# BS Renewable Energy Engineering

# 2021-22 Assessment Report

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# Contents

# 1 Introduction

## 1.1 Program Design and Goals

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

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

## 1.2 Program History

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

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

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

industry cluster in the Pacific Northwest convinced us that an engineering degree, the BSREE degree, was the only suitable option for our students.

### 1.3 Industry Relationships

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

### 1.4 Program Locations

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

### 1.5 Program Enrollment and Graduation Data

Table 1 presents the BSREE program enrollment from Fall 2016 to Fall 2021. Table 2 represents the number of BSREE degrees awarded over the same time span. Based on a rolling average of survey data collected for the BSREE graduating classes of 2017 – 2019, 88% of BSREE graduates are employed and 10% are continuing education after graduation. The median salary of BSREE graduates is reported as $65,000. Current employers of BSREE graduates include PacificCorp, David Evans and Associates, Bonneville Power Administration, Portland General Electric, US Forest Service, Inc.

**Table 1: BSREE Program Enrollment Headcounts**

| | 2016-17 | 2017-18 | 2018-19 | 2019-20 | 2020-21 | 2021-22 |
|---|---|---|---|---|---|---|
| Klamath Falls | 60 | 78 | 80 | 80 | 72 | 69 |
| Portland-Metro | 78 | 64 | 62 | 59 | 48 | 28 |
| Total | 138 | 142 | 142 | 159 | 120 | 97 |

**Table 2: Number of BSREE Degrees Awarded**

| | 2016-17 | 2017-18 | 2018-19 | 2019-20 | 2020-21 | 2021-22 |
|---|---|---|---|---|---|---|
| Klamath Falls | 14 | 15 | 5 | 12 | 9 | 9 |
| Portland-Metro | 17 | 22 | 8 | 13 | 14 | 14 |
| Total | 31 | 37 | 13 | 25 | 23 | 23 |

# 2 Program Mission, Educational Objectives and Outcomes

## 2.1 Program Mission

The mission of the Bachelor of Science in 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.

## 2.2 Program Educational Objectives

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

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

## 2.3 Relationship between Program Objectives and Institutional Objectives

The BSREE PEOs are in alignment with the university's mission. Specifically, PEO1 relates to graduates having a rigorous and relevant preparation that allows them to excel professionally in careers within the energy engineering sector. This links to the university's mission of offering "innovative, professionally-focused degree programs" in engineering, with an emphasis on "hands-on education".

PEO2 emphasizes commitment lifelong learning, which is required to stay current in the rapidly evolving field of energy engineering, as well as social, professional, and ethical responsibility. This PEO is in alignment with the university's mission to meet "current and emerging needs".

PEO3 focuses on graduates being critical thinkers, problem solvers and effective communicators. This is consistent with the university's mission to be committed to leadership development and focused on innovation.

## 2.4 Program Outcomes

Currently, the BSREE SOs follow ABET's EAC (1)-(7) outcomes. The outcomes are published on the BSREE website, as well as the annual BSREE assessment reports (also available on the program website). The BSREE student outcomes are listed below:

**(1) (Problem Solving)** an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

**(2) (Design / Broader Factors)** an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

**(3) (Communication)** an ability to communicate effectively with a range of audiences.

**(4) (Ethics)** an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

**(5) (Teamwork)** an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

**(6) (Experimentation)** an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

**(7) (Independent Learning)** an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

The rubric based on the outcomes are represented in the appendix.

### 2.5 Relationship between PEOs and SOs

The mission and program educational objectives (PEOs) describe the capabilities of the graduates after they have entered their chosen career. The student outcomes (SOs) are used to develop the necessary foundation of knowledge and skills that a graduate will need to accomplish these objectives as they mature in their disciplines. It is the student outcomes that allow graduates to excel at the educational objectives.

Table 3-2 shows a map of the BSREE student outcomes to the program education objectives. As the table indicates, the student learning outcomes correlate strongly with the education objectives, with each SO mapping to at least one PEO.

**Table 3: Mapping between BSREE Student Outcomes (1)–(7) and Program Educational Objectives (PEO1, PEO2, PEO3)**

| | PEO1 | PEO2 | PEO3 |
|---|---|---|---|
| (1) Problem Solving | X | X | X |
| (2) Broader Factors | X | X | X |
| (3) Communication | | | X |
| (4) Ethics | | X | X |
| (5) Teamwork | X | | X |
| (6) Experimentation | X | | X |
| (7) Independent Learning | | X | X |

### 2.6 Process for Establishment and Revision of PEOs and SOs

The BSREE student outcomes were set in accordance to the current ABET criteria (Criterion 3) for accrediting engineering programs. The BSREE SOs include ABET EAC outcomes (1)-(7), which are the general outcomes for all baccalaureate engineering programs.

At the annual EERE Convocation meeting in the Fall, the EERE faculty have an opportunity to review the SOs for each program in light of the results from the assessment activities conducted the previous year (i.e., direct assessments collected in program courses, as well as indirect assessment from senior exit survey), results of graduate surveys provided by Career Services, the input gathered from IAB members and employers during the previous academic year, as well as any changes to the institutional or college mission, or the ABET criteria (if any have occurred). Based on the discussion, the EERE faculty may approve to make no changes to the program SOs or make recommendations for proposed changes. The results are determined by a simple majority vote.

During the academic year, two meetings are held with the IAB (typically Fall and Spring). These meetings provide an opportunity for faculty to present program updates, assessment results, etc., as well as gather input from the IAB to inform strategic direction of the program. If changes to the SOs have been proposed by the faculty at the Fall Convocation meeting, these are discussed with the IAB members. The IAB members may approve the changes or propose alternative changes. The results are determined by a simple majority vote.

As part of the assessment cycle, the BSREE program faculty have a Closing-the-Loop meeting. This meeting is typically scheduled in the Fall term, prior to 31 October. At this meeting, the program faculty discuss the results of the assessment activities carried out during the previous academic year and have an opportunity to review the SOs. If any changes to the SOs have been approved by the faculty and the IAB, these are announced at the Closing-the-Loop meeting and included in the annual Assessment Report, which is submitted to the Director of Assessment for the university, and if approved, the new SOs are published on the BSREE program website and submitted for inclusion in the catalog for the following academic year. Table 3-1 summarizes the process for review of the BSREE program student outcomes.

**Table 4: BSREE Student Outcomes Review Process**

| Event | Task |
|---|---|
| Convocation | • EERE faculty Review PEOs in light of assessment data and other feedback collected in previous academic year.<br>• Faculty may propose and approve changes to PEOs |
| Fall IAB meeting | • If changes to PEOs have been proposed and approved by EERE faculty, they are presented to IAB for consideration and approval or revision. |
| BSREE Closing the Loop (CTL) meeting | • If PEO changes have been approved by EERE faculty and IAB, they are announced and included in Assessment Report.<br>• New PEOs are submitted for update on the website and catalog for following academic year. |

### 2.7 Institutional Assessment and ISLOs

In addition to program-level student outcomes, Oregon Tech has defined and regularly assesses university-wide

student outcomes. These are commonly referred to as Essential Student Learning Outcomes (ISLOs) and are linked to the general education requirements which are common to all majors. A description of the ISLOs can be found at https://www.oit.edu/academic-excellence/GEAC/essential-studies/eslo.

Oregon Tech's ISLOs support the university's mission. They reflect the common expectations about the knowledge, skills, and abilities that Oregon Tech students will acquire and are reflected in the General Education requirements that lay the foundation upon which the major curricula build. Engaging in these ISLOs will support Oregon Tech graduates in developing the habits of mind and behaviors of professionals and lifelong learners.

Institutional Student Learning Outcomes: Oregon Tech students will:

(ISLO1) ***communicate*** effectively orally and in writing;

(ISLO2) engage in a process of ***inquiry and analysis***;

(ISLO3) make and defend reasonable ***ethical*** judgments;

(ISLO4) collaborate effectively in ***teams*** or groups;

(ISLO5) demonstrate ***quantitative literacy***;

(ISLO6) explore ***diverse perspectives***.

An initial comparison of the ISLOs to the BSREE SOs reveals good alignment between the two sets of outcomes. Both the program level and institutional level outcomes support and complement each other in a synergistic manner. This also facilitates the coordination of assessment and continuous improvement efforts at the program and institutional level. Table 3-3 shows a tentative map of the BSREE student outcomes to the ISLOs. As the table indicates, the student learning outcomes correlate strongly with the ISLOs, with each SO mapping to at least one ISLO.

**Table 5: Mapping between BSREE SOs (1)–(7) and Institutional Student Learning Outcomes (ISLOs)**

| | ***ISLO1:communicate*** effectively orally and in writing | **ISLO2:** engage in a process of ***inquiry and analysis*** | **ISLO3**:make and defend reasonable ***ethical*** judgments | **ISLO4**collaborate effectively in ***teams*** or groups | **ISLO5:**demonstrate ***quantitative literacy*** | **ISLO6:**explore ***diverse perspectives*** |
|---|---|---|---|---|---|---|
| (1) Problem Solving | | X | | | | |
| (2) Design /Broader Factors | | | | | | X |
| (3) Communication | X | | | | | |
| (4) Ethics | | | X | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| (5) Teamwork | | | | X | | |
| (6) Experimentation | | | | | X | |
| (7) Independent Learning | | X | | | | |

### 2.8 Mapping of BSREE Curriculum to Student Outcomes

The table below shows the mapping of the BSREE curriculum to the student outcomes (SOs) (1)-(7), as well as the six institutional ISLOs. For each course, the table indicates whether the outcome is covered at the foundational (F), practice (P), or capstone (C) level. In the case of electives, the student outcomes covered are dependent on the specific elective course selected by the student. They have been marked with X.

**Table 6: Mapping of BSREE curriculum to SOs and ISLOs**

| **BSREE Student Outcomes** | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| **Institutional Student Learning Outcomes** | ISLO2 | ISLO6 | ISLO1 | ISLO3 | ISLO4 | ISLO5 | ISLO2 |
| **BSREE Curriculum** | | | | | | | |
| **Communication** | | | | | | | |
| SPE 111: Public Speaking | F | | F | | | | |
| SPE 321: Small Group & Team Comm. | | | P | | F | | |
| WRI 121: English Composition | F | | F | | | | |
| WRI 227: Technical Report Writing | P | | P | | | | |
| WRI 3xx/4xx: Adv. Writing Elective | P | | C | | | | |
| **Math/Science** | | | | | | | |
| MATH 251: Differential Calculus | F | | | | | F | |
| MATH 252: Integral Calculus | P | | | | | P | |
| MATH 254: Vector Calculus I | C | | | | | C | |
| MATH 321: Applied Differential Eq. I | C | | | | | C | |
| MATH 341: Linear Algebra I | C | | | | | C | |
| MATH 361: Statistical Methods I | C | | | | | C | |
| CHE 201/4: General Chemistry I & Lab | F | | | | F | F | |
| CHE 202/5: General Chemistry II & Lab | F | P | | | | P | |
| CHE 260: Electrochemistry for RE applications | | | | | C | P | F |
| PHY 221: General Physics w/ Calculus | F | | | | F | F | |
| PHY 222: General Physics w/ Calculus | P | | | | F | P | |
| PHY 223: General Physics w/ Calculus | C | | | | F | C | |
| **General Education** | | | | | | | |
| ECO 20X: Principle of Economics, Macro or Micro | | | | P | | | F |
| HIST 35X: HIST 356: A History of Energy or 357: History of the Electric Grid. | | | F | P | | | P |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Humanities Electives (varies) | X | X | X | X | X | X | X |
| Social Science Electives (varies) | X | X | X | X | X | X | X |
| **Electrical Engineering** | | | | | | | |
| EE 221: Circuits I | F | | F | | F | F | F |
| EE 223: Circuits II | F | | F | | F | F | F |
| EE 225: Circuits III | P | | P | | P | P | P |
| EE 321: Electronics I | P | F | P | | P | P | P |
| EE 461: Control Systems Design | F | | | | | C | P |
| EE 419: Power Electronics | C | | | | C | C | C |
| Engineering Electives (varies) | X | X | X | X | X | X | X |
| **General and Mechanical Engineering** | | | | | | | |
| ENGR 211: Engineering Mechanics: Statics | F | F | F | | | | |
| ENGR 267: Engineering Programming | P | | | | | P | |
| ENGR 355: Thermodynamics | F | F | F | | | | |
| MECH 318: Fluid Mechanics I | P | | F | | F | P | |
| MECH 323: Heat Transfer I | P | | | | | F | |
| **Renewable Energy Engineering** | | | | | | | |
| ENGR 101: Intro. to Engineering I | F | F | F | F | F | | F |
| ENGR 102: Intro. to Engineering II | F | F | F | F | F | | F |
| REE 243: Electric Power | F | P | F | | F | F | F |
| REE 253: Electromechanical Energy Conversion | F | P | F | | F | F | F |
| REE 33X: REE 331: Fuel Cells, 333: Batteries or 335: Hydrogen | F | | P | | F | C | P |
| REE 337: Materials for RE Applications | P | | | | | | F |
| REE 412: Photovoltaic Systems | C | C | F | F | F | C | C |
| REE 413: Electric Power Conversion Systems | C | | | | C | C | C |
| REE 463: Energy Systems Instrumentation | C | C | C | C | C | C | |
| REE 4XX: Senior Sequence I | F | P | | | F | F | |
| REE 4XX: Senior Sequence II | F | F | | F | C | P | F |
| REE 4XX: Senior Sequence III | F | F | P | P | F | | |
| **Senior Project and Technical Electives** | | | | | | | |
| ENGR465: Capstone Project | C | C | C | C | C | C | C |
| REE 42X: Global Energy Issues Elective | X | X | X | X | X | X | X |
| REE XXX: Thermal Energy Elective | X | X | X | X | X | X | X |
| REE 3XX/4XX: REE Technical Electives | X | X | X | X | X | X | X |
| REE 3XX: Hydro Energy Elective | X | X | X | X | X | X | X |

# 3 Cycle of Assessment for Program Outcomes

## 3.1 Introduction

In BSREE, assessment of the program outcomes is conducted over a three year-cycle, as shown in Table 7. The assessment cycle was last revised in AY2018-19, when the program transitioned from the previous ABET SOs (a)-(k) to the new ABET SOs (1)–(7).

In addition to the program outcomes scheduled for a particular year, assessment is also performed for Oregon Tech's Institutional Student-Learning Outcomes (ISLOs) that are scheduled for that year by the Executive Assessment Committee.

The BSREE student outcomes (1) – (7) for the historic, present and future years are presented in table 7. The current year is shown as a shaded column.

**Table 7: BSREE student outcome assessment cycle**

| Student Outcome | YEAR 1 (2019/20) | YEAR 2 (2020/21) | YEAR 3 (2021/22) | Year 4 (2022/23) | Year 5 (2023/24) | Year 6 (2024/25) |
|---|---|---|---|---|---|---|
| (1) Problem Solving<br>ISLO2 Inquiry & Analysis | ● | <br>**x** | ●<br>**x** | | ●<br>**x** | |
| (2) Design/Broader Aspects<br>ISLO6 Diverse Perspectives | x | ● | | ●<br>**x** | | |
| (3) Communication<br>ISLO1 Communication | ● | | | | | ●<br>**x** |
| (4) Ethics<br>ISLO3 Ethical Reasoning | | ● | ●<br>**x** | | | ●<br>**x** |
| (5) Teamwork<br>ISLO4 Teamwork | | ● | ●<br>**x** | | | ●<br>**x** |
| (6) Experimentation<br>ISLO5 Quantitative Literacy | ● | ●<br>**x** | ●<br>**x** | | ●<br>**x** | |
| (7) Independent Learning<br>ISLO2 Inquiry & Analysis | | ●<br>**x** | | | ●<br>**x** | |

Bullets ( ● ) indicate BSREE SO (1) – (7) assessment cycle. Crosses ( x ) indicate ISLO assessment cycle

## 3.2 Methodology for Assessment of Student Outcomes

At the beginning of the academic year (typically at the Fall Convocation meeting), an assessment plan is generated by the Assessment Coordinator in consultation with the faculty. This plan includes the outcomes to be assessed during the academic year, as well as the courses and terms where these outcomes will be assessed. The BSREE curriculum is mapped to student outcomes and program educational objectives in a systematic way, as described in the previous chapter (Table 6). This facilitates the task of selecting adequate courses to perform assessment of each outcome. The target for EERE programs is to perform at least two direct assessments (one at each campus) for each outcome under assessment, according to the assessment cycle presented in Table 7, as well as one indirect assessment measure for all outcomes (1) – (7) every year (through a senior exit survey).

### 3.2.1 Collection of assessment data

Direct assessment of student outcomes are evaluated as part of the course curriculum in course assignments by the faculty members teaching the course. A systematic, rubric based process is used by faculty to assess the

level of attainment of the program outcome, based on a set of performance criteria. . The BSREE rubrics were collectively created and are periodically reviewed by the program faculty. For consistency, the same rubric is used for all assessments of a particular outcome. The complete set of rubrics for all SOs are included at the end of every assessment report. The work produced by each student in the assignment assessed is evaluated according to the different performance criteria listed in the rubric, and assigned a level of 1-developing, 2-accomplished, or 3-exemplary. The results are summarized in a document including a description of the assignment and how it relates to the outcome, as well as a summary of the results in tabular form.

In addition to direct assessment measures, indirect assessment of the student outcomes is performed on an annual basis through a senior exit survey. The survey is sent to graduating seniors in Spring term, and it includes questions where students are asked to indicate their level of preparedness in each of the SOs, as well as their opinion regarding to what extent the program has helped them to attain each of the student outcomes. For each of the outcomes, graduates rate their preparedness on a 3-point scale: "inadequately prepared", "prepared", or "highly prepared".

### 3.2.2 Evaluation of Assessment data

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 as well as the courses and terms where these outcomes will be assessed.

The BSREE mapping process links specific tasks within BSREE 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.

### 3.2.3 Assessment Report and Curriculum Changes

Degree completion, retention and equity data are also collected by the university and annually reviewed by the program faculty as part of an initiative to identify and close equity gaps. This is done through the use of the university's dashboards, which all to track the 6-year graduation rates as well as the 1-year retention rates, and sort this data along different demographic categories such as gender, race and socio-economic status. At the closing-the-loop meeting, program faculty review the equity data for their program to identify trends or equity gaps. Potential ways to address these are discussed and appropriate action plans are developed as needed.

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 assessment report for the particular program, which is reviewed by the Department Chair and submitted to the Office of Academic Excellence for the university, which also reviews it and subsequently publishes it on the program website. Any suggested changes to the curriculum are presented and discussed with the department faculty as well as with the Industry Advisory Board at the following IAB meeting. If approved, these changes are implemented in the curriculum. For changes that affect the curriculum map, course descriptions, or course pre-requisites, the Program Director submits the necessary paperwork to the university Curriculum Planning Commission (CPC) for final approval. If approved, these changes are reflected in the catalog for the following academic year.

# 4 Assessment Data

## 4.1 Direct Assessment

The following student outcomes were assessed in the 2021-22 academic year in the courses indicated:

- (1)Problem Solving (ISLO2 Inquiry & Analysis): REE412 (PM)
- (4)Ethics (ISLO3 Ethical Reasoning): REE454 (KF)
- (5)Teams (ISLO4 Teamwork): ENGR 465(KF), REE413 (PM)

- (6)Experimentation (ISLO5 Quantitative Literacy): EE461 (KF)

The sections below describe the 2021-22 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 1- developing level, 2- accomplished level, and 3- exemplary level for each performance criteria, as well as the percentage of students performing at an accomplished level or above (i.e., assessed level ≥ 2).

The target attainment level for all outcomes is 80% of students at or above a level 2 (Accomplished). All direct assessment was performed using the rubrics in section 6 (Rubrics).

### 4.1.1 Direct Assessment of Outcome (1): Problem Solving

Outcome: An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

REE 412, Winter 2022, Dr. Slobodan Petrovic – Portland Metro

This outcome was assessed in REE 412 in Winter 2022 by means of a project. The project consisted of designing a complete distributed PV system with battery storage, including sizing battery storage, PV arrays, charge controllers, inverters, and wiring. Students were also provided with suggested locations and were required to justify the use of a PV system for a particular application. In summary, the students were expected to identify, analyze, and solve a set of technical problems related to implementation of photovoltaic systems.

Six students were assessed in Winter 2022 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 8 summarizes the results of this targeted assessment. The results indicate that the minimum acceptable performance level of 80% was NOT met on all performance criteria for this program outcome, that is, less than 80% of students were able to identify, analyze, and solve technical problems. The result has been unusual for this class and can be considered an anomaly since this has been the first time in over 10 years that a minimum acceptable performance has not been met, However, a special attention will be assigned to this class in the following years to monitor the performance and implement adjustments if necessary..

**Table 8 - Outcome (1): REE 412, Winter 2022, Dr. Slobodan Petrovic; N=6**

| CRITERIA | 1-DEVELOPING | 2-ACCOMPLISHED | 3-EXEMPLARY | % STUDENT ≥2 |
|---|---|---|---|---|
| **ABILITY TO IDENTIFY A COMPLEX ENGINEERING PROBLEM** | 2 | 3 | 1 | 66.67% |

| | | | | |
|---|---|---|---|---|
| **ABILITY TO FORMULATE A COMPLEX ENGINEERING PROBLEM BY APPLYING PRINCIPLES OF ENGINEERING, SCIENCE AND MATHEMATICS** | 1 | 3 | 2 | 83.33% |
| **ABILITY TO SOLVE A COMPLEX ENGINEERING BY APPLYING PRINCIPLES OF ENGINEERING, SCIENCE AND MATHEMATICS** | 3 | 1 | 2 | 50.00% |

### 4.1.2 Targeted Assessment for Outcome (4): Ethics

Outcome: An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

**REE 454, Winter 2021, Dr. Eklas Hossain – Klamath Falls**

This outcome was assessed using a quiz that presented some ethical situations and dilemmas in the REE454: Power Sys Protection & Control Class (Winter 2022). The students had the role of an electrical engineer where they needed to go through the details of electrical codes and standards (NEC, NESC, NFPA) and select appropriate standards for different applications. The problem centered around mathematical calculations regarding appropriate cable/conductor selection, safety measurement and its standards, influence of temperature, Energy Storage Systems with some ethical dilemmas presented. Students were asked to read the IEEE Ethics Code, Identify the violation(s) and describe how they would respond.

Nine (9) students were assessed in Winter 2022 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 proficiency or high proficiency 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, over 80% of students were able to identify and perform the professional, ethical, and social responsibilities while carrying out their assigned tasks.

**Table 9 – Outcome (4) : REE 454, Winter 2022, Dr. Eklas Hossain; N= 9**

| **Performance Criteria** | 1-Developing | 2-Accomplished | 3-Exemplary | % student >1 |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| ABILITY TO RECOGNIZE ETHICAL AND PROFESSIONAL RESPONSIBILITIES IN ENGINEERING SITUATIONS | 1 | 3 | 5 | 88.89% |
| ABILITY TO JUDGE THE IMPACT OF ENGINEERING SOLUTIONS ON GLOBAL, ECONOMIC, ENVIRONMENTAL, AND SOCIETAL CONTEXTS | 1 | 1 | 7 | 88.89% |
| ABILITY TO IDENTIFY GLOBAL, ECONOMIC, ENVIRONMENTAL, AND SOCIETAL CONTEXTS IN ENGINEERING SITUATIONS | 0 | 3 | 6 | 100% |

### 4.1.3 Targeted Assessment for Outcome (5): Teams

Outcome: An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

**REE 413, Spring 2022, Dr. Chitra Venugopal – Portland Metro**

This outcome was assessed in REE 413 Electric Power Conversion System - Spring 2021. The outcome was assessed using the course Electric Power Conversion Systems. This assessment was done in the project which as team based. A common project, "Analysis of PV Array with MPPT-Boost Converter" was given to the entire class. There were 8 students in the class. Three teams were formed with 3 members in 2 groups and 2 members in one grope. Each section of the project was discussed in the lecture with similar topics throughout the course. Students were asked to do a power point presentation and submit a group report. The guidelines of report and important section that needed to be addressed during the presentation were given at the first lecture. Students were asked to run the given project using Matlab software and discuss the answers for the questions during the presentation session. Students teamed up to work on the project and engaged in discussions sections related to the project during and after lecture sessions. In week 10, each team presented the project. Each member of team selected a section of the project and completed their parts, resulting in the completion of the whole work as teams. All the teams successfully presented the project and submitted the report addressing the questions and important points related to the topic.

8 students were assessed in term Spring 2021 using the performance criteria listed below. The minimum acceptable performance level was to have 80% of the students performing at the accomplished or exemplary level in all performance criteria.

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 function on multi-disciplinary teams. It is observed that student teamwork was improved significantly through this project assessment.

**Table 10 – Outcome (5): REE 413, Spring 2021, Dr. Chitra Venugopal, N = 8**

| Performance Criteria | 1-Developing | 2-Accomplished | 3-Exemplary | % student≥ 2 |
|---|---|---|---|---|
| **ABILITY TO PROVIDE TEAM LEADERSHIP** | 0 | 1 | 7 | 100% |
| **ABILITY TO CREATE A COLLABORATIVE AND INCLUSIVE ENVIRONMENT AS A TEAM MEMBER** | 0 | 0 | 8 | 100% |
| **ABILITY TO ESTABLISH GOALS, PLAN TASKS, AND MEET OBJECTIVES AS A TEAM MEMBER** | 0 | 0 | 8 | 100% |

### 4.1.4 Targeted Assessment for Outcome (5): Teams

Outcome: An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

**ENGR 465, Spring 2022, Dr. Feng Shi – Klamath Falls**

The outcome was assessed using the senior capstone projects of ENGR465 III Spring 2022. All senior projects are team based. The student teams are formed through two different ways. (1) Senior project topics are offered by course advisor or external sponsors for students to select. The advisor and external sponsors give presentations to introduce the background of the offered projects. Then students register for their selected projects. During this process, students may randomly register for some projects and the students who register for the same project form a team or students team up to register for a project. (2) Students team up and propose their own projects. In the senior project sequence of 2021-2022 Academic Year, 2 student teams are formed and work on 2 different projects, namely, "Design, Development, And Implementation of an Off-Grid Guest House", And "Wheelchair Iphone Charger". The interdisciplinary teams are formed. The students from electrical engineering, and renewable energy engineering, teamed up to work on the interdisciplinary projects. The student groups were asked to give three presentations to demonstrate their project progresses and submit written report to conclude their project. Students are also required to prepare and attend the student senior project symposium as a team.

7 senior students were assessed in term Spring 2022 using the performance criteria listed below. The minimum acceptable performance level was to have 80% of the students performing at the accomplished or exemplary level in all performance criteria.

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 function on multi-disciplinary teams. It is observed that student teamwork was improved significantly through senior capstone project.

**Table 11 – Outcome (5): ENGR 465, Spring 2022, Dr. Feng Shi; N= 10**

| Performance Criteria | 1-Developing | 2-Accomplished | 3-Exemplary | % student ≥2 |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| **ABILITY TO PROVIDE TEAM LEADERSHIP** | 0 | 2 | 8 | 100% |
| **ABILITY TO CREATE A COLLABORATIVE AND INCLUSIVE ENVIRONMENT AS A TEAM MEMBER** | 0 | 2 | 8 | 100% |
| **ABILITY TO ESTABLISH GOALS, PLAN TASKS, AND MEET OBJECTIVES AS A TEAM MEMBER** | 0 | 2 | 8 | 100% |

### 4.1.5 Targeted Assessment for Outcome (6): Experimentation

Outcome: an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

**EE 461, Spring 2021, Dr. Eklas Hossain – Klamath Falls**

This outcome was assessed in EE461 – Control System Engineering in Spring 2022 by means of a Hardware Project. The project's main objective was to create a hardware model of a line-following robot, which necessitated knowledge of the design of an obstacle-avoiding robot based on the control system and engineering programming knowledge. It tested the amount of knowledge the student had on control algorithms, programming languages and electrical circuitry.

Twelve (12) students were assessed in Spring 2022 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, over 80% of students were able to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions while carrying out their assigned tasks.

**Table 12 – Outcome (6): EE 461, Spring 2022, Dr. Eklas Hossain; N= 12**

| Performance Criteria | 1- Developing | 2- Accomplished | 3-Exemplary | %Students ≥2 |
|---|---|---|---|---|
| **DEVELOPING AN EXPERIMENT** | **2** | **4** | **6** | **83.33%** |

| | | | | |
|---|---|---|---|---|
| **ABILITY TO DEVELOP AND CONDUCT AN EXPERIMENT** | **0** | **3** | **9** | **100.00%** |
| **ABILITY TO USE ENGINEERING JUDGEMENT TO DRAW CONCLUSIONS** | **1** | **2** | **9** | **91.67%** |

### 4.2 Indirect Assessments

In addition to direct assessment measures, student outcomes (1)-(7) were indirectly assessed through a senior exit survey of graduating students.

The following questions were posed to the BSEE graduating class for each of the outcomes listed above as part of the Senior Exit Survey:

- Q1 Rate your proficiency in the following areas
- Q2 Rate how much your experiences at Oregon Tech contributed to your knowledge, skills, and personal development in these areas

Students are asked to rate their proficiency in each of the program outcomes as well as the contribution of Oregon Tech to their attainment of each outcome on a 4-point scale (0-lowest to 3-highest). The departmental objective is to have at least 80% of participants give a rating of 2 or 3 in both questions.

Figure 1 and 2 show the results of the indirect assessment of the BSREE student outcomes for the 2021-22 graduating class. A total of 7 BSREE graduating seniors completed the survey, with respondents indicating that as a result of completing the BSREE program they feel proficient or highly proficient in each of the student outcomes. In indirect assessment Q1, more than 80% of the students rated themselves as "Proficient" or "Highly Proficient" in all categories except in outcomes (4) Ethics and (7) Independent learning. Only 71.46% and 71.43% expressed High Proficiency or Proficiency in Ethics and Independent learning respectively. In indirect assessment Q2, more than 80% of the students responded that Oregon Tech contributed to their knowledge, skills and personal development areas and rated 3 – very much or 2 – Quite a bit except in outcomes (3) Communication and (5) Teamwork. The results were discussed were discussed by the faculty in the closing the loop meeting (see section 5).

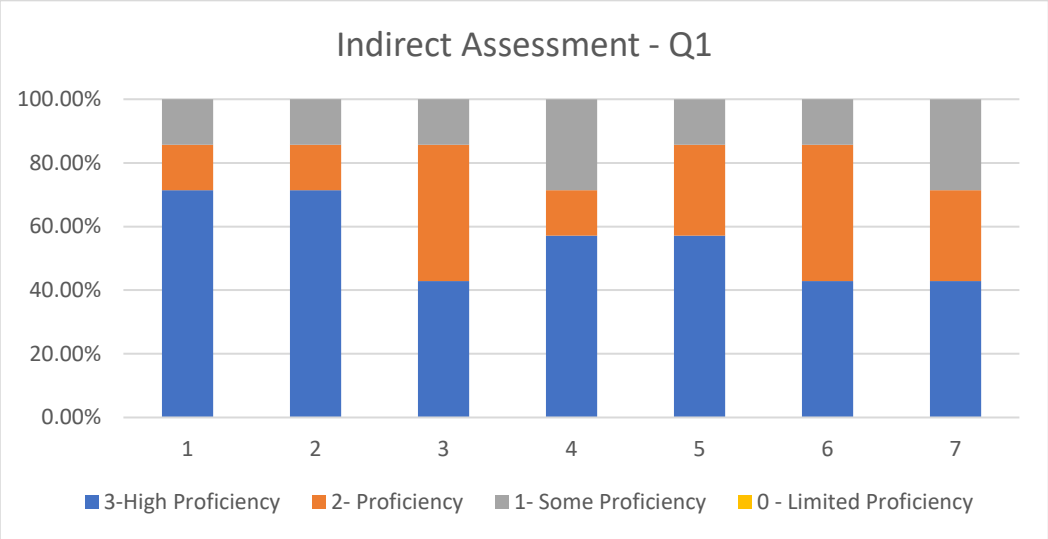


Figure 1: Results of Indirect assessment, Q1: Rate your proficiency in the following areas (N=7)

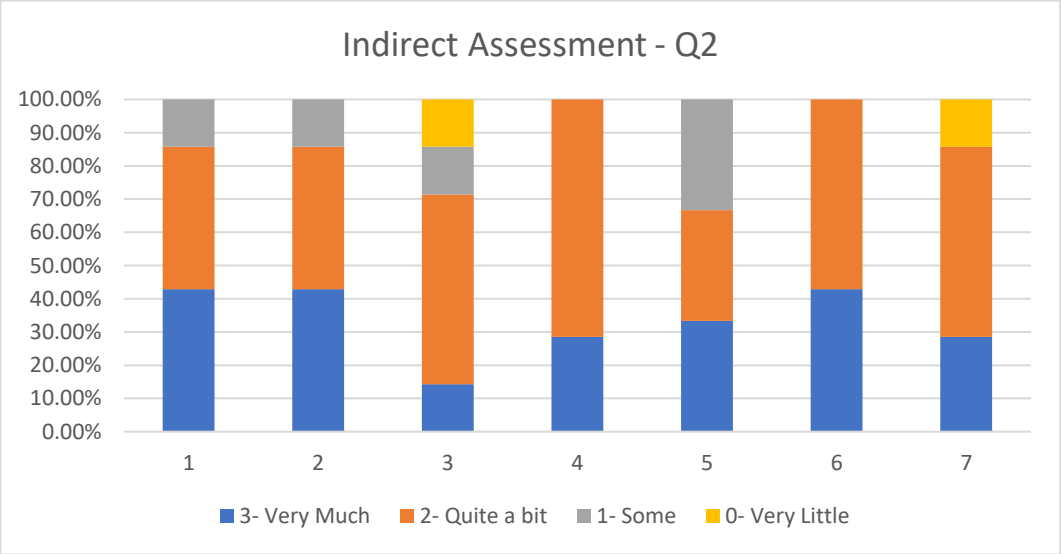


Figure 2: Results of indirect assessment, Q2: Rate how much your experiences at Oregon Tech contributed to your knowledge, skills, and personal development in these areas (N=7)

## 5. Degree Completion, Retention and Equity Data

The university has implemented several dashboards to track 6-year graduation data and 1-year retention data to identify and close the equity gaps in different categories such as gender, race and socio-economic status. Figure 3 shows the 6-year degree completion rates of students starting their degree in Fall 2011 through Fall 2015. Figure 4 shows the 4th term retention rates for students starting at Oregon Tech in Fall 2015 through Fall 2019. The 4th term retention rate represents the proportions of students who were still enrolled at Oregon Tech four terms after their start of the term ( excluding the summer term). Both sets of data are presented for three student populations: (1) BSREE students, (2) College of ETM students, and (3) all Oregon Tech students. By

overlapping these 3 populations, we can identify whether there are trends that pertain specifically to BSREE students, or whether they follow the overall college or university trend.

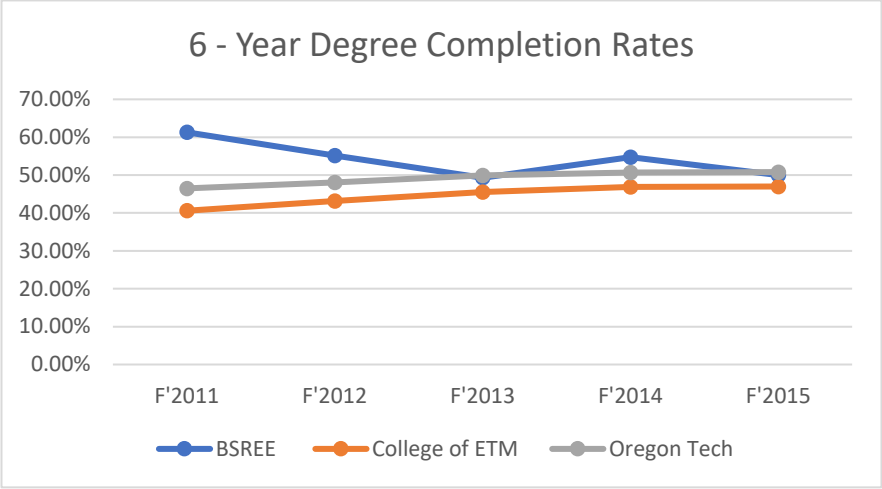


Figure 3: 6- year degree completion rates for students who started at Oregon Tech in Fall 2011 through Fall 2015.

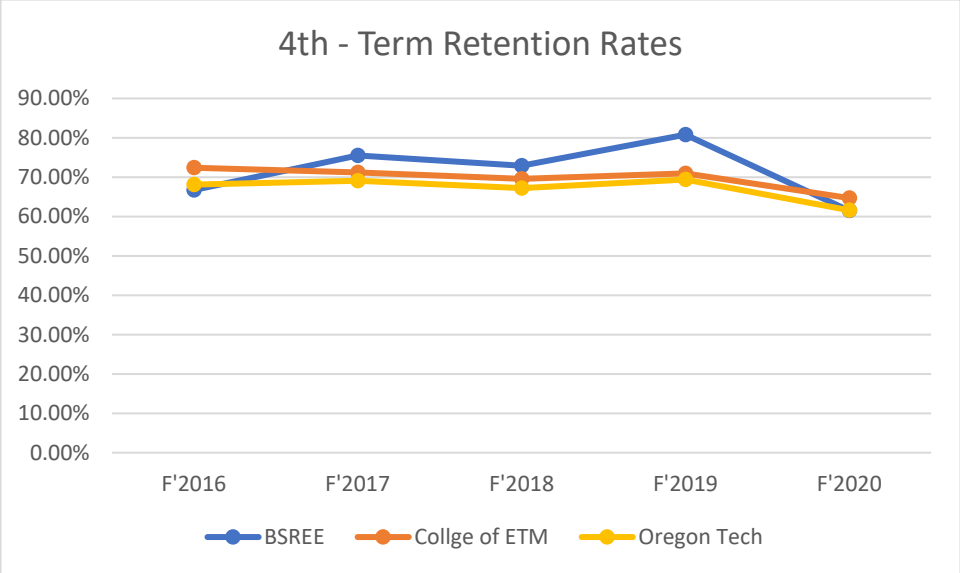


Figure 4: 4th term retention rates for students who started at Oregon Tech in Fall 2015 through Fall 2020.

For the 6-year degree completion rate and 4th – term retention rate, the BSREE program seems to follow a similar pattern to the College of ETM and the overall university, with slightly higher values in F'2017, 18 and 19.

From the current dashboards, it was difficulty to extract meaningful information regarding equity in the degree completion and retention rates. The main problem is that the data is currently displayed as absolute numbers, instead of proportions or percentages. For example, out of the 36 students who started their BSREE degree in Fall 2015, 20 students graduated in 6 years. Per the dashboard, 1 out of these 20 students were classified as "female" and 10 as "male" (with males outnumbering females), it is expected that the absolute number of males completing their degree within 6 years will exceed the number of females. Without knowing the male:female proportion in the original cohort of 36 students, it is difficult to establish whether there is an equity gap between the degree completion rates based on gender. This same principle applies to all equity categories.

# 6. Continuous Improvement and Closing – the – Loop

## 6.1 Summary of Assessment Results

Table 13 provides a summary of the 2020-21 assessment results for the outcomes which were directly assessed. The objective set by BSREE department is at least 80% of the students perform at the level of (2) accomplished or (3) exemplary in all performance criteria of the assessed outcomes.
The changes resulting from the assessment activities carried out during the year 2020-21. 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.

**Table 13 - Summary of BSREE direct assessment for 2021-22**

| Student Outcome | AY18-19 | AY19-20 | AY20-21 | AY21-22 | Outcome Met? |
|---|---|---|---|---|---|
| **(1) Problem Solving ISLO2 Inquiry and analysis** | | N = 8 N = 11 | | N=6 | |
| 1.1 Identify | | 87.5% 81.82% | | 33% | No |
| 1.2 Analyze | | 100% 90.91% | | 33% | No |
| 1.3 Solve | | 87.5% 90.91% | | 66.7% | No |
| **(2) Design/Broader Factors ISLO6 Diverse Perspectives** | | | N=19 N = 13 | | |
| 2.1 Engineering design | | | 89.47% 92.31% | | Yes |
| 2.2 Broader Factors | | | 94.74% 92.31% | | Yes |
| **(3) Communication ISLO1 Communicate** | N=8 N=8 | N = 11 | | | |
| 3.1 Oral | 87.5% 87.5% | 90.91% | | | Yes |
| 3.2 Acquiring information | 100% 87.5% | 90.91% | | | Yes |
| 3.3 Written | 87.5% 100% | 100% | | | Yes |
| **(4) Ethics ISLO4 Ethical thinking** | N=8 | | N=9 | N=9 | |
| 4.1 Recognize | 85.71% | | 100% | 88.89% | Yes |
| 4.2 Identify | 92.86% | | 100% | 88.89% | Yes |
| 4.3 Judge | 92.86% | | 100% | 100% | Yes |
| **(5) Teamwork ISLO5 Teams** | N=11 N=16 | | N=8 | N=15 N =10 | |

| | | | | | |
|---|---|---|---|---|---|
| 5.1 Leadership | 90.91% 93.75% | | 100% | 93.33% 100% | Yes |
| 5.2 Collaboration | 90.91% 87.50% | | 100% | 93.33% 100% | Yes |
| 5.3 Effectiveness | 81.82% 100% | | 100% | 93.33% 100% | Yes |
| **(6) Experimentation ISLO6 Quantitative Literacy** | N=15 | N=19 | N=15 | N = 12 | |
| 6.1 Develop | 86.67% | 100% | 100% | 83.33% | Yes |
| 6.3 Analysis | 93.33% | 100% | 100% | 100% | Yes |
| 6.5 Conclusion | 93.33% | 89.4% | 93.3% | 91.67% | Yes |
| **(7) Independent Learning ISLO2 Inquiry and analysis** | | | N=8 N=14 | | |
| 7.1 Acquire new knowledge | | | 100% 92.86% | | Yes |
| 7.2 Apply | | | 100% 100% | | Yes |

### 6.2 Evaluation of Results and Proposed Changes

The results of the 2021-22 Assessment indicate that the minimum acceptable performance level of 80% was met on all performance criteria for all assessed outcomes except outcome in (1). Areas of improvement to the curriculum were discussed during the Closing the Loop Meeting in October 22, 2020 with respect to these results. These areas include:

- **Outcome (1): Problem Solving**

  **Outcome assessed in**

  **Results:** The results show that the threshold of attainment of this outcome was NOT met in all performance criteria. These results are anomalous and not consistent with those obtained the last time this outcome was assessed.

  **Action Plan:** The faculty identified a problem with this outcome, and therefore recommends special attention and monitoring of this outcome. If the similar result is obtained in the following year it is recommended that a detailed analysis is performed.

  **Person in Charge, Deadline: Slobodan Petrovic, Winter 2023.**

- **Outcome (4) Ethics**

  **Outcome assessed in REE454 in KF**

  **Results:** The results show that the threshold of attainment of this outcome was exceeded in all performance criteria.

  The faculty identified no problem with this outcome, and therefore recommended no changes at this time. However, indirect assessment reflects only 71.43% responded as proficient in this area but 100% said that Oregon Tech contributed to their knowledge in this area.

  **Action Plan:** Faculty proposed to provide students more opportunities to develop their ethical

judgement by including some coverage of ethics in other courses throughout the curriculum. An ethics module will be added to EE461

**Person in Charge, Deadline:** Robert Melendy, Spring 2023

- **Outcome (5) Teamwork**
  **Outcome assessed in REE413 in PM and ENGR 465 in KF**

  **Results:** The results show that the threshold of attainment of this outcome was exceeded in all performance criteria. The faculty identified no problem with this outcome, and therefore recommended no changes at this time. However, Indirect assessment reflects more than 80% responded as proficient in this area but less than 67% said that Oregon Tech contributed to their knowledge in this area.

  **Action Plan:** Team forming method will be more formalized to make it uniform for the entire class.

  **Person in charge, Deadline:** Dr. Feng Shi, Fall 2022.

- **Outcome (6) Experimentation**
  **Outcome assessed in EE 461 in KF**

  **Results:** The results show that the threshold of attainment of this outcome was exceeded in all performance criteria. Indirect assessment reflects high ratings in this area (≥ 80%).

  **Action Plan:** None. Outcome will be reassessed per assessment cycle

  **Person in charge, Deadline:** N/A

## 7. Program Enrollment and Graduation Data

The enrollment in BSREE are steadily decreasing from AY2019-20 in both campuses. Data in Table 1 and 2 reflect there was 10% decrease in AY2019-20 and 4% decrease in AY2021-22 in KF. The decrease in enrollment in PM was larger than KF with 11 students in AY2020-21 and 20 students in AY2021-22. The graduation rate in Portland-metro campus reminded fairly stable as a proportion of enrollment (≤25%) whereas in Klamath Falls the graduation rate is less than 12%.

Further analysis of the 2021-22 exit survey report participated by 7 BSREE students indicates that 30.43% of them are attracted to Oregon Tech because of the degree offerings. Regarding the student advising, 42.86% of the students expressed are satisfied. with availability of faculty advisor and faculty advisor's assistance in choosing courses. There were 71.43% of students mentioned that they were planning to take FE exams within next year.

**Action Plan**: Continue to monitor enrollment data and collaborate with Admissions on recruiting and registration events

**Person in charge, Deadline**: Chitra Venugopal, Aaron Scher

## 8. Degree Completion, Retention Data and Equity Data

For the 6-year degree completion rate of BSREE follows a similar pattern to the College of ETM and the overall university, with slightly higher values than College of ETM (50.9) and the overall university (46.9) in 2014. See figure 3.

The 4th – term retention rate, the BSREE program seems to follow a similar pattern to the College of ETM and the overall university, with higher values in compared to College of ETM (71%) and the overall university (69.4%) in 2019. See figure 4.

**Action Plan**: Request for faculty positions to cover those of faculty who have recently resigned to continue to ensure program quality

**Person in charge, Deadline**: Scott Prahl, Fall 2022

Equity Data showed in dashboards not yet updated to reflect proportions in equity data, so it is not easy to draw meaningful conclusions.

**Action Plan:** Cristina Crespo brought this up to the Executive Assessment Commission and will be working with the Director of Institutional Research to update dashboards to report equity data in a way that is informative.

**Person in Charge, Deadline:** Cristina Crespo, Fall 2022.

No other program changes are recommended at this time.

## 9. Review of Implementation of Changes from Prior Assessments

Below is the status of implementation of recommendations for changes based on prior assessments

The results of the 2020-21 Assessment indicate that the minimum acceptable performance level of 80% was met on all performance criteria for all assessed outcomes. Areas of improvement to the curriculum were discussed during the Closing the Loop Meeting in October 22, 2021 with respect to these results.

Outcomes (2), (4), (5), (6), and (7) were assessed. The faculties identified no problem with theses outcomes, and therefore recommended no changes at this time.

# Appendix:

**Table A1: Rubric for EAC-1- An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics**

| CRITERIA | 1-DEVELOPING | 2-ACCOMPLISHED | 3-EXEMPLARY | SCORE |
|---|---|---|---|---|
| **ABILITY TO IDENTIFY A COMPLEX ENGINEERING PROBLEM** | An engineering problem is not identified, or the identification is too vague or unclear. | An engineering problem of reasonable complexity is adequately identified and its significance minimally explained. | A complex engineering problem is properly identified and clearly stated. Its significance is thoroughly explained. | |
| **ABILITY TO FORMULATE A COMPLEX ENGINEERING PROBLEM BY APPLYING PRINCIPLES OF ENGINEERING, SCIENCE AND MATHEMATICS** | A complex engineering problem is not properly formulated in engineering, scientific, and/or mathematical terms. Most of the assumptions and specifications are either missing or unclear. | A complex engineering problem is adequately formulated in engineering, scientific, and/or mathematical terms, but some of the assumptions and specifications may be missing or not clearly presented. | A complex engineering problem is clearly formulated with a valid and complete set of assumptions and specifications. | |
| **ABILITY TO SOLVE A COMPLEX ENGINEERING BY APPLYING PRINCIPLES OF ENGINEERING, SCIENCE AND MATHEMATICS** | The solution to a complex engineering problem is not developed according to engineering, scientific, and mathematical principles, or it does not follow the original set of assumptions and specifications. | The solution to a complex engineering problem is developed according to engineering, scientific, and mathematical principles. The solution reasonably meets most of the original set of assumptions and specifications. | The solution to a complex engineering problem is very well developed according to engineering, scientific, and mathematical principles. The solution meets or exceeds the original set of assumptions and specifications. | |

**Table A2. Rubric for EAC-2- An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors**

| CRITERIA | 1-DEVELOPING | 2-ACCOMPLISHED | 3-EXEMPLARY | SCORE |
|---|---|---|---|---|
| **ABILITY TO APPLY ENGINEERING DESIGN TO PRODUCE SOLUTIONS THAT MEET SPECIFIED NEEDS** | Does not follow the engineering design process, or the designed solution does not meet the specified need(s). | Reasonably follows the engineering design process to produce a solution that adequately meets the specified need(s). | Methodically follows the engineering design process to produce a solution that thoroughly meets the specified need(s). | |
| **ABILITY TO DESIGN SOLUTIONS ACCOUNTING FOR BROADER CONSIDERATIONS, SUCH AS PUBLIC HEALTH, SAFETY, AND WELFARE, AS WELL AS GLOBAL, CULTURAL, SOCIAL, ENVIRONMENTAL, AND ECONOMIC FACTORS** | The solution provided does not take into account broader practical considerations, such as public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. | The solution provided takes into account and partially addresses some of the broader practical considerations, such as public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. | The solution provided takes into account and thoroughly addresses several of the broader practical considerations, such as public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. | |

**Table A3: Rubric for EAC-3- An ability to communicate effectively with a range of audiences**

| CRITERIA | 1-DEVELOPING | 2-ACCOMPLISHED | 3-EXEMPLARY | SCORE |
|---|---|---|---|---|
| **ABILITY FOR EFFECTIVE ORAL COMMUNICATION** | The main ideas are not clearly presented. Low volume or monotonous tone make it hard for audience to engage. Speaker does not transmit any interest or enthusiasm about the topic. | The main ideas are clearly presented. Adequate volume and dynamic tone are used to engage audience. Speaker occasionally transmits interest and enthusiasm about the topic. | Speaker is an excellent communicator. The main ideas are clearly presented. Speaker is eloquent and dynamic, effective at engaging the audience. Speaker displays and transmits a strong interest and enthusiasm about the topic. | |
| **ABILITY FOR EFFECTIVE WRITTEN COMMUNICATION** | Content is disorganized, the main ideas are not clearly stated and developed. Writing style is rough or imprecise. Frequent grammar/spelling errors. Document presentation and format rough or inconsistent. | Content is well organized and the main ideas are clearly stated and reasonably developed. Writing style is adequate for purpose and readable. Grammar/spelling mostly correct. Document presentation and format adequate and consistent. | Content is very well organized and easy to follow, main ideas are clearly presented and thoroughly developed. Writing style is adequate for purpose, readable, and tailored to intended audience. Grammar/spelling correct. Work is professionally presented and very well formatted. | |
| **ABILITY FOR EFFECTIVE GRAPHICAL COMMUNICATION** | Inadequate use of figures, charts, and/or tables to display data. Figures are not well placed, many figures, charts, and tables missing key formatting elements, such as titles, labels, units, captions, etc. Overall, figures do not contribute to a better understanding of key ideas or results. | Adequate use of figures, charts, and tables to display data. Figures are well placed, most figures, charts, and tables are properly labeled and formatted. Figures moderately contribute to a better understanding of key ideas or results. | Excellent use of figures, charts, and tables to display data. All figures, charts, and tables properly labeled and formatted, easy to read and interpret. Figures substantially and effectively contribute to a better understanding of key ideas or results. | |
| **ABILITY TO ADDRESS A RANGE OF AUDIENCES** | Does not address target audience. Content is too technical or too superficial to be | Adequately addresses the target audience. Content has a reasonable balance of technical and non-technical information to be understood | Effectively addresses the target audience. Content has the right balance of technical and non-technical information to be understood | |

| | | | | |
|---|---|---|---|---|
| | understood by and of interest to a wide range of audiences. | by and of interest to a wide range of audiences. | by and of interest to a wide range of audiences. | |

**Table A4: Rubric for EAC-4- An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts**

| CRITERIA | 1-DEVELOPING | 2-ACCOMPLISHED | 3-EXEMPLARY | SCORE |
|---|---|---|---|---|
| **ABILITY TO RECOGNIZE ETHICAL AND PROFESSIONAL RESPONSIBILITIES IN ENGINEERING SITUATIONS** | Description of ethical and professional responsibilities is limited or rudimentary. | Description of ethical and professional responsibilities is substantive. | Description of ethical and professional responsibilities is complete and thorough. | |
| **ABILITY TO IDENTIFY GLOBAL, ECONOMIC, ENVIRONMENTAL, AND SOCIETAL CONTEXTS IN ENGINEERING SITUATIONS** | Identifies a single context area relevant in an engineering situation. Explanation of the context is rudimentary. | Identifies most context areas relevant in an engineering situation. Explanation of the contexts is substantive. | Identifies all context areas relevant in an engineering situation. Explanation of contexts is complete and thorough. | |
| **ABILITY TO JUDGE THE IMPACT OF ENGINEERING SOLUTIONS ON GLOBAL, ECONOMIC, ENVIRONMENTAL, AND SOCIETAL CONTEXTS** | Analysis and judgement of the impact of engineering solutions on contexts is rudimentary. | Analysis and judgement of the impact of engineering solutions on contexts is substantive. | Analysis and judgement of the impact of engineering solutions on contexts is complete and thorough. | |

**Table A5: Rubric for EAC-5- An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives**

| CRITERIA | 1—DEVELOPING | 2—ACCOMPLISHED | 3—EXEMPLARY | SCORE |
|---|---|---|---|---|
| **ABILITY TO PROVIDE TEAM LEADERSHIP** | Lacks adequate ability to resolve problems and conflicts. Lacks ability to provide adequate leadership in decision making, planning, and goal setting. Does not show appreciation for other team members' contributions. Exhibits poor team communication skills (e.g., interrupts others, gets defensive, does not ask questions, gets distracted). Does not motivate others or lead by example. | Capable of resolving problems and conflicts. Demonstrates adequate leadership ability in decision making, planning, and goal setting. Occasionally shows appreciation for other team members' contributions. Exhibits reasonable team communication skills. Capable of motivating others. Willing to share problems and progress. Mainly does assigned work instead of willingly taking on additional responsibilities. | Proficient in resolving problems and conflicts and exhibits proficient leadership ability in decision making, planning, and goal setting. Appropriately recognizes and shows appreciation for other team members' contributions. Exhibits proficient team communication skills including good body language and active listening. Transparent about expectations and objectives. Motivates others and leads by example. Willing to share problems and take on additional responsibilities and help others when necessary. | |
| **ABILITY TO CREATE A COLLABORATIVE AND INCLUSIVE ENVIRONMENT AS A TEAM MEMBER** | Rarely uses respectful language or show cooperative communication skills. Does not demonstrate mutual respect and tends to dismiss others' unique perspectives, opinions, or ideas. Does not demonstrate ability and willingness to compromise with other group members. | Generally, uses respectful language and shows cooperative communication skills. Does not disrespect other group members or dismiss their unique perspectives, opinions, or ideas. Demonstrates adequate ability and willingness to compromise with other group members. Does not dismiss the sharing of ideas. | Uses respectful language and shows cooperative communication skills. Actively demonstrates mutual respect and welcomes others' unique perspectives. Demonstrates high ability and willingness to compromise with other group members. Makes other group members feel safe and valued through openly encouraging the sharing of ideas. | |
| **ABILITY TO ESTABLISH GOALS, PLAN TASKS, AND MEET OBJECTIVES AS A TEAM MEMBER** | Lacks basic awareness of team duties and responsibilities. Lacks basic awareness of the links between project goals and tasks. Fails to identify risks to meet project deadlines. | Capable of performing most team duties and responsibilities. Capable of establishing goals and performing necessary talks on time to meet project deadlines and identifies most issues impacting project success. | Proficient execution of all team duties and responsibilities. Proficient in establishing goals and performing necessary tasks on time to meet project deadlines and identifies issues impacting projects success. | |

**Table A6: Rubric for EAC-6- An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions**

| CRITERIA | 1-DEVELOPING | 2-ACCOMPLISHED | 3-EXEMPLARY | SCORE |
|---|---|---|---|---|
| **ABILITY TO DEVELOP AND CONDUCT AN EXPERIMENT** | Demonstrates inadequate knowledge and abilities for conducting experiments with standard test and measurement equipment to collect experimental data. May not observe lab safety and procedures. | Demonstrates adequate knowledge and abilities for conducting experiments. Able to use standard test and measurement equipment to collect experimental data. Reasonably capable of troubleshooting to overcome measurement problems. May require supervision and steering in the right direction. Overall, observes lab safety plan and procedures. | Demonstrates comprehensive knowledge, exceptional abilities, and resourcefulness for conducting experiments. Selects appropriate equipment and measuring devices and methodology for conducting experiments. Demonstrates a proficient ability to troubleshoot, predict and overcome measurement problems. Observes established lab safety plan and procedures. Proposes improvements as necessary. | |
| **ABILITY TO ANALYZE AND INTERPRET DATA** | Demonstrates inadequate knowledge and abilities for analyzing and interpreting experimental results. Reporting methods are unsatisfactory. | Demonstrates adequate abilities for experimental data analysis, interpretation, and visualization. Able to draw some reasonable conclusions based on experimental results. Demonstrates an awareness for measurement error. Reporting methods are satisfactorily organized, logical, and complete | Demonstrates exceptional ability for experimental data analysis, interpretation, and visualization. Able to draw insightful conclusions based on experimental results. Analyzes and interprets data using appropriate theory, accounts for measurement error into analysis and interpretation, reporting methods are well-organized, logical, and complete. | |
| **ABILITY TO USE ENGINEERING JUDGEMENT TO DRAW CONCLUSIONS** | Lacks the ability and awareness for interpreting experimental data to draw meaningful conclusions, decide, act, and/or communicate suggestive actions using of appropriate scientific/engineering principles, standards, and practices. Not adept at navigating complexity, open ended problems, or ambiguous data. | Adequately capable of interpreting experimental data to draw meaningful conclusions, decide, act, and/or communicate suggestive actions based upon the use of appropriate scientific/engineering principles, standards, and practices. May require significant guidance in the face of complexity, open ended problems, or ambiguous data. | Proficient in interpreting experimental data to draw meaningful conclusions, decide, act, and/or communicate suggestive actions based upon the use of appropriate scientific/engineering principles, standards, and practices. Able to make quality engineering decisions/conclusions, especially in the face of complexity, open-ended problems, or ambiguous data. | |

**Table A7: Rubric for EAC-7- An ability to acquire and apply new knowledge as needed, using appropriate learning strategies**

| CRITERIA | 1-DEVELOPING | 2-ACCOMPLISHED | 3-EXEMPLARY | SCORE |
|---|---|---|---|---|
| **ABILITY TO ACQUIRE NEW KNOWLEDGE USING APPROPRIATE LEARNING STRATEGIES** | Shows poor ability and little openness to acquire new knowledge and diagnosing their learning needs. Does not identify proper opportunities or resources to expand knowledge and skills. Unable or uninterested to find new information without significant guidance and prompting. Lacks awareness at one's current knowledge and skills for identifying basic gaps in understanding. Lacks the strategies and motivation necessary for self-directed learning. | Shows sufficient ability and openness to acquire new knowledge and diagnosing their learning needs. Able to identify some opportunities or resources to expand knowledge and skills. Able and interested to find new information, perhaps with some prompting. Uses current knowledge and skills to identify basic gaps in understanding. Exhibits adequate strategies and motivation necessary for self-directed learning. | Demonstrates proficient ability and openness to acquire new knowledge and diagnosing their learning needs. Independently identifies and uses a diverse range of resources to expand knowledge and skills. Able and interested to find new information with minimal prompting. Uses current knowledge and skills to identify key gaps in understanding. Exhibits exemplary strategies and motivation necessary for self-directed learning. | |
| **ABILITY TO APPLY NEW KNOWLEDGE AS NEEDED** | Inadequately unmotivated and skilled at applying new knowledge as needed for decision making, completing tasks, drawing conclusions, and/or understanding a topic in more depth. Insufficiently understands and determines the significance or relevance of the learned information needed for the task. | Adequately motivated and skilled at applying new knowledge as needed for decision making, completing tasks, drawing conclusions, and/or understanding a topic in more depth. Partially understands and determines the significance or relevance of the learned information needed for the task. | Proficiently skilled and motivated at applying new knowledge as needed for decision making, completing tasks, drawing conclusions, and/or understanding a topic in more depth. Understands and determines the significance or relevance of the learned information needed for the task. | |