SYLLABUS

Duke University
ENERGY 620: Energy Finance
Professors Emma Rasiel and Chris Wedding

Instructor Contact Information

Professor Emma Rasiel

- Email: ebr4@duke.edu
- Office Hours: Virtual walk-in. Mondays & Wednesdays 10:30 – 12:00.

Professor Chris Wedding

- Email: chris.wedding@duke.edu
- Office Hours: Schedule a 15-minute call at this link

TA: Hassan Nadeem

- Email: hassan.nadeem@duke.edu
- Office hours: Monday 11am-1pm

Course Objectives

This course exposes students to key topics in energy finance including: discount rates and discounted cash flows, valuation approaches, project finance, option pricing, real options, ratios analysis, energy derivatives, venture capital, corporate acquisitions, the business case for clean energy, energy access, and green real estate finance. The goal of the course is to increase your understanding of financing, investment, and hedging decisions as they relate to energy companies and energy-related projects.

Organizational Matters

The Sakai site contains links to all course materials that are not linked in this document.

Class Meetings and Attendance:

We expect you to attend all classes regularly and on time, having prepared beforehand all assignments and readings. If you are unable to attend class on a given day (and this should not be a regular occurrence), you will not be permitted to make-up that participation in some other way.

Assignments and grading:

Your course grade will be based on a final exam, individual and team assignments, and class participation. The following weights will be used in calculating your final grade:

Final Exam	30%
Individual Assignments	30%
Team Assignments	30%
Class Participation	10%

The final exam reflects your individual effort, is cumulative, and is *open-book, open-notes*.

Class participation is an individual effort. It is critical that you attend class and come prepared to participate actively in the discussion. The questions provided for cases and readings will help you prepare for class. Learning for everyone in this class is enhanced through debate, different perspectives, and new insights. Keep in mind that your goal should be to contribute high *quality* comments, *not* high *quantity*.

There will be a number of individual and team assignments over the course of the semester.

For group assignments, students will provide assessments of peers' quality and quantity of work via confidential scores (sent as an email to the professors) where 1 = below expectations, 2 = met expectations, and 3 = above expectations.

Students may submit at most *one* late assignment during the semester, and must notify the professor before the assignment's due date with a reasonable explanation for why the assignment is late, and when it will be delivered (certainly no more than a very few days after the official due date). Other late assignments will not be graded.

Students are also encouraged to subscribe and listen to these podcasts, which frequently cover energy finance trends:

Energy Gang

Interchange

My Climate Journey

Currents

Redefining Energy

Duke University Honor Code:

The Duke University Honor Code applies to all aspects of this course. We will not tolerate any infraction of the Honor Code. The nature of each assignment indicates the type of communication and consultation that is permitted. Work that is described as an individual effort is to be your work alone, without consultation or assistance from any other person. Work that is described as a team effort is to be your team's effort alone, again without consultation or assistance from anyone else. If you are uncertain about the nature of collaboration for any assignment, please ask us.

Bloomberg Market Concepts (BMC) Certification:

In addition to the assignments listed below, students will earn a certificate for completing the Bloomberg Market Concepts course, which they can list on their resume. See summary below and more background here. Depending on your pace, completion requires 7-10 hours of study. Students should submit a certificate of their completion by 4/26 at noon via Sakai. We recommend that students complete modules of this training throughout the semester instead of waiting until the end of the course. For login details, see Sakai.

"Bloomberg Market Concepts (BMC) is a self-paced e-learning course that provides an interactive introduction to the financial markets. BMC consists of 3 sections — Core Concepts (includes four modules – Economic Indicators, Currencies, Fixed Income, Equities), Getting Started on the Terminal and Portfolio Management. The sections are woven together from Bloomberg data, news, analytics and television."

Course Schedule

Lectures from Dr. Emma Rasiel

Weeks 1-2

(1/21, 1/28)

Topics: The Net Present Value (NPV) formula and incremental cashflows. Equivalence between NPV and IRR. Leverage and tax shield on debt. Weighted Average Cost of Capital (WACC). Worked examples.

In class: NPV exercise

Assignment: Saito Solar case

Week 3
(2/4)

Topics: Introduction to real options; From NPV to option-adjusted PV; expansion, timing and learning options; case study for electricity generator project; delay and abandonment options.

In Class: Electricity Generator problem, Part 2

Assignment: Read Amaranth case study

Week 4
(2/11)

Topics: Forwards and futures; spot vs futures markets; hedging vs. speculation; futures pricing using no-arbitrage; exceptions in the commodities futures markets; contango and backwardation

In Class: Amaranth case study discussion

Assignment: *Jetfuel hedging*

Weeks 5-6
(2/18)

Topics: Financial Options. Option pricing: Binomial model; relationship between options and futures; options for hedging and speculation. The “greeks” and risk analysis.

Assignment: *Options Problem Set*

Week 7

(2/25, 3/4)

Topics: More on real options; extracting the value of the real option through dynamic hedging

In class: Rigby Oil

Assignment: Real Options Valuation of Oil Field Concession in the North Sea (team-based)

Lectures from Dr. Chris Wedding

Week 8
(3/11)

Topics: Overview of global investment in clean energy (financial and non-financial drivers)

Readings for class:

- New Energy Outlook - Bloomberg NEF (in Sakai > Readings - Chris Wedding)
- January 2020 Monthly Update - Nomura Greentech

Assignment: [individual or as a team of 2-3 students]

- Based on your readings, generate 3-4 specific clean energy business strategies (e.g., geography, customer type, technology type, market niche) that are likely to be good (or bad) investment opportunities between now and 2025. Don't just list "solar projects" as one of your ideas. I'm looking for much more detail. Be prepared to support your suggestions with 2-3 data points from these readings or other sources. I will call on some students to share their ideas. This will not be submitted via Sakai.

Week 9
(3/18)

Topics: Cleantech and climate tech venture capital

Readings for class:

- Climate Tech VC Newsletter - read 6 issues of your choice

- The State of Climate Tech - PwC (skim, focus on graphs/charts)

Guest lecture:

- Dr. Eric Toone - Executive Managing Director, Breakthrough Energy Ventures

Assignment: [individual]

- *Write a memo explaining similarities and differences between cleantech and climate tech, and how today's investments will fare better (or worse, or the same) as cleantech version 1.0 from 2005-2010.*
- *See Sakai > Assignments for more detail.*

Week 10

(3/25)

Topics: Energy access (i.e., addressing energy poverty in developing countries)

Readings for class:

- Blue Haven Initiative: The PEGAfrica Investment - Harvard Business Publishing (you need to purchase this case study)
- Strategic investments in off-grid energy access - Wood Mackenzie (in Sakai > Readings - Chris Wedding) (skim, focus on graphs/charts)

Guest lecture:

- *Jonathan Phillips - Director, Energy Access Project, Duke University*

Assignment:

- *None*

Week 11

(4/1)

Topics: Project finance for renewable energy and energy storage

Readings for class:

- The Unglamorous Approach to Impact Investing In Energy - Lacuna Sustainable Investments

- LEvelized Cost of Energy (v14) - Lazard (download via link under top banner photo) (skim, focus on graphs/charts)
- Levelized Cost of Storage (v6) - Lazard (download via link under top banner photo) (skim, focus on graphs/charts)

Guest lecture:

- Andrew Ellenbogen - Managing Director, EIG Partners

Assignment: [team]

- *Wind project financial modeling*
- *Energy storage project financial modeling*
- *See Sakai > Assignments for more detail.*

Week 12

(4/8)

Topics: Green real estate finance

Readings for class:

- Edward Lundberg and the Rockville Building: Energy Efficiency Finance in Commercial Real Estate - Harvard Business Publishing (you need to purchase this case study)
- Bricks, Mortar and CarbonHow Sustainable Buildings Drive Real Estate Value - Morgan Stanley

Guest lecture:

- Brad Dockser - Founder and CEO, Green Generation

Assignment: [individual]

- *Green building pro forma: Base case vs. LEED building*

Week 13

(4/15)

Topics: Corporate acquisitions; Fundamental (ratios) analysis; Corporate reporting (10-K)

Readings for class:

- Corporate Finance Ratios - CFI
- How to Calculate the Debt Service Coverage Ratio? - CFI
- ENGIE: Strategic Transformation of an Energy Conglomerate - Harvard Business Publishing (you need to purchase this case study)

Guest lecture:

- None

Assignment: [team]

- *Quantitative analysis to decide whether to invest in Tesla or First Solar*

Week 14

(4/22)

Topics: Carbon Tech - Capture, Sequestration, Upcycling

Readings for class:

- Circular Carbon Market Report 2020 - Circular Carbon Network (skim, focus on graphs/charts)
- The role of CCUS in low-carbon power systems - IEA

Guest lecture:

- Aaron Ratner - President, Cross River Infrastructure Partners

Assignment: [team]

- *Carbon pricing outlook and impact on feasibility for CCUS*