ENERGY MODELING:
A TUTORIAL AND INTRODUCTION TO eQUEST

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ABSTRACT

Buildings consume over 70% of all electricity in the United States. It is critical for project teams to have the ability to evaluate and assess performance throughout a project's life-cycle. Energy modeling is a process that enables decision-makers to estimate performance, compare impacts, and select among viable design alternatives. Modeling building performance, however, is complex, and requires numerous inputs and assumptions. The fidelity of results largely depends on the quality of such assumptions. In this exercise students explore the basics of the energy modeling, including a detailed look at the inputs required and outputs generated. Students use results to evaluate and compare alternatives. The learning objective is to expose students to a basic energy modeling process and to explore the value of the results.

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INTRODUCTION

Buildings consume approximately 73% of electricity and 41% of the energy produced in the United States (USGBC, 2012). This energy consumption represents significant costs as well as causes negative environmental impacts. The operation phase of a building can account for up to 97% of the total primary energy consumed, highlighting the long term value of energy efficiency measures (Scheuer, Keoleian, & Reppe, 2003). Opportunity exists for project teams to utilize energy modeling software to help evaluate design decisions in terms of life-cycle cost impacts in order to maximize building performance.

Building energy performance is a function of numerous, interdependent internal and external factors, such as material selection, mechanical and electrical systems, solar orientation, climate, and occupant usage. Modification of various design components can produce complex interactions that are difficult to analyze in isolation. Building energy simulation softwares provide tools for evaluating energy impacts across dynamic interrelated systems. This teaching module illustrates the interactive effects of such decisions for a specific building type across various climates. The primary software used is eQUEST, a free software available as an interface to the Department of Energy's calculation engine, DOE-2.

DOE-2 is a building energy simulation engine developed by the Lawrence Berkeley National Laboratory and the Department of Energy to provide a public domain building energy simulation tool that uses real localized weather data and can be operated by practitioners (Birdsall, 1990). The engine incorporates thermodynamic characteristics of a building, weather data, and operating assumptions to calculate estimated performance over time using complex algorithms. eQuest is a DOE-2 interface that provides simple wizards to guide the user through model development, while accessing DOE-2 capabilities. eQuest and other simulation tools are commonly used by project design teams as a tool to enable evaluation of energy consumption impacts related to specific design options. It is also used to simulate energy performance in support of fulfillment of LEED energy performance credits.

Energy modeling software, in general, is best used to compare and evaluate relative energy performance, rather than to predict actual building energy use. Industry experts estimate that building energy models accuracy ranges from +/-10 – +/-40% when used to predict actual non-residential building performance (Clevenger & Haymaker, 2006). Sources of error in energy model predictions generally include overly optimistic assumptions about system performance, unknowable and uncertain conditions such as actual weather, "as-built" construction, and/or over-simplified modeling assumptions. Nevertheless, the basic building science and calculation algorithms of most energy modeling softwares are sound and can serve as powerful and valuable tools to accurately to compare the relative impact of design alternatives. As such, building simulation can inform building component selection in both formal and informal design development, value engineering and performance optimization exercises.

In the following exercise, students will use eQUEST to input, model and analyze select design alternatives.

INSTRUCTORS GUIDE

The following instructors guide outlines how to lead into and teach the eQuest Energy Modeling module. Variations and suggestions are welcome to improve the module and to enhance its ability to support meaningful development instructor's curriculum.

Step 1: Assignment Preparation

Install eQuest software onto computers. If lab computers will be used, install the software in advance of the class. It is wise to run though the tutorial and assignment beforehand so any software kinks can be worked out ahead of time. The software can be downloaded free at: http://doe2.com/equest/ Prepare assignment by printing or sending the assignment to the students.

Step 2: Energy Modeling Tutorial (approximately 1 hour)

Students should read though the assignment before beginning so they know what to expect. The instructor may follow the directions by beginning the first tutorial located in Appendix A followed by Appendix B in class with the students (descriptions below). Instructors are encouraged to work though the tutorials in class with the student's click-by-click. It is important to follow the tutorials exactly the way they are described otherwise the answer key will be incorrect.

> Appendix A- includes a tutorial that shows how to create a building within eQuest in Fort Collins, Colorado by setting parameters such as building type, size, location, mechanical systems, etc. The tutorial walks through all the steps necessary to create a simplified building which can be used to run an energy simulation. Note you may use "your location." However sample answers provided are for Fort Collins, Colorado
>
> Appendix B- includes a tutorial that shows how to simulate the energy consumption of the building created in the first tutorial. It will also show how to create an Energy Efficiency Measure (EEM) which will be used to compare to the baseline simulation to show energy savings.

Step 3: Energy Modeling Assignment (approximately 1 hour)

Once the tutorials have been completed, the students should know how to use the eQuest software and can complete Question Set 1 & 2 on their own and answer both question sets (described below). This portion of the assignment can be left as homework or completed in class.

> Question Set 1- students should answer these questions after completing the both tutorials. These questions serve to get the students familiar with extracting data from the energy consumption reports. After the questions have been answered and reports printed off the students can move on with the rest of the assignment.
>
> Question Set 2- students should be able to answer these questions after changing the building location to "another location with a different climate" and by also creating three

new Energy Efficiency Measures (EEM's) listed in the assignment. These questions serve to increase the students' knowledge of how energy efficiency measures can affect the energy use of a building and also how they can aid in making design decisions. Sample answers provided in the answer key are for Austin, Texas.

Step 4: Collecting Assignments & Grading

Question Sets 1 & 2, once collected can be graded based upon the locations that the students choose for their assignment. A sample answer key can be found below under the heading "Sample Instructor Answer Key." Answer Key document assumes "your location" is Fort Collins, and "another location with a different climate" is Austin, Texas. In addition, the DHW EEM assumes a hot water temperature of 130F.

ENERGY MODELING ASSIGNMENT

Energy Modeling Assignment NAME:_____

The purpose of this assignment is to allow students to simulate energy efficiency measures (EEM) within the virtual environment of a building energy model using the Department of Energy's (DOE) eQUEST software. eQUEST (short for the QUick Energy Simulation Tool) is a front-end interface that runs the DOE-2 energy simulation engine. More information and a free-download of the software are available at: http://doe2.com/equest/.

In this exercise, students will create a model of a building in class using the eQUEST software, apply energy efficient measures, and study the changes in energy consumption.

DIRECTIONS:

1. Your instructor will guide you through a tutorial on how to use the software and how to create a simplified building to simulate energy consumption and energy efficiency measures. You may also refer to the tutorial handouts:
    a. eQuest Tutorial #1- Create Baseline Building (PDF): https://drive.google.com/file/d/0B_fYQEvG3SS9MHRXczlCVlVycnc/edit?usp=sharing
    b. eQuest Tutorial #2- Simulation/ EEM (PDF): https://drive.google.com/file/d/0B_fYQEvG3SS9UUZPbWFGZlo0am8/edit?usp=sharing
2. Please follow along during class to create the baseline building. Note the example provided uses the location of Fort Collins, Colorado. However, you may change the location to "your location". It is important to follow all the steps precisely. After creating the baseline building using Tutorial 1, move on to Tutorial 2 to simulate the energy model and create two sample Energy Efficiency Measures (EEMs).
3. After completing the tutorials in class or on your own using the handouts, print off the **Baseline Design** case, **Lighting Power Density EEM** case, and the **Skylight Area EEM** case. Use these to answer Question Set 1.
4. Be sure to save the file!
5. With the remaining time in class, or after class as homework, modify the building model you created with the new building parameters listed below for a building in "another location with a different climate." You can modify the new building parameters by clicking on *Tools> Schematic Design Wizard > OK (warning box)*. Navigate through the wizard by selecting *General Information* from the drop down menu in the bottom left corner of the screen. Be sure to change the building location to "another location with different climate."
6. Modify the building parameters listed below, and then click *Finish* to save the new building parameters. Choose *OK* to use new project name from the wizard.
7. Now that you have updated the new building parameters, create the new Energy Efficiency Measures listed below in the table.
8. Simulate all the new Energy Efficient Measures including the baseline case.

9. Print off all of the building simulations for "another location with a different climate": **Baseline Design** case**, DHW EEM** case**, TStat Management EEM** case**,** and the **Daylighting EEM** case.
10. Answer Question Set 2 below using the energy simulations you printed off. Write in answers on this sheet and turn in next class session.
11. Turn in a hard copy of your answers to Question Set 1 & 2 along with a copy of all of the data for each building simulation run that is specified above. You may enter your answers electronically into this PDF, save and print.

ENERGY EFFICIENT MEASURES:

#	**Measure Category:**	**Measure Type:**	**Apply Measure To:**	**EEM Run Details:**
1	Domestic Hot Water	Domestic Hot Water	-Baseline Run-	Change Supply Temp to: 130° *
2	HVAC System	Thermostat Management	-Baseline Run-	Change the Cooling Set Points to: 79° for Occupied & 85° for Unoccupied - - - - - - - - - - - - Change the Heating Set Points to: 68° for Occupied & 62° for Unoccupied
3	Internal Loads	Daylighting	-Baseline Run-	Change Daylighting Options to Side Lit for each floor, Leave default Control Method to dimming 30%

**OSHA states, 'the temperature of the water should be 50°C (122°F) or higher at the faucet" to prevent Legionnaire's Disease.*

Energy Modeling Questions

Note: The multiplication factor <u>may</u> change for the energy consumption tables (example: btu x000,000 → btu x000,000,000). Keep this in mind when answering the questions. Also note that results may differ slightly for individual simulation runs.

<u>QUESTIONS SET 1</u>: Use the original unadjusted building parameters for **"your location"** to answer questions 1-4.

1. What was the energy consumption for the Baseline Design case for "your location" for the entire year?
    a. Electrical Consumption (kWh)? _____
    b. Gas Consumption (Btu)? _____
2. What was the energy consumption for the Lighting Power EEM case for "your location" for the entire year?
    a. Electrical Consumption (kWh)? _____
    b. Gas Consumption (Btu)? _____
3. What was the energy consumption for the Skylight Area EEM case for "your location" for the entire year?
    a. Electrical Consumption (kWh)? _____
    b. Gas Consumption (Btu)? _____
4. How much did the electrical consumption change for each EEM compared to the baseline for "your location"? Explain each change and why the change occurred.

<u>QUESTION SET 2:</u> Use the adjusted building parameters for **"another location with a different climate"** to answer questions 5-12.

5. What was the energy consumption for the Baseline Design case for "another location with a different climate" for the entire year?
    a. Electrical Consumption (kWh)? _____
    b. Gas Consumption (Btu)? _____

6. Compare the total baseline cases of electric and gas consumption for both “your location” and “another location with a different climate”. How do they differ and why?

7. Based on the Domestic Hot Water EEM for “another location with a different climate”:
    a. What was the change in Btu’s annually compared to the baseline case by implementing this measure? _____
    b. If the cost of natural gas in “another location with a different climate” was equal to $0.3565 per Therm (1 Therm= 100,000 Btu’s) what would be the change in cost annually for lowering the supply temperature of the hot water to 120 degrees? Round to nearest dollar. _____
8. Based on the TStat Management EEM for “another location with a different climate”:
    a. What was the change in kWh annually compared to the baseline case by implementing this measure? _____
    b. What was the change in Btu’s annually compared to the baseline case by implementing this measure? _____
    c. If the cost of electricity is equal to $0.02851 per kWh and natural gas is equal to $0.3565 per Therm (1 Therm= 100,000 Btu’s), what would the change in cost be annually of the TStat Management EEM compared to the baseline? Round to nearest dollar. _____
9. Based on the Daylighting EEM for “another location with a different climate”:
    a. What was the change in kWh annually compared to the baseline case by implementing this measure? _____
    b. What was the change in Btu’s annually compared to the baseline case by implementing this measure? _____
    c. If the cost of electricity is equal to $0.02851 per kWh and natural gas is equal to $0.3565 per Therm (1 Therm= 100,000 Btu’s) what would be the total cost change annually of electricity and gas from reducing the amount of electrical lighting when replaced by natural light? Remember, this EEM measure impacted the amount of natural gas used. Round to nearest dollar.

       _____

d. Why do you think the gas consumption changed as a result of this EEM measure? Please explain below.

10. If you were an energy engineer given the task of analyzing the various Energy Efficiency Measures simulated for a building in "another location with a different climate" what option (s) would you recommend? Write your recommendation(s) below as if you were 'pitching' it to your design team. Think in terms of environmental impact, cost, human comfort, etc. You will need to write enough to back up your recommendation!

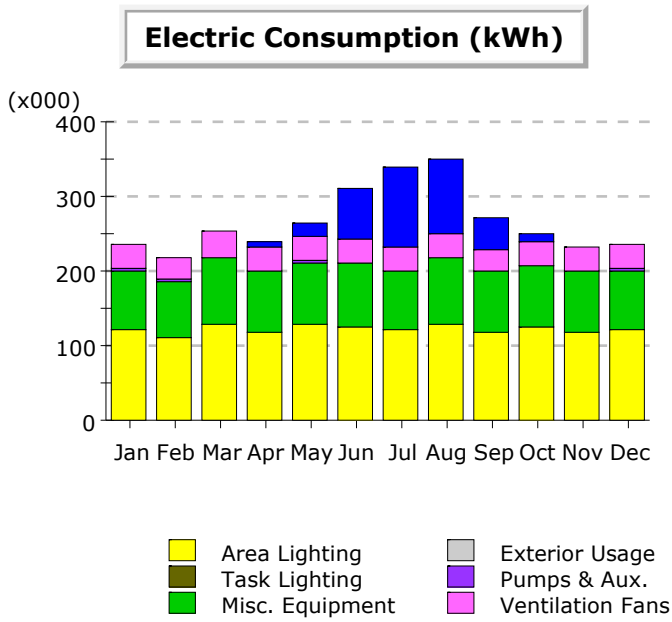
11. How important do you think it is for construction managers and /or interior designers to know how to perform energy modeling? Under what circumstances should a CM or ID perform energy modeling (as opposed to an energy consultant) on a project? What data or information, if any, do you think is directly relevant to a CM or ID professional?

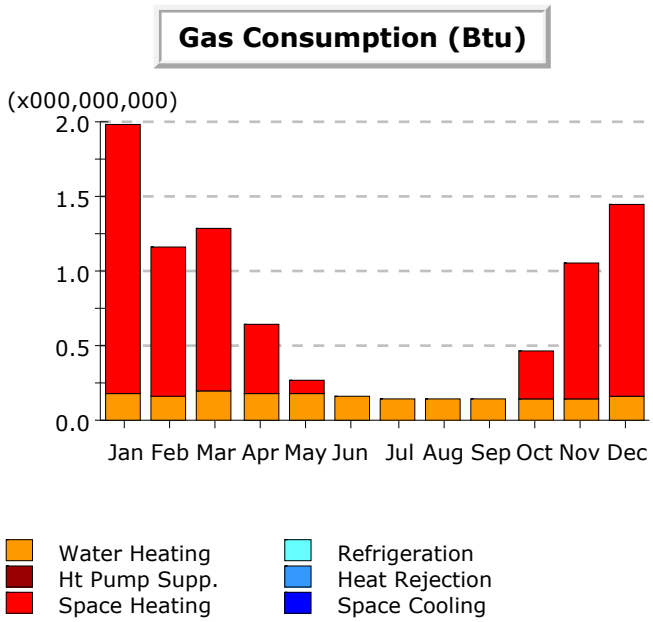
12. EXTRA CREDIT- Go back to the “schematic design wizard” and explore impacts of changes to the building envelope and/or building orientation, re-run the simulation(s) and discuss your findings below.

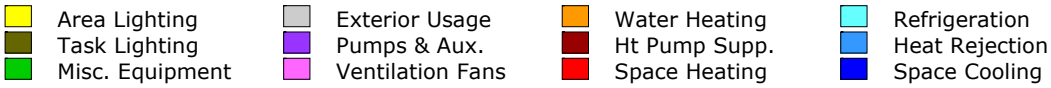
SAMPLE INSTRUCTOR ANSWER KEY

Student answers can be slightly different than the answers below, the answer key can also be located as an attachment with this module: The answer key results provided assume "Fort Collins, Colorado" for "your location," and "Austin, Texas" for "another location with a different climate."

1.
    a. 3,190,600 KWH
    b. 8,900,000,000 BTU
2.
    a. 2,817,200 KWH
    b. 9,660,000,000 BTU
3.
    a. 3,185,400 KWH
    b. 9,640,000,000 BTU
4. Lighting Power Density: 3,190,600-2,817,200= 373,400 KWH (decrease in energy)
   Skylight Area: 3,190,600-3,185,400= 5200 KWH (decrease in energy)
5.
    a. 4,705,800 KWH
    b. 2,134,300,000 BTU
6. Electric: 4,705,800-3,190,600= 1,515,200 KWH (increase for Austin)
   Gas: 2,134,300,000-8,900,000,000= -6,765,700,000 BTU (decrease for Austin)
7.
    a. 109,700,000 BTU
    b. $391
8.
    a. 211,300 KWH
    b. 328,500,000 BTU
    c. $7,195
9.
    a. 196,800 KWH
    b. 57,800,000 BTU
    c. $5,405
    d. Interpret Question
10. Interpret Question
11. Interpret Question
12. Interpret Question





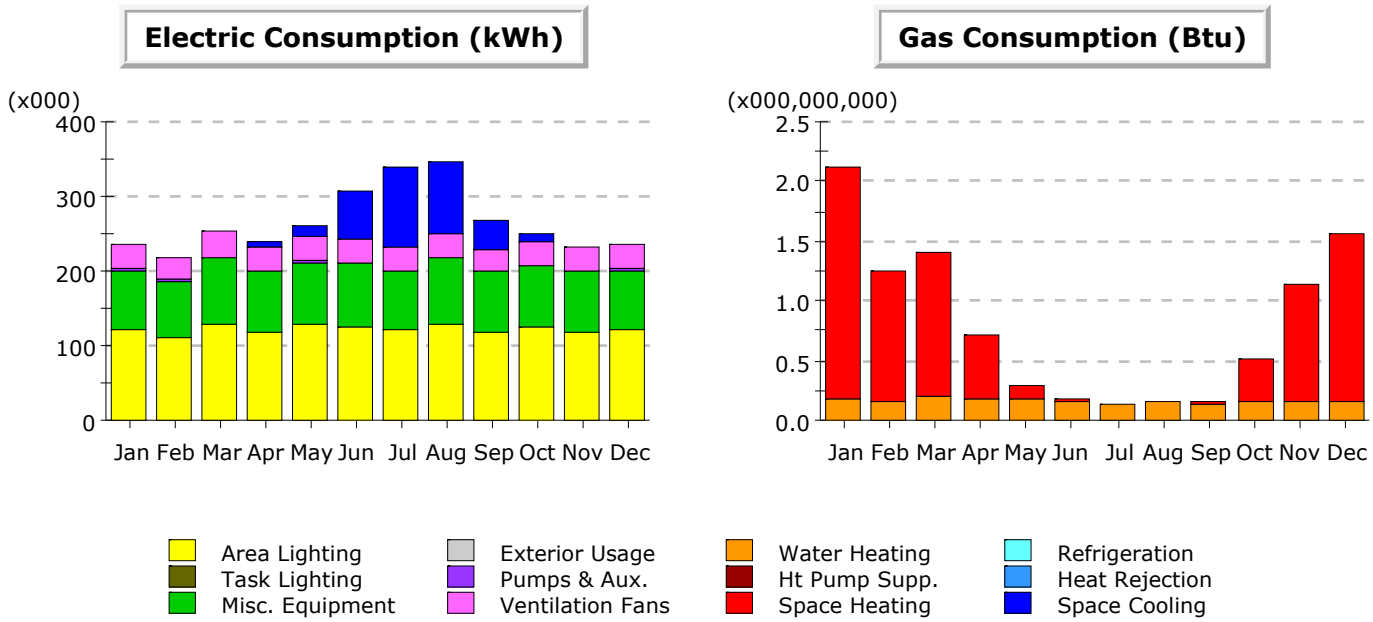


Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	0.9	9.2	16.7	67.5	107.4	97.3	40.4	9.6	-	-	349.0
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	32.0	29.3	33.2	31.2	32.8	32.1	32.0	33.2	31.2	32.4	31.2	32.0	382.8
Pumps & Aux.	1.0	0.8	0.9	0.8	0.5	0.1	0.0	0.0	0.3	0.7	0.9	0.9	7.1
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	81.2	75.4	87.8	80.0	85.6	84.4	81.2	87.8	80.0	83.4	80.0	81.2	988.1
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	120.2	111.7	130.3	118.5	126.9	125.2	120.2	130.3	118.5	123.5	118.5	120.2	1,463.7
Total	234.4	217.2	253.1	239.6	262.5	309.3	340.8	348.6	270.4	249.6	230.6	234.3	3,190.6

Gas Consumption (Btu x000,000,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	1.80	0.99	1.09	0.47	0.09	0.00	-	-	0.01	0.32	0.90	1.29	6.98
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	0.17	0.16	0.19	0.17	0.17	0.16	0.14	0.15	0.14	0.15	0.15	0.16	1.92
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	1.98	1.16	1.29	0.65	0.27	0.16	0.14	0.15	0.15	0.46	1.05	1.45	8.90

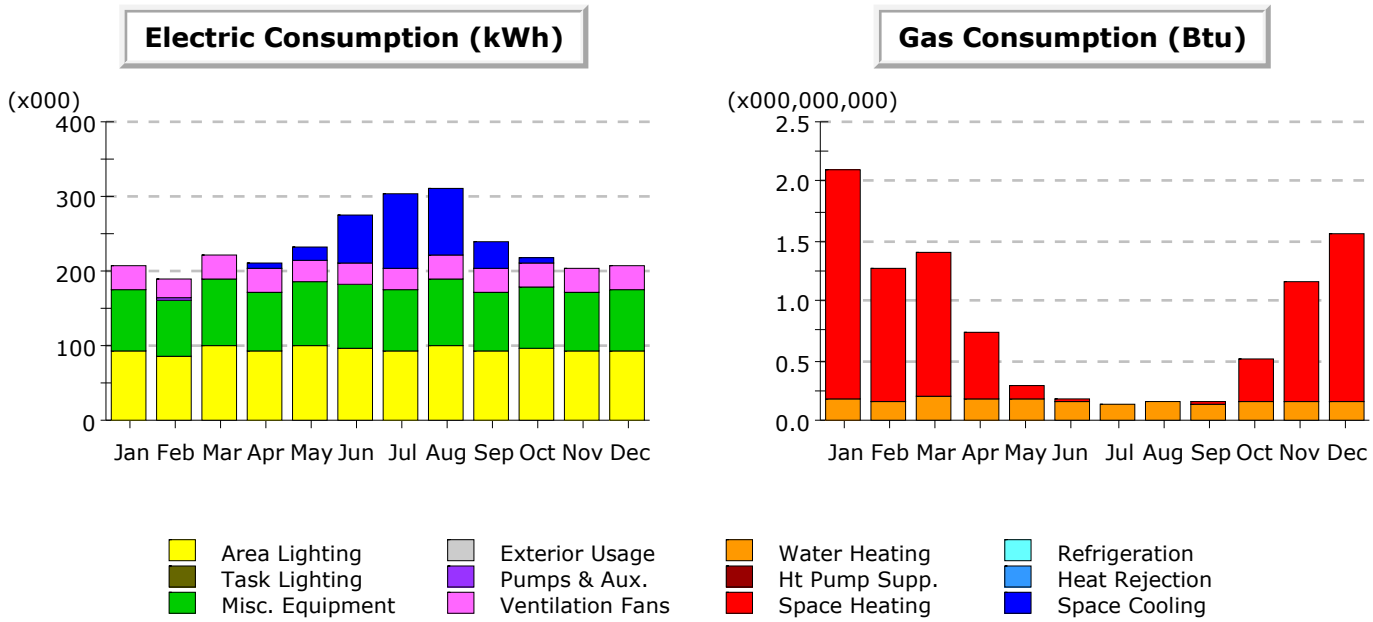


Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	0.9	8.7	16.1	66.0	106.2	95.5	39.1	9.0	-	-	341.6
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	32.2	29.5	33.4	31.4	33.0	32.3	32.2	33.4	31.4	32.6	31.4	32.2	385.0
Pumps & Aux.	1.0	0.8	0.9	0.8	0.5	0.1	0.0	0.0	0.3	0.7	0.9	0.9	7.1
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	81.2	75.4	87.8	80.0	85.6	84.4	81.2	87.8	80.0	83.4	80.0	81.2	988.1
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	120.2	111.7	130.3	118.5	126.9	125.2	120.2	130.3	118.5	123.5	118.5	120.2	1,463.7
Total	234.6	217.4	253.3	239.4	262.1	308.0	339.8	347.0	269.4	249.2	230.8	234.5	3,185.4

Gas Consumption (Btu x000,000,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	1.94	1.09	1.21	0.55	0.12	0.01	-	-	0.02	0.38	1.00	1.40	7.72
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	0.17	0.16	0.19	0.17	0.17	0.16	0.14	0.15	0.14	0.15	0.15	0.16	1.92
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	2.11	1.26	1.40	0.72	0.29	0.17	0.14	0.15	0.16	0.52	1.15	1.57	9.64



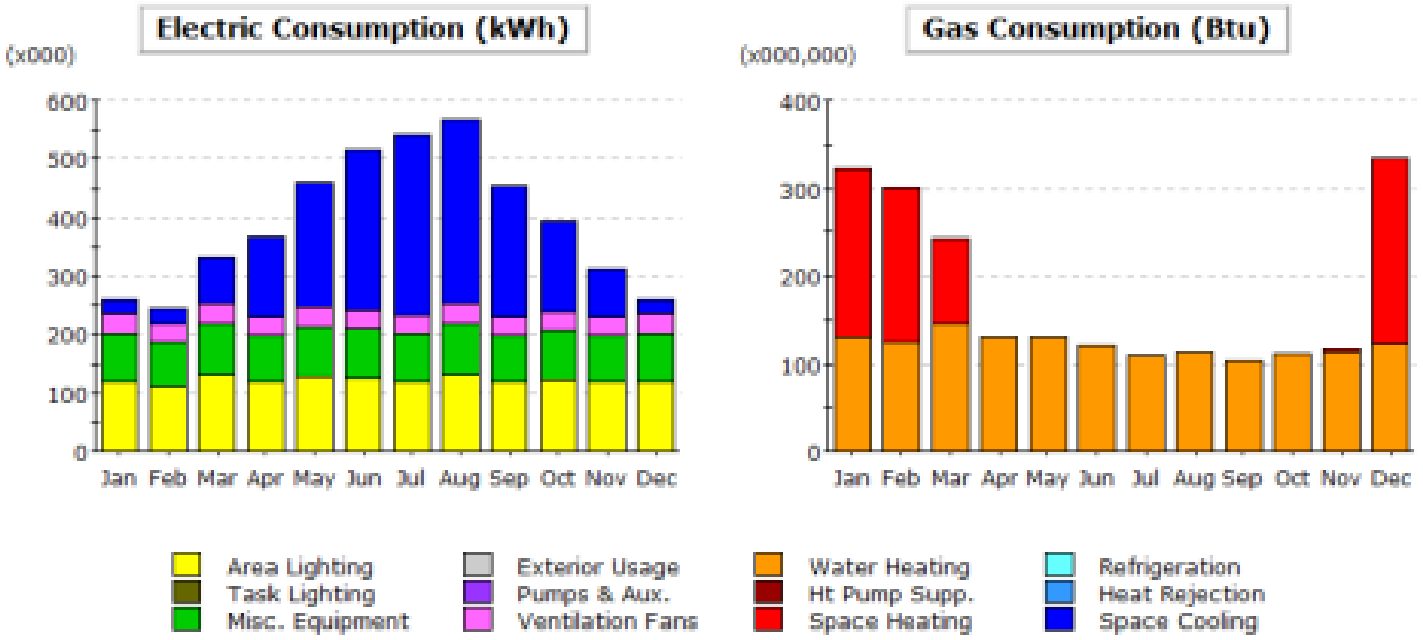
Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	0.8	8.1	14.9	61.8	100.1	89.6	36.6	8.3	-	-	320.1
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	30.6	28.0	31.8	29.9	31.4	30.7	30.6	31.8	29.9	31.0	29.9	30.6	366.4
Pumps & Aux.	1.0	0.8	0.9	0.8	0.5	0.1	0.0	0.0	0.3	0.7	0.9	0.9	7.1
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	81.2	75.4	87.8	80.0	85.6	84.4	81.2	87.8	80.0	83.4	80.0	81.2	988.1
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	93.2	86.6	101.0	91.9	98.4	97.1	93.2	101.0	91.9	95.8	91.9	93.2	1,135.5
Total	206.1	190.9	222.4	210.7	230.9	274.1	305.2	310.2	238.8	219.3	202.7	206.0	2,817.2

Gas Consumption (Btu x000,000,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	1.92	1.10	1.22	0.56	0.12	0.01	-	-	0.02	0.38	1.01	1.41	7.74
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	0.17	0.16	0.19	0.17	0.17	0.16	0.14	0.15	0.14	0.15	0.15	0.16	1.92
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	2.09	1.26	1.41	0.73	0.29	0.17	0.14	0.15	0.15	0.52	1.16	1.57	9.66

Project/Run: Knox_Michael - Baseline Design Run Date/Time: 11/04/12 @ 10:48



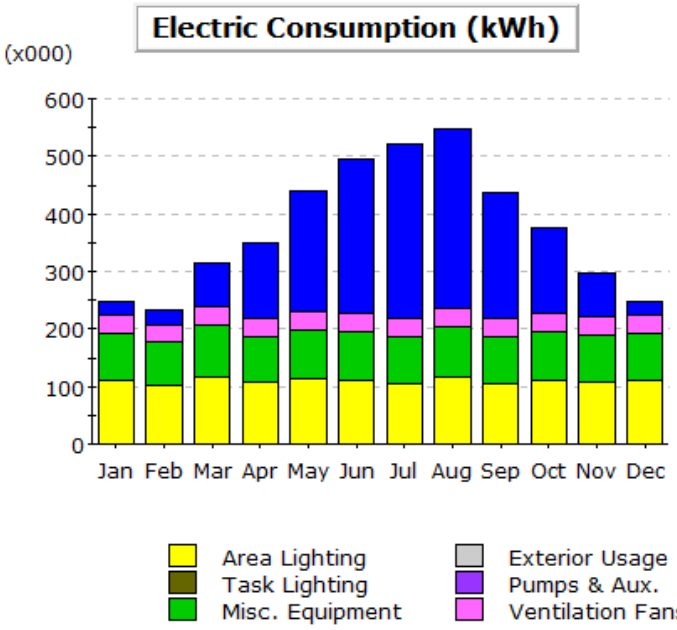
Electric Consumption (kWh x000)

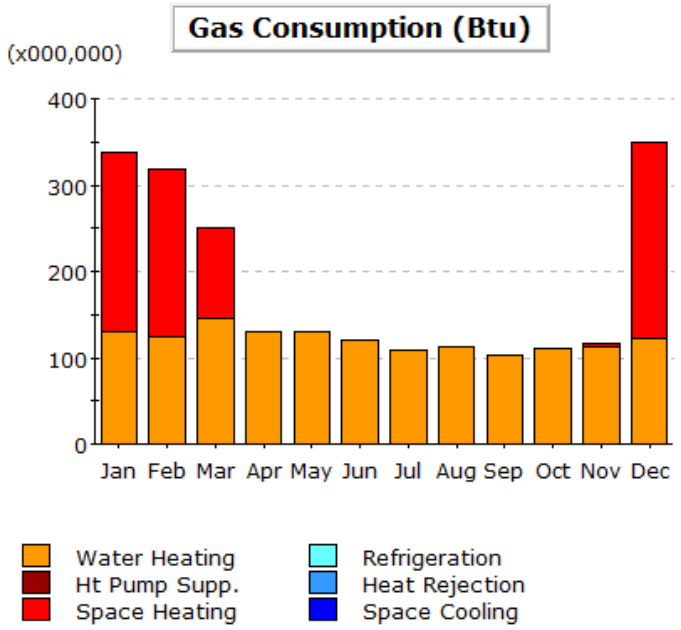
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	23.0	27.0	78.2	136.6	215.1	273.4	308.8	316.8	223.8	152.9	79.9	23.5	1,858.9
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	32.9	30.1	34.2	32.1	33.7	32.9	32.9	34.2	32.1	33.3	32.1	32.9	393.3
Pumps & Aux.	0.5	0.4	0.2	0.0	-	-	-	-	-	0.0	0.2	0.5	1.9
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	81.2	75.4	87.8	80.0	85.6	84.4	81.2	87.8	80.0	83.4	80.0	81.2	988.1
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	120.2	111.7	130.3	118.5	126.9	125.2	120.2	130.3	118.5	123.5	118.5	120.2	1,463.7
Total	257.8	244.6	330.7	367.2	461.3	515.9	543.0	569.0	454.3	393.1	310.7	258.2	4,705.8

Gas Consumption (Btu x000,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	191.6	176.2	97.5	-	-	-	-	-	-	-	2.7	211.4	679.4
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	130.3	124.9	145.6	130.4	131.0	120.7	109.0	113.1	102.8	110.9	113.2	123.0	1,454.8
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	321.9	301.1	243.1	130.4	131.0	120.7	109.0	113.1	102.8	110.9	115.9	334.4	2,134.3

Project/Run: Knox_Michael - Daylighting EEM Run Date/Time: 11/04/12 @ 10:49





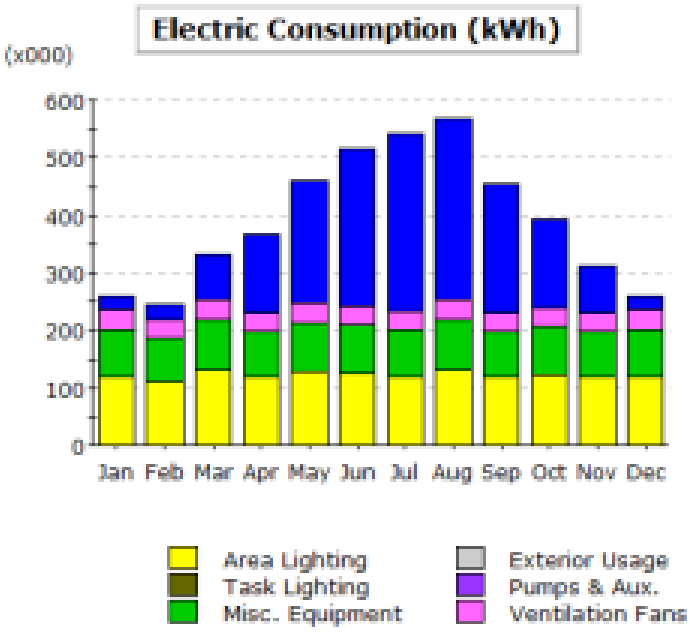
Electric Consumption (kWh x000)

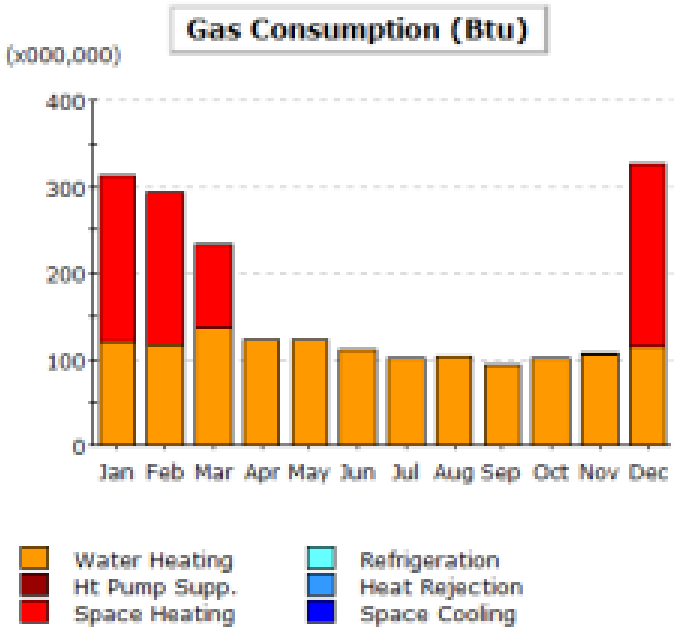
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	22.1	25.9	75.9	132.9	209.9	267.8	303.0	311.0	219.2	149.1	77.8	22.5	1,817.1
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	32.0	29.3	33.2	31.2	32.8	32.0	32.0	33.2	31.2	32.4	31.2	32.0	382.3
Pumps & Aux.	0.5	0.4	0.2	0.0	-	-	-	-	-	0.0	0.2	0.5	1.9
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	81.2	75.4	87.8	80.0	85.6	84.4	81.2	87.8	80.0	83.4	80.0	81.2	988.1
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	110.8	102.1	117.9	106.4	112.9	110.6	105.6	115.7	106.0	111.6	108.8	111.1	1,319.6
Total	246.6	233.1	315.1	350.6	441.2	494.8	521.8	547.7	436.4	376.5	298.0	247.2	4,509.0

Gas Consumption (Btu x000,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	207.2	193.8	105.3	-	-	-	-	-	-	-	3.7	227.1	737.2
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	130.3	124.9	145.6	130.4	131.0	120.7	109.0	113.1	102.8	110.9	113.2	123.1	1,454.9
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	337.5	318.7	250.9	130.4	131.0	120.7	109.0	113.1	102.8	110.9	117.0	350.2	2,192.1

Project/Run: Knox_Michael - DHW EEM Run Date/Time: 11/04/12 @ 10:48





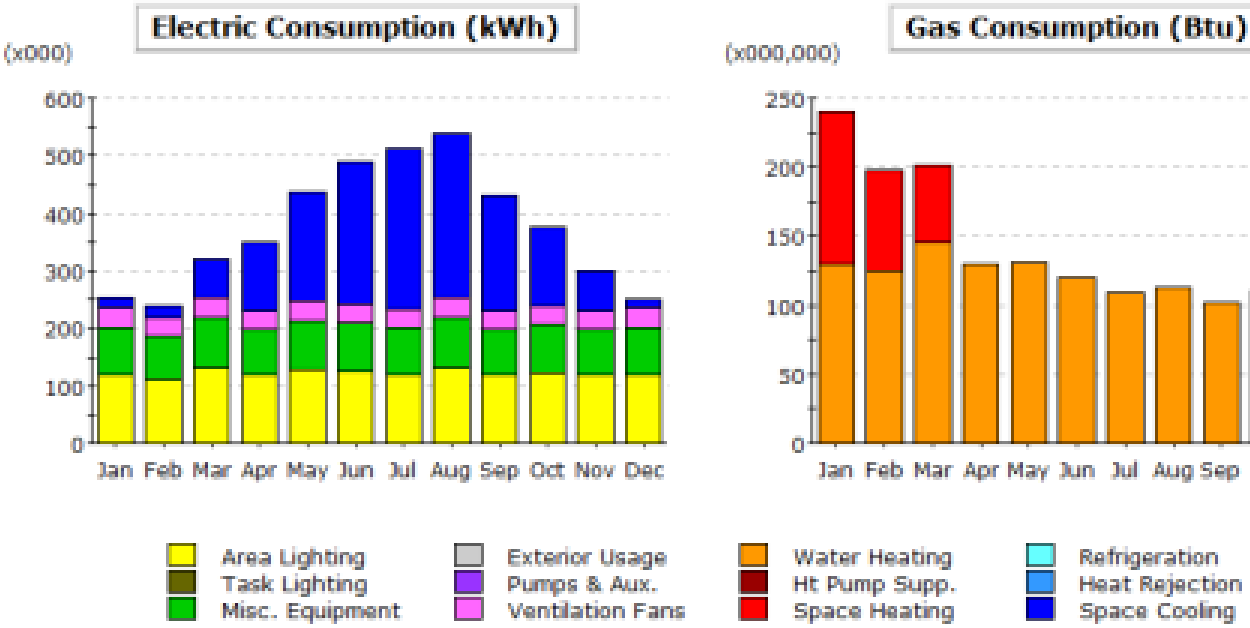
Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	23.0	27.0	78.2	136.6	215.1	273.4	308.8	316.8	223.8	152.9	79.9	23.5	1,858.9
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	32.9	30.1	34.2	32.1	33.7	32.9	32.9	34.2	32.1	33.3	32.1	32.9	393.3
Pumps & Aux.	0.5	0.4	0.2	0.0	-	-	-	-	-	0.0	0.2	0.5	1.9
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	81.2	75.4	87.8	80.0	85.6	84.4	81.2	87.8	80.0	83.4	80.0	81.2	988.1
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	120.2	111.7	130.3	118.5	126.9	125.2	120.2	130.3	118.5	123.5	118.5	120.2	1,463.7
Total	257.8	244.6	330.7	367.2	461.3	515.9	543.0	569.0	454.3	393.1	310.7	258.2	4,705.8

Gas Consumption (Btu x000,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	191.6	176.2	97.5	-	-	-	-	-	-	-	2.7	211.4	679.4
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	121.2	116.5	135.9	121.6	121.5	111.3	100.0	103.3	93.9	101.6	104.4	114.0	1,345.2
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	312.9	292.8	233.4	121.6	121.5	111.3	100.0	103.3	93.9	101.6	107.0	325.4	2,024.6

Project/Run: Knox_Michael - TStat Management EEM Run Date/Time: 11/04/12 @ 10:48



Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	17.3	21.2	67.2	119.4	189.4	246.5	279.3	286.8	200.4	135.0	68.3	16.7	1,647.6
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	32.9	30.1	34.2	32.1	33.7	32.9	32.9	34.2	32.1	33.3	32.1	32.9	393.3
Pumps & Aux.	0.5	0.4	0.2	0.0	-	-	-	-	-	0.0	0.2	0.5	1.9
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	81.2	75.4	87.8	80.0	85.6	84.4	81.2	87.8	80.0	83.4	80.0	81.2	988.1
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	120.2	111.7	130.3	118.5	126.9	125.2	120.2	130.3	118.5	123.5	118.5	120.2	1,463.7
Total	252.1	238.8	319.7	350.0	435.6	489.0	513.5	539.0	430.9	375.3	299.1	251.4	4,494.5

Gas Consumption (Btu x000,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	110.4	73.5	56.6	-	-	-	-	-	-	-	0.0	113.9	354.4
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	130.2	124.8	145.3	130.1	130.6	120.3	108.7	112.7	102.4	110.5	112.9	122.9	1,451.4
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	240.6	198.3	201.9	130.1	130.6	120.3	108.7	112.7	102.4	110.5	112.9	236.9	1,805.8

REFERENCES

Birdsall, B., Buhl, W. F., Ellington, K. L., Erdem, A. E., and Winkelmann, F. C. (1990). "Overview of the DOE-2 building energy analysis program, Version 2.1D." Lawrence Berkeley Laboratory LBL-19735-Rev.1, Berkeley, CA. 53 pp.

Clevenger, C. & Haymaker, J. (2006). The Impact of the Building Occupant on Energy Modeling Simulations. Joint International Conference on Computing and Decision Making in Civil and Building Engineering, Montreal, Canada.

Scheuer, C., Keoleian, G. A., & Reppe, P. (2003). Life cycle energy and environmental performance of a new university building: modeling challenges and design implications. *Energy and buildings*, *35*(10), 1049-1064.

US Green Building Council. (2012).Green Building Facts Retrivied 4/21/13, from http://www.usgbc.org/Docs/Archive/General/Docs18693.pdf

APPENDIX A:
eQUEST TUTORIAL #1- CREATE BASELINE BUILDING

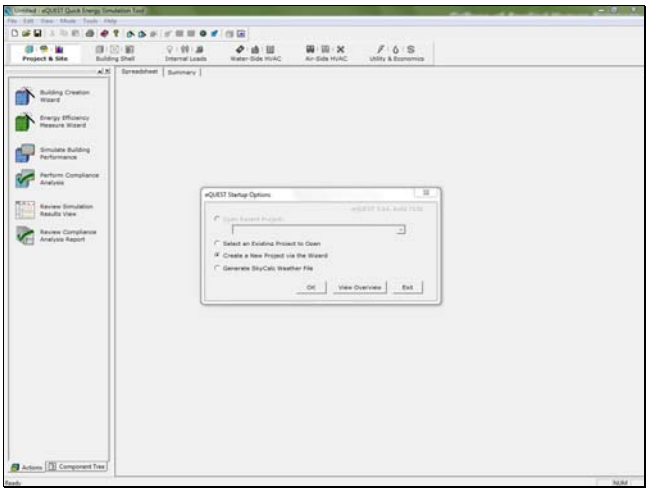
The file is available as an attachment, uploaded with this document or can be accessed online at:
https://drive.google.com/file/d/0B_fYQEvG3SS9MHRXczlCVlVycnc/edit?usp=sharing

Instructions:

This tutorial will walk you through the process of creating a simplified building located on a university campus in “your location” using the eQuest software. Note: sample step-by-step tutorial uses Fort Collins, Colorado as “your location”. The eQuest software should be installed on the computer prior to starting the tutorial.

After tutorial #1 has been completed, please proceed to tutorial #2 to simulate building performance.

Slide 1 - Slide 1



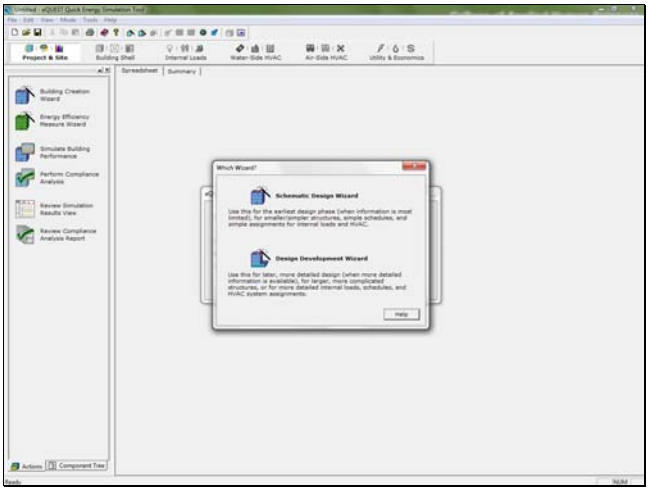
Slide notes

Open eQuest on your computer and choose "Create New Project via the Wizard."

Text Captions

Click the **OK** button

Slide 2 - Slide 2



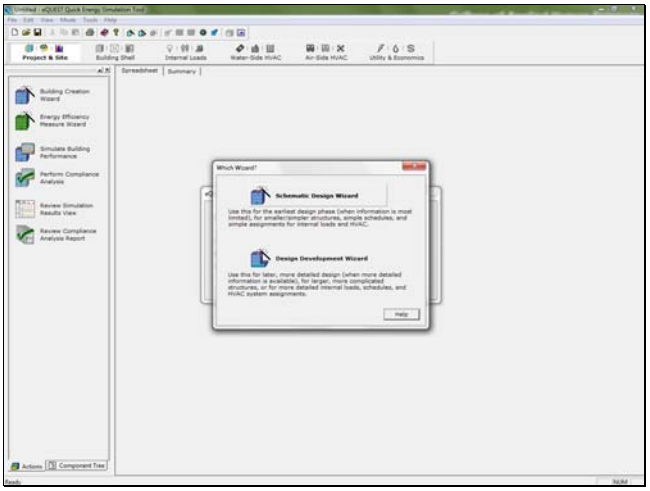
Slide notes

Choose "Schematic Design Wizard"

Text Captions

The **Which Wizard?** window opens

Slide 3 - Slide 3



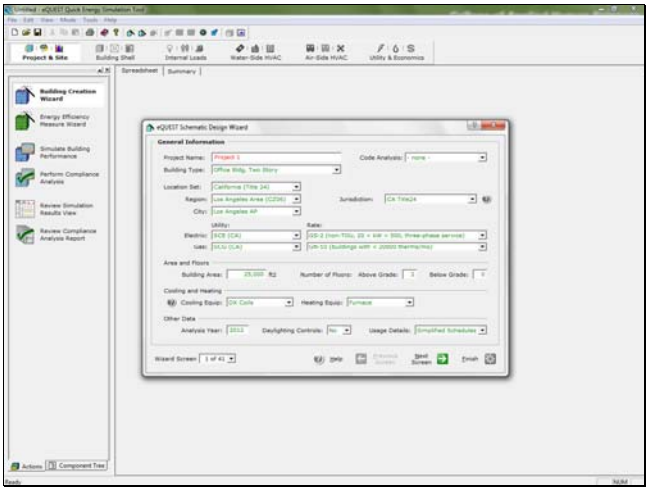
Slide notes

Choose "Schematic Design Wizard," this wizard will help guide you through creating your building.

Text Captions

Click the **Schematic Design Wizard** button

Slide 4 - Slide 4



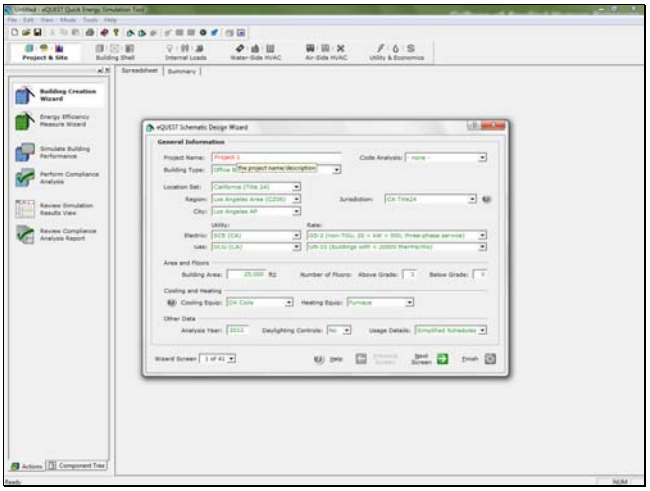
Slide notes

This screen will collect general information about your building such as size, location, etc.

Text Captions

The **eQUEST Schematic Design Wizard** window opens

Slide 5 - Slide 5

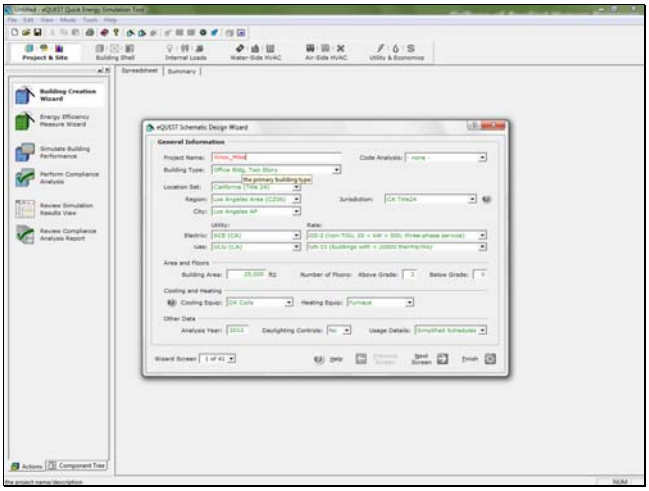


Slide notes

Rename project using your name such as: "Last_First"

Text Captions

Slide 6 - Slide 6

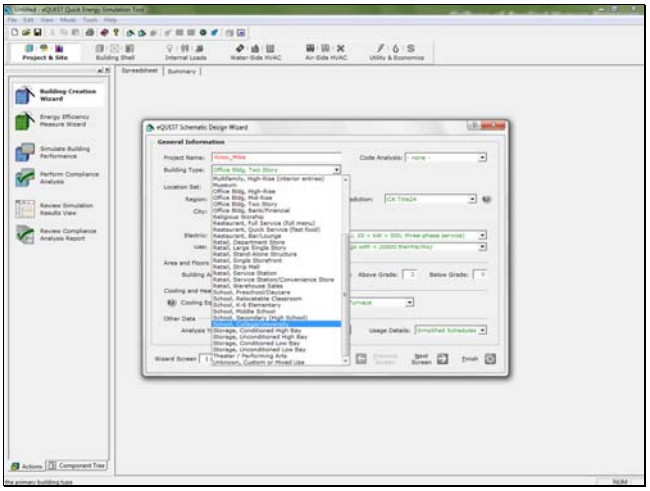


Slide notes

Text Captions

Select the **Office Bldg, Two Story** combo box

Slide 7 - Slide 7



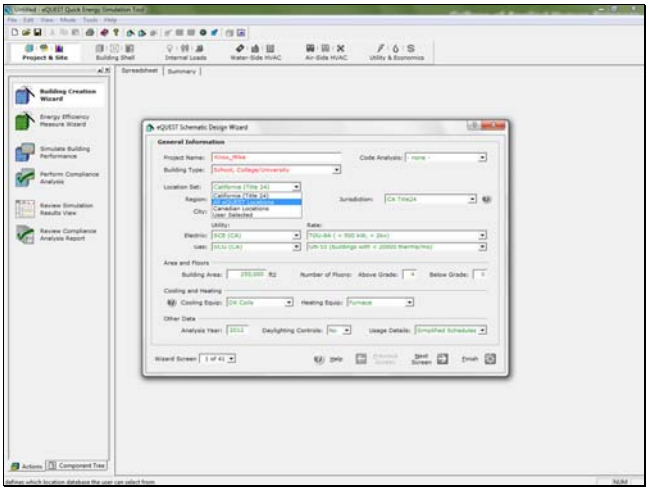
Slide notes

Change building type to "School, College/University"

Text Captions

Select the **School, College/University** item

Slide 8 - Slide 8



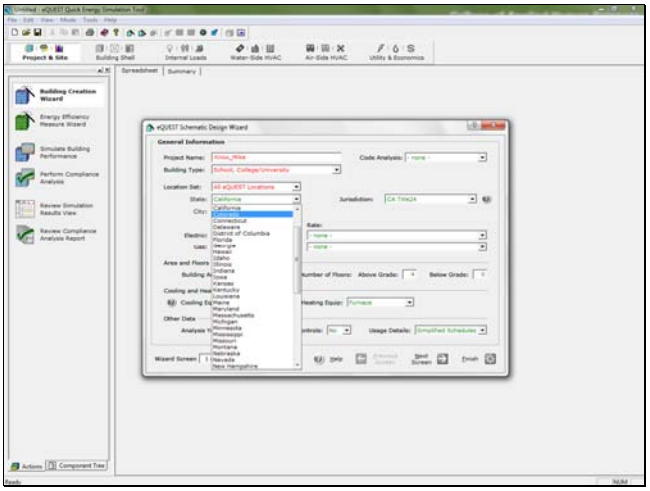
Slide notes

Change the Location Set to “All eQuest Locations”

Text Captions

Select the **All eQUEST Locations** item

Slide 9 - Slide 9



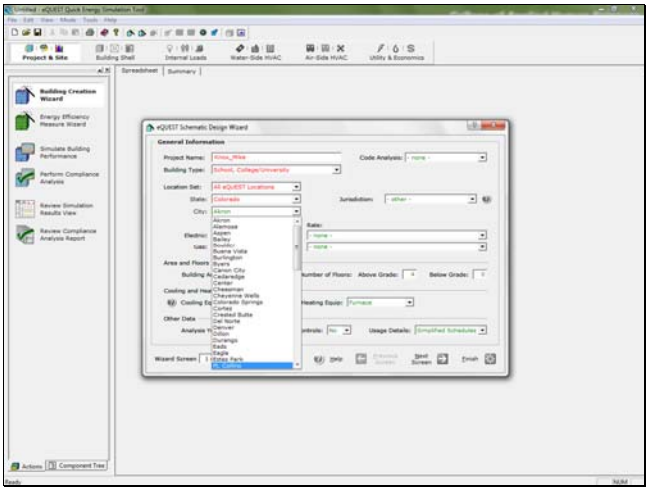
Slide notes

Change State to "Colorado"

Text Captions

Select the **Colorado** item

Slide 10 - Slide 10



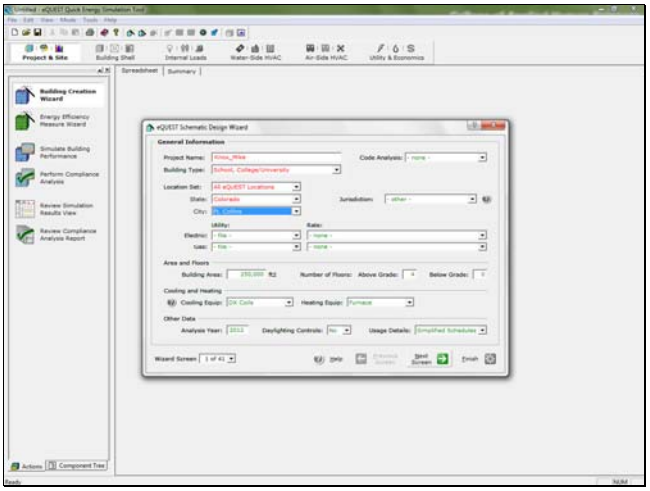
Slide notes

Change City to "Ft. Collins"

Text Captions

Select the **Ft. Collins** item

Slide 11 - Slide 11



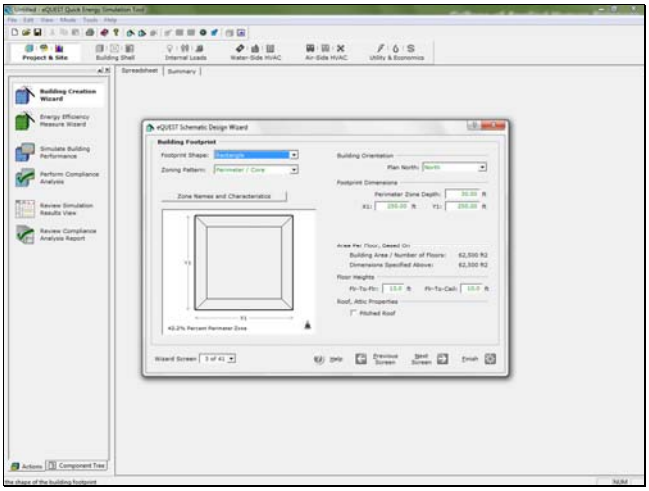
Slide notes

Review all other settings; click the "Next Screen" button

Text Captions

Click the **Next Screen** button

Slide 12 - Slide 12



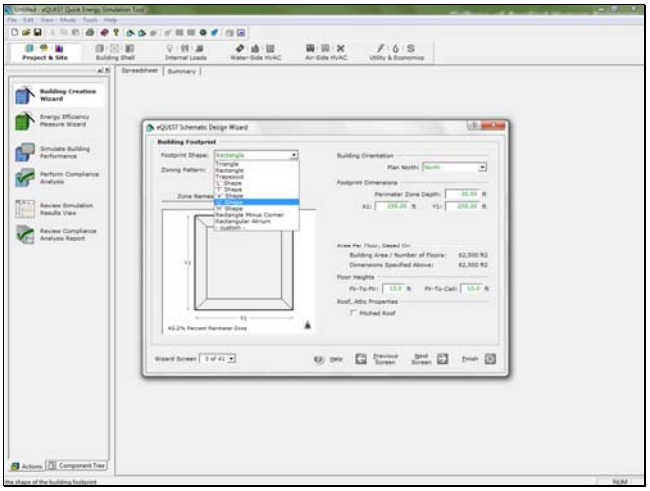
Slide notes

We can select the shape of the building here.

Text Captions

Select the **Rectangle** combo box

Slide 13 - Slide 13



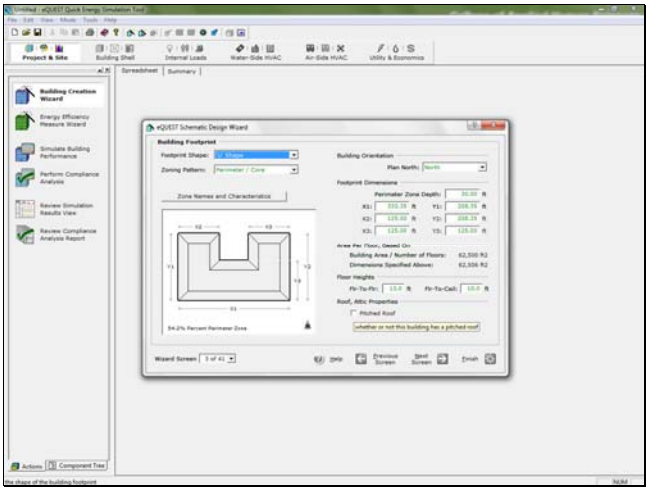
Slide notes

Change footprint shape to "U Shape"

Text Captions

Select the **'U' Shape** item

Slide 14 - Slide 14



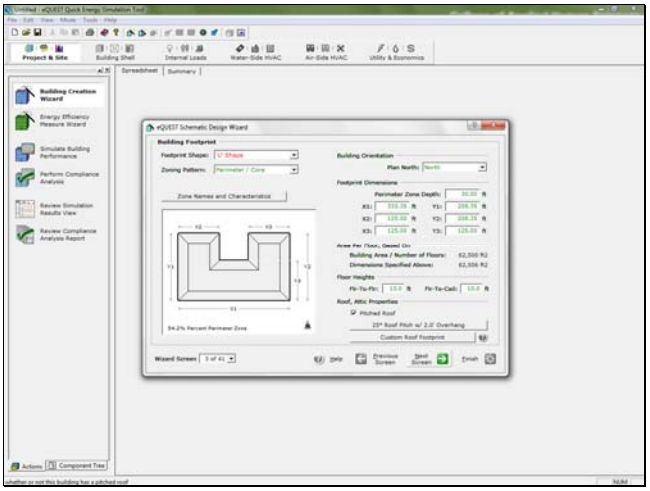
Slide notes

Choose "Pitched Roof" check box

Text Captions

Select the **Pitched Roof** check box

Slide 15 - Slide 15



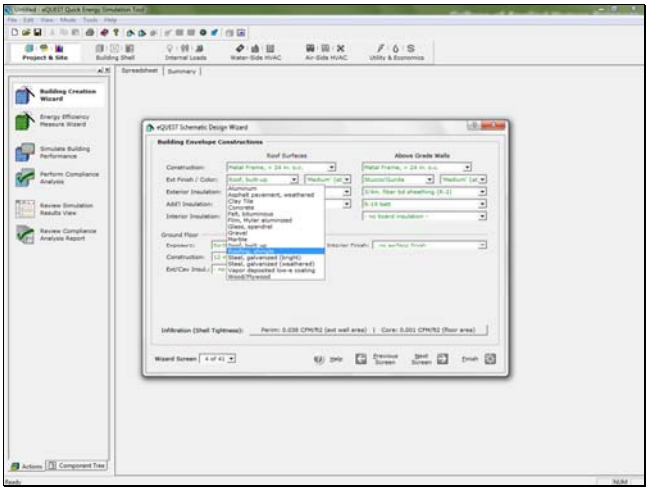
Slide notes

Review all other settings; click the "Next Screen" button

Text Captions

Click the **Next Screen** button

Slide 16 - Slide 16



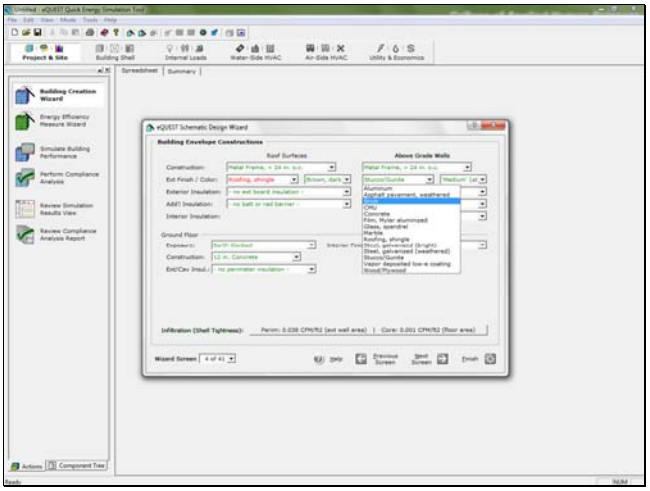
Slide notes

Change the Ext. Finish of the roof to "Roofing, Shingle"

Text Captions

Select the **Roofing, shingle** item

Slide 17 - Slide 17



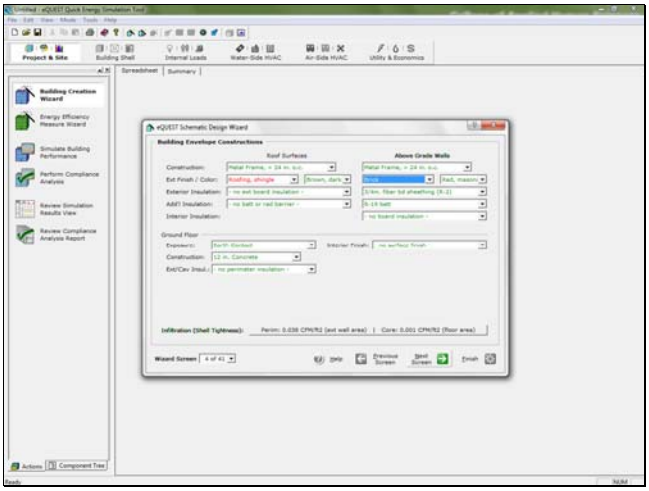
Slide notes

Change the Ext. Finish of the above grade walls to "Brick"

Text Captions

Select the **Brick** item

Slide 18 - Slide 18



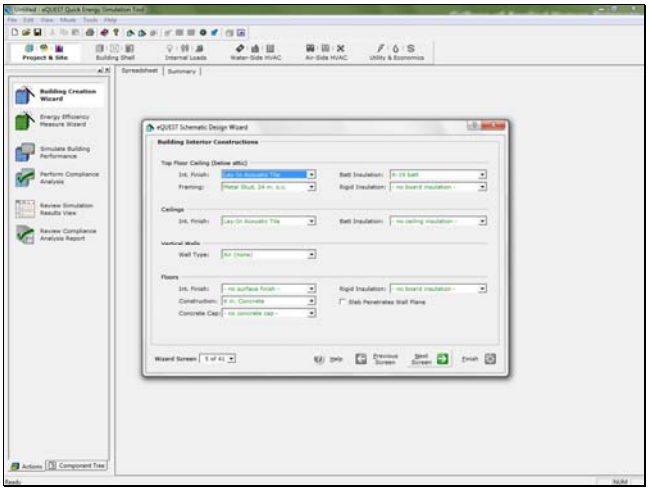
Slide notes

Review all other settings; click the "Next Screen" button

Text Captions

Click the **Next Screen** button

Slide 19 - Slide 19



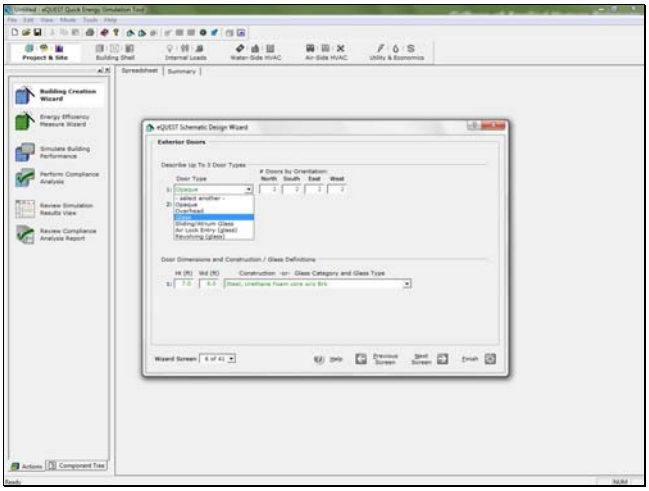
Slide notes

This screen is for changing the interior construction of the building. Let's leave the defaults as they are. Review all other settings; click the "Next Screen" button

Text Captions

Click the **Next Screen** button

Slide 20 - Slide 20



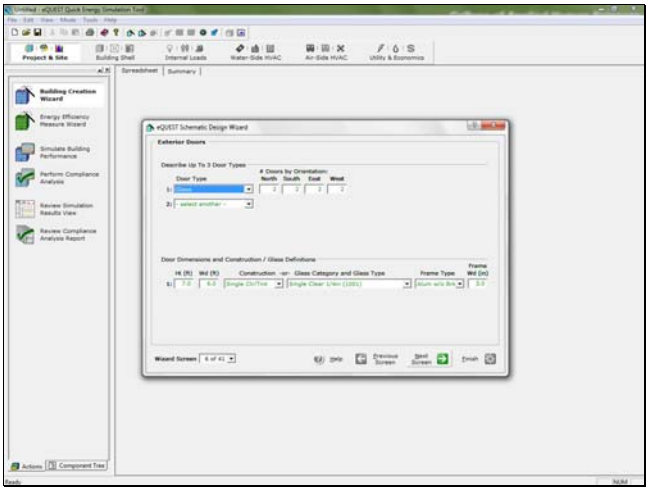
Slide notes

Change the Door Type to "Glass"

Text Captions

Select the **Glass** item

Slide 21 - Slide 21



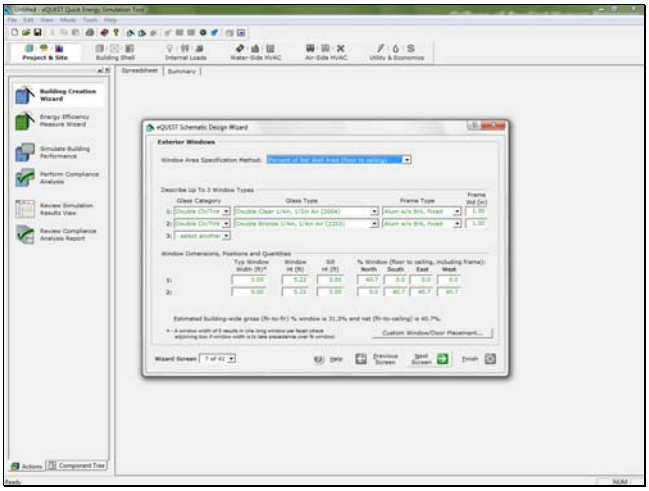
Slide notes

Review all other settings; click the "Next Screen" button

Text Captions

Click the **Next Screen** button

Slide 22 - Slide 22



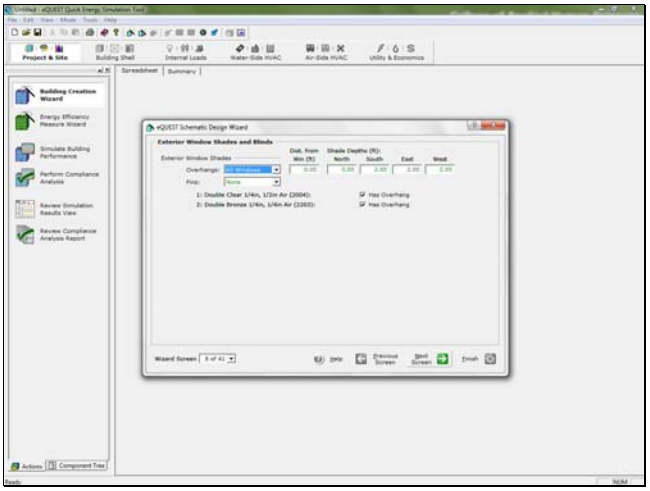
Slide notes

We will accept the default values for this screen for exterior windows. Notice that the windows are roughly 41% of the wall area. Also notice that the glazing specifications for the windows to the south, west, and east is different than the north windows. The north windows use a higher transparency since it will get little to no direct sunlight. Review all other settings; click the "Next Screen" button

Text Captions

Click the **Next Screen** button

Slide 23 - Slide 23



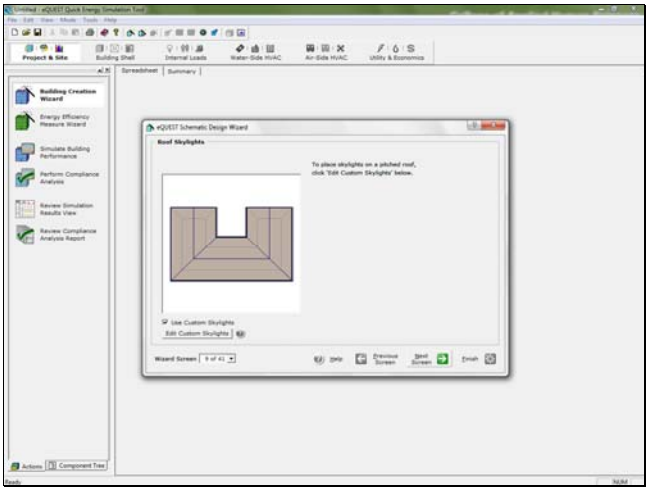
Slide notes

This screen is for modifying exterior window shades and blinds, accept all default values. Review all other settings; click the "Next Screen" button.

Text Captions

Click the **Next Screen** button

Slide 24 - Slide 24



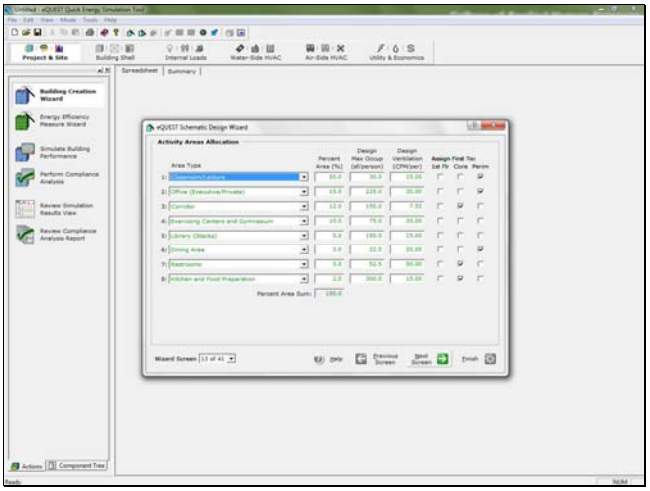
Slide notes

This is the roof skylight screen. We will place sky lights later. For now, click the "Next Screen" button.

Text Captions

Click the **Next Screen** button

Slide 25 - Slide 25



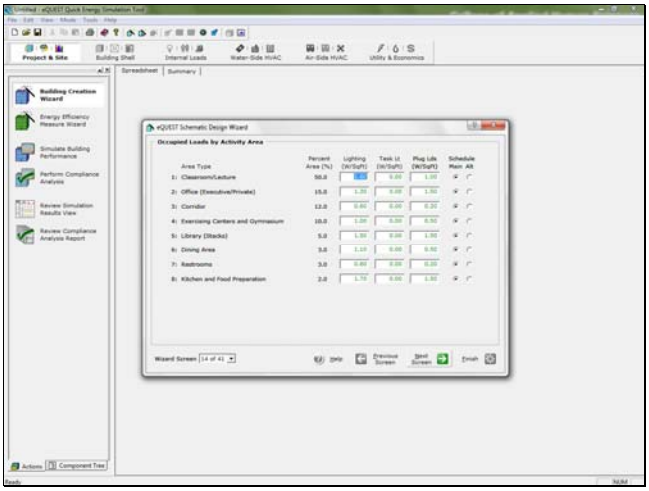
Slide notes

Here we can modify the type and amount of space allocated to each area type. Review all other settings; click the "Next Screen" button.

Text Captions

Click the **Next Screen** button

Slide 26 - Slide 26



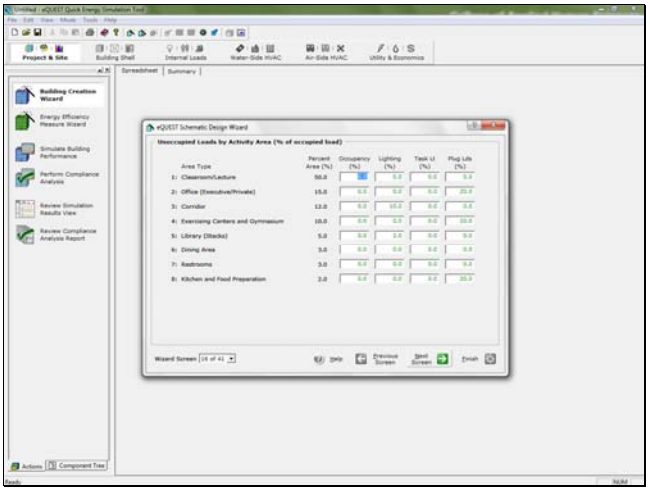
Slide notes

Here we can assign energy loads per area type, note that this applies to occupied loads only. Review all other settings; click the "Next Screen" button

Text Captions

Click the **Next Screen** button

Slide 27 - Slide 27



Slide notes

Here we can assign energy loads per area type for unoccupied areas. Some areas will have energy loads even though the space is not used such as lighting for interior corridors for safety reasons.

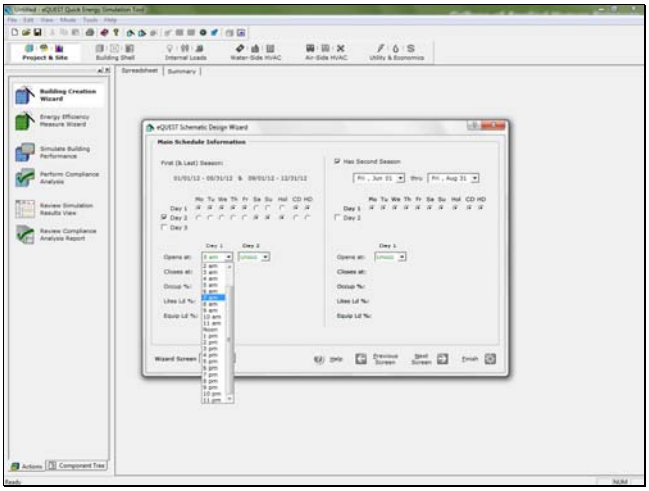
Notice the plug loads for the unoccupied spaces. Some of these loads are due to “Phantom Loads,” loads which are caused by electronic equipment using electricity in sleep mode such as computers, etc.

Review all other settings; click the "Next Screen" button

Text Captions

Click the **Next Screen** button

Slide 28 - Slide 28



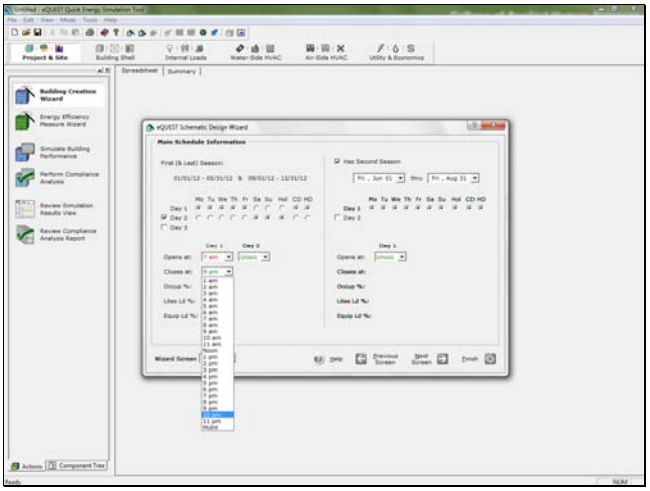
Slide notes

Here we can change the times for which the building is occupied during the week. Change the week day times (Day 1) to reflect the building opening at 7am and closing at 10pm

Text Captions

Select the **7 am** item

Slide 29 - Slide 29

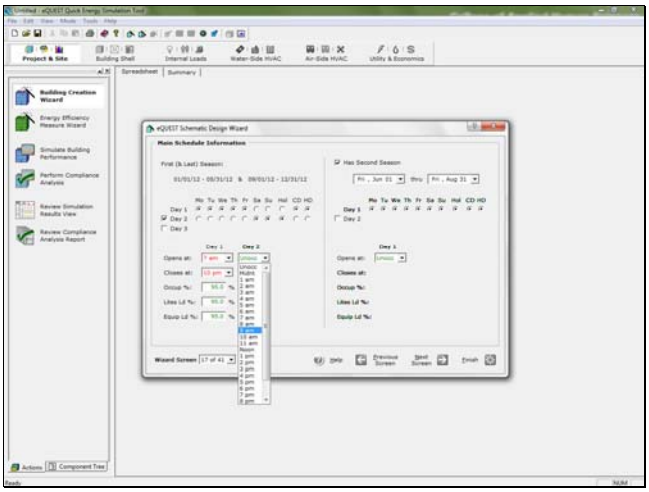


Slide notes

Text Captions

Select the **10 pm** item

Slide 30 - Slide 30



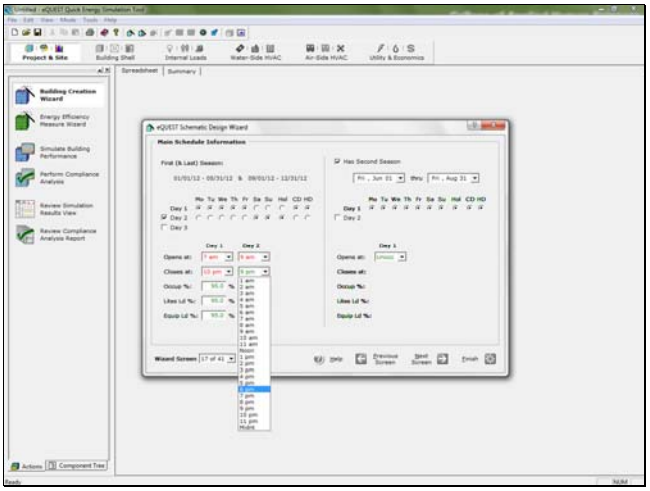
Slide notes

Change the weekend/holiday times (Day 2) to reflect the building opening at 9am and closing at 6pm.

Text Captions

Select the **9 am** item

Slide 31 - Slide 31

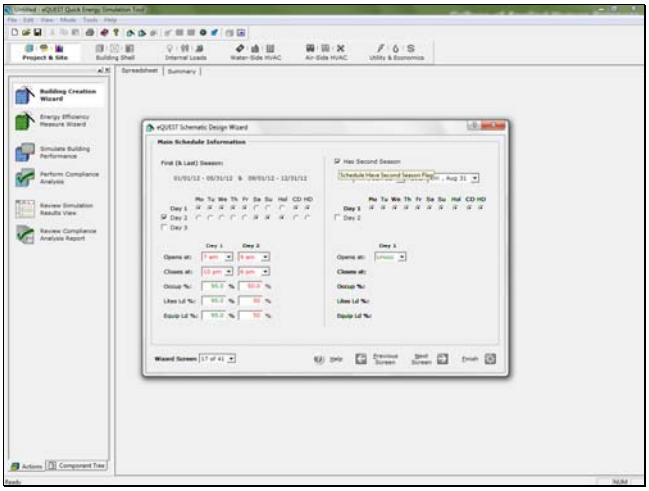


Slide notes

Text Captions

Select the **6 pm** item

Slide 32 - Slide 32

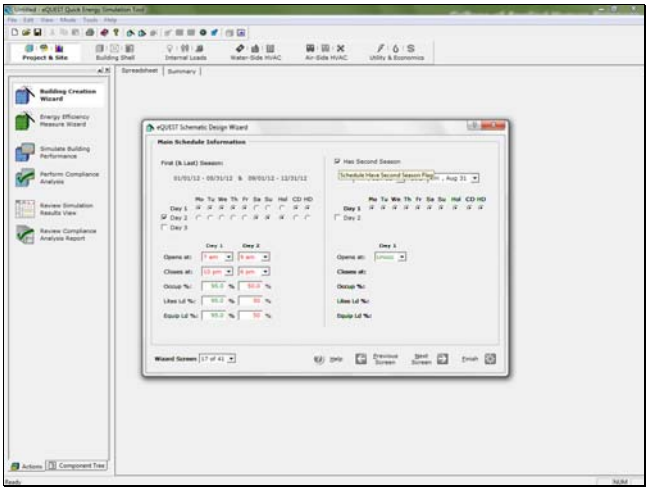


Slide notes

Change ALL Occupancy, Lites Ld, and Equipment Ld to 50% for the weekends/holidays (Day 2)

Text Captions

Slide 33 - Slide 33



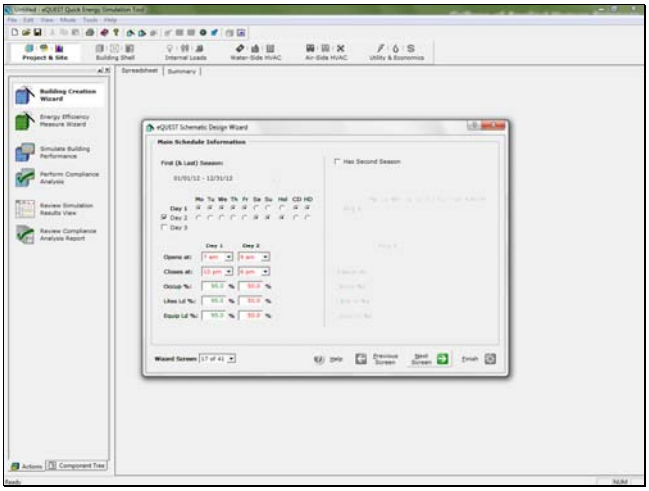
Slide notes

Uncheck the box for "Has Second Season" since classes typically run all year round at most colleges.

Text Captions

Select the **Has Second Season** check box

Slide 34 - Slide 34



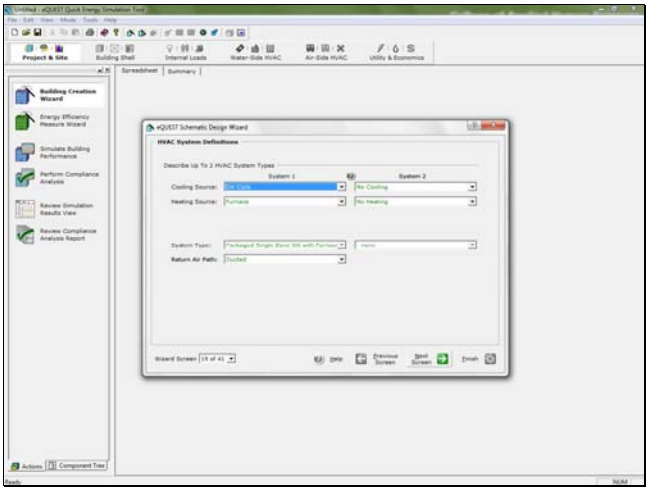
Slide notes

Review all other settings; click the "Next Screen" button

Text Captions

Click the **Next Screen** button

Slide 35 - Slide 35



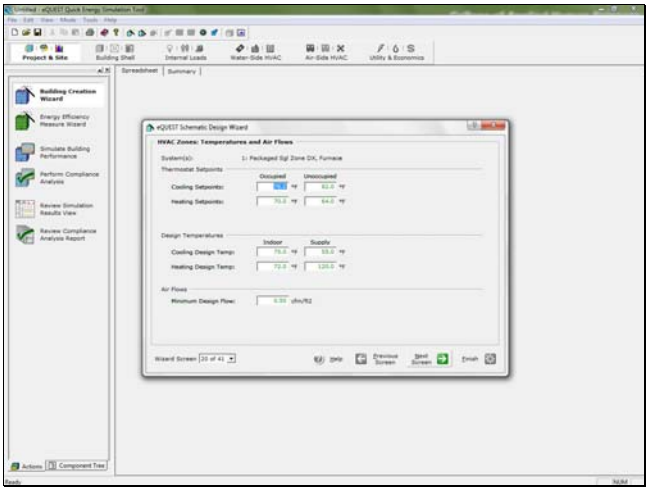
Slide notes

This is the HVAC System Screen. Notice the default settings. Review all other settings; click the "Next Screen" button

Text Captions

Click the **Next Screen** button

Slide 36 - Slide 36



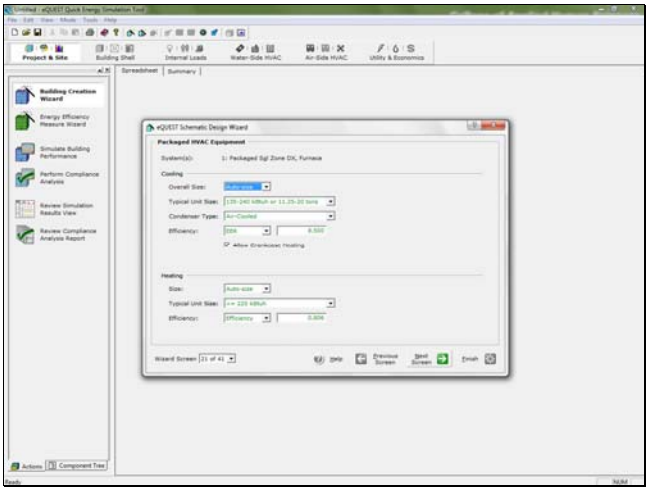
Slide notes

Here we can modify the temperature set points during occupied and unoccupied times. For our purposes, let's keep all defaults unchanged. Review all other settings; click the "Next Screen" button

Text Captions

Click the **Next Screen** button

Slide 37 - Slide 37



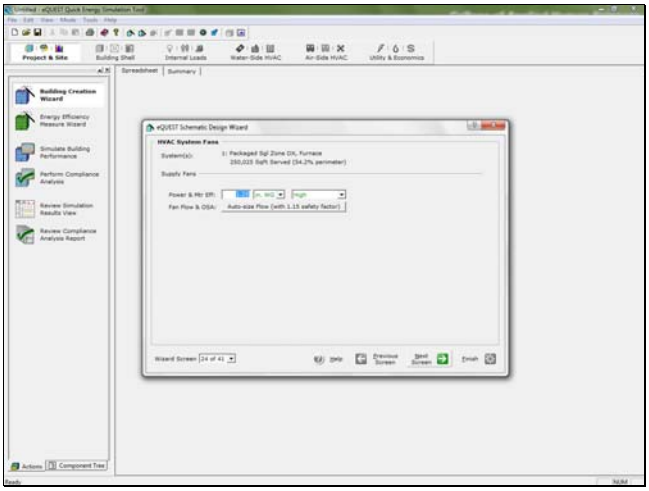
Slide notes

This is where you would size the heating and cooling systems. Review all other settings; click the "Next Screen" button

Text Captions

Click the **Next Screen** button

Slide 38 - Slide 38



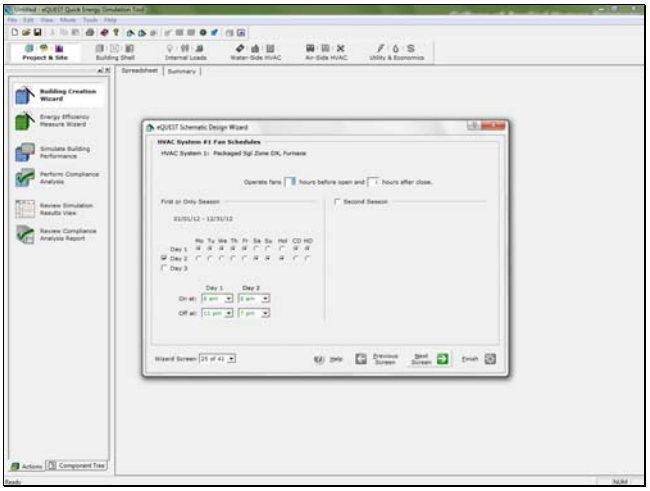
Slide notes

This is the HVAC Fan screen. Review all other settings; click the "Next Screen" button

Text Captions

Click the **Next Screen** button

Slide 39 - Slide 39



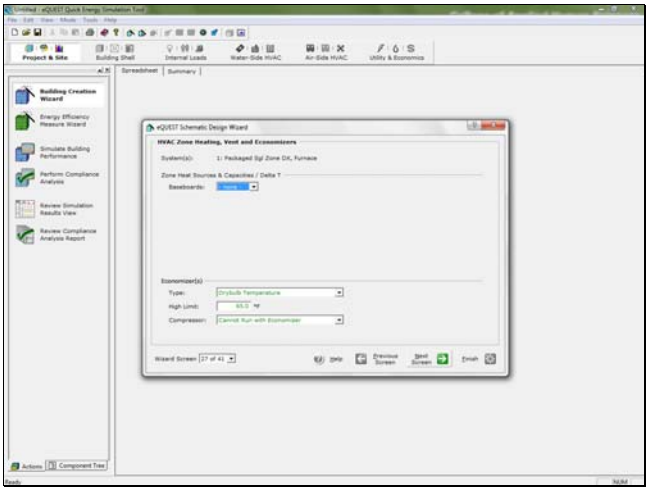
Slide notes

Fans will operate 1 hour before and after the building closes each day, accept all defaults. Review all other settings; click the "Next Screen" button.

Text Captions

Click the **Next Screen** button

Slide 40 - Slide 40



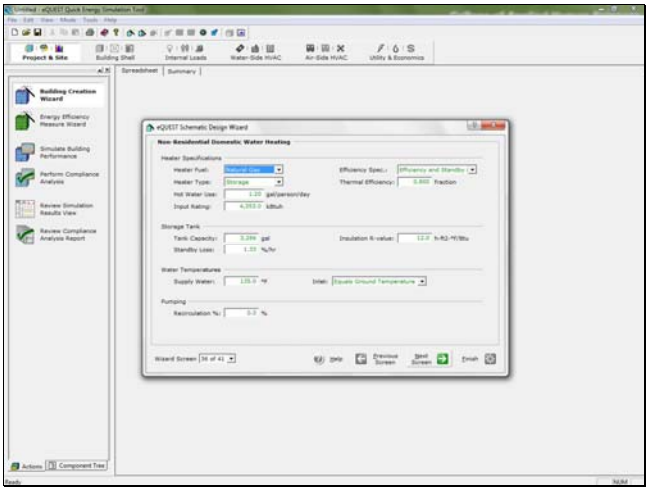
Slide notes

No baseboard heaters are needed for this building since the building will use forced air. Review all other settings; click the "Next Screen" button.

Text Captions

Click the **Next Screen** button

Slide 41 - Slide 41



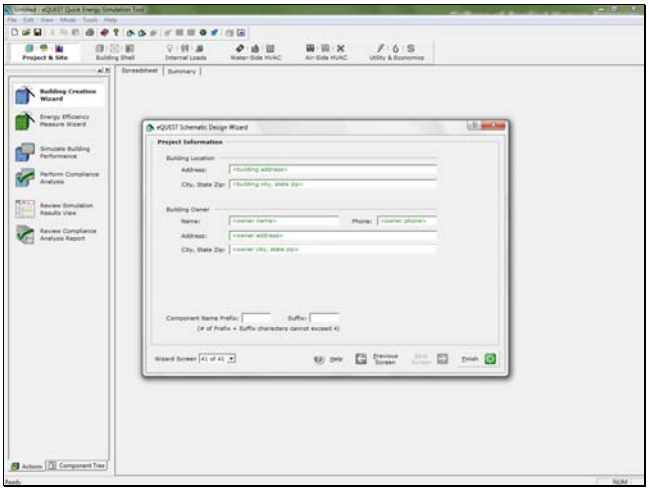
Slide notes

This screen is for modifying Water Heater use, accept all defaults. Review all other settings; click the "Next Screen" button.

Text Captions

Click the **Next Screen** button

Slide 42 - Slide 42



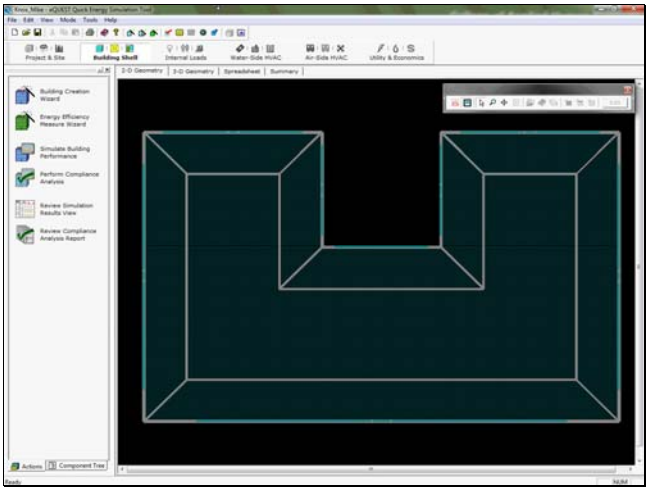
Slide notes

Enter building information as necessary. Click the "Finish" button to create model based on the parameters we set up. You can come back to this wizard at any time to modify the parameters.

Text Captions

Click the **Finish** button

Slide 43 - Slide 43

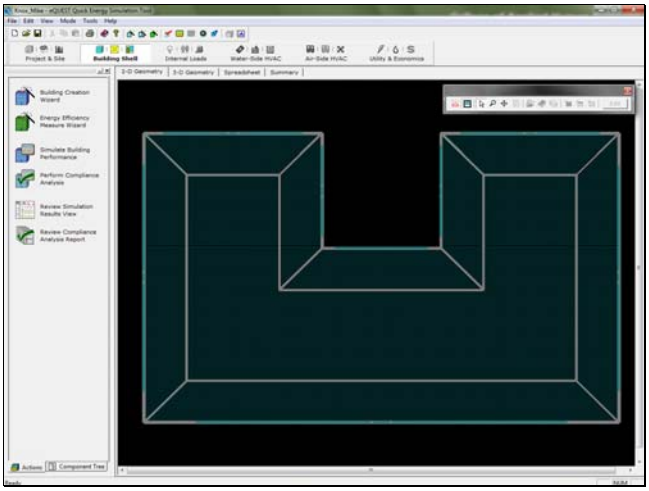


Slide notes

The model is now complete!

Text Captions

Slide 44 - Slide 44



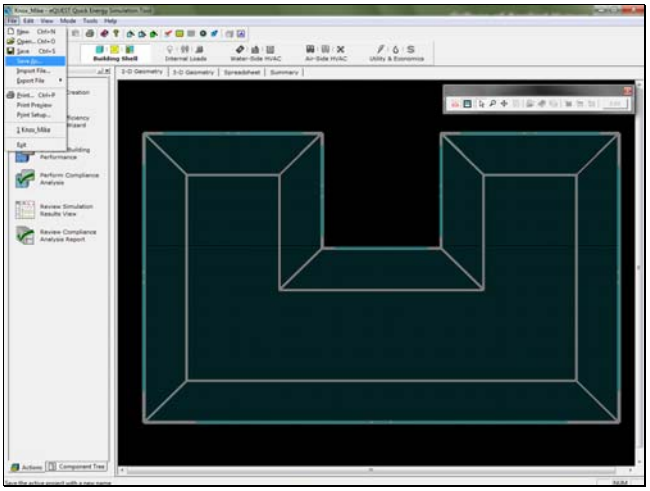
Slide notes

Save the file to the computer. Your instructor will tell you where to save the file. Please create a new folder to save the file in as the program will also create other files pertaining to this model. This will keep everything organized.

Text Captions

Select the **File** menu item

Slide 45 - Slide 45

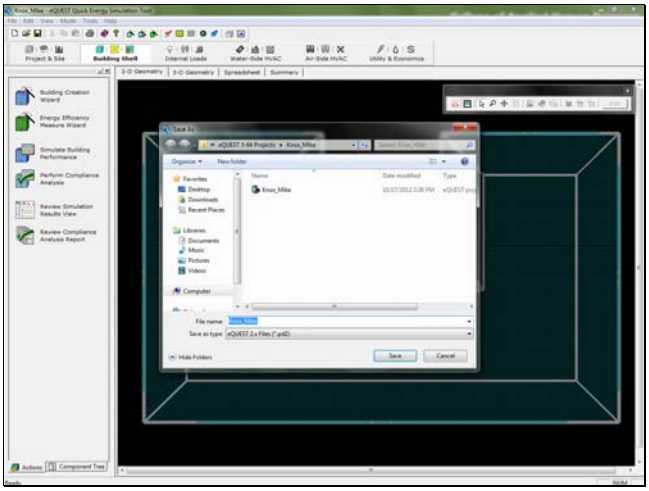


Slide notes

Text Captions

Select the **Save As...** menu item

Slide 46 - Slide 46



Slide notes

Create new folder and then name the file Last_First.

You are now ready to move on to eQuest Tutorial #2.

Text Captions

The **Save As** window opens

APPENDIX B:
eQUEST TUTORIAL #2- SIMULATION/ EEM

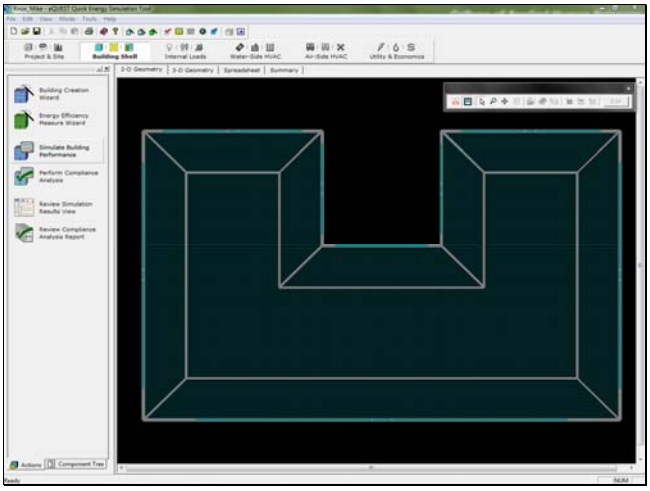
The file is available as an attachment, uploaded with this document or can be accessed online at:
https://drive.google.com/file/d/0B_fYQEvG3SS9UUZPbWFGZlo0am8/edit?usp=sharing

Instructions:

This tutorial will show you how to simulate building energy performance and also how to apply energy efficiency measures. This should be started after finishing Tutorial #1.

After simulating the building you will notice a baseline design case. This baseline design case is based off the building parameters that were set in Tutorial #1, and is important when comparing the same building against energy efficiency measures that are created.

Slide 1 - Slide 1



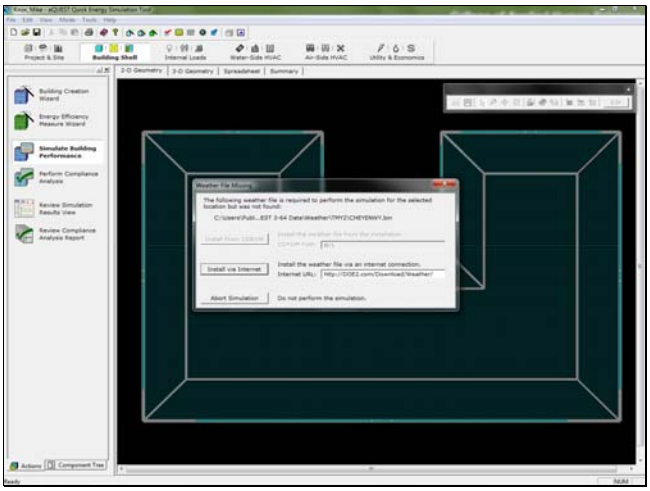
Slide notes

Next we can simulate the building performance based on the conditions we set in the Schematic Design Wizard. Click the “Simulate Building Performance" button on the left.

Text Captions

Click the **Simulate Building Performance** button

Slide 2 - Slide 2



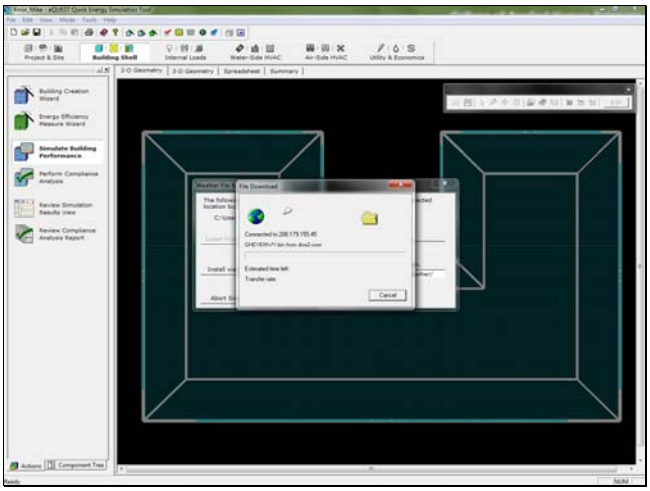
Slide notes

If the weather data is missing, select "Install via Internet"

Text Captions

Click the **Install via Internet** button

Slide 3 - Slide 3



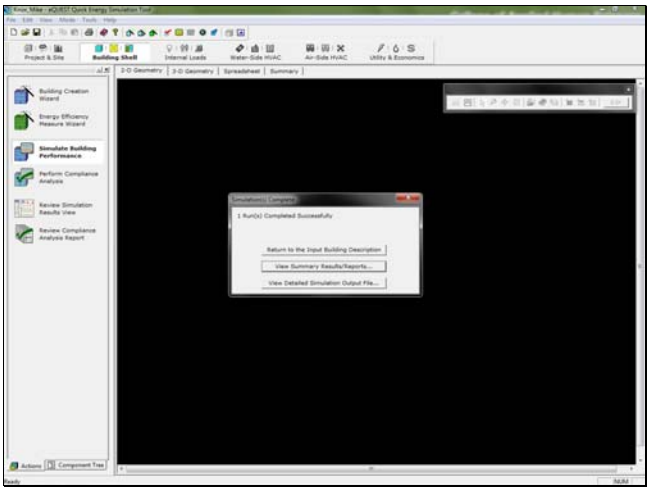
Slide notes

Weather data will download...

Text Captions

The **File Download** window opens

Slide 4 - Slide 4

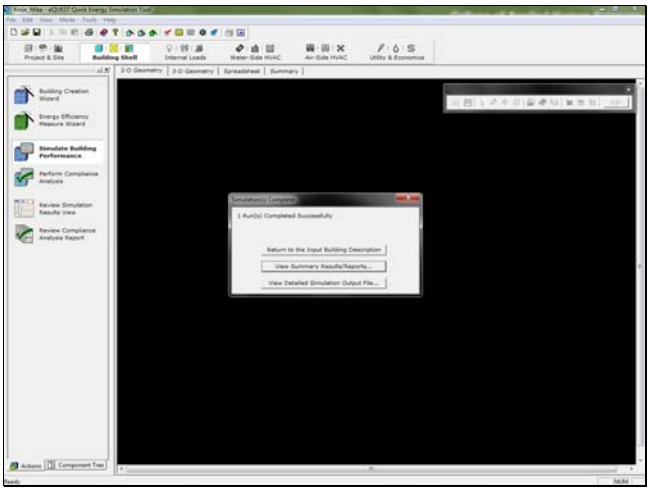


Slide notes

Text Captions

The **Simulation(s) Complete** window opens

Slide 5 - Slide 5



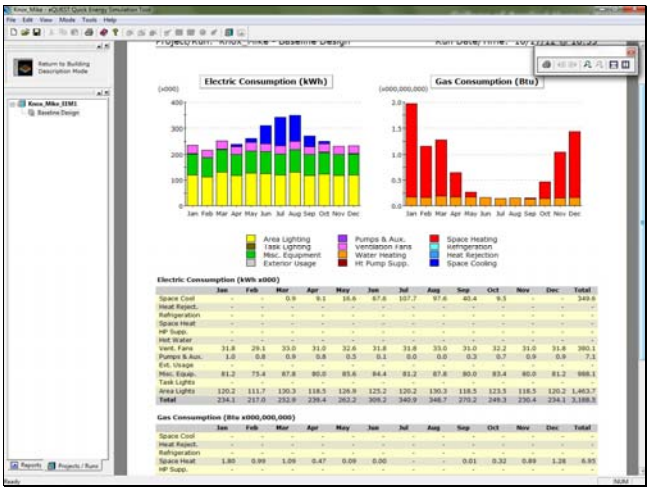
Slide notes

Choose "View Summary Report" to view the energy simulation.

Text Captions

Click the **View Summary Results/Reports...** button

Slide 6 - Slide 6

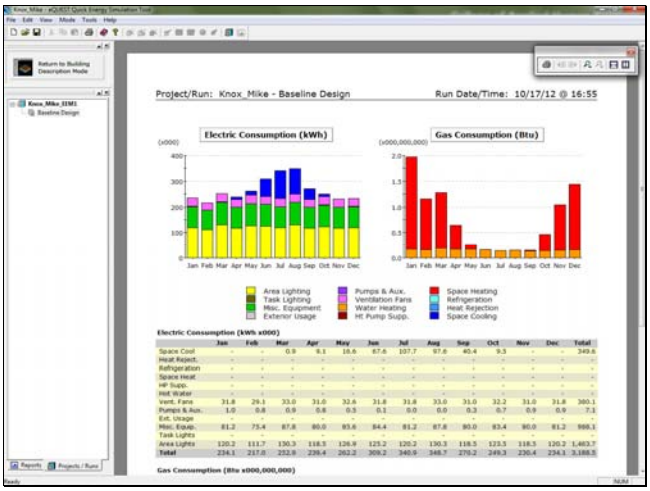


Slide notes

Review data. Take a look at the monthly totals for the building electric and gas usage. Pay attention to the grand total on the right side. We'll be comparing these baseline figures to the energy efficiency measures we create next. **Print this baseline case.**

Text Captions

Slide 7 - Slide 7



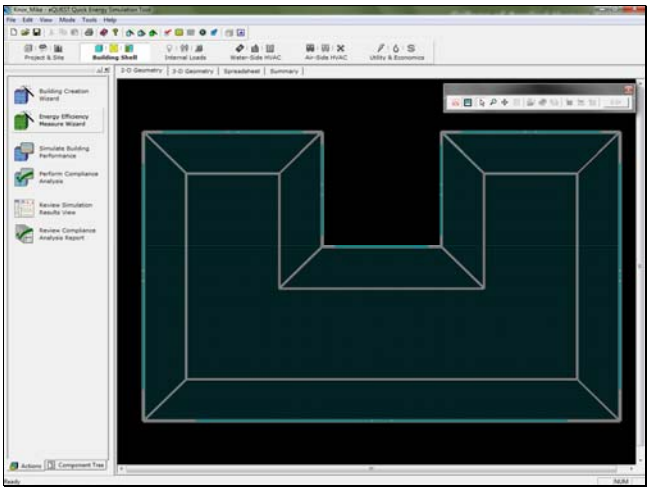
Slide notes

To exit, choose "Return to Building Description Mode"

Text Captions

Click the **Return to Building Description Mode** button

Slide 8 - Slide 8



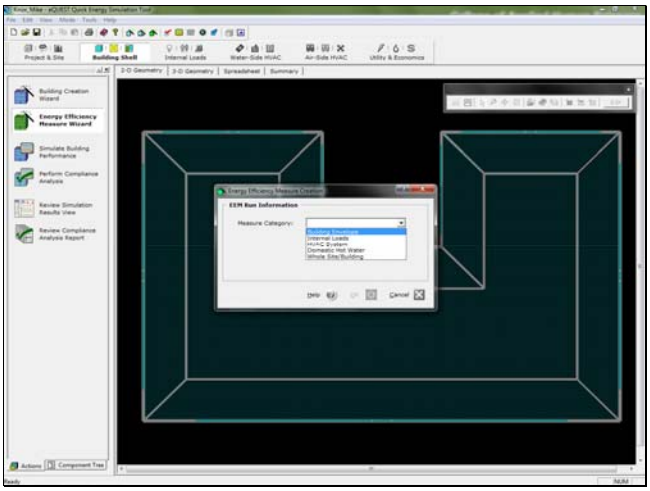
Slide notes

Let's increase the energy efficiency of our building by selecting "Energy Efficiency Measure Wizard"

Text Captions

Click the **Energy Efficiency Measure Wizard** button

Slide 9 - Slide 9



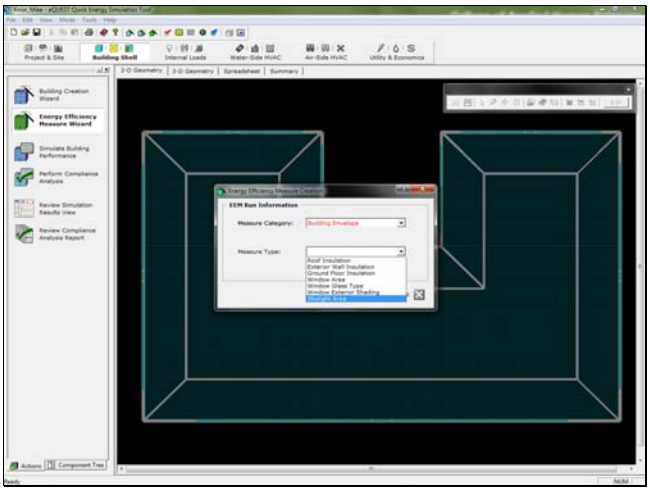
Slide notes

Select "Building Envelope" for the Measure Category

Text Captions

Select the **Building Envelope** item

Slide 10 - Slide 10



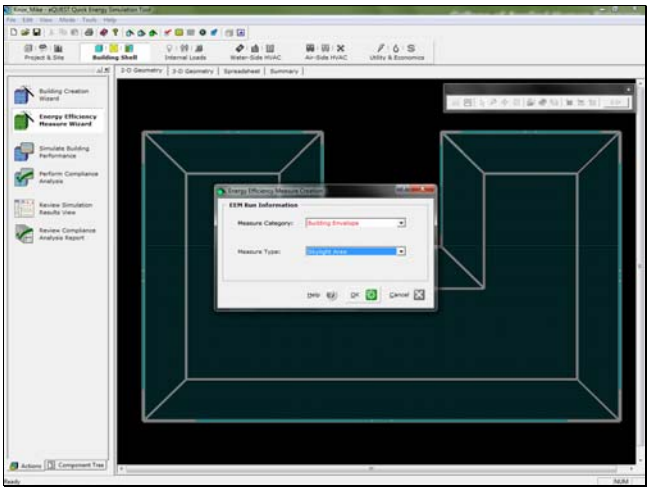
Slide notes

Select "Sky Light" for Measure Type

Text Captions

Select the **Skylight Area** item

Slide 11 - Slide 11



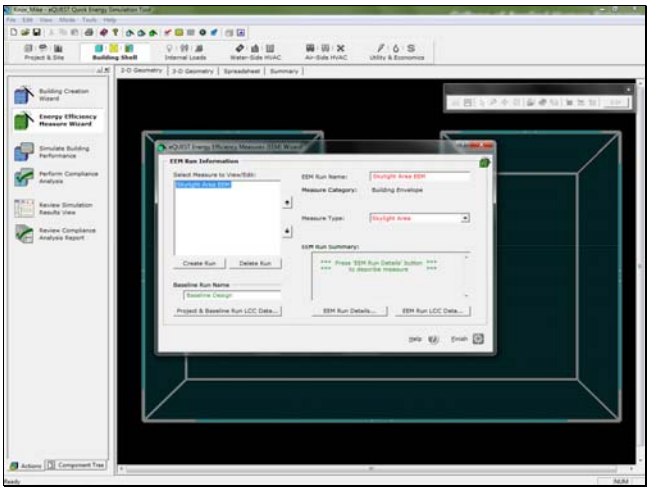
Slide notes

Click OK

Text Captions

Click the **OK** button

Slide 12 - Slide 12

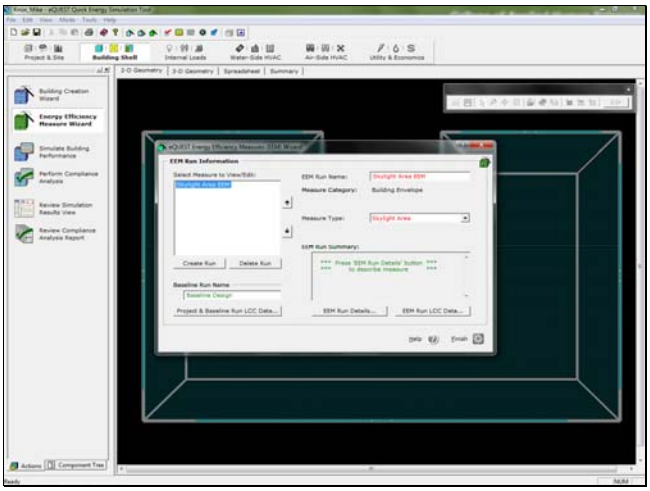


Slide notes

Text Captions

The **eQUEST Energy Efficiency Measures (EEM) Wizard** window opens

Slide 13 - Slide 13



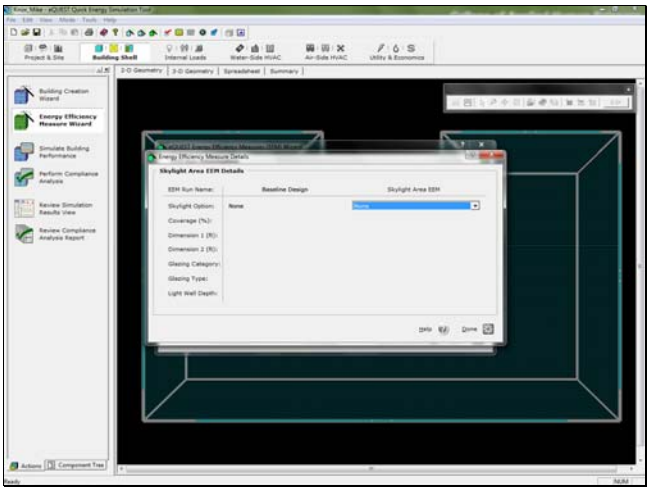
Slide notes

Make sure "Sky Light Area EEM" is highlighted in the top left. Then choose "EEM Run Details", this will allow us to change the setting for the sky lights.

Text Captions

Click the **EEM Run Details...** button

Slide 14 - Slide 14

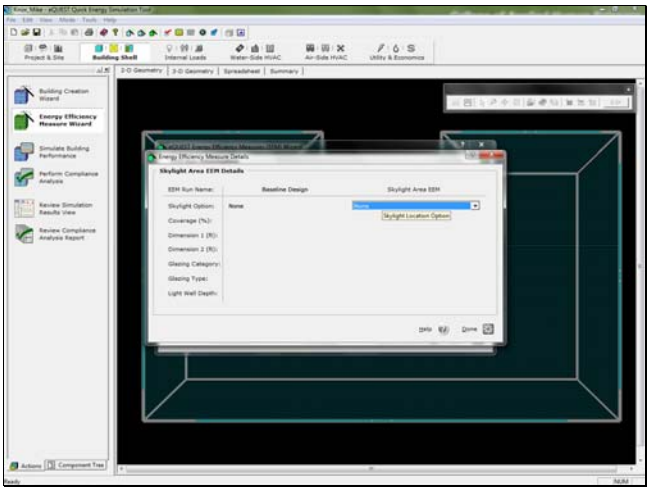


Slide notes

Text Captions

The **Energy Efficiency Measure Details** window opens

Slide 15 - Slide 15

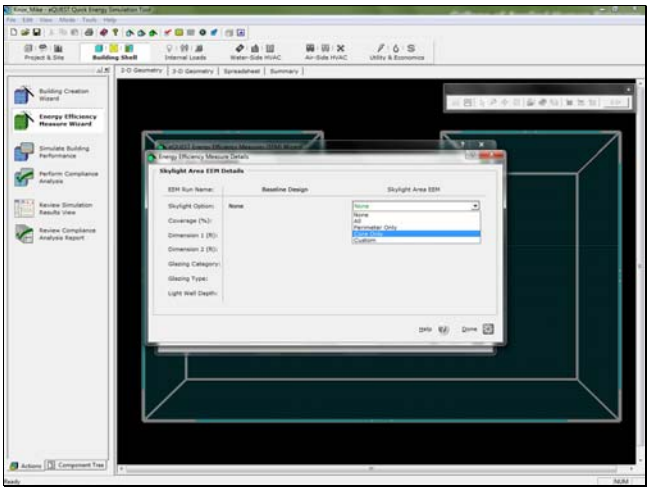


Slide notes

Text Captions

Select the **None** combo box

Slide 16 - Slide 16



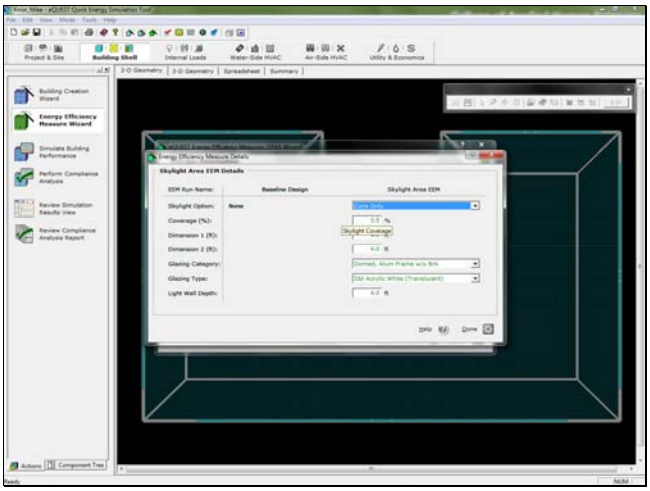
Slide notes

Choose "Core Only" to place the sky lights in the core.

Text Captions

Select the **Core Only** item

Slide 17 - Slide 17



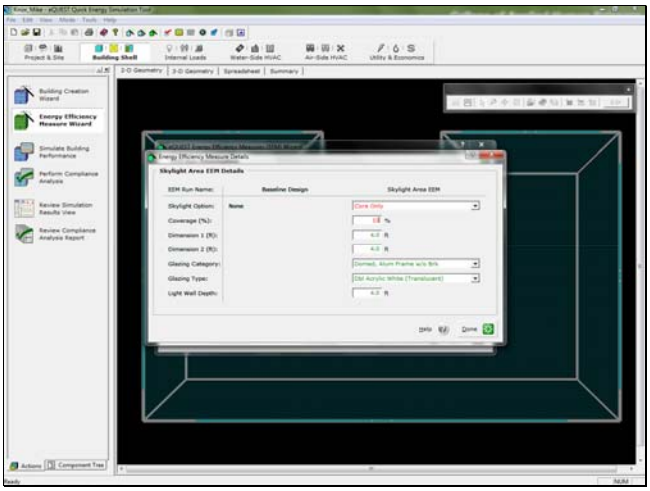
Slide notes

Increase the coverage of the sky light from 3.5% to 10%.

Text Captions

Select the **3.5** text box

Slide 18 - Slide 18



Slide notes

Click the "Done" button

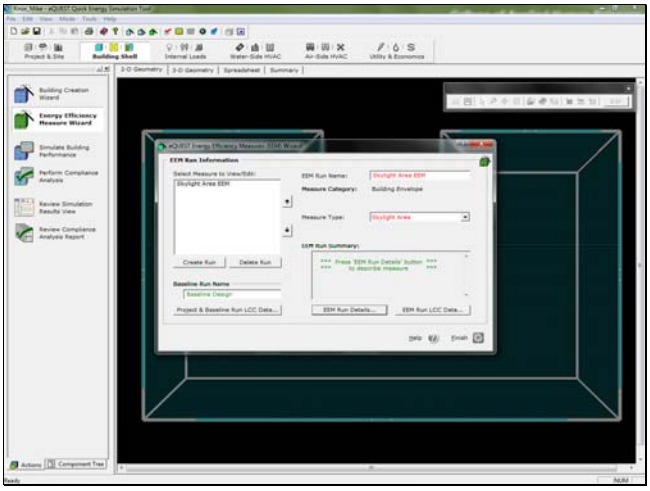
Text Captions

Click the **Done** button

Discussion:

How do you think the energy consumption of the Skylight EEM will change the gas and electrical consumption for this building?

Slide 19 - Slide 19



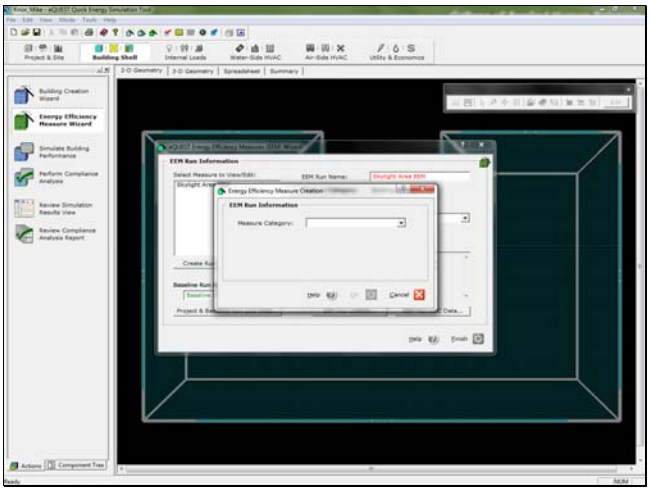
Slide notes

Click "Create Run" button to create another EEM.

Text Captions

Click the **Create Run** button

Slide 20 - Slide 20



Slide notes

Text Captions

The **Energy Efficiency Measure Creation** window opens

Slide 21 - Slide 21

Slide notes

Choose "Internal Loads"

Text Captions

Select the **Internal Loads** item

Slide 22 - Slide 22

Slide notes

Choose "Lighting Power Density" as the Measure type.

Text Captions

Select the **Lighting Power Density** item

Slide 23 - Slide 23

Slide notes

Apply the measure to the Baseline Run. This will allow us to compare the two EEM's to the baseline. This will allow us to compare to the baseline run case created before.

Text Captions

Select the **- baseline run -** item

Slide 24 - Slide 24

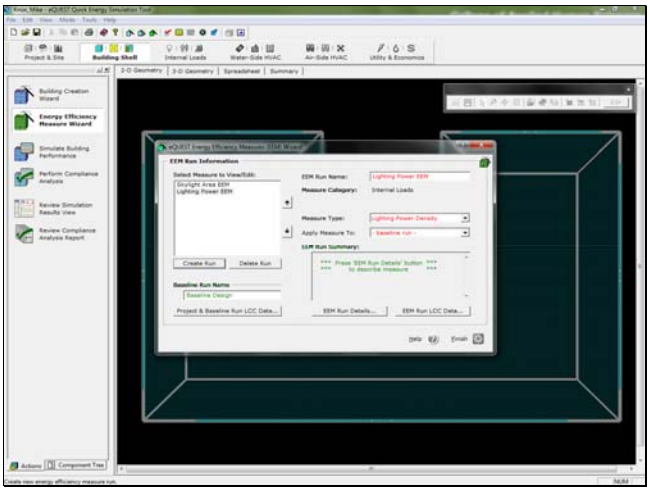
Slide notes

Click OK

Text Captions

Click the **OK** button

Slide 25 - Slide 25



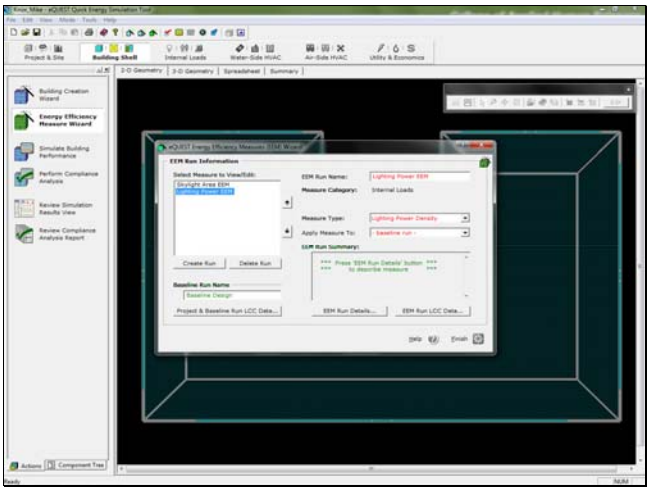
Slide notes

Make sure "Lighting Power EEM" is highlighted.

Text Captions

Select the **Lighting Power EEM** item

Slide 26 - Slide 26



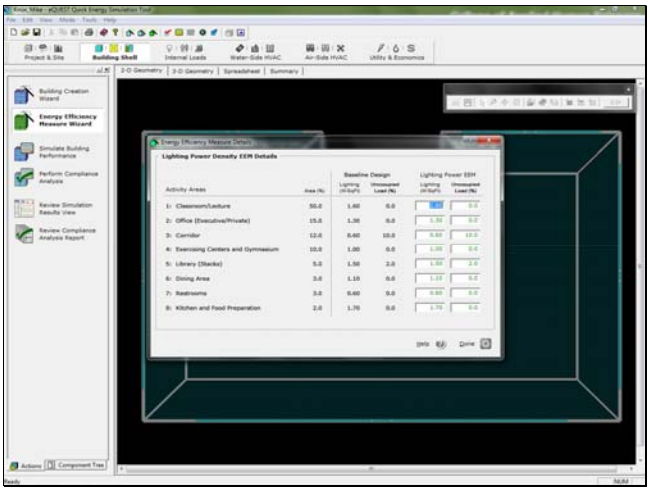
Slide notes

Click "EEM Run Details" to modify the EEM

Text Captions

Click the **EEM Run Details...** button

Slide 27 - Slide 27



Slide notes

Text Captions

The **Energy Efficiency Measure Details** window opens

Slide 28 - Slide 28

Slide notes

Here we can change the light densities per activity area. Change the power density of the Classroom/Lecture and Office to 1.00 leaving everything else the same.

Text Captions

Slide 29 - Slide 29

Slide notes

Click Done.

Notice the units of measure. Lighting is measured in watts/SF, this means that decreasing the number of watts that light each square foot decrease the amount of energy that is needed to light the building. This can be accomplished several different ways.

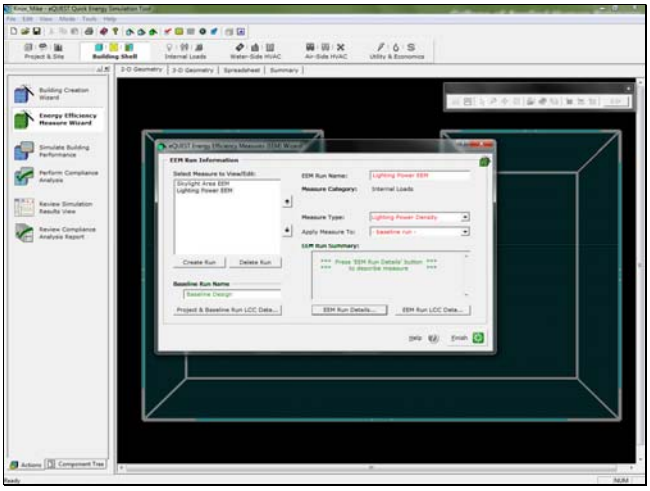
Text Captions

Click the **Done** button

Discussion:

How do you think the energy consumption of the Lighting Power Density EEM will change the gas and electrical consumption for this building?

Slide 30 - Slide 30



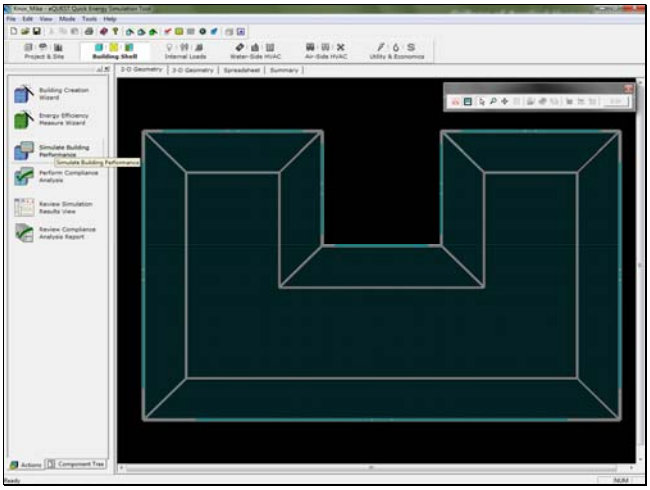
Slide notes

Click "Finish"

Text Captions

Click the **Finish** button

Slide 31 - Slide 31



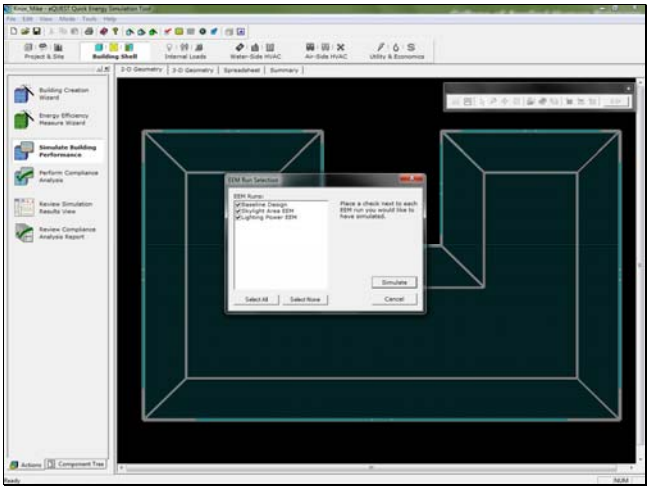
Slide notes

Click "Simulate Building Performance" to simulate the building baseline run and the Energy Efficiency Measures.

Text Captions

Click the **Simulate Building Performance** button

Slide 32 - Slide 32



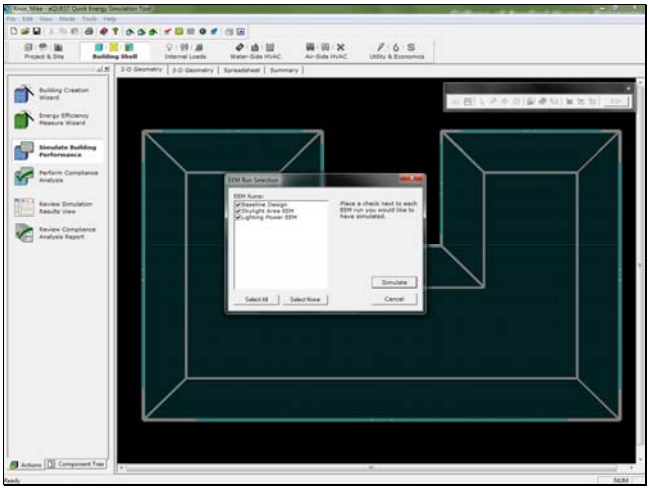
Slide notes

Make sure all EEM runs are selected.

Text Captions

The **EEM Run Selection** window opens

Slide 33 - Slide 33



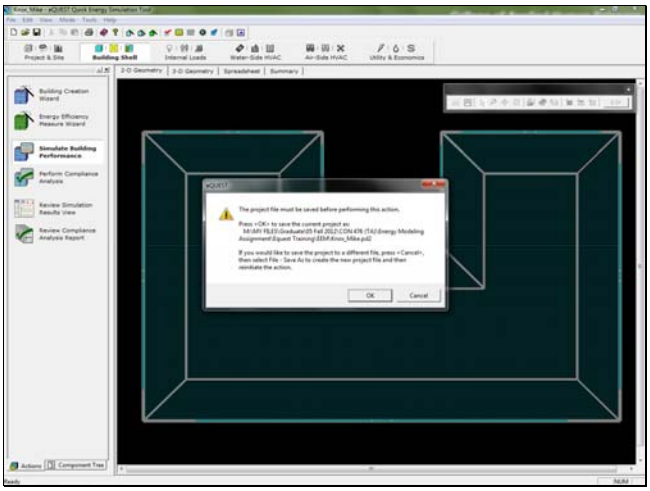
Slide notes

Click the simulate button. The program will run the simulation 3 separate times, one baseline and 2 EEMs.

Text Captions

Click the **Simulate** button

Slide 34 - Slide 34



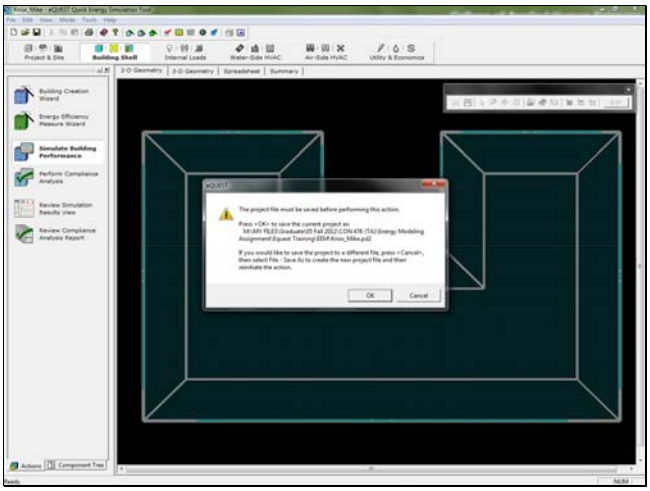
Slide notes

Choose OK to save.

Text Captions

The **eQUEST** window opens

Slide 35 - Slide 35

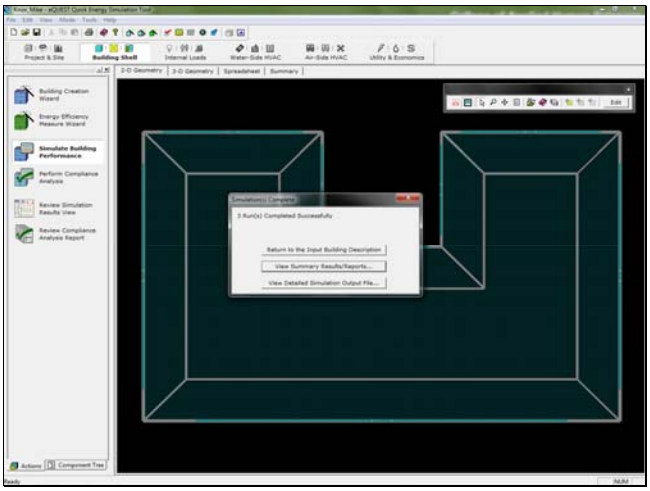


Slide notes

Text Captions

Click the **OK** button

Slide 36 - Slide 36



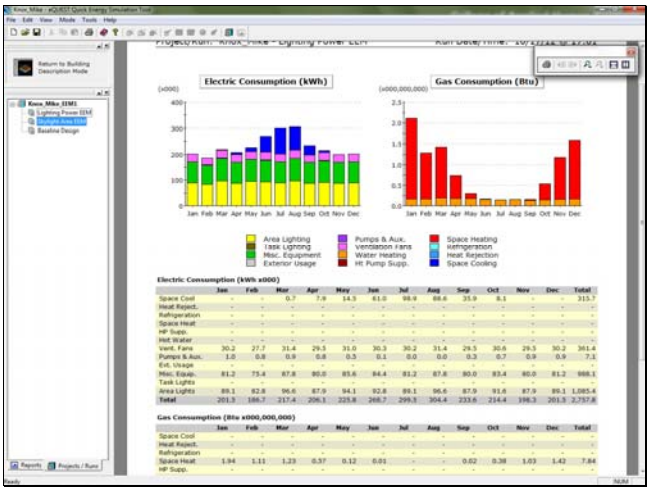
Slide notes

Click "View Summary Results"

Text Captions

Click the **View Summary Results/Reports...** button

Slide 37 - Slide 37



Slide notes

Notice that the Baseline Run and the two EEM we just created are listed on the side. Click each one to switch between each one, notice that the energy consumption changes. Baseline case should not have changed from last simulation. **Print Skylight EEM and Lighting Power EEM.**

Text Captions

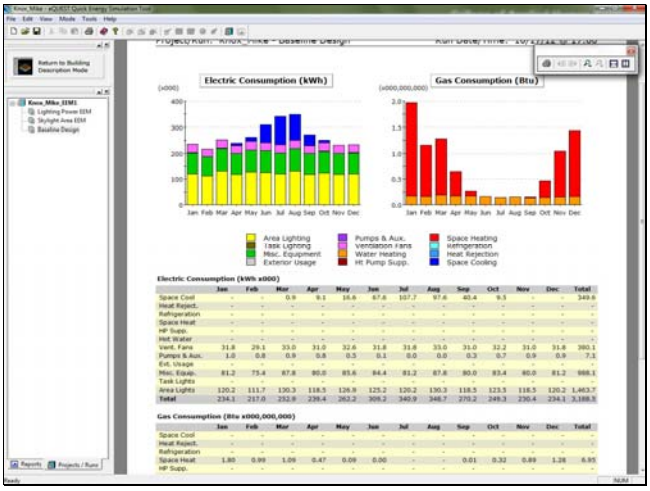
Discussion:

While energy models give data on what makes a buildings energy consumption change (up or down), they are not good for basing absolute estimates on.

A building built to exact specifications of one that is simulated in the computer may have drastically different energy outcomes in the real world. Energy modeling software is better suited to make decisions on deigns elements.

What do you think are the variables that may exist to influence a building performing different in the real world as in an energy simulation?

Slide 38 - Slide 38



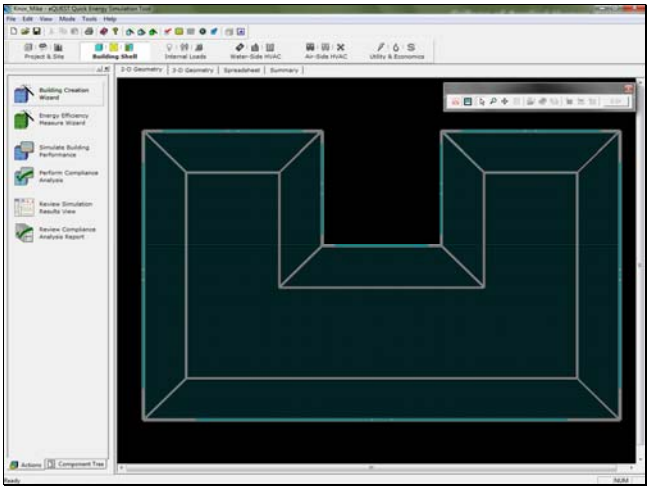
Slide notes

To exit, click "Return to Building Description Mode"

Text Captions

Click the **Return to Building Description Mode** button

Slide 39 - Slide 39



Slide notes

If you need to change any of the building parameters, click "Building Creation Wizard." Once you change the building parameters you will need to re-simulate the building.

Save file once again.

Text Captions

Now that you have completed both tutorials, please refer back to the energy modeling assignment for next steps.