Duke | MASTER *of* ENGINEERING MANAGEMENT

Clean Energy Practicum Syllabus
EGRMGMT 590.10 — Spring 2024

Class Time: Th 8:30-11:15, Hudson 218

Instructor

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Course Description

There is an increasing need for smarter, cleaner Energy Transition decarbonization strategies for global energy generating assets. However, global energy generation and its use by industries and society involves challenging, frequently competing goals for economic GDP per capita growth/societal prosperity alongside environmental stewardship. Critical thinking/analysis skills to solve these challenges requires understanding & applying key engineering, economic, & environmental principles. ("3Es")

1) Engineering (energy conversion, fossil fuels & cleaner energy technologies)
2) Economics (macroeconomics, financial analysis & incentives)
3) Environmental (GHG emissions, regulations & other impacts)

This practicum course gives students the opportunity to learn these skills through a team-based, fossil fuel asset decarbonization project alongside energy industry clients/mentors. In-class activities include: instructor+guest lectures, project work, case studies & short quizzes. Students collaborate in 3-6 person project teams with periodic review presentations to clients/mentors. Project activities include:

- establish team charter & project assumptions/goals
- determine asset's current performance, economics & carbon emissions
- evaluate asset company's strategic context, geography & infrastructure
- learn and apply an industry decarbonization consulting process (WOOD, plc Decarbonization SCORE) https://www.woodplc.com/solutions/expertise/a-z-list-of-our-

expertise/decarbonisation-score
- analyze cleaner energy technologies, economics & environmental impacts
- choose most promising decarbonization strategies
- explore 3Es analysis & insights on most promising ideas
- conduct in-class project reviews with industry mentors & peer classmates
- establish a NetZero 2050 energy transition strategic project plan for the asset
- summarize clean energy transition/decarbonization recommendations with 3Es justification rationale in a final executive presentation.

This MEMP technical elective is appropriate for Duke graduate students interested in learning & applying technical/business skills towards energy decarbonization. The course is lighter on theoretical calculation depth than many other Duke grad energy-related courses as this course focuses on developing fundamentals intuition for leaders and applying across practical applications. (i.e. research/analyze data, apply basic 3E principles, estimate energy, economic and environmental outcomes) Skills learned in this course apply to future careers in cleaner/renewable energy/decarbonization/sustainability as: product managers, program managers, consultants, climate-tech entrepreneurs, infrastructure construction managers, or financial analysts.

Prerequisites

3Es energy concepts are reviewed in the course. There are no prerequisites as this course is intended for students with undergraduate degrees in engineering.

Learning Objectives - By the end of the semester, **you** will be able to:

- Identify, analyze & provide strategies for cleaner energy transition/decarbonization
- Critically evaluate & explain 3Es pros/cons of both fossil fuel & cleaner energy solutions. (Biomass, Coal, GeoThermal, Hydro, Natural Gas, Nuclear, Solar, & Wind)
- Critically evaluate & explain 3Es GHG abatement solutions (carbon capture utilization & storage (CCUS), Hydrogen or Batteries & balance of system aspects for electrical grids.
- Explain engineering, economics & GHG environmental emissions analysis methods for energy solutions through an industry decarbonization consulting process.
- Synthesize research, explain concepts to others, practice project management, effectively work in a team, and give executive presentations to industry clients.

Course Delivery and In-Class Logistics

This is an in-person synchronous class using Canvas. (Panopto enabled). A Course Deliverables Timeline with assigned readings, multimedia materials, due dates, etc.) will be available on Canvas on the first day of class viewable by all course registered students.

Similar to other MEMP Classes (e.g. EGRMGMT 540), this class is a "limited electronics device class". Laptops are needed & used during in-class quizzes/exercises/project work. Students will be required to store smartphones, laptops, etc. during lectures & after quizzes/exercises project work.

Violating classroom rules or distracting other people who are paying to learn does not demonstrate good professionalism. You may be asked to leave class if you are making your class less effective and more distracting.

Here's why:

a) Our stakeholders include your future employers who want professionalism

b) Students pay for class learning and not to be distracted by others' device use. Here's the science, courtesy of Duke psychology professor Dr. Bridgette Martin Hard:
https://mailchi.mp/duke/the-data-behind-psych-101s-tech-ree-policy-9165495

Course Materials/Online Textbook/Software Tools

Readings/Multimedia is provided. Some readings will be in Duke Libraries Online Textbook
"Sustainable Energy, 2nd Ed, Choosing Amongst Options", Tester, et al. MIT Press c2012
https://find.library.duke.edu/catalog/DUKE010140394

Other tools freely available to Duke Students used in class are: Microsoft Teams/Excel/Word/Powerpoint, Google Docs/Sheets/Forms, MURAL, Teammates Peer Assessment, Visio/Lucid Drawing, and various Energy Data/Tools (EIA, NREL, EPA, IEA, etc.)

Course Activities:

1) **In-class**
    a) Instructor lectures with practical active exercises/discussions/cases
    b) Guest lectures from energy industry leaders
    c) 7 Quizzes *(< 10 min ea @beginning of some classes noted on Canvas schedule)*
    d) Working on clean energy project with your team
    e) 3 project update presentations to industry clients
2) **Out-of-class**
    a) Reviewing class materials/readings/multimedia
    b) 7 Reflection Insights - 1-2 paragraph response to a posed question
    c) Working on clean energy project with your team

Late Additions/Audits, Late Assignments, Class Attendance Policies

Late Class Additions

Late class additions are responsible for all previous class assignments, readings & quizzes. Significant extra time is needed to catch up on past items alongside existing materials. No class audits are allowed due to the extensive team exercises.

Attendance & Quality Engagement

Per MEMP policies, if you are registered for the class you must attend first class in person. Per MEMP policy, students registered for class who do not attend first class in-person are automatically dropped from class. You are also required to be present in person each class and during final exam time (consistent with Duke policy in effect at the time) Showing respect each week for fellow classmates, TAs, and Instructors is key for an effective learning community & important for future job success. On time in-person attendance & quality class engagement is critical in this regard (consistent with Duke policy expectations in place at the time).

Missed Quizzes & Attendance Expectations

Students receive a ZERO on any in-class quiz missed. There are NO quiz makeups. If a student will miss a class, a student must provide the instructor a valid excuse BEFORE class. Any excuses provided by students are per Duke Community standard. Duke resources may be used to assess/validate any student info provided.
Students are responsible for any class materials during absence. If a rare situation occurs requiring extended class absence or multiple class absences, contact MEMP student services coordinator AND instructor to determine accommodations. Being late by >10 min to class (except for emergencies) is COUNTED AS AN ABSENCE. Leaving before class is complete without a valid excuse is also considered an ABSENCE. In-class emergencies requiring leaving are understood to sometimes happen, please quietly excuse yourself letting TA & instructor know later you are okay.
NOTE: 2pts are deducted at the end of the semester BEFORE final grades are determined for EACH UNEXCUSED Absence.

Late Assignments

Missed or Late submissions are NOT accepted & receive a ZERO on that assignment. Project presentations to industry clients cannot be made up. If a student must miss a project review 1 or 2 their grade will be based on the Team's Project Review Grade with adjustments per the Team Assessment (if needed). A student should complete additional work to help team prepare Project Review #1 or #2 materials if a student anticipates an absence. Attending the Final client project presentation during Exam time is required.

Assignments & Grading: I = Individual Grade, T = Team Grade

7 Quizzes ***<10min ea,*** ***Keep 6 of 7 grades, drop lowest***	**I**	**18 pts**	**3 pts per quiz.** **Quiz based on in & out of class materials.**
7 Reflective Insight Assignments ***Keep 6 of 7 grades, drop lowest***	**I**	**12 pts**	**2 pts per assignment.** **Individual student 1-2 paragraph reply to a posed question based on in & out of class materials.**
Clean Energy Team Project **(3 in-class Project Reviews)**	**T**	**70 pts**	**Team grade per project review based on student inter-team peer assessment plus instructor / mentor observations per grading criteria.** **Students will provide intra-team feedback on contributions & team dynamics for each other which may +/- adjust individual grades.**

Grading Scale - cumulative assignment points for final letter grade per this grading scale. There will be no negotiation or rounding up for grades.

100	**A+**	**Exceptional**		**73 to 76**	**C**	**Average**
95 to 99	**A**	**Excellent**		**70 to 73**	**C-**	
90 to 94	**A-**			**67 to 69**	**D+**	**Below Average**
87 to 89	**B+**	**Very Good**		**63 to 67**	**D**	
83 to 86	**B**	**Good**		**60 to 63**	**D-**	
80 to 83	**B-**			**< 60**	**F**	**Failing**
77 to 80	**C+**	**Above Average**				

Quizzes - 18 pts *(3pts each)*
6 of 7 grades counted, lowest dropped

Starting week 2, there will be 7 closed book/closed note quizzes (< 10min, short answer/multiple choice) given at the BEGINNING of most classes based on previous in-class lectures/materials & out-of-class assignments.

Project Assignment - 70 pts

Effective teamwork & project management is a key career skill. The project puts 4-6 students in consultant teams alongside industry mentors to decarbonize a company's fossil fuel electricity generating asset. Teams will evaluate less carbon intensive energy generation technologies alongside GHG emissions abatement strategies using a 3Es framework and an industry decarbonization consulting process.

Consists of 3 project review grades incorporating two aspects

1) **Project Review Team Grade (per Peer Team(s) & Instructor/Mentor Observation)**

1st Project Review - 15 pts	Peer Teams Survey + Mentor/Instructor Observation
2nd Project Review - 25 pts	Peer Teams Survey + Mentor/Instructor Observation
Final Project Review - 30 pts	Peer Teams Survey + Mentor/Instructor Observation

2) **Potential Individual Student Adjustments to base Project Review Team Grade**
Individual adjustments may occur to ensure fairness & equitable contribution from each team member. Students will fill out an **Intra-Team Assessment** after each project review. This feedback will be evaluated by the instructor & anonymously shared to the team. If needed, adjustments are typically +/- 5% to +/-15% of team base grade if multiple teammates noted specific example impactful feedback for a student. In rarer cases of significant poor quantity/quality of contribution or disruptive student behaviors noted by team members or determined by instructor/TA, an individual grade can be adjusted more substantially. Feedback is to be per each student's personal observations per the Duke Community Standard.

Potential Individual Adjustment to Team Grade (per Student Assessment of Teammates)

1st Team Assessment	Individual Survey After Project 1 Review	No individual grade adjustments, feedback only for review
2nd Team Assessment	Individual Survey After Project 2 Review	Potential individual grade adjustments
3rd Team Assessment	Individual Survey After Project 3 Review	Potential individual grade adjustments

Reflection Assignments - 12pts *(2pts each), 6 of 7 grades counted, lowest dropped*

Each student is expected to respond to a weekly reflective insight assignment question related to course material and project. Worth 2 pts each assignment. Responses are due at midnight before the next in-class session. (you are allowed & encouraged to discuss the question with others, however, each student's individual response is to be independently written & represent the student's personal 3E insights & explanations per the course materials. We want to know what YOU can do by reflecting and providing additional insights in applying course materials… Generative AI may be helpful for other course aspects BUT SHOULD NOT be used for the reflective insight assignments. Students MUST NOT copy others' work or use AI responses for the Reflection Assignment.

Reflective/Insight Response Rubric - 2pts each weekly response

Does the response effectively provide enough information to answer the question & integrate key 3E aspects of course materials? - 1pt	Written response (at least 100 words) effectively provides enough info to answer the question, integrates key 3E aspects of course materials & demonstrates professionalism in organization, language and proper grammar.
Does the response provide unique insights or add'l insightful follow-on considerations towards the project? - 1pt	Each insight/reflective response provides unique personal insights applying course material or additional insightful follow-on considerations relevant to the project. Response correctly applies 3E fundamentals rationale for statements and insights referring to course materials info as appropriate. Things to avoid: "I agree" response lacks additional 3E insight or references to other materials. "This is what we learned in class" without any additional references to specific concepts covered in class/readings or without any additional to specific references. "Yeah, I thought about it". Response not using professionalism or proper grammar

Objectivity, In-class/out of class energy discussions and perspective diversity

- Efficient energy generation and use by any means (fossil fuels or renewable energy) touches our lives profoundly in many ways (agriculture, transportation, heating/cooling, etc). Energy enables substantial global Gross Domestic Product (GDP) economic growth and societal prosperity. ("Energy is life.")
- Future careers need smart energy transition and decarbonization strategies to solve society's tough engineering, economic & environmental challenges.
- Student in-class & out of class discussions are expected to attempt to synthesize 3Es thinking & insights from class materials, readings, multimedia, etc. or other cited sources to enhance energy understanding and insights.
- Students are expected to actively engage in this course, maintain a respectful tone & constructive atmosphere, & ensure discussion stays on topic within time constraints. No one should dominate discussion to exclude others.
- It can be hard to objectively evaluate energy info due to subjectivity in its presentation (especially from many media sources). Real-world issues faced by society & companies are complex and nuanced with challenging constraints & often conflicting goals. **It is important in this class to support your rationale *with objective evidence and 3Es rigor versus subjective opinions*.** Let's strive to be analytical thinkers in our cleaner energy transition journey while respecting globally diverse perspectives.

Pratt School Honor Code/Duke Community Standard

Activities as part of this class are governed by the Duke Community Standard & adherence is expected. In-class quizzes are explicitly to be your own work without any engagement with others or info sources. Project work involves a significant amount of team collaborative work. It is important that each student contribute equally to their team's efforts. Project reviews for a grade must represent the team's own work with proper citations denoting materials that were not the team's own creation. Generative AI can be helpful to research concepts however, it is crucial students consult & reference original sources & use their OWN words in project presentations.

- See Duke Community Standard website info and your obligation to act regarding it.
- Academic dishonesty, including lying, cheating (including plagiarism), or stealing, is a violation of university policy. Please visit Duke University Libraries for more information about properly citing sources and avoiding plagiarism.
    - I will not lie, cheat, or steal in my academic endeavors;
    - I will conduct myself honorably in all my endeavors; and
    - I will act if the Standard is compromised

Professor & TA are required to report suspected Duke Community Standard violations to the Office of Student Conduct for further review. We will observe Duke's current policy classroom rules to keep us safe. (adapted per any Duke semester policy changes). Do not eat or drink in the classroom. Sit in the same seat each class once teams are formed.