

Carnegie Mellon University

Energy Demand and Utilization

CIT 39-611

Tuesday & Thursday 9:30AM – 11:20AM

Wean Hall 5302

Spring 2016

Professor: Costa Samaras

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Office Hours: By appointment

Summary:

Energy Demand & Utilization examines how human demands for energy have evolved over time and how they differ across nations. The course begins from a historical perspective and proceeds to an evaluation of present demand and synthesis of future projections. The course focuses on the technologies used in the different sectors: housing, commerce, food, industry and transportation. Students successfully completing this course will be able to demonstrate an understanding of a variety of tools for energy analysis and measurement, including some fundamentals of economic analysis, energy efficiency, and demand response. We will also analyze strategies for inducing the adoption of efficient technologies and consumption.

Learning Objectives

Upon successful completion of the course, students should be able to:

- Describe how energy demand has evolved over time across various sectors
- Analyze trends and forecast energy consumption for different sectors: housing, commerce, food, industry and transportation
- Collect and use open data to analyze energy efficiency and demand response problems and quantify solutions
- Work in small teams to succinctly communicate their technical recommendations on efficient technologies and energy consumption

Readings and Lecture Material

The course will utilize multiple academic and popular press articles as readings throughout the course. **All required readings will be available on BlackBoard**, with students expected to review required readings before each class. There will also be several suggested readings and links for specific topic areas available on Blackboard.

As course background material, there are several suggested books. **You don't need to buy the books below**, but these are good sources to learn more about energy demand and forecasts across various sectors. The library should have copies of these and you can always obtain books from Carnegie Mellon Library's Interlibrary Loan Program.

1. L. D. D. Harvey, Energy and the New Reality 1: Energy Efficiency and the Demand for Energy Services. Earthscan/Routledge Publications Ltd., 2010.
2. F. Vanek and L. Albright, Energy Systems Engineering: Evaluation and Implementation, 1st ed. McGraw-Hill Professional, 2008.

As stated above, **you do not need to purchase these books for the class**. All of the reading material to achieve the course learning objectives will be provided by the instructor.

Assessments and Grading Rubric

Technical Quizzes: 40%

In-Class Exercises and Participation: 20%

Final Project Presentation: 20%

Final Project Briefing Report: 20%

Technical Quizzes (40%): Four mini-quizzes will be assigned, occurring after approximately every three or four classes. Quizzes will be quantitative and qualitative assessments, will include multiple choice questions, short answer questions requiring judgment and technical writing, and quantitative problems. Quizzes will be completed electronically on Blackboard out-of-class and on your own. You may use your course notes and other data, but complete the quiz individually.

Class Participation and Practice (20%): Good discussion makes an important contribution to everyone's experience in this class. You are expected to prepare for class and review all required readings, attend class, ask questions, and be an active participant in the discussion.

In the beginning of each class, I will ask for volunteers to briefly summarize something in recent energy demand news, preferably something that addresses the current class topic. A good source of this news is E&E News, which you have a subscription to at CMU. If you're on campus (or tethered via VPN), you have access to the stories at <http://www.eenews.net/>. Check EnergyWire, ClimateWire, GreenWire, etc on there. You can get the headlines emailed to you. Always come to class with at least one story on here read and be able to describe it in 2-5 min. This will count toward your participation grade.

During some classes, we will have individual or group exercises that will result in a written product turned in to the instructor with each person's name on it. Completion of these will count toward the class participation grade. Students will sometimes have to miss class for various reasons, and you may miss up to two in-class exercises without affecting your participation grade.

Before some classes, I will assign short online assignments based on the readings, to be completed before class. These will be assessed and counted toward participation as well.

Final Group Project: Presentation (20%), Final Proposal (20%)

40% of the grades for the course will be based on a group project, which consists of a written report and a presentation. The main objective of this project is to elaborate a formal proposal for a solution that can have the potential of reducing and/or controlling the energy demand (and/or GHG emissions) in a chosen sector. The solution will need to be described in detail, and accompanied by theoretical evaluations of the potential savings, costs of implementation, ease of deployment, etc.

The final project of this class consists of proposing a solution to help reduce or better manage the energy demand of one sector. You will need to estimate and forecast the energy saved with this solution.

Here are some general guidelines to help you out prepare your final report and presentation.

1. You should imagine that you will be presenting a formal proposal to a client (the mayor of a city, a large company, the government, etc.).
2. You will propose one solution for the sector you are given. This solution can be a management plan, a technological improvement, a new policy, etc.
3. You will quantify the feasibility of the solution: economic viability, environmental benefits, etc. These should be demonstrated both quantitatively and qualitatively. Use the tools we have learned in class to tackle this.
4. You will use your own template for the slides, and will write the final report in no more than 8 pages, **1.5 spacing**. Again, imagine you are presenting to a formal client. The presentation should be compelling, and the written proposal should contain all the necessary details for the client to evaluate and make a decision on his own.
5. Your solution should contain technical details on how to implement it and what the expected outcomes are. No client will buy into your solution if you don't persuade them on why it is a good idea.
6. Your presentation should be no longer than 20 minutes. There will be 10 minutes for questions from the audience. Even though you should divide the presentation so that each member of the group has the opportunity to present, the questions will be addressed to any member and it is expected that all members will know about the entire work.
7. The organization of the written proposal is flexible. However, it will be taken into account when evaluating your document. In general, you want to include the following sections into your proposal:
 - a. Executive Summary
 - b. Introduction, which may include: motivation, context, background information, related work
 - c. Proposal, where you describe the idea and provide the technical content
 - d. Evaluation, where you present the results of your evaluation (economic feasibility, environmental impact, potential benefits, etc.
 - e. Limitations
 - f. Deliverables and schedule

These same sections should be included in your oral presentation. You will turn in your slides and your report in blackboard under assignments.

Slides are Due by 3PM February 23rd
Report is Due by 3PM March 3rd

Course Procedures and Protocols

- Class begins promptly at 9:30 AM.
- Assignments are due before class via Blackboard's **assignment page** on the designated date and time. **Assignments should not be submitted via email.** To submit an assignment, select assignments in the tool bar, and then select view/complete assignment under the heading of the assignment you wish to complete. **Assignments submitted late will incur a penalty of 20% of total points per day late.**
- Collaboration is working together to come to frame a problem and work through a solution, discussing results, and analyzing the process. All members of the group contribute, understand the process (sometimes by being taught by other members of the group), and are prepared to complete a similar problem by themselves afterward. Collaboration is encouraged on homework assignments. However, for individual assignments, individual submissions are required. While you may have worked with another in solving the problem the work you hand in must be your own.
- Academic integrity is a core value at Carnegie Mellon. Cheating, including copying someone else's work and handing it in as your own work is unacceptable. It is equally unacceptable to allow others to use your work.
- Plagiarism is using someone else's published work and not giving them credit. Several web sources or the library have guidelines for referencing work from published journals, books, or newspapers, and from websites. (See "Citations and References" section, below.)
- Cheating and plagiarism will be handled according to university policies, which include the penalty for the assignment (usually a zero grade), and reporting the incident to Student Affairs.

Regrading Policy

- Regrades are possible within a one-week timeframe after the assignments are returned. After that time, no regrades will be considered (except for simple addition errors). To submit a regrade, you should attach a sheet of paper detailing your concerns about the score given and argue your point. Regrade requests should be handed to the professor in class.

Citations and References

In order to put together a professional report and to avoid plagiarism, it is imperative to become familiar with the proper procedures and styles for citing sources. There are several different styles and many online guides on proper citing. For this class, the specific style used (APA, MLA, etc.) is up to you, so as long as it is consistent and properly done. Below are some resources that outline citation styles.

1) Duke University reference for citations:

http://www.lib.duke.edu/libguide/cite/works_cited.htm

A good online reference, where you can easily find how to cite several different types of works.

2) CMU Reference for citations:

<https://libwebspace.library.cmu.edu:4430/Genref/citing.html>

3) University of California Berkeley reference for citations and definitions of plagiarism:

<http://www.lib.berkeley.edu/instruct/guides/citations.html>

Course Topics

Date	No.	Topic	Assessment
Tues, Jan. 12	1.	Introduction and Historical Demand	
Thur, Jan. 14	2.	Understanding Current Demand (EIA MER, RECS,)	
Tues, Jan. 19	3.	Modeling Future Demand Sources (EIA AEO, STEO, IEO, IEA, others)	Mini Quiz 1 Out
Thur, Jan. 21	4.	Energy Project Finance and Engineering Economics	Mini Quiz 1 on Classes 1-3 Due
Tues, Jan. 26	5.	Energy Markets	Project Topics Defined and Emailed
Thur, Jan. 28	6.	Energy and the Rebound Effect	Mini Quiz 2 on Classes 4-6 Out
Tues, Feb. 2	7.	Residential Energy	Mini Quiz 2 on Classes 4-6 Due
Thur, Feb. 4	8.	Commercial Energy	
Tues, Feb. 9	9.	Industrial Energy	Mini Quiz 3 on Classes 7-9 Out
Thur, Feb. 11	10.	Transportation – Personal	Mini Quiz 3 on Classes 7-9 Due
Tues, Feb. 16	11.	Transportation – Freight	
Thur, Feb. 18	12.	Food Production and Consumption	Mini Quiz 4 on Classes 10-12 Out
Tues, Feb. 23	13.	Final Presentations	All Final Presentation Slides Due
Thur, Feb. 25	14.	Final Presentations	
Mon., Feb. 28			Mini Quiz 4 on Classes 10-12 Due
Thur., Mar. 3			Final Report Due