Master of Science
Renewable Energy Engineering

2015-16 Assessment Report

Electrical Engineering and Renewable Energy Department

Contents

1 Introduction

1.1 Program Design and Goals

The Master of Science in Renewable Energy Engineering (REE) program at Oregon Institute of Technology (Oregon Tech) has been designed to prepare graduates to be energy engineering professionals who have advanced knowledge and skills that enable them to assume a broad range of technical leadership roles.

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

1.2 Program History

In 2005, the Oregon Institute of Technology (Oregon Tech) began offering its new Bachelor of Science degree in Renewable Energy Systems program (BSRES) at its satellite campus in Portland, Oregon. In 2008, the BSRES degree was discontinued and replaced by the Bachelor of Science degree in Renewable Energy Engineering (BSREE). Analysis of the marketplace and observed growth in career options across the renewable energy fields revealed significant opportunities for graduates with a solid energy engineering education. Building upon this strong foundation of renewable energy engineering education, the MSREE was launched in 2012. In 2013, an accelerated, concurrent degree option was launched for exceptional undergraduate students in the BS Renewable Energy Engineering and BS Electrical Engineering programs.

We anticipate MSREE graduates will enter energy engineering careers as leaders in the fields of power engineering, PV/semiconductor processing engineering, facilities and energy management, energy system integration engineering, HVAC and hydronics engineering, design and modeling engineering for net-zero energy buildings, biofuels plant and operations engineering, energy systems control engineering, power electronics engineering, utility program management, as researchers and educators in renewable energy fields, as well as in the roles of LEED accredited professionals (AP) and 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. MSREE graduates with strong interests in research and academia will be well situated to pursue further advanced degrees at PhD granting institutions.

1.3 Industry Relationships

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

1.4 Program Locations

Among the advantages that make Oregon Tech an ideal institution for offering the MSREE program is the benefit of having a campus in urban Portland in proximity to the Pacific Northwest's energy industry cluster, and with close ties to Oregon Tech's campus in rural Southern Oregon, which exceptional natural energy resources and on-campus facilities generating renewable energy. The Portland campus allows students to leverage their classroom experience within internships at the Northwest's world-class energy and power companies. Graduate-level courses are offered at the Klamath Falls campus and on line to accommodate students in Klamath Falls pursuing the concurrent BS/MS REE option.

1.5 Enrollment and Graduates

Enrollment in the program has been growing. The inaugural graduating class in Spring 2014 included just one student. Thirteen students graduated or have degrees pending from Fall 2015 through Summer 2016 terms.

2 Program Educational Objectives and Outcomes

2.1 Program Educational Objectives

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

- MSREE graduates will excel as leaders in the various fields of energy engineering.
- MSREE graduates will demonstrate an ability to apply advanced engineering methods to the solutions of complex energy-related engineering problems.
- MSREE graduates will demonstrate an ability to acquire emerging knowledge and remain current in the dynamic field of renewable energy.

2.2 Relationship between Program Objectives and Institutional Objectives

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

2.3 Program Outcomes

The MSREE program builds on the engineering knowledge students gained as undergraduates. The MSREE program outcomes are these:

(a) an ability to identify, formulate, and solve energy-related engineering problems.

(b) an ability to communicate effectively.

(c) an ability to independently acquire knowledge of contemporary technical, political, and economic issues related to energy.

3 Cycle of Assessment for Program Outcomes

3.1 Introduction and Methodology

Assessment of the program outcomes is conducted over a three year-cycle. Table 1 shows the outcomes assessed during each academic year and the courses in which they are typically assessed.

3.2 Assessment Cycle

Table 1 – MSREE Outcome Assessment Cycle

		2014-15	2015-16	2016-17
(a)	Problem Solving		REE 599, REE 529	
(b)	Communication			REE 516, REE 512
(c)	Independent/Contempo	REE 573, REE 515		

3.3 Summary of Assessment Activities & Evidence of Student Learning

3.3.1 Introduction

The MSREE faculty conducted formal assessment during the 2015-16 academic year using direct measures, such as designated assignments and evaluation of coursework normally assigned. Additionally, the student outcomes were assessed using indirect measures, primarily results from a graduate exit survey.

3.3.2 Methods for Assessment of Program Outcomes

At the beginning of the assessment cycle, an assessment plan is generated by the Assessment Coordinator in consultation with the faculty. This plan includes the outcomes to be assessed during that assessment cycle (according to Table 1), as well as the courses and terms where these outcomes will be assessed.

The MSREE mapping process links specific tasks within MSREE course projects and assignments to program outcomes and on to program educational objectives in a systematic way. The program outcomes are evaluated as part of the course curriculum primarily by means of assignments. These assignments typically involve a short project requiring the student to apply math, science, and engineering principles learned in the course to solve a particular problem requiring the use of modern engineering methodology and effectively communicating the results.

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 relevant 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.

A systematic, rubric-based process is then used to quickly assess the level of attainment of a given program outcome, based on a set of performance criteria. The work produced by each student is evaluated according to the different performance criteria, and assigned a level of 1-developing, 2-accomplished, or 3-exemplary. The results for each outcome are then summarized in a table, and reviewed by the faculty at the annual Closing-the-Loop meeting.

The acceptable performance level is to have at least 80% of the students obtain a level of accomplished or exemplary in each of the performance criteria for any given program outcome.

If any of the direct assessment methods indicates performance below the established level, that triggers the continuous improvement process, where all the direct and indirect assessment measures associated with that outcome are evaluated by the faculty, and based on the evidence, the faculty decides the adequate course of action. The possible courses of action are these:

- Collect more data (if there is insufficient data to reach a conclusion as to whether the outcome is being attained or not); this may be the appropriate course of action when assessment was conducted on a class with low enrollment, and it is recommendable to re-assess the outcome on the following year, even if it is out-of-cycle, in order to obtain more data.
- Make changes to the assessment methodology (if the faculty believe that missing the performance target on a specific outcome may be a result of the way the assessment is being conducted, and a more proper assessment methodology may lead to more accurate numbers); for example, this could be the suggested course of action if an outcome was assessed in a lower-level course, and the faculty decide that the outcome should be assessed in a higher-level course before determining whether curriculum changes are truly needed.
- Implement changes to the curriculum (if the faculty conclude that a curriculum change is needed to improve attainment of a particular outcome). A curriculum change will be the course of action taken when the performance on a given outcome is below the target level, and the evidence indicates that

there is sufficient data and an adequate assessment methodology already in place, and therefore there is no reason to question the results obtained.

If the faculty decide to take this last course of action and implement curriculum changes, the data from the direct assessments is analyzed and the faculty come up with a plan for continuous improvement, which specifies what changes will be implemented to the curriculum to improve outcome performance.

In addition to direct assessment measures, indirect assessment of the student outcomes is performed on an annual basis through a senior exit survey.

The results of the direct and indirect assessment, as well as the conclusions of the faculty discussion at the Closing-the-Loop meeting are included in the annual MSREE Assessment Report, which is reviewed by the Department Chair and the Director of Assessment for the university. The suggested changes to the curriculum are presented and discussed with all the department faculty at the annual Convocation meeting in Fall, as well as with the Industry Advisory Board at the following IAB meeting. If approved, these changes are implemented in the curriculum and submitted to the University Graduate Council (if catalog changes are required) for the following academic year.

3.3.3 2015-2016 Targeted Direct Assessment Activities

The sections below describe the 2015-16 targeted assessment activities and detail the performance of students for each of the assessed outcomes. Unless otherwise noted, the tables report the number 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. Outcome (a) was assessed for 2015-2016.

The minimum acceptable performance level for all outcomes is to have 80% or more of the students performing at the accomplished or exemplary level for all performance criteria. The summary data presented in this section represent the percentages of students meeting course-specific criteria.

3.3.4.1 Targeted Assessment for Outcome (a): an ability to identify, formulate, and solve energy-related engineering problems.

Wilsonville, REE 599, Spring 2015 – Winter 2016 – Dr. H. J. Corsair

This outcome was assessed in REE 599 – Graduate Thesis or Project over the course of terms Spring 2015 – Winter 2016 by means of an evaluation of a final graduate-level thesis or project. Students submitted a graduate thesis, which answered a research question or tested a hypothesis with an element of novelty, or a graduate project, which solved an advanced engineering design project with evidence of added value. Students submitted written documentation of their work, presented an oral defense, and made revisions and corrections based on feedback from both written and oral presentations of work.

Five MSREE students were assessed from Spring 2015 – Winter 2016 using the performance criteria listed in the table below. The minimum acceptable performance level was to have above 80% of the students performing at the accomplished or exemplary level in all performance criteria.

Table 1 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, that is, at least 80% of students were able to identify, formulate, and solve energy-related engineering problems.

Table 1: Targeted Assessment for Outcome (a)

Outcome (a): an ability to identify, formulate, and solve energy-related engineering problems				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
1 – Identify problems	1	2	2	80%
2 – Formulate problems	1	2	2	80%
3 – Solve problems	1	2	2	80%

Wilsonville, REE 529, Fall 2015 – Professor Frank Rytkonen

This outcome was assessed in REE 529 – Power Systems Analysis in Fall 2015 by means of a project. The term-long assignment consisted of designing an electrical power system for a combined-cycle power plant, developing a computer model of the system, performing analysis to determine power flow and short circuit characteristics, and updating engineering drawings.

Eight students were assessed in Fall 2015 using the performance criteria listed in the table below. The minimum acceptable performance level was to have above 80% of the students performing at the accomplished or exemplary level in all performance criteria.

Table 2 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, that is, at least 80% of students were able to identify, formulate, and solve energy-related engineering problems..

Table 2: Targeted Assessment for Outcome (a)

Outcome (a): an ability to identify, formulate, and solve energy-related engineering problems				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students >= 2
1 – Identify problems	0	2	6	100%
2 – Formulate problems	1	1	6	87.5%
3 – Solve problems	1	1	6	87.5%

3.3.5 2015-2016 Indirect Assessment

In addition to direct assessment measures, the student outcomes were indirectly assessed through a graduate exit survey. The 2014-15 data collected in Spring 2015 was used in the last assessment report, which covers the period from Spring 2014 to Winter 2015. The indirect assessment data used in the 2014-15 report was not collected during the assessment cycle. In order to avoid this inconsistency, in this and the subsequent annual assessment reports, we will use indirect assessment data collected during spring term in the respective assessment cycle. To this end, the 2014-15 academic year senior exit survey, conducted in Spring 2015, will be used again in this assessment report, which covers the terms from Spring 2015 to Winter 2016.

The survey asked students to indicate how well the MSREE program prepared them in each of the three specified outcomes. Figures 1 and 2 show the results of the indirect assessment of the MSREE student outcomes for the 2014-2015 graduating class.

Eleven MSREE graduating students completed the survey, with 100% of respondents indicating that as a result of completing the MSREE program they feel prepared or highly prepared in each of the student outcomes. This suggests that graduates feel that they have attained the MSREE student outcomes. Both direct and indirect assessment indicate that the MSREE program is preparing students in the program's student outcomes.

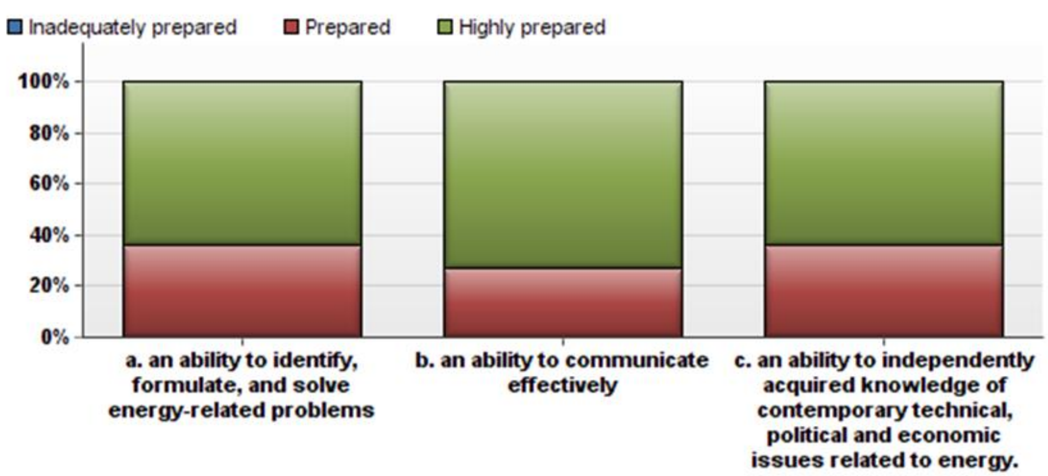

Figure 1: Graph of results of the indirect assessment for the MSREE Student Outcomes as reported in the Graduate Exit Survey (AY 2014-15).

Outcome	Inadequately prepared	Prepared	Highly prepared
a. an ability to identify, formulate, and solve energy-related problems	0	4	7
b. an ability to communicate effectively	0	3	8
c. an ability to independently acquire knowledge of contemporary technical, political and economic issues related to energy.	0	4	7

Figure 2. Table of results of the indirect assessment for the MSREE Student Outcomes as reported in the Graduate Exit Survey (AY 2014-15).

4 Changes Resulting from Assessment

4.1 Changes Resulting from the 2015-16 Assessment

This section describes the changes resulting from the assessment activities carried out during the academic year 2015-2016.

One of the students was assessed as "developing" in the evaluation of his thesis/project work when it was presented the first time, as reported in Section 3.3.4.1.Because a minimum score of "accomplished" is necessary to pass the course and earn the MSREE degree, he re-submitted and re-presented his work after the timeframe included in this assessment report. His revised work will be included in the AY 2016-17 Assessment Report.

The results of the 2015-16 Assessment indicate that the minimum acceptable performance level of 80% was met on all performance criteria for all assessed outcomes; no areas for improvement were identified with respect to these results.

4.2 Changes to Assessment Methodology

This section describes changes to the assessment methodology that were proposed in the 2015-2016 assessment cycle for implementation in the 2016-17 assessment cycle.

The current assessment assignments were discussed relative to their ability to adequately assess the intended outcomes. The very positive assessment results from AY 2014-2015 suggested the possibility that the assessment assignments were not sufficiently nuanced to capture the range of skill represented among MSREE students. Because this was the first assessment cycle for this program, no changes were recommended to the assessment methodology, but the faculty were to monitor this over subsequent assessment cycles. The 20115-16 assessment period showed a broader range of scores among outcomes assessed; therefore, the assessment process seems to be functioning as intended but will continue to be monitored by faculty. If future assessments show unusually high scores again, assessment assignments may be revised to ensure that the quality of student learning (expected to be high because of a selective admissions process), not an artifact of the assignments, is being reflected in these assessments.