

Bunker Interpretive Center Energy Analysis

Calvin College
Engineering 333

2011

An analysis determining whether LEED certification leads to Energy Star eligibility by studying the Bunker Interpretive Center at Calvin College.

Introduction:

Analysis of the Bunker Interpretive Center (BIC) began during the spring of 2011 with the Engineering 382 Instrumentation Lab. To determine the energy use at the BIC, sensing equipment was placed on 44 different energy consuming devices, ranging from pumps to lights to heating and ventilation (HVAC) equipment. These data were collected over the spring and summer and then analyzed by the Engineering 333 Thermal Systems Design class during the fall of 2011. The class was tasked with determining whether or not the BIC was eligible for Energy Star certification. While the building was built to be LEED Gold certified, meaning that it had an energy efficient design and used environmentally friendly materials, the actual use of the BIC is covered by Energy Star, not LEED. Thus, the central question posed to the class was: Does the Bunker Interpretive Center currently qualify for Energy Star certification, and if not, how can it be improved until it does? Unfortunately, the BIC does not fall into one of the predefined categories required for Energy Star certification. As such, the class decided that a new category designed especially for the BIC had to be created and used as a metric for determining the BIC's Energy Star status.

Project Organization:

The original plan for the class to acquire data to compare the BIC against was to research similar buildings in the United States, contact the facilities, and use the acquired data to calculate an energy use intensity, or EUI, for each building. The collected data would serve as the reference against which the BIC would be compared. This body of data would allow the class to calculate the 75th percentile that would serve as the goal for a unique “BIC Star” equivalent of Energy Star certification. If the BIC achieved an EUI better than the 75th percentile, meaning the EUI was lower than the corresponding value for the 75th percentile of the collected data, then it would qualify for BIC Star, and would satisfy the objective of the problem statement. The team was organized into five different work groups: Total Building EUI, Natural Gas EUI, Electricity EUI, Energy Cost Index (ECI), and Renewables and External Comparisons. Each group focused on a different aspect of acquiring data, evaluating the BIC, and proposing improvement projects to reduce the BIC's EUI by either 15%, or to the point that it would qualify for BIC Star if it did not meet the requirements initially.

After combining, collecting, and analyzing energy data for the BIC, along with calculating the BIC Star's 75th and 50th percentiles, the class concluded that the BIC had an EUI of 132 kBtu/ft²-yr. The 75th percentile was calculated to be 127.5 kBtu/ft²-yr. The BIC did not qualify for BIC Star, and needed to be improved, as shown by the boxplot in Figure 2.

Project Direction:

As the project progressed it became clear that most other buildings would not be able to report the correct data or they would not respond with data. This was one reason for a shift in focus of the project away from comparing the BIC to similar buildings and towards comparing it to

national averages. Another reason for this is the discovery of national average data in Portfolio Panager. With this data the class was able to construct boxplots showing where the BIC's performance is against these national averages. Since the BIC doesn't fit into any of the Energy Star predefined categories the class created BIC Star; a new category based on categories most similar to the BIC and weighted with a floor space average (see Figure C-2).

Improvements:

In order to try and reach the BIC Star energy rating the class had to research different ways to reduce the total EUI. Improvements that were considered for electricity included regulating the on-time for a circulating pump, replacing household appliances with Energy Star rated ones, and changing the type of lighting that is used in the hallway lighting. The renewable energy group also focused on ways to create more electric power with the addition of more solar panels or the addition of a wind turbine, but found these to be far too expensive. For the natural gas, the majority of this energy is used in heating so the class looked for ways to reduce heat loss. Some improvements that were considered included replacing the boiler with a more efficient one, replacing the windows with high efficiency windows, and replacing the insulation used in the walls of the BIC.

Recommendations and Future Work:

The two improvements that had a high enough impact on our EUI and were cheap enough to implement were better regulating the circulating pump in the floor and installing a solar water heater for use in heating domestic hot water. Both of these systems require further analysis and design for implementation. Two other areas of possible improvement zoned ventilation and moving the banners, which activate the motion sensors on the lights whenever the ventilation system turns on. The zoned ventilation is expensive but the benefits need further investigation, while the banner problem would likely see a small improvement but at no cost.

EUI Improvement Effects and Costs

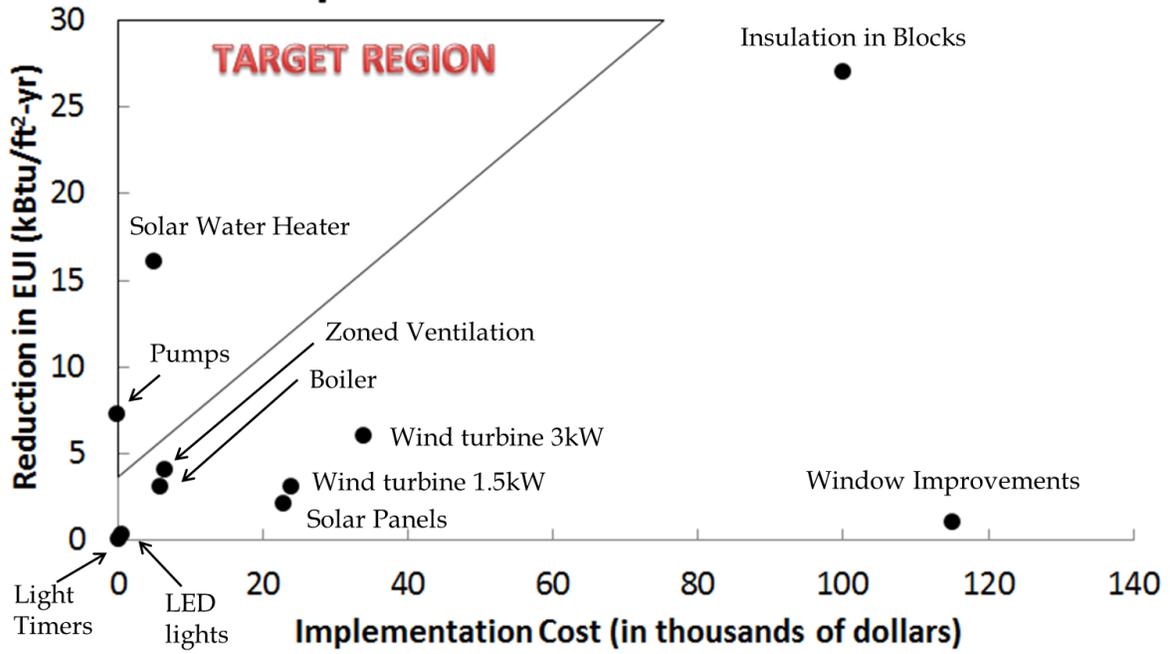


Figure 1: EUI Reduction and Cost Comparison for Improvement Ideas.

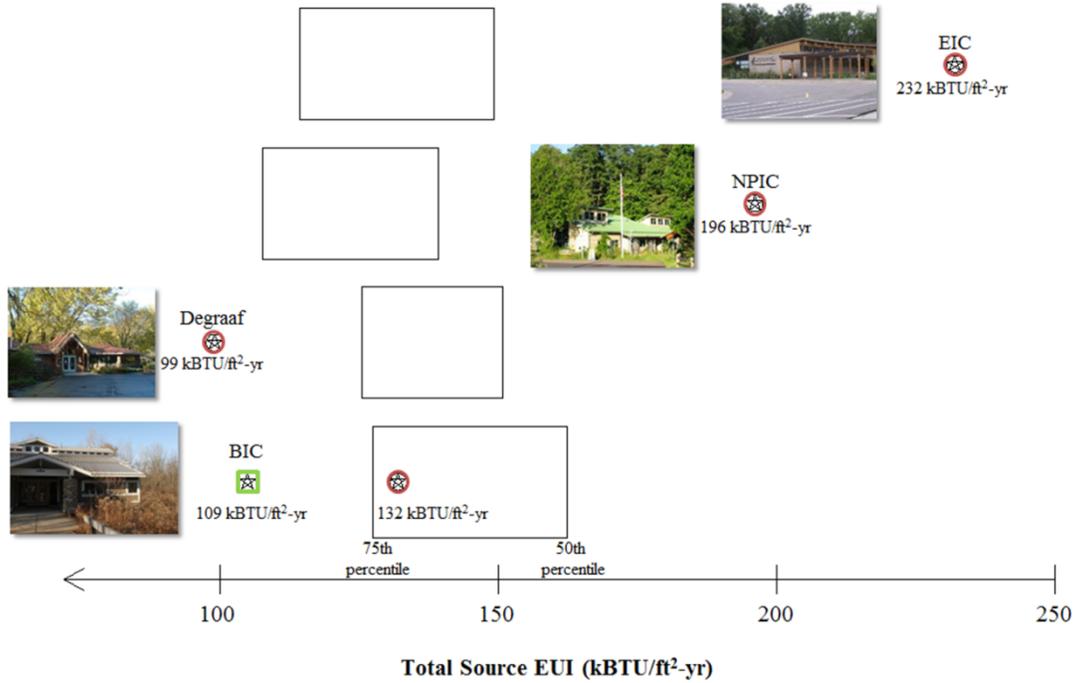


Figure 2: Comparison Plot for Similar Buildings with Original and Improved BIC EUI.

BIC Energy Use by Source

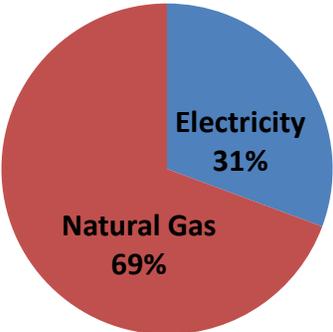


Figure 3: BIC Energy Breakdown by Source

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APPENDIX A: Total Energy Use Intensity

Objective:

The purpose of this group was to develop statistical analyses on the total building Energy Use Index (EUI) for the *Tertiary Academic: Mixed Use* category and to calculate and compare the BIC's total building EUI to other buildings in the new category.

Procedure:

The main focus of this group was to input acquired data into an interactive energy management tool, called Portfolio Manager, which is available on the Energy Star website. One capability of Portfolio Manager that this group will be using is the ability to assess energy and water consumption for different types of buildings. Some other information that Portfolio Manager factors in to the energy assessment is the number of workers as well as the size and geographic location of the building.

Once a Portfolio Manager account was set up for the Bunker Interpretive Center (BIC), necessary data on energy and water use was acquired from the other project subgroups. Twelve consecutive months of data are required for an assessment of the building EUI. This data was then entered and assessed by Portfolio Manager as K-12, Office, and Mixed building types. Because the BIC is being classified as *Tertiary Academic: Mixed Use*, the actual EUI and percentiles must be calculated by multiplying the weighted floor percentage with the EUI and percentiles for that building type and then summed together. There is some subjectivity in the decided floor percentages, so a sensitivity analysis was done to account for the possible values. Table A-1 shows the weighted floor percentages along with the minimum and maximum accepted values of each.

Table A-1: Varying Floor Weights

	Minimum	Given Floor Space Weight	Maximum
K-12	40%	68%	100%
Office	0%	23%	50%
Other	0%	9%	10%

The three other buildings that the BIC was compared to are the DeGraaf Nature Center, Environmental Interpretive Center (EIC), and the Nature Park Interpretive Center (NPIC). These buildings were added into the existing Portfolio Manager account and the EUI and percentiles were calculated for each.

Results and Conclusions:

Figure A-1 compares the EUI and percentiles of each building. EUIs for the buildings compared to the BIC were calculated using data that was provided by a contact person from each building as well as assuming weighted floor percentages of 70% and 30% for K-12 and Office building types respectively. The BIC is not doing as well as DeGraaf, but is doing much better than the NPIC and the EIC.

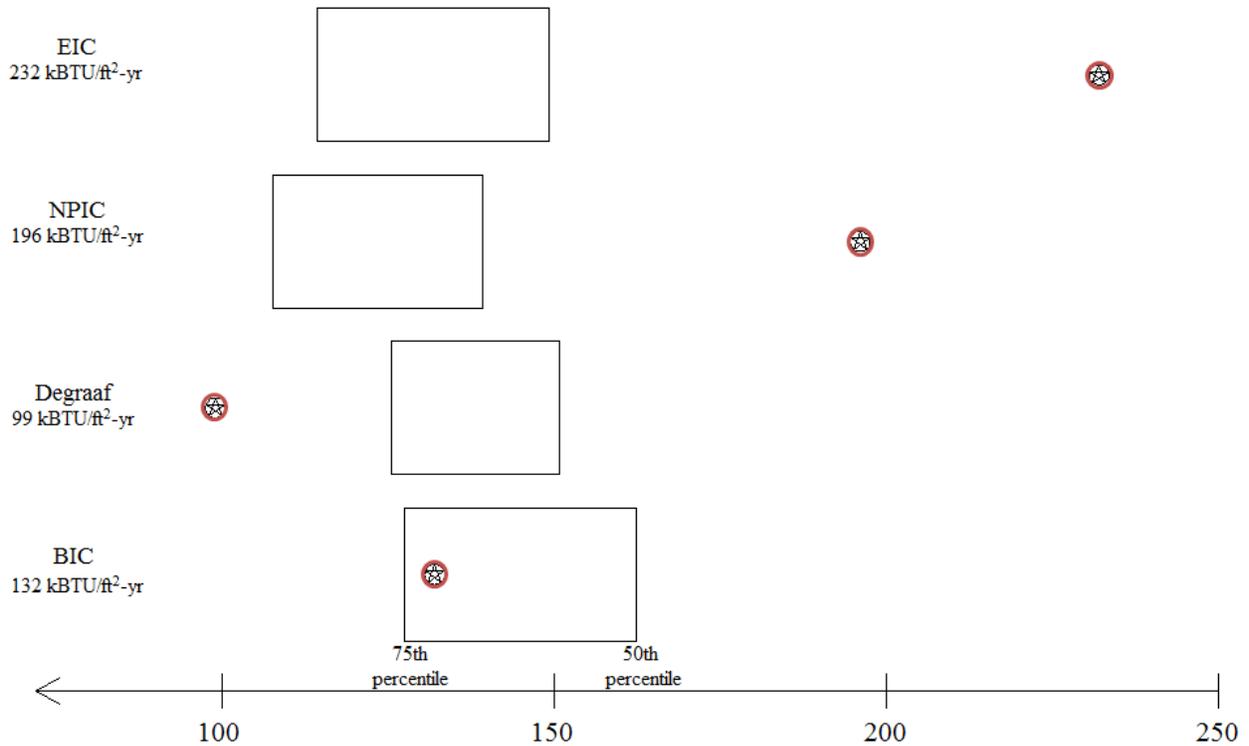
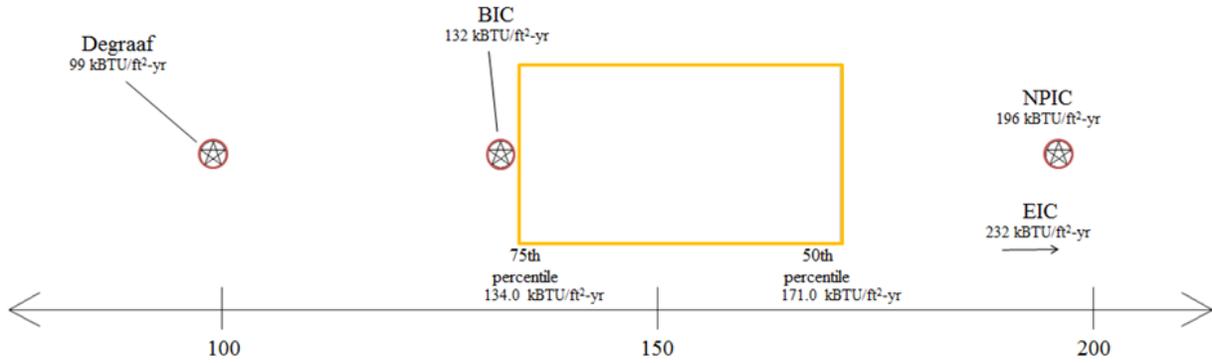
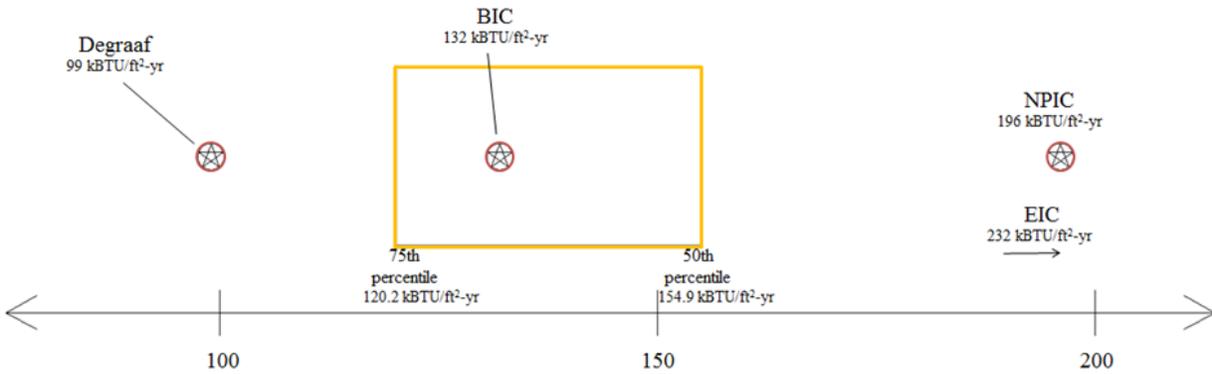


Figure A-2 shows the upper range for the sensitivity analysis and Figure A-3 shows the lower range. The 50th and 75th percentile numbers have units of kBTU/ft²-yr. Table A-2 in Appendix A-1 shows all the variations of floor weight combinations as well as EUI and percentile values. The upper range values come from modeling the BIC building type as 100% K-12. The lower range values come from modeling the BIC as the given floor space weight with 40% K-12, 50% Office, and 10% as shown in Table A-1.



Total Source EUI (kBTU/ft²-yr)
Figure A-2: Upper BIC-Star Range



Total Source EUI (kBTU/ft²-yr)
Figure A-3: Lower BIC-Star Range

APPENDIX A-1: Tables

Table A-2 Varying Floor Weights

	Minimum	Given Floor Space Weight	Maximum
K-12	40%	68%	100%
Office	0%	23%	50%
Other	0%	9%	10%

Table A-3: Sensitivity Analysis for the BIC

K-12	Office	Mixed	50th	75th
100%	0%	0%	171.0	134.0
90%	10%	0%	168.3	131.3
80%	20%	0%	165.6	128.6
80%	10%	10%	165.7	131.0
70%	30%	0%	162.9	125.9
70%	20%	10%	163.0	128.3
60%	40%	0%	160.2	123.2
60%	30%	10%	160.3	125.6
50%	50%	0%	157.5	120.5
50%	40%	10%	157.6	122.9
40%	50%	10%	154.9	120.2

Table A-4: Individual Building EUI Ranges with Assumptions

ASSUME		K-12		Office		Weighted	
70%	K-12	50th	75th	50th	75th	50th	75th
30%	Office						
		145	139	164	94	150.7	125.5
		148	115	152	113	149.2	114.4
		148	116	119	88	139.3	107.6

APPENDIX A-2: Figures

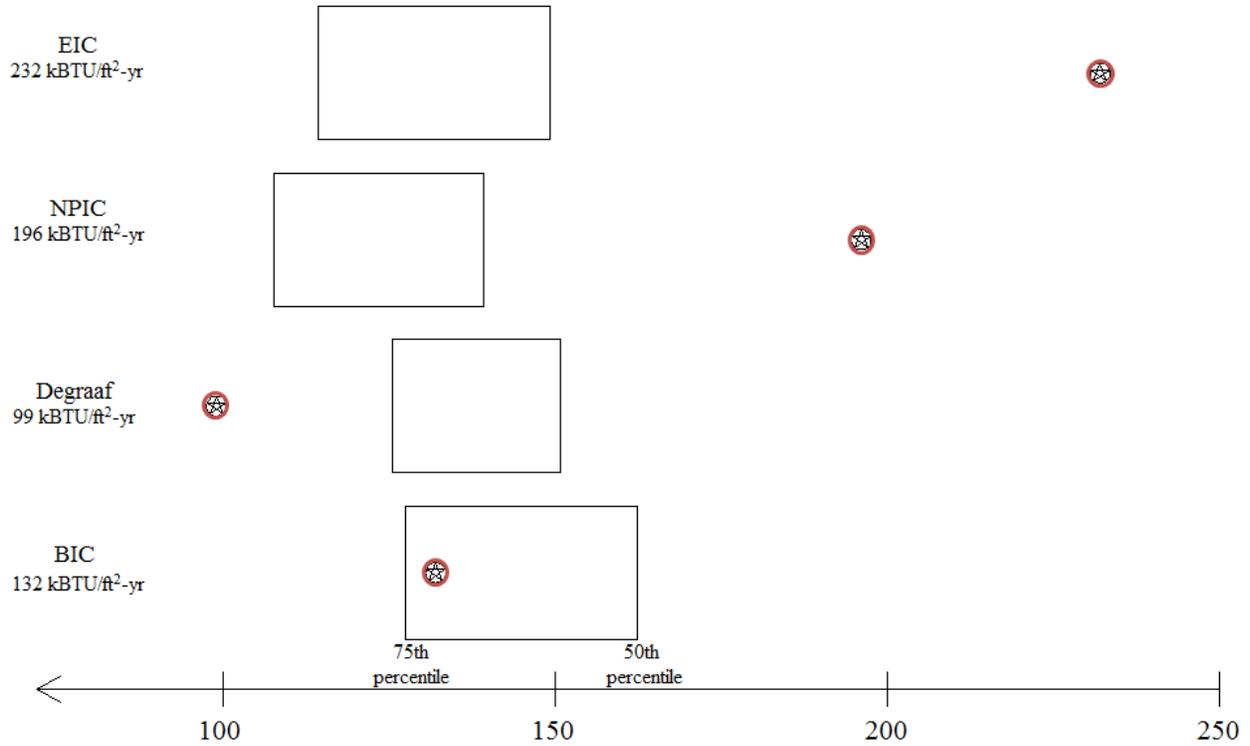


Figure A-4: Total Source EUI Comparison (kBTU/ft²-yr)

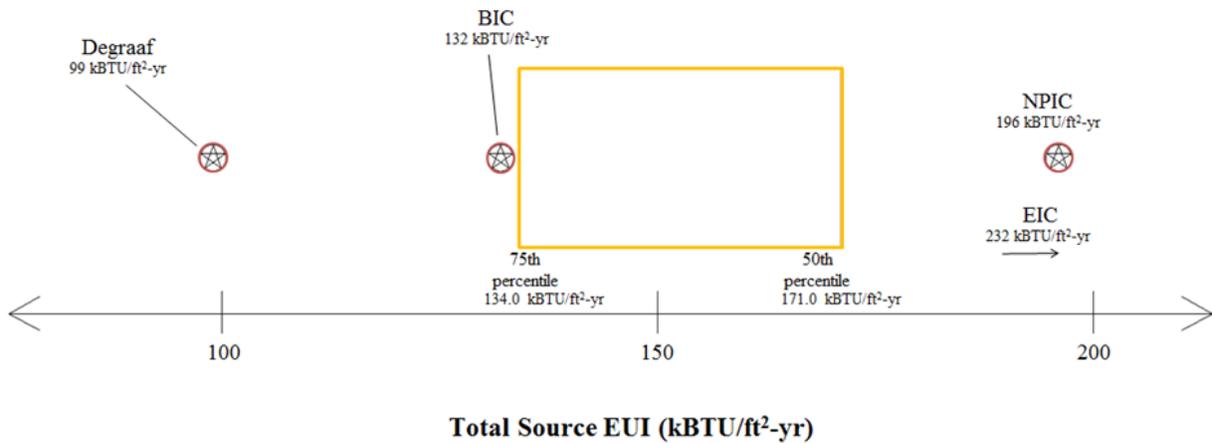
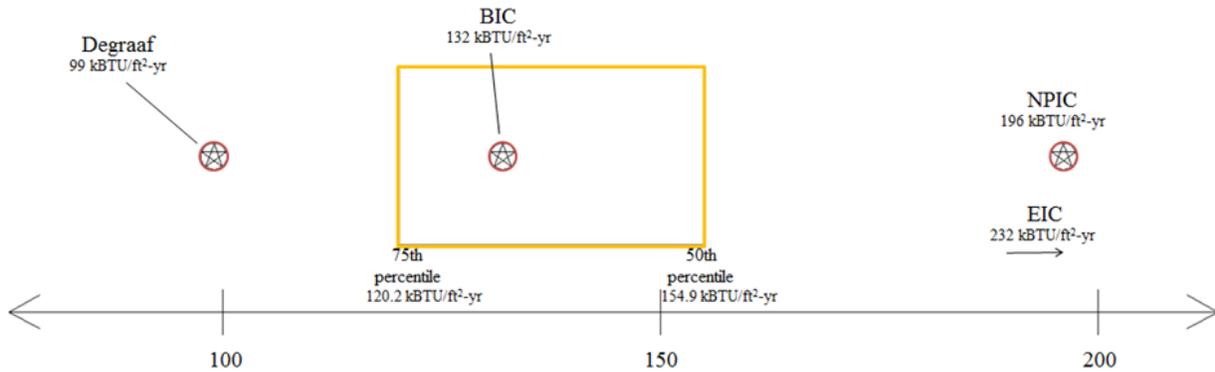
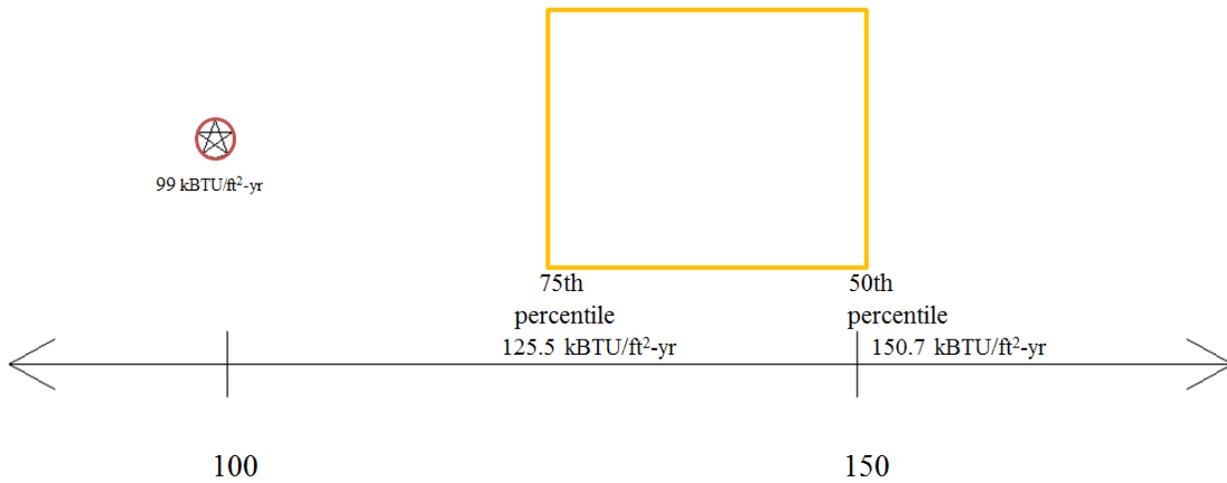


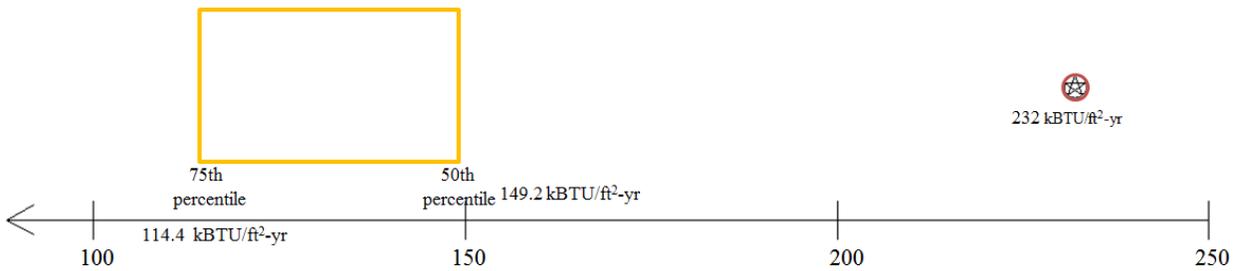
Figure A-5: Upper BIC-Star Range



Total Source EUI (kBTU/ft²-yr)
Figure A-6: Lower BIC-Star Range



Total Source EUI (kBTU/ft²-yr)
Figure A-7: DeGraaf Nature Center Assessment



Total Source EUI (kBTU/ft²-yr)
Figure A-8: Environmental Interpretive Center Assessment

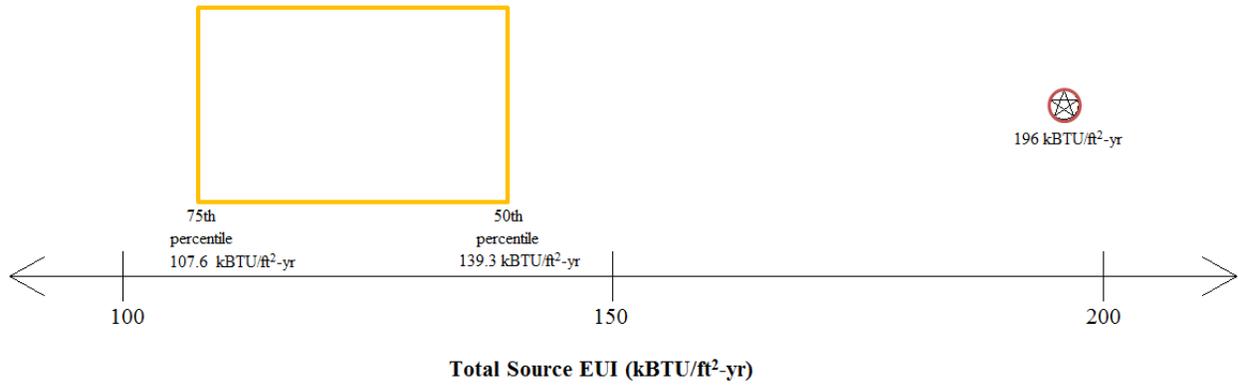


Figure A-9: Nature Park Interpretive Center Assessment

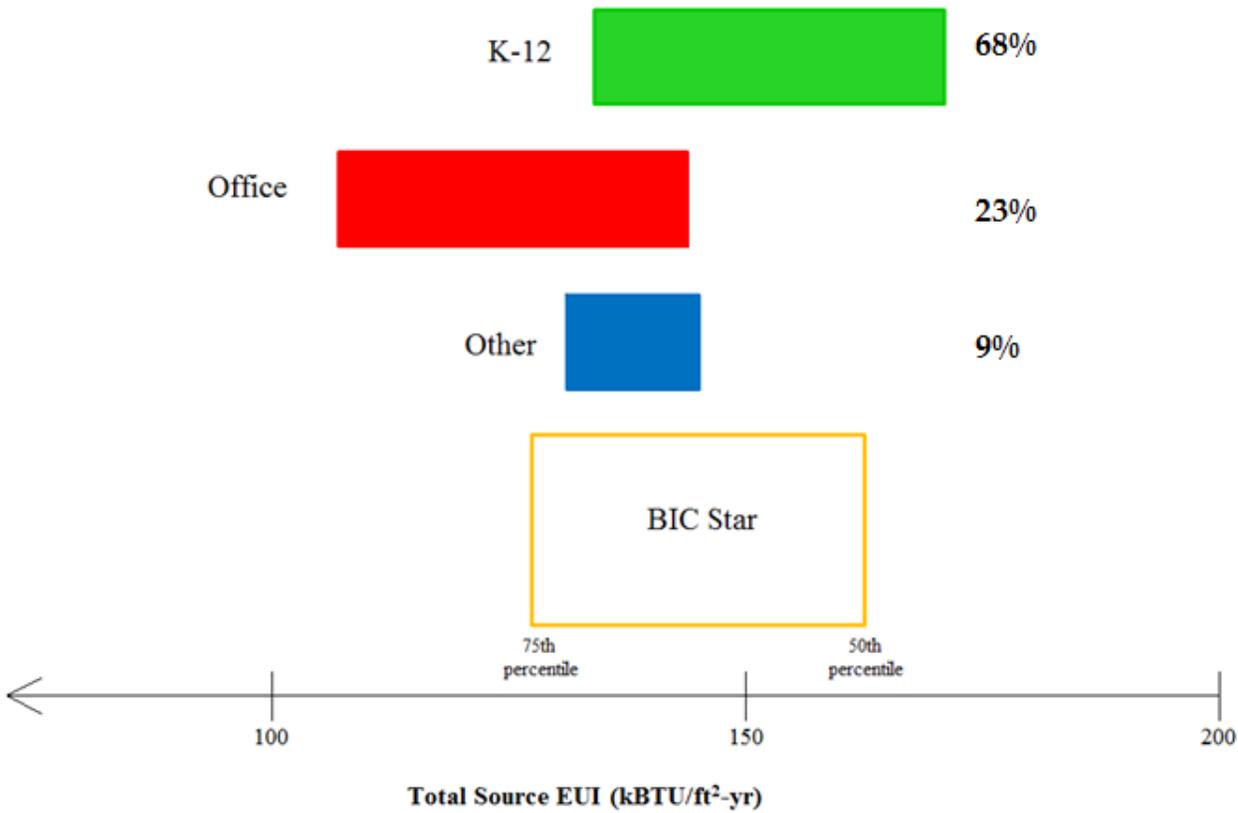


Figure A-10: BIC Star Components

APPENDIX B: Total Energy Cost Intensity

Introduction:

The main focus for the team's work this semester was Energy Cost Intensity (ECI). This is calculated by applying energy costs to the EUI numbers to further understand how much it costs to use the building. In addition to this task, the team acted in support of other groups, contacting external sources and researching improvement ideas.

ECI:

As stated above, the main focus of the team's work was to come up with ECI numbers for both the BIC and for other buildings. This enabled the team to make energy comparisons between the BIC and other similar buildings on a per-dollar basis. ECI is calculated by equation B.1, below:

$$ECI = \frac{\text{Energy Cost}}{\text{Floor Space} * \text{Time}} = \frac{\$}{\text{ft}^2 \cdot \text{yr}} \quad \text{B.1}$$

In order to effectively create these numbers, an "ECI Calculator" was created in excel. This enabled users to input the required data (price of energy, amount used, and floor space), and the ECI would be calculated. Please see Appendix B-1 for this ECI Calculator, and for graphical illustrations of how the BIC compared to other building's ECI.

External Sources:

At the beginning of the semester, the class decided that contacting other nature centers and similar buildings was an important task, as it would allow the comparison of the BIC to outside sources. Class members compiled a large list of buildings known in different parts of the country, and then they were divided amongst the groups. The ECI team was responsible for contacting three centers: the DeGraaf Nature Center in Holland, Michigan, the Nature Park Interpretive Center in Beaverton, Oregon, and the Environmental Interpretive Center in Dearborn, Michigan. Another classmate developed an Excel worksheet that was sent to all external sources that allowed them to enter their energy usage information. Each of the team's sources returned with completed sheets and this data was used to compare with the BIC, using the Portfolio Manager tool. When compared, the DeGraaf Nature Center performed better than the BIC, and the Nature Park Interpretive Center and Environmental Interpretive Center performed poorer. Appendix B-2 contains comparison graphs and data.

Improvement Ideas:

In addition to the ECI, this group considered several improvements to the BIC to improve the overall efficiency and the ECI of the BIC. The first idea proposed was to have zoned ventilation throughout the building. This idea would close off certain parts the BIC during different parts of the day and only supply heating and cooling to those areas. This would cut down on the overall heating and cooling costs and would cost somewhere in the range of \$5,000-\$8,000. The second

suggestion was to install air conditioning systems in the windows of the offices only to save on cooling the whole building. These two ideas are valid, but in the end were decided as ineffective. They would save energy, but the whole build still needs to be air conditioned and heated.

The third improvement idea proposed was a look into the usage habits of the building. These ideas involved turning off lights, cutting building hours, and turning off the fireplace. These ideas are not valid because the BIC still has to be used. The hours cannot be changed and the fireplace is in the BIC so it can be used. See Figure B-1, in Appendix B-1, for a graph of the ECI of the BIC after all of the improvements from each group were implemented.

Conclusion:

To conclude, the work done by the group this semester was important to the overall analysis of the BIC. The external comparisons data was the most reliable data obtained by any of the other groups. The ECI calculations gave a useful look at the cost of energy per area. Improvement ideas researched by the team were considered to be feasible, but would require more research and consulting with outside sources to implement.

APPENDIX B-1: ECI Data

Table B-1: An ECI Calculator, Showing the Results of the BIC and Other Buildings

Building:	Floor Area (ft ²):	Nat. Gas (ccf/yr):	Nat. Gas (BTU/yr)	Price (\$/BTU):	Elect. (kW-hr/yr):	Price (\$/kW-hr):
BIC	5226.84	-----	328170000	6.46E-06	42538	0.12
Improved BIC	5226.84	-----	328170000	6.46E-06	35058	0.12
DeGraaf	3111	1000	102900000	6.46E-06	17508	0.12
NPIC	7700	1851.4	190509060	6.46E-06	114920	0.12
EIC	13000	14879	1531049100	6.46E-06	123682	0.12

Nat. Gas ECI (\$/yr-ft ²):	Elect. ECI (\$/yr-ft ²):	Total ECI (\$/yr-ft ²):
0.41	0.98	1.38
0.41	0.80	1.21
0.21	0.68	0.89
0.16	1.79	1.95
0.76	1.14	1.90

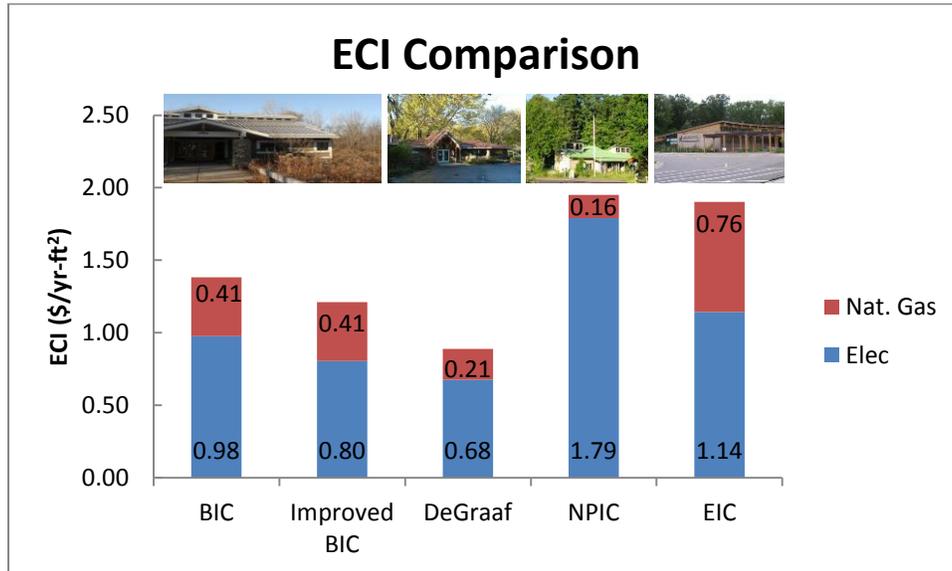


Figure B-1: ECI Comparison of the BIC with Other Nature Centers

APPENDIX B-2: External Comparison Data and Graphs.

Table B-2: External Building EUI Data

ASSUME							
70%	K-12	K-12		Office		Weighted	
30%	Office	50th	75th	50th	75th	50th	75th
Degraaf Nature Center		145	139	164	94	150.7	125.5
Environmental Interpretive Center		148	115	152	113	149.2	114.4
Nature Park Interpretive Center		148	116	119	88	139.3	107.6

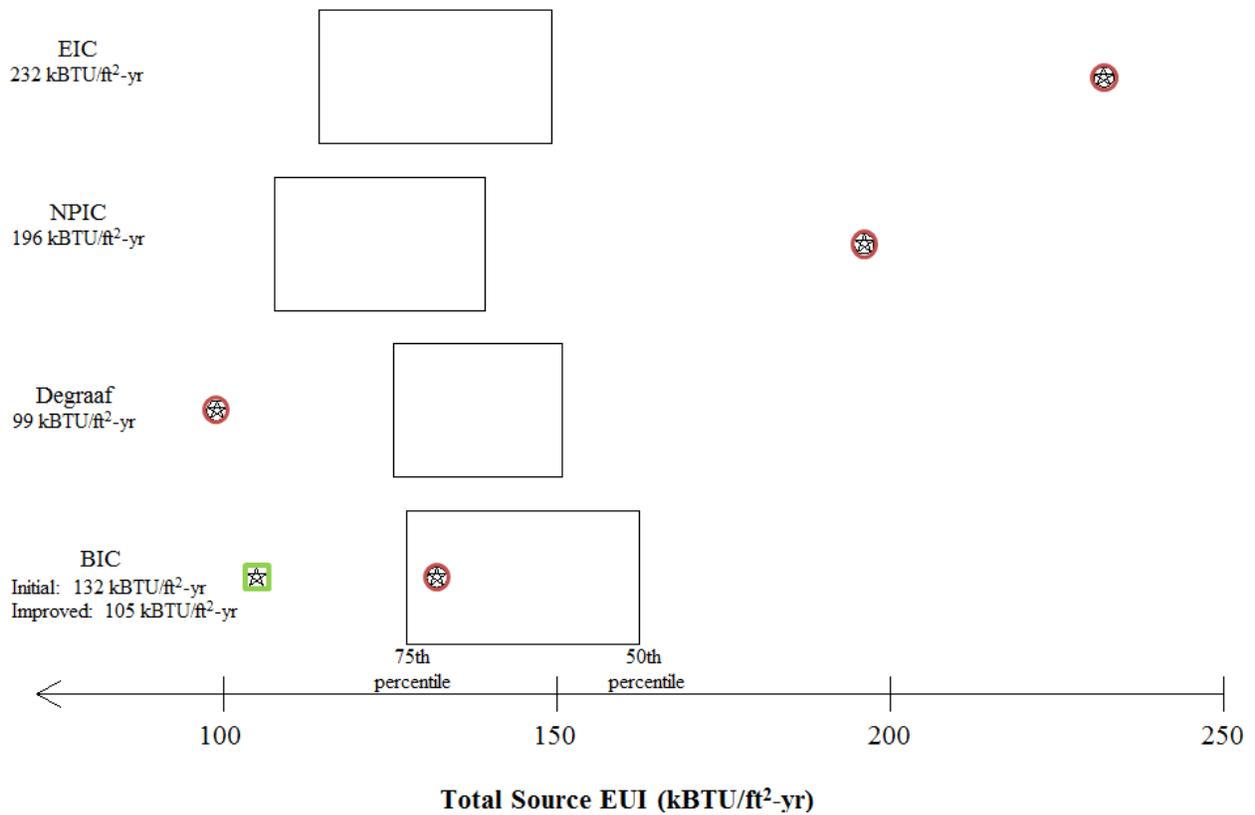


Figure B-2: Source EUI of External Buildings Compared to BIC

APPENDIX C: Renewable Energy and External Comparisons

The goal of the Renewable Energy and External Comparisons Group was to review how renewable technologies affect building's total energy balance and to determine how to utilize renewable energy production for the total EUI for the building. This group was also responsible for evaluating the effects of site, weather, and occupancy on the EUI levels of the BIC, as well as researching and comparing the Bunker Interpretive Center to other similar buildings in the United States. Another goal of the group was to research the similarities and differences between LEED and Energy Star[®] certification. The final goal was to propose renewable energy options that would help achieve an Energy Star[®] rating.

The group determined the impacts of renewable energy systems on the EUI by evaluating how the solar panels on the BIC affect total energy usage. This was done by utilizing the data collected for the solar panels since its installment in order to compare solar production with average energy needs. A graph showing the relationship of solar power energy production and average energy requirement for the BIC is found below in Figure C-1.

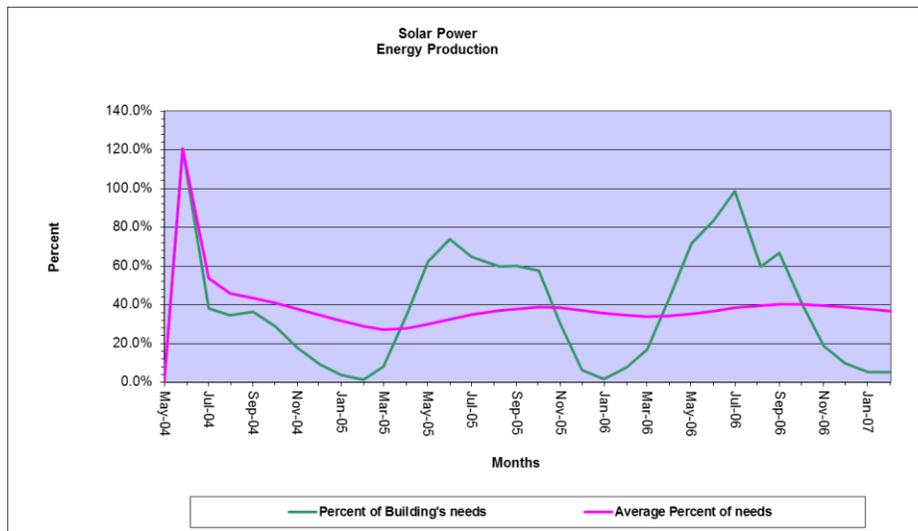


Figure C-4: Solar Power Energy Production vs. Energy Need

The green line shows the percentage of BIC energy needs that were supplied by the solar array, and the magenta line shows the average amount percentage of BIC energy needs met. As shown, the solar panels produce roughly 25% of the BIC energy needs since installation.

One of the group's goals was to determine how site information affects the BIC EUI. This was completed by obtaining and analyzing weather data in order to determine cooling and heating degree days for Grand Rapids, MI. A heating degree day is a measurement of the energy demand needed to heat a building. Conversely, a cooling degree day represents the energy demand needed to cool a building. For example, if the outside air temperature was 45 degrees

and the building was heated to 65 degrees then that day would be a 20 degree heating day. The value for heating degree days was 7909 days°F, and the value for cooling degree days was 358 days°F. This was a required input in order to evaluate the EUI of the BIC with Portfolio Manager.

The group addressed how occupancy affects the EUI by breaking the BIC up into three different subsections that were predetermined by Energy Star criteria. The categories were K-12 school, office, and other. A graph showing the floor space breakdown by category is shown below in Figure C-2.

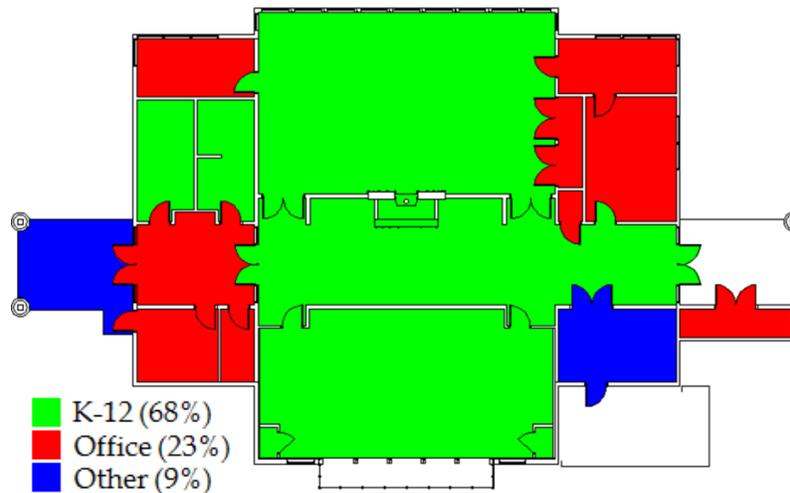


Figure C-5: Floor Space Breakdown

This was another criterion necessary in order to accurately calculate the BIC EUI using Portfolio Manager.

Another goal was to contact similar buildings for comparisons. This goal was not met as two of the nature centers did not reply, and one provided unusable information (estimates too rough to be reliable.)

The second to last objective for the renewables group was to determine the difference between LEED and Energy Star® ratings. The largest difference is that LEED certification only takes into account the design of the building (must utilize Best Available Technology), and not how the building is operated. Energy Star® certification is dependent on the energy usage of the building in comparison with the energy usage of other similar buildings, which is why the BIC was broken into subcategories.

The final goal of the project was to propose renewable energy systems in order to secure an Energy Star® rating for the BIC. The best solution is the JXIP480-58/1800-10 solar water heater, which would achieve approximately 100% of the required hot water during the summer months. This would allow the BIC to reach an Energy Star® rating. A major benefit is the system only

costs \$614.78; compared to other renewable energy systems this is much cheaper. Other options considered are: adding onto the current solar array system, installing a wind turbine, and removing snow off the panels during the winter months. For each of the other options considered the solar water heater is the only one whose benefits outweigh the costs. For comparison a wind turbine would cost approximately \$34,000, additional solar panels would cost approximately \$23,600 dollars, and snow removal would cost \$844 per winter. Because the solar arrays save approximately \$300 per winter the cost to remove snow outweighs the worth of removing snow.

APPENDIX C-1: LEED Versus Energy Star

Introduction:

The ENGR333 BIC project focuses on the energy usage of the already-gold certified LEED Bunker Interpretive Center at Calvin College. The LEED certification and Energy Star program are similar in that they can be considered “green” programs, but different in that they consider different aspects of the building. This report discusses what LEED and Energy Star certification is and how you get it as well as some differences in how EUI can be calculated.

LEED:

The Leadership in Energy and Environmental Design (LEED) certification considers 5 main building design components: Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources and Indoor Environmental Quality, as well as Innovation in Design and Regional Priority. Each category is split up into subcategories with a point value; if your building design meets the requirement for the subcategory you obtain the point(s). With 100 total points, a design will fall into one of the 4 categories:

Certified:	40-49 points
Silver:	50-59 points
Gold:	60-79 points
Platinum:	80+ points.

It can be said that LEED certification mainly considers *building design*, but it does consider energy use as well. In the Energy and Atmosphere point category a building can obtain up to 31 points just from installing monitored renewable energy systems and optimizing the building’s energy use. However, the other 69 points are concerned with materials, recycling, land, water use, and those which do not directly affect the building’s energy use. As Peter C. D’Antonio summarizes in his online article, “LEED was created as a way to define high performance green buildings, set quantifiable targets and goals, recognize leaders, promote improvement over time, stimulate green competition, and raise consumer awareness.”¹

Energy Star:

The Energy Star program was administered by the Environmental Protection Agency (EPA) and the Department of Energy (DOE) in the early 1990’s to promote the use of energy efficient products and building use. Using a statistical approach to energy efficiency, Energy Star uses the DOE’s Commercial Buildings Energy Consumption Survey (CBECS) to determine how much energy buildings in a certain category fall in to. These categories are: Government, Healthcare, Higher Education, Hospitality/Entertainment, Industrial, K-12, Real Estate/Multifamily, Retail, Small Business, Congregations, Service & Products Providers, Utilities & Energy Efficiency Program Sponsors and Waste/Wastewater Utilities. Any building outside of these categories cannot receive Energy Star certification unless they divide up their floor layout into subcategories as seen on the Energy Star website². Energy data is entered into an online program offered by Energy Star called Portfolio Manager, which will then calculate your building’s

¹ http://contractingbusiness.com/feature/cb_imp_6605/

² http://www.energystar.gov/index.cfm?c=eligibility.bus_portfoliomanager_eligibility

Energy Usage Index (EUI). Buildings are compared by their EUI numbers, and those that find themselves in the top 25% receive Energy Star certification.

Energy Use Comparison:

Do the LEED and Energy Star certification programs help improve building energy efficiency? Does one or the other do a better job? Because its metrics are based on more than just energy use, LEED certification itself does not guarantee that a building will be any more or less energy efficient. In fact, 28—35% of LEED certified buildings in the US are currently using more energy than their non-certified counterparts (Newsham 903). And the level of certification, silver, gold, and platinum seems to have only a mitigated effect on energy efficiency within the LEED certification itself. According to statistical t-tests performed on 159 different buildings in the US, anywhere from 31—54% of the variance in energy performance could be explained by differences in certification level for medium energy use buildings and offices respectively (Newsham 902).

However, the LEED certification process does seem to show a general societal benefit with the average trends showing an EUI reduction of anywhere from 29—35% for LEED certified buildings compared to their non-certified CBECS counterparts (Newsham 902). The 29—35% reduction calculation is based on an average EUI for a set of 'N' buildings calculated as:

$$EUI_{avg} = \sum \frac{EUI_N}{N} \quad C.1$$

Critics contend that the 29—35% EUI reduction cited is not an accurate representation of the energy saving effectiveness of LEED certification. They argue that the method involving equation C.1 does not take into account the weighted effect of buildings with larger floor space. In other words, an EUI reduction for a building with only $\sim 5,000 \text{ ft}^2$ will be weighted equally with one having say $\sim 27,000 \text{ ft}^2$ even though an EUI reduction in the larger building would result in a greater reduction in societal energy use. By comparison they suggest taking the average EUI as:

$$EUI_{avg} = \frac{\sum \text{Energy Use}_N}{\text{Total Area}_N} \quad C.2$$

This affects the overall EUI reduction to a range of 10—17%, (Scofield) still indicating an overall reduction of societal energy use. Every analyst, however, warns against drawing too many conclusions from small sample sizes but notes that LEED certification shows trends in the right direction. Energy Star certification by comparison requires the building in question to be within the top 25% most efficient in terms of EUI. Primarily, Energy Star differs from LEED on both focus and usage. LEED certification is design based. It provides a means for designers to evaluate and optimize their building plans with energy, sustainability, and environmental impact before the structure is built. Energy Star, on the other hand, focuses on improvement to energy efficiency specifically and provides a means for measuring behavioral impacts. In addition to being energy use specific, Energy Star certification provides a means of “filling the gaps” in LEED certification which its critics are quick to point out. Namely:

1. Occupancy Behavioral Assumptions
2. Discrete Analysis vs. Holistic Approach

Conclusion:

In comparison, Energy Star is clearly much more concerned with energy usage and efficiency while LEED is concerned with building materials and design. These two programs should not be completely exclusive as discussed above, but should be considered separate programs with different goals. One can assume that a LEED certified building was designed and built to be a “green” building with its lifecycle in mind while an Energy Star building is attempting to minimize energy use.

APPENDIX D: Electricity Group

Introduction:

The electricity team's goal was to analyze the electricity use at the Bunker Interpretive Center (BIC) and to research and propose methods for reducing this electricity use to comply with the BIC-Star requirements. The data used for the analysis performed on the BIC was the product of a previous engineering class, ENGR 382 Instrumentation Lab. The project for this class was to accurately map the energy usage of the BIC. The electrical mapping consisted of the electrical and small appliances, air and water flow, and lighting teams.

Procedure:

The electrical and small appliance team used Kill-a-Watt® meters to measure each outlet's energy consumption. The air and water flow group used Hobbs meters to measure the time the pumps were turned on and the startup energy consumption. Air conditioning compressor was measured with an enV meter and the ventilation fan records its total energy used. The lighting group used Hobbs meter to determine the on-time for each lighting area and calculated the energy used based on the wattage rating on the bulbs. The electricity use at the BIC for the past two years is shown in Figure D-1.

Results:

Based on 6 months' of collected data, the team discovered that the four most electricity-intensive components at the BIC are, in descending order of electricity use: the circulation fan, the air conditioning compressor, the hallway track lights, and the hallway indirect lights. The circulation fan is used for cooling and heating, as well as general ventilation to comply with LEED certification. The air conditioning is used for cooling in the summer, and the hallway lights are used about six to seven hours per operating day to light the main exhibit hallway. Figure D-2 shows the top 12 electricity consumers at the BIC.

Electricity Use for Sept. 2009 to Sept. 2010 and Sept. 2010 to Sept. 2011

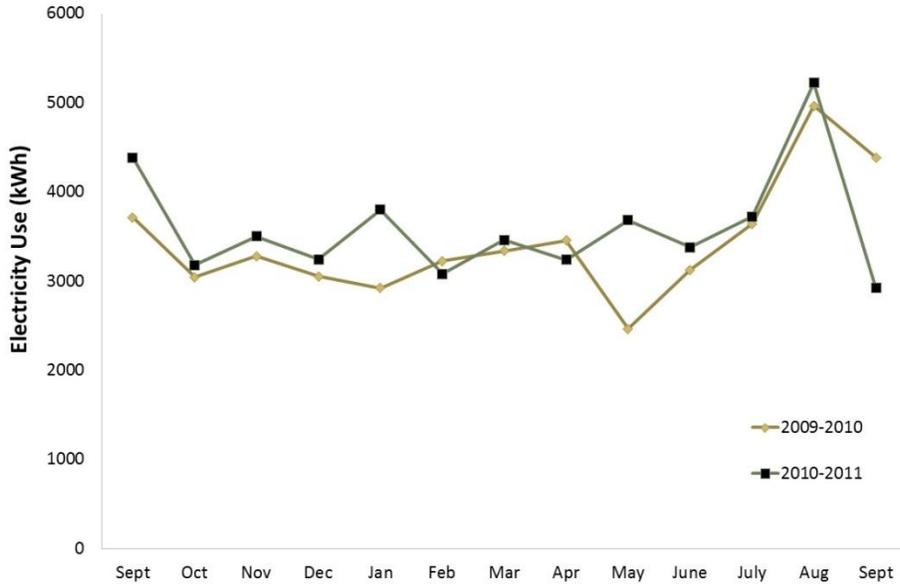


Figure D-1: Electricity Use at the BIC Over the Past Two Years

Top 12 Electricity Consumers Over 6 Months (June 2011 to Oct 2011)

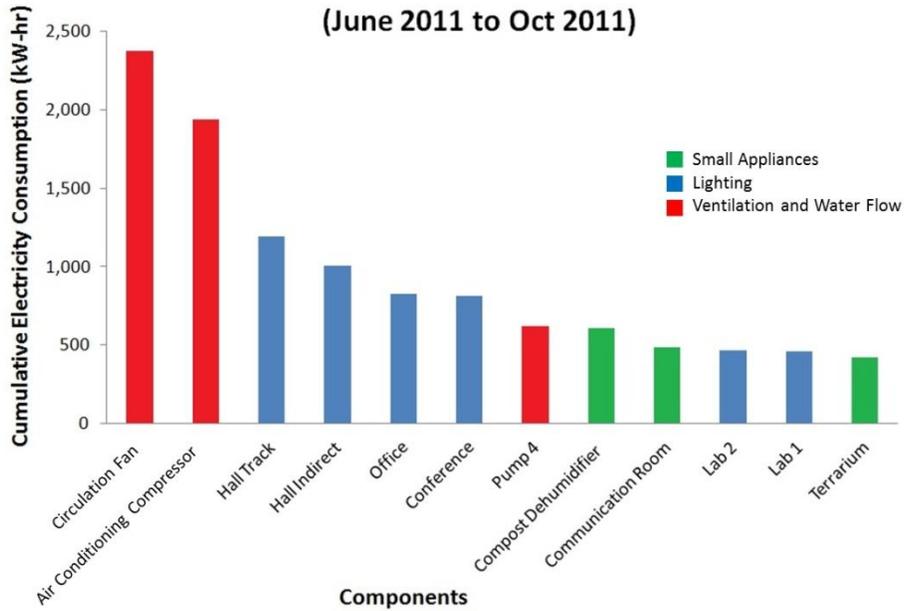


Figure D-2: Top 12 Electricity Consumers at the BIC

Improvements:

The electricity team has proposed three options for reducing the electricity use of the BIC: replacement of energy-intensive appliances with more efficient ones, installing LED lights in place of the current hall track compact fluorescent (CFL) bulbs, and turning off the radiant floor heating pumps during the summer months.

Currently, the BIC has 2 refrigerators and one microwave. While these appliances are not major electricity consumers (the refrigerator is ranked 20 out of 44, see Table), the team investigated the effects of replacing them with more efficient versions. As shown in Table D-2, the large fridge could be replaced by Replacement 1 for \$680, saving 90 kWh per year. However, this reduction is not cost effective based on its negligible impact on EUI. The microwave is used so infrequently that the team determined that replacement is not feasible.

Installing LED bulbs in the hall track light fixtures was another option. By replacing the existing CFL bulbs, approximately 204 kWh per year could be saved. This equates to about \$43.80 less per year in operating costs. However, the initial cost of LED bulbs is too large to produce a payback within 20 years, as shown in Figure (bulb replacement costs annualized for CFL and incandescent bulbs).

The final option analyzed by the electricity team was shutting down the floor heating pumps during the summer. The cost to implement this solution would be approximately \$155, as a pump control would be required to run the pumps for five to ten minutes every week to prevent them from binding due to nonuse. This option would save approximately 824 kWh over the summer months, which is a significant reduction in electricity consumption.

APPENDIX D-1: Lighting

Lighting was one of the things that the team tried to improve in the BIC. Based on our research and findings, both the Hall track and Hall indirect lighting are the main consumers of electricity throughout the air. Although the Air conditioning is high during the summer, it drastically takes a decline during the winter because of the reduced usage.

Currently the light fixtures used in the Bunker Interpretive Center’s (BIC) hall track and indirect fixtures are the compact fluorescent lamp (CFLs). The BIC was built with an energy efficient mindset, that’s why the CFL are used in the BIC track and indirect because of the hours that those lights are on and the effect of having those kinds of fixtures on the total electricity usage of the building

For improvements, we as a group considered two other possible light fixtures that could be seen as improvements above the ones that the building has right now. Those fixtures are the Incandescent and the LED lighting fixtures. Below is a table that shows a comparison between all three light fixtures looking at both the pros and the cons for each light system? The analysis is based on the 14 bulbs/year that are currently in the track and indirect fixtures. Our decision was based on which lighting fixture will be most effective and energy inefficiency for the BIC in the long run. We as a group also wanted to honor the motive of building the BIC, so our analysis could not consist of shutting off the lights or closing the building for a while, because that will not help the BIC serve its purpose.

Table D-1: Hall Track Light Replacement Cost and Energy Savings (at \$0.12/kWh)

Efficiencies	LEDs	Incandescent	CFLs (in use)
Life span	50,000 hrs	1,200 hrs	8,000 hrs
Lumens (light output) 800	6-8 watts	60 watts	13-15 watts
Kilo Watt of electricity used (14 bulbs/year)	154 kWh/yr	1533kWh/yr	358kWh/yr
Initial Cost	\$335.58	\$18.62	\$41.58
Annual operating cost	\$32.85/yr	\$328.59/yr	\$76.65/yr
Durability	LEDs can handle jarring and bumping	Glass or filament can break easily	Glass can break easily

The figure below analyzes the three sources of lighting in graphical form. Figure shows the cost of electricity for the next twenty years for each lighting system assuming the cost of electricity (\$0.12/kWh) remained constant. From the graph, an Incandescent bulb seems to be the next option for the first seven years in cost. After that time the LEDs conserve more electricity in the long run based on life span of the bulbs. Unlike the Incandescent bulbs that have to be replaced twice a year, one LED can last for twenty years. Based on our research, it will take a hike in electricity price (\$0.47/kWh) for LEDs to be more cost efficiency than CFLs in five years. Illustration of this trend can be seen in Figure .

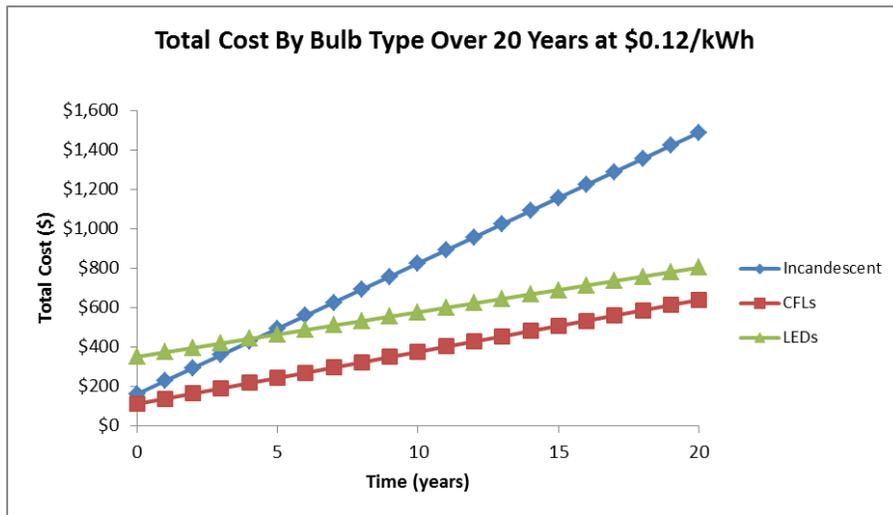


Figure D-3: Cost Analysis of Hall Track Light Bulb Replacement at \$0.47/kWh

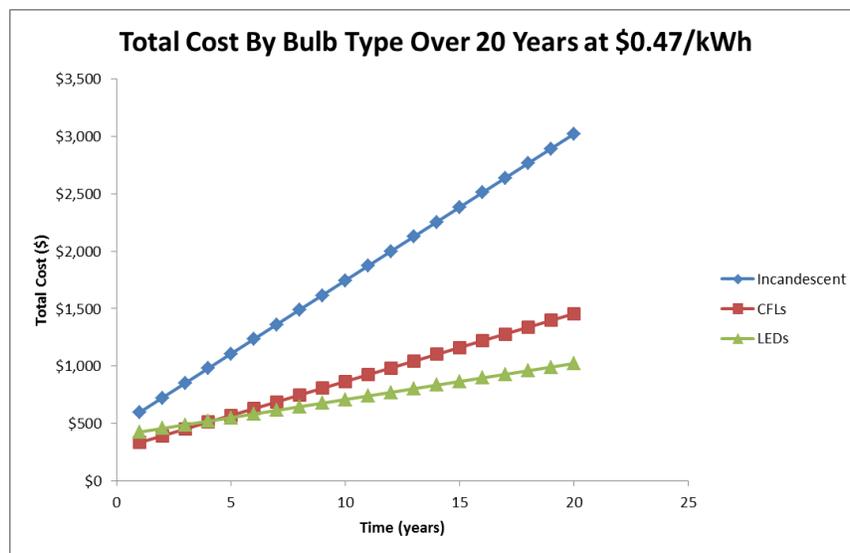


Figure D-4: Cost Analysis of Hall Track Light Bulb Replacement at \$0.47/kWh

CFLs which are currently in use in the BIC are the best option going forward. They have a reasonable life span (3-4 years before replacement) and produce a little higher cost values than the LEDs. Also the CFLs are also the best choice for the BIC because all the light fixtures in the hall track and hall indirect will have to be replaced in order to install the LEDs which will be an additional cost added to the price of LEDs.

APPENDIX D-2: Refrigerators and Microwave

The large fridge in the BIC uses an average of about 500 kWh/year and the small one uses about 150 kWh/year. After doing some research on appliance sights the best case scenario found regarding the large fridge would save about 90 kWh/year and cost about \$680. No suitable replacement for the mini fridge was found. All options had projected energy usages above what is being currently used. The data can be seen in Table D-2 below and the sources are listed at the end of the document

Table D-2: Refrigerator Replacement Cost and Energy Savings

Appliance	Initial Cost	Energy Use (kW-hr/yr)	Energy Reduction (kW-hr/yr)
Kenmore 76203	\$1319.99	465	35
Kenmore 6215	\$679.99	410	90
Kenmore 6880	\$423.99	683	-183
Frigidaire BFPH33M4LM	\$164.99	267	-117
Frigidaire BFPH44M4LM	\$209.99	274	-124

After talking to Jeanette it was established that the microwave is not used frequently, about once or twice a day maximum. Alternative options were researched but none were found specifying the total kWh/year usage. It comes down to usage: the more used by the appliance the more energy consumed overall.

APPENDIX D-3: Collected Data

Table D-5: Individual Component Electricity Use Over Last 6 Months

Component	Electricity Used in Last 6 Months (kWh)
Circulation Fan	2,376.00
Air-Conditioning	1,935.00
Hall Track	1,192.91
Hall Indirect	1,005.49
Office	826.4
Conference	813.3
Pump 4	623.92
Compost Dehumidifier	611
Communication Room	486.03
Lab 2	464.6
Lab 1	462.4
Terrarium	423
Pump 2	347.41
Lab 3	312
Men's Room	305.5
Pump 1	304.87
Lab 4	292
Pump 3	290.69
Lab Terrariums	277
Compost #1	197
107 Fridge	181
Classroom 3	168.2
Classroom 1	166.1
Classroom 4	158.7
Classroom 2	151.9
Kiosk	141
Fish Tank	134
114 Copier	130
108 A #1	116
108 B	103
Well Pump	97
107 Computer	93.9
Pump 6	76.14
114 Fridge	63.19
107 Printer	62.32
108 Projector	49.21
108 A #2	47.08
108 Podium	42.73
107 Projector	39.12
Pump 5	36.78
114 Microwave	35.81
Compost #3	1.31
Gray Water Pump	0.88
Compost Pump	0.13

APPENDIX E: Natural Gas Group

Introduction:

Calvin College is becoming more mindful of its energy usage and ways that they can reduce it. This is evident in one of the buildings on its campus called the Bunker Interpretive Center (BIC). Leadership in Energy and Environmental Design (LEED) is a rating system devised by the United States Green Building Council to evaluate the environmental performance of a building and encourage market transformation towards sustainable design. The system is credit-based, allowing projects to earn points for environmentally friendly actions taken during construction and use of a building. The BIC is LEED certified, however, LEED certification does not take into account Energy use within the building.

Energy Star rating on the other hand evaluates how efficiently energy is used in buildings, relative to similar buildings nationwide. The rating system's 1-100 scale allows everyone to quickly understand how a building is performing – a rating of 50 indicates average energy performance, while a rating of 75 or better indicates top performance.

The aim of this project was to evaluate the energy usage of the Bunker Interpretive Center to determine if the BIC met Energy Star requirements and if not, to propose energy saving ideas to help it achieve a rating of 75 or better. This project built on an instrumentation class which placed measurement devices with which one can evaluate energy usage within the building. This report highlights the actions of the team focused on the consumption of natural gas within the BIC.

Consumption and Collection:

Natural gas in the BIC is used in two distinct locations: the boiler and the fire place. The boiler is used to heat water which is run through the building to heat the floors of the building and also for domestic use. The fire place on the other hand is manually controlled by a switch and only runs when activated, used to heat a meeting room within the BIC. However, the pilot light for the fire place is constantly running and was calculated to consume $5.1 \times 10^{-3} \text{ ft}^3/\text{hr}$.

There is a DTE meter located on the outside of the building already recording the total usage of the building and HOBBS meters were installed to record the amount of times that both of the boiler and fire place are running. The data was collected on the 7th of each month and then analyzed, as discussed in the section below.

Interpretation:

The data collected on gas usage within the building helped us evaluate how gas is being used within the building and what the major player is as seen in Figure E-1 below. Figure E-1 shows that approximately 90% of the gas entering the building was used in the boiler and only about 10% was used at the fire place.

Understanding the energy breakdown at the BIC would help in coming up with improvement ideas but it did not help us understand how the natural gas effected our potential Energy Star rating. In order to understand the buildings Energy Star status a program called Portfolio Manager was used. This program takes all the different energy aspects of a building into account and compares it against buildings of similar nature. To generate an Energy Use Index number

however, twelve months of energy data is required. Since the installation of the measurement instruments in May, only 6 months of data has been collected. This required the team to use previous gas usage data obtained from electricity bills to predict future gas usage for the BIC. This data could then be plugged in the Portfolio Manager and used for calculations. Figure E-2 below shows the calculated gas usage in the BIC. The data was calculated using the natural gas consumption log for the past five years for the entire campus of Calvin College. With the data we had collected we were able to find the ratio of gas used at the BIC on a monthly basis compared to the gas used by the entire campus. With the ratio, and based on the trend of gas usage over the years, future monthly gas usage was predicted.

With the data for all the energy forms consumed within the BIC was plugged into Portfolio Manager it was found that the BIC had an Energy Use Index of 132 kBTU/ft²-yr. And with the calculated Energy star rating for the building, we find that the BIC missed an Energy Star rating by 4.5 kBTU/ft²-yr. This meant that we had to come up with improvement ideas to reduce the energy used at the BIC. Knowing that the boiler was the major consumer of natural gas we focused most of our attention in that direction.

Improvements:

We investigated several options for reducing the natural gas consumption of the BIC which are discussed below. However, none of the following options are recommended for implementation.

The first option was to replace the boiler with a higher efficiency boiler, which better utilizes the heat generated by the natural gas. Since the current boiler has a 95% efficiency rating, there is little room for improvement. The replacement boiler would save up to 2.5% of the natural gas consumption from the boiler. The cost of the equipment was estimated to be \$4,500, which does not include installation costs. This option is not feasible, because the low impact is outweighed by the initial costs of the equipment.

Another option was augmenting the existing cellulose insulation by adding insulation in the air gaps in the bricks of the outer walls. Perlite insulation was chosen because it is a common form of insulation with a high insulating value. This option made a large reduction of the current EUI however, it was much too expensive due to the cost of the insulation, and the very high installation costs.

Replacing the existing windows with insulating glass was the third option that the Natural Gas group investigated. This would reduce the heat loss through the windows by 50%. This figure is low due to the high efficiency of the current windows making a very small impact on the performance of the building. This was weighted with the high cost of the windows which made it obvious that this option was not feasible.

Conclusion:

In conclusion the quest for achieving Energy Star rating of the BIC would require a lot of capital investment for any gas usage improvements to be implemented. Because of the cost of implementation and the long payback period, no gas usage improvements are recommended.

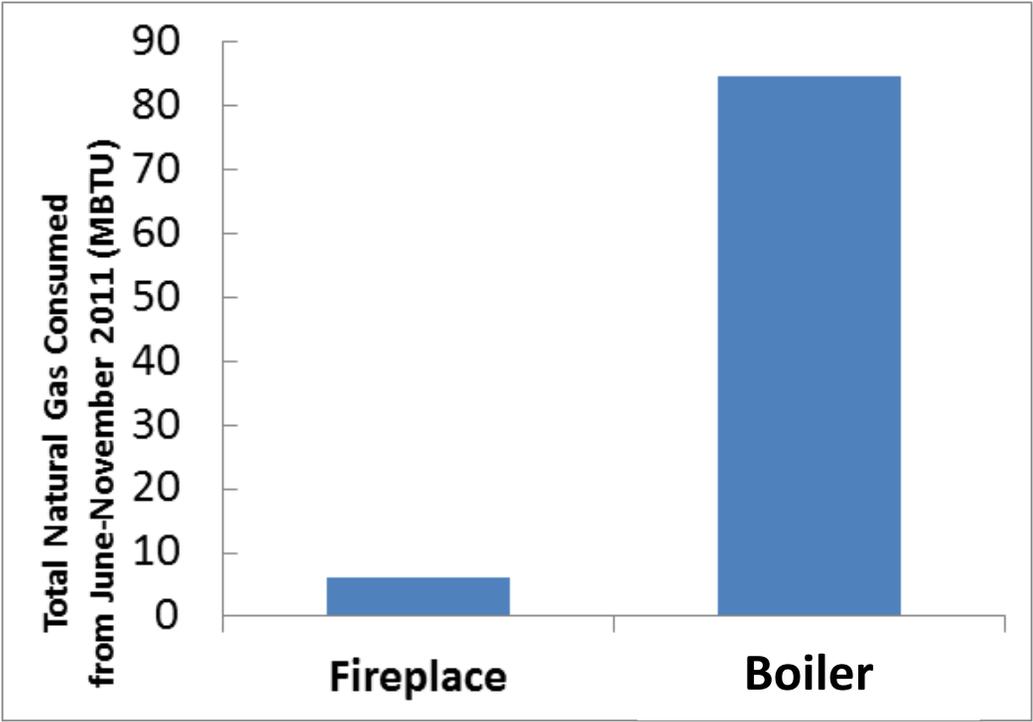


Figure E-1: Natural Gas Usage Break Down for the BIC

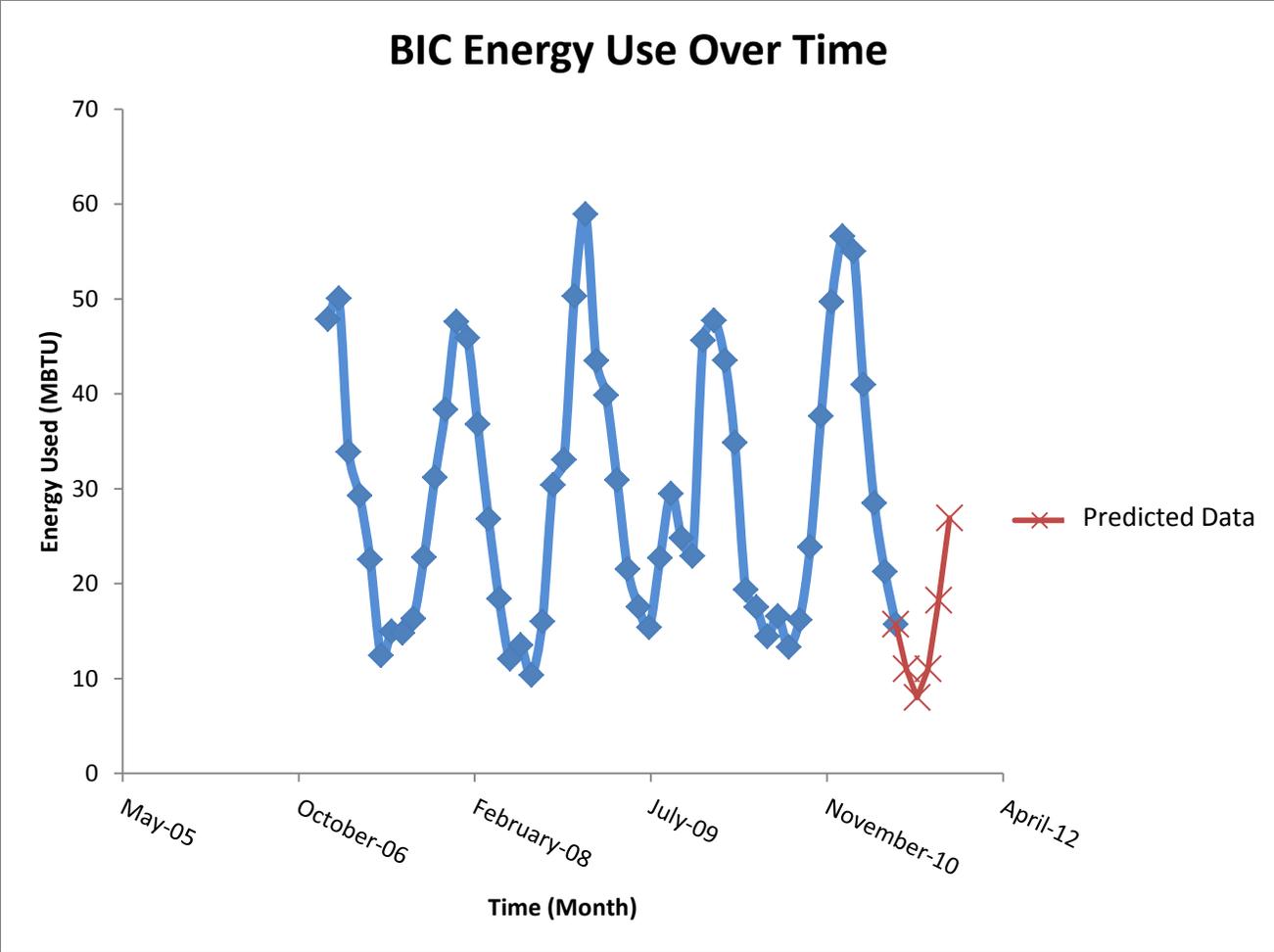


Figure E-2: Calculated Monthly Natural Gas usage of BIC

APPENDIX E-1: Data Collected and Calculated

Table E-1 Recorded Gas Consumption

	Date	Time	Fire Place					Water Heater					DTE Meter			
			Energy Co	Measured	End Time	Volume Co	Percentage	Energy Co	Measured	End Time	Volume Co	Percentage	Measured	Volume Consumed [ft^3]		
	21-Apr-11		N/A	0.2	0.3	N/A	N/A	N/A	0.2	80	N/A	N/A	449300	N/A		
*Fire Place	3-May-11	N/A	153.964	0.3	0.4	0.149	0.001	11970000	80	101	11,621.36	88.041	462500	13200		
*Fire Place	6-May-11	N/A	39.519	0.4	0.5	0.038	0.001	3150000	101	205.8	3,058.25	78.417	466400	3900		
*Fire Place	7-Jun-11	11:30 AM	408.285	0.5	0.6	0.396	0.002	15720000	205.8	279.4	15,262.14	87.212	483900	17500		
*Fire Place	7-Jul-11	11:30 AM	382.852	0.6	0.7	0.372	0.003	11040000	279.4	332.7	10,718.45	94.021	495300	11400		
*Fire Place	5-Aug-11	11:30 AM	370.136	0.7	0.8	0.359	0.005	7995000	332.7	406.2	7,762.14	106.331	502600	7300		
*Fire Place	7-Sep-11	1:30 PM	421.001	0.8	2.1	0.409	0.004	11025000	406.2	527.8	10,703.88	102.922	513000	10400		
	7-Oct-11	11:30 AM	399.304	2.1	11.9	0.388	0.002	18240000	527.8	707.2	17,708.74	90.351	532600	19600		
	8-Nov-11	11:30 AM	541.27	11.9		0.526	0.002	26910000	707.2		26,126.21	78.222	566000	33400		

Table E-2: History of Natural Gas Usage

Calculated Gas Usage for the BIC												
2011	1/1/2011	2/1/2011	3/1/2011	4/1/2011	5/1/2011	6/1/2011	7/1/2011	8/1/2011	9/1/2011	10/1/2011	11/1/2011	
Cost/MCF	\$6.22	\$5.59	\$5.79	\$5.87	\$5.92	\$5.99	\$6.72					
Billed Gas Usage (MCF)	27558	26783.2	19948.4	13872.9	10361.3	6438.2	6625.2					
Billed Gas Usage (BTU)	2755800000.0	2678320000.0	1994840000.0	1387290000.0	1036130000.0	643820000.0	662520000.0					
BIC Gas Usage (BTU)	56606367.47	55014865.42	40975631.79	28496062	21282951	15720408	11040383	7995370	11025421	18240399	26910541	
BIC Gas Usage (MCF)	56.61	55.01	40.98	28.50	21.28	15.72	11.04					
BIC Monthly Gas Expenses	\$352.15	\$307.31	\$237.25	\$167.19	\$126.06	\$94.20	\$74.16					
old avg	51142662	49704774	37020621	25745593	19928698							
new avg	56606367	55014865	40975632	28496062	21282951						49698698.07	
	-5463705	-5310092	-3955010	-2750469	-1354253							
new values for PM	56606.37	55014.87	40975.63	28496.06	21282.95	15720.41	11040.38	7995.37	11025.42	18240.40	26910.54	
2010	1/1/2010	2/1/2010	3/1/2010	4/1/2010	5/1/2010	6/1/2010	7/1/2010	8/1/2010	9/1/2010	10/1/2010	11/1/2010	12/1/2010
Cost/MCF	\$7.21	\$7.21	\$7.08	\$6.94	\$7.18	\$7.29	\$6.56	\$7.17	\$8.18	\$6.79	\$6.65	\$6.53
Billed Gas Usage (MCF)	23241.8	21200.1	16970.5	9430.4	8530.6	7025.3	8071.2	6492.2	7876.3	11613.8	18326.3	24195.1
Billed Gas Usage (BTU)	2324180000.0	2120010000.0	1697050000.0	943040000.0	853060000.0	702530000.0	807120000.0	649220000.0	787630000.0	1161380000.0	1832630000.0	2419510000.0
BIC Gas Usage (BTU)	47740542.54	43546725.12	34858783.62	19370806.58	17522544.39	14430536.08	16578899.52	13335505.44	16178559.11	23855687.29	37643706.8	49698698.07
BIC Gas Usage (MCF)	47.74	43.55	34.86	19.37	17.52	14.43	16.58	13.34	16.18	23.86	37.64	49.70
BIC Monthly Gas Expenses	\$343.97	\$313.88	\$246.77	\$134.39	\$125.86	\$105.14	\$108.82	\$95.55	\$132.32	\$162.00	\$250.41	\$324.63
2009	1/1/2009	2/1/2009	3/1/2009	4/1/2009	5/1/2009	6/1/2009	7/1/2009	8/1/2009	9/1/2009	10/1/2009	11/1/2009	12/1/2009
Cost/MCF	\$8.20	\$8.30	\$7.98	\$8.10	\$8.16	\$8.24	\$7.43	\$7.25	\$7.09	\$7.27	\$6.96	\$7.04
Billed Gas Usage (MCF)	28693.2	21178.6	19412.4	15059.4	10489.1	8542.6	7495.9	11053.5	14358.8	12088.1	11149.9	22223.3
Billed Gas Usage (BTU)	2869320000.0	2117860000.0	1941240000.0	1505940000.0	1048910000.0	854260000.0	749590000.0	1105350000.0	1435880000.0	1208810000.0	1114990000.0	2222330000.0
BIC Gas Usage (BTU)	58938160.35	43502562.38	39874644.31	3093329.2	21545462.26	17547193.36	15397186.66	22704785.64	29494139.97	24829937.97	22902799.06	45648460.92
BIC Gas Usage (MCF)	58.94	43.50	39.87	30.93	21.55	17.55	15.40	22.70	29.49	24.83	22.90	45.65
BIC Monthly Gas Expenses	\$483.00	\$361.20	\$318.20	\$250.65	\$175.70	\$144.59	\$114.42	\$164.70	\$209.02	\$180.51	\$159.43	\$321.32
2008	1/1/2008	2/1/2008	3/1/2008	4/1/2008	5/1/2008	6/1/2008	7/1/2008	8/1/2008	9/1/2008	10/1/2008	11/1/2008	12/1/2008
Cost/MCF	\$8.68	\$9.23	\$10.04	\$12.34	\$13.11	\$14.58	\$12.86	\$10.83	\$10.15	\$9.78	\$8.65	\$8.33
Billed Gas Usage (MCF)	23172.5	22345.6	17921.6	13065.9	8957.4	5874.8	6585.2	5048.5	7790.8	14802.3	16093	24481.4
Billed Gas Usage (BTU)	2317250000.0	2234560000.0	1792160000.0	1306590000.0	895740000.0	587480000.0	658520000.0	504850000.0	779080000.0	1480230000.0	160930000.0	2448140000.0
BIC Gas Usage (BTU)	47598194.72	45899675.04	36812420.17	26838418.49	18399226.21	12067315.76	13526534.98	10370028.53	16002935.18	30405124.94	33056327.44	50286781.5
BIC Gas Usage (MCF)	47.60	45.90	36.81	26.84	18.40	12.07	13.53	10.37	16.00	30.41	33.06	50.29
BIC Monthly Gas Expenses	\$413.20	\$423.52	\$369.60	\$331.16	\$241.16	\$175.92	\$173.99	\$112.28	\$162.46	\$297.33	\$285.90	\$418.99
2007	1/1/2007	2/1/2007	3/1/2007	4/1/2007	5/1/2007	6/1/2007	7/1/2007	8/1/2007	9/1/2007	10/1/2007	11/1/2007	12/1/2007
Cost/MCF	\$9.03	\$8.74	\$9.50	\$8.67	\$9.10	\$8.77	\$9.42	\$9.17	\$8.40	\$8.33	\$8.85	\$8.59
Billed Gas Usage (MCF)	23302.7	24383.1	16502	14256.8	10986.5	6058	7280.2	7205.4	7944.9	11090.2	15186.6	18669.4
Billed Gas Usage (BTU)	2330270000.0	2438310000.0	165020000.0	1425680000.0	1098650000.0	60580000.0	728020000.0	720540000.0	794490000.0	1109020000.0	1518660000.0	1866940000.0
BIC Gas Usage (BTU)	47865636.08	50084865.32	33896446.62	29284623.69	22567162.21	12443623.42	14954121.36	14800476.09	16319469.08	22780170.42	31194508.32	38348462.04
BIC Gas Usage (MCF)	47.87	50.08	33.90	29.28	22.57	12.44	14.95	14.80	16.32	22.78	31.19	38.35
BIC Monthly Gas Expenses	\$432.42	\$437.59	\$321.88	\$253.81	\$205.43	\$109.07	\$140.79	\$135.78	\$137.12	\$189.83	\$276.13	\$329.57

APPENDIX F: Portfolio Manager Results

OMB No. 2060-0347



STATEMENT OF ENERGY PERFORMANCE BIC K-12

Building ID: 2905932
For 12-month Period Ending: September 30, 2011¹
Date SEP becomes ineligible: N/A

Date SEP Generated: November 13, 2011

Facility
BIC K-12
1750 East Beltline Ave SE
Grand Rapids, MI 49546

Facility Owner
Calvin College
3201 Burton St
Grand Rapids, MI 49546

Primary Contact for this Facility
N/A

Year Built: 2004
Gross Floor Area (ft²): 5,227

Energy Performance Rating² (1-100) 72

Site Energy Use Summary³

Electricity - Grid Purchase(kBtu)	99,370
Electricity - On-Site Solar(kBtu)	45,776
Natural Gas (kBtu) ⁴	328,168
Total Energy (kBtu)	473,314

Energy Intensity⁵

Site (kBtu/ft ² /yr)	91
Source (kBtu/ft ² /yr)	138

Emissions (based on site energy use)

Greenhouse Gas Emissions (MtCO ₂ e/year)	39
---	----

Electric Distribution Utility

Consumers Energy Co [CMS Energy Corp]

National Median Comparison

National Median Site EUI	112
National Median Source EUI	171
% Difference from National Median Source EUI	-19%
Building Type	K-12 School

Stamp of Certifying Professional

Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.

Meets Industry Standards⁵ for Indoor Environmental Conditions:

Ventilation for Acceptable Indoor Air Quality	N/A
Acceptable Thermal Environmental Conditions	N/A
Adequate Illumination	N/A

Certifying Professional
N/A

Notes:

1. Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
2. The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
3. Values represent energy consumption, annualized to a 12-month period.
4. Values represent energy intensity, annualized to a 12-month period.
5. Based on Meeting ASHRAE Standard 62 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

The government estimates the average time needed to fill out this form is 6 hours (includes the time for entering energy data, Licensed Professional facility inspection, and notarizing the SEP) and welcomes suggestions for reducing this level of effort. Send comments (referencing OMB control number) to the Director, Collection Strategies Division, U.S. EPA (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460.

EPA Form 5900-16

Figure F-6: BIC Base Case K-12



STATEMENT OF ENERGY PERFORMANCE
BIC Office

Building ID: 2905082
 For 12-month Period Ending: September 30, 2011¹
 Date SEP becomes ineligible: N/A

Date SEP Generated: November 13, 2011

Facility
 BIC Office
 1750 East Beltline Ave SE
 Grand Rapids, MI 49546

Facility Owner
 Calvin College
 3201 Burton St
 Grand Rapids, MI 49546

Primary Contact for this Facility
 N/A

Year Built: 2004
 Gross Floor Area (ft²): 5,227

Energy Performance Rating² (1-100) 53

Site Energy Use Summary³

Electricity - Grid Purchase(kBtu)	99,370
Electricity - On-Site Solar(kBtu)	45,776
Natural Gas (kBtu) ⁴	328,170
Total Energy (kBtu)	473,316

Energy Intensity⁵

Site (kBtu/ft ² /yr)	91
Source (kBtu/ft ² /yr)	138

Emissions (based on site energy use)

Greenhouse Gas Emissions (MtCO ₂ e/year)	39
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Electric Distribution Utility

Consumers Energy Co [CMS Energy Corp]

National Median Comparison

National Median Site EUI	95
National Median Source EUI	144
% Difference from National Median Source EUI	-4%
Building Type	Office

Stamp of Certifying Professional

Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.

Meets Industry Standards⁶ for Indoor Environmental Conditions:

Ventilation for Acceptable Indoor Air Quality	N/A
Acceptable Thermal Environmental Conditions	N/A
Adequate Illumination	N/A

Certifying Professional
 N/A

Notes:

1. Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
2. The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
3. Values represent energy consumption, annualized to a 12-month period.
4. Values represent energy intensity, annualized to a 12-month period.
5. Based on Meeting ASHRAE Standard 62 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

The government estimates the average time needed to fill out this form is 8 hours (includes the time for entering energy data, Licensed Professional facility inspection, and notarizing the SEP) and welcomes suggestions for reducing this level of effort. Send comments (referencing OMB control number) to the Director, Collection Strategies Division, U.S., EPA (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460.

Figure F-7: BIC Base Case Office



STATEMENT OF ENERGY PERFORMANCE

BIC K-12

Building ID: 2905032
 For 12-month Period Ending: September 30, 2011¹
 Date SEP becomes ineligible: N/A

Date SEP Generated: November 13, 2011

Facility
 BIC K-12
 1750 East Beltline Ave SE
 Grand Rapids, MI 49546

Facility Owner
 Calvin College
 3201 Burton St
 Grand Rapids, MI 49546

Primary Contact for this Facility
 N/A

Year Built: 2004
Gross Floor Area (ft²): 5,227

Energy Performance Rating² (1-100) 58

Site Energy Use Summary³

Electricity - Grid Purchase(kBtu)	145,143
Electricity - On-Site Solar(kBtu)	0
Natural Gas (kBtu) ⁴	328,168
Total Energy (kBtu)	473,311

Energy Intensity⁵

Site (kBtu/ft ² /yr)	91
Source (kBtu/ft ² /yr)	158

Emissions (based on site energy use)

Greenhouse Gas Emissions (MtCO ₂ e/year)	49
---	----

Electric Distribution Utility

Consumers Energy Co [CMS Energy Corp]

National Median Comparison

National Median Site EUI	98
National Median Source EUI	171
% Difference from National Median Source EUI	-7%
Building Type	K-12 School

Stamp of Certifying Professional

Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.

Meets Industry Standards⁶ for Indoor Environmental Conditions:

Ventilation for Acceptable Indoor Air Quality	N/A
Acceptable Thermal Environmental Conditions	N/A
Adequate Illumination	N/A

Certifying Professional
 N/A

Notes:
 1. Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
 2. The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
 3. Values represent energy consumption, annualized to a 12-month period.
 4. Values represent energy intensity, annualized to a 12-month period.
 5. Based on Meeting ASHRAE Standard 62 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

The government estimates the average time needed to fill out this form is 6 hours (includes the time for entering energy data, Licensed Professional facility inspection, and notarizing the SEP) and welcomes suggestions for reducing this level of effort. Send comments (referencing OMB control number) to the Director, Collection Strategies Division, U.S., EPA (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460.

Figure F- 8: BIC All Energy Purchased, K-12



STATEMENT OF ENERGY PERFORMANCE BIC Office

Building ID: 2905082
For 12-month Period Ending: September 30, 2011¹
Date SEP becomes ineligible: N/A

Date SEP Generated: November 13, 2011

Facility	Facility Owner	Primary Contact for this Facility
BIC Office 1750 East Beltline Ave SE Grand Rapids, MI 49546	Calvin College 3201 Burton St Grand Rapids, MI 49546	N/A

Year Built: 2004
Gross Floor Area (ft²): 5,227

Energy Performance Rating² (1-100) 41

Site Energy Use Summary³

Electricity - Grid Purchase(kBtu)	144,964
Electricity - On-Site Solar(kBtu)	0
Natural Gas (kBtu) ⁴	328,170
Total Energy (kBtu)	473,134

Energy Intensity⁵

Site (kBtu/ft ² /yr)	91
Source (kBtu/ft ² /yr)	158

Emissions (based on site energy use)

Greenhouse Gas Emissions (MtCO ₂ e/year)	49
---	----

Electric Distribution Utility

Consumers Energy Co [CMS Energy Corp]

National Median Comparison

National Median Site EUI	82
National Median Source EUI	144
% Difference from National Median Source EUI	10%
Building Type	Office

Stamp of Certifying Professional
Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.

Meets Industry Standards⁶ for Indoor Environmental Conditions:

Ventilation for Acceptable Indoor Air Quality	N/A
Acceptable Thermal Environmental Conditions	N/A
Adequate Illumination	N/A

Certifying Professional
N/A

Notes:

1. Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
2. The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
3. Values represent energy consumption, annualized to a 12-month period.
4. Values represent energy intensity, annualized to a 12-month period.
5. Based on Meeting ASHRAE Standard 62 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

The government estimates the average time needed to fill out this form is 6 hours (includes the time for entering energy data, Licensed Professional facility inspection, and notarizing the SEP) and welcomes suggestions for reducing this level of effort. Send comments (referencing OMB control number) to the Director, Collection Strategies Division, U.S., EPA (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460.

EPA Form 5900-16

Figure F-9: BIC All Energy Purchased, Office



STATEMENT OF ENERGY PERFORMANCE

BIC K-12

Building ID: 2905032
 For 12-month Period Ending: September 30, 2011¹
 Date SEP becomes ineligible: N/A

Date SEP Generated: November 13, 2011

Facility
 BIC K-12
 1750 East Beltline Ave SE
 Grand Rapids, MI 49546

Facility Owner
 Calvin College
 3201 Burton St
 Grand Rapids, MI 49546

Primary Contact for this Facility
 N/A

Year Built: 2004
Gross Floor Area (ft²): 5,227

Energy Performance Rating² (1-100) 87

Site Energy Use Summary³

Electricity - Grid Purchase(kBtu)	99,370
Electricity - On-Site Solar(kBtu)	45,772
Natural Gas (kBtu) ⁴	193,890
Total Energy (kBtu)	339,032

Energy Intensity⁵

Site (kBtu/ft ² /yr)	65
Source (kBtu/ft ² /yr)	111

Emissions (based on site energy use)

Greenhouse Gas Emissions (MtCO ₂ e/year)	32
---	----

Electric Distribution Utility

Consumers Energy Co [CMS Energy Corp]

National Median Comparison

National Median Site EUI	100
National Median Source EUI	171
% Difference from National Median Source EUI	-35%
Building Type	K-12 School

Stamp of Certifying Professional

Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.

Meets Industry Standards⁶ for Indoor Environmental Conditions:

Ventilation for Acceptable Indoor Air Quality	N/A
Acceptable Thermal Environmental Conditions	N/A
Adequate Illumination	N/A

Certifying Professional
 N/A

Notes:
 1. Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
 2. The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
 3. Values represent energy consumption, annualized to a 12-month period.
 4. Values represent energy intensity, annualized to a 12-month period.
 5. Based on Meeting ASHRAE Standard 62 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

The government estimates the average time needed to fill out this form is 6 hours (includes the time for entering energy data, Licensed Professional facility inspection, and notarizing the SEP) and welcomes suggestions for reducing this level of effort. Send comments (referencing OMB control number) to the Director, Collection Strategies Division, U.S. EPA (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460.

Figure F-10: BIC Improved Insulation, K-12



STATEMENT OF ENERGY PERFORMANCE
BIC Office

Building ID: 2905982
 For 12-month Period Ending: September 30, 2011¹
 Date SEP becomes ineligible: N/A

Date SEP Generated: November 13, 2011

Facility
 BIC Office
 1750 East Beltline Ave SE
 Grand Rapids, MI 49546

Facility Owner
 Calvin College
 3201 Burton St
 Grand Rapids, MI 49546

Primary Contact for this Facility
 N/A

Year Built: 2004
Gross Floor Area (ft²): 5,227

Energy Performance Rating² (1-100) 72

Site Energy Use Summary³

Electricity - Grid Purchase(kBtu)	99,370
Electricity - On-Site Solar(kBtu)	45,772
Natural Gas (kBtu) ⁴	193,890
Total Energy (kBtu)	339,032

Energy Intensity⁵

Site (kBtu/ft ² /yr)	65
Source (kBtu/ft ² /yr)	111

Emissions (based on site energy use)

Greenhouse Gas Emissions (MtCO ₂ e/year)	32
---	----

Electric Distribution Utility

Consumers Energy Co [CMS Energy Corp]

National Median Comparison

National Median Site EUI	84
National Median Source EUI	144
% Difference from National Median Source EUI	-23%
Building Type	Office

Stamp of Certifying Professional

Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.

Meets Industry Standards⁶ for Indoor Environmental Conditions:

Ventilation for Acceptable Indoor Air Quality	N/A
Acceptable Thermal Environmental Conditions	N/A
Adequate Illumination	N/A

Certifying Professional
 N/A

Notes:

1. Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
2. The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
3. Values represent energy consumption, annualized to a 12-month period.
4. Values represent energy intensity, annualized to a 12-month period.
5. Based on Meeting ASHRAE Standard 62 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

The government estimates the average time needed to fill out this form is 6 hours (includes the time for entering energy data, Licensed Professional facility inspection, and notarizing the SEP) and welcomes suggestions for reducing this level of effort. Send comments (referencing OMB control number) to the Director, Collection Strategies Division, U.S. EPA (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460.

Figure F-11: BIC Improved Insulation, Office



STATEMENT OF ENERGY PERFORMANCE

BIC K-12

Building ID: 2905932
 For 12-month Period Ending: September 30, 2011¹
 Date SEP becomes ineligible: N/A

Date SEP Generated: November 13, 2011

Facility
 BIC K-12
 1750 East Beltline Ave SE
 Grand Rapids, MI 49546

Facility Owner
 Calvin College
 3201 Burton St
 Grand Rapids, MI 49546

Primary Contact for this Facility
 N/A

Year Built: 2004
Gross Floor Area (ft²): 5,227

Energy Performance Rating² (1-100) 72

Site Energy Use Summary³

Electricity - Grid Purchase(kBtu)	98,838
Electricity - On-Site Solar(kBtu)	45,772
Natural Gas (kBtu) ⁴	328,168
Total Energy (kBtu)	472,778

Energy Intensity⁵

Site (kBtu/ft ² /yr)	90
Source (kBtu/ft ² /yr)	138

Emissions (based on site energy use)

Greenhouse Gas Emissions (MtCO ₂ e/year)	39
---	----

Electric Distribution Utility

Consumers Energy Co [CMS Energy Corp]

National Median Comparison

National Median Site EUI	113
National Median Source EUI	171
% Difference from National Median Source EUI	-20%
Building Type	K-12 School

Stamp of Certifying Professional

Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.

Meets Industry Standards⁵ for Indoor Environmental Conditions:

Ventilation for Acceptable Indoor Air Quality	N/A
Acceptable Thermal Environmental Conditions	N/A
Adequate Illumination	N/A

Certifying Professional
 N/A

Notes:
 1. Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
 2. The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
 3. Values represent energy consumption, annualized to a 12-month period.
 4. Values represent energy intensity, annualized to a 12-month period.
 5. Based on Meeting ASHRAE Standard 62 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

The government estimates the average time needed to fill out this form is 6 hours (includes the time for entering energy data, Licensed Professional facility inspection, and notarizing the SEP) and welcomes suggestions for reducing this level of effort. Send comments (referencing OMB control number) to the Director, Collection Strategies Division, U.S., EPA (2622T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460.

Figure F-12: BIC Light Timer, K-12



STATEMENT OF ENERGY PERFORMANCE
BIC Office

Building ID: 2905982
 For 12-month Period Ending: September 30, 2011¹
 Date SEP becomes ineligible: N/A

Date SEP Generated: November 13, 2011

Facility
 BIC Office
 1750 East Beltline Ave SE
 Grand Rapids, MI 49546

Facility Owner
 Calvin College
 3201 Burton St
 Grand Rapids, MI 49546

Primary Contact for this Facility
 N/A

Year Built: 2004
 Gross Floor Area (ft²): 5,227

Energy Performance Rating² (1-100) 54

Site Energy Use Summary³

Electricity - Grid Purchase(kBtu)	98,838
Electricity - On-Site Solar(kBtu)	45,772
Natural Gas (kBtu) ⁴	328,170
Total Energy (kBtu)	472,780

Energy Intensity⁵

Site (kBtu/ft ² /yr)	90
Source (kBtu/ft ² /yr)	138

Emissions (based on site energy use)

Greenhouse Gas Emissions (MtCO ₂ e/year)	39
---	----

Electric Distribution Utility

Consumers Energy Co [CMS Energy Corp]

National Median Comparison

National Median Site EUI	95
National Median Source EUI	144
% Difference from National Median Source EUI	-4%
Building Type	Office

Stamp of Certifying Professional

Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.

Meets Industry Standards⁶ for Indoor Environmental Conditions:

Ventilation for Acceptable Indoor Air Quality	N/A
Acceptable Thermal Environmental Conditions	N/A
Adequate Illumination	N/A

Certifying Professional
 N/A

Notes:

1. Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
2. The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
3. Values represent energy consumption, annualized to a 12-month period.
4. Values represent energy intensity, annualized to a 12-month period.
5. Based on Meeting ASHRAE Standard 62 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

The government estimates the average time needed to fill out this form is 8 hours (includes the time for entering energy data, Licensed Professional facility inspection, and notarizing the SEP) and welcomes suggestions for reducing this level of effort. Send comments (referencing OMB control number) to the Director, Collection Strategies Division, U.S., EPA (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460.

Figure F-13: BIC Light Timer, Office



STATEMENT OF ENERGY PERFORMANCE

BIC K-12

Building ID: 2905932
 For 12-month Period Ending: September 30, 2011¹
 Date SEP becomes ineligible: N/A

Date SEP Generated: November 13, 2011

Facility
 BIC K-12
 1750 East Beltline Ave SE
 Grand Rapids, MI 49546

Facility Owner
 Calvin College
 3201 Burton St
 Grand Rapids, MI 49546

Primary Contact for this Facility
 N/A

Year Built: 2004
Gross Floor Area (ft²): 5,227

Energy Performance Rating² (1-100) 77

Site Energy Use Summary³

Electricity - Grid Purchase(kBtu)	88,154
Electricity - On-Site Solar(kBtu)	45,772
Natural Gas (kBtu) ⁴	328,168
Total Energy (kBtu)	462,094

Energy Intensity⁵

Site (kBtu/ft ² /yr)	88
Source (kBtu/ft ² /yr)	131

Emissions (based on site energy use)

Greenhouse Gas Emissions (MtCO ₂ e/year)	37
---	----

Electric Distribution Utility

Consumers Energy Co [CMS Energy Corp]

National Median Comparison

National Median Site EUI	116
National Median Source EUI	171
% Difference from National Median Source EUI	-24%
Building Type	K-12 School

Stamp of Certifying Professional

Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.

Meets Industry Standards⁶ for Indoor Environmental Conditions:

Ventilation for Acceptable Indoor Air Quality	N/A
Acceptable Thermal Environmental Conditions	N/A
Adequate Illumination	N/A

Certifying Professional
 N/A

Notes:
 1. Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
 2. The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
 3. Values represent energy consumption, annualized to a 12-month period.
 4. Values represent energy intensity, annualized to a 12-month period.
 5. Based on Meeting ASHRAE Standard 62 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

The government estimates the average time needed to fill out this form is 8 hours (includes the time for entering energy data, Licensed Professional facility inspection, and notarizing the SEP) and welcomes suggestions for reducing this level of effort. Send comments (referencing OMB control number) to the Director, Collection Strategies Division, U.S., EPA (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460.

Figure F-14: BIC Pump Usage, K-12



STATEMENT OF ENERGY PERFORMANCE BIC Office

Building ID: 2905982
For 12-month Period Ending: September 30, 2011¹
Date SEP becomes ineligible: N/A

Date SEP Generated: November 13, 2011

Facility	Facility Owner	Primary Contact for this Facility
BIC Office 1750 East Beltline Ave SE Grand Rapids, MI 49546	Calvin College 3201 Burton St Grand Rapids, MI 49546	N/A

Year Built: 2004
Gross Floor Area (ft²): 5,227

Energy Performance Rating² (1-100) 59

Site Energy Use Summary³

Electricity - Grid Purchase(kBtu)	87,559
Electricity - On-Site Solar(kBtu)	45,772
Natural Gas (kBtu) ⁴	328,170
Total Energy (kBtu)	461,501

Energy Intensity⁵

Site (kBtu/ft ² /yr)	88
Source (kBtu/ft ² /yr)	130

Emissions (based on site energy use)

Greenhouse Gas Emissions (MtCO ₂ e/year)	37
---	----

Electric Distribution Utility

Consumers Energy Co [CMS Energy Corp]

National Median Comparison

National Median Site EUI	97
National Median Source EUI	144
% Difference from National Median Source EUI	-9%
Building Type	Office

Stamp of Certifying Professional
Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.

Meets Industry Standards⁵ for Indoor Environmental Conditions:

Ventilation for Acceptable Indoor Air Quality	N/A
Acceptable Thermal Environmental Conditions	N/A
Adequate Illumination	N/A

Certifying Professional
N/A

Notes:

1. Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
2. The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
3. Values represent energy consumption, annualized to a 12-month period.
4. Values represent energy intensity, annualized to a 12-month period.
5. Based on Meeting ASHRAE Standard 62 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

The government estimates the average time needed to fill out this form is 6 hours (includes the time for entering energy data, Licensed Professional facility inspection, and notarizing the SEP) and welcomes suggestions for reducing this level of effort. Send comments (referencing OMB control number) to the Director, Collection Strategies Division, U.S. EPA (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460.

EPA Form 5900-16

Figure F-15: BIC Pump Usage, Office



STATEMENT OF ENERGY PERFORMANCE

BIC K-12

Building ID: 2905932
 For 12-month Period Ending: September 30, 2011¹
 Date SEP becomes ineligible: N/A

Date SEP Generated: November 13, 2011

Facility
 BIC K-12
 1750 East Beltline Ave SE
 Grand Rapids, MI 49546

Facility Owner
 Calvin College
 3201 Burton St
 Grand Rapids, MI 49546

Primary Contact for this Facility
 N/A

Year Built: 2004
Gross Floor Area (ft²): 5,227

Energy Performance Rating² (1-100) 82

Site Energy Use Summary³

Electricity - Grid Purchase(kBtu)	73,663
Electricity - On-Site Solar(kBtu)	45,772
Natural Gas (kBtu) ⁴	328,168
Total Energy (kBtu)	447,603

Energy Intensity⁵

Site (kBtu/ft ² /yr)	86
Source (kBtu/ft ² /yr)	122

Emissions (based on site energy use)

Greenhouse Gas Emissions (MtCO ₂ e/year)	34
---	----

Electric Distribution Utility

Consumers Energy Co [CMS Energy Corp]

National Median Comparison

National Median Site EUI	121
National Median Source EUI	171
% Difference from National Median Source EUI	-29%
Building Type	K-12 School

Stamp of Certifying Professional

Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.

Meets Industry Standards⁶ for Indoor Environmental Conditions:

Ventilation for Acceptable Indoor Air Quality	N/A
Acceptable Thermal Environmental Conditions	N/A
Adequate Illumination	N/A

Certifying Professional
 N/A

Notes:

1. Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
2. The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
3. Values represent energy consumption, annualized to a 12-month period.
4. Values represent energy intensity, annualized to a 12-month period.
5. Based on Meeting ASHRAE Standard 62 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

The government estimates the average time needed to fill out this form is 6 hours (includes the time for entering energy data, Licensed Professional facility inspection, and notarizing the SEP) and welcomes suggestions for reducing this level of effort. Send comments (referencing OMB control number) to the Director, Collection Strategies Division, U.S., EPA (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460.

Figure F-16: BIC Solar Water Heater, K-12



STATEMENT OF ENERGY PERFORMANCE

BIC Office

Building ID: 2905082
 For 12-month Period Ending: September 30, 2011¹
 Date SEP becomes ineligible: N/A

Date SEP Generated: November 13, 2011

Facility
 BIC Office
 1750 East Beltline Ave SE
 Grand Rapids, MI 49546

Facility Owner
 Calvin College
 3201 Burton St
 Grand Rapids, MI 49546

Primary Contact for this Facility
 N/A

Year Built: 2004
Gross Floor Area (ft²): 5,227

Energy Performance Rating² (1-100) 65

Site Energy Use Summary³

Electricity - Grid Purchase(kBtu)	73,680
Electricity - On-Site Solar(kBtu)	45,772
Natural Gas (kBtu) ⁴	328,170
Total Energy (kBtu)	447,602

Energy Intensity⁵

Site (kBtu/ft ² /yr)	86
Source (kBtu/ft ² /yr)	122

Emissions (based on site energy use)

Greenhouse Gas Emissions (MtCO ₂ e/year)	34
---	----

Electric Distribution Utility

Consumers Energy Co [CMS Energy Corp]

National Median Comparison

National Median Site EUI	101
National Median Source EUI	144
% Difference from National Median Source EUI	-16%
Building Type	Office

Stamp of Certifying Professional

Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.

Meets Industry Standards⁶ for Indoor Environmental Conditions:

Ventilation for Acceptable Indoor Air Quality	N/A
Acceptable Thermal Environmental Conditions	N/A
Adequate Illumination	N/A

Certifying Professional
 N/A

Notes:

1. Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
2. The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
3. Values represent energy consumption, annualized to a 12-month period.
4. Values represent energy intensity, annualized to a 12-month period.
5. Based on Meeting ASHRAE Standard 62 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

The government estimates the average time needed to fill out this form is 6 hours (includes the time for entering energy data, Licensed Professional facility inspection, and notarizing the SEP) and welcomes suggestions for reducing this level of effort. Send comments (referencing OMB control number) to the Director, Collection Strategies Division, U.S., EPA (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460.

Figure F-17: BIC Wolar Water Heater, Office



STATEMENT OF ENERGY PERFORMANCE BIC K-12

Building ID: 2905832
For 12-month Period Ending: September 30, 2011¹
Date SEP becomes ineligible: N/A

Date SEP Generated: November 14, 2011

Facility
BIC K-12
1750 East Beltline Ave SE
Grand Rapids, MI 49546

Facility Owner
Calvin College
3201 Burton St
Grand Rapids, MI 49546

Primary Contact for this Facility
N/A

Year Built: 2004
Gross Floor Area (ft²): 5,227

Energy Performance Rating² (1-100) 74

Site Energy Use Summary³

Electricity - Grid Purchase(kBtu)	93,230
Electricity - On-Site Solar(kBtu)	45,772
Electricity - On-Site Wind(kBtu)	6,142
Natural Gas (kBtu) ⁴	328,170
Total Energy (kBtu)	473,314

Energy Intensity⁵

Site (kBtu/ft ² /yr)	91
Source (kBtu/ft ² /yr)	135

Emissions (based on site energy use)

Greenhouse Gas Emissions (MtCO ₂ e/year)	38
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Electric Distribution Utility

Consumers Energy Co [CMS Energy Corp]

National Median Comparison

National Median Site EUI	115
National Median Source EUI	171
% Difference from National Median Source EUI	-21%
Building Type	K-12 School

Stamp of Certifying Professional

Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.

Meets Industry Standards⁶ for Indoor Environmental Conditions:

Ventilation for Acceptable Indoor Air Quality	N/A
Acceptable Thermal Environmental Conditions	N/A
Adequate Illumination	N/A

Certifying Professional
N/A

Notes:

1. Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
2. The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
3. Values represent energy consumption, annualized to a 12-month period.
4. Values represent energy intensity, annualized to a 12-month period.
5. Based on Meeting ASHRAE Standard 62 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

The government estimates the average time needed to fill out this form is 6 hours (includes the time for entering energy data, Licensed Professional facility inspection, and notarizing the SEP) and welcomes suggestions for reducing this level of effort. Send comments (referencing OMB control number) to the Director, Collection Strategies Division, U.S., EPA (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460.

EPA Form 5900-16

Figure F-18: BIC 1.5kW Wind Turbine, K-12



STATEMENT OF ENERGY PERFORMANCE BIC Office

Building ID: 2905982
For 12-month Period Ending: September 30, 2011¹
Date SEP becomes ineligible: N/A

Date SEP Generated: November 14, 2011

Facility	Facility Owner	Primary Contact for this Facility
BIC Office 1750 East Bellline Ave SE Grand Rapids, MI 49546	Calvin College 3201 Burton St Grand Rapids, MI 49546	N/A

Year Built: 2004
Gross Floor Area (ft²): 5,227

Energy Performance Rating² (1-100) 55

Site Energy Use Summary³

Electricity - Grid Purchase(kBtu)	93,230
Electricity - On-Site Solar(kBtu)	45,772
Electricity - On-Site Wind(kBtu)	6,142
Natural Gas (kBtu) ⁴	328,170
Total Energy (kBtu)	473,314

Energy Intensity⁵

Site (kBtu/ft ² /yr)	91
Source (kBtu/ft ² /yr)	135

Emissions (based on site energy use)

Greenhouse Gas Emissions (MtCO ₂ e/year)	38
---	----

Electric Distribution Utility

Consumers Energy Co [CMS Energy Corp]

National Median Comparison

National Median Site EUI	96
National Median Source EUI	144
% Difference from National Median Source EUI	-6%
Building Type	Office

Stamp of Certifying Professional
Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.

Meets Industry Standards⁶ for Indoor Environmental Conditions:

Ventilation for Acceptable Indoor Air Quality	N/A
Acceptable Thermal Environmental Conditions	N/A
Adequate Illumination	N/A

Certifying Professional
N/A

Notes:

1. Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
2. The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
3. Values represent energy consumption, annualized to a 12-month period.
4. Values represent energy intensity, annualized to a 12-month period.
5. Based on Meeting ASHRAE Standard 62 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

The government estimates the average time needed to fill out this form is 6 hours (includes the time for entering energy data, Licensed Professional facility inspection, and notarizing the SEP) and welcomes suggestions for reducing this level of effort. Send comments (referencing OMB control number) to the Director, Collection Strategies Division, U.S. EPA (2622T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460.

EPA Form 5900-16

Figure F-19: BIC 1.5kW Wind Turbine, Office



STATEMENT OF ENERGY PERFORMANCE

BIC K-12

Building ID: 2905932
 For 12-month Period Ending: September 30, 2011¹
 Date SEP becomes ineligible: N/A

Date SEP Generated: November 14, 2011

Facility
 BIC K-12
 1750 East Beltline Ave SE
 Grand Rapids, MI 49546

Facility Owner
 Calvin College
 3201 Burton St
 Grand Rapids, MI 49546

Primary Contact for this Facility
 N/A

Year Built: 2004
Gross Floor Area (ft²): 5,227

Energy Performance Rating² (1-100) 76

Site Energy Use Summary³

Electricity - Grid Purchase(kBtu)	85,739
Electricity - On-Site Solar(kBtu)	45,772
Electricity - On-Site Wind(kBtu)	13,634
Natural Gas (kBtu) ⁴	328,170
Total Energy (kBtu)	473,315

Energy Intensity⁵

Site (kBtu/ft ² /yr)	91
Source (kBtu/ft ² /yr)	132

Emissions (based on site energy use)

Greenhouse Gas Emissions (MtCO ₂ e/year)	36
---	----

Electric Distribution Utility

Consumers Energy Co [CMS Energy Corp]

National Median Comparison

National Median Site EUI	118
National Median Source EUI	171
% Difference from National Median Source EUI	-23%
Building Type	K-12 School

Stamp of Certifying Professional

Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.

Meets Industry Standards⁶ for Indoor Environmental Conditions:

Ventilation for Acceptable Indoor Air Quality	N/A
Acceptable Thermal Environmental Conditions	N/A
Adequate Illumination	N/A

Certifying Professional
 N/A

Notes:

1. Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
2. The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
3. Values represent energy consumption, annualized to a 12-month period.
4. Values represent energy intensity, annualized to a 12-month period.
5. Based on Meeting ASHRAE Standard 62 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

The government estimates the average time needed to fill out this form is 6 hours (includes the time for entering energy data, Licensed Professional facility inspection, and notarizing the SEP) and welcomes suggestions for reducing this level of effort. Send comments (referencing OMB control number) to the Director, Collection Strategies Division, U.S. EPA (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460.

Figure F-20: BIC 3kW Wind Turbine, K-12



STATEMENT OF ENERGY PERFORMANCE
BIC Office

Building ID: 2905982
 For 12-month Period Ending: September 30, 2011¹
 Date SEP becomes ineligible: N/A

Date SEP Generated: November 14, 2011

Facility
 BIC Office
 1750 East Beltline Ave SE
 Grand Rapids, MI 49546

Facility Owner
 Calvin College
 3201 Burton St
 Grand Rapids, MI 49546

Primary Contact for this Facility
 N/A

Year Built: 2004
Gross Floor Area (ft²): 5,227

Energy Performance Rating² (1-100) 58

Site Energy Use Summary³

Electricity - Grid Purchase(kBtu)	85,739
Electricity - On-Site Solar(kBtu)	45,772
Electricity - On-Site Wind(kBtu)	13,634
Natural Gas (kBtu) ⁴	328,170
Total Energy (kBtu)	473,315

Energy Intensity⁵

Site (kBtu/ft ² /yr)	91
Source (kBtu/ft ² /yr)	132

Emissions (based on site energy use)

Greenhouse Gas Emissions (MtCO ₂ e/year)	36
---	----

Electric Distribution Utility

Consumers Energy Co [CMS Energy Corp]

National Median Comparison

National Median Site EUI	99
National Median Source EUI	144
% Difference from National Median Source EUI	-8%
Building Type	Office

Stamp of Certifying Professional

Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.

Meets Industry Standards⁶ for Indoor Environmental Conditions:

Ventilation for Acceptable Indoor Air Quality	N/A
Acceptable Thermal Environmental Conditions	N/A
Adequate Illumination	N/A

Certifying Professional
 N/A

Notes:
 1. Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
 2. The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
 3. Values represent energy consumption, annualized to a 12-month period.
 4. Values represent energy intensity, annualized to a 12-month period.
 5. Based on Meeting ASHRAE Standard 62 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

The government estimates the average time needed to fill out this form is 6 hours (includes the time for entering energy data, Licensed Professional facility inspection, and notarizing the SEP) and welcomes suggestions for reducing this level of effort. Send comments (referencing OMB control number) to the Director, Collection Strategies Division, U.S. EPA (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460.

Figure F-21: BIC 3kW Wind Turbine, Office



STATEMENT OF ENERGY PERFORMANCE

BIC K-12

Building ID: 2905932
 For 12-month Period Ending: September 30, 2011¹
 Date SEP becomes ineligible: N/A

Date SEP Generated: November 13, 2011

Facility
 BIC K-12
 1750 East Beltline Ave SE
 Grand Rapids, MI 49546

Facility Owner
 Calvin College
 3201 Burton St
 Grand Rapids, MI 49546

Primary Contact for this Facility
 N/A

Year Built: 2004
Gross Floor Area (ft²): 5,227

Energy Performance Rating² (1-100) 72

Site Energy Use Summary³

Electricity - Grid Purchase(kBtu)	99,370
Electricity - On-Site Solar(kBtu)	45,772
Natural Gas (kBtu) ⁴	325,561
Total Energy (kBtu)	470,703

Energy Intensity⁵

Site (kBtu/ft ² /yr)	90
Source (kBtu/ft ² /yr)	137

Emissions (based on site energy use)

Greenhouse Gas Emissions (MtCO ₂ e/year)	39
---	----

Electric Distribution Utility

Consumers Energy Co [CMS Energy Corp]

National Median Comparison

National Median Site EUI	112
National Median Source EUI	171
% Difference from National Median Source EUI	-20%
Building Type	K-12 School

Stamp of Certifying Professional

Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.

Meets Industry Standards⁶ for Indoor Environmental Conditions:

Ventilation for Acceptable Indoor Air Quality	N/A
Acceptable Thermal Environmental Conditions	N/A
Adequate Illumination	N/A

Certifying Professional
 N/A

Notes:
 1. Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
 2. The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
 3. Values represent energy consumption, annualized to a 12-month period.
 4. Values represent energy intensity, annualized to a 12-month period.
 5. Based on Meeting ASHRAE Standard 62 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

The government estimates the average time needed to fill out this form is 6 hours (includes the time for entering energy data, Licensed Professional facility inspection, and notarizing the SEP) and welcomes suggestions for reducing this level of effort. Send comments (referencing OMB control number) to the Director, Collection Strategies Division, U.S., EPA (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460.

Figure F-22: BIC Window Improvement, K-12



STATEMENT OF ENERGY PERFORMANCE
BIC Office

Building ID: 2905082
 For 12-month Period Ending: September 30, 2011¹
 Date SEP becomes ineligible: N/A

Date SEP Generated: November 13, 2011

Facility
 BIC Office
 1750 East Beltline Ave SE
 Grand Rapids, MI 49546

Facility Owner
 Calvin College
 3201 Burton St
 Grand Rapids, MI 49546

Primary Contact for this Facility
 N/A

Year Built: 2004
 Gross Floor Area (ft²): 5,227

Energy Performance Rating² (1-100) 54

Site Energy Use Summary³

Electricity - Grid Purchase(kBtu)	99,370
Electricity - On-Site Solar(kBtu)	45,772
Natural Gas (kBtu) ⁴	325,561
Total Energy (kBtu)	470,703

Energy Intensity⁵

Site (kBtu/ft ² /yr)	90
Source (kBtu/ft ² /yr)	137

Emissions (based on site energy use)

Greenhouse Gas Emissions (MtCO ₂ e/year)	39
---	----

Electric Distribution Utility

Consumers Energy Co [CMS Energy Corp]

National Median Comparison

National Median Site EUI	94
National Median Source EUI	144
% Difference from National Median Source EUI	-4%
Building Type	Office

Stamp of Certifying Professional

Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.

Meets Industry Standards⁶ for Indoor Environmental Conditions:

Ventilation for Acceptable Indoor Air Quality	N/A
Acceptable Thermal Environmental Conditions	N/A
Adequate Illumination	N/A

Certifying Professional
 N/A

Notes:

1. Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
2. The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
3. Values represent energy consumption, annualized to a 12-month period.
4. Values represent energy intensity, annualized to a 12-month period.
5. Based on Meeting ASHRAE Standard 62 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

The government estimates the average time needed to fill out this form is 8 hours (includes the time for entering energy data, Licensed Professional facility inspection, and notarizing the SEP) and welcomes suggestions for reducing this level of effort. Send comments (referencing OMB control number) to the Director, Collection Strategies Division, U.S., EPA (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460.

Figure F-23: BIC Window Improvements, Office



STATEMENT OF ENERGY PERFORMANCE

BIC K-12

Building ID: 2905932
 For 12-month Period Ending: September 30, 2011¹
 Date SEP becomes ineligible: N/A

Date SEP Generated: November 13, 2011

Facility
 BIC K-12
 1750 East Beltline Ave SE
 Grand Rapids, MI 49546

Facility Owner
 Calvin College
 3201 Burton St
 Grand Rapids, MI 49546

Primary Contact for this Facility
 N/A

Year Built: 2004
Gross Floor Area (ft²): 5,227

Energy Performance Rating² (1-100) 75

Site Energy Use Summary³

Electricity - Grid Purchase(kBtu)	93,148
Electricity - On-Site Solar(kBtu)	45,772
Natural Gas (kBtu) ⁴	328,168
Total Energy (kBtu)	467,088

Energy Intensity⁵

Site (kBtu/ft ² /yr)	89
Source (kBtu/ft ² /yr)	134

Emissions (based on site energy use)

Greenhouse Gas Emissions (MtCO ₂ e/year)	38
---	----

Electric Distribution Utility

Consumers Energy Co [CMS Energy Corp]

National Median Comparison

National Median Site EUI	114
National Median Source EUI	171
% Difference from National Median Source EUI	-22%
Building Type	K-12 School

Stamp of Certifying Professional

Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.

Meets Industry Standards⁶ for Indoor Environmental Conditions:

Ventilation for Acceptable Indoor Air Quality	N/A
Acceptable Thermal Environmental Conditions	N/A
Adequate Illumination	N/A

Certifying Professional
 N/A

Notes:

1. Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
2. The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
3. Values represent energy consumption, annualized to a 12-month period.
4. Values represent energy intensity, annualized to a 12-month period.
5. Based on Meeting ASHRAE Standard 62 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

The government estimates the average time needed to fill out this form is 6 hours (includes the time for entering energy data, Licensed Professional facility inspection, and notarizing the SEP) and welcomes suggestions for reducing this level of effort. Send comments (referencing OMB control number) to the Director, Collection Strategies Division, U.S., EPA (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460.

Figure F-24: BIC Zoned Ventilation, K-12



STATEMENT OF ENERGY PERFORMANCE BIC Office

Building ID: 2905982
For 12-month Period Ending: September 30, 2011¹
Date SEP becomes ineligible: N/A

Date SEP Generated: November 13, 2011

Facility	Facility Owner	Primary Contact for this Facility
BIC Office 1750 East Beltline Ave SE Grand Rapids, MI 49546	Calvin College 3201 Burton St Grand Rapids, MI 49546	N/A

Year Built: 2004
Gross Floor Area (ft²): 5,227

Energy Performance Rating² (1-100) 56

Site Energy Use Summary³

Electricity - Grid Purchase(kBtu)	93,148
Electricity - On-Site Solar(kBtu)	45,772
Natural Gas (kBtu) ⁴	328,170
Total Energy (kBtu)	467,090

Energy Intensity⁵

Site (kBtu/ft ² /yr)	89
Source (kBtu/ft ² /yr)	134

Emissions (based on site energy use)

Greenhouse Gas Emissions (MtCO ₂ e/year)	38
---	----

Electric Distribution Utility

Consumers Energy Co [CMS Energy Corp]

National Median Comparison

National Median Site EUI	96
National Median Source EUI	144
% Difference from National Median Source EUI	-7%
Building Type	Office

Stamp of Certifying Professional
Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.

Meets Industry Standards⁶ for Indoor Environmental Conditions:

Ventilation for Acceptable Indoor Air Quality	N/A
Acceptable Thermal Environmental Conditions	N/A
Adequate Illumination	N/A

Certifying Professional
N/A

Notes:

1. Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
2. The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
3. Values represent energy consumption, annualized to a 12-month period.
4. Values represent energy intensity, annualized to a 12-month period.
5. Based on Meeting ASHRAE Standard 62 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

The government estimates the average time needed to fill out this form is 6 hours (includes the time for entering energy data, Licensed Professional facility inspection, and notarizing the SEP) and welcomes suggestions for reducing this level of effort. Send comments (referencing OMB control number) to the Director, Collection Strategies Division, U.S. EPA (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460.

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Figure F-25: BIC Zoned Ventilation, Office



STATEMENT OF ENERGY PERFORMANCE Nature Park Interpretive Center

Building ID: 2930110
For 12-month Period Ending: September 30, 2011¹
Date SEP becomes ineligible: N/A

Date SEP Generated: November 21, 2011

Facility Nature Park Interpretive Center 15655 Southwest Millikan Way Beaverton, OR 97006	Facility Owner Calvin College 3201 Burton St Grand Rapids, MI 49546	Primary Contact for this Facility N/A
---	---	---

Year Built: 2000
Gross Floor Area (ft²): 7,700

Energy Performance Rating² (1-100) 20

Site Energy Use Summary³

Electricity - Grid Purchase(kBtu)	392,080
Natural Gas (kBtu) ⁴	190,500
Total Energy (kBtu)	582,580

Energy Intensity⁵

Site (kBtu/ft ² /yr)	76
Source (kBtu/ft ² /yr)	196

Emissions (based on site energy use)

Greenhouse Gas Emissions (MtCO ₂ e/year)	55
---	----

Electric Distribution Utility

Portland General Electric Co

National Median Comparison

National Median Site EUI	57
National Median Source EUI	148
% Difference from National Median Source EUI	32%
Building Type	K-12 School

<p>Stamp of Certifying Professional</p> <p>Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.</p>

Meets Industry Standards⁵ for Indoor Environmental Conditions:

Ventilation for Acceptable Indoor Air Quality	N/A
Acceptable Thermal Environmental Conditions	N/A
Adequate Illumination	N/A

Certifying Professional
N/A

Notes:

1. Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
2. The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
3. Values represent energy consumption, annualized to a 12-month period.
4. Values represent energy intensity, annualized to a 12-month period.
5. Based on Meeting ASHRAE Standard 62 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

The government estimates the average time needed to fill out this form is 6 hours (includes the time for entering energy data, Licensed Professional facility inspection, and notarizing the SEP) and welcomes suggestions for reducing this level of effort. Send comments (referencing OMB control number) to the Director, Collection Strategies Division, U.S., EPA (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460.

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Figure F-26: Nature Park Interpretive Center, Sheet 1

FOR YOUR RECORDS ONLY. DO NOT SUBMIT TO EPA.

Please keep this Facility Summary for your own records; do not submit it to EPA. Only the Statement of Energy Performance (SEP), Data Checklist and Letter of Agreement need to be submitted to EPA when applying for the ENERGY STAR.

Facility
Nature Park Interpretive Center
15655 Southwest Millikan Way
Beaverton, OR 97006

Facility Owner
Calvin College
3201 Burton St
Grand Rapids, MI 49546

Primary Contact for this Facility
N/A

General Information

Nature Park Interpretive Center	
Gross Floor Area Excluding Parking: (ft ²)	7,700
Year Built	2000
For 12-month Evaluation Period Ending Date:	September 30, 2011

Facility Space Use Summary

building	
Space Type	K-12 School
Gross Floor Area(ft ²)	7,700
Open Weekends?	Yes
Number of PCs	2
Number of walk-in refrigeration/freezer units	0
Presence of cooking facilities	No
Percent Cooled	90
Percent Heated	90
Months ^a	12
High School?	No
School District ^b	N/A

Energy Performance Comparison

Performance Metric	Evaluation Periods		Comparisons		
	Current (Ending Date 09/30/2011)	Baseline (Ending Date 09/30/2011)	Rating of 76	Target	National Median
Energy Performance Rating	20	20	75	N/A	50
Energy Intensity					
Site (kBtu/ft ²)	76	76	45	N/A	57
Source (kBtu/ft ²)	196	196	116	N/A	148
Energy Cost					
\$/year	N/A	N/A	N/A	N/A	N/A
¢/ft ² /year	N/A	N/A	N/A	N/A	N/A
Greenhouse Gas Emissions					
MtCO ₂ e/year	55	55	33	N/A	42
kgCO ₂ e/ft ² /year	7	7	4	N/A	5

More than 50% of your building is defined as K-12 School. Please note that your rating accounts for all of the spaces listed. The National Median column presents energy performance data your building would have if your building had a median rating of 50.

Notes:

a - This attribute is optional.

b - A default value has been supplied by Portfolio Manager.

Figure F-27: Nature Park Interpretive Center, Sheet 2



STATEMENT OF ENERGY PERFORMANCE Degraaf Nature Center

Building ID: 2930071
For 12-month Period Ending: September 30, 2011¹
Date SEP becomes ineligible: N/A

Date SEP Generated: November 15, 2011

Facility	Facility Owner	Primary Contact for this Facility
Degraaf Nature Center 600 Graafschap Road Holland, MI 49423	Calvin College 3201 Burton St Grand Rapids, MI 49546	N/A

Year Built: 2000
Gross Floor Area (ft²): 3,111

Energy Performance Rating² (1-100) N/A

Site Energy Use Summary³

Electricity - Grid Purchase(kBtu)	59,737
Natural Gas (kBtu) ⁴	102,896
Total Energy (kBtu)	162,633

Energy Intensity⁵

Site (kBtu/ft ² /yr)	52
Source (kBtu/ft ² /yr)	99

Emissions (based on site energy use)

Greenhouse Gas Emissions (MtCO ₂ e/year)	19
---	----

Electric Distribution Utility

Holland Board of Public Works

National Median Comparison

National Median Site EUI	57
National Median Source EUI	145
% Difference from National Median Source EUI	-32%
Building Type	K-12 School

Stamp of Certifying Professional

Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.

Meets Industry Standards⁵ for Indoor Environmental Conditions:

Ventilation for Acceptable Indoor Air Quality	N/A
Acceptable Thermal Environmental Conditions	N/A
Adequate Illumination	N/A

Certifying Professional
N/A

Notes:

- Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
- The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
- Values represent energy consumption, annualized to a 12-month period.
- Values represent energy intensity, annualized to a 12-month period.
- Based on Meeting ASHRAE Standard 62 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

The government estimates the average time needed to fill out this form is 6 hours (includes the time for entering energy data, Licensed Professional facility inspection, and notarizing the SEP) and welcomes suggestions for reducing this level of effort. Send comments (referencing OMB control number) to the Director, Collection Strategies Division, U.S. EPA (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460.

EPA Form 5900-16

Figure F-28: DeGraaf Nature Center, Sheet 1

FOR YOUR RECORDS ONLY. DO NOT SUBMIT TO EPA.

Please keep this Facility Summary for your own records; do not submit it to EPA. Only the Statement of Energy Performance (SEP), Data Checklist and Letter of Agreement need to be submitted to EPA when applying for the ENERGY STAR.

Facility
 Degraaf Nature Center
 600 Graafschap Road
 Holland, MI 49423

Facility Owner
 Calvin College
 3201 Burton St
 Grand Rapids, MI 49546

Primary Contact for this Facility
 N/A

General Information

Degraaf Nature Center	
Gross Floor Area Excluding Parking: (ft ²)	3,111
Year Built	2000
For 12-month Evaluation Period Ending Date:	September 30, 2011

Facility Space Use Summary

building	
Space Type	K-12 School
Gross Floor Area(ft ²)	3,111
Open Weekends?	Yes
Number of PCs	2
Number of walk-in refrigeration/freezer units	0
Presence of cooking facilities	No
Percent Cooled	90
Percent Heated	90
Months ^a	12
High School?	No
School District ^b	N/A

Energy Performance Comparison

Performance Metrics	Evaluation Periods		Comparisons		
	Current (Ending Date 09/30/2011)	Baseline (Ending Date 09/30/2011)	Rating of 75	Target	National Median
Energy Performance Rating	N/A	N/A	75	N/A	N/A
Energy Intensity					
Site (kBtu/ft ²)	52	52	74	N/A	57
Source (kBtu/ft ²)	99	99	139	N/A	145
Energy Cost					
\$/year	N/A	N/A	N/A	N/A	N/A
\$/ft ² /year	N/A	N/A	N/A	N/A	N/A
Greenhouse Gas Emissions					
MtCO ₂ e/year	19	19	27	N/A	21
kgCO ₂ e/ft ² /year	6	6	8	N/A	7

More than 50% of your building is defined as K-12 School. This building is currently ineligible for a rating. Please note the National Median column represents the CBECG national median data for K-12 School. This building uses 32% less energy per square foot than the CBECG national median for K-12 School.

Notes:

o - This attribute is optional.

d - A default value has been supplied by Portfolio Manager.

Figure F-29: DeGraaf Nature Center, Sheet 2



STATEMENT OF ENERGY PERFORMANCE Environmental Interpretive Center

Building ID: 2930183
For 12-month Period Ending: September 30, 2011¹
Date SEP becomes ineligible: N/A

Date SEP Generated: November 15, 2011

Facility
Environmental Interpretive Center
4901 Evergreen Road
Dearborn, MI 48128

Facility Owner
Calvin College
3201 Burton St
Grand Rapids, MI 49546

Primary Contact for this Facility
N/A

Year Built: 2001
Gross Floor Area (ft²): 13,000

Energy Performance Rating² (1-100): 9

Site Energy Use Summary³

Electricity - Grid Purchase(kBtu)	422,003
Natural Gas (kBtu) ⁴	1,531,049
Total Energy (kBtu)	1,953,052

Energy Intensity⁵

Site (kBtu/ft ² /yr)	150
Source (kBtu/ft ² /yr)	232

Emissions (based on site energy use)
Greenhouse Gas Emissions (MtCO₂e/year) 175

Electric Distribution Utility
Detroit Edison Co (The) [DTE Energy Co]

National Median Comparison

National Median Site EUI	98
National Median Source EUI	148
% Difference from National Median Source EUI	57%
Building Type	K-12 School

Stamp of Certifying Professional

Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.

Meets Industry Standards⁵ for Indoor Environmental Conditions:

Ventilation for Acceptable Indoor Air Quality	N/A
Acceptable Thermal Environmental Conditions	N/A
Adequate Illumination	N/A

Certifying Professional
N/A

Notes:
1. Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
2. The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
3. Values represent energy consumption, annualized to a 12-month period.
4. Values represent energy intensity, annualized to a 12-month period.
5. Based on Meeting ASHRAE Standard 62 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

The government estimates the average time needed to fill out this form is 6 hours (includes the time for entering energy data, Licensed Professional facility inspection, and notarizing the SEP) and welcomes suggestions for reducing this level of effort. Send comments (referencing OMB control number) to the Director, Collection Strategies Division, U.S. EPA (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460.

Figure F-30: Environmental Interpretive Center, Sheet 1

FOR YOUR RECORDS ONLY. DO NOT SUBMIT TO EPA.

Please keep this Facility Summary for your own records; do not submit it to EPA. Only the Statement of Energy Performance (SEP), Data Checklist and Letter of Agreement need to be submitted to EPA when applying for the ENERGY STAR.

Facility
Environmental Interpretive Center
4901 Evergreen Road
Dearborn, MI 48128

Facility Owner
Calvin College
3201 Burton St
Grand Rapids, MI 49546

Primary Contact for this Facility
N/A

General Information

Environmental Interpretive Center	
Gross Floor Area Excluding Parking: (ft ²)	13,000
Year Built	2001
For 12-month Evaluation Period Ending Date:	September 30, 2011

Facility Space Use Summary

Building	
Space Type	K-12 School
Gross Floor Area(ft ²)	13,000
Open Weekends?	Yes
Number of PCs	2
Number of walk-in refrigeration/freezer units	0
Presence of cooking facilities	No
Percent Cooled	90
Percent Heated	90
Months ^a	N/A
High School?	No
School District ^b	N/A

Energy Performance Comparison

Performance Metric	Evaluation Periods		Comparisons		
	Current (Ending Date 09/30/2011)	Baseline (Ending Date 09/30/2011)	Rating of 76	Target	National Median
Energy Performance Rating	9	9	75	N/A	50
Energy Intensity					
Site (kBtu/ft ²)	150	150	75	N/A	96
Source (kBtu/ft ²)	232	232	115	N/A	148
Energy Cost					
\$/year	N/A	N/A	N/A	N/A	N/A
¢/ft ² /year	N/A	N/A	N/A	N/A	N/A
Greenhouse Gas Emissions					
MtCO ₂ e/year	175	175	87	N/A	111
kgCO ₂ e/ft ² /year	13	13	6	N/A	8

More than 50% of your building is defined as K-12 School. Please note that your rating accounts for all of the spaces listed. The National Median column presents energy performance data your building would have if your building had a median rating of 50.

Notes:

a - This attribute is optional.

b - A default value has been supplied by Portfolio Manager.

Figure F-31: Environmental Interpretive Center, Sheet 2

APPENDIX G: Proposed Improvements Detail

Solar Water Heater:

The BIC uses its existing boiler for two main purposes: radiant heat flow from running hot water through the floor pipes, and heating running water for domestic use. The boiler runs on burning natural gas. The group received natural gas numbers from Paul Pennock and determined that the natural gas usage is a leading source of energy use and EUI contributions in the BIC. The Renewable Energy and External Comparisons group analyzed renewable sources to reduce the BIC's EUI and determined that a solar water heater could be effective in reducing significant natural gas usage.

A solar water heater was found online, the specifications of which are contained below. A notable specification is that the system promises to produce 100 liters of water at 60 degrees Celsius per day under optimal solar conditions.

- Model Name: JXIP480-58/1800-10
- 10 parallel heating tubes (works if individual tubes are inactive)
- 0.8 square meter area
- 15/30/45/60 degree angle options
- 100L 60°C water supplied at max solar per day
- \$614.78 for system
- Approximately \$5000 total cost with installation.

The BIC already has a solar array of PV panels on the East and West roofs, the energy of which is monitored by Calvin data logging systems. From this data we are able to estimate the amount of solar energy to expect throughout the year. The solar trend throughout the year is presented in Figure G-1 which was used to calculate expected production of hot water.

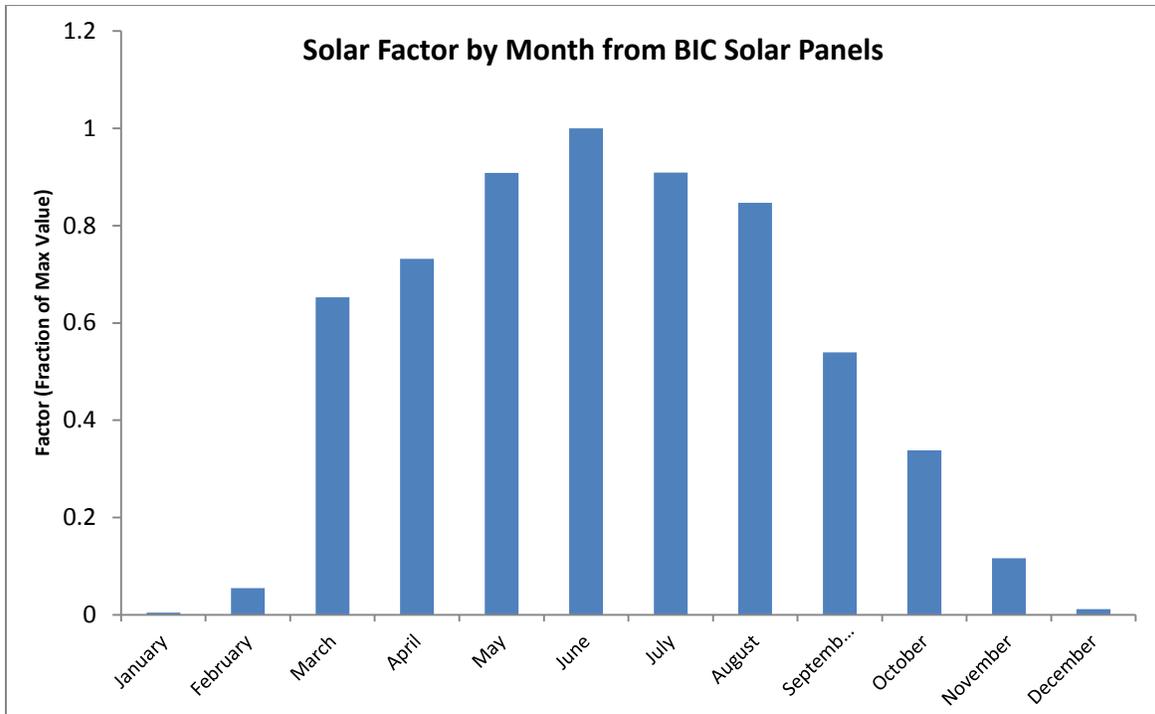


Figure G-32. Monthly Solar Trends in Grand Rapids from Solar PV Data

From prior study and knowledge of Michigan’s solar situation, a limiting factor of 70% was implemented since Michigan never reaches optimal solar conditions that the website says the system needs to produce the 100 liters of water per day. This limited solar factor in conjunction with the monthly trend data allowed an analysis of the expected production of hot water per year.

The data taken from the BIC from the 382 class provided numbers for gallons of water flowing through the boiler and the natural gas usage for prior months. A month was analyzed to produce a constant for gas usage per gallon of hot water in order to convert hot water production to natural gas savings. The expected numbers for the year are presented below.

Table G-5. Expected Natural Gas Savings Numbers

	January	February	March	April	May	June	July	August	September	October	November	December
Solar Trend 2010	11.2	128.1	1521	1705.2	2115.3	2329.4	2118.1	1973.1	1256.3	787.2	271.2	28.1
Factor	0.004808	0.054993	0.652958	0.732034	0.908088	1	0.90929	0.847042	0.539323431	0.337941	0.1164248	0.0120632
Gallons/Day expected	0.088912	1.016927	12.07452	13.5368	16.7924	18.49204	16.81463	15.66354	9.973192445	6.249222	2.1529331	0.2230731
Gallons/month saved	2.667351	30.50782	362.2357	406.1041	503.772	554.7613	504.4389	469.9062	299.1957733	187.4766	64.587992	6.6921923
BTU saved/month	151702.3	1735095	20601719	19297987	15719999	33583123	23420410	16300129	13181813.22	10662507	3673363.7	380610.32

The numbers for expected savings were compared with the natural gas usage numbers for the BIC, since savings cannot exceed usage. This comparison is framed in the figure below.

From running these savings through the Portfolio Manager program, we can expect a 16 kBTU/ft²-yr reduction in EUI from this solar water heater.

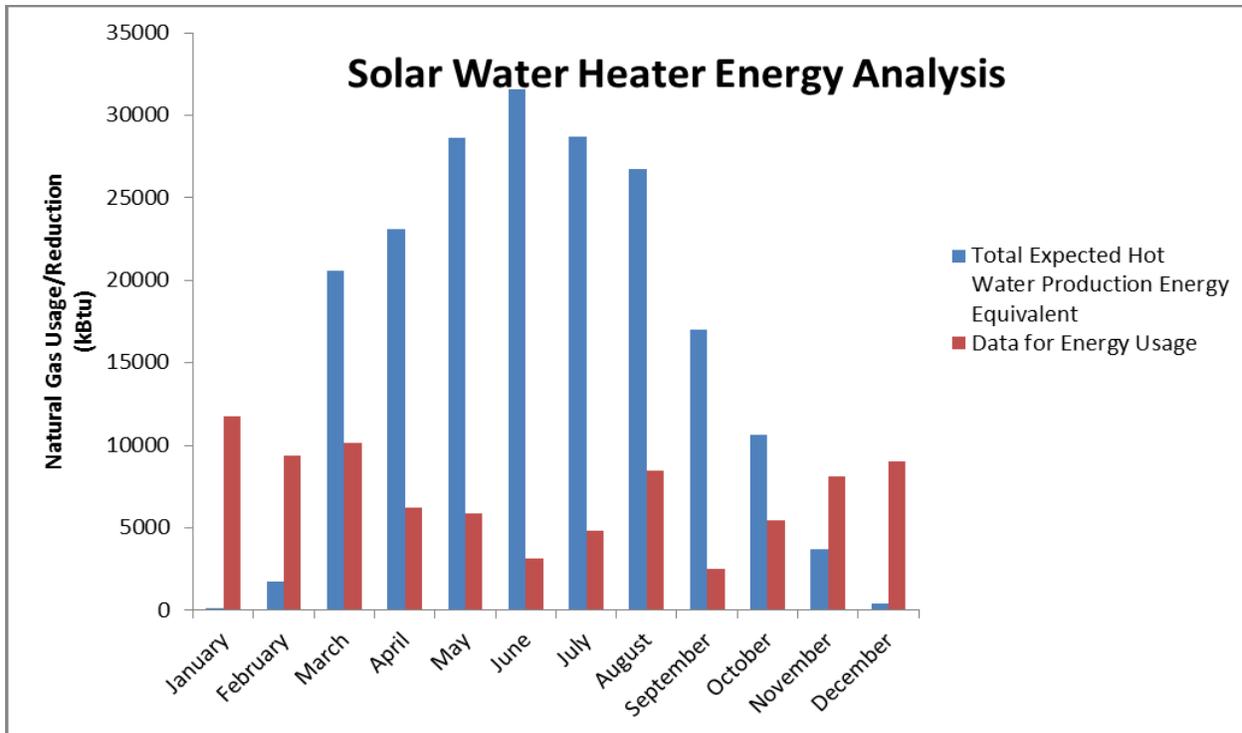


Figure G-33. Expected Natural Gas Savings

Pumps:

The BIC is heated by a conventional duct heating system as well as a radiant floor heating system. The radiant floor system uses networks of pipes carrying hot water to heat provide heat to the floors. There are 4 pumps that circulate the water around the building that continuously throughout the year. The electricity team suggests that a controller could be used to shut off the pumps during the summer months when the building is not being heated and thus reducing the electricity use of the pumps. If the pumps are turned off the electricity savings are calculated to be 824 kWh/month. If the pumps are turned off for the summer months June, July, August, and September the yearly energy savings are calculated to be 3296 kW/year. These estimates are biased off of on time data provided by Hobbs meters for the months of June through November 2011. Kilowatt hours were then calculated using the wattage ratings of each pump. The wattage ratings and power consumption of each pump used in the radiant floor heating system are listed in Table G-2 and G-3 respectively.

Table G-2: Radiant Floor Pump Wattage Ratings

Pump Number	Pump 1	Pump 2	Pump 3	Pump 4
Wattage Rating (W)	215	245	205	440

Table G-3: Radiant Floor Pump Power Consumption

	Pump 1 - Hobbs meter	Pump 2 - Hobbs meter	Pump 3 - Hobbs meter	Pump 4 - Hobbs meter
	[kWh]	[kWh]	[kWh]	[kWh]
June	166	189	158	339
July	154	176	147	316
August	170	193	162	347
September	152	172	144	311
October	153	175	146	313
November	176	200	128	360

The team consulted with Paul Pennock, an expert in mechanical projects, who suggested running the pumps 10 to 15 minutes every 3 days to prevent the pumps from binding. For this reason a programmable pump controller is suggested to be used to turn each pump off and on during the summer months. Carlson meter PPC5001 is suggested to control each pump.