Duke | MASTER *of* ENGINEERING MANAGEMENT

Clean Energy Practicum Syllabus - v1
EGRMGMT 590.10 — Spring 2025

Class Time & Location: Thursdays 8:30am-11:15am, TBD

Instructor

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Teaching Assistant

TBD

Course Description

There is an increasing need for smarter, cleaner energy transition decarbonization strategies for global energy generating assets. However, global energy generation and 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 Clean Energy Practicum course gives student teams the opportunity to learn these skills by doing an industry energy decarbonization project for an existing USA fossil fuel electricity generating plant. In-class activities include: instructor & guest lectures, active learning exercises, project work, case studies & short quizzes. Project activities include:

- establish team charter & project assumptions/goals
- determine plant's current performance, economics & GHG emissions
- evaluate company owner strategic context, plant geography & infrastructure
- learn and apply a modern industry energy decarbonization consulting process (WOOD, plc Decarbonization SCORE) https://www.woodplc.com/solutions/expertise/a-z-list-of-our-expertise/decarbonisation-score
- learn & analyze a wide variety of potential cleaner energy technology strategies for

the electricity generating plant (Coal or Natural Gas with Carbon Capture, Biomass, Geothermal, Hydro, Hydrogen, Nuclear (Large or SMR), Solar (PV or CSP), Wind (Onshore or Offshore) and hybrid battery storage options.
- choose 1-2 most promising decarbonization strategies to explore further
- provide project review updates
- establish a NetZero 2050 energy transition strategic project plan for the plant
- 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 in industry. The course is lighter in theory than most other Duke grad energy-related courses as this course focuses on developing fundamental intuition and applying it in practical engineering conceptual estimation. (i.e. research/analyze data with basic 3E principles to estimate project outcomes) Skills learned in this course will apply to future careers in cleaner/renewable energy/sustainability jobs as: product managers, program managers, consultants, climate-tech entrepreneurs, infrastructure construction managers, or financial analysts.

Prerequisites

3Es basics for energy are reviewed early in the course. There are no prerequisites as this course is intended for students with undergraduate degrees in engineering. Most students have seen these basic concepts before in freshman or sophomore engineering courses.

Learning Objectives / Skills Obtained - 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 for fossil fuel & cleaner energy solutions. (Biomass, Coal, GeoThermal, Hydro, Natural Gas, Nuclear, Solar, & Wind)
- Critically evaluate & explain 3Es of GHG abatement solutions (carbon capture utilization & storage (CCUS), Hydrogen, Batteries + electrical grid impact).
- Explain engineering, economics & environmental emissions analysis methods in a modern energy decarbonization industry consulting process.
- Synthesize research, explain concepts to others, practice project management, work effectively in a team, and give executive presentations.

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 Class policies (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 rationale, 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

Course Readings/Multimedia materials will be provided in Canvas. There will be no need to get a physical textbook or pay for online materials access.

Other tools freely available to Duke Students used in class are: Microsoft Teams/Excel/Word/Powerpoint, Google Docs/Drive/Sheets, MURAL, TEAMMATES Peer Assessment, Visio/Lucid Drawing, and various Energy Sites/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 in Canvas schedule)*
    d) Working on industry clean energy project with your team
    e) 3 project review presentations
2) **Out-of-class**
    a) Reviewing class materials/readings/multimedia
    b) 7 Weekly Reflection Insights - Several paragraph response to posed question
    c) Working on industry 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 many team-based activities in this class.

Attendance & Quality Engagement

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

Missed Quizzes & Attendance Expectations

Students receive a ZERO on any in-class quiz missed (one lowest quiz dropped per semester) 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 your 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 cannot be made up. If a student has an excused absence for 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 project presentation in-person during course 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**	**18 pts**	**3 pts per assignment.** **Individual several paragraph replies to posed insight topic questions at the end of class based on in & out of class materials.**
Clean Energy Team Project **(3 in-class Project Reviews)**	**T**	**64 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 *, 7 quizzes, 3pts ea (6 of 7 grades counted, drop lowest)*

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 assignment materials.

Project Assignment - 64 pts - 3 Grades
(Team Grade + Potential Individual Grade Adjustments)

Assigned project teams of 3-6 students will determine their recommended strategy to decarbonize an existing USA fossil fuel electricity generating plant. Teams will explore & analyze various cleaner energy generation technologies & abatement strategies using an industry energy decarbonization consulting process. Grade aspects are comprised of:

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

1st Project Review - 14 pts	Peer Teams Survey + Instructor & Guest Observation
2nd Project Review - 20 pts	Peer Teams Survey + Instructor & Guest Observation
Final Project Review - 30 pts	Peer Teams Survey + Instructor & Guest 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 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 Insights - 18 pts (3pts ea, *6 of 7 grades counted, drop lowest)*

Each student individually provides a several paragraph response to weekly reflective insight assignment questions related to course material and project. 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 when applying course learnings… Generative AI can be helpful for researching project aspects & quickly finding source materials **BUT AI is NOT ALLOWED for the reflective insight assignments**. **Students also MUST NOT copy others' work.** (doing either of these is considered a violation of Duke Community Standard and additional AI auditing tools will be used to detect any suspected AI writings in submitted Reflection Insight assignments.

Reflective/Insight Response Rubric - 3 pts each weekly response

Does the response effectively provide enough information to answer the question & integrate key 3E aspects of course materials? - 1.5 pt	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? - 1.5 pt	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" (this statement alone is not enough. It needs additional 3E insight, references, or other supporting 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 cleaner energy to solve society's tough engineering, economic & environmental challenges.
- Student in-class & out of class discussions are expected 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 help to research concepts however, it is crucial students consult & reference original sources 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. (adapted per Duke semester policy changes). Do not eat or drink in the classroom per building rules. Sit in the same seat each class once teams are formed.