

Master of Science
Renewable Energy Engineering

2018-19 Assessment Report

Electrical Engineering and Renewable Energy Department

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1 Introduction

1.1 Program Design and Goals

The Master of Science in Renewable Energy Engineering (MSREE) 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 the Portland-Metro campus 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. The MSREE concurrent degree was launched in Klamath Falls in 2016. Full time offering of the MSREE program was extended to the Klamath Falls campus for the first time in 2018.

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 also offered at the Klamath Falls campus. Online courses offer flexibility to concurrent degree and full time students in both campuses.

1.5 Enrollment and Graduates

The inaugural graduating class in Spring 2014 included just one student. Forty-two students have graduated from the program as of Summer 2019 term.

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 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

The original assessment plan considered assessment of the program outcomes in different courses over a three-year cycle, as shown in **Table 1**. However, faculty found out that the selected courses were not representative of the program outcomes and the methodology had to be revised. Long considerations during academic years 2016-17 and 2017-18 led to the decision that REE 599 Graduate Thesis/Project was the best course to evaluate the program outcomes over a three year cycle. Students taking REE 599 have to present a written thesis or project, and defend it in front of a three-member committee composed by their advisor, a member of the department, and an external committee member. The three members of the committee read the written document prior to the defense. It was decided that the assessment should be made by the non-advisor committee member, who could provide an unbiased opinion over the student work. Assessment year 2018-19 has been used as a resetting point, considering all three outcomes, to continue with a regular 3-year cycle, as shown in Table 2.

3.2 Assessment Cycle

Table 1. Original 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/Contemporary	REE 573, REE 515		

Table 2. Updated MSREE Outcome Assessment Cycle

	2018-19	2019-20	2020-21
(a) Problem Solving	REE 599	REE 599	
(b) Communication	REE 599		REE 599
(c) Independent/Contemporary	REE 599		

3.3 Summary of Assessment Activities & Evidence of Student Learning

3.3.1 Introduction

The MSREE faculty conducted formal assessment during the 2018-19 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 2), as well as the courses and terms where these outcomes will be assessed.

The program outcomes are evaluated as part of the course curriculum primarily by means of students' final theses or projects. These theses or projects require 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.

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 graduate 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 2018-2019 Targeted Direct Assessment Activities

The sections below describe the 2018-19 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. Outcomes (a), (b) and (c) were assessed for academic year 2018-2019 by means of four theses or projects completed during the year by graduating students of the MSREE program under the course denoted REE 599. These students conducted their graduate research or thesis under three different advisors. Dr. H.J. Corsair advised two students. Drs. Slobodan Petrovic and Teshome Jiru advised one student each. The assessment work was performed by other faculty in the department.

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.

This outcome was assessed in REE 599 – Graduate Thesis or Project 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.

Four MSREE students were assessed from 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 3 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 3. 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 \geq 2
Identify problems		2	2	100
Formulate problems	2		2	50
Solve problems		2	2	100

3.3.4.2 Targeted Assessment for Outcome (b): an ability to communicate effectively

This outcome was assessed in REE 599 – Graduate Thesis or Project 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.

Four MSREE students were assessed from 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 4 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 4. Targeted Assessment for Outcome (b)

Outcome (b): an ability to communicate effectively				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students \geq 2
Written communication		3	1	100
Acquiring information		3	1	100

3.3.4.3 Targeted Assessment for Outcome (c): an ability to independently acquired knowledge of contemporary technical, political and economic issues related to energy

This outcome was assessed in REE 599 – Graduate Thesis or Project 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.

Four MSREE students were assessed from 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 5 summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was met on all performance criteria for this program outcome, that is, at least 80% of students were able to identify, formulate, and solve energy-related engineering problems.

Table 5. Targeted Assessment for Outcome (c)

Outcome (c): an ability to independently acquired knowledge of contemporary technical, political and economic issues related to energy				
Performance Criteria	1-Developing	2-Accomplished	3-Exemplary	%Students \geq 2
Knowledge of contemporary issues		3	1	100
Identifying, gathering and analyzing information		3	1	100

3.3.5 2018-2019 Indirect Assessment

In addition to direct assessment measures, the student outcomes are normally indirectly assessed through a graduate exit survey. The indirect assessment data for the period 2018-19 were not available at the time of generating this report.

4 Changes Resulting from Assessment

4.1 Changes Resulting from the 2018-19 Assessment

This section describes the changes resulting from the assessment activities carried out during the academic year 2018-2019.

The results of the 2018-19 Assessment indicate that the minimum acceptable performance level of 80% at the levels “accomplished” or “exemplary” was met on performance criteria for the three assessed outcomes, with one exception. Only 50% of the thesis or projects assessed were identified to have an “exemplary” level for criterion *Formulate problems* of outcome (a) an ability to identify, formulate, and solve energy-related engineering problems, whereas the remaining 50% was identified at “developing” level.

Faculty has decided on the collection of more data for outcome (a) as a course of action, since the assessed sample size is too small (four), and the number of thesis or projects falling under the minimum acceptable performance is two. This need to reassess outcome (a) coincides with the scheduled assessment for the following academic year 2019-20, according to the MSREE outcome assessment cycle presented in Table 2. Criterion *Formulate problems* will be closely monitored.

4.2 Changes to Assessment Methodology

This section describes changes to the assessment methodology that were proposed in the 2018-2019 assessment cycle for implementation in the 2019-20 assessment cycle.

As mentioned in section 3.1, the MSREE outcome assessment cycle was revised and year 2018-19 was used to assess all three outcomes using REE 599 Graduate Thesis/Project. This course involves the final work of students in the MSREE degree and provides a window into the three program outcomes. Starting in AY 2019-20, each outcome will be assessed each year, following the new MSREE outcome assessment cycle presented in Table 2.

Students taking REE 599 have to present a written thesis or project, and defend it in front of a committee composed by their advisor, a member of the department, and an external committee member. The three members of the committee read the written document prior to the defense. Department faculty who are members of the students committees but not their REE 599 advisors will be assigned with the assessment of outcomes.