level of accomplishment.

Table 5 Targeted Assessment for Outcome (a).

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students ≥ 2
(a) an ability to apply knowledge of mathematics, science, and engineering				
A1: Apply knowledge of mathematics	6%	53%	41%	94%
A2: Apply knowledge of science, engineering	6%	59%	35%	94%

Assessment a3: [REE 412, Winter 2012 – Wilsonville]

This outcome was assessed using an individual written project with the topic "Photovoltaic Systems for Developing Countries". Students were required to research a sector of the population with a particular energy need in which photovoltaic systems could be a viable alternative. After assessing the solar resource and social, economical, and political factors surrounding the particular application, the students had to design a photovoltaic system that meet the local conditions. The written paper had to be in the form of a document that could potentially be submitted to a sponsor, funding agency, or serve to analyze local incentives. This assignment contained elements in which the students had to apply their knowledge of mathematics (performance criteria A1) and their knowledge of science and engineering (performance criteria A2). Projects with a grade of 90 or above were considered "Exemplary", whereas projects with a grade between 80 and 89 were considered "Accomplished". Projects with a grade below 70 were considered "Developing".

Eighteen students were assessed in Winter 2012 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 6 below 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 met or exceeded expectations; they demonstrated their abilities to apply math, science and engineering principles to predict and analyze experimental results and solve technical problems.

Table 6 Targeted Assessment for Outcome (a).

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students ≥ 2
(a) an ability to apply knowledge of mathematics, science, and engineering				
A1: Apply knowledge of mathematics	17%	5%	78%	83%
A2: Apply knowledge of science, engineering	17%	5%	78%	83%

3.3.4.2 Targeted Assessment of Outcome (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

Performance Criteria:

C1	Recognize need for an engineering solution
C2	Develop a design strategy within realistic constraints
C3	Evaluate relative value of a feasible solution

Assessment c1: [REE 346, Fall 2011 – Klamath Falls]

The outcome was assessed using the course project of REE346 Biofuel and Biomass taught in Fall 2011. The project is a team based project. The project involves in an algae related biodiesel generation system. The objective of this project is to get students understanding the process of biodiesel generation from algae from algae growing through oil extraction to biodiesel production by working on an algae-growing reactor design, algae-growing process design, and algae oil extractor design. The students of this class implemented their designs, tested the performance of their subsystems and evaluate the feasibilities of their systems. The whole class of the students is divided into three groups to work on three subsystems of the project. The first team worked on algae growing reactor design, implementation and test. The second team worked on algae growing process design, implementation and test. The third team worked on the algae oil extractor design, implementation, and test. The project was used to assess the student's capability to design a system, or a process to meet desired needs within realistic constraints. The algae reactor design wais used to test student ability to design a system that meets the requirements of supplying CO_2 and light efficiently, and harvesting algae easily, and students had to be able to implement their designs within the time and financial constraints. The algae-growing group has to design a process to grow algae with local strains of algae efficiently. The algae harvesting and algae oil extracting group has to design a machine that can extract algae oil and that can be implemented within the constraints of current conditions.

The project was checked by having students give presentation every other week to present progress and the project was evaluated based on the presentations and their final project reports. The students are required to demonstrate the recognition of needs, the ability to develop a design strategy, and the capability to evaluate the relative value of a feasible solution. For assessment of the outcome through the project, the instructor invited another two faculty members to carry out the evaluation. The three faculty members attended the final presentations of the three groups and judged the groups. For more concrete details of the projects, the faculty members read the final reports of the three teams.

In the final presentation, the reactor group exhibited their prototype of real reactor for algae growing, the algae-growing group showed the test results for optimized growing conditions, and the extractor group showed the system design and feasibility analysis, as well as the process to treat algae.

Fourteen students were assessed in term Fall 2011 using the performance criteria listed below. The minimum acceptable performance level was to have 80% of the students performing at the accomplished or exemplary level in all performance criteria.

Table 7 below 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 met or exceeded expectations; they demonstrated their abilities to recognize the need for engineering solutions, develop a design strategy within realistic constrains, and evaluate relative value of a feasible solution.

Table 7 Targeted Assessment for Outcome (c).

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students ≥ 2
(C) an ability to design a system, component or process to meet desired needs within realistic constraints such as economic, environmental etc.				
C1: Recognize the need for engineering solutions	16%	24%	60%	84%
C2: Develop a design strategy within realistic constraints	10%	27%	63%	90%
C3: Evaluate relative value of a feasible solution	16%	36%	48%	84%

Assessment c2: [REE439], Winter 2012 – Wilsonville]

This outcome was assessed using a term project, in which students work in a team to complete energy assessment of an office building, and a final exam. There were only six students enrolled, and taking the size of the project in to account, all the students worked as a team on the same project. The team was provided with mechanical and construction drawings, energy monitoring data, and one year energy bill of the facility. The team was assigned to (1) analyze the operations of the building HVAC system, the savings and design alternatives, and (2) document their findings and recommendations. The final exam was used to assess individual performance.

Six students were assessed in winter 2012 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 8 below 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 met or exceeded expectations; they demonstrated their collective and individual abilities to design a system for clients that met realistic constraints.

Table 8 Targeted Assessment for Outcome (c).

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students ≥ 2
(C) an ability to design a system, component or process to meet desired needs within realistic constraints such as economic, environmental etc.				
C2: Develop a design strategy within realistic constraints	0%	50%	50%	100%
C3: Evaluate relative value of a feasible solution	0%	50%	50%	100%

Assessment c3: [REE 331, Fall 2011 – Wilsonville]

This outcome was assessed using a group laboratory project. The project didn't include pre-planned experiments, but constituted a simulated research study. The goal was to design and build a practical fuel cell within realistic economic, environmental, and time constraints; and considering as well health and safety, manufacturability, and sustainability. The group was given general parameters and possible directions; and advised to first perform a thorough literature search, select a promising topic, build experimental capabilities within a limited budget, duplicate it first, and then expand on it. Finally, the group was asked to submit a written report and give an individual oral presentation. The students were expected to use their knowledge of different fuel cell types, use their judgment to select adequate fuel, make a choice of the best catalysts for anodic and cathodic reaction, design a system, calculate the rate of use of fuel and oxidant, build a functional cell, and use the knowledge of experimental techniques to characterize the fuel cell performance.

Ten students were assessed in Fall 2011 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.

This group project produced a practical fuel cells system. The actual device performance was consistent with the amount of time, availability of materials and economic constraints.

Table 9 below 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. All students exceeded expectations. These results were uniform for all students based on the group project structure and the fact that the students equally contributed to the design. All individual presentations were exemplary as a result of group preparation and practice.

Table 9 Targeted Assessment for Outcome (c).

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students ≥ 2
(C) an ability to design a system, component or process to meet desired needs within realistic constraints such as economic, environmental etc.				
C1: Recognize the need for engineering solutions	0%	10%	90%	100%
C2: Develop a design strategy within realistic constraints	0%	10%	90%	100%
C3: Evaluate relative value of a feasible solution	0%	10%	90%	100%

3.3.4.3 Targeted Assessment of Outcome (d)

An ability to function on multi-disciplinary teams

Performance Criteria:

D1	Team participation, communication
D2	Management of team, delegation of responsibilities

Assessment d1: [REE 449, Winter 2012 – Klamath Falls]

This outcome was assessed using a preliminary design review (PDR) for the second course (three courses) of the capstone senior project. The three teams presented a 20 – 30 minute design review to the class and other faculty and staff members. In the PDR the teams discussed the project design, design decisions and the overall test plan. The teams received questions and feedback regarding the current project status to guide possible changes as the project approaches completion in spring term. The students discussed preliminary design solutions, how they chose one and how they plan to test and characterize the design choice. Teams were evaluated on how well they conducted the PDR, group participation and overall teamwork on project.

Ten students (on three teams) from EE and REE programs were assessed in Winter term 2012 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. One team project was designing an electric bike using a combination of fuel cells and batteries for energy storage. Another team is developing a new type of down hole heat exchanger for a geothermal well (direct use). The final team is design a solar powered emergency water generation system. The teams discussed designs in a PDR and submitted a written test plan to discuss solution verification and characterization.

Table 10 below 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 met or exceeded expectations; they demonstrated their abilities to work on teams to solve engineering problems or design a project. The students showed ability to manage the team, assign project duties, have meetings to discuss progress and issues. All presentations were done in a very professional manner with smooth transitions between group members with all actively participating. All three teams showed a delegation of responsibility to all team members with design partitioning between team members.

Table 10 Targeted Assessment for Outcome (d).

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students ≥ 2
(d) an ability to function on multi-disciplinary teams				
D1: Team participation, communication	0%	40%	60%	100%
D2: Management of team, delegation of responsibilities	0%	100%	0%	100%

Assessment d2: [MECH 433, Fall 2011 – Wilsonville]

This outcome was assessed using a term projects involving a commercial building air conditioning system assessment. A class of 13 students was divided into two teams of four students and one team of five students. The teams were provided with mechanical drawings of the three levels of a newly designed educational facility. Each team had a responsibility of assessing the air conditioning system of one level of the building.

Each team was assigned to (1) identify the supply and return duct work, (2) identify the number of thermal zones, (3) use duct design software to redesign the ducts and compare their value with as-built duct size, and calculate the total supply air pressure drop in each zone and select a fan. Team participation, communication, management and delegation of responsibilities were observed by the instructor during design class.

Thirteen students were assessed for this course during the Fall 2011 term using detailed evaluation rubrics for the written report. The detailed rubrics have been condensed into the two main performance criteria listed in the table below. The minimum acceptable performance level was to have above 80% of the students graded at the accomplished or exemplary level in all performance criteria.

Table 11 below summarizes the results of this targeted assessment. The students were assessed using performance criteria condensed into the two main performance criteria listed in the table. The results indicate that the minimum acceptable performance level of 80% was met on both performance criteria for this program outcome. All teams managed to participate and delegate responsibilities.

Table 11 Targeted Assessment for Outcome (d).

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students ≥ 2
(d) an ability to function on multi-disciplinary teams				
D1: Team participation, communication	0%	35%	65%	100%
D2: Management of team, delegation of responsibilities	0%	35%	65%	100%

Assessment d3: [REE 463, Section 01, Fall 2011 – Wilsonville]

This outcome was assessed for REE 463 (Section 01) in Fall 2011 using the final lab assignments and reports turned in, which focused on controls and instrumentation device functionality and drawings. This lab assignment was different for each group, because for the last five labs of the term, a different group was assigned one of the five possible lab options, and they rotated every lab period. The rubric for evaluating team communication, participation, delegation of responsibilities, and team management were observed by the instructor during the lab and office hours. Also, it should be noted that some students from this class section had other students from the second section class part of their lab, because the lab groups involved students from both sections.

Nineteen students were assessed for this course during the Fall 2011, and they were divided into five groups—four groups of four people, and one group of three people. All were assessed 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 12 below 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 met or exceeded expectations; they seemed to work well together in their teams overall, delegated the work proportionally, and communicated decently well.

Table 12 Targeted Assessment for Outcome (d).

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students ≥ 2
(d) an ability to function on multi-disciplinary teams				
D1: Team participation, communication	0%	16%	84%	100%
D2: Management of team, delegation of responsibilities	0%	16%	84%	100%

3.3.4.4 Continuous Improvement 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

Assessment i1: [REE 451, Fall 2011 – Klamath Falls]

This outcome was assessed using a required project research paper on geothermal power plants. Students were asked to research some west coast regions for power plant types and usage. They compared and analyzed the types of power plants, power production, power utilization and its' relationship to the geological region. Students needed to research the reservoir parameters for the selected regions and analyze the power plant decisions for these regions. This required researching different sources and professional societies involved in geothermal power. The main deliverable was an 8-10 page project paper discussing the results of their study.

Six senior level students were assessed in fall 2011 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 13 below 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 met or exceeded expectations; they demonstrated their abilities to apply research methods and information collecting techniques to analyze and compare engineering solutions and the feasibility for a given application in geothermal energy.

Table 13 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	0%	47%	53%	100%
I2: Identify, gather and analyze information	5%	16%	79%	95%
I3: Recognize the acquisition of knowledge is a continuous process	NA	NA	NA	NA

Assessment i2: [REE 407 – Contemporary Power Systems, Spring2012 – Wilsonville]

This outcome was assessed using two assignments. The first assignment required each student to select and read a recent technical research paper or textbook chapter and provide a written summary of the material. The second assignment required each student to attend a technical conference or seminar related to the course, meet three people from industry and learn about their jobs, and provide a written summary of the material presented and the industry contacts they made.

[8] This is a continuous improvement item carried over from the 2010-11.

Twenty-seven students were assessed in Spring 2012 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 14 below 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 met or exceeded expectations.

Table 14 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	0%	0%	100%	100%
I2: Identify, gather and analyze information	0%	20%	80%	100%
I3: Recognize the acquisition of knowledge is a continuous process	0%	0%	100%	100%

Assessment i3: [REE 407 – Energy Markets and Modeling, Winter 2012 – Wilsonville]

This outcome was assessed using two assignments. The first, to assess performance criteria I1 and I3, was a written assignment explicitly asking students about their career goals, concrete plans to engage in lifelong learning (including continuing education), and familiarity with relevant professional societies and organizations. This was a graded homework assignment of approximately 4 pages, and assessed against an existing Oregon Tech Lifelong Learning Rubric. Performance criterion I2 was assessed based on a term-long research project.

Nine students were assessed in Winter 2012 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 15 below summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met for all three performance criteria for this program outcome. Students met or exceeded expectations of awareness that knowledge must be gained, and recognized that the acquisition of knowledge is a continuous process, as reflected by their "Lifelong Learning" assignment. Students' ability to identify, gather and analyze information was judged by the diversity and appropriateness of sources used for their term projects, with particular attention paid to those sources that were not suggested or required readings as part of the course. Additionally, students' understanding of the material was analyzed by whether the material was simply paraphrased or copied from the source or was presented in a form that reflects both analysis of the material and relevance to the paper.

Table 15 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	0%	11%	89%	100%
I2: Identify, gather and analyze information	11%	67%	22%	89%
I3: Recognize the acquisition of knowledge is a continuous process	11%	67%	22%	89%

3.3.4.5 Targeted Assessment of Outcome (l)

An ability to apply the fundamentals of energy conversion and applications

Performance Criteria:

L1	Understand the fundamental principles of energy and energy conversion
L2	Apply energy fundamentals in engineering practice
L3	Apply energy fundamentals to improve system design

Assessment l1: [REE 412, Winter 2012 – Klamath Falls]

This outcome was not assessed as planned.

Assessment l2: [REE 333, Winter 2012 – Wilsonville]

This assessment was not performed as planned.

Assessment l3: [EE 419, Winter 2012 – Wilsonville]

This outcome was assessed for EE 419 in Winter 2012 using the final lab assignments and IEEE papers turned in, which focused on designing, modeling in LTSpice, building, and analyzing an actual buck and boost converter. The rubric for evaluating the students' understanding of fundamental principles of energy conversion, application of energy in practice, and application to improve system design were observed by the instructor during the multiple lab hours, office hours, and based on the final grades for the IEEE paper and term.

There were a total of 21 students in the class, with nine groups of two and one group of three. All were assessed 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 16 below 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 met or exceeded expectations; they seemed to grasp the fundamentals of energy and different applied energy conversion devices well, did a good job with their converter designs, and did a decent job of improving their designs.

Table 16 Targeted Assessment for Outcome (l).

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students ≥ 2
(l) an ability to apply the fundamentals of energy conversion and applications				
L1: Understand the fundamental principles of energy/conversion	0.0%	29.0%	71.0%	100%
L2: Apply energy fundamentals in energy practice	0.0%	29.0%	71.0%	100%
L3: Apply energy fundamentals to improve system design	0.0%	38.0%	62.0%	100%

Summary of Direct Measure Assessment for 2011-12

Strengths

The results indicated that REE graduates will be strong in the areas of knowledge and ability to apply math, science, engineering, and energy fundamentals while working in teams that are designing components or systems within constraints.

Weaknesses

There were no official weaknesses identified, though some areas within various outcomes where the percentage of students assessed were only slightly over the criteria set for demonstrating achievement.

Recommendations

A direct reassessment of outcome (l) is recommended for the Klamath Falls campus during the 2012-13 assessment cycle.

Outcome-Specific Strengths, Weaknesses and Recommendations

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

Assessment of this outcome showed great success in the areas of ability to apply knowledge of math, science, and engineering. Almost all students demonstrated accomplished or exemplary performance in the assessments that were concentrated in 200-level courses. However, only 83% of the students assessed in the senior level course demonstrated accomplished or exemplary performance in the assessment concentrated in the 400-level course. This drop in achievement can be explained due to the higher standard of performance used for assessment in the higher level course. Based on these assessments, no weaknesses have been detected. Recommendations include extending the outcome to be evaluated in other core 400-level REE classes.

(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

Assessment of this outcome showed high abilities in the areas of identifying a need for an engineering solution, developing a design strategy with realistic constraints, and evaluating the relative value of a feasible solution. All students demonstrated accomplished or exemplary performance in the second area, developing a design strategy with realistic constraints, in all three assessments. However, in one assessment, only 84% of the students demonstrated accomplished or exemplary performance. There is variation in the levels of student performance across the three assessments, which suggests differences in course content and teaching methods may be a factor in how accomplished students are in a given subject area. Based on these assessments, no weaknesses were found. However, there is a need for consensus among the faculty about what factors are being evaluated for this outcome to ensure consistency in both expectations of students and student assessment.

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

Assessment of this outcome showed overall success in the areas of team participation and communication, and management of teams and delegation of responsibilities where 100% or more of the students met the accomplished or exemplary performance levels. Based on these assessments, no weaknesses were found.

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

Overall, students have developed good skills in the areas of independent learning, with all able to demonstrate an awareness that knowledge must be gained. Most students assessed were able to demonstrate the ability to identify, gather, and analyze information, as well as recognize that acquiring knowledge is a continuous process. Based on these assessments, no weaknesses were found.

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

Assessment of this outcome showed students proficient in understanding the fundamental principles of energy and energy conversion, applying engineering fundamentals in engineering practices, and capable in applying energy fundamentals to improve systems design. All students assessed met the accomplished or exemplary criteria. However, only one assessment was conducted at one campus for this outcome. Therefore, it is recommended that this outcome must be assessed at both campuses and be repeated during the next school year at the Klamath Falls campus.

3.3.5 2011-12 IDEA Center Indirect Assessments

3.3.5.1 Methodology for Assessment of Program Outcomes using IDEA Center Course Evaluations

At Oregon Tech, course evaluations are conducted using the course evaluation form developed by the IDEA Center[9], an organization originating from Kansas State University in the 1960s. Using the course evaluation forms, an IDEA Center Diagnostic Report is generated and returned to the instructor. The report provides feedback from the students over a range of topics. Of interest to this indirect assessment are the Relevant Objectives of the course. These are listed in the table below.

The BSREE faculty uses these diagnostic reports as a means for collecting data for indirect assessment of program outcomes. Table 17 shows how the IDEA Center Relevant Objectives map (loosely) to the ABET-based a-through-k program outcomes. Note this mapping does not allow for assessment of all fourteen ABET outcomes; only outcomes (a), (d), (e), (g), (i) and (k) could be reasonably mapped to the IDEA Center Relevant Objectives.

Table 17 IDEA Center Mapping of Relevant Objectives to Student Outcomes

	IDEA Center Relevant Objectives	Related a-n Outcomes
21	Gaining factual knowledge	i
22	Learning fundamental principles, generalizations, or theories	e
23	Learning to *apply* course material	a, k
24	Developing specific skills, competencies and points of view needed by professionals	k
25	Acquiring skills in working with others as a team	d
26	Developing creative capcities (writing, etc.)	g
27	Gaining a broader understanding and appreciation of intellectual/cultural activity	none
28	Developing skills in expressing myself orally or in writing	g
29	Learning how to find and use resources for answering questions or solving problems	i
30	Developing a clearer understanding of, and commitment to, personal values	none
31	Learning to *analyze* and *crtiticaly evaluate* ideas, arguments and points of view	none
32	Aquiring an interest in learning more by asking my own questions and seeking answers	i

The IDEA Center Relevant Objectives are scored using a one-through-five numbering scheme, with the student asked to rate the amount of progress made on each objective. A score of one indicates no apparent progress, while a five indicates exceptional progress. For each course, faculty select which Relevant Objectives are pertinent to the course; typically, only three or four are indicated as Essential. For the purposes of assessing program outcomes, the faculty assumes an average score of 3.5 (between moderate and substantial progress) on Relevant Objectives as indicating success in meeting the related program outcomes.

9 www.theideacenter.org

3.3.5.2 Assessment of Program Outcomes using IDEA Center Course Evaluations

The sections below describe the targeted indirect assessment activities based on the IDEA Center diagnostic reports. The assessment tables indicate which IDEA Center Relevant Objectives were deemed pertinent to the course, graded as "essential (E)," "important (I)," or "minor (M)." Based on the average score for each Relevant Objective, an indication is made determining whether the associated program outcomes were satisfied.

Mapping the IDEA Center Relevant Objectives to program outcomes is justified as follows:

Program Outcome (a), *an ability to apply knowledge of mathematics, science, and engineering*, maps to one Relevant Objective.

- (23), *learning to apply course materials*: Assuming the course material is math-, science- and/or engineering-based, students who identify with having made progress on learning to apply course material should have the ability to apply that material.

Program Outcome (d), *an ability to function on multi-disciplinary teams*, maps to one Relevant Objective.

- (25), *acquiring skills in working with others as a team*: Though not specific to *multi-disciplinary* teams, this Objective does ask students whether they have made progress in acquired the skills need to function on teams. Students who report having made progress are developing the ability to function on teams.

Program Outcome (e), *an ability to identify, formulate, and solve engineering problems*, maps to one Relevant Objective.

- (22), *learning fundamental principles, generalizations or theories*: This Objective only relates to the student's abilities to identify and formulate engineering problems, not to solve them. Identification and formulation of an engineering problem are dependent upon the student having learned fundamental principles and theories of engineering. Students who identify with having made progress towards learning these fundamentals are likely to have the ability to identify and formulate engineering problems.

Program Outcome (g), *an ability to communicate effectively*, maps to two Relevant Objectives.

- (26), *developing creative capacities*: Writing is explicitly identified by the IDEA Center as one of the 'creative capacities' applicable to this Objective. Whether technical writing qualifies as a 'creative' capacity is debatable, so the correlation between this Objective and program outcome (g) is weak. Nevertheless, students who identify with having made progress towards developing writing capacities, though not directly stated by the Objective, are gaining the ability to communicate effectively.
- (28), *developing skills in expressing myself orally or in writing*: Students who identify with having made progress towards developing oral presentation and/or writing skills are gaining the ability to communicate effectively.

Program Outcome (i), *a recognition of the need for, and an ability to engage in life-long learning*, maps to three Relevant Objectives.

- (21), *gaining factual knowledge*: Students who identify with having made progress towards gaining factual knowledge have noted their ability to engage in learning, though not necessarily 'life-long' learning.
- (29), *learning how to find and use resources for answering questions or solving problem*: Again, noting they've made progress towards learning how to learn (*find and use resources*), students are implying they have the ability to engage in learning, though again, not 'life-long' learning.
- (32), *acquiring an interest in learning more by asking my own questions and seeking answers*: Acquiring an interest in learning hints that, though does not demonstrate explicitly, the student has recognized the need for learning. Further, noting that learning is done by '*asking questions*' and '*seeking answers*', students are showing that they have made progress on gaining the ability to engage in learning.

The potential to employ an indirect assessment of program outcome (i) is notable, since effective assessment of this outcome has shown to be problematic using our ABET Assignment direct assessment method. Much of this difficulty has to do with assessing a student's understanding the need to engage in a "life-long" process (learning) using coursework that spans no more than ten weeks.

Program Outcome (k), *an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice*, was determined to map to two Relevant Objectives.

- (23), *learning to apply course materials*: Assuming that the course curriculum covers the techniques, skills and modern engineering tools necessary for engineering practice, students who note they've made progress towards learning to apply course material should have the ability to apply them in practice. This correlation between (k) and (23) should be used carefully, as many engineering courses present material that may not be considered 'techniques', 'skills' or 'modern engineering tools' necessary for engineering practice. For instance, the correlation may be appropriate for an engineering programming class that covers modern programming tools, but not for a theory-based course such as thermodynamics, which does not introduce tools used in every-day engineering practice.
- (24), *developing specific skills, competencies and points of view needed by professionals*: Students who identify with having made progress towards developing skills and competencies needed by professionals should have the ability to use those skills and competencies (or 'techniques' and 'modern engineering tools') in professional engineering practice.

The following indirect assessments were conducted based on random selection of faculty evaluations from the two most experienced faculty.

<u>IDEA Center Indirect Assessment: [EE 419, Fall 2011 – Klamath Falls]</u>

Table 18 IDEA Center Indirect Assessment

No.	Relevant Objective	Related Outcome a-n	Import. Rating	Average	Std. Dev.	Outcome Met (>=3.5)
21	Gaining factual knowledge	i	I	4.5	0.6	Y
22	Learning fundamental principles, generalizations, or theories.	e	I	4.6	0.6	Y
23	Learning to apply course material	a, k	I	4.5	0.9	Y
24	Developing specific skills, competencies, and points of view needed by professionals.	k	M	4.3	0.9	Y
25	Acquiring skills in working with others as a team.	d	I	4.3	1.2	Y
26	Developing creative capacities (writing, design etc.).	c, g	M	3.5	1.5	Y
28	Developing skills in expressing myself orally or in writing.	g	M	3.5	1.5	Y
29	Learning how to find and use resources for answering questions or solving problems.	i	M	4.1	1.3	Y
32	Acquiring an interest in learning more by asking my own questions/seeking answers.	i	M	3.9	1.3	Y
	Total Students = 17					

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) An ability to engage in independent learning and recognize the need for continual professional development
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Relevant Objectives deemed "essential" or "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: [REE 451, Fall 2011 – Klamath Falls]

Table 19 IDEA Center Indirect Assessment

No.	Relevant Objective	Related Outcome a-n	Import. Rating	Average	Std. Dev.	Outcome Met (>3.5)
21	Gaining factual knowledge	i	I	4.4	1.3	Y
22	Learning fundamental principles, generalizations, or theories.	e	I	4.2	1.5	Y
23	Learning to apply course material	a, k	I	4.6	0.9	Y
24	Developing specific skills, competencies, and points of view needed by professionals.	k	I	4.6	0.9	Y
25	Acquiring skills in working with others as a team.	d	M	3.6	1.5	Y
26	Developing creative capacities (writing, design etc.).	c, g	M	3.4	1.8	N
28	Developing skills in expressing myself orally or in writing.	g	M	3.8	1.8	Y
29	Learning how to find and use resources for answering questions or solving problems.	i	M	4.4	1.3	Y
32	Acquiring an interest in learning more by asking my own questions/seeking answers.	i	M	4.8	0.4	Y
	Total Students = 5					

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) An ability to engage in independent learning and recognize the need for continual professional development
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Relevant Objectives deemed "essential" or "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.

IDEA Center Indirect Assessment: [EE 321, Fall 2011 – Wilsonville]

Table 20 IDEA Center Indirect Assessment

No.	Relevant Objective	Related Outcome a-n	Import. Rating	Average	Std. Dev.	Outcome Met (>3.5)
21	Gaining factual knowledge	i	E	4.5	0.7	Y
22	Learning fundamental principles, generalizations, or theories.	e	E	4.4	0.7	Y
23	Learning to apply course material	a, k	E	4.4	0.7	Y
24	Developing specific skills, competencies, and points of view needed by professionals.	k	I	4.3	0.7	Y
25	Acquiring skills in working with others as a team.	d	I	3.8	0.9	Y
26	Developing creative capacities (writing, design etc.).	g	I	3.2	1.3	N
28	Developing skills in expressing myself orally or in writing.	g	I	3.3	1.0	N
29	Learning how to find and use resources for answering questions or solving problems.	i	I	4.1	0.9	Y
32	Acquiring an interest in learning more by asking my own questions/seeking answers.	i	I	4.0	1.0	Y
	Total Students = 12					

For almost 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) An ability to engage in independent learning and recognize the need for continual professional development
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Relevant Objectives deemed "essential" or "important" to this course all scored above the 3.5 threshold, indicating substantial progress has been made on program outcomes (a), (d), (e), (i) and (k). Students reported weakness in developing creative capacities (g) such as writing, inventing, or design. This may be due to the faculty member perceiving the two Relevant Objectives related to this as Important to the course while students may have not perceived these as Important, but rather as Minor. Supporting this conclusion are the large standard deviations, indicating that students are unsure whether or not these objectives are classified as Essential, Important, or Minor,

Summary of IDEA Center Indirect Measure Assessment for 2011-12

Strengths

For almost 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.

Weaknesses

Faculty and students often perceive Relevant Objectives as having different importance to a course, especially as they relate to developing creative capacities, e.g., design, writing. Some engineering students deem these as unimportant as they think of creative capacities as related to the arts, not engineering.

Recommendations

Faculty need to reach consensus in the way the IDEA Center Relevant Objectives are rated Essential, Important, or Minor/No Importance for courses. Differences in ratings assigned by individual faculty members can affect the efficacy of the IDEA Center indirect measure assessments. It is recommended that the faculty develop more standardization for this method of assessment.

FE Exam Use as an Assessment Tool Removed for 2011-12

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, making it impossible to perform assessment of BSREE graduates. As such, the assessment coordinators decided to remove this measure from this assessment.

4 Changes Resulting from Assessment

4.1 Changes to 2011-12 Assessment Methods Resulting from the 2010-11 Assessment

The assessments conducted during the 2010-11 academic year revealed the following areas of recommended improvement (shown in italics). The 2011-12 actions taken are shown following each recommendation.

1. *The performance criteria used to assess outcomes must be the same throughout the faculty, 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 so that a consensus is reached.*

   Faculty members agreed to the meaning of each performance criteria and agreed to use the same criteria throughout when assessment was addressed in the Fall 2011 convocation department meeting.

2. *The faculty should consider including indirect assessments from the IDEA Center evaluations in the assessment plan each cycle of assessment, and the rules for including this type of assessment should be reviewed with all faculty.*

   Of the nine EERE faculty members assigned REE assessment activities, five faculty members were new to the department and three others had not performed indirect assessments using the IDEA Center evaluations, and there was no opportunity during the year to discuss the methods used for this type of assessment. Consequently, only three indirect assessments were completed by the two most experienced faculty members.

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

   The FE exam results for April and October 2011 provide no useful direct data since the data from student's selecting "Other" as a major may be corrupted by students from majors outside of REE.

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

   Three direct assessment activities were assigned for each targeted outcome to improve assessment opportunities.

4.2 Recommended Changes to Methods Resulting from the 2011-12 Assessment

The assessments conducted during the 2011-12 academic year revealed the following areas needing improvement:

1. *The FE exam has been dropped as an assessment tool due to inconclusiveness of data regarding REE students since they select "Other" as a major, and enrollee and graduates from other majors may also select "Other."*

2. *Due to completing only one of the three assigned direct assessments for outcome (l), reassess outcome (l) in 2012-13 at the Klamath Falls campus.*

3. *Revisit IDEA Center indirect mapping with faculty and provide training on how to use the mapping consistently as a faculty. Develop other indirect assessment methods for outcomes not mapped, such as use of student exit surveys.*

4. *Require faculty complete assigned assessments by linking them to faculty annual performance evaluations.*

5. *Update mapping between SLOs and the BSREE curriculum to reflect curriculum change.*

4.3 Recommended Changes to Curriculum Resulting from the 2011-12 Assessment

Based on the data contained in the above sections of the report, no changes are recommended to the REE curricula.

Appendix A - Mapping Between SLOs and the BSREE Curriculum

Table 21 - 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	√	√	√	√	√		√				√			