Final Building Energy Model

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MAE 125: Building Energy Efficiency

Professor Kleissl

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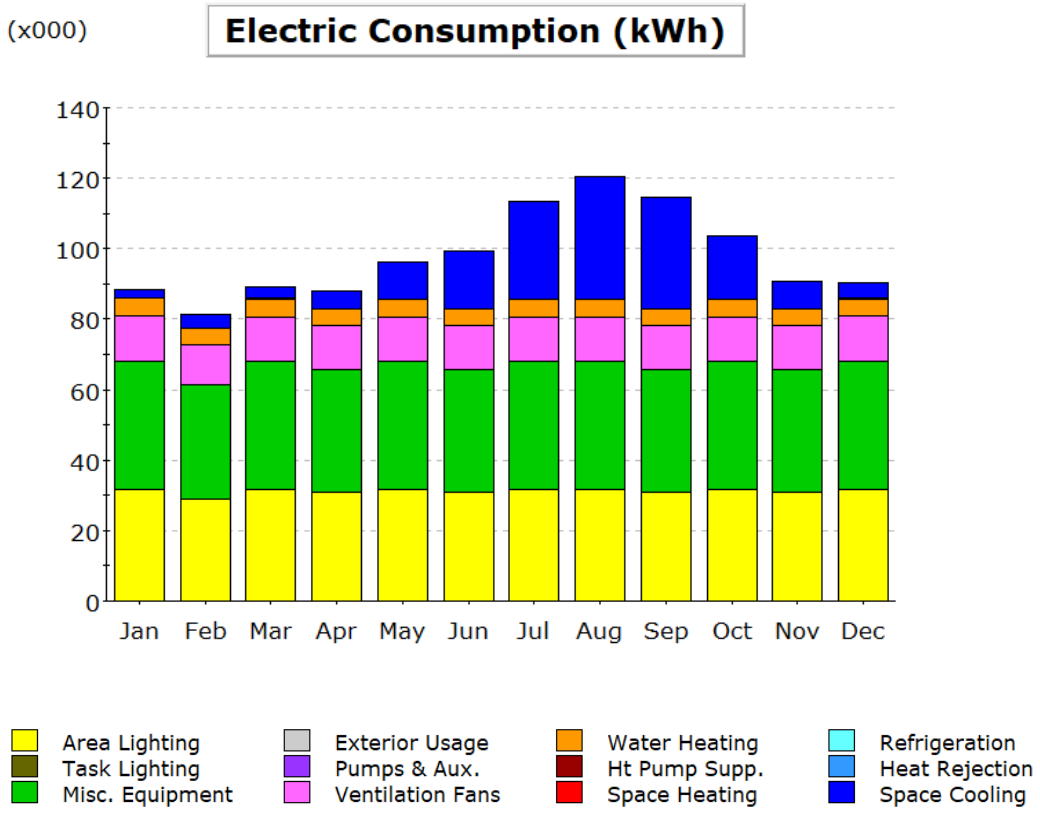
1) Building Operation Schedule

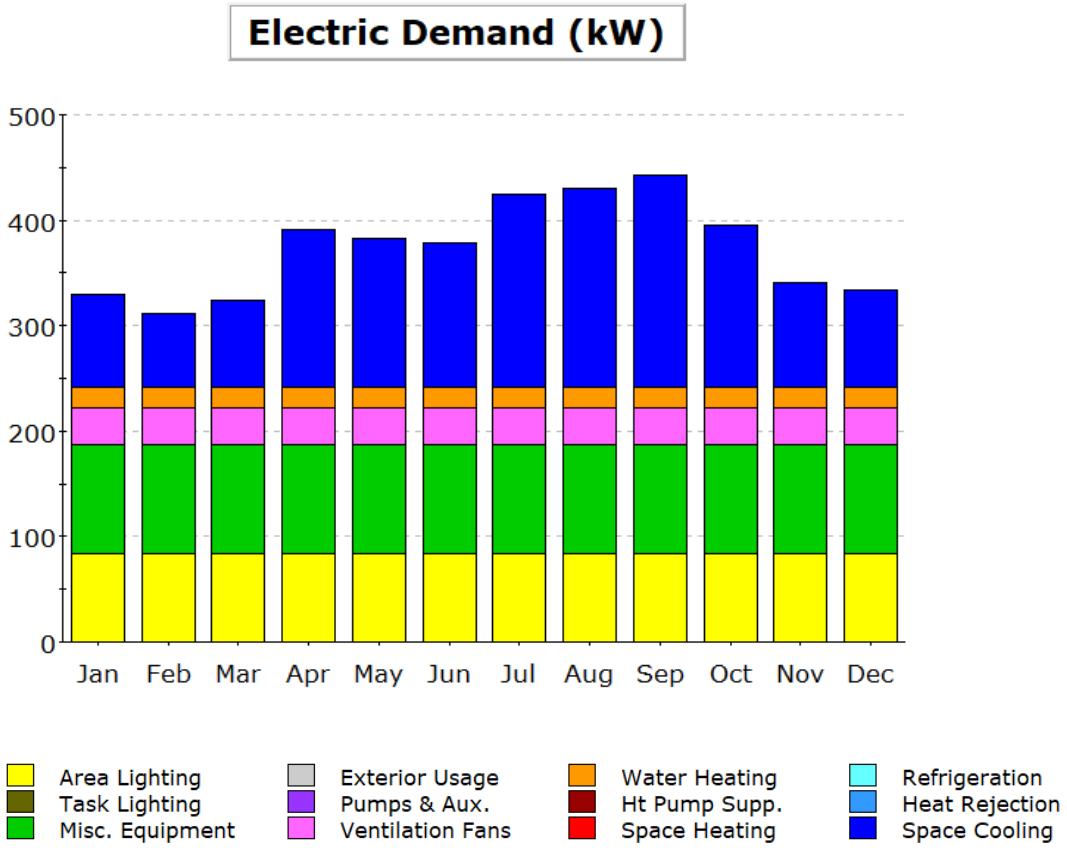
Monthly Energy Consumption by End Use



Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	2.3	3.8	3.5	4.8	10.6	16.5	27.8	35.0	32.0	18.0	7.6	4.4	166.2
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	0.2	0.0	0.1	0.1	-	-	-	-	-	-	0.1	0.2	0.7
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	5.0	4.6	5.1	4.9	5.0	4.8	4.9	4.9	4.7	4.9	4.8	5.0	58.6
Vent. Fans	12.7	11.5	12.7	12.3	12.7	12.3	12.7	12.7	12.3	12.7	12.3	12.7	149.7
Pumps & Aux.	0.2	0.1	0.1	0.0	-	-	-	-	-	-	0.1	0.1	0.6
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	36.1	32.6	36.1	34.9	36.1	34.9	36.1	36.1	34.9	36.1	34.9	36.1	425.0
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	31.8	28.8	31.8	30.8	31.8	30.8	31.8	31.8	30.8	31.8	30.8	31.8	374.8
Total	88.4	81.3	89.3	87.9	96.3	99.3	113.4	120.5	114.8	103.6	90.6	90.4	1,175.7

Monthly Peak Demand by End Use



Electric Demand (kW)

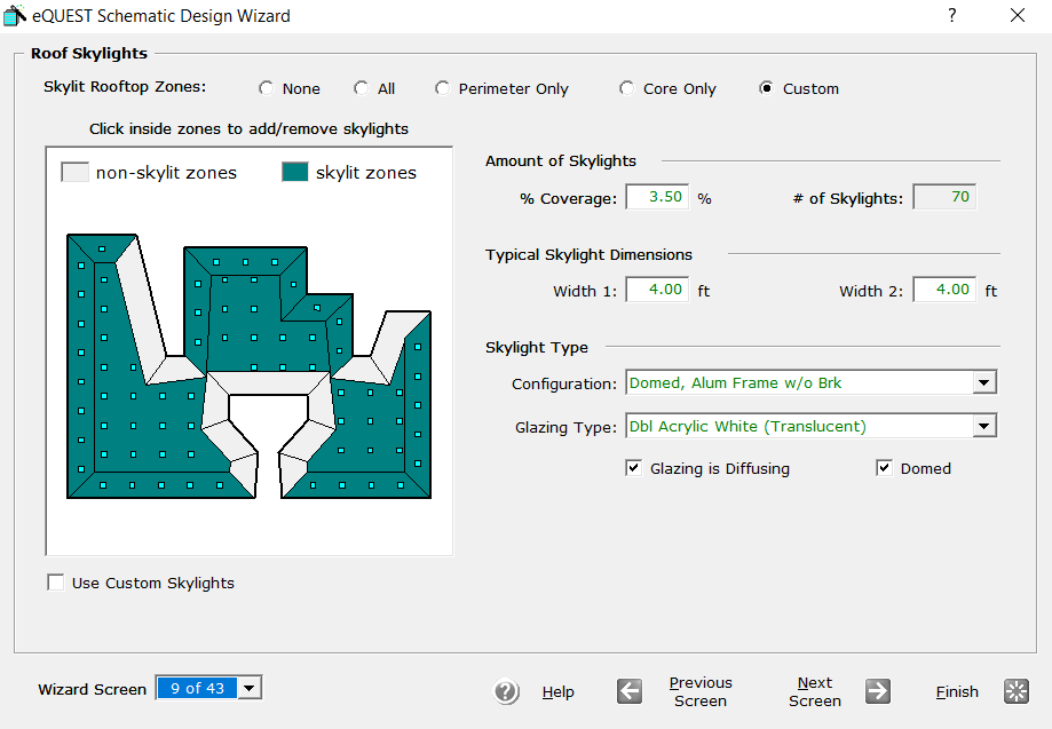
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	88.4	69.5	82.9	148.8	141.0	136.9	183.0	189.6	201.4	153.6	99.8	93.0	1,587.8
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	20.3	20.4	20.4	20.3	20.1	19.9	19.7	19.7	19.7	19.7	19.9	20.1	240.2
Vent. Fans	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	34.2	410.2
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0	1,247.6
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	83.3	83.3	83.3	83.3	83.3	83.3	83.3	83.3	83.3	83.3	83.3	83.3	999.1
Total	330.0	311.2	324.7	390.5	382.5	378.3	424.1	430.7	442.4	394.8	341.1	334.5	4,484.9

a. 2 Largest Contributors

	Summer (May – Sep.)	Winter (Oct. – Apr.)
Monthly Energy Consumption by End Use	1) Miscellaneous equipment 2) Area lighting	1) Area lighting 2) Miscellaneous equipment
Monthly Peak Demand by End Use	1) Space cooling 2) Area lighting	1) Space cooling 2) Area lighting

2) Roof Skylights

a. Modeling Choices



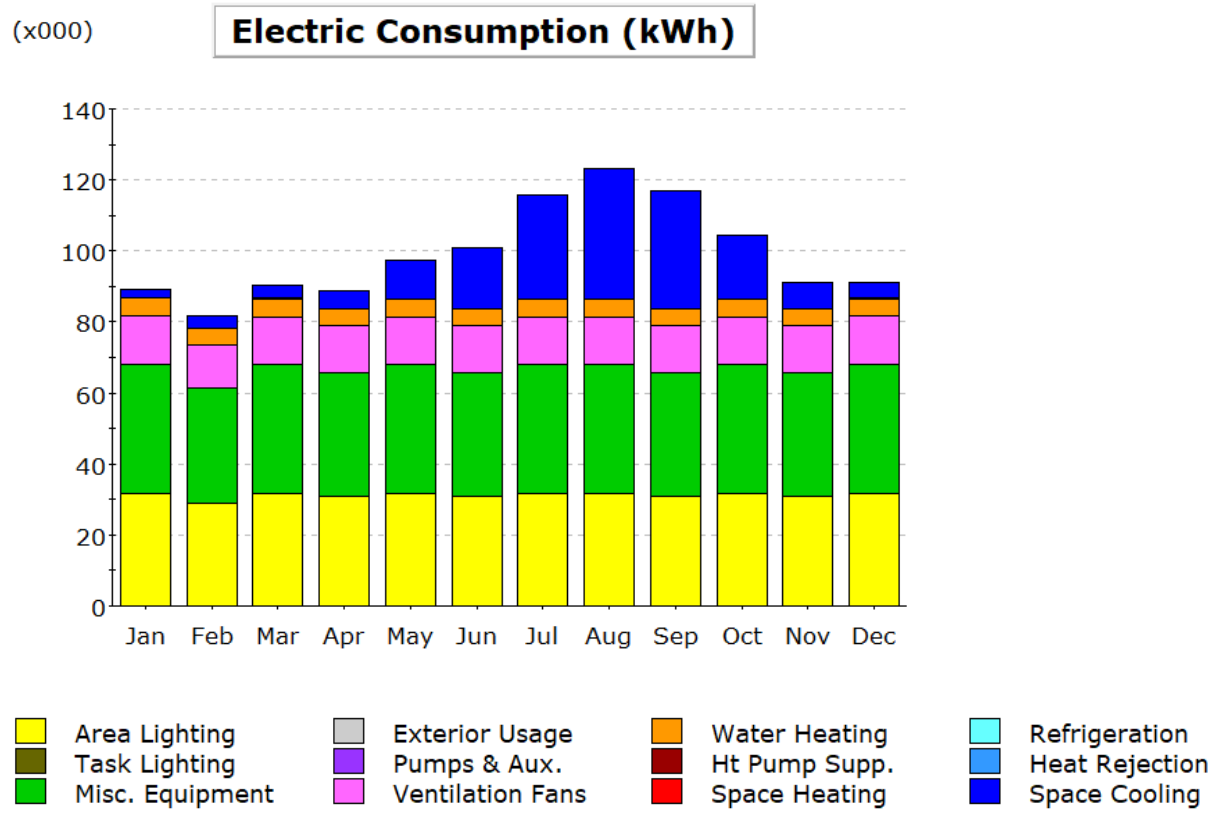
The default roof skylights generated by eQuest was used with one modification made. Initially, it was assumed that all zones are exposed to skylights. Then, the zones located near windows were modified to not be exposed to skylights. This modification was made because these zones already receive sunlight from the vertical windows during daytime. Thus, no skylights were added to these zones. Furthermore, no other modifications were made because there are already numerous light fixtures installed. Thus, the small size of each skylight was kept.

b. Impact on Building Energy Use

In the context of heat transfer, the windows will have a higher transmissivity of heat than the walls. This is because glass has a higher transmissivity of heat than other materials such as metal and wood. Thus, the addition of skylights will increase the energy use for space cooling during the summer because more heat will be transmitted from the outside environment through the windows into the inside environment. In other words, the addition of more skylights, windows, will increase the amount of solar energy entering MySpace and thus induce higher heat gains and losses through conduction. Furthermore, there will be an increase in energy use for space heating during the winter because more heat will be transmitted from the inside environment through the windows to the outside environment. Aside from heat transfer, some light fixtures may be switched off during the daytime to reduce energy use for area lighting. The addition of skylights will allow more natural sunlight into the room during the daytime. Thus, turning on all the light fixtures during the daytime may lead to a waste in energy use.

c. Simulation of Building Energy Use

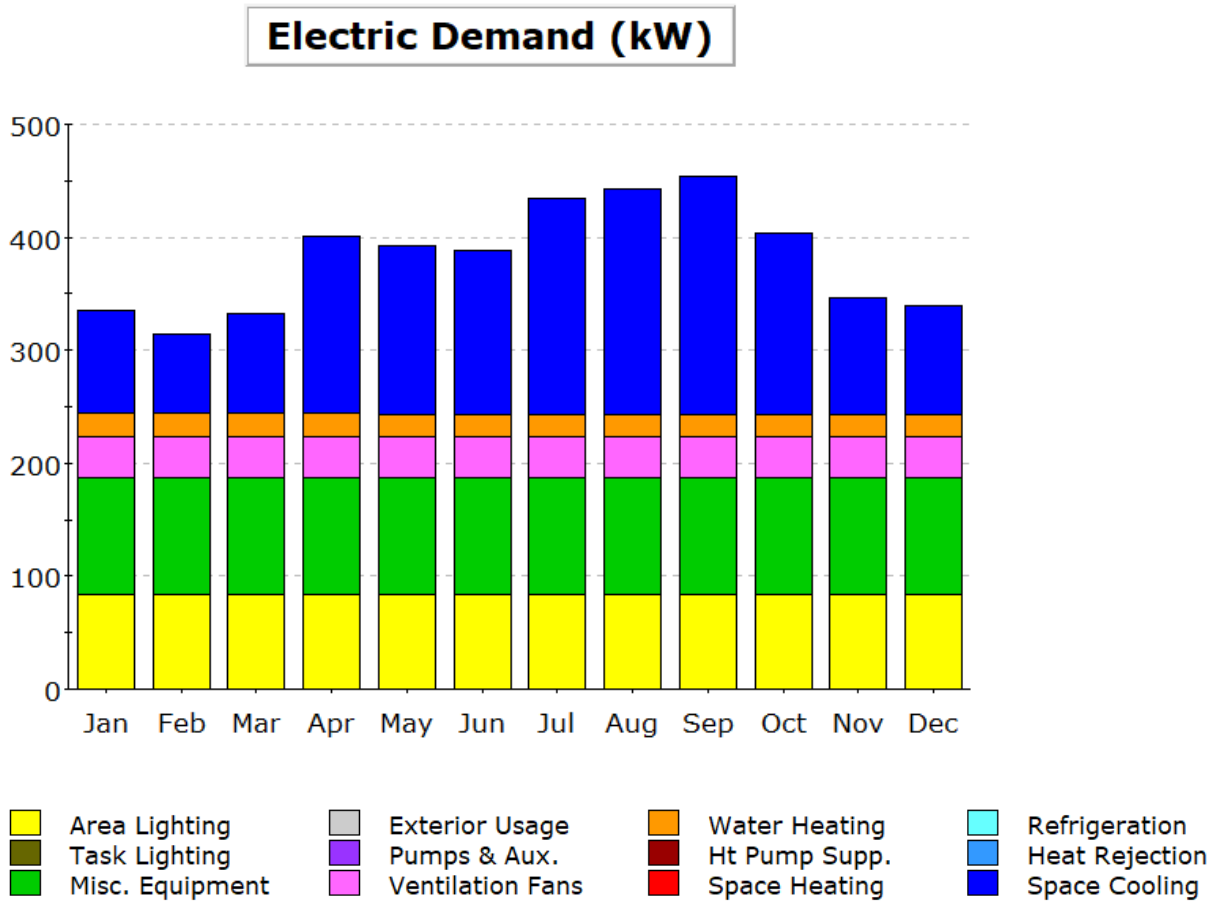
Monthly Energy Consumption by End Use



Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	2.1	3.5	3.6	5.1	11.0	17.4	29.3	36.8	33.2	18.2	7.4	4.2	171.7
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	0.3	0.0	0.1	0.1	-	-	-	-	-	-	0.1	0.3	0.9
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	5.0	4.6	5.1	4.9	5.0	4.8	4.9	4.9	4.7	4.9	4.8	5.0	58.6
Vent. Fans	13.5	12.2	13.5	13.1	13.5	13.1	13.5	13.5	13.1	13.5	13.1	13.5	159.2
Pumps & Aux.	0.2	0.1	0.1	0.0	-	-	-	-	-	-	0.1	0.1	0.6
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	36.1	32.6	36.1	34.9	36.1	34.9	36.1	36.1	34.9	36.1	34.9	36.1	425.0
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	31.8	28.8	31.8	30.8	31.8	30.8	31.8	31.8	30.8	31.8	30.8	31.8	374.8
Total	89.1	81.8	90.2	88.9	97.5	101.0	115.7	123.1	116.7	104.5	91.2	91.1	1,190.8

Monthly Peak Demand by End Use



Electric Demand (kW)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	90.7	70.9	87.9	156.5	149.2	145.3	191.0	199.3	211.1	160.8	103.5	95.8	1,661.8
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	20.3	20.4	20.4	20.3	20.1	19.9	19.7	19.7	19.7	19.7	19.9	20.1	240.2
Vent. Fans	36.3	36.3	36.3	36.3	36.3	36.3	36.3	36.3	36.3	36.3	36.3	36.3	436.1
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0	1,247.6
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	83.3	83.3	83.3	83.3	83.3	83.3	83.3	83.3	83.3	83.3	83.3	83.3	999.1
Total	334.5	314.9	331.8	400.4	392.9	388.8	434.2	442.5	454.4	404.1	347.0	339.4	4,584.8

d. End Uses Impacted

For Monthly Energy Consumption by End Use, the addition of skylights increased the energy consumption for space cooling, space heating, and ventilation fans. For Monthly Peak Demand by End Use, the addition of skylights increased the energy consumption for space cooling and ventilation fans. Ultimately, adding skylights led to an increase in energy usage for end uses meant to maintain the temperature set by the thermostat: space cooling, space heating, and ventilation fans. This is due to the greater heat gains and losses produced by a greater amount of solar energy being conducted through the skylights and a greater amount of internal heat gains being conducted out through the skylights. Specific reasoning is the same as the anticipated reasoning explained in part b.

3) Skylight Area

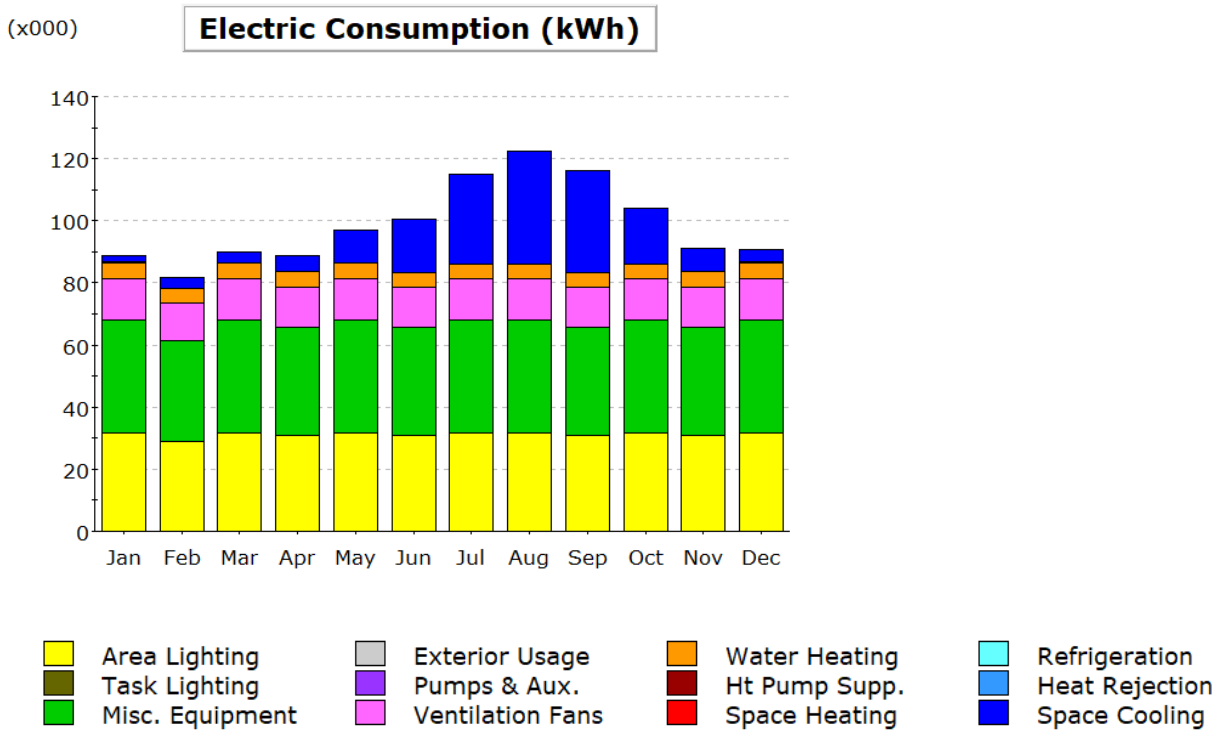
a. Modifications

Three modifications were made to minimize the impact of adding skylights. The first modification made was the glazing category was altered from domed, aluminum frame without brick to flat/pyramid, wood or vinyl frame. Since a dome captures light at more angles than a pyramid, changing the shape of the skylights from a dome to a pyramid will decrease the number of angles that light can be directly transmitted through the skylights. Furthermore, wood insulates better than aluminum, thus the frame material was altered from aluminum to wood. The second modification made was the glazing type was altered from double acrylic white (translucent) to single acrylic grey. Changing the glazing from translucent to grey will cause less light to be transmitted since grey will absorb more light than translucent. The third modification made was the light well depth was altered from 1 ft to 3 ft. A deeper light well will cause more sun rays to hit the sides of the well instead of directly hitting the inside space. Thus, more solar energy will be absorbed by the sides of the well instead of being directly transmitted into the

inside space. Consequently, the three modifications will overall decrease the energy consumption for space cooling and ventilation fans since the heat gains from the outside environment will decrease with a less amount of solar energy being transmitted directly into MySpace.

b. Simulation of Building Energy Use

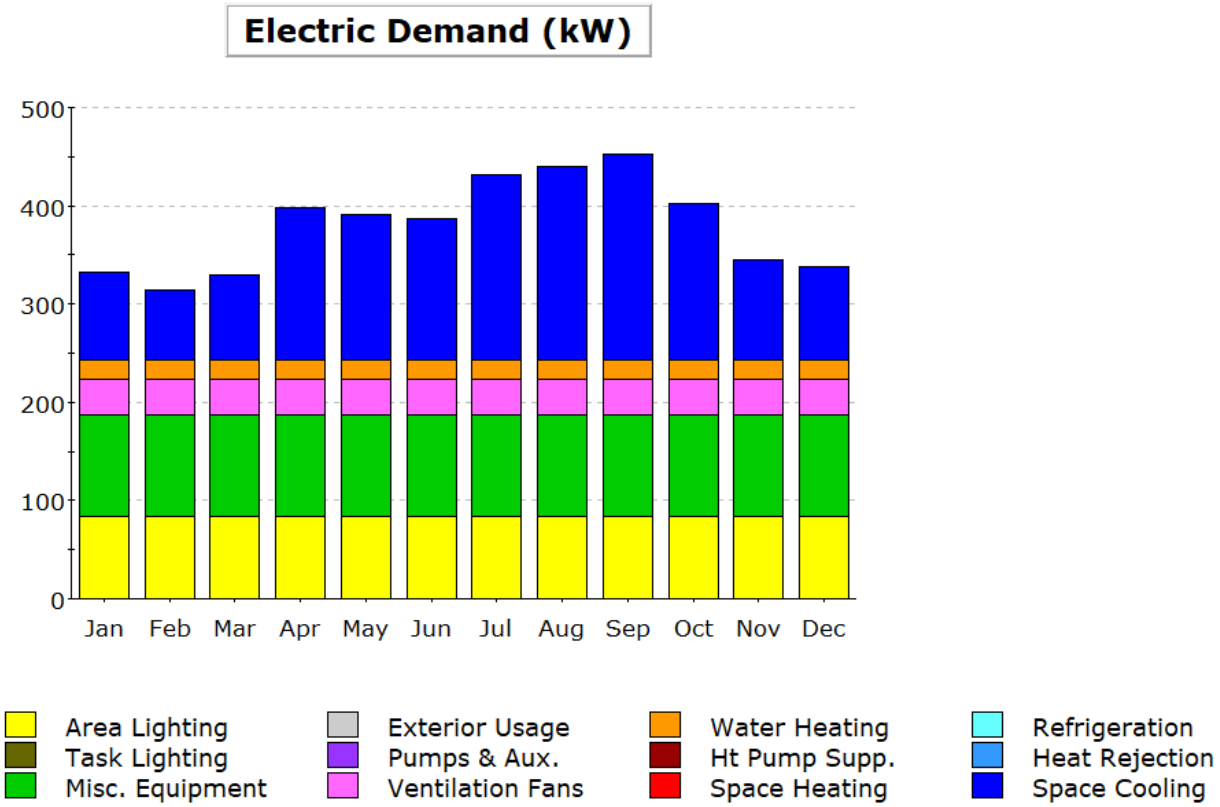
Monthly Energy Consumption by End Use



Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	2.1	3.5	3.5	5.0	10.8	17.1	28.9	36.4	32.9	18.0	7.3	4.1	169.5
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	0.3	0.0	0.1	0.1	-	-	-	-	-	-	0.1	0.3	0.9
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	5.0	4.6	5.1	4.9	5.0	4.8	4.9	4.9	4.7	4.9	4.8	5.0	58.6
Vent. Fans	13.4	12.1	13.4	12.9	13.4	12.9	13.4	13.4	12.9	13.4	12.9	13.4	157.4
Pumps & Aux.	0.2	0.1	0.1	0.0	-	-	-	-	-	-	0.1	0.1	0.6
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	36.1	32.6	36.1	34.9	36.1	34.9	36.1	36.1	34.9	36.1	34.9	36.1	425.0
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	31.8	28.8	31.8	30.8	31.8	30.8	31.8	31.8	30.8	31.8	30.8	31.8	374.8
Total	88.9	81.6	90.0	88.7	97.1	100.6	115.1	122.5	116.3	104.2	91.0	90.9	1,187.0

Monthly Peak Demand by End Use



Electric Demand (kW)

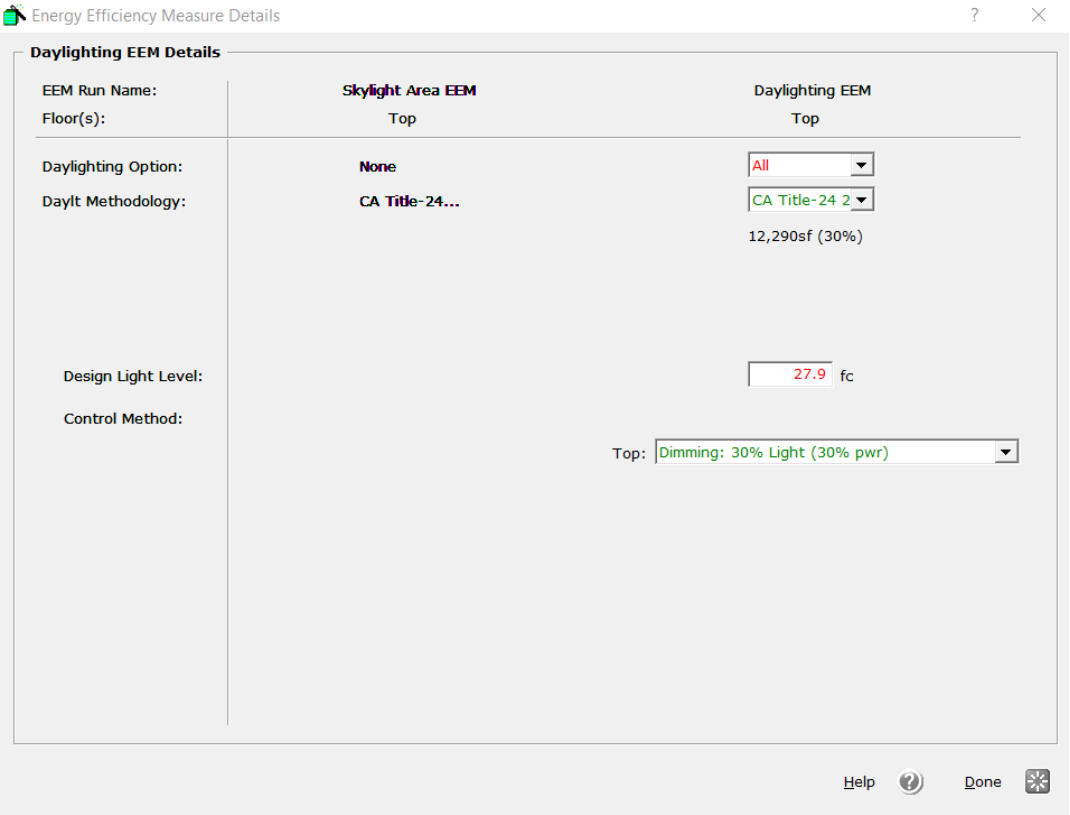
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	89.5	70.3	86.5	154.7	147.4	143.5	189.2	197.2	209.3	159.3	102.4	94.5	1,643.9
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	20.3	20.4	20.4	20.3	20.1	19.9	19.7	19.7	19.7	19.7	19.9	20.1	240.2
Vent. Fans	35.9	35.9	35.9	35.9	35.9	35.9	35.9	35.9	35.9	35.9	35.9	35.9	431.4
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0	1,247.6
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	83.3	83.3	83.3	83.3	83.3	83.3	83.3	83.3	83.3	83.3	83.3	83.3	999.1
Total	332.9	313.8	330.0	398.2	390.7	386.7	432.1	440.0	452.2	402.2	345.5	337.8	4,562.1

c. Analysis of Results

For Monthly Energy Consumption by End Use, the end uses impacted were space cooling and ventilation fans. Energy consumption for both decreased. For Monthly Peak Demand by End Use, the end uses impacted were space cooling and ventilation fans. Energy consumption for both decreased as well. Specific reasoning for why they were impacted is the same as the anticipated reasoning explained in part a. Space heating was not impacted because the modifications: glazing category, glazing type, and light well depth, only affect heat gains from the outdoor environment. Thus, such modifications will only decrease the need for space cooling, not space heating. eQuest did not even generate values for space heating, indicating that the peak demands are very miniscule. No impact may also be due to the internal heat gains being enough to heat MySpace. Seasonally for Monthly Energy Consumption by End Use, energy for space heating was consumed only for the months of November through April. This is due to the colder temperatures MySpace is exposed to during the seasons of fall, winter, and spring. No heating was consumed for the months of May through October during the summer season. Furthermore, more energy was used for space cooling for the months of May through October since the outdoor temperature is higher during the summer season.

4) Daylighting

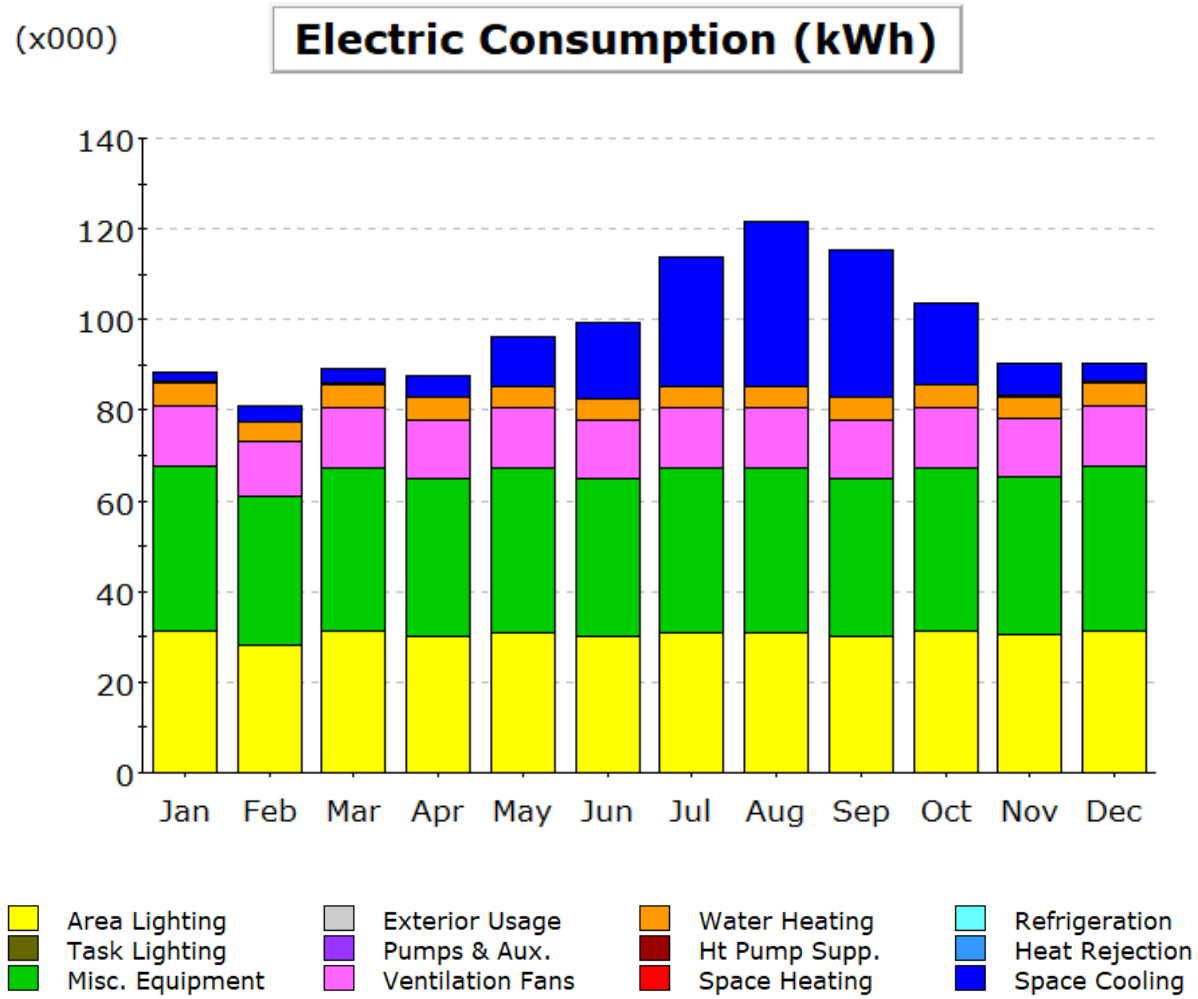
a. Modifications



One modification was made to maximize reduction in lighting energy use. The design light level was reduced from 50 fc to 27.9 fc. According to Leadership in Energy and Environmental Design (LEED) indoor lighting standards, the illuminance level should be at least 300 lux. This converts to 27.9 fc which is used. This modification will maximize reduction in lighting energy use because a lower light level will utilize less energy. Thus, the end use that will be impacted is area lighting where its energy consumption will decrease.

b. Simulation of Building Energy Use

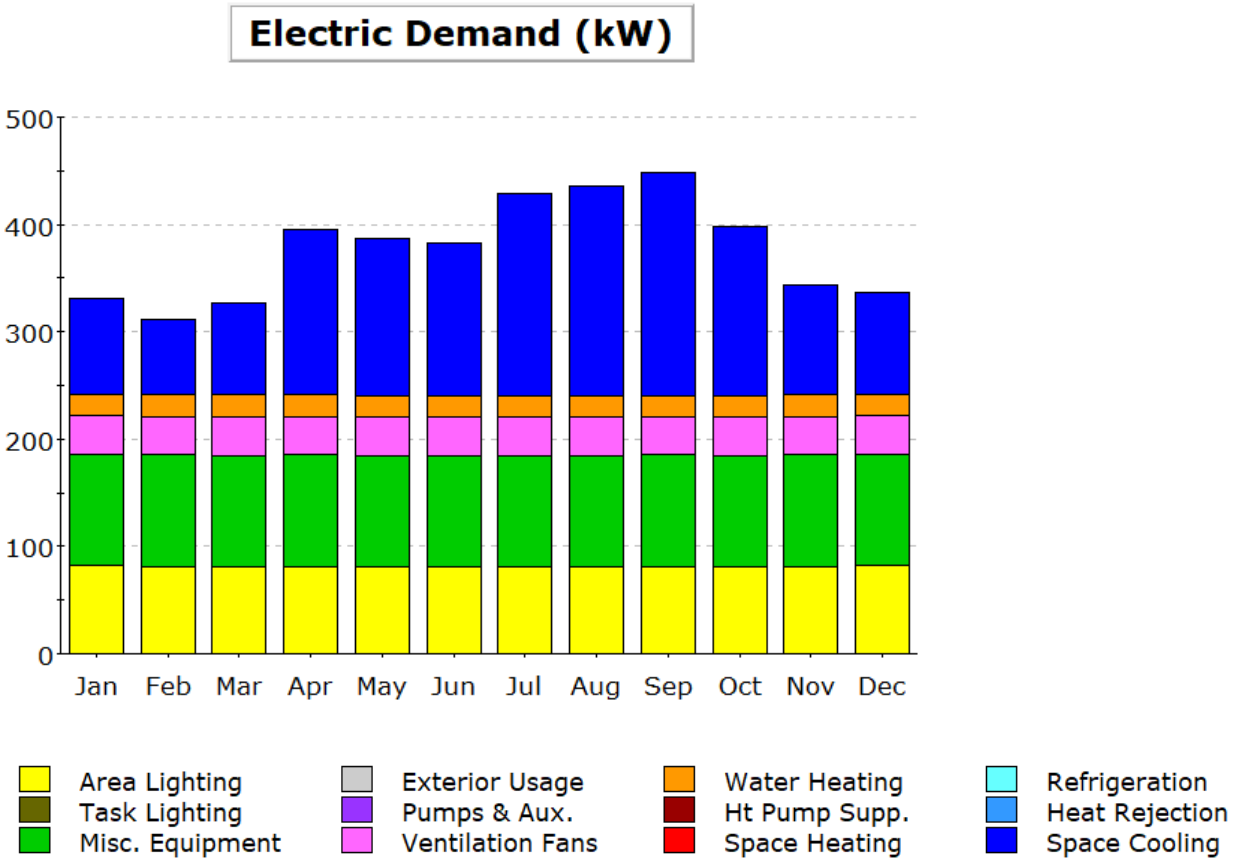
Monthly Energy Consumption by End Use



Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	2.1	3.5	3.4	4.9	10.7	16.9	28.7	36.1	32.7	17.9	7.3	4.1	168.1
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	0.3	0.0	0.1	0.1	-	-	-	-	-	-	0.1	0.3	1.0
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	5.0	4.6	5.1	4.9	5.0	4.8	4.9	4.9	4.7	4.9	4.8	5.0	58.6
Vent. Fans	13.3	12.0	13.3	12.9	13.3	12.9	13.3	13.3	12.9	13.3	12.9	13.3	156.7
Pumps & Aux.	0.2	0.1	0.1	0.0	-	-	-	-	-	-	0.1	0.1	0.6
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	36.1	32.6	36.1	34.9	36.1	34.9	36.1	36.1	34.9	36.1	34.9	36.1	425.0
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	31.4	28.3	31.2	30.0	31.0	30.0	31.0	31.1	30.2	31.3	30.4	31.5	367.3
Total	88.4	81.0	89.3	87.8	96.1	99.5	114.0	121.5	115.4	103.5	90.4	90.5	1,177.3

Monthly Peak Demand by End Use



Electric Demand (kW)

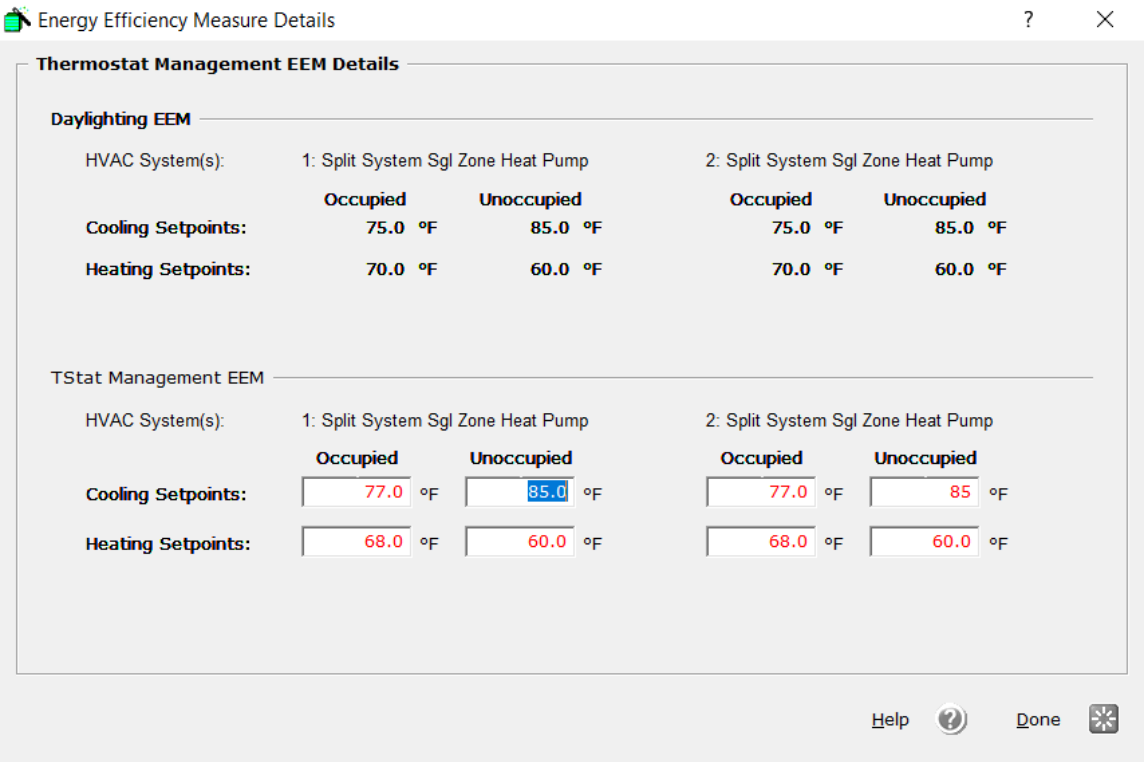
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	89.1	69.8	85.8	153.8	146.5	142.6	188.3	196.1	208.5	158.5	101.9	94.0	1,635.0
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	20.3	20.4	20.4	20.3	20.1	19.9	19.7	19.7	19.7	19.7	19.9	20.1	240.2
Vent. Fans	35.8	35.8	35.8	35.8	35.8	35.8	35.8	35.8	35.8	35.8	35.8	35.8	429.3
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0	1,247.6
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	82.2	81.5	80.9	81.1	80.9	80.9	80.5	80.5	81.1	80.6	81.4	82.0	973.4
Total	331.2	311.4	326.8	395.0	387.3	383.2	428.2	436.0	449.0	398.6	342.9	335.9	4,525.5

c. Analysis of Results

For Monthly Energy Consumption by End Use, the end uses impacted were space cooling, ventilation fans, area lighting, and space heating. Energy consumption for space cooling, ventilation fans, and area lighting decreased. There was also a miniscule increase of energy consumption for space heating (increase of 0.1 kWh x000). Specific reasoning for why area lighting was impacted is the same anticipated reason explained in part a. Contrary to the initial expectation, space cooling, ventilation fans, and space heating were impacted in addition to area lighting. Energy consumption for space cooling decreased due to a less amount of heat being radiated from the light fixtures resulting from the reduced design light level. Energy consumption for ventilation fans decreased because less radiated heat from the light fixtures needs to be ventilated out. Energy consumption for space heating slightly increased at a very miniscule amount which may be due to a slight calculation variation produced by eQuest. For Monthly Peak Demand by End Use, the end uses impacted were ventilation fans, area lighting, and space cooling. Energy consumption for ventilation fans and area lighting decreased. There was a miniscule increase of energy consumption for space cooling (increase of 8.9 kW). Specific reasoning for why area lighting was impacted is the same anticipated reason explained in part a. Contrary to the initial expectation, ventilation fans and space cooling were impacted in addition to area lighting. Energy consumption for ventilation fans decreased because less radiated heat from the light fixtures needs to be ventilated out. Energy consumption for space cooling slightly increased at a very miniscule amount which may be due to a slight calculation variation produced by eQuest. The same seasonal trends are exhibited as in part 3 where energy for space heating was not consumed and more energy for space cooling was consumed during summer.

5) Thermostat Management

a. Modifications

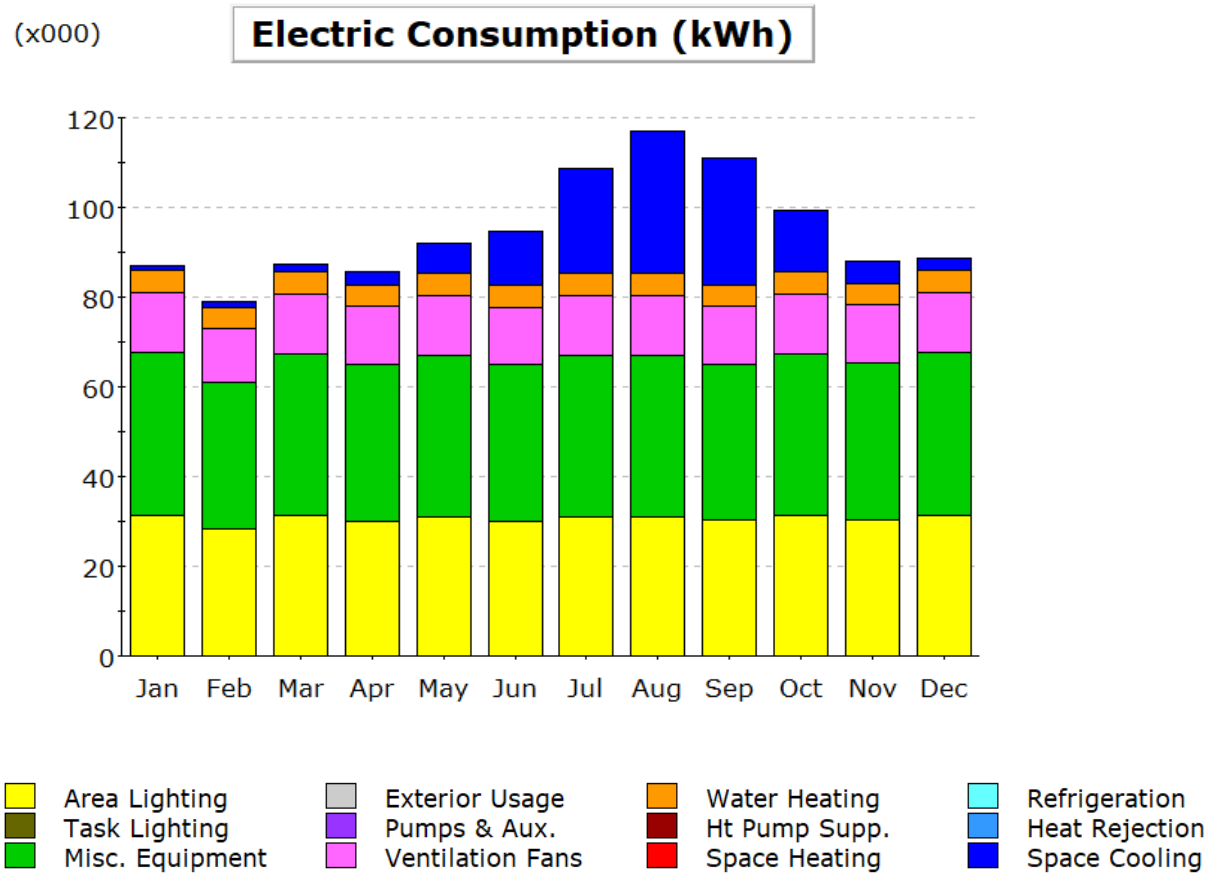


Two modifications were made to reduce the total energy consumption. The first modification was that the occupied cooling setpoint was increased from 75 to 77 degrees Fahrenheit. The temperature was increased by two degrees because the occupants in the MySpace are students who are mostly sitting down studying. Thus, they are not involved in high physical activity and do not possess a high metabolic rate that would require a cooler temperature for thermal comfort. This modification will reduce the total energy consumption because a higher occupied cooling setpoint means less energy will used be used to cool down MySpace to a certain temperature: the thermostat will cool down MySpace until the indoor temperature reaches 77 degrees Celsius instead of 75, thus the energy that would have been used to further cool down the indoor temperature to 75 is saved. Consequently, the end use that will be impacted is space cooling where its energy consumption will decrease. The second modification was that the occupied

heating setpoint was decreased from 70 to 68 degrees Celsius. MySpace is located in San Diego, California where the outside temperature often requires students to wear layers of clothing. Thus, lowering the temperature by two degrees will not have a major impact on thermal comfort as long as the students in MySpace keep on their layers of clothing. This modification will reduce the total energy consumption because a lower occupied heating setpoint means less energy will be used to heat up MySpace to a certain temperature: the thermostat will heat up MySpace until the indoor temperature reaches 68 degrees Celsius instead of 70, thus then energy that would have been used to further heat up the indoor temperature to 70 is saved. Consequently, the end use that will be impacted is space heating where its energy consumption will decrease.

b. Simulation of Building Energy Use

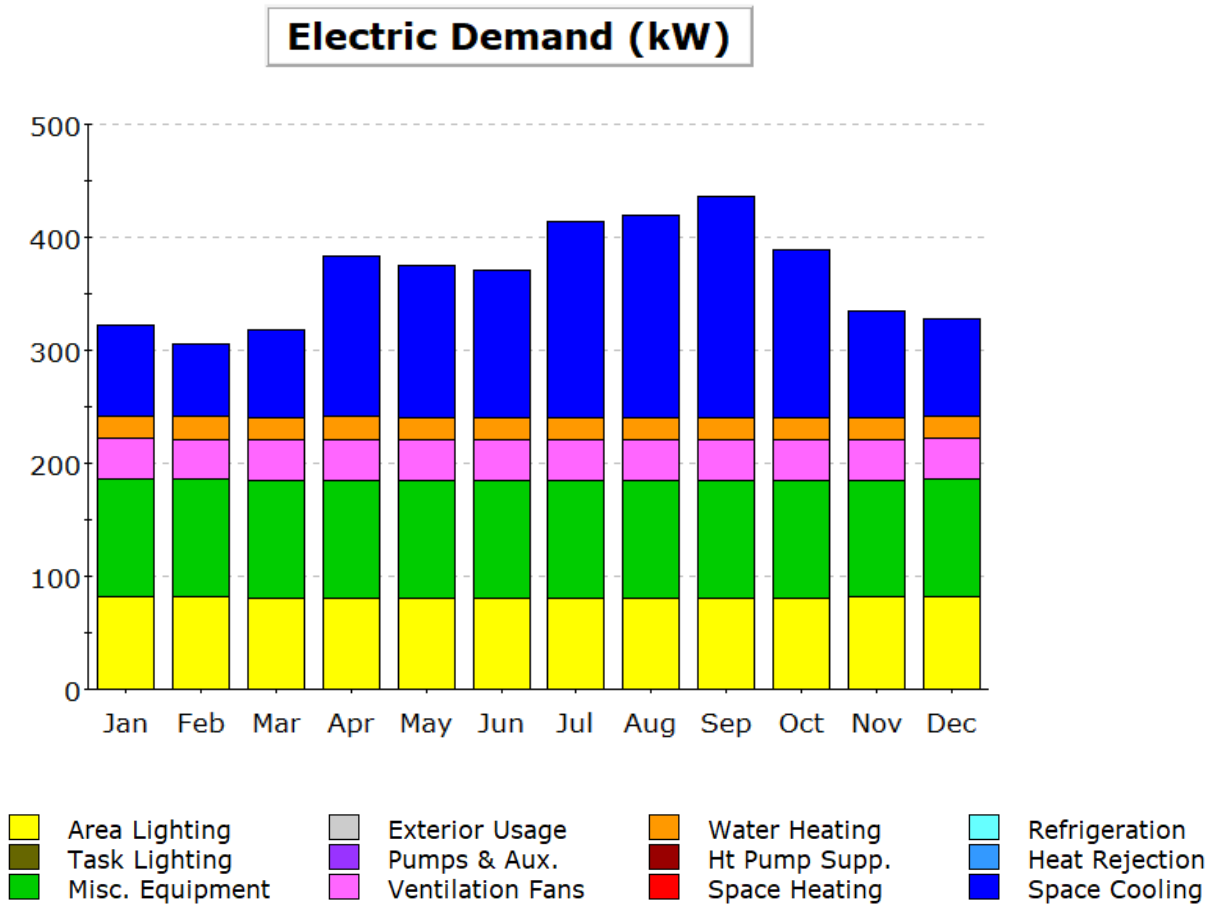
Monthly Energy Consumption by End Use



Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	0.9	1.6	1.6	3.0	6.7	12.0	23.5	31.7	28.4	13.8	4.8	2.8	130.8
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	0.0	-	0.0	0.0	-	-	-	-	-	-	0.0	0.0	0.0
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	5.0	4.6	5.1	4.9	5.0	4.8	4.9	4.9	4.7	4.9	4.8	5.0	58.5
Vent. Fans	13.3	12.0	13.3	12.9	13.3	12.9	13.3	13.3	12.9	13.3	12.9	13.3	156.7
Pumps & Aux.	0.2	0.1	0.1	0.0	-	-	-	-	-	-	0.1	0.1	0.6
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	36.1	32.6	36.1	34.9	36.1	34.9	36.1	36.1	34.9	36.1	34.9	36.1	425.0
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	31.4	28.3	31.2	30.0	31.0	30.0	31.0	31.1	30.2	31.3	30.4	31.5	367.3
Total	87.0	79.1	87.4	85.8	92.1	94.6	108.8	117.0	111.1	99.4	87.9	88.8	1,138.9

Monthly Peak Demand by End Use



Electric Demand (kW)

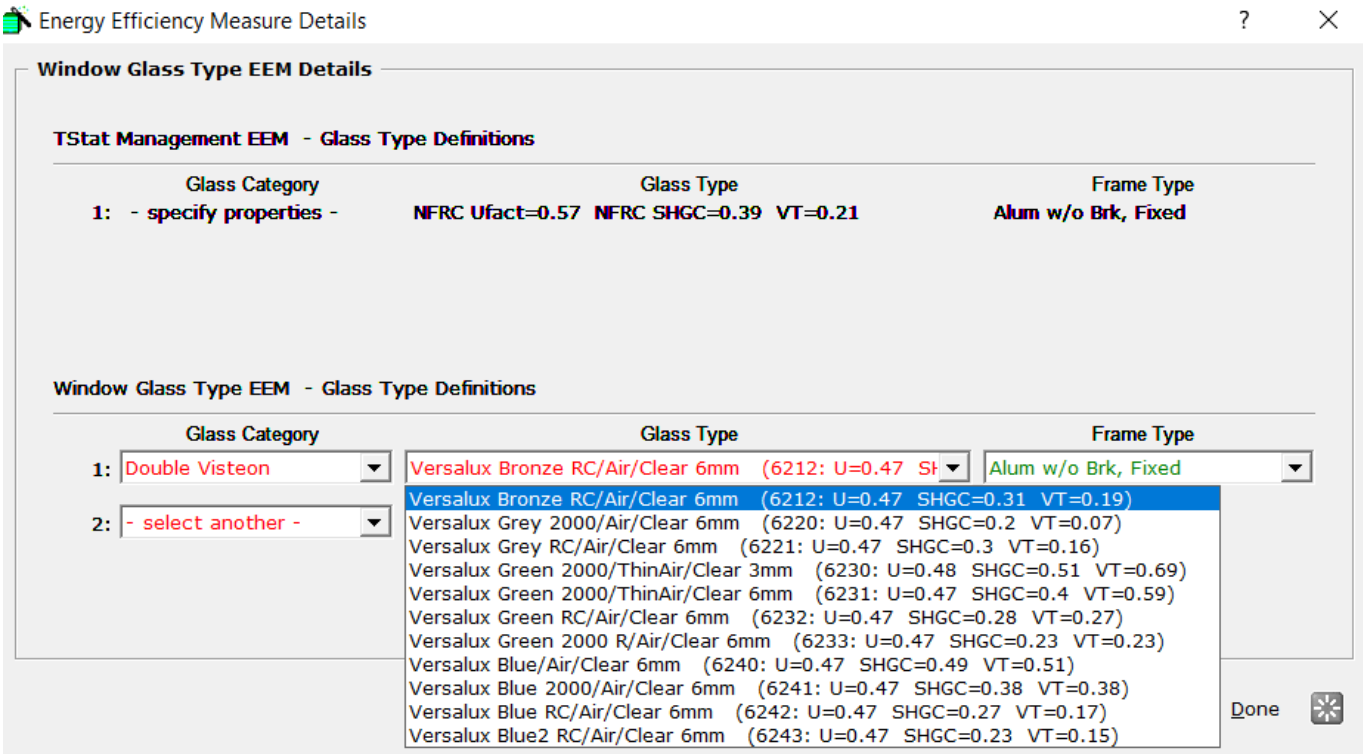
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	80.4	63.8	77.5	141.6	134.8	130.4	173.7	180.0	196.0	148.6	93.5	85.9	1,506.3
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	20.2	20.3	20.3	20.3	20.1	19.9	19.7	19.6	19.6	19.7	19.9	20.0	239.5
Vent. Fans	35.8	35.8	35.8	35.8	35.8	35.8	35.8	35.8	35.8	35.8	35.8	35.8	429.3
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0	1,247.6
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	82.2	81.5	80.9	81.1	80.9	80.9	80.5	80.5	81.1	80.6	81.4	82.0	973.4
Total	322.5	305.3	318.4	382.7	375.5	370.8	413.6	419.9	436.5	388.7	334.5	327.7	4,396.1

c. Analysis of Results

For Monthly Energy Consumption by End Use, the end uses impacted were space cooling, space heating, water heating. Energy consumption for space cooling and space heating decreased. There was a miniscule decrease of energy consumption for water heating (decrease of 0.1 kWh x000). Specific reasoning for why space cooling and space heating were impacted is the same anticipated reason explained in part a. Contrary to the initial expectation, water heating was impacted in addition to space cooling and space heating. Energy consumption for water heating slightly decreased due to the occupied cooling setpoint being increased. With a higher indoor temperature, the extra heat may be heating the water and thus decrease the amount of energy used to heat the water. For Monthly Peak Demand by End Use, the end uses impacted were space cooling and water heating. Energy consumption for space cooling decreased. There was a miniscule decrease of energy consumption for water heating (decrease of 0.7 kW). Contrary to the initial expectation, water heating was impacted in addition to space cooling. Specific reasoning for why space cooling was impacted is the same anticipated reason explained in part a. Energy consumption for water heating slightly decreased due to the occupied cooling setpoint being increased. With a higher indoor temperature, the extra heat may be heating the water and thus decrease the amount of energy used to heat the water. Space heating was not measured by eQuest likely due to very low peak demand numbers being produced. The same seasonal trends are exhibited as in part 3 where energy for space heating was not consumed and more energy for space cooling was consumed during summer.

Window Glass Type

a. Modifications

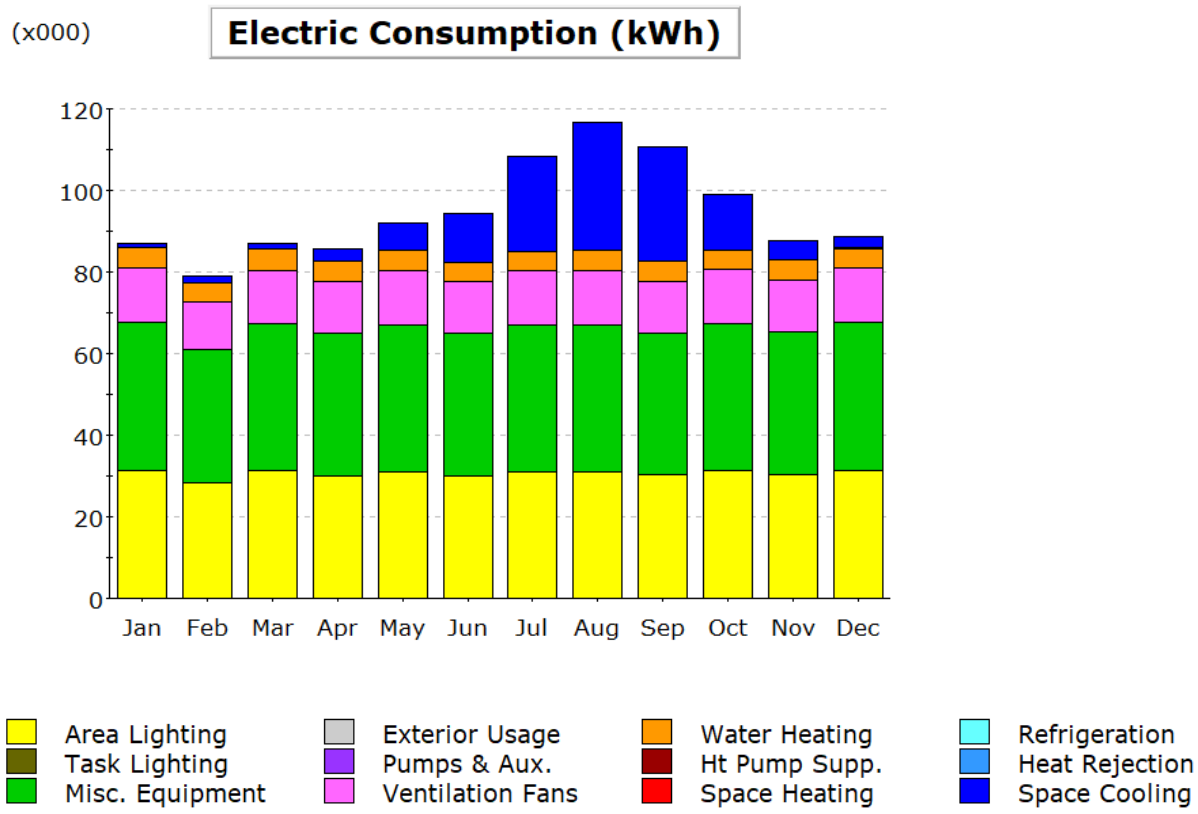


Two modifications were made to reduce the total energy consumption. The first modification was that the window glass type was changed from the specified properties of the baseline model to double Visteon. A double-paned glass was chosen to provide more insulation for the indoor temperature: the gas in between the two panes decreases heat gain through conductive means. This modification will reduce the total energy consumption because heat conducts slower through two panes of glass with a gas in between than a single pane of glass. The second modification was that the glass type was changed from the specified properties of the baseline model U-factor=0.57 SHGC=0.39 VT=0.21 to Versalux Bronze RC/Air/Clear 6mm (6212: U=0.47 SHGC=0.31 VT=0.19). This glass type was chosen because it has a lower U-factor, a lower solar heat gain coefficient, and about the same visible transmittance compared to the baseline model's glass type. A lower U-factor will provide better insulation, a lower solar heat

gain coefficient will decrease the rate of solar heat conducting through the window, and a similar visible transmittance will ensure the amount of lighting is comparable to the baseline model. This modification will reduce the total energy consumption because improving the windows' insulation and performance in blocking solar heat will decrease the need for heating or cooling. Consequently, the end uses that will be impacted are space heating and space cooling where their energy consumption will decrease.

b. Simulation of Building Energy Use

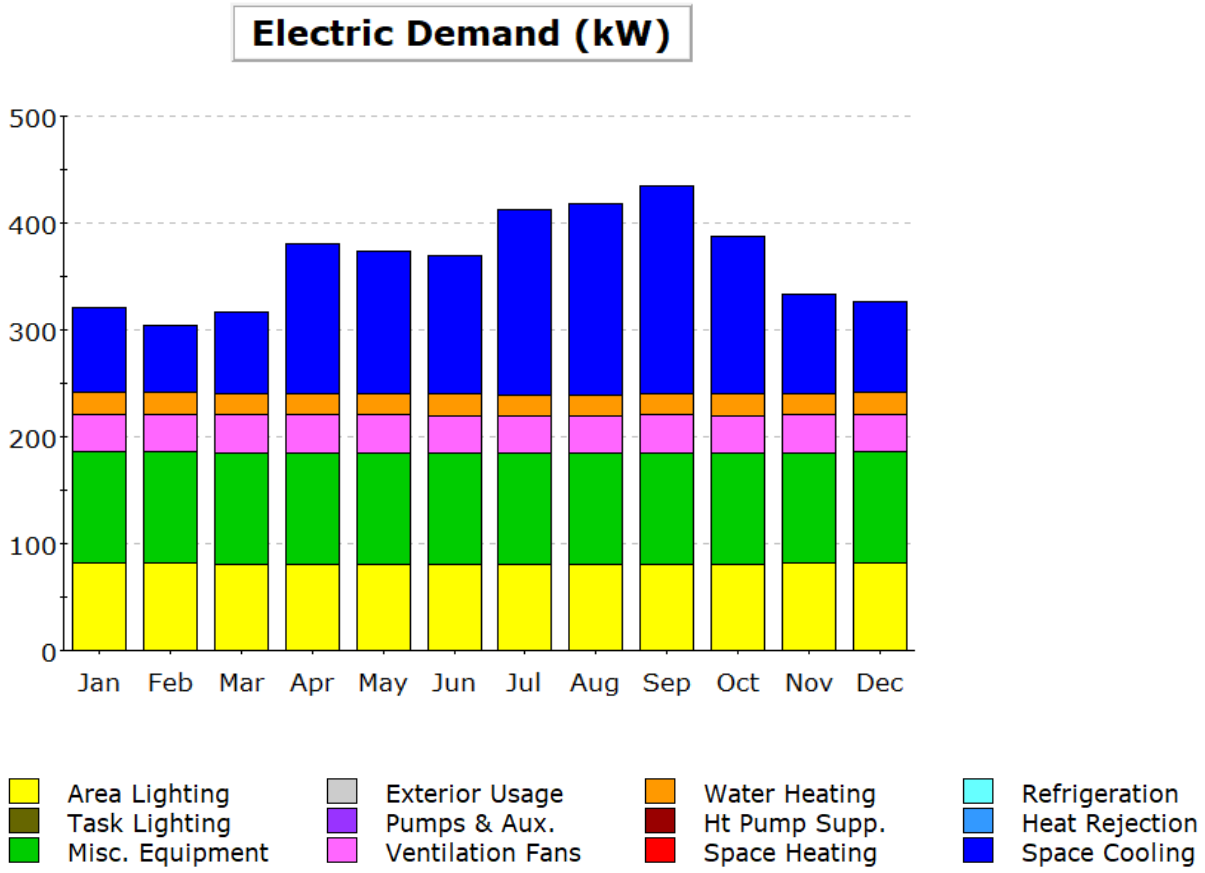
Monthly Energy Consumption by End Use



Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	0.9	1.6	1.6	3.0	6.7	12.0	23.3	31.4	28.2	13.7	4.8	2.8	130.1
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	0.0	-	0.0	0.0	-	-	-	-	-	-	0.0	0.0	0.0
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	5.0	4.6	5.1	4.9	5.0	4.8	4.9	4.9	4.7	4.9	4.8	5.0	58.5
Vent. Fans	13.1	11.9	13.1	12.7	13.1	12.7	13.1	13.1	12.7	13.1	12.7	13.1	154.6
Pumps & Aux.	0.2	0.1	0.1	0.0	-	-	-	-	-	-	0.1	0.1	0.6
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	36.1	32.6	36.1	34.9	36.1	34.9	36.1	36.1	34.9	36.1	34.9	36.1	425.0
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	31.4	28.3	31.2	30.0	31.0	30.0	31.0	31.1	30.2	31.3	30.4	31.5	367.3
Total	86.8	78.9	87.2	85.6	91.9	94.4	108.5	116.6	110.8	99.2	87.7	88.6	1,136.1

Monthly Peak Demand by End Use



Electric Demand (kW)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	79.8	63.4	76.6	140.0	133.5	129.3	172.7	178.4	194.5	147.6	92.9	85.4	1,494.1
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	20.2	20.3	20.3	20.3	20.1	19.9	19.7	19.6	19.6	19.7	19.9	20.0	239.5
Vent. Fans	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	423.6
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0	104.0	1,247.6
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	82.2	81.5	80.9	81.1	80.9	80.9	80.5	80.5	81.1	80.6	81.4	82.0	973.4
Total	321.5	304.4	317.0	380.6	373.7	369.3	412.1	417.7	434.5	387.2	333.4	326.7	4,378.2

c. Analysis of Results

For Monthly Energy Consumption by End Use, the end uses impacted were space cooling and ventilation fans. Energy consumption for space cooling and ventilation fans decreased. Contrary to the initial expectation, ventilation fans was impacted in addition to space cooling and space heating was not impacted. The reasoning for why space cooling was impacted is the same anticipated reason explained in part a. Since the window type provides better insulation for MySpace, there is a lesser need on the ventilation fans to exchange cooler or warmer air with the outside environment. Furthermore, the internal heat gains combined with the improved insulation from the glass type allows for no space heating to be needed. For Monthly Peak Demand by End Use, the end uses impacted were space cooling and ventilation fans. Energy consumption for space cooling and ventilation decreased. Contrary to the initial expectation, ventilation fans was impacted in addition to space cooling and space heating was not impacted. The reasoning for why space cooling was impacted is the same anticipated reasoning explained in part a. Better insulation provided by the window type causes a lower need for ventilation fans to exchange cooler or warmer air with the outside environment. Space heating was not measured by eQuest likely to very low peak demand numbers being produced. The same seasonal trends are exhibited as in part 4 where energy for space heating was not consumed and more energy for space cooling was consumed during summer.

Works Cited

United States Green Building Council. “Daylight.” *United States Green Building Council*, United States Green Building Council, https://www.usgbc.org/credits/new-construction-commercial-interiors-schools-new-construction-retail-new-construction-ret-1?view=language.