Duke | MASTER *of* ENGINEERING MANAGEMENT

Hi-Tech Energy Strategies
EGRMGMT 590.10 — Fall 2025

Class Time & Location: TBD

Instructor

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Course Description

Tremendous global growth in AI Datacenters, Factory Robotic Automation & Electrification Infrastructure is increasing global demands for economically reliable energy. A growing population, goals to improve both global living standards and future environmental prosperity creates an unfolding energy crisis over the next several decades. There are increasing jobs for skilled leaders, product managers, project managers, supply chain professionals, entrepreneurs, and consultants to strategically navigate the techno-business opportunities in these energy areas.

Students in this course will gain a wide breadth of practically valuable technical/business job skills related to modern energy solutions. Skills practice occurs through a team project to determine the best CTO/CFO level strategic recommendations to power a hi-tech company's (i.e. Amazon, Microsoft, Meta, Tesla, Google, etc.) modern assets (e.g. robotic factory, AI datacenter, EV storage/charging infrastructure, etc.). Project & course content was developed in consultation with industry colleagues to best align the course with the latest critical thinking skills desired by industry. Objectively evaluating modern energy solutions involves learning & applying key principles ("3Es"):

1) Engineering (efficiency, reliability, & fuels/cleaner/renewable technologies)
2) Economics (financial evaluation & incentives)
3) Environment (infrastructure & emissions)

Class activities help students learn these skills in a step by step, structured learning

manner through: instructor lectures, readings/multimedia videos,Q&A interactions with industry experts, reflective insights/case study project explorations & short quizzes.

Project Team activities include:

- evaluating a hi-tech company asset's typical energy demands & options to achieve reliable, economic & environmentally suitable energy supplies.
- learning & evaluating 3Es for a wide variety of energy solutions:
  Coal, Natural Gas, BioMass, Geothermal, Hydroelectric, Hydrogen Fuel, Nuclear (Large or SMR), Solar (PV or CSP), Wind (Onshore or Offshore) as well as Hybrid Storage solutions (Battery or Hydrogen) and Carbon Capture & Storage (CCS)
- evaluating a company's strategic context, geography/ infrastructure & real- world constraints alongside modern energy solution options
- choosing a few most promising energy strategies to explore further
- presenting project review updates with 3Es decisions rationale
- providing final strategic recommendations & project concept plan to industry guest experts with estimated outcomes that objectively consider engineering risk/technology performance, economics & environmental aspects.

Learning Objectives / Skills Obtained - By the end of course, **you** will be able to:

1. Explain methods to evaluate engineering, economic and environmental considerations for current & future hi-tech global energy needs.
2. Use analysis tools & objective data sources to evaluate energy solutions (e.g Dept of Energy, EIA, National Renewable Energy Laboratory, EPA, Statista, etc.)
3. Critically evaluate & explain 3E pros/cons & insights for a variety of technologies:
   a) Energy solutions - Biomass, Coal, GeoThermal, Hydrogen, Hydroelectric, Natural Gas, Nuclear (Large & SMR), Solar (PV & CSP), & Wind (Onshore & Offshore)
   b) Emissions abatement options - Pre/Post/Oxy Carbon Capture & Storage (CCS)
   c) Hybrid Storage solutions - Battery or Hydrogen
   d) Reliability considerations- electrical infrastructure security & grid resilience
4. Articulate key 3Es assumptions, research analysis & fundamentals rationale to support your strategy in typical CTO/CFO level project executive presentations.
5. Explain the best practices & lessons learned from working in a project team

This elective is appropriate for graduate students interested in learning & applying technical/business skills in an energy related project under real world constraints.

Prerequisites

There are no prerequisites, as this course is intended for students with undergraduate degrees in engineering. Due to practical industry applications focus, content is purposefully lighter in theory than typical engineering courses. Technical and business basics are reviewed early in the course. The goal is to help students develop insightful intuition and practical methods to reasonably estimate energy solution outcomes under real world constraints & higher levels of uncertainty during concept planning phases.

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 for all registered students in the course.

Similar to other MEMP Class policies (e.g. EGRMGMT 540), this class is a "limited electronics device class". Laptops are brought out for use during many in-class exercises/project work. However, during lecture content presentations students are asked to close their laptops & store smartphones, etc. in backpacks, under tables, etc.

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 is no need to get a textbook or pay for class materials access.
Some 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, etc.)

Course Activities:

1) **In-class**
    a) Instructor lectures with practical active exercises/discussions/cases
    b) Guest Q&A interaction with energy industry experts
    c) 7 Quizzes *(< 10 min ea @beginning of some classes noted in Canvas schedule)*
    d) Working on team project
    e) 3 project review update presentations
2) **Out-of-class**
    a) Reviewing class materials/readings/multimedia
    b) 7 Weekly Short Reflection Insights - responses to a few posed reflective insight questions to guide in applying course 3E insights to the project.
    c) Working on team project

Late Additions/Audits, Attendance Policies, Late Assignments

Late Class Additions/Audits

Late additions are responsible for previous class assignments & materials. TA & Instructor can help late add students' efforts to review/understand week 1 materials so they are ready for week 2's quiz and reflective insight assignment. Also, semester project kickoff & forming teams happens in week 3, after drop/add date. Instructor permission to audit this course may be possible depending on student background, motivation & their level of agreement to attend/engage in the course materials.

Attendance Policies

Per Duke MEMP policies, all registered students are expected to attend the first class day in person. You must be present for the final executive presentation (see weekly Canvas schedule as since there is no final exam in this class, the final presentation will occur during the graduate reading period before exam week).

Showing respect each week for fellow classmates, TAs, Instructors & Guests is key for an effective learning community. Arriving at class before start time & quality class engagement is critical in this regard. **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. Students without a valid excuse BEFORE class receive a ZERO on any in-class quiz that day. More than 1 unexcused absence per semester can also negatively affect a student's final grade tally.**

Students are responsible for any class materials during absence. If a rare situation occurs requiring multiple class absences, contact your student services coordinator AND course instructor to determine accommodations. Being late by >10 min to class without valid PRIOR excuse (except for unexpected emergencies) is COUNTED AS AN ABSENCE. In-class emergencies sometimes happen, please quietly excuse yourself letting the TA & instructor know later you are okay if not returning.

Late Reflective Insight/Project Review Assignments

Late submissions are NOT accepted & receive a ZERO on that assignment. Project presentations cannot be made up, however, if a student has a PRIOR excused absence for project review 1 or 2 their grade will be based on the Team's Project Review Grade with any adjustments per the Team Assessment (if needed). If a student anticipates such an absence, they should do additional work to help team prepare Project Review #1 or #2 materials to balance contribution. Attending the final project presentation in-person during course time noted on Canvas during the reading period is required.

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

7 Quizzes ***<10min ea, keep 6 of 7 grades, lowest grade dropped***	**I**	**12 pts**	**2 pts per quiz.** **Quiz based on in & out of class materials.**
7 Reflective Insight Assignments ***Keep 6 of 7 grades, lowest grade dropped***	**I**	**18 pts**	**3 pts per assignment.** **Paragraph replies to a few posed insight questions to help guide the practical applications of course 3Es towards the project.**
Team Project **3 in-class Project Reviews**	**T**	**70 pts**	**See Project Assignment description below…**

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 - 12 pts, *7 quizzes, 2pts ea (6 of 7 grades counted, drop lowest two)*

Starting week 2, there will be 7 closed book/closed note quizzes (< 10min, short answer/multiple choice..no calculator needed) at the **BEGINNING** of some classes. A helpful, 1-slide preview of 4-6 representative questions on material will be provided during each week's preceding class to help guide the following week's quiz preparation.

Reflective Insights - 18 pts (3pts ea, count *5 of 7 grades, drop lowest two)*

Each individual student provides a several paragraph response to a couple reflective insight questions that apply course material to the project. Questions help students focus on important 3E project concepts as well as facilitating upcoming in-class exercises and discussion. Responses are due at midnight before the next class. (you are allowed & encouraged to discuss the questions within your team, 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 & applying course learnings… Generative AI is okay to use on other assignments in this class and can be helpful to find research material. **BUT AI is NOT ALLOWED on Reflective Insight Assignments. Students also MUST NOT copy others' work.** Doing either of these is considered a violation of Duke Community Standard. AI auditing & plagiarism tools will be used to detect any suspected AI writings or plagiarism on Reflection Insight submissions.

Reflective/Insight Response Grading Rubric - 3 pts each assignment

Does the response effectively provide enough information to answer the question & integrate key 3E aspects of course materials? **1.5 pts**	Written response (at least 100 words) effectively provides enough information to answer the question & demonstrates professionalism in organization of ideas, language and proper grammar: Examples of some things to avoid: "I agree" or "This is what we learned in class" (too generic without any additional info…statement alone is not enough. Statement needs additional 3E insight, references, or supporting materials.) "Yeah, I thought about it". (Response not using professionalism or proper grammar.)
Does the response provide unique objective critical thinking and add'l insightful follow-on considerations to help progress the project? **1.5 pts**	Each insight/reflective response provides unique, objective critical 3Es thinking insights in personally applying course materials/readings/multimedia while providing additional 3Es insightful follow-on considerations relevant to progressing the project.

Project Assignment - 70 pts - 3 Grades

(Team Grade with potential +/- Individual Grade Adjustments)

Project teams of 3-6 students develop a strategy, explain 3Es rationale, & provide a project for powering a hi-tech asset. Teams will learn, explore & analyze a wide variety of modern energy technology solution options. Project grade aspects are comprised of:

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

1st Project Review - 15 pts	Peer Teams Survey + Instructor & Guest Observation
2nd Project Review - 20 pts	Peer Teams Survey + Instructor & Guest Observation
Final Project Review - 35 pts	Peer Teams Survey + Instructor & Guest Observation

2) **Potential Individual Student Adjustments Project Review Team Grade**
Individual adjustments may occur to ensure fairness & equitable contribution from each team member. Students will provide feedback to the instructor through an **Intra-Team Assessment** after each project review. 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 team 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

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

- Student in-class & out of class discussions are expected to objectively synthesize 3Es critical thinking & insights from class materials, readings, multimedia, etc. or other cited sources to enhance energy understanding and insights. **It is important to always support your rationale with objective evidence and 3Es rigor versus subjective opinions**.
- Students are expected to actively engage in this course, maintain a respectful tone & constructive atmosphere, appreciate the perspective diversity from others & ensure discussion stays on topic within time constraints. No one should dominate discussion to exclude others.

Pratt School Honor Code/Duke Community Standard

Per Duke policy, adhering to the Duke Community Standard for activities in this class is expected. In-class quizzes are to be your own work without any engagement with others or info sources. Project work involves a significant amount of team collaborative work and it is important to attribute key reference sources and for each student to 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. AI can help to research project concepts however, it is crucial students consult & reference original sources in their OWN words in project presentations & note those reference sources in their work.

- 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. Please adhere to Duke building specific rules regarding eating or drinking in the classroom. Sit in the same seat each class once teams are formed.