Renewable Energy Engineering Program
2008-09 Assessment Report

Introduction

The Renewable Energy Engineering program was implemented at the Portland campus in 2005 with an initial enrollment of ten students. As of fall 2008, the program was added at the Klamath Falls campus. The enrollment has grown to 110 students, with 79 students in Portland and 31 students in Klamath Falls in fall 2008.

Program Mission, Objectives and Student Learning Outcomes

During the fall 2008 convocation, the program faculty agreed upon the following mission, objectives and student learning outcomes statements for the program. The objectives were modified in winter 2009 as per suggestions from the ABET 2008 evaluation team.

Program Mission

The Renewable Energy Engineering degree program prepares students for the challenges of designing, promoting and implementing renewable energy systems in society's rapidly-changing energy-related industries. The department will be a leader in providing career-ready candidates for the various renewable and sustainable engineering fields. Faculty and students will engage in applied research in emerging technologies and provide professional services to their communities.

Program Educational Objectives

In support of the mission, the program has the following program educational objectives:

- 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.

Student Learning Outcomes

Students in the Renewable Energy Engineering program must demonstrate:

(a) an ability to apply knowledge of mathematics, science, and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multi-disciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility

(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
(l) an ability to apply the fundamentals of energy conversion and applications
(m) an understanding of the obligations for implementing sustainable engineering solutions
(n) an appreciation for the influence of energy in the history of modern societies

Assessment Cycle for Student Learning Outcomes
The program faculty will assess the student learning outcomes in a three-year cycle according to the schedule shown in the table below.

Outcome	2007/8	2008/9	2009/10	2010/11	2011/12	2012/13
A (Math/Sci)		X			X	
B (LabExp)	X		X			X
C (SysDes)		X			X	
D (Teams)	X	X			X	
E (ProbSol)				X		
F (Ethics)			X			X
G (Comm.)	X		X			X
H (Impacts)			X			X
I (LifeLong)				X		
J (Contemp)				X		
K (EngTools)	X			X		
L(EnergyFund)		X			X	
M (Sustain)			X			X
N (EnergyHist)				X		

Three-year cycle for assessment of student learning outcomes.

Summary of 2008-09 Assessment Activities
During the 2008-09 academic year, the program faculty conducted assessment of five student learning outcomes, summarized below. Additional records of these assessment activities can be found in department records. Appendix A includes mapping of each learning outcome to the curriculum for the program.

Outcome a: an ability to apply knowledge of mathematics, science, and engineering
This outcome was assessed using a mix of sophomore and junior classes in the new EE/REE program. The sophomore courses are a sequence of circuit analysis courses and the junior course was a new semiconductor physics course.

OUTCOME SUMMARY FOR SLO a: An ability to apply knowledge of mathematics, science and engineering									
PERFORMANCE CRITERIA	PERCENTAGE > =2 in a COURSE								AVERAGE
	EE225K	EE225K	EE343K	EE343K	EE223K	EE223P	EE223P		PERCENT
Use of math, science and engineering principles to predict and analyze solve problems.	100%	67%	83.3%	61%	100%	100%	100%		87%
Apply fundamental concepts to solve technical problems	100%	67%	72.2%	72%	100%	100%	94%		86%
Sample Size	5	5	18	18	8	16	16		

The established program target goal is > 80% of the students performing at a satisfactory level (2) or higher (3). The final column is an average of all the course assignments used for an assessment.

STRENGTHS:
The circuits sequence involved some basic calculus applications and complex algebra and the students were very strong here.
WEAKNESSES
The upper division course assignment involved applying some basic principles of probability and statistics to solid state problems. This is one of the first times the students had been exposed to problems of this type. Other data from the Portland campus indicates that this weakness may be due to the group and course selected for evaluation.
RECOMMENDATIONS:
Overall this outcome is being satisfied, but there may be some specialized topic areas that need to be watched.

Outcome b: an ability to design and conduct experiments, as well as to analyze and interpret data.
This outcome was assessed in two lab assignment in EE 223, an AC circuit analysis course. It had been assessed last year and was rechecked for consistency.

OUTCOME SUMMARY FOR SLO b: The ability to design and conduct experiments as well as analyze and interpret data									
PERFORMANCE CRITERIA	PERCENTAGE > 2 in a COURSE								AVERAGE
	EE(223)	EE(223)	CRS	CRS	CRS	CRS	CRS	CRS	PERCENT
Design an experiment	NA	NA							NA
Conduct an experiment	NA	100%							100%
Analyze results and data	94%	100%							100%
Interpret results and data	94%	100%							100%
Improve a design or process		100%							100%
Sample Size	16	16							

The established program target goal is > 80% of the students performing at a satisfactory level (2) or higher (3). The final column is an average of all the course assignments used for an assessment.

STRENGTHS:
The lab portion of the program is a definite strength. The students learn the course material well through lab experiments and mini-projects.
WEAKNESSES:
None noted. Labs are a strength of the program.
RECOMMENDATIONS:
Need to check experiment design in later courses.

Outcome c: an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
This outcome was assessed in an early sophomore circuits class and a later project class for the solar energy course sequence (start of senior year).

OUTCOME SUMMARY FOR SLO c: An ability to design a system, component or process to meet desired needs									
Within realistic constraints such as economic, environmental, social, political etc. (Major Project)									
PERFORMANCE CRITERIA	PERCENTAGE > =2 in a COURSE								AVERAGE
	EE321K	REE412P	CRS	CRS	CRS	CRS	CRS	CRS	PERCENT
Define design problem		100%							100%
Design Strategy	50%	100%							75%
Gathers Information	50%	100%							75%
Employs models/simulations	50%	100%							75%
Evaluates solutions	50%	95%							72%
Selects best design solution	50%								50%
Sample Size	8	16							

The established program target goal is > 80% of the students performing at a satisfactory level (2) or higher (3). The final column is an average of all the course assignments used for an assessment.

STRENGTHS:
The project proposal class had all students perform above the target. This is to be expected in a project based class where the focus is on project design and development.
WEAKNESSES:
The early circuits class had only half of the class reach the outcome target and this is not a major concern at this point. The students have not had much exposure to how to design and develop a project at this time.
RECOMMENDATIONS:
The results from the project proposal class indicate that the program does address this outcome well after some instructional work in this area. The outcome in the future will be assessed only in the upper division courses.

Outcome j: a knowledge of contemporary issues

This outcome was assessed using some report assignments in the Introduction to REE course (a beginning course) and a junior project proposal course on the Portland campus.

OUTCOME SUMMARY FOR SLO j: A knowledge of contemporary issues									
PERFORMANCE CRITERIA	PERCENTAGE > 2 in a COURSE								AVERAGE
	REE412P	REE201P	REE201P	REE339P	CRS	CRS	CRS	CRS	PERCENT
Understands socio-economic issues (relevance)	100%	82%	95%	78%					88.8%
Understands political issues (coverage)	NA	76%	95%	100%					90.3%
Understands environmental issues (Conclusions)	NA	82%	95%	NA					88.5%
Sample Size	16	17	17	7					

STRENGTHS:

Most of the reports did focus well on relating socio-economic, environmental and political issues to energy solutions. Most were well developed and stuck to topic.

WEAKNESSES:

A few of the Intro reports did not relate the solutions to contemporary issues. This can be expected with it being an introduction course. The senior level courses showed improvement.

RECOMMENDATIONS:

None at this current time, will consider assessing only in upper division courses.

Outcome k: an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

This outcome was assessed in winter term of the freshman year in an Introductory Digital Class. This class has a focus on using CAE tools for design, analysis and simulation on lab analysis of digital circuits.

OUTCOME SUMMARY FOR SLO k: An appropriate mastery of knowledge, techniques, skills									
and modern tools of their discipline (Mastery of skills/tools)									
PERFORMANCE CRITERIA	PERCENTAGE > 2 in a COURSE								AVERAGE
	EE223P	CRS	CRS	CRS	CRS	CRS	CRS	CRS	PERCENT
Understands tools & techniques	100%								100%
Applies skills& techniques	94%								94.00%
Use tools & techniques to improve	NA								NA
Sample Size	16								

The established program target goal is > 80% of the students performing at a satisfactory level (2) or higher (3). The final column is an average of all the course assignments used for an assessment.

STRENGTHS:
WEAKNESSES:
RECOMMENDATIONS:
None at this time, assessment scheduled for 2010/11.

Outcome l: an ability to apply the fundamentals of energy
This outcome was assessed in a senior level project based solar energy course (part of a sequence).

OUTCOME SUMMARY FOR SLO l: An ability to apply the fundamentals of energy									
PERFORMANCE CRITERIA	PERCENTAGE > =2 in a COURSE								AVERAGE
	REE412P	CRS	CRS	CRS	CRS	CRS	CRS	CRS	PERCENT
Understand the fundamentals of energy systems	100%								100%
Develop an efficient energy distribution system for a society	100%								100%
Sample Size	7								

The established program target goal is > 80% of the students performing at a satisfactory level (2) or higher (3). The final column is an average of all the course assignments used for an assessment.

STRENGTHS:
By senior year, students have a good grasp on energy engineering fundamentals and this is a strength of the program (a focus).
WEAKNESSES:
None noted
RECOMMENDATIONS:
None at this time except to assess again in the normal cycle.

Outcome Continuous Improvement
(Based on Recommendations in 2007-08 Assessment Report)
During the 2007-08 academic year, the EE faculty assessed the student learning outcomes and recommended improvements that are summarized below.

SLO d: an ability to function on multi-disciplinary teams
Plan for 2008-09: Outcome will be assessed in the normal cycle to collect more samples to draw a better conclusion. (Only one sample in 2007-08 initially). This needs to be assessed in another year's cycle in an upper division class to gauge student performance after the SPE 321 Class when possible. This was assessed again in the winter term after an in class discussion was given on teamwork and communication. It involved a team performance on a circuit analysis problem set and presentation to the class.

OUTCOME SUMMARY FOR SLO d: An ability to function on multi-disciplinary teams									
PERFORMANCE CRITERIA	PERCENTAGE > 2 in a COURSE								
	EE101K	EE101K	EE101K	EE102K	EE102K	CRS			AVG %
Team Development	NA		92%	100%					96%
Team Participation	100%	40%	69%	100%	92%				80%
Team Communication	100%	40%	92%	67%	92%				78%
Reaching a group consensus	100%	100%	92%		92%				96%
Sample Size	18	15	13	12	13				

The established program target goal is > 80% of the students performing at a satisfactory level (2) or higher (3). The final column is an average of all the course assignments used for an assessment.

STRENGTHS:
The student cohort has been together for over one term. They have formed definite study/learning groups and after a teamwork discussion in class (EE102) the students showed a significant improvement at the different performance criteria. The team communication on one assignment was a bit lower than the target but remember this is a freshman class
WEAKNESSES:
No glaring weakness but a concern on the basic team communication skills, but this is expected to improve after some more reinforcing in other classes and the students taking the upper division speech course on group processes.
RECOMMENDATIONS:
Recheck after the student cohort has had a SPE 321 course. No major concern at this point.

SLO g: an ability to communicate effectively
Plan for 2008-09: Outcome will be assessed again in the 2008/09 cycle, this is normally a strength so it needs to be reassessed in the EE102 course after students have taken the freshman speech class (SPE111). It was recommended to assess again after students have SPE 111 or 321. This will be done in a later course when the program has junior or senior classes being offered.

Outcome g: an ability to communicate effectively (A reassessment for 2008/09)
This outcome was assessed previously in winter 2008 in EE102. It should be noted that this is an Introduction to Engineering class and happens before students have a good foundation in speech (SPE 111 Course is later).

OUTCOME SUMMARY FOR SLO g: An ability to communicate effectively									
PERFORMANCE CRITERIA	PERCENTAGE > 2 in a COURSE								
	EE102K	CRS	CRS	CRS	CRS	CRS	CRS	CRS	AVG %
Organizing an Oral Presentation	65%								65.00%
Answering Questions(oral)	70%								70.00%
Performance of presentation(oral)	70%								70.00%
Gathering Information	82%								82.00%
Content and Org.(written)	NA								
Techniques (Written)	NA								
Conclusions (Written)	NA								
Sample Size	17								

The established program target goal is > 80% of the students performing at a satisfactory level (2) or higher (3). The final column is an average of all the course assignments used for an assessment.

STRENGTHS:
None at this point in the program but these are freshman classes that occur before students have had normal course work in a communication course.
WEAKNESSES:
Slightly below the target of 80% but it is expected to improve if assessed in upper division courses.
RECOMMENDATIONS:
Assess later in an upper division course, discontinue in the introduction course except as a point of reference.

APPENDIX
OUTCOME CURRICULUM MAP FOR OUTCOMES A, C, D, (G), L

Outcome a: an ability to apply knowledge of mathematics, science, and engineering

TERM	FRESHMAN			SOPHMORE		
	EE101	Intro Engineering	I	EE221	DC Circuits	R
	MATH251	Diff. Calculus	I	PHY221	Physics I	I
	CHEM201	Chem I	I	CHEM260	Electrochemistry	I
	CHEM204	Chem I Lab	I	MATH321	Diff. Eqns.	I
	WRI121	Comp I				
	SPE111	Speech				
FALL						
	EE102	Intro Engineering	I	EE223	AC Circuits	R
	MATH252	Int. Calculus	I	ECON201/2	Economics	
	ENGR266	Computer Prog.	I	ENGR211	Statics	R
	WRI122	Comp II		PHY222	Physics II	I
	CHEM202	Chemistry II	I			
	CHEM205	Chem. II Lab	I			
WINTER						
	EE103	Intro Engineering	I	EE225	LaPlace Trans.	R
	MATH254N	Vector Calculus	I	PHY223	Physics III	I
	WRI227	Technical Writing		REE243	Electrical Power	R
	SS Elec	Social Science		REE253	Electromech Conv	R
	MATH/SCI	Math/Sci. Elective	I			
	REE201*	Intro to RE	I			
SPRING						

S = Strengthened (Covered strongly)

R = Reinforced (Covered moderately)

I = Introduced (Covered lightly)

Blank = No Coverage

TERM	JUNIOR			SENIOR		
	EE321	Electronics I	R	EE343	Solid State Devices	R
	MECH318	Fluid Mech I	R	REE339	SR Project I	S
	REE331	Fuel Cells	S	REE421	Energy Sys. Des.	S
	REE Elec	RE Elective	S	REE463	RE Instr. and Cont.	R
				REE Elec	RE Elective	S
FALL						
	ENGR355	Thermodynamics	R	EE456	Control Systems	R
	MATH361	Statistics I	I	REE412	PV Systems	S
	WRI327	Adv. Technical Wri.		REE449	SR Project II	S
	REE Elec	RE Elective	S	SPE321	Team Comm.	
	HUM Elec	Humanities Elec.		REE Elec	RE Elective	S
				SS Elec	Social Sci. Elec	
WINTER						
	EE419	Power Elec	S	REE413	Elect Power Conv.	S
	MECH323	Heat Transfer	S	REE439	Energy Sys. Man.	R
	REE Elec	RE Elective	S	REE455	Energy Eff. Bldg.	S
	HUM Elec	Humanities Elec.		REE459	SR Proj. III	S
	SS Elec	Social Sci. Elec.		HUM Elec	Humanities Elec.	
SPRING						

S = Strengthened (Covered strongly)

R = Reinforced (Covered moderately)

I = Introduced (Covered lightly)

Blank = No Coverage

Outcome c: an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

TERM	FRESHMAN			SOPHMORE		
	EE101	Intro Engineering	I	EE221	DC Circuits	I
	MATH251	Diff. Calculus		PHY221	Physics I	
	CHEM201	Chem I		CHEM260	Electrochemistry	
	CHEM204	Chem I Lab		MATH321	Diff. Eqns.	
	WRI121	Comp I				
	SPE111	Speech				
FALL						
	EE102	Intro Engineering	I	EE223	AC Circuits	I
	MATH252	Int. Calculus		ECON201/2	Economics	
	ENGR266	Computer Prog.		ENGR211	Statics	
	WRI122	Comp II		PHY222	Physics II	
	CHEM202	Chemistry II				
	CHEM205	Chem. II Lab				
WINTER						
	EE103	Intro Engineering	I	EE225	LaPlace Trans.	I
	MATH254N	Vector Calculus		PHY223	Physics III	
	WRI227	Technical Writing		REE243	Electrical Power	I
	SS Elec	Social Science		REE253	Electromech Conv	I
	MATH/SCI	Math/Sci. Elective				
	REE201*	Intro to RE	I			
SPRING						

S = Strengthened (Covered strongly)

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TERM	JUNIOR			SENIOR		
	EE321	Electronics I	R	EE343	Solid State Devices	R
	MECH318	Fluid Mech I	I	REE339	SR Project I	R
	REE331	Fuel Cells	S	REE421	Energy Sys. Des.	S
	REE Elec	RE Elective	S	REE463	RE Instr. and Cont.	R
				REE Elec	RE Elective	S
FALL						
	ENGR355	Thermodynamics	I	EE456	Control Systems	R
	MATH361	Statistics I		REE412	PV Systems	S
	WRI327	Adv. Technical Wri.		REE449	SR Project II	S
	REE Elec	RE Elective	S	SPE321	Team Comm.	
	HUM Elec	Humanities Elec.		REE Elec	RE Elective	S
				SS Elec	Social Sci. Elec	
WINTER						
	EE419	Power Elec	R	REE413	Elect Power Conv.	R
	MECH323	Heat Transfer	R	REE439	Energy Sys. Man.	R
	REE Elec	RE Elective	S	REE455	Energy Eff. Bldg.	S
	HUM Elec	Humanities Elec.		REE459	SR Proj. III	S
	SS Elec	Social Sci. Elec.		HUM Elec	Humanities Elec.	
SPRING						

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Outcome d: an ability to function on multi-disciplinary teams

TERM	FRESHMAN			SOPHMORE		
	EE101	Intro Engineering	I	EE221	DC Circuits	R
	MATH251	Diff. Calculus		PHY221	Physics I	I
	CHEM201	Chem I		CHEM260	Electrochemistry	I
	CHEM204	Chem I Lab	I	MATH321	Diff. Eqns.	
	WRI121	Comp I				
	SPE111	Speech				
FALL						
	EE102	Intro Engineering	I	EE223	AC Circuits	R
	MATH252	Int. Calculus		ECON201/2	Economics	
	ENGR266	Computer Prog.		ENGR211	Statics	
	WRI122	Comp II		PHY222	Physics II	I
	CHEM202	Chemistry II				
	CHEM205	Chem. II Lab	I			
WINTER						
	EE103	Intro Engineering	I	EE225	LaPlace Trans.	R
	MATH254N	Vector Calculus		PHY223	Physics III	I
	WRI227	Technical Writing		REE243	Electrical Power	R
	SS Elec	Social Science		REE253	Electromech Conv	I
	MATH/SCI	Math/Sci. Elective				
	REE201*	Intro to RE	I			
SPRING						

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TERM	JUNIOR			SENIOR		
	EE321	Electronics I	R	EE343	Solid State Devices	I
	MECH318	Fluid Mech I		REE339	SR Project I	R
	REE331	Fuel Cells	R	REE421	Energy Sys. Des.	R
	REE Elec	RE Elective	R	REE463	RE Instr. and Cont.	S
				REE Elec	RE Elective	
FALL						
	ENGR355	Thermodynamics		EE456	Control Systems	R
	MATH361	Statistics I		REE412	PV Systems	R
	WRI327	Adv. Technical Wri.		REE449	SR Project II	S
	REE Elec	RE Elective	R	SPE321	Team Comm.	
	HUM Elec	Humanities Elec.		REE Elec	RE Elective	R
				SS Elec	Social Sci. Elec	
WINTER						
	EE419	Power Elec	R	REE413	Elect Power Conv.	I
	MECH323	Heat Transfer		REE439	Energy Sys. Man.	R
	REE Elec	RE Elective	R	REE455	Energy Eff. Bldg.	S
	HUM Elec	Humanities Elec.		REE459	SR Proj. III	S
	SS Elec	Social Sci. Elec.		HUM Elec	Humanities Elec.	
SPRING						

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Outcome l: an ability to apply the fundamentals of energy

TERM	FRESHMAN			SOPHMORE		
	EE101	Intro Engineering		EE221	DC Circuits	
	MATH251	Diff. Calculus		PHY221	Physics I	
	CHEM201	Chem I		CHEM260	Electrochemistry	
	CHEM204	Chem I Lab		MATH321	Diff. Eqns.	
	WRI121	Comp I				
	SPE111	Speech				
FALL						
	EE102	Intro Engineering		EE223	AC Circuits	
	MATH252	Int. Calculus		ECON201/2	Economics	
	ENGR266	Computer Prog.		ENGR211	Statics	
	WRI122	Comp II		PHY222	Physics II	
	CHEM202	Chemistry II				
	CHEM205	Chem. II Lab				
WINTER						
	EE103	Intro Engineering		EE225	LaPlace Trans.	
	MATH254N	Vector Calculus		PHY223	Physics III	
	WRI227	Technical Writing		REE243	Electrical Power	I
	SS Elec	Social Science		REE253	Electromech Conv	I
	MATH/SCI	Math/Sci. Elective				
	REE201*	Intro to RE	I			
SPRING						

S = Strengthened (Covered strongly)

R = Reinforced (Covered moderately)

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TERM	JUNIOR			SENIOR		
	EE321	Electronics I		EE343	Solid State Devices	
	MECH318	Fluid Mech I	I	REE339	SR Project I	R
	REE331	Fuel Cells	R	REE421	Energy Sys. Des.	S
	REE Elec	RE Elective	S	REE463	RE Instr. and Cont.	R
				REE Elec	RE Elective	S
FALL						
	ENGR355	Thermodynamics	I	EE456	Control Systems	R
	MATH361	Statistics I		REE412	PV Systems	S
	WRI327	Adv. Technical Wri.		REE449	SR Project II	S
	REE Elec	RE Elective	S	SPE321	Team Comm.	
	HUM Elec	Humanities Elec.		REE Elec	RE Elective	S
				SS Elec	Social Sci. Elec	
WINTER						
	EE419	Power Elec	I	REE413	Elect Power Conv.	R
	MECH323	Heat Transfer	I	REE439	Energy Sys. Man.	R
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	HUM Elec	Humanities Elec.		REE459	SR Proj. III	S
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