Columbia Business School

B8201 Climate Change and the Energy Transition
Spring Semester 2022, B Term

Gernot Wagner
392 Kravis
gw2245@columbia.edu

Office Hours:
Wednesday 2:30-4:30 pm
Please sign up via calendly.com/gwa/oh
Alternatively, join me on a morning run.
If none of these times work, please email me.

COURSE ASSISTANT
Raksha Muralidharan
RMuralidharan22@gsb.columbia.edu

Office Hours:
Tuesdays 2:00-4:00 pm
(Please arrange location via email.)

Please see Canvas for all course materials and communications.
For any questions or concerns, don't hesitate to email me.

COURSE DESCRIPTION

About 80% of the greenhouse gases (primarily carbon dioxide and methane) that drive climate change are emitted as a result of the use of fossil fuels (coal, oil, and gas). Minimizing climate change will therefore require that societies move away from fossil fuels in most of their applications, the most important of which are electricity generation, transportation, and heating. This transition from fossil fuels to alternatives such as renewable energy and nuclear power poses substantial challenges and also offers once-in-a-lifetime opportunities to the business world. These challenges and opportunities are the topic of this class.

STUDENT LEARNING OUTCOMES

This course is designed for both MBA students planning careers in any kind of business or financial sector directly impacted by climate change, and for students planning careers in a climate change-related field (such as renewable energy companies, non-profit or government organizations), who want to understand the process of policy formulation and their impacts.

Specifically, the course objectives are to:

1. Understand and analyze the risks of unmitigated climate change.
2. Understand and analyze the impacts of current and future technologies and climate policies and the implications for businesses.
3. Develop tools to analyze competing technologies and business models using, e.g. via net-present value analysis.

REQUIRED COURSE MATERIALS

All cases, articles, and background notes will be available via Canvas.

CONNECTION TO THE CORE

The learning in this course will utilize, build on and extend concepts covered in the following core courses:

Core Course	Connection with Core
Corporate Finance	1. Time value of money
Managerial Economics	1. Consumer demand 2. Cost analysis 3. Agency and incentives

Students will be expected to have mastered these concepts and be able to apply them in the course.

CLASSROOM NORMS AND EXPECTATIONS

Students are expected to adhere to CBS Core Culture in this class by being Present, Prepared, and Participating. Students are required to prepare for each class by reading and analyzing the assigned cases and other materials and utilizing the study guidance questions which are provided via Canvas. In class, students are expected to add thoughtful points to each class discussion.

COURSE ROADMAP/SCHEDULE

Session	Topic(s)	Required Pre-Readings	Assignments Due (Type)
Module 1 (23 March 2022): The Size of the Problem			
8:30-10:00	The Cost to Achieve Net-Zero	Wagner & Usher, "The Cost to Achieve Net-Zero," Columbia CaseWorks #220310	Please come prepared to discuss and engage with this case [* Won't be called out each time in the syllabus, but yes, please come to class having done the required pre-readings.]
10:00-10:15	Break *Won't be called out explicitly going forward, but we will make sure to stick to this schedule each week.		
10:15-10:45	Course overview	Syllabus	Read syllabus carefully (C: Indiv) Answer online quiz (C: Indiv)
10:45-11:45	Climate Risk & Policy Risk	Wagner, "How bad?" Wagner, "Pretty bad"	
Module 2 (30 March 2022): Renewables			
8:30-10:00	Wind	Heal & Usher, "Ørsted's Offshore Wind Farms," Columbia CaseWorks # 210304	
10:15-11:45	Solar	Heal & Usher, "ELP Greenport Solar," Columbia CaseWorks # 210305	ELP Greenport Solar LCOE Analysis (due April 29th)

Module 3 (6 April 2022): Nuclear			
8:30-10:00	What role for nuclear power?	Wagner, "Is Nuclear Power Part of the Climate Solution?" *WSJ* (2022).	
10:15-11:45	Financing nuclear *Guest* (10:45-11:45)*:* Mark Nelson, Managing Director, Radiant Energy Fund	Keefer & Nelson Decouple podcast, "The Lazard People Are Taking Over" (1:09:38)	
Module 4 (13 April 2022): Offsets			
8:30-10:00	Offsetting emissions *Guest* (9:30-10:00 via zoom): Danny Cullenward, Policy Director, CarbonPlan	Offsets case [TK]	TK
10:15-11:45	Direct Air Capture	Stripe case [TK]	TK
Module 5 (20 April 2022): Finance			
8:30-10:00	Financing Air Capture *Guest:* Ryan Orbuch, Partner, Lowercarbon Capital	TK	TK
10:15-11:45	Climate Finance *Guest:* Paul Bodnar, Global Head of Sustainable Investing, BlackRock	TK	TK
Module 6 (27 April 2022): The Business Case for Action			
8:30-10:00	Corporate Climate Goals	TK	TK
10:15-11:45	The Business Case for Action	TK	TK

METHOD OF EVALUATION

Cost of Decarbonization NPV Analysis (B^1 + Discussion)	25%
ELP Greenport Solar LCOE Analysis (B^1 Indiv + Discussion)	25%
Nuclear or DAC 4-page paper (B^2 Indiv + Concepts only)	25%
Participation (C Indiv)	25%

ASSIGNMENTS

There are three assignments in this course, each worth 25% of your final grade:

1. **Cost of Decarbonization Net Present Value (NPV) Analysis** (Type B^1, due by **Friday, April 15th** via Canvas): The McKinsey Net-Zero case calculates the cost of replacing fossil fuels with low-carbon energy sources. Focus on the spreadsheet model and explore the sensitivity to core modeling assumptions, probing their importance to the final conclusion. Submit your spreadsheet model and a 2-page analysis presenting your argument and conclusion.
2. **ELP Greenport Solar Levelized-Cost of Energy (LCOE) Analysis** (Type B^1, due by **Friday, April 29th** via Canvas): How would you incorporate energy storage into ELP Greenport Solar's financial model? Submit your spreadsheet model and a 2-page analysis presenting your argument and conclusion.
3. **Nuclear or direct air capture (DAC) 4-page paper** (Type B^2, due by **Friday, April 29th** via Canvas): Write a 4-page paper on the potential role either nuclear or direct air capture might play in a carbon-free economy. Argue for (or against) the business case for either.

All of your assignment submissions are subject to the CBS Honor Code. Violations of the CBS Honor Code may lead to failing the assignment, failing the course, suspension, and/or dismissal. In order to avoid ambiguity that may lead to unintentional violations of the Honor Code, assignment description types have been standardized and specified below.

Type	Designation	Grade	Preparation of submission	Discussion of Submission*	Discussion of Concepts**
A	Group Work	Same grade for all group members	By the group	Permitted to discuss (within group)	Permitted
B^1	Individual w/ Discussions of Concepts and Submission	Individual grade	Individual preparation	Permitted to discuss; sharing solutions or submission files is not allowed	Permitted
B^2	Individual w/ Discussions of Concepts Only	Individual grade	Individual preparation	Not permitted to share/discuss solutions or submission	Permitted
C	Individual	Individual grade	Individual preparation	Not permitted to share/discuss solutions or submission	Not permitted***

The designated group can be either an assigned study group or a self-selected one.

* Submission means any work and/or output pertaining to the specific assignment. If an assignment submission contains a calculation or decision related to a specific set of data and setting, discussing the details how to make this calculation or decision with regard the data/setting is to discuss the submission. Providing another student with a draft of the calculation or decision is sharing the submission.

** Concepts mean any ideas, examples, readings, or other related materials from the class/course. Conceptual discussion should not be based on a specific set of data or setting related to a calculation or decision required in the assignment, but could be based on other related examples, preferably those from class/course materials.

*** As no conceptual discussion is permitted, Type C is akin to a take-home exam.

ATTENDANCE POLICY

Students are required to attend each class. Students should reach out to the instructor or TA regarding excused absences (for religious observances; personal, medical, and family emergencies; military service; court appearances such as jury duty). Unexcused absences will affect your course grade.

NOTE: The following is applicable for Core Courses:

- Students that miss more than **33%** of their classes (unexcused absences) will at most receive a **P for the course grade**
- Students that miss more than **50%** of their classes (unexcused absences) will receive a **F for the course grade**

NOTE: The following is applicable for Core Courses and for any electives with OSA-administered exams:

- Students that miss the exam for an **excused** reason but are unable to take the exam within the stated make-up period will receive a **zero for the final exam grade**
- Students that miss the exam without notifying OSA (**unexcused**), will receive an **F for the course grade.**

This course may use PollEverywhere as a tool to increase in-class student engagement. PollEverywhere may also be used to confirm student attendance and participation records. Students who have concerns regarding whether their responses have been recorded should contact the course assistant.

If a student is absent from class and is allowed to attend a different cluster's class meeting, it is at the discretion of the faculty member to count responses to any polls presented during this time as attendance or participation.

Finally, if a student is not present in the classroom at the time of a poll (due to absences or any other reasons), the poll should not be answered. Responding to a poll when not present in the classroom is a violation of the Honor Code.

INLUSION, ACCOMMODATIONS, AND SUPPORT FOR STUDENTS

At Columbia Business School, we believe that diversity strengthens any community or business model and brings it greater success. Columbia Business School is committed to providing all students with the equal opportunity to thrive in the classroom by providing a learning, living, and working environment free from discrimination, harassment, and bias on the basis of gender, sexual orientation, race, ethnicity, socioeconomic status, or ability.

Columbia Business School will make reasonable accommodations for persons with documented disabilities. Students are encouraged to contact the Columbia University's Office of Disability Services for information about registration. Students seeking accommodation in the classroom may obtain information on the services offered by Columbia University's Office of Disability Services online at www.health.columbia.edu/docs/services/ods/index.html or by contacting (212) 854-2388.

Columbia Business School is committed to maintaining a safe environment for students, staff and faculty. Because of this commitment and because of federal and state regulations, we must advise you that if you tell any of your instructors about sexual harassment or gender-based misconduct involving a member of the campus community, your instructor is required to report this information to a Title IX Coordinator. They will treat this information as private, but will need to follow up with you and possibly look into the matter. Counseling and Psychological Services, the Office of the University Chaplain, and the Ombuds Office for Gender-Based Misconduct are confidential resources available for students, staff and faculty. "Gender-based misconduct" includes sexual assault, stalking, sexual harassment, dating violence, domestic violence, sexual exploitation, and gender-based harassment. For more information, see http://sexualrespect.columbia.edu/gender-based-misconduct-policy-students.