Renewable Energy Engineering
2009-2010 Assessment Report

Department of Electrical Engineering and Renewable Energy

FINAL REPORT

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Contributing Faculty

Dr. Robert Bass
Dr. Claudia Torres-Garibay
Dr. Slobodan Petrovic
Prof. Thomas White
Prof. James Zipay

Contents

1 Introduction

1.1 Program Goals and Design

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 2005-2006 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.

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 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.
- SREE 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) a recognition of the need for, and an ability to engage in life-long learning

(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

3 Cycle of Assessment for Program Outcomes

3.1 Introduction and Methodology

Table 1 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. Assessment in 2007/08 was done for the RES program, prior to the creation of the REE program.

3.2 Assessment Cycle

Table 1 – BSREE Outcome Assessment Cycle

		2007/08	2008/09	2009/10	2010/11	2011/12	2012/13
(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			√	√		

3.3 Summary of Assessment Activities & Evidence of Student Learning

3.3.1 Introduction

The BSREE faculty members conducted formal assessment of all a-through-m Program Outcomes during the 2009/2010 academic year using direct measures such as comprehensive ABET Projects and ABET Assignments.[1] Additionally, the Program Educational Objectives (PEOs) were assessed using indirect measures, namely results from student evaluations based on methodology developed by the IDEA Center[2] originating at Kansas State University.

[1] 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.

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

3.3.2 Background of Assessment of Program Educational Objectives

Because the BSREE program is seeking ABET accreditation for the first time, the faculty has taken lessons from the accreditation visits for the Department's BSEET program as examples. In 2008/09, ABET evaluators found a Weakness in Criterion 2 of the BSEET program, due to the fact that the BSEET Program Educational Objectives were written as expected accomplishments of graduates immediately after graduation, as opposed to desired career and professional accomplishments that the program is preparing students to achieve three to five years after graduation. The BSREE faculty designed the PEOs using broader statements describing career and professional accomplishments that the graduates can expect to achieve.

Future appendices of the annual REE program assessment report will include detailed alumni and employer's surveys designed to assess these PEOs. Despite the fact that our graduates have not been out of school for three to five years, the faculty have decided to run the alumni surveys during 2010 - 2011 so that we may gauge the effectiveness of our continuous improvement process and use relevant, current feedback to improve the BSREE program.

3.3.3 Methodology 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.[3] 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.

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.

[3] "ABET rubrics" refer to rubrics especially designed by OIT BSREE faculty to assess ABET projects based on program-level 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 OIT, course evaluations are conducted using the course evaluation form developed by the IDEA Center[4], an organization originating from Kansas State University. From collected student evaluation forms, an IDEA Center diagnostic report is generated and returned to the instructor.

Methodology for this indirect assessment is detailed in Criteria 3. The sections below describe the 2009-2010 targeted indirect assessment activities based on the IDEA Center diagnostic reports. The Tables indicate which IDEA Center Relevant Objectives were deemed pertinent to the course, graded as 'essential,' "important" or "minor." Based on the average score for each Relevant Objective, an indication is made determining whether the associated program outcomes where satisfied.

3.3.4 2009/10 Targeted Assessment Activities

The sections below describe the 2009-2010 targeted assessment activities and detail the performance of students for each of the assessed outcomes. 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.

4 The IDEA Center, www.theideacenter.org

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: EE 221 – Circuits I: DC and 1st-Order Transient Analysis, Fall 2009

This outcome was assessed using an ABET Project in EE 221, Circuits I – DC and 1st-Order Transient Circuits, the mid-term laboratory presentations. The projects are laboratory assignments, and they are used to assess the students' abilities to apply knowledge of math, science and engineering principles to predict and analyze experiments, apply their knowledge of electronics test equipment, and apply fundamental circuits concepts to solve technical problems.

Twenty students were assessed in Fall 2009. The table 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 2 – Targeted Assessment for Outcome a1[5]

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% > 2
(a) an ability to apply knowledge of mathematics, science, and engineering				
A1: Apply knowledge of mathematics	0%	60%	40%	100%
A2: Apply knowledge of science, engineering	0%	53%	47%	100%

[5] Percentage numbers in the Targeted Assessment tables indicate the percentage of performance criteria pertinent to the column heading. The percentage numbers *do not* indicate a percent of students.

Assessment a2: EE 221 – Circuits I: DC and 1st-Order Transient Analysis, Fall 2009

This outcome was assessed using an ABET Project in EE 221, Circuits I – DC and 1st-Order Transient Circuits, the end-of-term laboratory presentations. The projects are laboratory assignments, and they are used to assess the students' abilities to apply knowledge of math, science and engineering principles to predict and analyze experiments, apply their knowledge of electronics test equipment, and apply fundamental circuits concepts to solve technical problems.

Twenty students were assessed in Fall 2009 using the performance criteria listed below. The table 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 3 – Targeted Assessment for Outcome a2

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% > 2
(a) an ability to apply knowledge of mathematics, science, and engineering				
A1: Apply knowledge of mathematics	0%	37%	63%	100%
A2: Apply knowledge of science, engineering	0%	37%	63%	100%

Assessment a3: EE 223 – Circuits II: AC and 2nd-Order Transient Analysis, Winter 2010

This outcome was assessed using an ABET Project in EE 223, Circuits II – AC and 2nd-Order Transient Circuits, the mid-term laboratory presentations. The project is a laboratory assignment, and it is used to assess the students' abilities apply knowledge of math, science and engineering principles to predict and analyze experiments, apply their knowledge of electronics test equipment, and apply fundamental circuits concepts to solve technical problems.

Nineteen students were assessed in Winter using the performance criteria listed below. The table 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. Notably, the ratio of exemplary to accomplished student scores increased over a similar assignment presented in EE 221 in the previous Fall term.

Table 4 – Targeted Assessment for Outcome a3

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% > 2
(a) an ability to apply knowledge of mathematics, science, and engineering				
A1: Apply knowledge of mathematics	0%	16%	84%	100%
A2: Apply knowledge of science, engineering	0%	16%	84%	100%

Assessment a4: EE 223 – Circuits II: AC and 2nd-Order Transient Analysis, Winter 2010

This outcome was assessed using an ABET Project in EE 223, Circuits II – AC and 2nd-Order Transient Circuits, the End-of-term Proficiency Exam. The exam required students design and build a residential power circuit according to NEC codes; measure voltage, current and real power; and, calculate apparent power, reactive power, power factor and load impedance. The exam provides an excellent opportunity to assess the students' abilities to apply knowledge of math, science and engineering, principally in relation to their calculations, but also when they are asked to explain the magnitude and phase relationships of the 120/208 3φ supply and when they're asked to infer the sign of the load power factor angle

Eighteen students were assessed in Winter using the performance criteria listed below. The table 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 when calculating power-related values, and when verbally explaining the engineering fundamentals fundamental to the power circuit.

Table 5 – Targeted Assessment for Outcome a4

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% > 2
(a) an ability to apply knowledge of mathematics, science, and engineering				
A1: Apply knowledge of mathematics	1%	10%	89%	99%
A2: Apply knowledge of science, engineering	0%	12%	88%	100%

Targeted Assessment of Outcome b

An ability to design and conduct experiments, as well as to analyze and interpret data

Performance Criteria:

B1	Design an experiment
B2	Conduct an experiment
B3	Analyze, interpret data

<u>Assessment b1: EE 221 – Circuits I: DC and 1st-Order Transient Analysis, Fall 2009</u>

This outcome was assessed using an ABET Project in <u>EE 221, Circuits I – DC and 1st-Order Transient Circuits</u>, the Mid-term laboratory presentations. The projects are laboratory assignments, and they are used to assess the students' abilities to conduct experiments and analyze results; understand the objectives of a set of laboratory experiments; follow and adapt laboratory procedures; collect data; and apply math, science and engineering principles to analyze results.

Twenty students were assessed in Fall 2009 using the performance criteria listed below. The table 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 demonstrated their ability to analyze and interpret data and to conduct various circuit experiments.

Table 6 – Targeted Assessment for Outcome b1

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% > 2
(b) an ability to design and conduct experiments, as well as to analyze and interpret data				
B2: Conduct an experiment	0%	40%	60%	100%
B3: Analyze, interpret data	0%	60%	40%	100%

Assessment b2: EE 221 – Circuits I: DC and 1st-Order Transient Analysis, Fall 2009

This outcome was assessed using a proficiency exam in EE 221, Circuits I – DC and 1st-Order Transient Circuits. The exam tested the students' abilities to conduct experiments, and analyze and interpret data; plot spice simulation results, use a spread sheet as an analysis tool, and compare simulated data with measured data; explain the circuit operation in terms of collected data and fundamental circuit theory.

Nineteen students were assessed in Fall 2009 using the performance criteria listed below. The table 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 demonstrated their ability to analyze and interpret data and to conduct various circuit experiments. Evidence of abilities to conduct an experiment and collect and interpret data were demonstrated.

Table 7 – Targeted Assessment for Outcome b2

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% > 2
(b) an ability to design and conduct experiments, as well as to analyze and interpret data				
B2: Conduct an experiment	7%	2%	89%	93%
B3: Analyze, interpret data	3%	18%	79%	97%

Assessment b3: EE 221 – Circuits I: DC and 1st-Oreder Transient Analysis, Fall 2009

This outcome was assessed using an ABET Project in EE 221, Circuits I – DC and 1st-Order Transient Circuits, the End-of-term laboratory presentations. The project is a laboratory assignments, and it is used to assess the students' abilities to conduct experiments and analyze results; understand the objectives of a set of laboratory experiments; follow and adapt laboratory procedures; collect data; and apply math, science and engineering principles to analyze results.

Twenty students were assessed in Fall 2009 using the performance criteria listed below. The table 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 demonstrated their ability to analyze and interpret data and to conduct various circuit experiments. Evidence of design abilities were demonstrated adequately in Lab 4 (Op Amps).

Table 8 – Targeted Assessment for Outcome b3

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% > 2
(b) an ability to design and conduct experiments, as well as to analyze and interpret data				
B2: Conduct an experiment	0%	29%	71%	100%
B3: Analyze, interpret data	0%	26%	74%	100%

Assessment b4: EE 223 - Circuits II: AC and 2nd-Oreder Transient Analysis, Winter 2010

This assessment was applied to outcomes for three aspects of a lab assignment in the EE 223 circuits course during the term. This lab assignment was done in a class of 14 sophomore EE and REE students analyzing a basic series parallel AC circuiting. Results are calculated and compared to measured results from standard test instruments.

Table 9 – Targeted Assessment for Outcome b4

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% > 2
(b) an ability to design and conduct experiments, as well as to analyze and interpret data				
B2: Conduct an experiment	0%	29%	71%	100%
B3: Analyze, interpret data	0%	36%	64%	100%

A similar assessment was done using an AC Power lab with a collection of 12 from a different class of students. The results were comparable and shown below. All students performed at an acceptable or exemplary level.

Table 10 – Targeted Assessment for Outcome b4

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% > 2
(b) an ability to design and conduct experiments, as well as to analyze and interpret data				
B2: Conduct an experiment	0%	17%	83%	100%
B3: Analyze, interpret data	0%	42%	58%	100%

Final collection for this class was done near the end of the term using a cohort of 11 students from the same lab section. The lab assignment this time was a simulation lab of three phase power. As expected the results were similar to those in the previous table.

Table 11 – Targeted Assessment for Outcome b4

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% > 2
(b) an ability to design and conduct experiments, as well as to analyze and interpret data				
B2: Conduct an experiment	0%	18%	82%	100%
B3: Analyze, interpret data	0%	55%	45%	100%

Assessment b5: EE 223 - Circuits II: AC and 2nd-Oreder Transient Analysis, Winter 2010

This outcome was assessed using an ABET Project in EE 223, Circuits II – AC and 2nd-Order Transient Circuits, the Mid-term laboratory presentations. The project was a laboratory assignment, and it is used to assess the students' abilities apply knowledge of math, science and engineering principles to predict and analyze experiments, apply their knowledge of electronics test equipment, and apply fundamental circuits concepts to solve technical problems.

Nineteen students were assessed in Winter using the performance criteria listed below. The table 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 demonstrated their ability to analyze and interpret data and to conduct various circuit experiments. Notably, the ratio of exemplary to accomplished student scores increased over a similar assignment presented in EE 221 in Fall, 2009.

Table 12 – Targeted Assessment for Outcome b5

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% > 2
(b) an ability to design and conduct experiments, as well as to analyze and interpret data				
B2: Conduct an experiment	0%	8%	92%	100%
B3: Analyze, interpret data	0%	24%	84%	100%

Assessment b6: EE 223 - Circuits II: AC and 2nd-Order Transient Analysis, Winter 2010

This outcome was assessed using an ABET Project in EE 223, Circuits II – AC and 2nd-Order Transient Circuits, the end-of-term Proficiency Exam. The exam required students design and build a residential power circuit according to NEC codes; measure voltage, current and real power; and, calculate apparent power, reactive power, power factor and load impedance. The exam provided an excellent opportunity to assess the students' abilities to conduct an experiment, collect data, analyze the results and interpret, orally, their findings to the lab instructor.

Eighteen students were assessed in Winter using the performance criteria listed below. The table 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 demonstrated their ability to conduct an experiment involving electric power components; collect power-related data (voltage, current and real power); analyze that data to determine additional parameters (apparent and reactive power, power factor, impedance); and, interpret that data during a one-on-one discussion with the lab instructor.

Table 13 – Targeted Assessment for Outcome b6

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% > 2
(b) an ability to design and conduct experiments, as well as to analyze and interpret data				
B2: Conduct an experiment	0%	33%	67%	100%
B3: Analyze, interpret data	0%	28%	72%	100%

Assessment b7: EE 419 – Power Electronics, Fall 2009, K-Falls

This outcome was assessed using a final lab project (linear power supply design) in the Senior EE 419 Power Electronics course that had a mix of 10 students from both the EE and REE degree programs. This is a senior class so the expected level of performance on such an assignment is high. The students also needed to design a experiment to calculate parameters for the various subsystems of the linear power supply. The results showed 80% of the students doing the experiment design at an acceptable target level.

Table 14 Targeted Assessment for Outcome b7

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% > 2
(b) an ability to design and conduct experiments, as well as to analyze and interpret data				
B1: Design an experiment	20%	30%	50%	80%
B2: Conduct an experiment	0%	20%	80%	100%
B3: Analyze, interpret data	0%	30%	70%	100%

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: EE 321 – Electronics I, Fall 2009

This outcome was assessed using an ABET Project in EE 321, Electronics I – Amplifiers and Semiconductor Devices. The project required students to identify an engineering problem (the need for a buffer circuit) and design a solution. The context of the problem was within a realistic system – the BSREE program's in-house solar thermal system, particularly the Off-peak Air Conditioning system (O-PAC). The students were given the following problem statement and asked to design a solution: *The off-peak air conditioning system (O-PAC) in the solar thermal systems lab (room 178) consists of two refrigeration compressors that are controlled by a LabView program. The program controls the power supplied to the compressors by applying a duty cycle to two optical relays via a data acquisition device (DAQ), an NI USB-6009. However, the DAQ cannot maintain its terminal voltage when sending an 'on' signal to the relays. The output signals from the DAQ have been found to decrease from an open-circuit voltage of 10V to less than 3V when connected to the relays. Investigate the source of this problem and build a well-tested prototype solution.*

Fifteen students were assessed in Fall 2009 in the course using the performance criteria listed below. The table 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 clearly demonstrated their abilities to design a system that met realistic constraints.

Table 15 – Targeted Assessment for Outcome c1

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, social, political, ethical, health and safety, manufacturability, and sustainability				
C2: Develop a design strategy within realistic constraints	0%	0%	100%	100%
C3: Evaluate relative value of a feasible solution	0%	19%	81%	100%

Assessment c2: EE 321 – Electronics I, Fall 2009

This outcome was assessed using an ABET Project in EE 321, Electronics I – Amplifiers and Semiconductor Devices. The project required students design, build and test a prototype differential temperature controller for a 120VAC 1/25HP solar thermal circulator pump. The project placed realistic constraints on the design, including proto-board dimensions, height and stand-off placement; controller modes of operation; differential set points; interface hardware (NTC thermistors); pilot devices and power supply specifications.

Fifteen students were assessed in Fall 2009 in the course using the performance criteria listed below. The table 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 clearly demonstrated their abilities to design a system that met realistic constraints. For this project, students designed and built differential temperature pump controllers for the BSREE program's in-house solar thermal collection system.

Table 16 – Targeted Assessment for Outcome c2

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, social, political, ethical, health and safety, manufacturability, and sustainability				
C2: Develop a design strategy within realistic constraints	0%	40%	60%	100%
C3: Evaluate relative value of a feasible solution	0%	0%	100%	100%

Assessment c3: REE 412 – Photovoltaic Systems, Winter 2010

This outcome was assessed using an ABET Project in REE 412, Photovoltaic Systems, the end-of-term project. The project required students develop a proposal for a PV-related business. The deliverables included an oral presentation in front of a public audience and a written report. Pertinent to Outcome C, students performed a market analysis of PV-related business in the Portland metropolitan area; developed engineering and financial tools for their businesses; develop a financial plan, including start-up funds, a 12-month operating budget and projected sales; consider human resource and support technology costs; investigate up-to-date financial incentives and present the proposal to a group acting as potential investors.

Twenty students were assessed in Winter using the performance criteria listed below. The table 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 clearly demonstrated their abilities to build viable business proposals based on realistic constraints.

Table 17 – Targeted Assessment for Outcome c3

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% > 2
(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				
C1: Recognize need for an engineering solution	4%	26%	70%	96%
C2: Develop a design strategy within realistic constraints	9%	23%	69%	91%

Assessment c4: REE 439 - Energy Management and Auditing, Winter 2010

This outcome was assessed using a term project in which the students, working as teams, completed a comprehensive energy assessment (audit) of the energy use in a designated building. The class of 20 students was divided into four teams of five students each, and the teams each chose a team leader during the third week of class. From this point on the teams acted on their own to (1) contact the building managers, (2) interview the occupants and maintenance staff, (3) perform a "Level 1" walk through assessment to identify opportunities for energy savings, (4) analyze the savings and design/operation alternatives, and (5) document and present their findings and recommendations. Individual performance was not assessed for this project, which was a team effort, but the outcomes reflect the collective contributions of everyone on the team.

Twenty students were assessed for this course during the Winter 2010 term using detailed evaluation rubrics for both the term's written report and the PowerPoint summaries presented to building clients. These 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.

The table below summarizes the results of the targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met on both performance criteria for this program outcome. As a team, students clearly demonstrated their collective abilities to design a system for clients that met realistic constraints. Because the assessment was performed on a team-level, there isn't enough resolution to identify individual strengths and weaknesses. However, when this class is repeated a year hence, we will endeavor to identify individual contributions to the team results.

Table 18 – Targeted Assessment for Outcome c4

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, social, political, ethical, health and safety, manufacturability, and sustainability				
C2: Develop a design strategy within realistic constraints	20%	30%	50%	80%
C3: Evaluate relative value of a feasible solution	20%	30%	50%	80%

Assessment c5: REE 307 - Batteries, Winter 2010

This outcome was assessed using an ABET Project in REE307 Batteries, laboratory assignment. The objective of this lab was to select application typical for the developing world and design battery pack to fit a complete renewable energy system including solar photovoltaics. After design was complete, battery pack assembly was completed and testing was conducted.

The project was a laboratory assignment, and it was used to assess the students' abilities to apply knowledge of math, science and engineering principles to predict and analyze experiments, apply their knowledge of electronics test equipment, and apply fundamental circuits concepts to solve technical problems connected with batteries.

The class was divided into 4 teams and overall 14 students were assessed in Winter 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 table below summarizes the results of this targeted assessment. The results indicate that the performance level of 90% was met on all performance criteria for this program outcome. All groups met or exceeded expectations; they demonstrated their abilities to design a system according to desired needs within realistic constraints.

Table 19 – Targeted Assessment for Outcome c5

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, social, political, ethical, health and safety, manufacturability, and sustainability				
C2: Develop a design strategy within realistic constraints	0%	0%	100%	100%
C3: Evaluate relative value of a feasible solution	0%	0%	100%	100%

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
D3: Reaching a Group Consensus

Assessment d1: EE 221 – DC and 1st-Ored Transient Analysis, Fall 2009

This outcome was assessed using an ABET Project in EE 221, Circuits I – DC and 1st-Order Transient Circuits, the End-of-term project presentation. The projects are laboratory assignments that require students work in teams. Team participation, communication, management and delegation of responsibilities are observed and noted by the instructor.

Nineteen students were assessed in Fall 2009 using the performance criteria listed below. The table 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 teams functioned effectively as teams, delegating responsibilities in order to utilize team strengths. Team dissonance was not observed with this group of students.

Table 20 – Targeted Assessment for Outcome d1

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%

Assessment d2: REE 439 - Energy Management and Auditing, Winter 2010

This outcome was assessed using a term project in which the students, working as teams, completed a comprehensive energy assessment (audit) of the energy use in a designated building. The class of 20 students was divided into four teams of five students each, and the teams each chose a team leader during the third week of class. From this point on the teams acted on their own to (1) contact the building managers, (2) interview the occupants and maintenance staff, (3) perform a "Level 1" walk through assessment to identify opportunities for energy savings, (4) analyze the savings and design/operation alternatives, and (5) document and present their findings and recommendations. This outcome reflects the collective contributions of everyone on the team, and individual performance was not evaluated for this particular outcome.

Twenty students were assessed for this course during the Winter 2010 term using detailed evaluation rubrics for both the term's written report and the PowerPoint summaries presented to building clients. These 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.

The table below summarizes the results of the targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met on both performance criteria for this program outcome. As a team, students clearly demonstrated their collective abilities to work together as a team, to divide up and apportion the work, and to synthesize their efforts into integrated solution for their clients. Because the assessment was performed on a team-level, there isn't enough resolution to identify individual strengths and weaknesses. However, when this class is repeated a year hence, we will endeavor to identify individual contributions to the team results.

Table 21 – Targeted Assessment for Outcome d2

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students > 2
(d) an ability to function on multi-disciplinary teams				
D1: Team participation, communication	20%	30%	50%	80%
D2: Management of team, delegation of responsibilities	20%	30%	50%	80%

Assessment d3: REE 339 – Senior Project I, Fall 2009

This outcome was assessed during a senior project proposal class with a team of two students on a micro-hydroelectric off grid project proposal. This is a small group of students that has worked together in the past and have always done well. The results reflected that level of performance as a team.

Table 22 – Targeted Assessment for Outcome d3

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students > 2
(d) an ability to function on multi-disciplinary teams				
D1: Team participation, communication	0%	0%	0%	100%
D2: Management of team, delegation of responsibilities	0%	0%	0%	100%
D3: Reaching a Group Consensus	0%	0%	0%	100%

Assessment d4: REE 243 – Electrical Power, Spring 2010, Portland

This outcome was assessed using an ABET Project in REE 243, Electric Power, the Term Project. This project requires the entire class work together on the design, planning, implementation and testing of a three-phase power distribution system. This project was designed to assess the students' teamwork and leadership, engagement in external learning, design capabilities, application of energy engineering fundamentals and their ability to identify and solve engineering problems. This particular assessment concentrates on teamwork and leadership.

The assessment for this project was conducted using a student self-assessment worksheet, within which students ranked their efforts related to the project. Students were also asked to recognize positive contributions of their peers. Self-assessed entries were examined by the instructor and compared to the peer evaluations; in a small number of cases, modest or immodest self-assessments were edited accordingly.

Eighteen students were assessed in Spring using the performance criteria listed below. The table summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met with regard to D1. For D2, the target threshold was not met; but, the nature of the questions used to derive this metric may not be suitable to the 80% threshold. Students were asked to rate their level of leadership (project level, group level or none). Five of the 18 students noted they 'performed duties as assigned' rather than engaging in leadership. Since it is unreasonable to assume all students would lead, the 80% threshold may be inappropriate for this metric. On the other hand, there are ample opportunities within this project for students to lead others, even on small engineering design tasks. In conclusion, students met or exceeded expectations; they demonstrated their abilities to participate within teams, engage in leadership positions and assume responsibilities as assigned.

Table 23 – Targeted Assessment for Outcome d4

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% > 2
(d) an ability to function on multi-disciplinary teams				
D1: Team participation, communication	19%	36%	44%	81%
D2: Management of team, delegation of responsibilities	28%	56%	17%	72%

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: EE 321 – Electronics I, Fall 2009

This outcome was assessed using an ABET Project in EE 321, Electronics I – Amplifiers and Semiconductor Devices. The project required students identify an engineering problem (the need for a buffer circuit) and design a solution. Specifically, students were charged with identifying a system problem and proposing a solution. A prescribed solution was not presented, and the problem was stated in general terms: *The off-peak air conditioning system (O-PAC) in the solar thermal systems lab (room 178) consists of two refrigeration compressors that are controlled by a LabView program. The program controls the power supplied to the compressors by applying a duty cycle to two optical relays via a data acquisition device (DAQ), an NI USB-6009. However, the DAQ cannot maintain its terminal voltage when sending an 'on' signal to the relays. The output signals from the DAQ have been found to decrease from an open-circuit voltage of 10V to less than 3V when connected to the relays. Investigate the source of this problem and build a well-tested prototype solution.*

Fifteen students were assessed in Fall 2009 in the course using the performance criteria listed below. The table 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 clearly demonstrated their abilities to identify, formulate and solve a complex engineering problem.

Table 24 – Targeted Assessment for Outcome e1

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%	19%	81%	100%
E2: Articulate the problem in engineering terms	19%	81%	0%	81%
E3: Develop solutions appropriate for the problem	0%	59%	41%	100%

Assessment e2: EE 321 – Electronics I, Fall 2009

This outcome was assessed using an ABET Project in EE 321, Electronics I – Amplifiers and Semiconductor Devices. The project required students design, build and test a prototype differential temperature controller for a 120VAC 1/25HP solar thermal circulator pump. The students were charged with identifying the engineering problem, formulating a solution and developing a prototype to test their proposed solution.

Fifteen students were assessed in Fall 2009 in the course using the performance criteria listed below. The table 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 built very impressive pump controllers that met design specifications and incorporated other features that improved the product's appeal.

Table 25 – Targeted Assessment for Outcome e2

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%	20%	80%	100%
E3: Develop solutions appropriate for the problem	0%	20%	80%	100%

Assessment e3: ENGR 355 - Thermodynamics, Fall 2009

This outcome was assessed using an ABET Project in ENGR 355, Thermodynamics. The project required students write an ASHRAE-formatted paper describing the operation of an espresso maker using principles developed in ENGR 355. For this assessment, students were asked to formulate an engineering description using thermodynamics models and property diagrams; articulate the system using terms of thermodynamics; and develop insights based on their model.

Nineteen students were assessed in Fall 2009 in the course using the performance criteria listed below. The table 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, though roughly half did not apply ideal gas analysis within their modeling (a minor component of the system). The papers clearly demonstrated the students' abilities to identify and formulate an engineering system.

Table 26 – Targeted Assessment for Outcome e3

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%	100%	0%	100%
E2: Articulate the problem in engineering terms	12%	47%	41%	88%
E3: Develop solutions appropriate for the problem	5%	72%	23%	95%

Assessment e4: REE 412 – Photovoltaic Systems, Winter 2010

This objective was assessed using a project in the REE 412 PV Systems class comprising individual PV system design, team project design and fabrication, and a series of test on design questions. Nine students were evaluated working individually and in 3 teams. The goal of the team project was to design PV powered lights for emergency applications; and to use the knowledge from the class to evaluate, size and design, and demonstrate a PV system for emergency lights. The objective of the individual assignment was to design a PV system for application in developing countries.

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 table below summarizes the results of this targeted assessment. The results indicate that the performance level of 80% was met on two out of three performance criteria for this program outcome. 78% of students were able to identify and define an engineering problem. All groups met or exceeded expectations regarding articulation of the problem in engineering teams and developing solutions appropriate for the problem.

Table 27 – Targeted Assessment for Outcome e4

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	22%	34%	44%	78%
E2: Articulate the problem in engineering terms	0%	44%	56%	100%
E3: Develop solutions appropriate for the problem	0%	22%	78%	100%

Targeted Assessment of Outcome f

An understanding of professional and ethical responsibility

Performance Criteria:

F1	Demonstrate knowledge of professional codes of conduct
F2	Evaluate ethical dimensions of engineering practice
F3	Demonstrate or recognize ethical practices

Assessment f1: REE 201 – Introduction to Renewable Energy, Winter 2010, K-Falls

This outcome was assigned to a group of incoming true freshman for the REE program as a white paper on an ethical case study. The case study was an industrial setting type situation that presented the students with multiple ethical situations that they needed to identify and evaluate. The assignment was given after an in class discussion on ethics and the IEEE code of ethics. The students did quite well considering the lack of overall experience in the program.

Table 28 – Targeted Assessment for Outcome f1

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students > 2
(f) An understanding of professional and ethical responsibility				
F1: Demonstrate a knowledge of a code of ethics	0%	33%	67%	100%
F2: Evaluate the ethical dimensions of a problem	0%	48%	52%	100%

Assessment f2: REE 455 – Energy Efficient Building Design, Spring 2010, Portland

To assess this outcome students were asked to consider three different codes of ethics, compare the difference codes, then choose one of the codes as a basis for the rest of the homework assignment. The three codes consisted of one offered by the National Society of Professional Engineers, one used by the Association of Energy Engineers, and another one developed by Louis Levinson, an REE student in Klamath Falls. Once the code was chosen, the assignment was to use the code to evaluate the ethical considerations in a real-world situation where an energy analyst is asked by his or her boss and clients to "adjust" data and results of a building energy model to fit a preferred outcome for a LEED certification project.

By and large, the students all understood and articulated the ethical implications, and they were able to identify the stakeholders, the options, and the benefits as well as the downside to whatever ethical choice they decided to make. Out of 20 students, 5 or 25% did not complete the assignment or completed it too late for grading. However, students seemed confused about the meaning of "conflicts of interest" and definitions of other ethical principles, even though they had the codes of ethics as a reference. Instead of having the students do this exercise on their own, one recommendation for future exercises on ethics would be to use relevant case studies, and to follow up with group discussions. With this approach, students would be better able to refine their understanding of the situation, and get clarification of the key definitions for the ethical principles at stake.

Table 29 – Targeted Assessment for Outcome f2

Performance Criteria	1 - Developing (not doing assignment)	2 - Accomplished	3 - Exemplary	% Students > 2
(f) An understanding of professional and ethical responsibility				
F1: Demonstrate a knowledge of a code of ethics	25%	0%	75%	75%
F2: Evaluate the ethical dimensions of a problem	25%	0%	75%	75%

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

Assessment g1: EE 221 – Circuits I: DC and 1st-Order Transient Analysis, Fall 2009

This outcome was assessed using an ABET Project in EE 221, Circuits I – DC and 1st-Order Transient Circuits, the End-of-term project presentation. The project required students give an oral presentation covering a laboratory assignment conducted in the latter half of the term. The students were assessed on their oral presentation skills, the thoroughness of topic coverage, the quality of their presentation, and the format of their presentation.

Nineteen students were assessed in Fall 2009 using the performance criteria listed below. The table 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.

Table 30 – Targeted Assessment for Outcome g1

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students > 2
(g) an ability to communicate effectively				
G1: Oral communication	0%	58%	42%	100%

Assessment g2: REE 201 – Introduction to Renewable Energy Systems, Fall 2009

This outcome was assessed using an ABET Project in REE 201, Introduction to Renewable Energy. The project required students select an energy related book to review. This aspect of the assessment analyzed their written communication skills (report organization, depth of coverage, spelling, grammar, punctuation, clarity, sentence and paragraph structure) and their use of sources in support of factual statements.

Fifteen students were assessed in Fall 2009 in the course using the performance criteria listed below. The table summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was not met on one of the performance criteria for this program outcome. Overall, students are demonstrating their ability to communicate effectively through writing. Chronically though, students neglect to site sources, and several are writing conclusions that can hardly be called such. In future assignments, emphasis will need to be placed on source citing.

Table 31 – Targeted Assessment for Outcome g2

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students > 2
(g) an ability to communicate effectively				
G2: Written communication	10%	41%	49%	90%
G3: Acquisition and application of information sources	47%	13%	40%	53%

Assessment g3: REE 439 - Energy Management and Auditing, Winter 2010

This outcome was assessed using a term project in which the students, working as teams, completed a comprehensive energy assessment (audit) of the energy use in a designated building. The class of 20 students was divided into four teams of five students each, and the teams each chose a team leader during the third week of class. From this point on the teams acted on their own to (1) contact the building managers, (2) interview the occupants and maintenance staff, (3) perform a "Level 1" walk through assessment to identify opportunities for energy savings, (4) analyze the savings and design/operation alternatives, and (5) document and present their findings and recommendations. This outcome reflects the collective contributions of everyone on the team, and individual performance was not evaluated for this particular outcome.

Twenty students were assessed for this course during the Winter 2010 term using detailed evaluation rubrics for both the term's written report and the PowerPoint summaries presented to building clients. These 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. The assessment for this outcome is based on three research and documentation assignments developed by each student. The documentation assignments was designed in such a way that each student's results would become contributions to their team's final project (see outcomes c4 and d2, above).

The table below summarizes the results of the targeted assessment. The results indicate that the minimum acceptable performance level of 80% was *not met* on both performance criteria for this program outcome. This shortfall can be attributed to the fact that 5 out of the 20 students in the class (25%) did not do the homework assignments. In this case, there is an incomplete basis for evaluating the performance of these deficient students. When this class is repeated a year hence, we will look at better ways to encourage students to complete the homework so a valid assessment can be made.

Table 32 – Targeted Assessment for Outcome g3

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students > 2
(g) an ability to communicate effectively				
G2: Written communication	25%	40%	35%	75%
G3: Acquisition and application of information sources	25%	40%	35%	75%

Assessment g4: REE 412 – Photovoltaic Systems, Winter 2010

This objective was assessed using an individual project in the REE 412 PV Systems class The objective of this individual assignment was to design a PV system for application in developing countries and to summarize design in a report. The report was expected to include the following: justification, social, economical, and political factors surrounding particular application in a particular region, statement to support the case for particular application based on larger humanitarian principle or global importance, detailed financial analysis; detailed written proposal suitable for submission to a funding agency, presentation based on the proposal.

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 table below summarizes the results of this targeted assessment. The results indicate that the performance level of 89% was met on two performance criteria for this program outcome: written communication and acquisition and application of information sources.

Table 33 – Targeted Assessment for Outcome g4

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students > 2
(g) an ability to communicate effectively				
G2: Written communication	11%	22%	67%	89%
G3: Acquisition and application of information sources	0%	11%	89%	100%

Targeted Assessment of Outcome h

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

Performance Criteria:

H1	Identify impacts of engineering solutions
H2	Understand impacts in various contexts

Assessment h1: REE 201 – Introduction to Renewable Energy, Fall 2009

This outcome was assessed using an ABET Project in REE 201, Introduction to Renewable Energy. The project required students select a book to review, based on the criteria that the book discuss engineering solutions in broad terms, such as global, economic, environmental, or societal contexts.

Fifteen students were assessed in Fall 2009 in the course using the performance criteria listed below. The table summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was not met on both performance criteria for this program outcome. Most of the book report introductions and conclusions indicated the selected books were relevant to global, economic, environmental and/or societal issues, but these metrics are below the objective of 80%. Many of the report conclusions did not demonstrate the student's understanding of the impact of engineering solutions. It seems students are selecting books that discuss engineering solutions, but fail to reflect that in their reports. Fortunately, REE 201 is an introductory course, and the faculty will have ample opportunity to address this outcome further in future courses.

Table 34 – Targeted Assessment for Outcome h1

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students > 2
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context				
H1: Identify impacts of engineering solutions	40%	47%	13%	60%
H2: Understand impacts in various contexts	27%	40%	33%	73%

Assessment h2: EE 419 – Power Electronics, Fall 2009

This outcome was assessed in a senior-level Power Electronics Final Exam with a targeted question that had students assess the impacts of possible solutions on a specific engineering problem. No previous discussion on how to do an impact analysis was given, so the students needed to rely on their basic knowledge of the topic and critical thinking skills. The results combined with above assessment indicate that students are well prepared in this area by senior year.

Table 35 – Targeted Assessment for Outcome h2

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students > 2
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context				
H1: Identify impacts of engineering solutions	0%	0%	100%	100%
H2: Understand impacts in various contexts	0%	11%	89%	100%

Assessment h3: REE 339 - Senior Project I, Winter 2010

This outcome was assessed in a senior project proposal class on the final project proposal being submitted. Part of the assignment allows the students to justify an engineering solution (micro-hydroelectric off grid) in light of various impacts (environmental and economic). This is a very good group of students (2) who have worked well in the past and this is reflected in the overall outcome performance. The data gathered for this assessment is not strong due to the low number of students in the class.

Table 36 – Targeted Assessment for Outcome h3

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students > 2
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context				
H1: Identify impacts of engineering solutions	0%	0%	100%	100%
H2: Understand impacts in various contexts	0%	0%	100%	100%

Assessment h4: REE 307 - Batteries, Winter 2010, PDX

This outcome was assessed using an ABET Project in REE 307 Batteries, laboratory assignment. The objective of this lab was to select a typical application for the developing world and design a battery pack to fit a complete renewable energy system including solar photovoltaics. After design was complete, battery pack assembly was completed and testing was conducted.

The project was a laboratory assignment, and it was used to assess the students' abilities to apply knowledge of math, science and engineering principles to predict and analyze experiments, apply their knowledge of electronics test equipment, and apply fundamental circuits concepts to solve technical problems connected with batteries.

The class was divided into 4 teams and overall 14 students were assessed in Winter 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 table below summarizes the results of this targeted assessment. The results indicate that the performance level of 90% was met on all performance criteria for this program outcome. All groups met or exceeded expectations.

Table 37 – Targeted Assessment for Outcome h4

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students > 2
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context				
H1: Identify impacts of engineering solutions	0%	0%	100%	100%
H2: Understand impacts in various contexts	0%	0%	100%	100%

Targeted Assessment of Outcome i

A recognition of the need for, and an ability to engage in life-long learning

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: EE 321 – Electronics I, Fall 2009

This outcome was assessed using an ABET Project in EE 321, Electronics I – Amplifiers and Semiconductor Devices. The project required students design, build and test a prototype differential temperature controller for a 120VAC 1/25HP solar thermal circulator pump. Intentionally, aspects of the controller were not covered in lecture or other laboratory exercises, forcing students to learn a body of knowledge on their own.

Fifteen students were assessed in Fall 2009 in the course using the performance criteria listed below. The table 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 are meeting or exceeding expectations; students recognized a need to find information beyond the topics presented in lecture. Students developed projects that incorporated sub-circuits were not discussed in lecture or presented in lab. Their ability to consult external sources and apply their electronics knowledge has been clearly demonstrated.

Table 38 – Targeted Assessment for Outcome i1

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students > 2
(i) a recognition of the need for, and an ability to engage in life-long learning				
I1: Demonstrate an awareness that knowledge must be gained	0%	40%	60%	100%
I2: Identify, gather and analyze information	0%	30%	70%	100%

Assessment i2: REE 243 – Electrical Power, Spring 2010

This outcome was assessed using an ABET Project in REE 243, Electric Power, the Term Project. This project requires the entire class work together on the design, planning, implementation and testing of a three-phase power distribution system. This project was designed to assess the students' teamwork and leadership, engagement in external learning, design capabilities, application of energy engineering fundamentals and their ability to identify and solve engineering problems. This particular assessment concentrates on engagement in external learning.

NOTE: This assessment substitutes the phrase "external learning" for "life-long learning," simply because the later is extremely difficult to assess over the course of a ten week project. A wording change to the BSREE program's Outcome i will be proposed during next Fall's convocation.

The assessment for this project was conducted using a student self-assessment worksheet, within which students ranked their efforts related to the project. Students were also asked to recognize positive contributions of their peers. Self-assessed entries were examined by the instructor and compared to the peer evaluations; in a small number of cases, modest or immodest self-assessments were edited accordingly.

Eighteen students were assessed in Spring using the performance criteria listed below. The table summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met for both performance criteria. Regarding I2, the question used to evaluate I2 derived from the question used to derive I1. For I1, students were asked to rate the amount of external learning they engaged in, with respect to the project. For I2, they were asked to evaluate the value of that learning. The 17% of students who noted they did not engage in external learning did not answer the follow up question.

From the student self-assessment survey, it is clear that most of the students, 15 of 18, acknowledged in engaging in learning beyond the material presented in lecture, and all but one of these 15 students acknowledged that that external learning enhanced or significantly enhanced their work on the project. Therefore, it is reasonable to conclude that students met or exceeded expectations; they demonstrated they understand the need to engage in learning beyond presented class material, and that external learning is beneficial to their engineering coursework.

Table 39 – Targeted Assessment for Outcome i2

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% > 2
(i) a recognition of the need for, and an ability to engage in life-long learning				
I1: Demonstrate an awareness that knowledge must be gained	17%	78%	6%	83%
I2: Identify, gather and analyze information	7%	47%	47%	93%

Assessment i3: CHE 260 – Electrochemistry, Spring 2010

The outcome was assessed using an ABET Project in CHE260 Electrochemistry. 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 assess the Request for Proposals on "Practical Electrolytic Hydrolysis of Magnesium Chloride" and develop a research proposal for the client. 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, derived half-cell reactions, corresponding reduction potentials, and overall reaction, proposed electrode material, geometry and configuration, and proposed electrolyte.

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; understand and remember new information; demonstrate critical thinking skills; and demonstrate ability to reflect on own understanding.

The class was divided into 9 teams and overall 34 students were assessed using the performance criteria listed below. The group and individual effort were evaluated based on report and group presentation. The proposals were evaluated for the following: the importance of lifelong learning in the field of electrochemistry, process for learning new material, explanation of the process to determine what is important to learn, and understanding of the need to learn on "your own" when necessary based on the initial knowledge from the class.

The table below summarizes the results of this targeted assessment. The results indicate that the performance level of 76% was met on 3 out of 4 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 develop proposals on previously unknown technology and showed capacity to engage in life-long learning.

The sub-optimal scores can be attributed to relative immaturity of the students and somewhat slower transition from learning dependency to autonomous professional development. For most of the students in this class, this was one of the first classes in the Renewable Energy Program as they are typically transferring from a community college. This outcome should be assessed in the future in the upper level classes to compare the progress that the students make towards being capable of life-long learning after some time in our program.

Table 40 – Targeted Assessment for Outcome i3

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students > 2
(c) A recognition of the need for, and ability to engage in life-long learning				
i1: Willingness to learn new material on their own	24%	64%	12%	76%
i2: Access information effectively and efficiently from a variety of soures	68%	32%	0%	32%
i3: Synthesizing new concepts by making connections, transfering prior knowledge, and generalizing	24%	64%	12%	76%
i4: Reason by predicting, inferring, using inductions, questioning assumiptions, using lateral thinking, and inquiring	24%	44%	32%	76%

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: REE 201 – Introduction to Renewable Energy, Fall 2009

This outcome was assessed using an ABET Project in REE 201, Introduction to Renewable Energy. The project required students select a book to review, based on the criteria that the book discuss contemporary issues related to energy. Specifically, the assessment analyzes whether students discussed contemporary energy issues within their book review.

Fifteen students were assessed in Fall 2009 in the course using the performance criteria listed below. The table summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was not met on the one performance criteria for this program outcome. In general, students are demonstrating their books are relevant to contemporary issues, and most demonstrate this in their reports. But, students generally are not meeting expectations. Many of the reports demonstrated how the selected books were relevant to contemporary issues, but below the objective mark of 80%. In general, report conclusions are quite dismal.

Table 41 – Targeted Assessment for Outcome j1

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students > 2
(j) a knowledge of contemporary issues				
J1: Demonstrate knowledge of contemporary issues	31%	29%	40%	69%

Assessment j2: REE 412 – Photovoltaic Systems, Winter 2010

This outcome was assessed using an ABET Project in REE 412, Photovoltaic Systems, the end-of-term project. The project required students develop a proposal for a PV-related business. The deliverables included an oral presentation in front of a public audience and a written report. Pertinent to Outcome J, students performed a market analysis of PV-related business in the Portland metropolitan area, developed business objectives relevant to that market analysis, investigated current business financing options, estimated current costs of human resources and support technologies, and incorporated up-to-date financial incentives.

Twenty students were assessed in Winter using the performance criteria listed below. The table 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 clearly demonstrated their abilities to design a business within the context of contemporary issues. This is especially challenging in the PV-marketplace as state and federal financial incentives continue to change rapidly, PV system component costs continue to plummet due to strong market mechanisms and business financing continues to be a challenge for small firms. The students clearly demonstrated their understanding of these dynamic contemporary issues and developed viable business plans within this changing environment.

Table 42 – Targeted Assessment for Outcome j2

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% > 2
(J) an ability to apply the fundamentals of energy conversion and applications				
J1: Demonstrate knowledge of contemporary issues	8%	34%	58%	92%

Assessment j3: REE 243, Electric Power, Spring 2010

The assessment added a special question to the second test of the term, assigned as a take-home problem. Students were asked to discuss economic and environmental impacts in the power industry due to the energy problem. The students were a mix of REE juniors and sophomores and some EE sophomores, all had AC circuits as a prerequisite. The issues of the electrical power industry were discussed frequently in the context of the course. The results in the table show that students have a high level of understanding of issues in the energy industry.

Table 43 – Targeted Assessment for Outcome j3

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students > 2
(j) a knowledge of contemporary issues				
J1: Demonstrate knowledge of contemporary issues	0%	8%	92%	100%
J2: Describe historical pretext of issues	8%	38%	54%	92%

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

Assessment k1: EE 221 – Circuits I: DC and 1st-Order Transient Analysis, Fall 2009

This outcome was assessed using a proficiency exam in EE 221, Circuits I – DC and 1st-Order Transient Circuits. The exam tested the students' familiarity with laboratory equipment, particularly function generators, oscilloscopes, multimeters and power supplies; their ability to simulate a circuit using spice; their ability to breadboard and test a circuit; and their ability to plot and compare data using a spreadsheet.

Nineteen students were assessed in Fall 2009 using the performance criteria listed below. The table 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, demonstrating their ability to build an operational amplifier circuit, use laboratory equipment and simulate a circuit using LTspice.

Table 44 – Targeted Assessment for Outcome k1

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students > 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%	18%	82%	100%
K2: Demonstrate proficiency with engineering hardware: test/measurement equipment, prototyping, etc	0%	4%	96%	100%

Assessment k2: EE 321 – Electronics I, Fall 2009

This outcome was assessed using an ABET Project in EE 321, Electronics I – Amplifiers and Semiconductor Devices. The project required students identify an engineering problem (the need for a buffer circuit) and design a solution. Students are expected to develop system specifications, employ block diagrams, gather background information, employ spice as a prototyping tool, develop a test bed for the prototype circuit and verify the prototype matches specifications.

Fifteen students were assessed in Fall 2009 in the course using the performance criteria listed below. The table 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 expectations.

Table 45 – Targeted Assessment for Outcome k2

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students > 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%	63%	38%	100%
K2: Demonstrate proficiency with engineering hardware: test/measurement equipment, prototyping, etc	0%	81%	19%	100%
K3: Apply communications tools and skills within engineering practice	6%	70%	23%	94%

Assessment k3: EE 321 – Electronics I, Fall 2009

This outcome was assessed using an ABET Project in EE 321, Electronics I – Amplifiers and Semiconductor Devices. The project required students design, build and test a prototype differential temperature controller for a 120VAC 1/25HP solar thermal circulator pump. Students are expected to develop system specifications, employ block diagrams, gather background information, employ spice as a prototyping tool, develop a test bed for the prototype circuit and verify the prototype matches specifications.

Fifteen students were assessed in Fall 2009 in the course using the performance criteria listed below. The table 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 clearly demonstrated their abilities to employ simulation software (LTspice), develop system specifications, build prototyping test beds and utilize electronics hardware.

Table 46 – Targeted Assessment for Outcome k3

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students > 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	20%	20%	60%	80%
K2: Demonstrate proficiency with engineering hardware: test/measurement equipment, prototyping, etc	0%	0%	100%	100%
K3: Apply communications tools and skills within engineering practice	0%	15%	85%	100%

Assessment k4: ENGR 355 - Thermodynamics, Fall 2009

This outcome was assessed using an ABET Project in ENGR 355, Thermodynamics. The project required students write an ASHRAE-formatted paper describing the operation of an espresso maker using principles developed in ENGR 355. For this assessment, students were asked apply ASHRAE formatting. Formatting a paper according to a prescribed template is a technique students will need to apply when writing company documents of contributing to conference and journal publications.

Nineteen students were assessed in Fall 2009 in the course using the performance criteria listed below. The table 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 demonstrated their ability to write journal-quality papers according to standards developed by an engineering society, in this case ASHRAE.

Table 47 – Targeted Assessment for Outcome k4

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students > 2
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice				
K3: Apply communications tools and skills used within engineering practice	4%	42%	54%	96%

Assessment k5: EE 223 – Circuits II: AC and 2nd-Oreder Transient Analysis, Winter 2010

This outcome was assessed using an ABET Project in EE 223, Circuits II – AC and 2nd-Order Transient Circuits, the end-of-term Proficiency Exam. The exam requires students design and build a residential power circuit according to NEC codes; measure voltage, current and real power; and, calculate apparent power, reactive power, power factor and load impedance. The exam provides an excellent opportunity to assess the students' abilities to apply techniques and skills required of modern engineers. The application of codes in engineering designs, the NEC in this case, and the use of measurement equipment, are central to this practical exam. Students are asked to design and build a residential circuit according to NEC codes, design and build a power measurement circuit and measure parameters with that test equipment.

Eighteen students were assessed in Winter using the performance criteria listed below. The table 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 design and build a power circuit according to established codes (the NEC) and use test equipment to measure power parameters.

Table 48 – Targeted Assessment for Outcome k5

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				
K2: Demonstrate proficiency with engineering hardware: test/measurement equipment, prototyping, etc	3%	10%	88%	97%

Assessment k6: REE 307 - Batteries, Winter 2010

This outcome was assessed using an ABET Project in REE307 Batteries, laboratory assignment. The objective of this lab was to select a typical application for the developing world and design a battery pack to fit a complete renewable energy system including solar photovoltaics. After design was complete, battery pack assembly was completed and testing was conducted. Particular skills related to this objective were related to product prototyping and testing.

The project was a laboratory assignment, and it was used to assess the students' abilities to apply knowledge of math, science and engineering principles to predict and analyze experiments, apply their knowledge of electronics test equipment, and apply fundamental circuits concepts to solve technical problems connected with batteries.

The class was divided into 4 teams and overall 14 students were assessed in Winter 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 table below summarizes the results of this targeted assessment. The results indicate that the performance level of 90% was met on all performance criteria for this program outcome. All students in all groups met or exceeded expectations.

Table 49 – Targeted Assessment for Outcome k6

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				
K2: Demonstrate proficiency with engineering hardware: test/measurement equipment, prototyping, etc	0%	0%	100%	100%

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: ENGR 355 - Thermodynamics, Fall 2009

This outcome was assessed using an ABET Project in ENGR 355, Thermodynamics. The project required students write an ASHRAE-formatted paper describing the operation of an espresso maker using principles developed in ENGR 355. For this assessment, students were charged with describing a system in terms of the fundamentals of energy conversion: thermodynamics. Students applied fundamental principles, including the 1st and 2nd Laws, control volume or closed-system analysis, the Ideal Gas Law, liquid-vapor quality, and phase transitions. Students applied energy fundamentals by modeling the system using ideal thermodynamics devices, and by developing a full thermodynamic model of the system.

Nineteen students were assessed in Fall 2009 in the course using the performance criteria listed below. The table 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, though roughly half did not apply ideal gas analysis within their modeling (this was a minor component of the system). The papers demonstrated the students' abilities to describe an engineering system in terms of thermodynamic principles. In future, the assignment should stress the importance of discussing the device in terms of the Ideal Gas Law. Several students did not apply the ideal gas law, though admittedly this law plays only a small role in the analysis of this system espresso machine).

Table 50 – Targeted Assessment for Outcome l1

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, energy conversion	10%	39%	51%	90%
L2: Apply energy fundamentals in engineering practice	0%	70%	30%	100%

Assessment l2: REE 412 – Photovoltaic Systems, Winter 2010

This outcome was assessed using an ABET Project in REE 412, Photovoltaic Systems, the end-of-term project. The project required students develop a proposal for a PV-related business. The deliverables included an oral presentation in front of a public audience and a written report. Development of a viable business proposal was contingent upon students having a fundamental understanding of energy conversion and being able to apply energy fundamentals in realistic applications, particularly photovoltaic systems. Students demonstrated these fundamentals within their oral presentations and written reports through discussions of their engineering design processes, samples of engineering drawings, discussions of the engineering tools used to design and assess their projects and examples of their design calculations.

Twenty students were assessed in Winter using the performance criteria listed below. The table 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 clearly demonstrated their abilities to apply their understanding of energy conversion and build business ideas based on energy conversion applications.

Table 51 – Targeted Assessment for Outcome l2

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% > 2
(l) an ability to apply the fundamentals of energy conversion and applications				
L1: Understand the fundamental principles of energy and energy conversion	0%	30%	70%	100%
L2: Apply energy fundamentals in engineering practice	4%	33%	64%	96%
L3: Apply energy fundamentals to improve system design	0%	34%	66%	100%

Assessment l3: REE 243, Spring 2010

This outcome was assessed using a final exam problem in REE 243 Electrical Power. The question required students analyze a power distribution using transmission lines and transformers. For this assessment, students were charged with developing a model for the electrical power conversion from generator to load. This problem was assigned to a group of sophomore and junior REE students and some sophomore EE students (group of 15). All students had a previous class in AC circuits.

The main strength was in understanding the basics of the electrical power conversion in a generation and distribution system. Most students set up the problem and model very well and some calculated the solutions OK. Some students had problems applying the model to developing a solution for the specific problems; most issues were in the transformers and impedance issues. The only recommendation would be to spend more time in the course next term on transformers in a link.

Table 52 – Targeted Assessment for Outcome l3

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, energy conversion	14%	72%	14%	86%
L2: Apply energy fundamentals in engineering practice	33%	53%	14%	67%

Targeted Assessment of Outcome m

An understanding of the obligations for implementing sustainable engineering solutions

Performance Criteria:

M1	Understand the impact of sustainable engineering solutions
M2	Contrast the impacts of conventional and sustainable solutions

Assessment m1: REE 201 – Introduction to Renewable Energy, Fall 2009

This outcome was assessed using an ABET Project in REE 201, Introduction to Renewable Energy. The project required students select a book to review, based on the criteria that the book discuss the obligations for implementing sustainable engineering solutions. Specifically, the assessment analyze whether students discuss such obligations within their book review.

Fifteen students were assessed in Fall 2009 in the course using the performance criteria listed below. The table summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was not met on one of the performance criteria for this program outcome. In general, students demonstrated their books are relevant to sustainable engineering solutions, and most demonstrate this in their reports. Many of the reports did not discuss this topic in the report introductions or report body, and more than half did not discuss the issue in the report conclusions. Students are writing very poor conclusions and introductions, and they are not addressing the obligations for implementing sustainable engineering solutions even though this is generally a feature within their books.

Table 53 – Targeted Assessment for Outcome m

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students > 2
(m) an understanding of the obligations for implementing sustainable engineering solutions				
M1: Understand the impact of sustainable engineering solutions	50%	27%	23%	50%
M2: Contrast the impacts of conventional and sustainable solutions	20%	27%	53%	80%

Assessment m2: REE 339 – Senior Project I, Winter 2010

This outcome was assessed in a senior project proposal class on the final project proposal being submitted. Part of the assignment allows the students to justify an engineering solution (micro-hydroelectric off grid) in light of various impacts (environmental and economic). The students need to present alternative solutions and explain how their sustainable approach is an improvement. This is a very good group of students (2) who have worked well in the past and this is reflected in the overall outcome performance

Table 54 – Targeted Assessment for Outcome m2

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students > 2
(m) an understanding of the obligations for implementing sustainable engineering solutions				
M1: Understand the impact of sustainable engineering solutions	0%	0%	100%	100%
M2: Contrast the impacts of conventional and sustainable solutions	0%	0%	100%	100%

Assessment m3: REE 439 - Energy Management and Auditing, Winter 2010

This outcome was assessed using a term project in which the students, working as teams, completed a comprehensive energy assessment (audit) of the energy use in a designated building. The class of 20 students was divided into four teams of five students each, and the teams each chose a team leader during the third week of class. From this point on the teams acted on their own to (1) contact the building managers, (2) interview the occupants and maintenance staff, (3) perform a "Level 1" walk through assessment to identify opportunities for energy savings, (4) analyze the savings and design/operation alternatives, and (5) document and present their findings and recommendations. This outcome reflects the collective contributions of everyone on the team, and individual performance was not evaluated for this particular outcome.

Twenty students were assessed for this course during the Winter 2010 term using detailed evaluation rubrics for both the term's written report and the PowerPoint summaries presented to building clients. These 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.

To assess this outcome, students had the homework assignment to research and analyze alternative methods or systems for reducing energy use or improving energy efficiency in their building projects. Their objective was to compare energy use and costs of current energy usage with energy-efficient alternatives. These alternatives and the benefits of implementing them were documented in some detail and then also incorporated into the students' final reports, which were compiled as a team effort. (See also outcomes c4, d2, and g4 above).

The table below summarizes the results of the targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met on both performance criteria for this program outcome. For the two students falling in the 10% Developing category, one did not complete the assignment and the other did a marginal effort. For the rest of the class, the students were very much up to the challenge and they seemed to adapt to the open-endedness of the problem challenge quite well.

Table 55 – Targeted Assessment for Outcome m3

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students > 2
(m) an understanding of the obligations for implementing sustainable engineering solutions				
M1: Understand the impact of sustainable engineering solutions	10%	25%	65%	90%
M2: Contrast the impacts of conventional and sustainable solutions	10%	25%	65%	90%

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
N3	Recognize the consequences of energy systems on the development of modern societies

Assessment n1: REE 201 – Introduction to Renewable Energy, Fall 2009

This outcome was assessed using an ABET Project in REE 201, Introduction to Renewable Energy. The project required students select a book to review, using the criteria that the book was one that discusses the historical influence of energy on modern society. Specifically, the assessment analyzes whether students discussed the influence of energy on modern society within their book review.

Fifteen students were assessed in Fall 2009 in the course using the performance criteria listed below. The table summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was not met on both performance criteria for this program outcome. Around half of the students discussed the influence of energy on modern societies; no improvement since Spring 2009. Around half of the reports did not relate the book to the historical influence of energy. Most books chosen by students do discuss historical issues to some degree, but the students are not picking this up and discussing the topic in their reviews. This requirement has been made much more explicit in the assignment description, but this expectation continues to bedevil efforts to get students to consider historical context.

Table 56 – Targeted Assessment for Outcome n1

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students > 2
(n) an appreciation for the influence of energy in the history of				
N2: Correlate historical events and resource conflicts	43%	27%	30%	57%
N3: Recognize the consequences of energy systems on the development of modern societies	47%	40%	13%	53%

Assessment n2: REE 347, Hydroelectric Power, Spring 2010

This outcome was assessed using a final paper in REE 347 Hydroelectric Power, an elective course for REE students. The class size was small with three REE juniors enrolled. The paper had a theme regarding the historical development of hydroelectric power.

Most of the students in the class had taken a class on the History of Energy (HIST356) and with a focus in the report on history of hydroelectric it is not surprising that the results would be high for this outcome. The program strategy of having a focused general studies course on energy and reinforcing in other courses to improve student learning seems to be working.

Table 57 – Targeted Assessment for Outcome n2

Performance Criteria	1 - Developing	2 - Accomplished	3 - Exemplary	% Students > 2
(n) an appreciation for the influence of energy in the history of modern societies				
N1: Understand the historical dev. of energy systems	0%	33%	67%	100%
N2: Correlate historical events and resource conflicts	0%	0%	100%	100%
N3: Recognize the consequences of energy systems on the development of modern societies	0%	0%	100%	100%

Summary of Direct Measure Assessment for 2009/10

Strengths

The results indicated that students in the REE will be strong in the areas of engineering, laboratory and design skills, problem solving and engineering tools (Outcome A, B, C, E, K and L) – in other words, the "hard" skill areas. 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 teamwork and somewhat in communication skills (Outcomes D, G). Some outcome results were inconclusive due to only one or two assessment activities being performed (Outcomes F, H, I and J)

Weaknesses

There may be some weaknesses in implementing sustainable solutions and influence of energy solutions (Outcomes M and N) with the results being marginal but with few samples it may be difficult to draw any sound conclusions at this point.

Recommendations

This first assessment cycle of this unique and new program showed a great deal of success. Many of the learning outcomes showed students performing at very high levels. Some outcomes need a bit more focus in the next assessment cycle and may require developing some unique assignments tailored to assessing the outcome. These results were similar to what was obtained using the indirect assessment of student evaluations as shown in the next section on IDEA Center Assessments.

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 both applying knowledge of mathematics and knowledge of science and engineering. Virtually 100% of all students demonstrated accomplished or exemplary performance in four of the assessments, which were concentrated on EE221 and EE223 circuits classes. Based on these assessments, no weaknesses have been detected. Recommendations include extending the outcome to be evaluated in other core REE classes such as statics, thermodynamics, fluid mechanics or heat transfer.

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

Assessment of this outcome showed students have high competence in the areas of both conducting experiments as well as analyzing data. Students demonstrated accomplished or exemplary performance, which were concentrated on EE221 and EE223 circuits classes. Only one assessment (b7) evaluated the design of experiments, and in this case 80% of the students demonstrated target level proficiency. Based on these assessments, no weaknesses have been found. However, assessments to evaluate the design of experiments can be broadened to fluid mechanics, HVAC, electrochemistry and other lab-based 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 both developing a design strategy with realistic constraints and evaluating the relative value of a feasible solution. In three out of the five assessments 100% of all students demonstrated accomplished or exemplary performance, and 80% or better reached this level of proficiency in the other two assessments. There is wide variation in the levels of student performance across the five 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 some discussion among the faculty about what factors are being evaluated for this outcome to ensure consistency in how students are graded and what is expected of them for design projects. Also, the outcome component to "recognize the need for an engineering solution," should be evaluated in multiple assessments.

(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 in "management of teams and reaching group consensus" where 80% or more of the students met the accomplished or exemplary performance levels. "Delegation of responsibilities," however, fell short in one assessment, with only 72% of students successful in the term project assignment for REE 243 Electric Power. Given some team assignments are graded as a team effort, there is some anecdotal evidence that suggests team assignments are carried by one or two members of the team. One recommendation is to find ways to make all team members equally accountable for results.

(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. For the four assessments of these two criteria, at least 80% of the students demonstrated either accomplished or exemplary results. Identifying and defining an engineering problem, though, is the one criteria where only 78% of the students met the performance threshold in assessment e1. The assessment methods appear suitable for evaluating this outcome, so no recommendations are suggested at this time.

(f) an understanding of professional and ethical responsibility

Assessment of this outcome showed mixed results, with 100% in one assessment and only 75% in the other showing accomplished or exemplary performance. As noted in the detailed assessments, in one case 25% of the students did not complete the ethics assignment, so it is difficult to judge competence. In one instance a student suggested that having done an ethics exercise in another class was enough to address this key ABET outcome, and any more effort would be redundant. Nevertheless, recommendations include using case studies and discussion groups to hash out ethical questions and define ethics principles.

(g) an ability to communicate effectively

This outcome is difficult to measure quantitatively. Nevertheless, the assessment results indicate that students do fairly well with both written and oral communication. For oral communication, with only one assessment for a project, 100% of the students met the performance criteria. For written communication, though, in one assessment only 75% of the students were either accomplished or exemplary. Finally for acquisition and application of information sources, the level of accomplished and exemplary ranged significantly from a low of 53% to a high of 100%. Give the wide variation in the types of communications required by the assessments, one recommendation is to identify written documentation requirements more explicitly, perhaps using examples. Another approach for addressing the need to use information sources is to educate students on the array of sources available for the kinds of information they are expected to find, and how to go about identifying and validating useful information. Also, since low performance may be attributed to assignments not done, assessment of this communication outcome could be broadened to other classes and assessment methods.

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

Of the four assessments for this outcome, three results show 100% of students meeting the criteria while one (h1) shows the requisite 80% of the students clearly did not demonstrate the abilities to identify impacts of engineering solutions nor understand impacts of engineering solutions in a broad context. It appears that students participating early on have the greatest difficulty since the 300- and 400-level classes showed competence in the criteria. Since there seems to be a disparity between the students early in the program (those taking REE 201, usually the first class students enroll in) and those in upper division status, it is important that the faculty concur on what kind of assessment is most appropriate what to expect of students at different levels.

(i) a recognition of the need for, and an ability to engage in life-long learning

Like outcome (f) this outcome shows mixed results. Overall, students have developed good skills in the areas of independent learning, with 76% or better able to "demonstrate an awareness that knowledge must be gained" and the ability to "identify, gather and analyze information." However, as with outcome (f), students appear to falter in accessing information on their own, with 68% showing only a developing ability in this skill area. Again, one recommendation is for faculty to develop strategies for information gathering and impart to students how to use these strategies successfully in the context of addressing questions that need answers not easily found in textbooks.

(j) a knowledge of contemporary issues

This assessment has mixed results, but with only three assessments – and not all three were comprehensive – it is difficult to draw conclusions. The assessments for the ability to "demonstrate knowledge of contemporary issues" ranged from 69% to 92% to 100%, respectively for the three assessments. It would be helpful for faculty to review definitions of what "knowledge of contemporary issues" means to help standardize the criteria as well come to terms with how this criteria might be effectively assessed.

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

Based on the results of six assessments for this outcome, nearly 100% of students have the ability to use the techniques, skills, and modern engineering tools necessary for engineering practice. The one area where some students showed difficulty was in demonstrating proficiency with engineering software. The one recommendation falling out of this assessment could be a tighter integration of software tools with the curriculum, and consideration of which software tools might be recommended as standard.

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

Assessment of this outcome showed students proficient in both understanding the fundamental principles of energy and energy conversion, as well as capable in applying energy fundamentals to improve systems design – better than 80% meet the accomplished or exemplary criteria. However, in one assessment (l3) only 67% met the criteria for "applying engineering fundamentals in engineering practices." For this outcome, the assessments appear appropriate but more attention should be place on fundamentals in engineering practices.

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

For this assessment, the results are not consistent. Like the assessment for outcome (h), the evaluations aren't comprehensive enough to draw clear conclusions. In one assessment (m1), only 50% of the students were able to understand the impact of sustainable engineering solutions. Again, this assessment is drawn from students studying early on in the program, whereas upper division students appear to have mastered the outcomes. Repeating the recommendation of outcome (h): Since there seems to be a disparity between the students early in the program (those taking REE 201, usually the first class students enroll in) and those in upper division status, it is important that the faculty concur on what kind of assessment is most appropriate what to expect of students at different levels.

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

Like the assessments for outcomes (h) and (m), there appears to be a disparity in the level of accomplishment between lower- and upper-classmen, but there are only two assessments on which to base any kind of conclusions. In one assessment (n1) only 57% of the students could "correlate historical events and resource conflicts," and only 53% of the students could "recognize the consequences of energy systems on the development of modern societies." In the other assessment, 100% of students demonstrated both these skills. So, again, repeating the recommendation of outcome (h): Since there seems to be a disparity between the students early in the program (those taking REE 201, usually the first class students enroll in) and those in upper division status, it is important that the faculty concur on what kind of assessment is most appropriate what to expect of students at different levels.

IDEA Center Assessments

<u>IDEA Center Indirect Assessment of ENGR 355, Thermodynamics, Fall 2009, PDX</u>

	ENGR 355, Thermodynamics					
	Fall 2009					
	IDEA Center Relevant Objectives	Related a-n Outcomes	IDEA Objective for this course?	Average	Standard Deviation	a-n Outcome met (>3)
21	Gaining factual knowledge	i	Essential	4.5	0.6	yes
22	Learning fundamental principles, generalizations, or theories	e	Essential	4.5	0.6	yes
23	Learning to *apply* course material	a, k	Essential	4.1	0.7	yes
24	Developing specific skills, competencies and points of view needed by professionals	k	Minor	4.2	0.7	yes
25	Acquiring skills in working with others as a team	d	Minor	3.2	1.2	no
26	Developing creative capacities (writing, etc.)	g	Minor	3.2	1.2	no
28	Developing skills in expressing myself orally or in writing	g	Minor	3.1	1.4	no
29	Learning how to find and use resources for answering questions or solving problems	i	Minor	4.2	1	yes
32	Acquiring an interest in learning more by asking my own questions and seeking answers	i	Minor	3.8	1.1	yes
		20	***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 progress has been made on the following program outcomes:

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

(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' to this course all scored above the 3.5 threshold, indicating substantial progress has been made on program outcomes (a), (e), (i) and (k). It is not surprising to see the survey results did not indicate substantial progress had been made on outcomes (d, teamwork) and (g, communication); students did not work on group projects, nor was the term paper intended to improve students' writing capabilities.

IDEA Center Indirect Assessment of EE 321, Electronics I, Fall 2009, PDX

	EE 321, Electronics I					
	Fall 2009					
	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	4.4	0.8	yes
22	Learning fundamental principles, generalizations, or theories	e	Essential	4.3	0.8	yes
23	Learning to *apply* course material	a, k	Essential	4.2	0.8	yes
24	Developing specific skills, competencies and points of view needed by professionals	k	Minor	3.9	0.8	yes
25	Acquiring skills in working with others as a team	d	Minor	3.9	1.2	yes
26	Developing creative capacities (writing, etc.)	g	Minor	3.6	1.4	yes
28	Developing skills in expressing myself orally or in writing	g	Minor	3.3	1.4	no
29	Learning how to find and use resources for answering questions or solving problems	i	Important	3.8	1.3	yes
32	Acquiring an interest in learning more by asking my own questions and seeking answers	i	Minor	3.8	1.2	yes
		13	***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 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), (k). Students reported progress in developing teamwork skills (d), even though that Relevant Objective was not deemed essential. Results pertaining to (g, communication) are mixed; writing assignments were not designed to enhance 'creative capacities,' nor were they intended to improve students' writing capabilities.

IDEA Center Indirect Assessment of EE 221, Circuits I, Fall 2009, PDX

	EE 221, Circuits I: DC and 1st-Order Transient Analysis					
	Fall 2009					
	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	4.4	0.6	yes
22	Learning fundamental principles, generalizations, or theories	e	Essential	4.4	0.5	yes
23	Learning to *apply* course material	a, k	Essential	4.1	0.7	yes
24	Developing specific skills, competencies and points of view needed by professionals	k	Minor	4.2	0.8	yes
25	Acquiring skills in working with others as a team	d	Minor	3.9	0.8	yes
26	Developing creative capacities (writing, etc.)	g	Minor	3.4	1.2	no
28	Developing skills in expressing myself orally or in writing	g	Minor	3.4	1.2	no
29	Learning how to find and use resources for answering questions or solving problems	i	Minor	4.1	0.8	yes
32	Acquiring an interest in learning more by asking my own questions and seeking answers	i	Minor	4.1	0.9	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 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), (k). Students also reported progress in developing teamwork skills, (d), even though that Relevant Objective was not deemed essential.

IDEA Center Indirect Assessment of EE 223, Circuits II, Winter 2010, PDX

	EE 223, Circuits II: AC and 2nd-Ored Transient Analysis					
	Winter 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	4.8	0.4	yes
22	Learning fundamental principles, generalizations, or theories	e	Essential	4.8	0.4	yes
23	Learning to *apply* course material	a, k	Essential	4.4	0.6	yes
24	Developing specific skills, competencies and points of view needed by professionals	k	Important	4.4	0.6	yes
25	Acquiring skills in working with others as a team	d	Important	4.1	1.0	yes
26	Developing creative capacities (writing, etc.)	g	Minor	3.9	0.9	yes
28	Developing skills in expressing myself orally or in writing	g	Important	3.9	1.0	yes
29	Learning how to find and use resources for answering questions or solving problems	i	Minor	4.2	1.0	yes
32	Acquiring an interest in learning more by asking my own questions and seeking answers	i	Minor	4.2	0.9	yes
		17	***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 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' to this course all scored above the 3.5 threshold, indicating substantial progress has been made on program outcomes (a), (e), (i) and (k). Survey results also showed progress had been made on objectives deemed 'important,' which relate to program outcomes (k), (d) and (g). Passing scores were also noted for the three 'minor' relevant objectives, indicating substantial progress was also made on program outcomes (g) and (i). Students are expected to present two lab reports orally and a third in writing, so it is not surprising that progress was made on this outcome too, despite it being ranked as a 'minor' objective.

__**IDEA Center Indirect Assessment of REE 412, Photovoltaic Systems, Winter 2010, PDX**__

	REE 412, Photovoltaic Systems					
	Winter 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	4.6	0.6	yes
22	Learning fundamental principles, generalizations, or theories	e	Essential	4.5	0.7	yes
23	Learning to *apply* course material	a, k	Essential	4.3	0.7	yes
24	Developing specific skills, competencies and points of view needed by professionals	k	Essential	4.5	0.6	yes
25	Acquiring skills in working with others as a team	d	Important	4.1	0.9	yes
26	Developing creative capacities (writing, etc.)	g	Minor	3.6	1.2	yes
28	Developing skills in expressing myself orally or in writing	g	Minor	3.6	1	yes
29	Learning how to find and use resources for answering questions or solving problems	i	Important	4.2	1	yes
32	Acquiring an interest in learning more by asking my own questions and seeking answers	i	Minor	3.9	1.1	yes
		19	***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 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' to this course all scored above the 3.5 threshold, indicating substantial progress has been made on program outcomes (a), (e), (i) and (k). Survey results also showed progress had been made on objectives deemed 'important,' which relate to program outcomes (d) and (i). Passing scores were also noted for the three 'minor' relevant objectives, indicating substantial progress was also made on program outcomes (g) and (i). Students are expected to present their term project orally to a group of 'investors' and in writing as a business plan, so it is not surprising that progress was made on this outcome too, despite it being ranked as a 'minor' objective.

4 Changes Resulting from Assessment

This section describes the changes resulting from the assessment activities carried out during the year 2009-2010. 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 the next assessment cycle.

4.1 Changes Resulting from the 2008-2009 Assessment

None noted.

4.2 Changes to Assessment Methodology Resulting from the 2009-2010 Assessment

During the 2009/10 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 (e.g. 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 2010-2011 academic year we will target five program outcomes for assessment.

The assessments conducted during the 2009-2010 academic year revealed the following areas of improvement:

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

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.

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

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.

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.

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.

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.

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.