1. **Name(s) of all program(s) and degree type(s) assessed** (Major, Minor, Graduate, or Non-Degree)
    - *Note:* aggregate reports should list all programs discussed in the report

    M.S. in Energy Systems Management (Graduate)

2. Names and contact information of the faculty coordinating the assessment of each program and report

    Jalel Sager (Academic Director and Assistant Professor)
    510 717 7242
    jsager3@usfca.edu

3. Your Mission Statement; note any changes since last report

    The MS in Energy Systems Management provides students with the knowledge, skills and networks to be leaders in the transition to a clean energy future.

    There were no changes in the Mission Statement.

4. Your PLOs; note any changes since last report

    - Analyze complex energy challenges from technological, environmental, economic and societal perspectives, with appreciation for their historical and institutional contexts.
    - Demonstrate a problem-solving mindset and correctly apply an interdisciplinary toolkit including methods of science, engineering, business and policy
    - Communicate effectively verbally and in writing on a wide range of energy topics
    - Formulate effective strategies to lead the transition toward a more just, sustainable and climate friendly energy system.

    No changes

5. Your current Curricular Map; note any changes since last report

    Attached

    Changes:

    - Added courses in GIS, Capital Markets, Microgrids (electrical), aligned I, D, M with PLOs.
    - Adjusted I, D, M rankings for Renewable Energy Economics to reflect new course content changes, essentially raising I to Ms for two PLOs.

6. Your assessment schedule between APRs: a year by year list of PLOs assessed since your last APR and those to be assessed before your next APR (Contact your FDCD for clarification if needed)

   We are assessing all PLOs for AY 22_23. I have no records of the PLOs being assessed through the pandemic years, but would appreciate confirmation of this from our FDCD.

7. Description of the assessment methodology

   ESM assessment methodology will consist of three components described below.

Grading data

While the PLOs as written were conceived at the outset of the program in 2017, they have largely guided the individual assignments and testing in each of the courses.

a. Oral presentations, both individually and in student groups
b. Written materials in the form of papers and/or briefs
c. Quantitative problem sets

For the 2022-23 assessment, ESM reviewed and analyzed student grades for assignments given in our core courses (Renewable Energy Economics, Quantitative Methods, Energy Technologies, and Electricity Systems), mapped to the PLOs to determine whether there are any clear indications that certain PLOs are not being met. For 2024 and 2025, the remaining seminar, half-semester, and elective courses will be assessed similarly, along with reviews of the core and final classes in our sequence.

2nd year Individual Student Interviews

ESM faculty and staff will conduct surveys with graduating students at the end of each year to determine if, in their opinion, the PLOs were met. This was done after graduation in 2023 but will be done prior to graduation in future years to ensure adequate numbers for response.

1st year Student Survey

In conjunction with the in person interviews, ESM will survey 1st year students in a similar fashion using an online survey platform.

8. Rubrics (and other instruments, if applicable)

   n/a

9. Description of your results, noting any significant findings from the data or assessment process

   Our analysis resulted in the following conclusions, by PLO:

   - Analyze complex energy challenges from technological, environmental, economic and societal perspectives, with appreciation for their historical and institutional contexts.
     - This foundational PLO is being met. The four core courses analyzed all map to "Developing" or intermediate levels of learning in this area, while Mastery is

demonstrated in the final projects required for completion of the program (either our Capstone individual projects or the team-based Integrated Resource Plans). The general trend in assignments mapping to this PLO show a rising trend over the course of the semester, with a wider spread of student grades (from C- to A+ levels) converging to an A- average grade by the end of the course as the general class level rises, with the students gaining confidence in their ability to perform multi-dimensional analysis of complex energy-environment challenges, while working within historical and institutional contexts. All the four classes provide this mixed quantitative/qualitative and historical approach. Mastery was successfully demonstrated in the final program projects by all students, to their degree of capacity (this was often limited by English language competence, ambition, and previous research experience, and to a much lesser extent by intellectual ability). Please see summary data in the annex.

  - Student exit survey respondents (n=7) unanimously supported the positive view of PLO attainment in this area, and enthusiastically pointed out examples. Their responses are recorded in the annex of this report.

- Demonstrate a problem-solving mindset and correctly apply an interdisciplinary toolkit including methods of science, engineering, business and policy.
  - This PLO is being met. Students receive an introductory level exposure to this PLO in Renewable Energy Economics, develop their skills in Quantitative Methods and Energy Technologies, and demonstrate mastery in Electricity Systems and their final projects. Problem-set-based grades in these courses all showed improvement through the semester, though in the intermediate-level problem-solving courses (Quantitative Methods, Energy Technologies), we see a few lower outlier grades later in the semester as students continue to work through the more difficult interdisciplinary material. Despite this, final grades tend to converge on the mixed-methods finals and final grades to a B+/A- average (see Electricity Systems final grade histogram).
  - Student enthusiastically support this PLO in their comments, with examples, in the exit survey, with all responding that yes, this PLO was met in their case.

- Communicate effectively verbally and in writing on a wide range of energy topics

  - **This PLO is met, but we find the most area for improvement here.** Effective written communication, in particular, is a special challenge for significant parts of our cohorts, as we have a large contingent of non-native speakers every year, perhaps 30-40% of our students. Last year we focused more on writing, especially in the Renewable Energy Economics class, assigning a series of short essays on problems in energy economics to the class over the semester. This was a great struggle for many of them, not only foreign nationals but also those whose background was in engineering and did not possess much experience in structured, logical writing. Nevertheless, the grades from those assignments (see Annex), show improvement and a general level of achievement in the class in this area, with slightly lower average scores than in the quantitative part of the course, but also a narrower (higher)

range, with fewer low-score outliers. Energy Economics and Electricity Systems are the developing courses for this PLO on our map, while Quantitative Methods and Energy Technologies are introductory. Written and oral presentations are the delivery mode for our mastery-level courses, the final project classes, and here students achieved successful grades and all demonstrated achievement, according to their scores, of this PLO.
    - Student opinion on achievement of this PLO was strongly positive, with 6 of 7 saying they had achieved the PLO, but there was one differing opinion who stated this was not a focus of the program—other students contradicted this directly in their comments, but our view is that more emphasis on writing and overall communication skills is something the program should build in. We have begun to do this with Renewable Energy Economics, as of last year, and we have also instituted an extracurricular professional communication series of workshops led by a former USF faculty member which we may formalize into a seminar course. Part of effective written communication also involves basic language skills, for which we screen incoming students more intensely now, as well as organizational research skills, which we are building into our core courses to better prepare students for the mastery-level research projects they undertake at the end of the program.

- Formulate effective strategies to lead the transition toward a more just, sustainable and climate friendly energy system.
    - This PLO is ambitious but we believe it is being met. Three of the four core courses (Renewable Energy Economics, Quantitative Methods, and Energy Technologies) work at introductory levels with regards to this PLO, as they provide students the analytical and knowledge tools to develop the PLO further in Electricity Systems, and then demonstrate mastery with their individual or group projects, which all, almost without exception, focus on some aspect of the energy system that requires them to work on the strategies mentioned in this PLO—for example, carbon offsets, electric vehicles, or utility plans to incorporate more renewable energy. By the grades and deliverables of the final projects, and by the anecdotal information that a number of students find work in policy and private industry in roles where they are required to do this, often building on their final projects, we assess that the PLO is met.
    - Students responses indicate agreement on their understanding of the evolution and transition of the energy/electricity systems, though our exit survey question in this case could have been phrased better.

10. Description of how the results were shared with faculty and how your department/program responded to the results. This is where you should lay out any plans for future improvement or assessment of your program indicated by the results

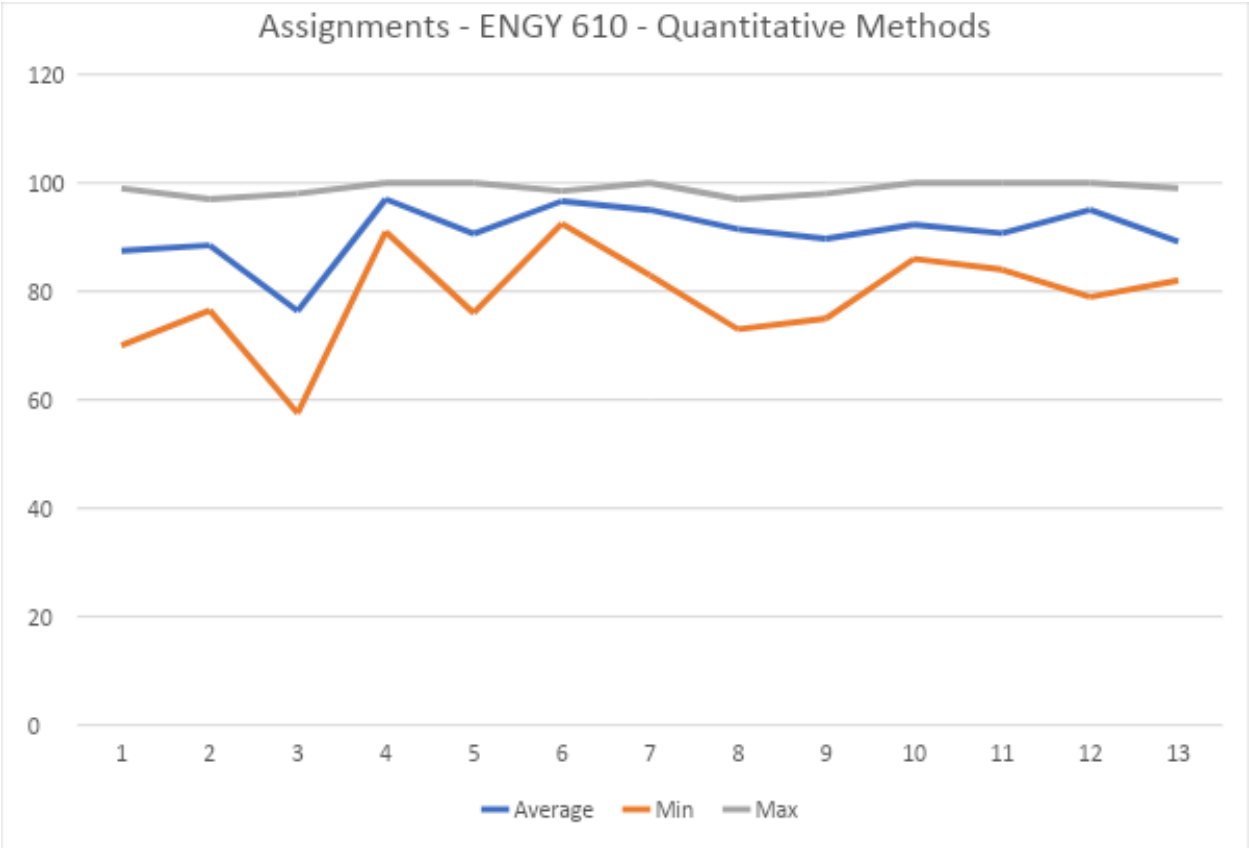
We have been in communication on the results, which were sent to all faculty in the program. There is broad consensus on the results. We will assess one PLO every year in depth through the next four years to allow for more intensive focus on specific PLOs, and assess every year whether we need to add,

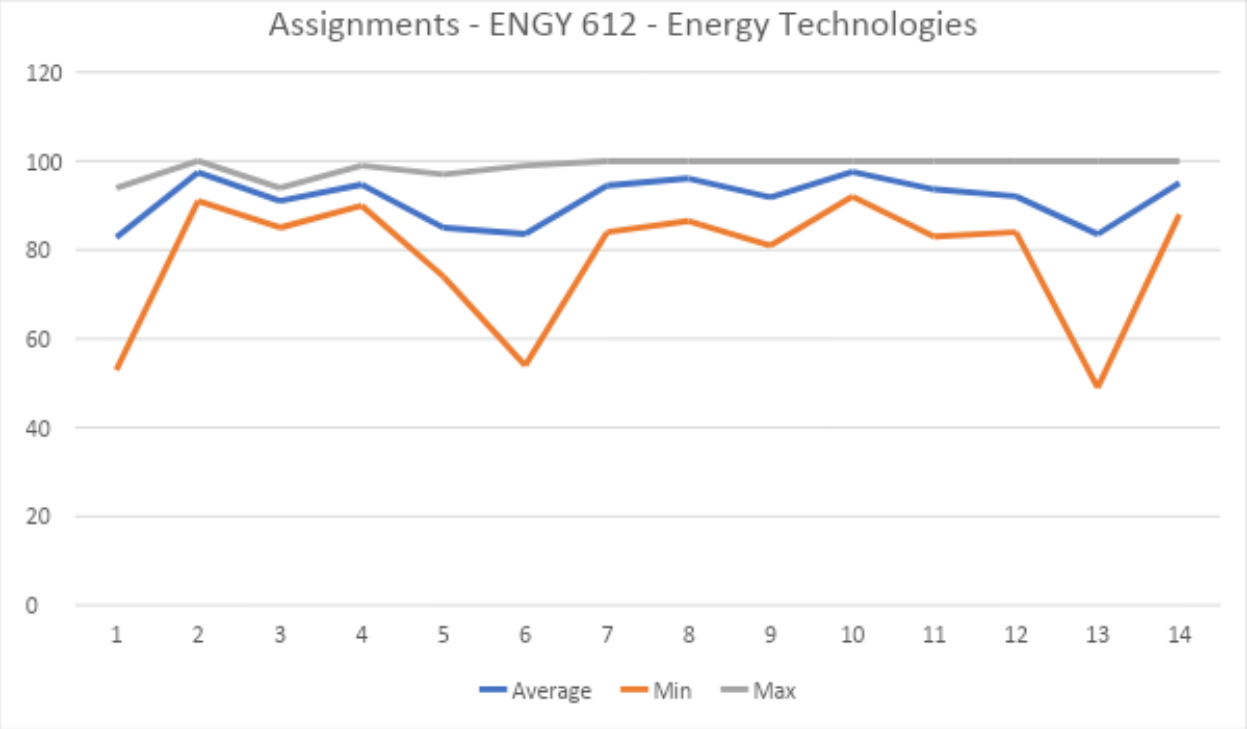
subtract, or modify any. This year adjusting the PLOs, which work well for the program and which the program serves in return, is not seen as a priority. Increasing student capacity for communication, especially writing and research report skills, are the major area in which we would like to improve our student results. This will require some work with the University as many students come in as ESL students, and there is limited help that we have found in central campus resources—we do urge students to use the writing center and what help is available. We also are working to "mainstream" writing and research skills in all classes (oral presentation is a lesser concern, as PPT is generally a lingua franca for students today, and they present in most classes with the exception of Quantitative Methods, our deepest science course).

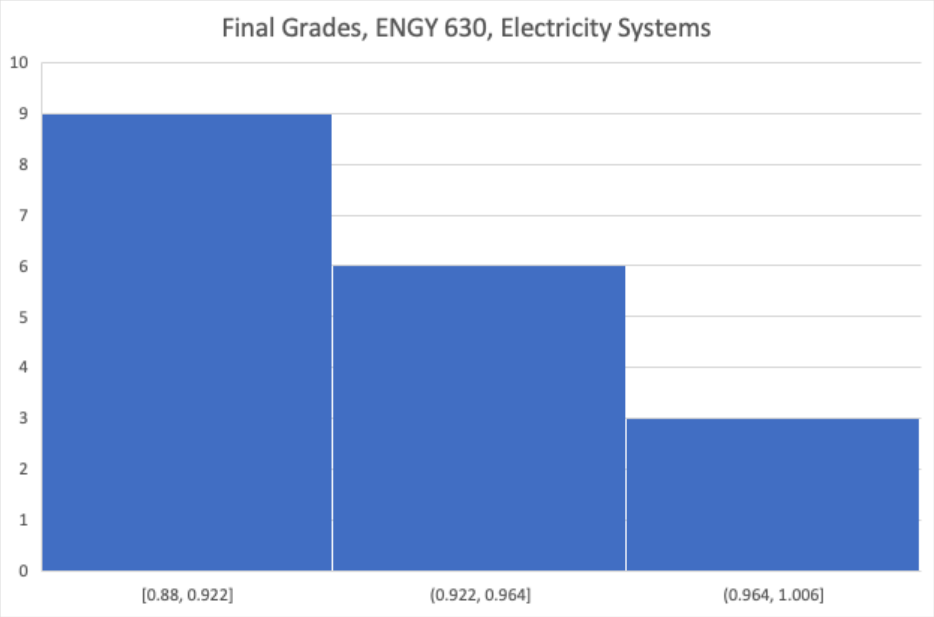
11. Discussion of any significant feedback from your previous year's report and how your program responded to that feedback

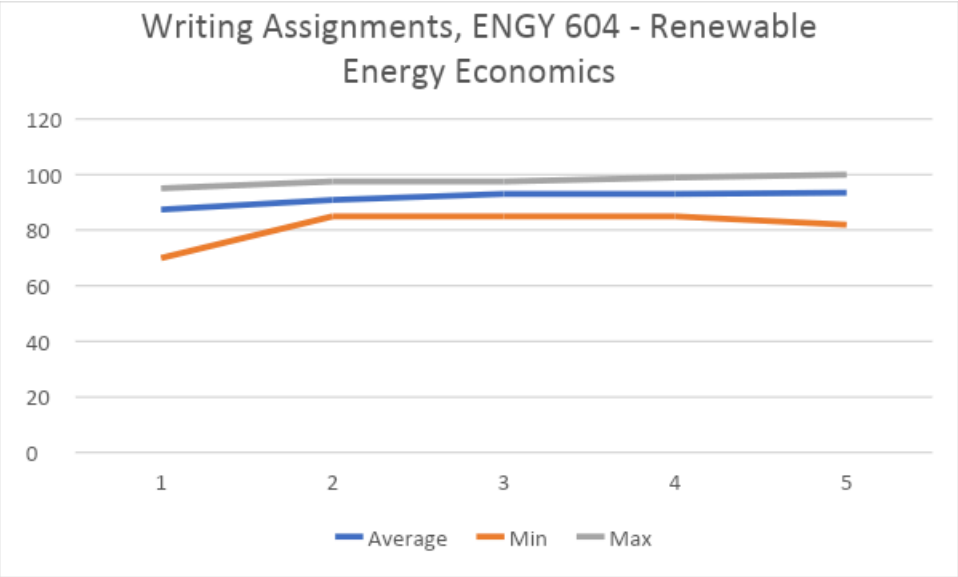
We did not conduct an assessment last year, but focused on building our methodology. Two of our three current full-time staff/faculty arrived in the late spring/summer of 2022 (Jalel Sager, Fred Wellington).

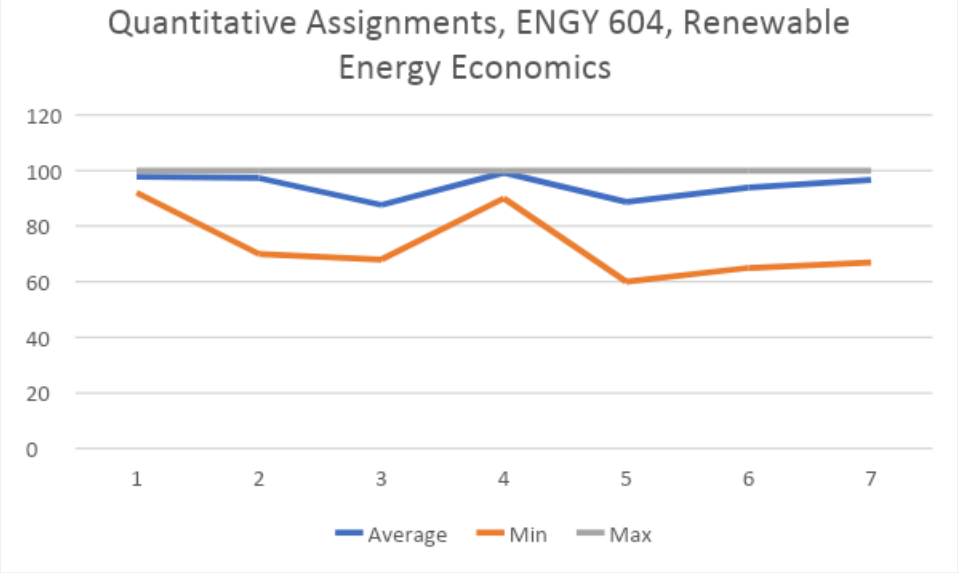
ANNEX, SUMMARY PLO ANALYSIS DATA
(CORE CLASS GRADES AND EXIT SURVEY RESPONSES)

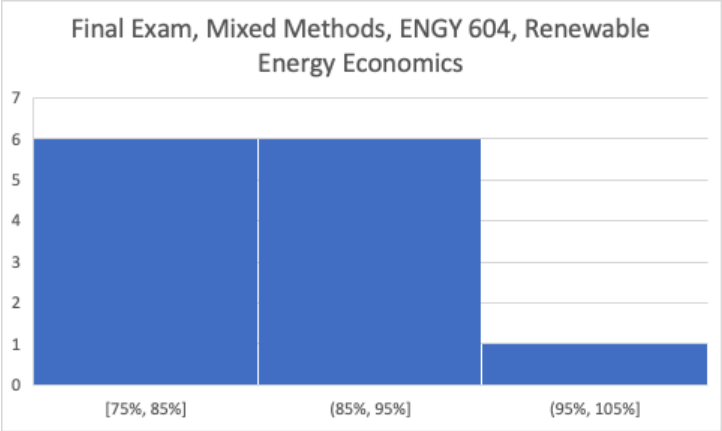



Assignments - ENGY 612 - Energy Technologies
120
100
80
60
40
20
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Average
Min
Max


Final Grades, ENGY 630, Electricity Systems
10
9
8
7
6
5
4
3
2
1
0
[0.88, 0.922]
(0.922, 0.964]
(0.964, 1.006]


Writing Assignments, ENGY 604 - Renewable Energy Economics
120
100
80
60
40
20
0
1
2
3
4
5
Average
Min
Max


Quantitative Assignments, ENGY 604, Renewable Energy Economics
120
100
80
60
40
20
0
1
2
3
4
5
6
7
Average
Min
Max


Final Exam, Mixed Methods, ENGY 604, Renewable Energy Economics
7
6
5
4
3
2
1
0
[75%, 85%]
(85%, 95%]
(95%, 105%]

Response to Exit Survey Question on PLO #1

- This was a great feature of the program. I appreciated lectures that provided historical perspective or pulled back and presented information from a broader perspective before diving in deeper. It allowed students to understand a "how we got here" view of energy systems.
- Quantitative methods helped understand the ecological aspect of Energy. Energy Law and strategy helped me understand the social aspect of Energy. Energy technology and electricity systems helped me understand the technical aspect of Energy.
- Especially in the first two semesters various physical, economical, and technical concepts were taught through calculation exercises using realistic and exemplary calculations in various problem sets.
- In short, yes. The MESM program does...from beginning to end. Jim's courses always include an element of historical principles and perspective while also examining the technical aspects of systems. For example, the Electricity Systems course began with a significant amount of historical information such as the Hyman book and the lecture on AC and DC standards and other aspects of electricty system history. This provided a good perspective before the course examined more technical aspects such as HVDC, 3-phase systems, or frequency control and also how the grid is challenged by the growing impact of distributed sources of generation.
- Very thorough course in this area
- Courses like Quantitative methods, Energy Technologies, Electricity Systems focused on all aspects like technical barriers and challenges related to ecosystems which revolve around ecology and society. Courses prepared us to solve those problems from first principles as well as developed nuances to understand the challenges to implement those solution from various policy angles.
- The courses covered everything from energy technologies, their impact on the environment, and the socio-economic cost of each technology. This is especially useful in understanding economy wide decarbonization.

Response to Exit Survey Question on PLO #2

- Yes, electricity markets and policy were discussed in a number of courses. However, I am still confused by the roles of various entities, regulatory structures, and energy market structures and how they vary across the U.S. and I doubt I'm alone in that.
- Through my final IRP project, I applied the understanding of how policies like RPS help shape the production side (supply side) of Energy. And also increased EV sales target help shape the consumption side (demand side) of Energy.
- Not only in the dedicated lecture but also outside of it our professors stimulated us in discussion and engaged us in viewing various current policies from all viewpoints (policy maker, customer, public companies etc) we were able to see effects and correlations.
- A good example is the energy strategy class (Jason Simon) where we spent the semester deeply exploring California's net metering policy (past, current and future), its impact across different stakeholders (utilities, solar industry, consumer groups), and learning the process of how the CPUC implements regulatory rule making. NEM 3.0 strategy paper and presentation, taking position from one of the three stakeholder groups.
- Energy law and policy classes explained the connection very well.

- There were many assignments where we calculated the global energy consumption and production and understood the geo-economics behind it which shapes the global energy policy and impact the market.
- From the weekly energy news segments to lectures on energy market dynamics to assignments wherein students dissected an actual electric utility bill to understand the components of it, there were plenty of opportunities for students to develop an understanding of the topics.

Response to Exit Survey Question on PLO #3

- Yes, I felt confident about my writing and speaking abilities before coming into the course, but was pleased at all the opportunities to write and present rather than just complete problem sets.
- Energy modelling elective taught me on how to communicate skillfully through written reports and oral presentations.
- A great proportion of most classes was about presenting and discussing results. Especially extracurricular assignments such as ,ÄûEnergy News,Äú was great for developing/ enhancing skills of visualizing and explaining technical aspects as if to a non technical audience.
- I believe this aspect of the MESM program is one of the highlights of the two years. There were multiple presentations and papers every quarter on all studied topics, culminating in the public presentation and written project for the IRP class. Jim consistently provided guidance in areas of presentation and written reports - especially the presentations. This is a vital skill to learn and improve on and should continue to be a major component to the program.
- Presentation and written report was not a key focus of the program. While we do a lot of news presentations these are not technical enough to be used at work. Similarly, the academic writing style is not usually adapted at work place as well.
- Last IRP was the culmination of everything where we presented in front of the public, prepared written report, prepared slideshow which encompasses every form of communication. But in other courses as well we did the same kind of exercise which was very helpful.
- There were plenty of presentations and reports that taught students how to develop effective presentations and detailed reports. However, it would have been better if there was an introductory class in the first semester that introduced students to the concepts of making effective presentations and reports.

Response to Exit Survey Question on PLO #4

- Yes, we were taught on the growth energy systems over time to the structure we have now. The IRP course really gave me insight into possible future pathways and the tradeoffs between various technologies and structures.
- Electricity systems class and Energy technology class helped me understand the evolution of the current electricity generation and distribution system.
- We were taught major influences through history, politics, environmental influences, disasters, customer behavior changes etc specific only to the US and California. This allows us to critically analyze issues and opportunities regarding the current state of US electricity systems.
- Electricity Systems course covered the current system in depth. This course helped prepare for the IRP Capstone project where we analyzed a utility's current generation and distribution

system and proposed a plan for the future, including different generation and distribution resource options.

- Research home work and classes explained this area well.
- We studied the historical development of electricity grid around the world and understood the causes which led to development of grid in Electricity Systems but we also spent time to analyze the challenges of today and the transition it is going through which gives me the direction to look into the future and also prepares me to work towards it.
- The readings and lectures covered these subjects in depth.