

# CLIMATE AND FINANCIAL MARKETS

## ACCT/BEPP 7640

*Spring Semester 2024, Tu/Th 10:15-11:45 a.m. and 1:45-3:15 p.m., JMHH 340*

*Note: This syllabus may be updated throughout the semester as policy developments occur. Please check Canvas for the latest version before you do the readings for the next lecture.*

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**Course overview.** Climate change might be the defining challenge of our times, with a wide range of effects on financial markets and the broader economy. At the same time, financial markets play an important role in financing the transition to a net-zero economy, and incentivizing firms and investors to adapt their strategies. In this course, we examine how climate risks—both physical and regulatory—affect firms, financial markets (including equity, bond, insurance, and carbon markets), and markets for energy and real estate. We also examine the role that firms' disclosures and third-party information sources play.

**Topics.** We start with discussing physical and transition risks from climate change. We then study the pricing and hedging of climate impacts and risks in equity, debt and real estate markets. We apply these insights to carbon markets. Because financial markets are shaped by the information that is available to market participants, we investigate the impact of ESG

reporting and rating agencies, including the costs and benefits of regulating ESG reporting and the impact of greenwashing. In the second part of the course, we study how governments and private investors finance investments in climate technologies. Here, we discuss various financial instruments that have been developed to address climate-change concerns. Given the enormous importance of electrification as a pathway towards a low-carbon future, there is special emphasis on renewable energy finance and economics. We end the semester with the latest evidence of how climate risk has affected insurance and energy markets, and how they shape decisions inside organizations, such as spin-offs, hedging, and the structure of executive-compensation contracts.

**Readings.** The research in this field is rapidly advancing, as are policy and financial-market developments. Rather than one comprehensive textbook, we rely on a mix of academic papers, newspaper articles, and reports by industry groups, policy makers and regulators. Starred (\*) readings are required. Non-starred readings are optional but we will often discuss them in class, and you are highly encouraged to read them if you want further background on a topic.

**Course format.** This is an experimental 1cu course. We encourage a lively class discussion. Attendance is mandatory. Please email the instructors if you need to miss a class.

**Guest lectures.** The course has six guest lectures/panels/simulations by external experts. This year's emphasis will be on ESG investing, carbon trading, renewable energy finance, and renewable energy dealmaking. Attendance is mandatory and the content is fair game for questions on assignments and tests.

**Assignments and grading.** Two tests (40%), four short case write-ups (as a group; up to three students; 20%), two quantitative assignments (as a group; up to three students; 20%), and class participation (20%). Your class participation grade will be based on the quality of your comments during class and Canvas prep-questions (graded based on completion only; 10%), and your participation in the experiments and the simulation (10%).

**AI policy.** You may use generative AI programs (e.g., tools like ChatGPT) to help generate ideas and brainstorm. However, you should note that the material generated by these programs may be inaccurate, incomplete, or otherwise problematic. Beware that use may also stifle your own independent thinking and creativity. You may not submit any work generated by an AI program as your own. If you include material generated by an AI program, it should be cited like any other reference material (with due consideration for the quality of the reference, which may be poor). Any plagiarism or other form of cheating will be dealt with severely under relevant Penn policies.

**Cheating policy.** It should not be necessary to say this – but for completeness: all students are expected to comply with the University of Pennsylvania’s [Code of Academic Integrity](#). It is the policy of the department, and this course, to immediately fail any student for the course who is in violation of the University’s Code of Academic Integrity. Additional sanctions may be imposed by the Office of Student Conduct.

**Other details.** The course is part of the MBA major in Business, Energy, Environment and Sustainability. Non-Wharton students are welcome and encouraged to contact the professors in advance to discuss prerequisites.

## **CLASS SCHEDULE**

Required readings are marked with (\*); additional readings that provide more in-depth insight are provided without the mark.

### **Lecture 1 (Jan 16): Course Introduction**

*Topics:* climate change science and projections; impacts on real assets and financial markets; physical and transition risks

- Video: The Science of Climate Change ([link](#)).

If you want to get into the mood, here is an NYT article on socially responsible investing:

- Sommer, J., “On Wall St., ‘Socially Responsible’ Is Common Sense. In Congress, It’s Political.” *New York Times*, 3/4/23 ([link](#)).

The EPA provides a nice summary on Climate Risks and Opportunities ([link](#)).

We will introduce the CAPM in returns form:

- Video: If you don’t remember it well, here is a very simple YouTube video that covers the main terminology ([link](#)).

### **Lecture 2 (Jan 18): Climate Impact on Asset Prices**

*Topics:* equity pricing; derivation of the CAPM; pricing of cash flows and risks; systematic risk of climate change; physical vs. transition risk; climate change impact on cash flows; future regulatory impact on cash flows.

- (\*) Ramani, V., “Addressing Climate as a Systemic Risk: A Call to Action for Financial Regulators”, *Harvard Law School Forum on Corporate Governance*, 6/28/20 ([link](#)).
- (\*) Alekseev, Giglio, Maingi, Selgrad, and Stroebel, 2022. “A Quantity-Based Approach to Constructing Climate Risk Hedge Portfolios,” working paper ([link](#)). Just read the introduction on pages 1-6.
- Lambert, R., C. Leuz, and R.E. Verrecchia, 2007. “Accounting Information, Disclosure, and the Cost of Capital.” *Journal of Accounting Research* 45 ([link](#)).

#### *In-class experiment*

- “Climate-Impact Preferences of Investors.” This experiment is based on Bonnefon, J.-F., A. Landier, P.R. Sastry, and D. Thesmar, 2022. “The Moral Preferences of Investors: Experimental Evidence.” NBER Working Paper 29647.

### Lecture 3 (Jan 23): **ESG Investing and Green Returns**

*Topics:* warm glow/preferences for “green investments”; greenium.

### Lecture 4 (Jan 25): **Climate Risk in Real Estate Markets**

*Topics:* housing and mortgage markets, muni bonds

### Lecture 5 (Jan 30): **Long-Run Discount Rates**

*Topics:* theory of long-run discounting; empirical evidence for long-run discount rates; the social cost of carbon.

#### *Pre-class experiment*

- “Very Long-Run Discount Rates” in which students decide how much to pay to (i) buy a property; (ii) lease it for time periods of varying length; based on Giglio, S. and J.C. Stroebel, 2015. “Very Long-Run Discount Rates.” *Quarterly Journal of Economics* 130(1): 1-53.

### Lecture 6 (Feb 1): **Climate Risk in Debt Markets**

*Topics:* green bonds; public debt; private equity; shareholder activism; housing and mortgage markets.

*Case*

- Does Sustainability Pay? Barry Callebaut's Sustainability Improvement Loan. Case discussion questions will be provided via Canvas.

Lecture 7 (Feb 6): **Carbon Markets**

*Topics:* participants in carbon markets; financial carbon instruments; fundamental analysis for trading insights; EU ETS market design and risks; impacts of carbon markets on corporate strategy.

Lecture 8 (Feb 8): **Carbon-Trading Simulation**

*Topics:* carbon market trading; market design; the effect of uncertainty on carbon markets.

*In-class experiment*

- Students participate in a simulated carbon market “CarbonSim”, where they develop and implement a carbon portfolio management strategy and learn the importance of market design.

Lecture 9 (Feb 13): **ESG Reporting**

*Topics:* impact of ESG reporting in financial markets; voluntary sustainability reporting standardized ESG reporting; materiality; scope 1, 2 and 3 emissions; greenwashing and regulation to curb it; corporate incentives for change.

Lecture 10 (Feb 15): **Panel Discussion on Climate Risk and Investment**

*Guest speakers:* Jeffrey Hales, Board Member of the International Sustainability Standards Board; Melanie Fornes, Climate Change Investment Specialist, Glenmede; Thomas O’Bannon, Vice President, Investor Relations, Shell

*Topics:* effect of climate risk on portfolio selection; the need for standardized ESG reporting; industry responses to climate risk as well as investor and regulatory pressures.

Note: This lecture will take place from 1:45-3:15pm only in a different classroom: JMHH G06. There will be no 10:15-11:45am section.

Lecture 11 (Feb 20): **ESG Ratings**

*Topics:* climate information and market efficiency; measuring and aggregating ESG performance; rating agencies.

*Case*

- Each group of students will be assigned a sustainability report before class and will present a short analysis of the report in class.

Lecture 12 (Feb 22): **Test I**

*Note:* The test will be held during the regular class time. Class will be split between JMHH 340 and SHDH 1206 (10:15am section) and between JMHH 340 and JMHH G55 (1:45pm section).

— MBA CORE EXAMS AND SPRING BREAK —

Lecture 13 (Mar 12): **The Economics of Renewable Energy**

*Topics:* key trends in renewable energy; levelized cost of electricity.

Lecture 14 (Mar 14): **Renewable Energy Finance (1)**

*Topics:* intermittency; the variable value of renewable energy; intro to renewable energy finance; tax credits; accelerated depreciation; solar leases and PPAs.

Lecture 15 (Mar 19): **Renewable Energy Finance (2)**

*Topics:* energy storage basics; tax equity; securitization; renewable portfolio standards; (S)RECs.

Lecture 16 (Mar 21): **Solar Energy Project Finance**

**Guest speaker:** Gianluca Signorelli, VP, Head of Project Finance and M&A Execution, U.S. SB Energy (SoftBank)

*Topics:* renewable energy project finance, tax equity, capital structure, PPAs, hedging.

*Note:* This lecture will be held in the usual location at the usual time (both sections).

Lecture 17 (Mar 26): **Renewable Energy and Climate Policy**

*Topics:* net metering; PACE; feed-in tariffs; tenders; import tariffs; green subsidy vs. carbon tax; waterbed effect.

Lecture 18 (Mar 28): **Financing Wind Energy Investments**

**Guest speaker:** Udit Goyal, Head of Project Finance, Offshore North America, Ørsted

*Topics:* investing in wind energy, wind energy finance, wind energy contracts.

*Note:* this lecture will be held in JMHH F85.

Lecture 19 (Apr 2): **Renewable Energy Dealmaking (1)**

**Guest speaker:** Kaam Sahely, Partner, Vinson & Elkins

*Topics:* case study in renewable energy dealmaking.

*Case*

- Details to be announced.

Lecture 20 (Apr 4): **Renewable Energy Dealmaking (2)**

**Guest speaker:** Kaam Sahely, Partner, Vinson & Elkins

*Topics:* case study in renewable energy dealmaking.

*Case*

- In-class presentations.

Lecture 21 (Apr 9): **Climate Risks in Insurance Markets**

*Topics:* climate as systematic and systemic risks, diversification strategies by insurance companies.

Lecture 22 (April 11): **Climate Risks in Energy Markets**

*Topics:* climate risks for energy firms; effects on strategies and investments by oil & gas, renewables, electric utilities and electric-vehicle companies.

*Case*

- Ørsted's Transformation from a Fossil into a Renewable-Energy Company. Case and discussion questions will be provided via Canvas.

Lecture 23 (Apr 16): **Corporate Climate Strategies**

*Topics:* firms' investment decisions; hedging climate risks; spinoffs vs. integrated companies; catastrophe insurance; the role of executive compensation contracts in investment and hedging decisions.

Lecture 24 (Apr 18): **Test II**

*Note:* The test will be held during the regular class time. Class will be split between JMHH 340 and SHDH 1206 (10:15am section) and between JMHH 340 and JMHH G55 (1:45pm section).



## **DUE DATES**

### **Tests**

Test 1: Thursday Feb 22, in class.

Test 2: Thursday Apr 18, in class.

### **Short case write-ups**

Case 1 (Does Sustainability Pay? Barry Callebaut's Sustainability Improvement Loan): due on Thursday Feb 1, before class.

Case 2 (Comment letters to SEC Proposed Rules on Climate-Related Disclosures): due on Thursday Feb 15, before class.

Case 3 (Renewable Energy Dealmaking): due on Thursday Apr 4, before class.

Case 4 (Ørsted's Transformation from a Fossil into a Renewable-Energy Company): due on Thursday Apr 11, before class.

### **Quantitative assignments**

Assignment 1 (Climate Risk in Asset, Housing, and Carbon Markets): due date tbd.

Assignment 2 (Renewable Energy Economics and Finance): due on Thursday Mar 21, midnight EST.

### **Class participation**

Short pre-lecture prep questions are due before the start of each lecture (Tu/Th 10:15 a.m.).