SUMA K4135 Analysis for Energy Efficiency
Instructor: Luke Falk

Course Objectives

Responsible resource management represents the cornerstone of any sustainability initiative. Because the generation, distribution, and use of energy has a profound, continuous, and global impact on natural resources, energy issues tend to be the fulcrum upon which sustainability programs hinge. Energy use is directly correlated to financial liability, a reality which endows energy efficiency improvements with the potential to deliver quantified financial savings to the end user. The ability to identify and articulate organizational upside from energy savings tied to efficiency and renewable energy projects, is a required skill-set for successful future managers of sustainability initiatives.

When building owners improve the energy performance of their buildings, the first step in the process is an analysis of the buildings' existing conditions. In existing building these studies typically take the form of energy audits or retro-commissioning reports. In new construction these studies typically include whole-building energy modeling and/or commissioning work. This physical dimensions / analytics-track course will provide real-world information on energy management issues from a practitioner's perspective with a focus on quantitative analysis. Through lectures, problem sets, and readings students will learn how manage energy audits, analyze building energy performance, and evaluate the energy use and financial impacts of potential capital and operations improvements to building systems.

Although the class will focus on understanding energy issues from a building owner's perspective, occasionally, discussions will include examining energy issues from the perspective of utility companies, energy generators, and policy makers.

Best practice in energy management will always involve some level of complex engineering to survey existing conditions and predict energy savings from various improvement options. Sustainability managers need to understand how to manage and quality control that analysis and to translate the opportunity it reveals to decision makers within their organization. This class seeks to empower students to do that by providing an understanding of building systems and methods for quantitatively analyzing the performance of alternatives.

This class requires an understanding of Microsoft Excel and an enthusiasm for quantitative analysis. Although there are no prerequisites for the class, an ability to do some math is required. If you are not interested in dealing with technical information, this class is not for you.

Class Content

Session 1: The Argument for Efficiency

Session 2: Introduction to Energy Audits and Energy Modeling

Session 3: Energy Use Metrics and Benchmarking

Session 4: Intro to Building Science: Thermodynamics, Enclosures, Fenestration

Session 5: Quantifying Air Movement and Air Sealing

Session 6: Heating Systems: Boilers, Distribution, Parasitic Loads

Session 7: Air Conditioning: Heat pumps, Chillers, Cooling towers, Splits

Session 8: Lighting

Session 9: Submetering, Demand Response and Smart Grid

Session 10: Cogeneration, Domestic Hot Water, Renewables

Session 11: Economic Analysis: Owners Perspective (including utility rates)

Session 12: Economic Analysis: Utility Administered Efficiency Programs

Session 13: Measurement and Verification

Session 14: Wrap Up / Building Tour

Assignments:

1. Wattzon

Each student will be required to benchmark their life's energy use intensity using the website wattzon.com.

2. Problem Sets

A. Dimensional Analysis
B. Heating Index
C. Heat Loss Calculation
D. Quantifying Air Leakage
E. Heating System Comparison
F. Cooling and VFDs
G. Lighting Retrofit
H. Financial Analysis

Problems sets will be assessed both on:

The ability of each student to follow the analysis method at issue as presented in the lectures (partial credit will be assessed for partial success) and;

The ability of each student to derive the answer to the problem based on the information provided.

Credit for Methodology: 50%, Credit for Answer: 50%

Please post all questions on Problem Sets to the Courseworks Discussion Board. Questions must be submitted by 10pm on the Monday evening before the assignment is due.

3. Midterm

Each student will be required to analyze a building's energy use in total. This will require obtaining all energy use data for an entire building for a twelve month period. This assignment is given with the knowledge that New York City graduate students may not have ready access to this type of data. Part of the assignment is to locate someone who does have access to this information for a building and retrieve it for analysis.

4. Final Exam

The final exam will be a take home project. It will entail an analysis of a set of energy audits from both and energy and financial perspective. Students will be asked to evaluate the finding of surveys for a set of buildings from the perspective of the sustainability manager employed by the privately-held company that owns or manages the assets in question. Students will be required to derive energy savings the result from the implementation of various efficiency improvements using information conveyed in the readings and lectures throughout the semester. Next students will be asked to perform financial analysis on the energy savings they previously determined. Analysis methodology and results will be articulated in excel spreadsheets and in memo form.

The final exam will be assessed both on:

The ability of each student to follow the analysis method at issue as presented in the lectures (partial credit will be assessed for partial success) and;

The ability of each student to derive the answer to the problem based on the information provided.

Credit for Methodology: 50%, Credit for Answer: 50%

Method of Evaluation (Grading)

Weighting of Assignments:

1. Wattzon: 2%
2. Midterm: 15%
4. Problem Sets: 55%
5. Final Exam: 20%
6. Class Participation: 8%

Any assignment submitted late will be penalized one letter grade (regardless of how late the submission is [one hour = one day = one week]). Any assignment that is not sent to the professor or TA by the end of the last day of classes will be given a zero. There will be no opportunity to discuss this policy or to make up the lost credit.