

**Classroom:** 227 Mudd

**N.B.:** Items highlighted below in yellow are TBD.

**Day and Time:** Tuesday evenings, 6:10 pm to 8:00 pm.

**Instructor:** Tom Sahagian, [ts3449@columbia.edu](mailto:ts3449@columbia.edu)

**Instructor's Office Hours:** By appointment, **Mondays 3:30 to 5:30 pm**, or after class or via zoom.

**Course Reader (CR) Office Hours:** By appointment or announcement.

Book office hours via email either with the instructor or the CR.

**Course Reader:** Christopher Plum, [cp3418@columbia.edu](mailto:cp3418@columbia.edu). Shortly after the due date for an assignment or exam, the CR will go over the solutions remotely with the class (see day/time via announcements on Courseworks or email).

### **Readings:**

Most weeks students are assigned a set of readings in Courseworks to be completed before each class. The readings are intended to prepare students for the material covered during class and serve as reference material for assignments.

### **Course Books:**

Sustainable Energy — Without the Hot Air, by David J.C. MacKay. The book is available for free in electronic form at <https://www.withouthotair.com/order.html>, but I strongly recommend buying the paperback edition as well.

Guide to Energy Management, by Barney L. Capehart, Wayne C. Turner and William J. Kennedy Eighth Edition, ISBN: 0-88173-765-8 or ISBN: 978-1-4987-5933-5

*Note: Older editions of this book are available electronically and are suitable for use in the course*

### **Course Objectives**

Energy management is the cornerstone of any sustainability initiative. How energy is used -- and frequently, wasted -- has a significant impact on an organization's cash flow and profitability, not to mention the impact on the environment.

All sustainability managers should be able to distinguish between sustainability projects that are worth pursuing and those that are not.

This Physical Dimensions/Quantitative Analytics course will provide real-world information about energy management. Through lectures, problem sets, and readings, students will learn about energy audits, analyze the energy performance of various technologies, and evaluate the energy use and financial impacts of upgrades and operational improvements to building systems.

Pending permission from various NYC jobsites, we will also make a handful of field trips to view various energy-consuming technologies *in vivo*.

This class requires at least a passing familiarity with Microsoft Excel. Although there are no course prerequisites, some basic math will be necessary to complete the coursework.

**If you prefer not to work with technical information and perform calculations, this class is not for you.**

## **Class Content (HW = Homework)**

- Week 01/Class 1 Jan 16: Course Intro; Intro to Building Systems **(HW)**
- Week 02/Class 2 Jan 23: More Building Systems; Energy Audits & Modeling **(HW)**
- Week 03/Class 3 Jan 30: Energy Benchmarking; Energy Consumption Measurement **(HW)**
- Week 04/Class 4 Feb 6: Utility Rates and Billing **(HW)**
- Week 05/Class 5 Feb 13: Lighting; Ventilation **(HW)**
- Week 06/Class 6 Feb 20: Properties of Air; Stack Effect; Air Handling **(HW) Field Trip 1**
- Week 07/Class 7 Feb 27: Review for midterm (**Midterm posted after class – due 3/4/24**)
- Week 08/Class 8 Mar 5: Space Heating and Domestic Hot Water **(HW) Field Trip 2**
- Week 09 Mar 12: Spring Break – NO CLASS
- Week 10/Class 9 Mar 19: Space Cooling; Controls **(HW) Field Trip 3**
- Week 11/Class 10 Mar 26: Heat Pumps; Electrification **(HW) Field Trip 4**
- Week 12/Class 11 Apr 2: Building Envelope and Heat Transfer **(HW)**
- Week 13/Class 12 Apr 9: Passive House, Solar Photovoltaics and Wind Power **(HW) Field Trip 5**
- Week 14/Class 13 Apr 16: Time Value of Money **(HW)**
- Week 15/Class 14 Apr 23: Review for final; **Guest Lecture – Carbon Capture** -- **(Final Exam posted)**
- Week 16 Final Exam Due 5/X/24, 11:59 pm.

## **Problem Sets:**

All Problems sets will assess the ability of each student to:

1. follow the analysis method at issue as presented in the lectures (partial credit will be given for partial success) and;
2. derive the answer to the problem based on the information provided.

Generally, credit for methodology is 50% and credit for the answer is 50%. However, this may vary somewhat depending on the individual homework problem.

You may directly email the instructor or the CR; please cc: both. Students must submit assignments in Excel unless otherwise directed.

An assignment submitted in other than Excel format will be given a zero. Late assignments will be given a zero unless there are extenuating circumstances (to be decided at the sole discretion of the instructor). The chances of receiving an extension will improve the sooner students bring extenuating circumstances to the instructor's attention. Last-minute and after-deadline requests are unlikely to be approved except under the most extreme circumstances.

## Presentations

Depending on the size of the class, each student or pair of students may be required to make a brief presentation(s) to the class on a technical topic.

## Midterm and Final Exams:

The two exams will be take-home assignments. The midterm will include problems designed to ensure understanding of the key concepts covered in class up to that point.

The final will be similar, except that it will address all the material covered during the semester.

**Exams are not group assignments. Students who collaborate on either exam will receive a grade of zero for that exam.**

As with the problem sets, the exams will be graded on the ability of each student to:

1. follow the analysis method at issue as presented in the lectures (partial credit will be given for partial success) and;
2. derive the answer to the problem based on the information provided.

The midterm exam will be posted on 2/27/24 between 8:00 pm and 9:00 pm and will be due on 3/4/24 by 6:00 pm. Please note that questions about the exam should be submitted before 3/2/24 at 6:00 pm. Questions submitted after that time may not be addressed.

The final exam will be posted on 4/23/24 between 8:00 pm and 9:00 pm and will be due on 5/3/24 by 4:00 pm. Please note that questions about the exam should be submitted before 5/1/24 at 6:00 pm. Questions submitted after that time may not be addressed.

Questions about either exam must be limited to clarifying the language of the problems. Questions about methodology or whether or not your approach is on the right track will not be answered.

## GRADING:

Weighting of Assignments:

1. Class Participation/Class Presentations: 10%
2. Problem Sets: 40%
3. Midterm: 25%
4. Final Exam: 25%

Midterm exams submitted late will receive a letter grade deduction (10 points off) for each day or part of a day they are late. Final exams not submitted by the deadline noted above will be given a zero.

**It is every student's responsibility to confirm they have successfully submitted their homework and exams into Courseworks prior to the relevant deadline. Excuses along the lines of "I thought I submitted it but then after the deadline I discovered I hadn't" will not be accepted.**

*If you encounter a problem submitting an assignment or exam into Courseworks, please immediately contact CUIT, the CR or the Instructor for support.*

## EXPECTATIONS

We cover a lot of material in this class. To make the most of our collective time, and to keep from needlessly having points deducted from your final grade, please take care to:

- Check your CU email at least once a day. Some class announcements will be made via Courseworks, but others will be via email. If you receive an email from either the instructor or the CR, and it asks you to confirm receipt, please do so asap.
- Attend every class, and arrive on time. If you plan to skip class, for whatever reason, inform the instructor in advance.
- Leave your phone off and in your bag or backpack during class
- I'd prefer it if you took notes on (shudder) paper instead of your laptop, but it's up to you.
- Read the assigned material before the relevant class
- Make sure to include your name or initials in your Excel homework files
- Use commas in numbers greater than 999
- Avoid excessive decimal places in your homework answers

### Spring 2024 Sustainability Management PS5135 ANALYSIS FOR ENERGY EFFICIENCY

[Section 001](#)

*ANALYSIS FOR ENERGY EFFIC*

**Call Number:** 12205 **Points:** 3 [View in Vergil](#)

**Day/Time:** T 6:10pm-8:00pm **Location:** 227 Seeley W. Mudd Building