Outcome 9. Graduates will have the broad education necessary to understand the impact of engineering solutions in a global and societal context.

This outcome maps to ABET Criterion 3 h

Course	Performance indicators
ChE 455, 456	Graduates will understand energy and the environment.
	Graduates will understand the impact of government, law, and public policy on engineering practice.

Tools used:	Yearlong Design Project Rubric
Data Collection:	The data are collected every semester based on the course offerings.
Frequency of data collection:	The data are collected every time courses are taught.
Data Analysis:	The data obtained are analyzed every year.
Closing the loop:	This outcome is subject to review every year based on performance criteria and metrics and specific action items are developed, if necessary, to revise the content of the courses. The analyzed data are presented separately to the following groups in meetings. a) Faculty b) Advisory Board *Performance criteria and metrics*: a) Students should reach a level of proficiency defined as a goal metric value of 3.0 based on the Yearlong Design Project Rubric scale of 1-4.

Assessment Tool:

Yearlong Design Project Rubric

Yearlong Design Project Rubric

Attribute	1-Not proficient	2-Progressing to proficiency	3-Proficient	4-Superior proficiency	Score
Design of equipment, Understand interrelationship between equipment in process					
Design of individual equipment	major errors in individual equipment design	some errors in equipment design	equipment designed correctly	unique aspects of equipment design enhance result	
Understand interrelationship between equipment on flowsheet	no understanding of equipment interrelationship	minimum understanding of equipment interrelationship	clear understanding of equipment interrelationship	exploitation of equipment interrelationship to enhance result	
Constraints/limitations of individual equipment and flowsheet understood	constraints/ limitations not understood	not all constraints/ limitations understood	constraints/ limitations clearly understood	exploitation of constraints/ limitations to enhance result	
Significance of conclusions understood	lack of understanding, no explanations	gaps in understanding, few explanations	clear understanding and explanations	superior understanding with in-depth explanations	
Apply chemistry, math, physics, life science, engineering science					
Apply engineering science	inability to apply principles	a few basic principles applied	most principles applied, demonstration of effect on design	all principles applied and interwoven with engineering to complete design	

Attribute	1-Not proficient	2-Progressing to proficiency	3-Proficient	4-Superior proficiency	Score
Apply chemistry	inability to apply principles	a few basic principles applied	most principles applied, demonstration of effect on design	all principles applied and interwoven with engineering to complete design	
Apply physics	inability to apply principles	a few basic principles applied	most principles applied, demonstration of effect on design	all principles applied and interwoven with engineering to complete design	
Apply life science	inability to apply principles	a few basic principles applied	most principles applied, demonstration of effect on design	all principles applied and interwoven with engineering to complete design	
Apply mathematics	inability to apply principles	a few basic principles applied	most principles applied, demonstration of effect on design	all principles applied and interwoven with engineering to complete design	
Response to questions indicates ability to apply these principles	response to questions demonstrates inability to apply these principles	response to questions shows application of a few basic principles	response to questions shows clear ability to apply most principles and to understand effect on design	response to questions shows superior ability to apply these principles, which are interwoven with engineering to complete design	
Apply economic, physical constraints and					

Attribute	1-Not proficient	2-Progressing to proficiency	3-Proficient	4-Superior proficiency	Score
optimization methods to obtain solution					
Show ability to use economics to drive solution to problem and focus on important parameters	economics not used to drive solution or to define key parameters	economics sparingly used to drive solution and to define key parameters	economics used to drive solution and to define key parameters	superior solution obtained by unique use of economics	
Define appropriate objective function	appropriate objective function not used	poorly-defined objective function used	correct objective function used	unique objective function used to obtain unique solution	
Define appropriate decision variables	inappropriate or no decision variables used	not all key decision variables used	correct decision variables used	unique decision variables used to obtain unique solution	
Correct use of optimization techniques	correct optimization techniques not used	errors in optimization methodology	correct/reasonable optimization methodology	superior optimization strategy yields unique solution	
Use of computer-based and other information systems	not used	omission of articles, books, etc., not available on web	uncover information from web, books, journals, etc.	uncover all pertinent information from web, books, journals, etc.	
Demonstrate ability to learn new material not taught in class	not demonstrated	reluctant to uncover and use material not taught in class, over dependence on Web-based material	uncovered and synthesized some new material and applied to project	willingly uncovered and synthesized needed new material and applied to project	
Demonstrate ability to function in assigned role					

Attribute	1-Not proficient	2-Progressing to proficiency	3-Proficient	4-Superior proficiency	Score
group member	delinquent in completing tasks	does assigned tasks and little more, often submits work late	participates in group assignments, occasionally goes beyond assigned tasks, usually submits work on time	enthusiastically participates in group assignments, routinely goes beyond assigned tasks, always submits work on time	
group leader	distributes work unevenly or does not distribute work at all, seeks no input from group, no coordination with other group leaders, does not synthesize information and is unprepared for client meetings	distributes work unevenly, seeks little input from group, coordinates poorly with other group leaders, does not synthesize information and is occasionally unprepared for client meetings	distributes work more or less evenly, usually seeks input from group, coordinates somewhat with other group leaders, synthesizes some information and is prepared for client meetings	distributes work evenly, actively seeks input from group, coordinates well with other group leaders, synthesizes information and is well prepared for client meetings	
chief engineer	unable to see big picture, does not delegate responsibilities, little or no communication with class, poor interactions with client and VP for research, will not make difficult decision when needed	difficulty seeing big picture, poor delegation of responsibilities, little communication with class, poor interactions with client and VP for research, reluctant to make difficult decision when needed	sees big picture, seeks input from group leaders, keeps class informed regarding project progress, treats group leaders and group members fairly, satisfactory interactions with client and VP for	sees big picture clearly, consistently seeks input from group leaders, consistently keeps class informed regarding project progress, treats group leaders and group members fairly, interacts well with	

Attribute	1-Not proficient	2-Progressing to proficiency	3-Proficient	4-Superior proficiency	Score
			engineering, is willing to make difficult decisions regarding personnel assignments and evaluations	client and VP for engineering, is willing and able to make difficult decisions regarding personnel assignments and evaluations	
Demonstration of ethical and professional behavior					
in dealings with peers	consistent unprofessional behavior, lying, cheating, backstabbing, disrespect for peers	generally treats peers professionally and in a forthright manner but minor occurrences of unprofessional behavior, lying, cheating, backstabbing, disrespect for peers	always treat peers professionally and in a forthright manner		
in use of information	uses work of others as own work (plagiarism)	does not always acknowledge source of information	always acknowledges source of information appropriately		
Demonstrate understanding of societal impact and need for assigned design					
inclusion of safety-related content	total ignorance of safety-related issues	reluctantly recognizes and includes relevant	usually recognizes and includes relevant	always recognizes, anticipates, and includes relevant	

Attribute	1-Not proficient	2-Progressing to proficiency	3-Proficient	4-Superior proficiency	Score
		safety-related design issues	safety-related design issues	safety-related design issues	
inclusion of environmentally related content	total ignorance of environmentally related issues	reluctantly recognizes and includes relevant environmentally related design issues	usually recognizes and includes relevant environmentally related design issues	always recognizes, anticipates, and includes relevant environmentally related design issues	
understanding of environmental impact of design	neither synthesizes nor demonstrates understanding of environmental impact	occasionally synthesizes and demonstrates understanding of environmental impact	usually synthesizes and demonstrates understanding of environmental impact	always synthesizes and demonstrates understanding of environmental impact	
understanding of legal issues associated with design	neither synthesizes nor demonstrates understanding of legal issues	occasionally synthesizes and demonstrates understanding of legal issues	usually synthesizes and demonstrates understanding of legal issues	always synthesizes and demonstrates understanding of legal issues	