Engineering Management Field Project

Payback Analysis for Ground Source Heat Pump Retrofits Using *eQuest* Modeling Software

By

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I would like to thank my committee members for enabling me with the educational and professional competencies to pursue this degree. They have also provided me the path through which to complete this field project.

I would also like to thank my wife and family for motivating me to complete this field project and my master's degree.

Executive Summary

There has been much research and analysis done on the performance and potential energy savings related to installing a ground source heat pump (GSHP) system. Much of this research has been dedicated to the new construction industry, and focused on a case by case basis. Many of these case studies are different in scope and magnitude and thus comparison between the studies is often difficult. This research shall determine the payback of converting an existing building with a water source heat pump system (WSHP) to a ground source heat pump system (GSHP) system in four different regions of the United States using *eQuest* modeling software. The model building shall remain constant as it is simulated in the following test locations:

1. Dallas, Texas
2. Los Angeles, California
3. Minneapolis, Minnesota
4. Richmond, Virginia

This research shall separate the constant variables from the differentiating variables and determine what has the most influential affect on the simple payback.

eQuest modeling software is a highly regarded modeling tool in the building energy analysis industry. Engineering firms and energy consultants often rely on this software to determine building heating and cooling loads as well as predicting energy savings. This research shall

also analyze the capabilities and limitations of *eQuest* modeling software for simulating ground source heat pump systems.

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Glossary of Terms

Building Load Profile – A building's heating and cooling requirements for a period of time. This is typically expressed in BTUs on an hourly basis over a year's time.

Btu - British Thermal Units - a measurement of energy consumption. More specifically, the quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit at 39 or 60 degrees. Note: MBtu = 1,000 Btu; MMBtu = 1,000,000 Btu

GSHP – Ground source heat pump. A heat pump that uses water instead of air as the heat transfer medium. The water is then circulated though the ground whereby heat is transferred.

HVAC – Heating, ventilation, and air-conditioning.

Heat Pump – An air-conditioning device that uses a refrigeration cycle for cooling. The cycle is reversed for heating.

kBTU - a measurement of energy consumption = 1,000 British Thermal Units

kWh - Kilowatt-Hours. This is the unit of measurement for electrical consumption. One kWh is equivalent to the energy consumed by ten 100-watt light bulbs burning for one hour.

Therm – A unit of heat equal to 100,000 British thermal units.

WSHP **– Water source heat pump. A heat pump that uses water instead of air as the heat transfer medium.**

Chapter 1 – Introduction

Ground source heat pump (GSHP) systems have been an energy-efficient alternative in heating, cooling, and ventilation design. With the design and development for over 60 years (IGSHPA 2009), the GSHP system has become an increasingly viable and accepted technology.

The downside of the technology has been the construction costs as compared to conventional designs. However, with the changing parameters such as rising utility costs, and more cost-effective technologies emerging in the design, the GSHP is becoming a more considerable option for new construction. Several studies have indicated that when deciding between a conventional air conditioner/gas furnace system, and a GSHP system, the cost to savings payback has deemed to be between 5-15 years (Lienau, Boyd, and Rogers 1995). Existing studies and research such as this shall be discussed further in the Literary Research section of the report.

Although several studies have been conducted for in the new construction realm, little analysis has been done for existing buildings. It has been estimated that existing commercial buildings alone use 18% of the total consumed energy in the United States. Of that energy, in BTUs, over 70% is used for heating, cooling, and ventilation (Capehart et al 2008). Existing building owners, with their antiquated equipment, are often unaware of the benefits of high efficiency technologies that could provide long-term utility cost savings. The payback for a retrofit would presumably be higher than new construction since existing equipment is being replaced. With new construction, a capital investment is required no matter what equipment is selected. In the case of a new construction project, the cost of the GSHP system can be subtracted from the cost of the conventional design to determine the payback. This would make the payback time shorter than a retrofit application.

The purpose of this research shall focus on four diverse regions in the country and determine the payback from retrofitting an existing heating and cooling system with a ground source heat pump system. This analysis shall be determined in the following locations:

1. Los Angeles, California
2. Dallas, Texas
3. Richmond, Virginia
4. Minneapolis, Minnesota

These cities were strategically chosen to showcase a broad range for varying parameters that would influence the paybacks of a GSHP system retrofit. The research shall analyze the following independent variables for each city:

Weather

Local weather patterns play a significant factor in utility costs. Since most of the energy consumed in buildings is heating, cooling, and ventilation, energy usage is highly weather dependent. Cities with more extreme weather conditions shall render more energy usage to condition the buildings, whereas cities in milder climates will use less energy in comparison. The cities chosen for this analysis shall cover a broad range of weather patterns in order to produce different results.

Ground Conductance

Ground conductance has a significant effect on the performance of the GSHP system. This value would determine how well the heat can be exchanged between the circulating fluid, and the earth. Thus, a higher ground conductance value shall yield a more energy efficient system. As the soil type varies though the region of the country so does the ground conductance values. For each city, a ground conductance value shall be determined and considered for the analysis.

Cost of Construction

Although the scope of work shall remain shall remain constant, there are other factors that influence the cost of construction. Well field size will vary depending upon location. Different weather patterns induce different system sizing and specifications. An energy model shall determine the system sizing. This will be discussed further in the Methods and Procedure section.

Utility Costs

Utility costs are also a diversifying element in the payback analysis. Utility rates vary greatly throughout the region. The greater the utility costs, the greater costs savings opportunity. For each city, utility baseline and post-retrofit costs shall be simulated using the energy modeling software, and the local utility tariff.

Energy Savings

Energy saving performance shall be analyzed using energy modeling software. This research shall expose the capabilities and limitations of *eQuest* software to simulate GSHP system. eQuest shall be the modeling platform used to determine the baseline energy usage as well as the post energy usage after the installation of the GSHP system. This process shall be replicated for each city. Input parameters such as weather and ground conductance shall be used to determine energy performance. The energy model shall take into account several parameters that shall remain constant as the simulations are performed for each city. These constant parameters shall include the following:

1. Building Size, Shape, and Orientation
2. Door and Windows Sizes and Orientation
3. Occupant Density
4. Lighting Loads
5. Miscellaneous Loads (Computers, Vending Machines etc…)
6. Heating and Cooling Setpoints

With the outlined procedure, this research should provide credible results that would indicate cost to savings ratios for a GSHP retrofit. Results shall be summarized in the Executive Summary section, and explained in detail in the Result section of the report.

Chapter 2 – Literature Review

There are several realms of research for GSHP Systems. This review shall begin coverage of the broad topics of research available, and then drive down to detail and increasing relevance to the topic and purpose of this research. Specifics of the problem statement, analysis, and design shall be discussed in the Methods and Procedure section.

International Ground Source Heat Pump Association (IGSHPA)

Although the technology has existed for over a century, the utilization of GSHP systems in buildings and residential areas is a relatively new technology. Several entities exist to promote awareness and advancement of these designs. The largest of these entities is the International Ground Source Heat Pump Association (IGSHPA). They seek to train and educate the public, more specifically architects, engineers, and contractors about GSHP designs and applications. They hold a variety of training seminars, workshops, to train and certify contractors and engineers in the industry. They also hold annual conferences to bring vendors, architects, engineers, and contractors together in an effort to promote the use of these systems. (IGSHPA 2011).

GSHP Basics

As with the IGSHPA, there are several resources that provide basic descriptions of GSHP systems. The goal of these resources is to better educate the public of the technology and promote the technology as a means of saving energy. The Department of Energy provides a several descriptions on their webpage. They describe and provide illustrations of different ground loop types including a horizontal loop, vertical loop, and pond loop, where the loop is submerged into a body of water (Department of Energy 2011). They also describe open loop systems, where the ground exchange loop is open to the atmosphere. Below are the illustrations provided on the Department of Energy's webpage:

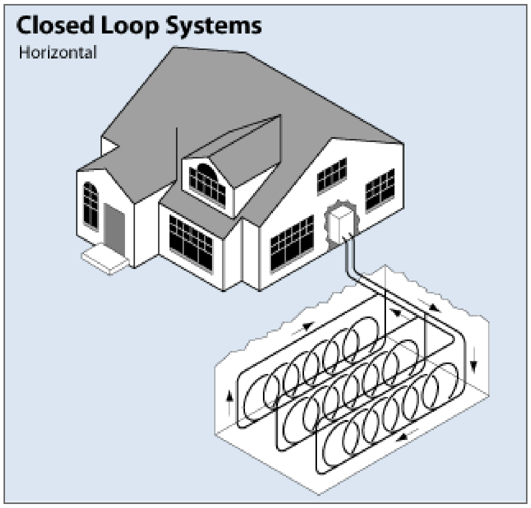

Figure 1

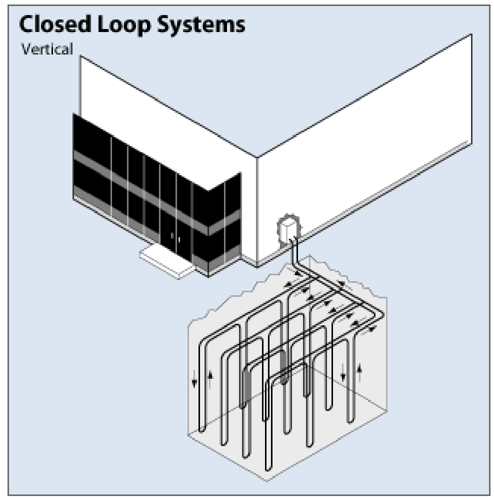

Figure 2

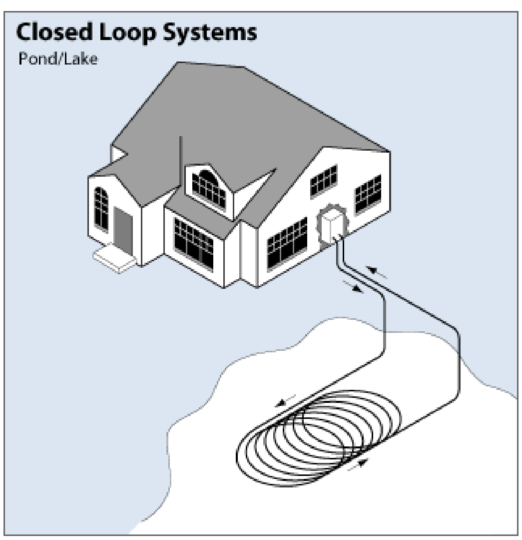

Figure 3

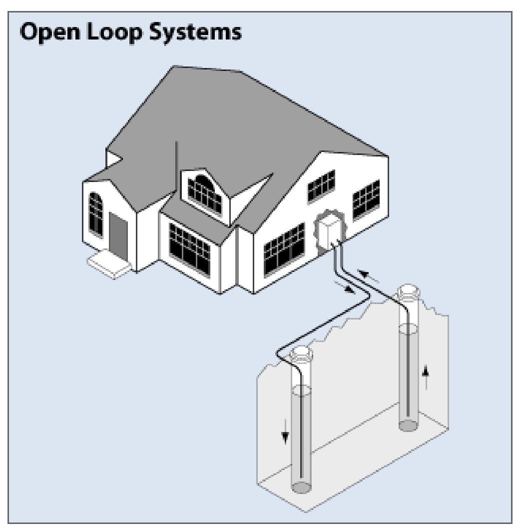

Figure 4

The system type for this research analysis shall be the closed, vertical loop configuration. The purpose of this research is to analyze the same system design and the payback comparison of four different regions in the U.S.. System selection and analysis approach shall be discussed further in the Methodology and Procedure section. Several other organizations contribute articles describing the basics of this technology. The Energy Center of Wisconsin has contributed to various articles in magazines providing awareness and basic education of the technology (Energy Center of Wisconsin 2011). Geoexchange is an organization that serves as a customer interface to not only provide basic education of GSHP technologies, but also provide lists of certified contractors that install GSHP systems (Geoexchange 2011).

GSHP Theory, Design, and Applications

There are several organizations that exist which fund and provide research to the advancement of GSHP design and applications. The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) is an international organization that strives to set standards for HVAC design and applications. Their revolving publications provide several resources for GSHP design. *ASHRAE Fundamentals* provides the fundamental theory of equations gathered by both internal and external research by which GSHP are sized and designed (ASHRAE Fundamentals 2009). *ASHRAE Systems and Equipment* provides a more high-level description of the system's components as well as general design and construction practices (ASHRAE Systems and Equipment 2008). *ASHRAE Applications* provides high-level descriptions of how GSHP system are applied, more specifically, what design fits best for certain buildings and geographical regions (ASHRAE

Applications 2011). The Energy Center of Wisconsin also provides a few publications for design and construction best practices. The IGSHPA also provides a series of design guides and manuals for GSHP systems (IGSHPA Publications 2006). In addition to societies and research organizations, vendors and equipment manufacturers have also contributed to GSHP design practices. Mcquay, a large HVAC equipment manufacturer published a design manual describing all of the components and considerations in GSHP design (McQuay International 2002).

Software and Modeling

There has been several software platforms developed for GSHP design for two primary purposes:

1. To effectively size the ground loop field depending upon the loop configuration.
2. To model the energy usage of a given ground loop design.

The first type of software inputs building heating and cooling loads and other location specific parameters such and loop type, ground conductivity and temperature. This data is then used to determine the size of the well field. A variety of this design software exists and varies in size and complexity. The following is a list of software platforms that provide well field design:

1. GLHEPRO 4.0
2. CLGS Software

The second type of software provides a more holistic approach. This type of software not only has the capability to size the ground loops, it also provides an energy model through which energy usage and savings can be evaluated and determined. This research shall determine the energy usage and savings for retrofitting a GSHP into an existing building by using energy modeling software. The following is a list of well-recognized energy modeling software platforms.

1. *RETScreen*

   RETScreen is a *Microsoft Excel*-based program that generates an energy model based upon monthly data. Data such as weather, building size and shape, and internal loads are averaged on a monthly basis. The program inputs this data and outputs monthly energy usage (RETscreen International 2011). This program is free of charge and is funded by Canada’s Department of Natural Resources.

2. *TRNSYS*

   TRNSYS, abbreviated for “Transient System” analysis, was developed by Thermal Energy Systems Specialists. This program provides a highly detailed modeling analysis for not only mechanical and electrical systems, but also biological and logistical processes such as traffic flow analysis. For building modeling, *TRNSYS* is able simulate and analyze electrical and mechanical systems, including GSHP system. *TRNSYS*, however, still requires input files such as the building load profile in order to simulate the equipment (TRNSYS 2011).

3. *TRACE*

   TRACE is another highly powerful energy modeling program developed by the Trane Corporation. *TRACE* is designed to determine a building’s peak heating and cooling loads as well as evaluate yearly the energy usage of many different HVAC equipment scenarios. It also has the capability to produce compliance reports for efficiency standards such as ASHRAE 90.1, and LEED®. *TRACE* would have the capability to fully input the parameters of a building and simulate the energy use of a GSHP system (Trane 2011). Of the energy modeling and simulation tools, *TRACE* offers a more holistic approach in that is can be completely user-specified. None of the program's inputs require the output of another program, as does *TRNSYS*. The program also simulates in an hourly analysis, thus providing a higher simulation complexity and degree of resolution than *RETScreen*, with only a monthly analysis.

4. *eQuest*

eQuest is very similar to Trane's *TRACE* software, providing a holistic and hourly analysis of a building's energy usage. *eQuest* was originally developed by the Department of Energy and is now continually funded by the State of California's utility customers, and is maintained by *James Hirsch and Associates* in collaboration with the Lawrence Berkeley National Laboratory. *eQuest* has many similarities to *TRACE* in building energy modeling with the exception that *eQuest* does not calculate water usage. The advantage to *eQuest* over *TRACE*, and many other modeling platforms is that it is free of charge. Another advantage to *eQuest* is that it allows several scenarios to be modeled in succession of one another. In *eQuest*, a baseline model can be built, and then certain parameters can be changed parametrically then evaluated against the original baseline. This makes *eQuest* a highly capable simulation tool for existing buildings. One disadvantage of *eQuest* particularly for GSHP system is that the will not optimize to determine the ground wells needed to match the heating and cooling loads. It is simply a predictive model. The user must run the program by trail and error to determine the number of ground wells needed (DOE2 2009). This shall be discussed further in the Methods and Procedure section.

Ground Conductivity

One of the independent variables for calculating the payback of a GSHP retrofit will be the ground conductance. This variable is unique to the location in which the system shall be installed. The higher the ground conductance value, the better the heat transfer shall be between the circulating fluid and the ground. The best source for this information is accessing actual reports from ground source well installers, and well testers. Ewbank and Associates is a consultant for building owners, architects and engineers for ground source and geothermal heat pump systems. They have performed thousands of well tests throughout the country to obtain thermal conductivity values. The United States Department of Agriculture (USDA) has also performed several soil surveys. This research shall use these surveys to determine average ground conductivity and diffusivity values in order to simulate the heat transfer of the ground loop for each test site.

Payback Analyses

There are several studies that analyze the payback of a ground source heat pump system. Most of which are individual case by base basis's. The IGSHPA has written several case studies of GSHP installations. These studies are reactive in that the cost and savings are analyzed and evaluated after the project has been installed. Here, the total construction cost is accounted for, as well as a year cycle of utility bills after the project was installed. Utility bills post construction are then compared to the year prior to determine the dollar savings. With this savings number, a simple payback can be extrapolated. The majority of payback analyses are done in this fashion. In 1995, a study was conducted at the Oregon Institute of Technology by Lienau, Boyd*,* and Rogers summarizing costs and savings for 253 GSHP installations throughout the United States. This research summarized the average energy and dollar savings for these installations. It was also concluded in the report that savings and equipment performance depended upon several variables:

1. Climate Conditions
2. Soil Conductivity
3. Length of Loop
4. Loop Configuration
5. Equipment Efficiency
6. Equipment Size

For this research variables such as length and type of loop shall remain constant for each location. Variables such as climate conditions and soil conductivity shall vary depending upon the location (Lienau, Boyd, Rogers, 1995).

Studies using theoretical energy modeling are rare compared to actual case studies. More recently, a study was published by Hackel and Pertzkorn of the Energy Center of Wisconsin, analyzing the payback of GSHP systems through energy modeling. *eQuest* was used to determine the building loads, and *TRNSYS* was used to analyze the ground source heat exchanger. The conjunction of these modeling methods was used to design and size the equipment. Two designs were actually implemented in separate facilities where actual costs and savings were evaluated and compared (Hackel, Pertzborn 2011).

To the date of this research, there hasn't been a theoretical analysis where an identical building was evaluated at different locations to illustrate how the payback of a GSHP retrofit varies. The purpose of this research is to eliminate as many subjective variables as possible, and only focus on the true variables that vary by location and determine what has the most influence on the simple payback from a GSHP installation.

Chapter 3 – Methods and Procedure

This section shall provide the procedure through which the payback analysis shall be performed. As stated in the Introduction, the following U.S. cities shall be analyzed.

1. Los Angeles, California
2. Dallas, Texas
3. Minneapolis, Minnesota
4. Richmond, Virginia

These cities were strategically chosen because they are diverse in climate. This in effect shall produce varying results for heat and cooling energy required. The diverse climates shall also have different requirements on the size of the well field to be installed. A building with higher heating and cooling requirement shall theoretically require a large well field. This will produce varying costs of construction. These locations are also diverse in the costs of energy. These four regions have very different utility rate structures. This will also have a varying effect on the results for comparison.

In order to determine energy savings from a retrofit, an energy baseline must be established. This will be done using energy modeling software. The software platform used for this analysis shall be *eQuest*. The following illustration is a 3-D rendering of the commercial building that will be used for the energy simulation in *eQuest*.

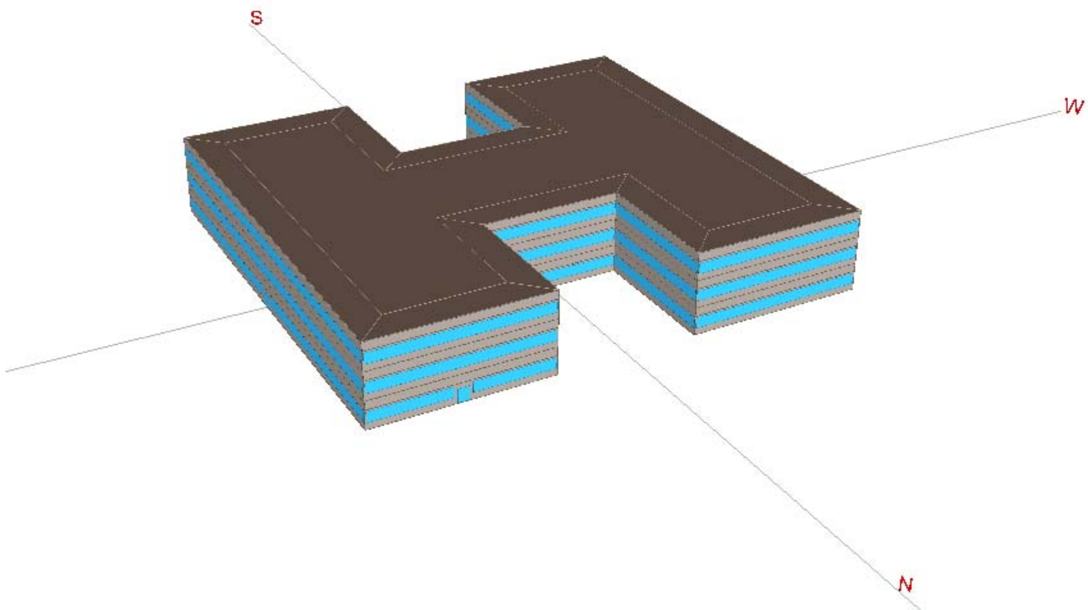

Figure 5 - 3D rendering of Building in *eQuest*

The building shape and orientation was chosen to emulate a typical office building. The lighting and occupant densities were also constructed in the *eQuest* model to reflect a typical office environment.

The baseline building and its components shall remain constant for each test city. The existing HVAC system within shall consist of a distributed water source heat pump system. The following figure shows the system architecture.

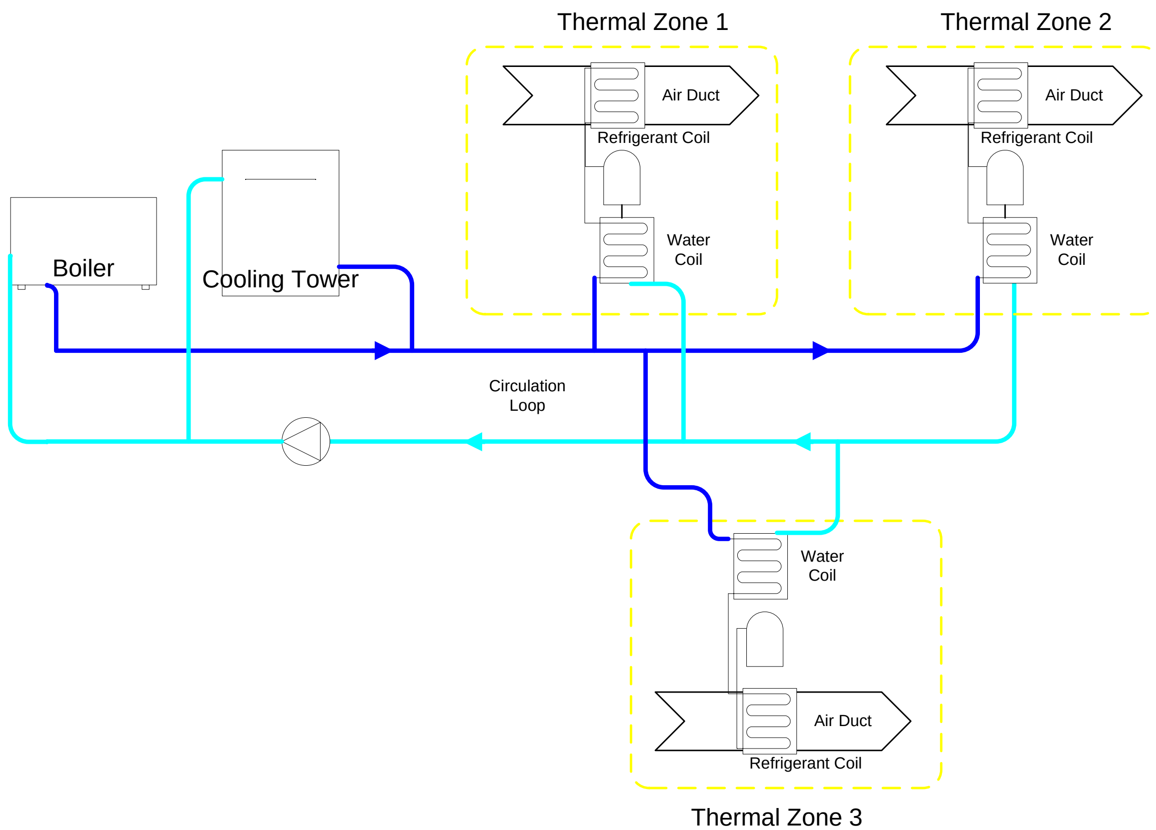

Figure 6 - Baseline HVAC System Architecture

Individual heat pumps shall serve each space within the building. Instead of having an outdoor condensing unit through which heat is absorbed and rejected, all of the heat transfer occurs between the refrigerant coil and a water loop which circulates throughout the building. During year when cooling is required, the circulation loop absorbs heat from the heat pumps. The loop is then tempered by a cooling tower, where the water is cooled by convection and evaporation. During the year when heating is required, the process is reversed. Heat from the circulation loop is transferred to the heat pumps, and the loop itself is tempered by a boiler. For the post retrofit, all of the existing equipment in the building shall remain. The building characteristics, including occupancy, and miscellaneous loads shall remain constant. The only alteration to the system architecture shall be the addition of the ground source loop. The figure below illustrates the post retrofit case that shall be analyzed.

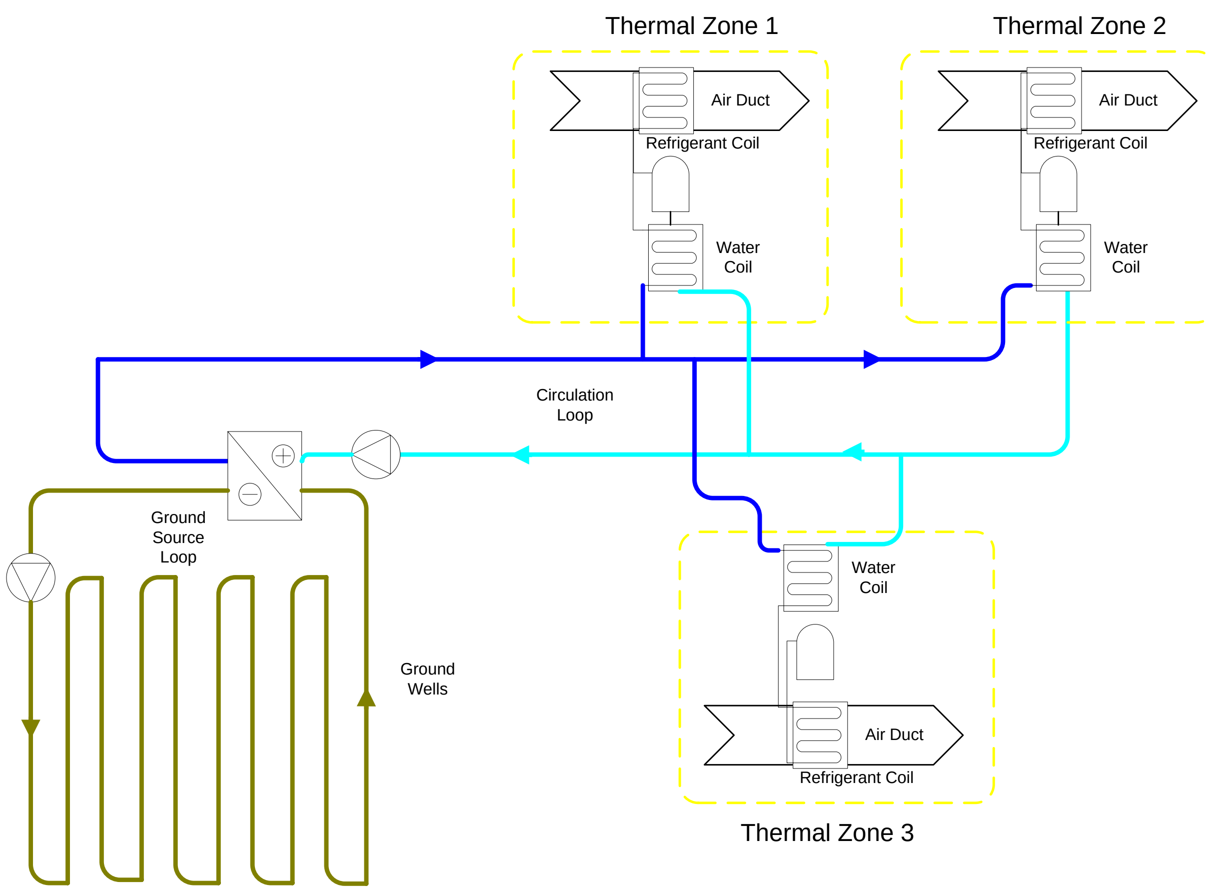

Figure 7 - Post Retrofit with Ground Loop Addition

The energy model shall require ground conductivity and diffusivity values in order to calculate the heat transfer of the ground loop. The following table describes the assumption and respective values used for this research.

Location	Soil Type Assumption	Average Conductivity	Average Diffusivity
Dallas, TX	33% Dry Clay; 33% Shale; 33% Marl	0.8667	0.0268
Minneapolis, MN	50% Compact Sand; 50% Silty	0.4500	0.0186
Richmond, VA	25% Sand, 50% Clay 25% Gravel	0.4500	0.0187
Los Angeles, CA	50% Sand, 25% Gravel, 25% Granite	0.9000	0.0299

Table 5 – Ground Properties for Test Locations

The research shall involve calculating the total energy cost before and after the ground loop is installed. The following process model shall be used to determine baseline energy costs.

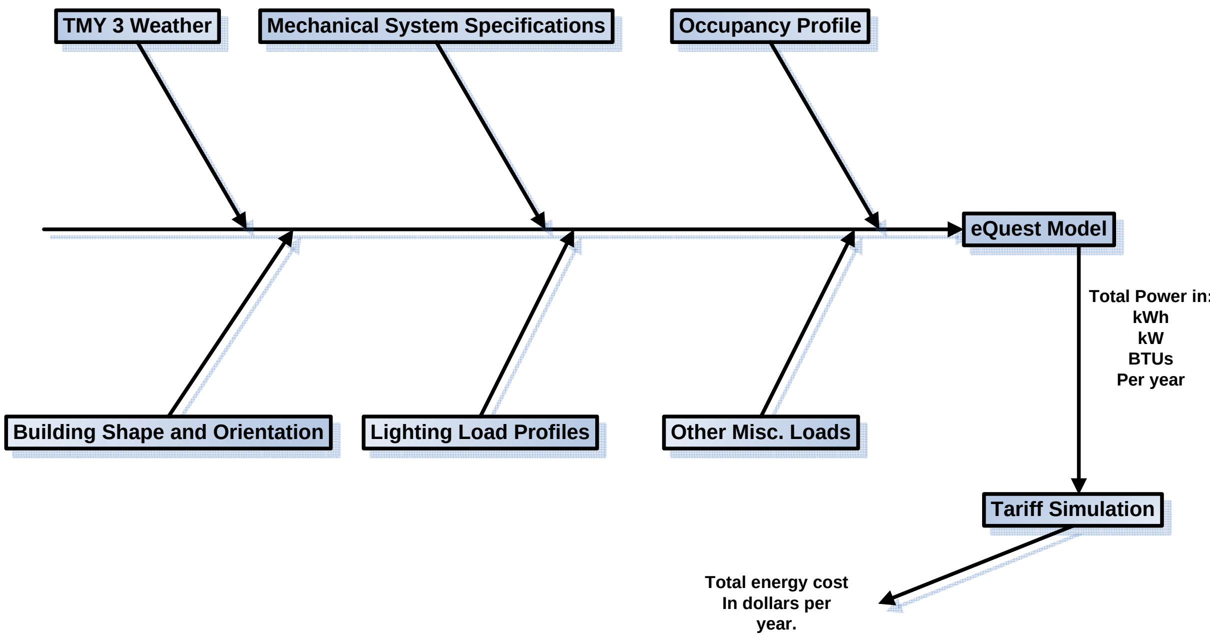

Figure 8 - Baseline Energy Cost Determination

The end result of the process model shall be the total energy costs for the building. For the retrofit application, a ground loop shall be added to the energy model. Below is another view of the process model as it is applied to determine the energy cost after the retrofit.

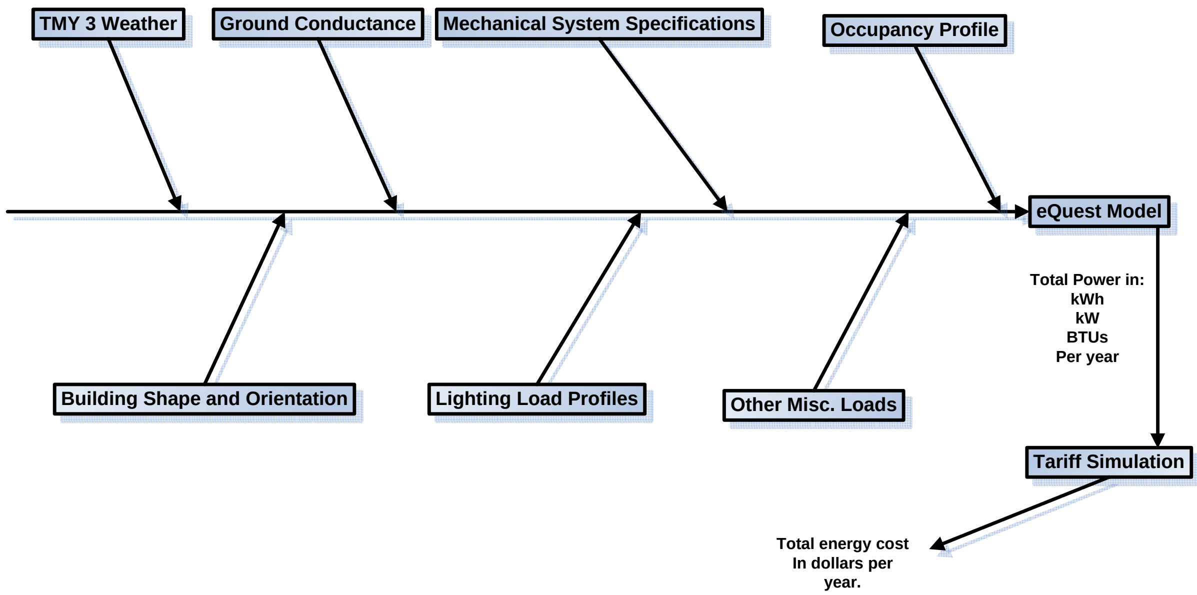

Figure 9 - Energy Cost Determination Post Retrofit

It can be seen that the energy cost determination after the retrofit is similar to the baseline with the additional variable of ground conductance added to the procedure.

Once the energy costs are calculated for both cases, the following equation shall be used to calculate a simple payback.

$$\frac{E_{Baseline} - E_{Retrofit}}{C}$$

Where:

E = Energy Cost

C = Construction Cost

Construction costs shall be calculated using an estimating tool proprietary to *Schneider Electric* using labor rates that are unique to each city analyzed. This process shall be performed for each analysis city. The results for each shall then be compared.

Chapter 4 – Results

The tables below display the calculated costs and energy savings for each of the cities.

Payback Analysis

Cost for Geothermal Well Installation

Number of Wells	Cost per Well	Contractor Markup (Labor, Material, and Project Management)	Design Fee (Analysis, Drawings, and Documents)	**Total**
160	$2,000	$48,000	$18,400	**$386,400**

Energy Savings	**Simple Payback**
$11,888	**33 years**

Table 6 - Payback Analysis, Dallas Texas

Number of Wells	Cost per Well	Contractor Markup (Labor, Material, and Project Management)	Design Fee (Analysis, Drawings, and Documents)	**Total**
66	$2,000	$19,800	$7,590	**$159,390**

Energy Savings	**Simple Payback**
$25,604	**6 years**

Table 7- Payback Analysis, Los Angeles, California

Number of Wells	Cost per Well	Contractor Markup (Labor, Material, and Project Management)	Design Fee (Analysis, Drawings, and Documents)	**Total**
140	$2,000	$42,000	$16,100	**$338,100**

Energy Savings	**Simple Payback**
$15,493	**22 years**

Table 8 - Payback Analysis, Minneapolis, Minnesota

Number of Wells	Cost per Well	Contractor Markup (Labor, Material, and Project Management)	Design Fee (Analysis, Drawings, and Documents)	**Total**
140	$2,000	$42,000	$16,100	**$338,100**

Energy Savings	**Simple Payback**
$43,463	**8 years**

Table 9 - Payback Analysis, Richmond, Virginia

Summary

The results and indicated paybacks for the four cities analyzed in this research is summarized in the charts below:

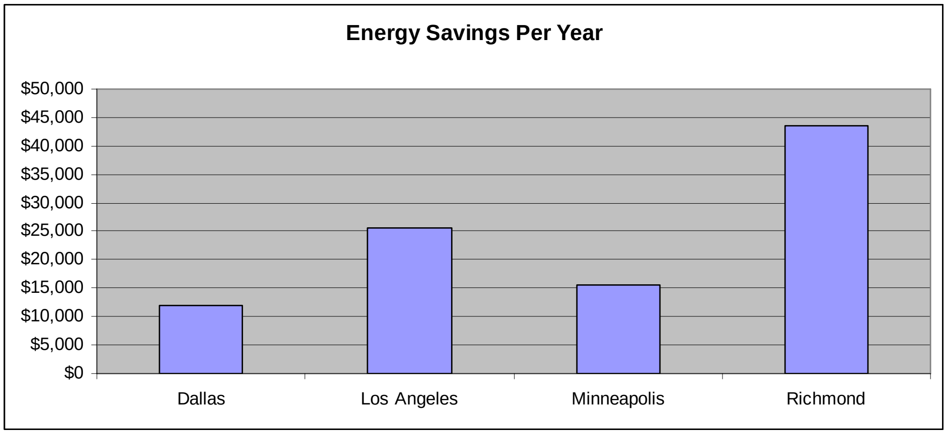

Figure 10 - Energy Savings per Year Comparison

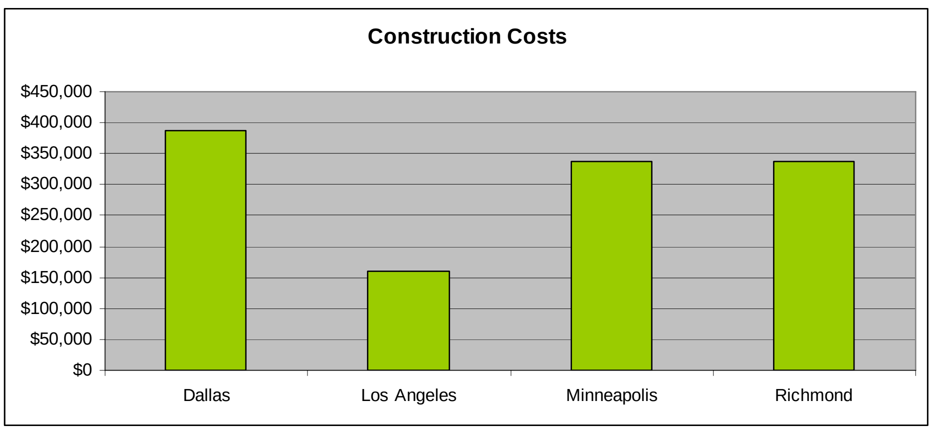

Figure 11 - Construction Cost Comparison

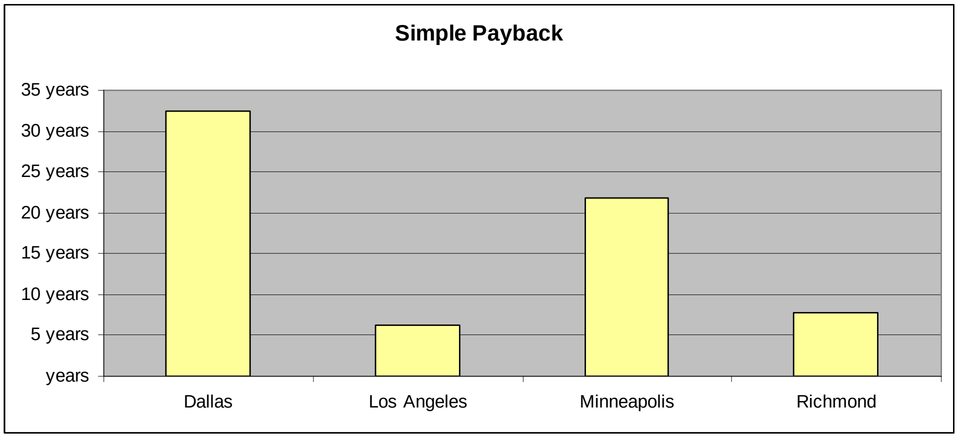

Figure 12 - Simple Payback Comparison

Of the four cities analyzed, Los Angeles, California would seem to yield the best payback for a GSHP system. This is in part of the high utility costs for the area. Dallas seemed to yield the worst payback of 33 years. This was due to a lack of natural gas usage, and low energy costs. The cost of construction in Dallas was also amongst the highest, requiring 160 wells for the model building. This is likely due the high cooling requirements of the building.

In summary, the results of this research suggest that the payback opportunity of the GSHP system is highly dependent upon location, and the cost of energy.

Conclusions

The purpose of this research was to determine the payback of converting an existing building with WSHP system to a GSHP system in four different regions of the United States using *eQuest* modeling software. Of all the variables that differentiated by region, it seems that cost of energy (i.e. electricity and natural gas), and the number of wells required were the most influential factors in the simple payback.

Even though Los Angeles had the least amount of energy savings of the cities analyzed, the dollar savings for were more than Dallas, and Minneapolis. Richmond yielded the highest dollar savings of the four cities analyzed. With a 140 well requirement for the ground source loop, this yielded an eight year simple payback. In summary, the results showed that Los Angeles and Richmond having the lowest simple payback. This suggests that the utility tariffs (i.e. the cost of energy) are significantly influential variables in the equation of simple payback determination.

Also for the city of Los Angeles, only 66 wells were required to meet the heating and cooling needs of the model building. This requirement was significantly less than the other cities analyzed, thus yielding a better payback than the other cities. The primary factor that affects the number of wells required for a building is weather. With Los Angeles having a milder climate than the other cities analyzed, the heating and cooling loads in the model building were significantly less. The results of this research suggest that the more extreme weather conditions will significantly increase the cost of the ground source loop, thus having a negative affect on the simple payback.

The results of the energy model also yielded an unexpected phenomenon in the electrical demand peak of the model building. The energy model illustrated that the peak demand increased after the building was retrofitted with a GSHP system. This is likely due to the temperature fluctuation of the loop. In a WSHP system the typical operating temperature is between 70 and 90 degrees due to the temperature limitations of the boiler and cooling tower. For the GSHP the loop, the temperature is less restricted, and can fluctuate between 30 and 100 degrees. This however has a negative effect on the unitary heat pump efficiency. For a GSHP system, the peak demand will likely occur when the loop temperature has reached these limits, when the heat pumps are operating least efficiently. This research suggests that the conversion from a WSHP to a GSHP will likely decrease the operating efficiency of the heat pumps, thus yielding an increase in peak demand.

The pursuit of this research has also exposed the modeling capabilities and limitations of *eQuest* modeling software. Several energy savings companies (ESCOs) depend upon *eQuest* to determine the energy savings of energy conservation measures. And with many of these companies putting a guarantee upon the predicted savings, this puts a heavy reliance upon the energy model. After performing these energy models for GSHP systems in this research, limitations of *eQuest* would suggest an increased risk on the savings guarantee. In order to mitigate this risk, further energy analysis and modeling may be required in order to accurately predict the energy savings.

GSHP systems are not a new technology. However, with the increasing in global energy demand, and the perpetuating trends that drive energy efficiency, GSHP systems are becoming a more viable option. Depending upon the location, existing buildings equipped with WSHPs may have an opportunity to considerably lower their energy costs, and yield a reasonable payback for the cost of construction.

Recommendations for Future Research

The analysis performed for this research provided a simple payback with energy savings for a clearly defined scope of work. The analysis for this research consisted of converting a water source heat pump system to a ground source heat pump system. Although this research yielded payback results, there are several other areas upon which the methods and procedure can be expanded for future research.

Limitations of *eQuest*

Although a detailed and comprehensive program, *eQuest* does have modeling limitations. *eQuest* can only simulate a ground loop when it is only connected to distributed heat pumps. The program will not allow a ground loop to be attached to any other type of equipment, such as a heat pump chiller. *eQuest* does not have the capability to simulate other equipment tied to the ground loop, such as boiler, or cooling tower. In the interest of this research, where existing buildings would be retrofitted, there may only be a finite space to install the wells. This constraint may potentially undersize the field for the heating and cooling requirements of the building. Such circumstances would require boilers and cooling towers to temper the water loop as needed. Another limitation of *eQuest* is that it will not automatically size the loop. The user must re-run the program several times while increasing the size of the ground loop until it no longer yields run-time errors. Another shortfall of *eQuest* is that it does not simulate the additional pumping needed for the ground source loop. Pumping energy would most likely increase due to the extended length of piping the fluid must pass through in the ground loop.

Other simulation programs, such as *TRNSYS* and *TRACE* also vary in capability in simulating the scenarios described above. It would be recommended to expand this research and analyze the simple payback of different HVAC system designs integrated with ground source heat pump loops. Other modeling programs may provide the ability to perform such analysis.

Performing Ground Testing

This research made general assumptions of the soils type based upon soil surveys provided by the United States Department of Agriculture. In order to accurately determine the ground conductance and diffusivity, a test well must be constructed, and a certified test should be performed. As of the date of this research, there isn't a published reference to access actual test results.

Analysis of Regions beyond the United States

This research only analyzed the simple payback of cities in the United States. This research can be expanded to include other regions in the world. Hourly weather data in a format that can be used in *eQuest* is sometimes difficult to obtain. Extra time would need to be taken to convert hourly weather data into a form that is acceptable to *eQuest.* Other paid for programs such as *Trace* have weather libraries for several foreign countries. The other obstacle is gathering construction cost data. More time would need to be taken in order to obtain labor rates, and cost of material for foreign countries.

Return on Investment (ROI) Calculations

This research was limited to providing only a simple payback for installing a ground source heat pump loop. A return on investment analysis would include the salvage value of the equipment being installed. Most equipment depreciates over time, thus generating a salvage value at a fraction of the value when it was new. Some organizations argue that the physical ground source loop does not depreciate. A ground source loop may retain if not increase in value over time, thus adding to the overall net worth of the system. It would be recommended that future research would include calculating the salvage value of a ground source system in order to produce a holistic return on investment.

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Appendices

Appendix A: Dallas Texas Model Results

Electric Consumption

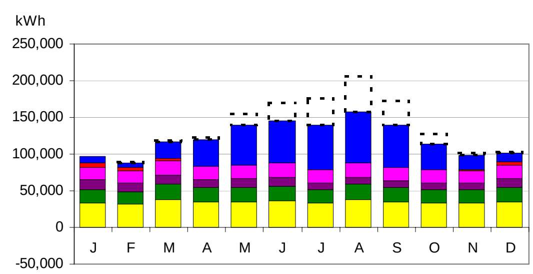
Baseline

Electric													kWh	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	
Space Cool	8,360	7,525	19,859	32,805	60,226	67,839	77,871	93,536	72,765	38,953	17,693	10,974	508,406	Space Cool
Heat Reject.	33	0	823	2,022	7,332	10,803	14,510	18,020	13,251	4,197	392	334	71,717	Heat Reject.
Refrigeration	0	0	0	0	0	0	0	0	0	0	0	0	0	Refrigeration
Space Heat	5,955	4,043	2,767	302	0	0	0	0	2	132	988	5,564	19,753	Space Heat
HP Supp.	0	0	0	0	0	0	0	0	0	0	0	0	0	HP Supp.
Hot Water	0	0	0	0	0	0	0	0	0	0	0	0	0	Hot Water
Vent. Fans	17,205	16,345	19,822	18,029	18,101	18,926	17,205	19,786	18,029	17,241	17,169	18,065	215,923	Vent. Fans
Pumps & Aux.	12,117	11,830	15,142	14,672	14,887	15,565	14,150	16,273	14,828	14,083	13,687	13,042	170,276	Pumps & Aux.
Ext. Usage	0	0	0	0	0	0	0	0	0	0	0	0	0	Ext. Usage
Misc. Equip.	18,645	17,565	20,976	19,307	19,429	20,091	18,645	20,967	19,307	18,655	18,533	19,419	231,539	Misc. Equip.
Task Lights	0	0	0	0	0	0	0	0	0	0	0	0	0	Task Lights
Area Lights	33,409	31,659	38,171	34,935	35,000	36,526	33,409	38,166	34,935	33,415	33,349	34,995	417,969	Area Lights
Total	95,725	88,967	117,559	122,071	154,975	169,749	175,790	206,747	173,117	126,675	101,810	102,394	1,635,582	

Post Retrofit

Electric													kWh	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	
Space Cool	8,377	7,528	21,526	35,615	54,374	58,041	61,151	69,569	56,791	35,616	20,036	11,803	440,429	Space Cool
Heat Reject.	0	0	0	0	0	0	0	0	0	0	0	0	0	Heat Reject.
Refrigeration	0	0	0	0	0	0	0	0	0	0	0	0	0	Refrigeration
Space Heat	6,302	4,194	2,851	307	0	0	0	0	0	105	895	5,315	19,968	Space Heat
HP Supp.	0	0	0	0	0	0	0	0	0	0	0	0	0	HP Supp.
Hot Water	0	0	0	0	0	0	0	0	0	0	0	0	0	Hot Water
Vent. Fans	17,205	16,345	19,822	18,029	18,101	18,926	17,205	19,786	18,029	17,241	17,169	18,065	215,923	Vent. Fans
Pumps & Aux.	12,368	11,307	12,642	11,131	11,910	12,210	9,273	9,593	9,746	9,137	8,843	12,219	130,377	Pumps & Aux.
Ext. Usage	0	0	0	0	0	0	0	0	0	0	0	0	0	Ext. Usage
Misc. Equip.	18,645	17,565	20,976	19,307	19,429	20,091	18,645	20,967	19,307	18,655	18,533	19,419	231,539	Misc. Equip.
Task Lights	0	0	0	0	0	0	0	0	0	0	0	0	0	Task Lights
Area Lights	33,409	31,659	38,171	34,935	35,000	36,526	33,409	38,166	34,935	33,415	33,349	34,995	417,969	Area Lights
Total	96,306	88,597	115,989	119,324	138,814	145,792	139,684	158,080	138,808	114,168	98,826	101,816	1,456,205	Total

Electric Consumption



Monthly Savings by End-use

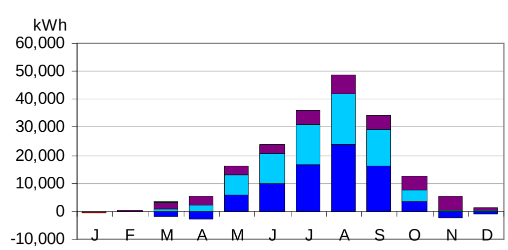


Figure 23 - Electricity Consumption Comparison, Dallas, Texas

Electrical Demand

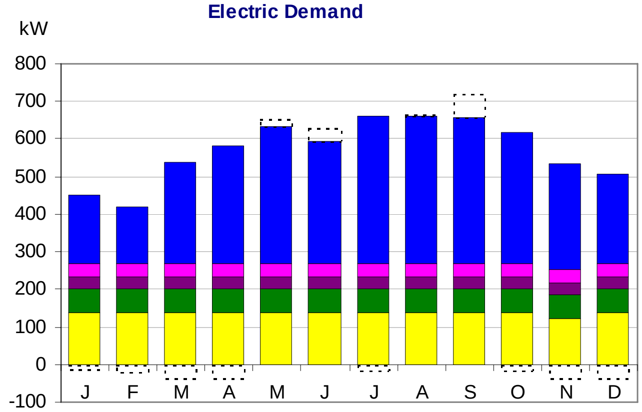
Baseline

Electric	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (kW)	
Space Cool	160	134	212	240	305	281	297	313	357	276	207	179	2,961	Space Cool
Heat Reject.	12	0	24	41	97	83	80	88	97	59	25	24	627	Heat Reject.
Refrigeration	0	0	0	0	0	0	0	0	0	0	0	0	0	Refrigeration
Space Heat	0	0	0	0	0	0	0	0	0	0	0	0	0	Space Heat
HP Supp.	0	0	0	0	0	0	0	0	0	0	0	0	0	HP Supp.
Hot Water	0	0	0	0	0	0	0	0	0	0	0	0	0	Hot Water
Vent. Fans	36	36	36	36	36	36	36	36	36	36	36	36	430	Vent. Fans
Pumps & Aux.	30	30	30	30	30	30	30	30	30	30	30	30	354	Pumps & Aux.
Ext. Usage	0	0	0	0	0	0	0	0	0	0	0	0	0	Ext. Usage
Misc. Equip.	64	64	64	64	64	64	64	64	64	64	64	64	770	Misc. Equip.
Task Lights	0	0	0	0	0	0	0	0	0	0	0	0	0	Task Lights
Area Lights	137	137	137	137	121	137	137	137	137	137	137	137	1,627	Area Lights
Total	438	400	502	547	652	630	644	667	720	601	499	469	6,769	
Utility Baseline	438	400	502	547	652	630	644	667	720	601	499	469	6,769	Utility Baseline

Post Retrofit

Electric	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (kW)	
Space Cool	184	150	270	313	365	326	391	391	390	349	283	238	3,650	Space Cool
Heat Reject.	0	0	0	0	0	0	0	0	0	0	0	0	0	Heat Reject.
Refrigeration	0	0	0	0	0	0	0	0	0	0	0	0	0	Refrigeration
Space Heat	0	0	0	0	0	0	0	0	0	0	0	0	0	Space Heat
HP Supp.	0	0	0	0	0	0	0	0	0	0	0	0	0	HP Supp.
Hot Water	0	0	0	0	0	0	0	0	0	0	0	0	0	Hot Water
Vent. Fans	36	36	36	36	36	36	36	36	36	36	36	36	430	Vent. Fans
Pumps & Aux.	32	32	32	32	32	32	32	32	32	32	32	32	384	Pumps & Aux.
Ext. Usage	0	0	0	0	0	0	0	0	0	0	0	0	0	Ext. Usage
Misc. Equip.	64	64	64	64	64	64	64	64	64	64	64	64	770	Misc. Equip.
Task Lights	0	0	0	0	0	0	0	0	0	0	0	0	0	Task Lights
Area Lights	137	137	137	137	137	137	137	137	137	137	121	137	1,627	Area Lights
Total	453	419	539	582	633	595	659	660	659	618	536	507	6,860	Total
Actual Savings	-15	-19	-37	-35	19	35	-16	7	61	-17	-37	-38	-91	

Electric Demand



Monthly Savings by End-use

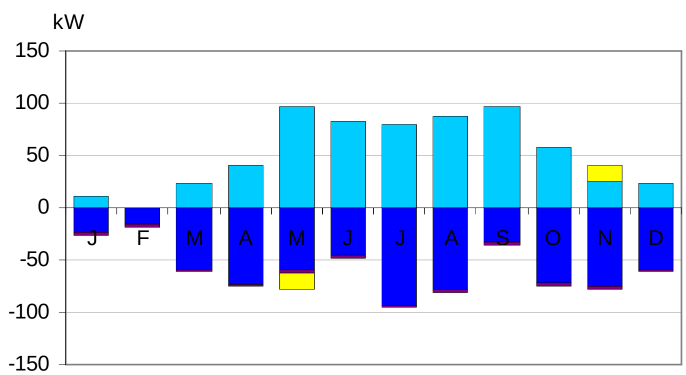


Figure 14 - Electricity Demand Comparison, Dallas, Texas

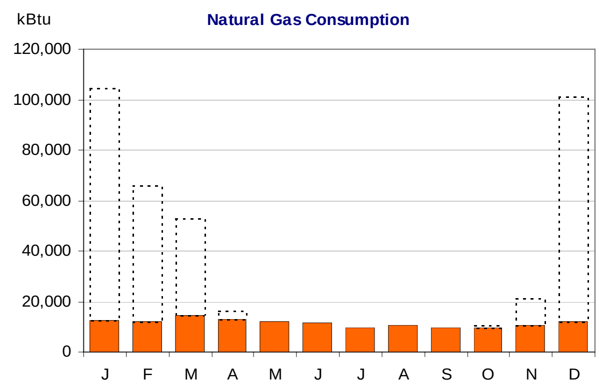
Natural Gas Consumption

Baseline

Natural Gas	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (kBtu)	
Space Cool	0	0	0	0	0	0	0	0	0	0	0	0	0	Space Cool
Heat Reject.	0	0	0	0	0	0	0	0	0	0	0	0	0	Heat Reject.
Refrigeration	0	0	0	0	0	0	0	0	0	0	0	0	0	Refrigeration
Space Heat	92,353	53,876	38,594	3,173	0	0	0	0	0	784	10,689	89,187	288,657	Space Heat
HP Supp.	0	0	0	0	0	0	0	0	0	0	0	0	0	HP Supp.
Hot Water	12,346	12,118	14,547	13,080	12,094	11,507	9,786	10,459	9,576	9,682	10,480	11,983	137,658	Hot Water
Vent. Fans	0	0	0	0	0	0	0	0	0	0	0	0	0	Vent. Fans
Pumps & Aux.	0	0	0	0	0	0	0	0	0	0	0	0	0	Pumps & Aux.
Ext. Usage	0	0	0	0	0	0	0	0	0	0	0	0	0	Ext. Usage
Misc. Equip.	0	0	0	0	0	0	0	0	0	0	0	0	0	Misc. Equip.
Task Lights	0	0	0	0	0	0	0	0	0	0	0	0	0	Task Lights
Area Lights	0	0	0	0	0	0	0	0	0	0	0	0	0	Area Lights
Total	104,699	65,994	53,141	16,254	12,094	11,507	9,786	10,459	9,576	10,465	21,168	101,170	426,315	

Post Retrofit

Natural Gas	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (kBtu)	
Space Cool	0	0	0	0	0	0	0	0	0	0	0	0	0	Space Cool
Heat Reject.	0	0	0	0	0	0	0	0	0	0	0	0	0	Heat Reject.
Refrigeration	0	0	0	0	0	0	0	0	0	0	0	0	0	Refrigeration
Space Heat	0	0	0	0	0	0	0	0	0	0	0	0	0	Space Heat
HP Supp.	0	0	0	0	0	0	0	0	0	0	0	0	0	HP Supp.
Hot Water	12,346	12,118	14,546	13,075	12,070	11,475	9,734	10,397	9,528	9,658	10,475	11,980	137,403	Hot Water
Vent. Fans	0	0	0	0	0	0	0	0	0	0	0	0	0	Vent. Fans
Pumps & Aux.	0	0	0	0	0	0	0	0	0	0	0	0	0	Pumps & Aux.
Ext. Usage	0	0	0	0	0	0	0	0	0	0	0	0	0	Ext. Usage
Misc. Equip.	0	0	0	0	0	0	0	0	0	0	0	0	0	Misc. Equip.
Task Lights	0	0	0	0	0	0	0	0	0	0	0	0	0	Task Lights
Area Lights	0	0	0	0	0	0	0	0	0	0	0	0	0	Area Lights
Total	12,346	12,118	14,546	13,075	12,070	11,475	9,734	10,397	9,528	9,658	10,475	11,980	137,403	Total



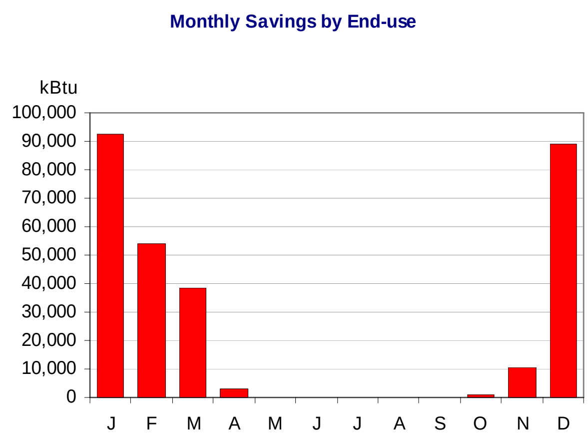


Figure 15 - Natural Gas Consumption Comparison, Dallas, Texas

Energy Comparison

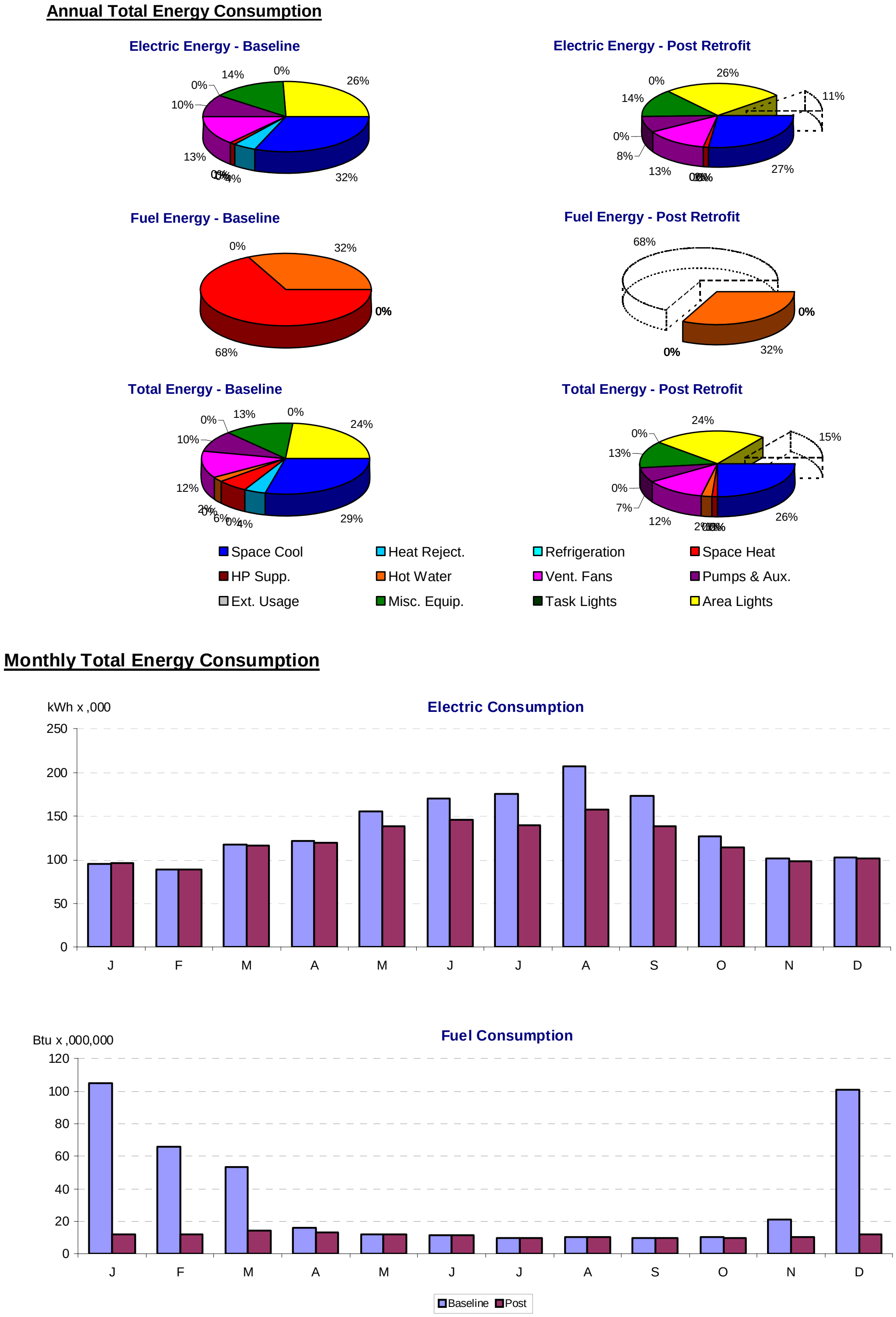
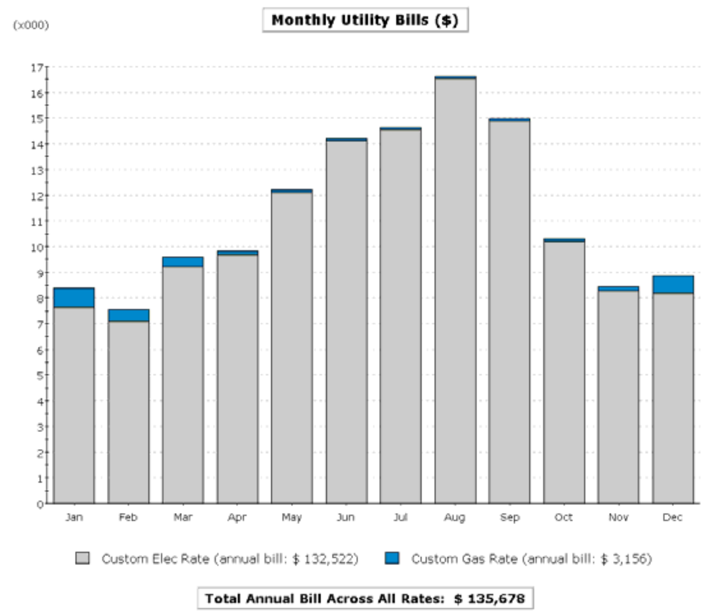


Figure 16 - Energy Summary, Dallas Texas

Energy Costs
Baseline



Post Retrofit

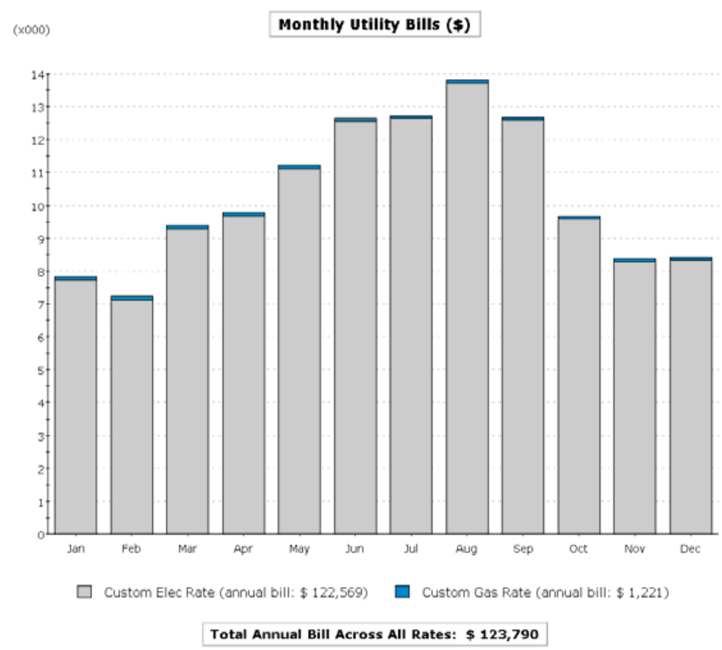


Figure 17 - Utility Comparison, Dallas Texas

Appendix B: Los Angeles California Model Results

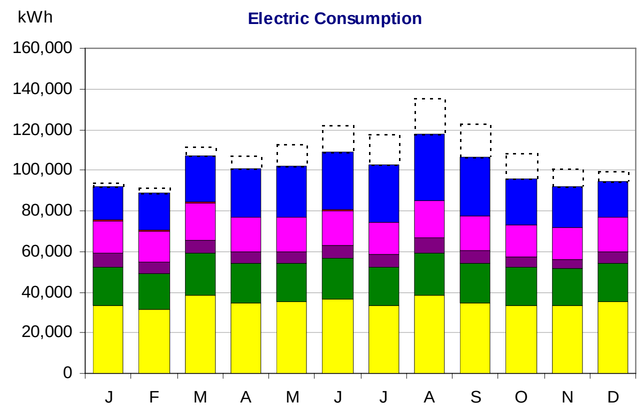
Electrical Consumption

Baseline

Electric	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (kWh)	
Space Cool	14,329	16,079	20,901	23,941	28,644	34,218	35,667	42,004	36,884	27,921	21,739	17,012	319,341	Space Cool
Heat Reject.	151	168	239	718	1,221	2,184	3,193	3,784	3,580	1,538	607	95	17,479	Heat Reject.
Refrigeration	0	0	0	0	0	0	0	0	0	0	0	0	0	Refrigeration
Space Heat	716	267	186	13	1	1	1	0	1	5	59	275	1,525	Space Heat
HP Supp.	0	0	0	0	0	0	0	0	0	0	0	0	0	HP Supp.
Hot Water	0	0	0	0	0	0	0	0	0	0	0	0	0	Hot Water
Vent. Fans	15,806	15,016	18,210	16,564	16,629	17,387	15,806	18,177	16,564	15,839	15,773	16,597	198,368	Vent. Fans
Pumps & Aux.	10,580	10,301	12,540	11,474	11,519	12,044	10,949	12,591	11,474	10,972	10,919	11,406	136,768	Pumps & Aux.
Ext. Usage	0	0	0	0	0	0	0	0	0	0	0	0	0	Ext. Usage
Misc. Equip.	18,645	17,565	20,976	19,307	19,429	20,091	18,645	20,967	19,307	18,655	18,533	19,419	231,539	Misc. Equip.
Task Lights	0	0	0	0	0	0	0	0	0	0	0	0	0	Task Lights
Area Lights	33,409	31,659	38,171	34,935	35,000	36,526	33,409	38,166	34,935	33,415	33,349	34,995	417,969	Area Lights
Total	93,638	91,055	111,224	106,951	112,444	122,450	117,670	135,690	122,744	108,345	100,979	99,799	1,322,989	

Post Retrofit

Electric	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (kWh)	
Space Cool	16,186	18,427	22,688	24,182	25,671	28,586	28,233	32,990	29,169	22,912	19,610	17,399	286,054	Space Cool
Heat Reject.	0	0	0	0	0	0	0	0	0	0	0	0	0	Heat Reject.
Refrigeration	0	0	0	0	0	0	0	0	0	0	0	0	0	Refrigeration
Space Heat	774	285	197	13	4	7	2	1	3	10	37	226	1,557	Space Heat
HP Supp.	0	0	0	0	0	0	0	0	0	0	0	0	0	HP Supp.
Hot Water	0	0	0	0	0	0	0	0	0	0	0	0	0	Hot Water
Vent. Fans	15,806	15,016	18,210	16,564	16,629	17,387	15,806	18,177	16,564	15,839	15,773	16,597	198,368	Vent. Fans
Pumps & Aux.	7,083	5,808	6,599	5,762	5,531	6,309	6,383	7,490	6,498	4,969	4,357	5,629	72,417	Pumps & Aux.
Ext. Usage	0	0	0	0	0	0	0	0	0	0	0	0	0	Ext. Usage
Misc. Equip.	18,645	17,565	20,976	19,307	19,429	20,091	18,645	20,967	19,307	18,655	18,533	19,419	231,539	Misc. Equip.
Task Lights	0	0	0	0	0	0	0	0	0	0	0	0	0	Task Lights
Area Lights	33,409	31,659	38,171	34,935	35,000	36,526	33,409	38,166	34,935	33,415	33,349	34,995	417,969	Area Lights
Total	91,904	88,760	106,842	100,763	102,264	108,905	102,479	117,790	106,474	95,800	91,660	94,264	1,207,904	Total



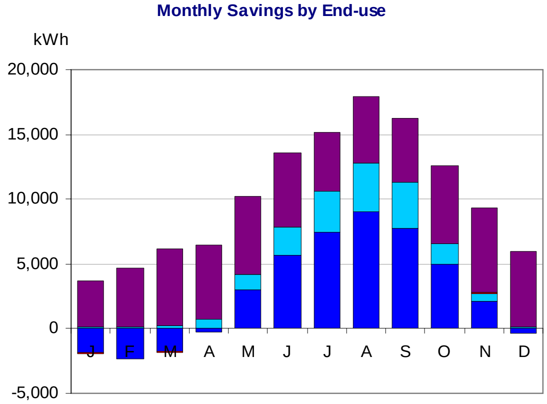


Figure 18 - Electricity Consumption Comparison, Los Angeles, California

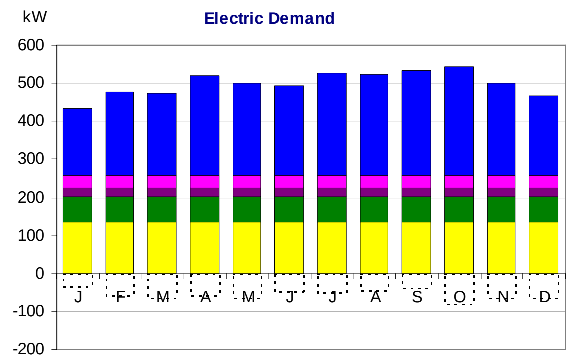
Electrical Demand

Baseline

Electric	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (kW)	
Space Cool	136	154	148	184	165	174	196	197	209	187	167	141	2,057	Space Cool
Heat Reject.	8	9	6	21	14	18	23	26	32	19	14	7	197	Heat Reject.
Refrigeration	0	0	0	0	0	0	0	0	0	0	0	0	0	Refrigeration
Space Heat	0	0	0	0	0	0	0	0	0	0	0	0	0	Space Heat
HP Supp.	0	0	0	0	0	0	0	0	0	0	0	0	0	HP Supp.
Hot Water	0	0	0	0	0	0	0	0	0	0	0	0	0	Hot Water
Vent. Fans	33	33	33	33	33	33	33	33	33	33	33	33	395	Vent. Fans
Pumps & Aux.	23	23	23	23	23	23	23	23	23	23	23	23	274	Pumps & Aux.
Ext. Usage	0	0	0	0	0	0	0	0	0	0	0	0	0	Ext. Usage
Misc. Equip.	64	64	64	64	64	64	64	64	64	64	64	64	770	Misc. Equip.
Task Lights	0	0	0	0	0	0	0	0	0	0	0	0	0	Task Lights
Area Lights	137	137	137	137	137	137	137	137	137	137	137	137	1,642	Area Lights
Total	400	420	411	462	436	449	476	480	497	463	437	404	5,336	

Post Retrofit

Electric	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (kW)	
Space Cool	175	220	217	263	241	236	268	265	276	284	241	208	2,892	Space Cool
Heat Reject.	0	0	0	0	0	0	0	0	0	0	0	0	0	Heat Reject.
Refrigeration	0	0	0	0	0	0	0	0	0	0	0	0	0	Refrigeration
Space Heat	0	0	0	0	0	0	0	0	0	0	0	0	0	Space Heat
HP Supp.	0	0	0	0	0	0	0	0	0	0	0	0	0	HP Supp.
Hot Water	0	0	0	0	0	0	0	0	0	0	0	0	0	Hot Water
Vent. Fans	33	33	33	33	33	33	33	33	33	33	33	33	395	Vent. Fans
Pumps & Aux.	25	25	25	25	25	25	25	25	25	25	25	25	296	Pumps & Aux.
Ext. Usage	0	0	0	0	0	0	0	0	0	0	0	0	0	Ext. Usage
Misc. Equip.	64	64	64	64	64	64	64	64	64	64	64	64	770	Misc. Equip.
Task Lights	0	0	0	0	0	0	0	0	0	0	0	0	0	Task Lights
Area Lights	137	137	137	137	137	137	137	137	137	137	137	137	1,642	Area Lights
Total	433	478	475	521	499	495	526	523	535	543	499	467	5,996	Total



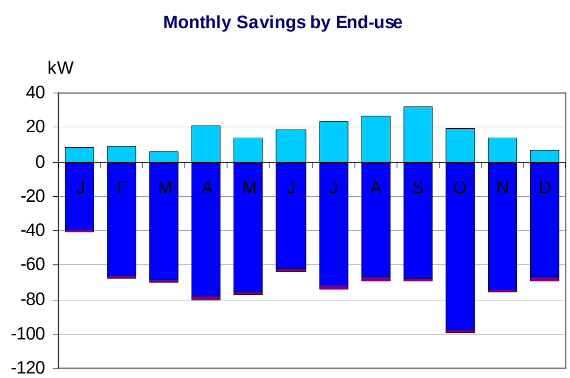


Figure 19 - Electricity Consumption Demand, Los Angeles, California

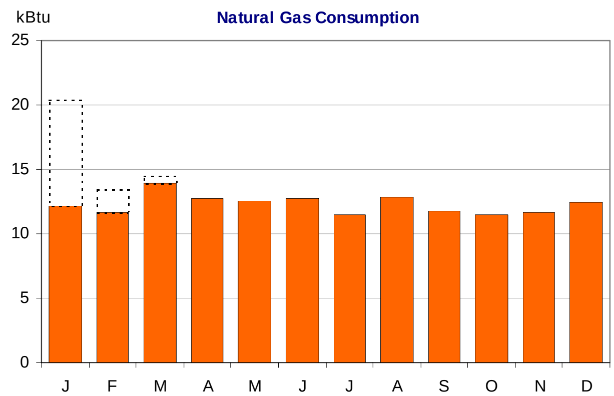
Natural Gas Consumption

Baseline

Natural Gas	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (kBtu)	
Space Cool	0	0	0	0	0	0	0	0	0	0	0	0	0	Space Cool
Heat Reject.	0	0	0	0	0	0	0	0	0	0	0	0	0	Heat Reject.
Refrigeration	0	0	0	0	0	0	0	0	0	0	0	0	0	Refrigeration
Space Heat	8,226	1,790	583	0	0	0	0	0	0	0	0	0	10,599	Space Heat
HP Supp.	0	0	0	0	0	0	0	0	0	0	0	0	0	HP Supp.
Hot Water	12,199	11,634	13,950	12,743	12,522	12,718	11,515	12,864	11,813	11,492	11,662	12,492	147,603	Hot Water
Vent. Fans	0	0	0	0	0	0	0	0	0	0	0	0	0	Vent. Fans
Pumps & Aux.	0	0	0	0	0	0	0	0	0	0	0	0	0	Pumps & Aux.
Ext. Usage	0	0	0	0	0	0	0	0	0	0	0	0	0	Ext. Usage
Misc. Equip.	0	0	0	0	0	0	0	0	0	0	0	0	0	Misc. Equip.
Task Lights	0	0	0	0	0	0	0	0	0	0	0	0	0	Task Lights
Area Lights	0	0	0	0	0	0	0	0	0	0	0	0	0	Area Lights
Total	20,424	13,424	14,532	12,743	12,522	12,718	11,515	12,864	11,813	11,492	11,662	12,492	158,202	

Post Retrofit

Natural Gas	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (kBtu)	
Space Cool	0	0	0	0	0	0	0	0	0	0	0	0	0	Space Cool
Heat Reject.	0	0	0	0	0	0	0	0	0	0	0	0	0	Heat Reject.
Refrigeration	0	0	0	0	0	0	0	0	0	0	0	0	0	Refrigeration
Space Heat	0	0	0	0	0	0	0	0	0	0	0	0	0	Space Heat
HP Supp.	0	0	0	0	0	0	0	0	0	0	0	0	0	HP Supp.
Hot Water	12,199	11,634	13,950	12,743	12,522	12,718	11,515	12,864	11,813	11,492	11,662	12,492	147,603	Hot Water
Vent. Fans	0	0	0	0	0	0	0	0	0	0	0	0	0	Vent. Fans
Pumps & Aux.	0	0	0	0	0	0	0	0	0	0	0	0	0	Pumps & Aux.
Ext. Usage	0	0	0	0	0	0	0	0	0	0	0	0	0	Ext. Usage
Misc. Equip.	0	0	0	0	0	0	0	0	0	0	0	0	0	Misc. Equip.
Task Lights	0	0	0	0	0	0	0	0	0	0	0	0	0	Task Lights
Area Lights	0	0	0	0	0	0	0	0	0	0	0	0	0	Area Lights
Total	12,346	12,118	14,546	13,075	12,070	11,475	9,734	10,397	9,528	9,658	10,475	11,980	137,403	Total



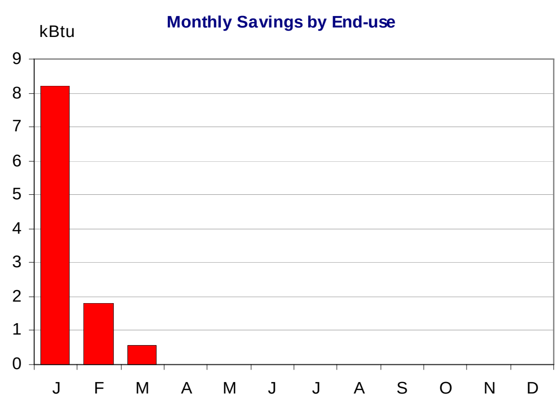
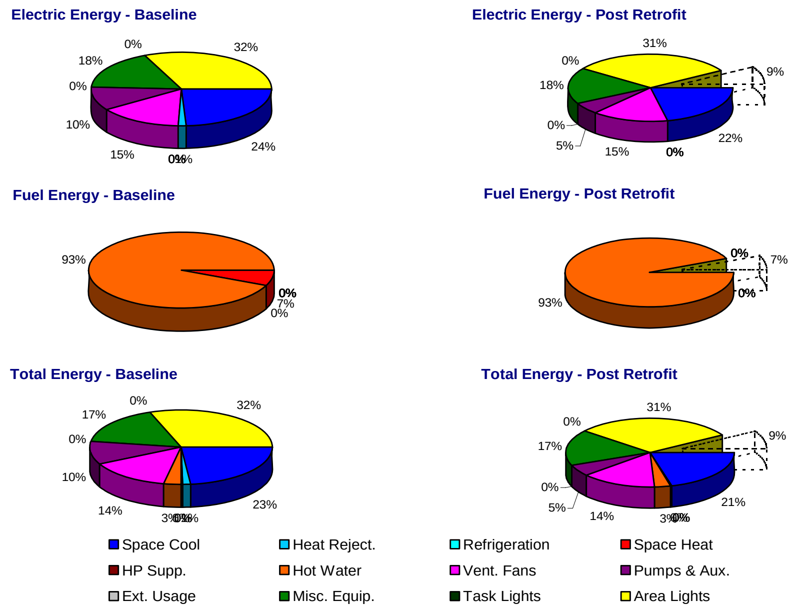


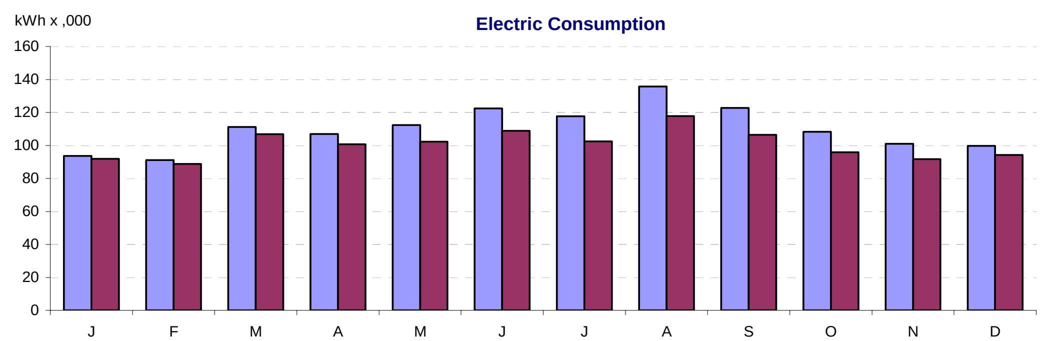
Figure 20 - Natural Gas Consumption Comparison, Los Angeles, California

Energy Comparison

Annual Total Energy Consumption



Monthly Total Energy Consumption



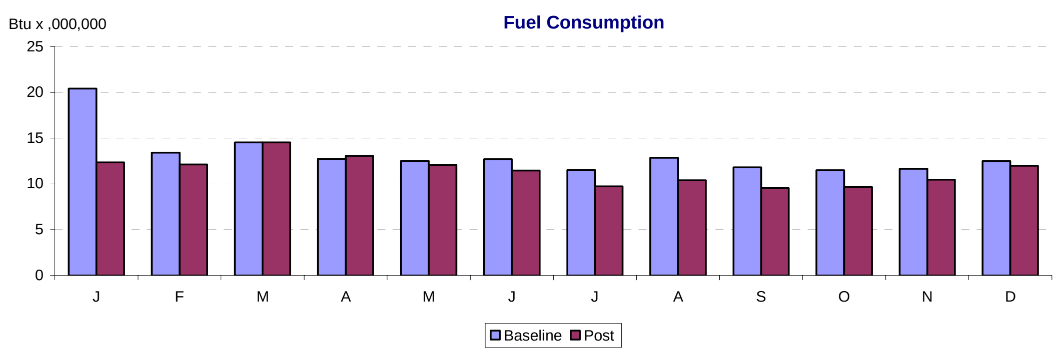
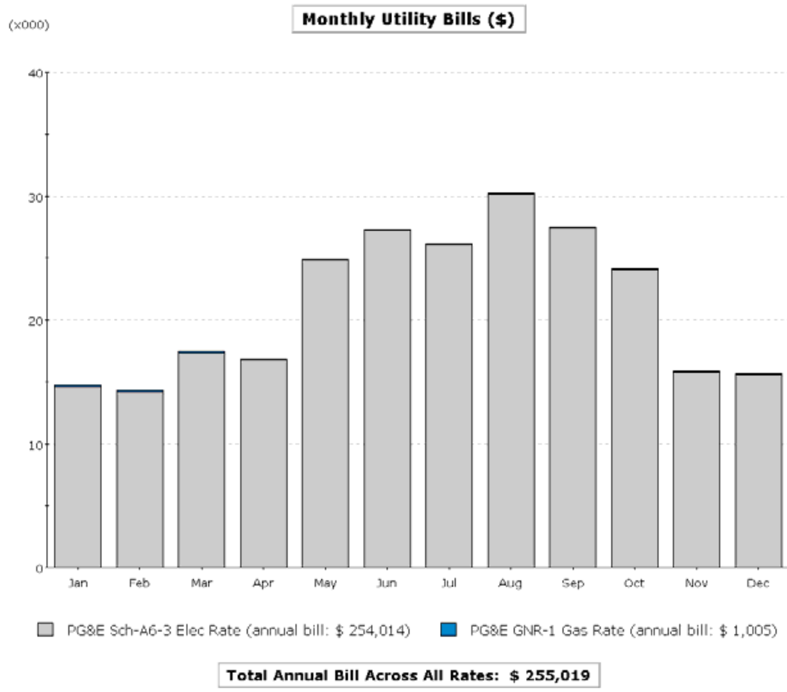


Figure 21 - Energy Summary, Los Angeles, California

Energy Costs
Baseline



Post Retrofit

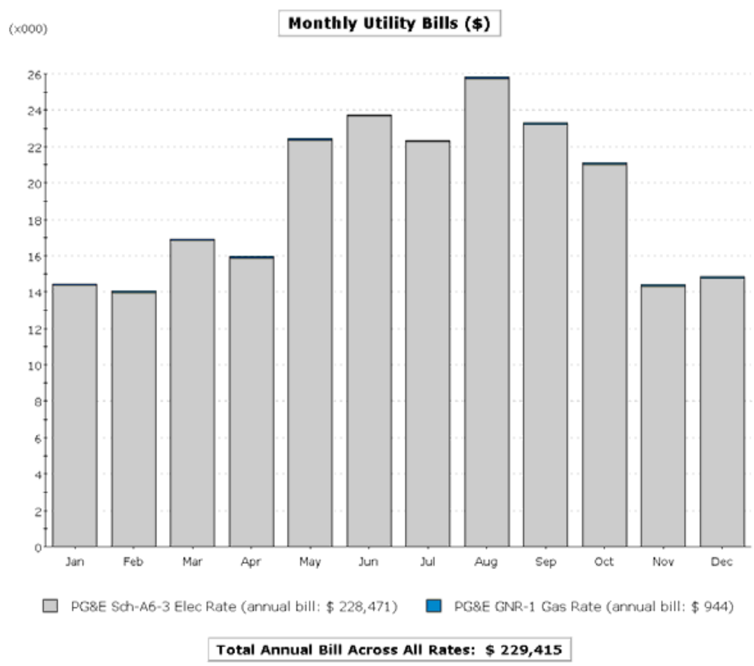


Figure 22 – Utility Comparison, Los Angeles, California

Appendix C: Minneapolis Minnesota Model Results

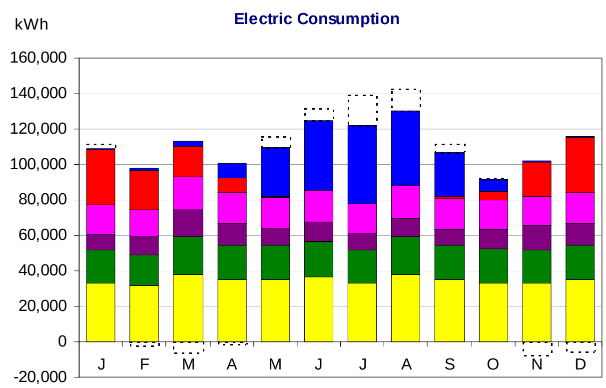
Electrical Consumption

Baseline

Electric	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total kWh	
Space Cool	869	1,455	3,583	9,584	28,371	39,787	50,996	45,330	24,527	8,011	1,029	836	214,378	Space Cool
Heat Reject.	0	0	0	350	1,478	2,507	6,463	4,423	1,285	0	0	0	16,507	Heat Reject.
Refrigeration	0	0	0	0	0	0	0	0	0	0	0	0	0	Refrigeration
Space Heat	32,964	20,468	13,737	6,484	502	17	0	1	1,093	4,321	15,651	27,884	123,123	Space Heat
HP Supp.	0	0	0	0	0	0	0	0	0	0	0	0	0	HP Supp.
Hot Water	0	0	0	0	0	0	0	0	0	0	0	0	0	Hot Water
Vent. Fans	16,386	15,567	18,878	17,171	17,240	18,025	16,386	18,844	17,171	16,420	16,352	17,205	205,646	Vent. Fans
Pumps & Aux.	9,427	9,155	11,871	11,758	13,748	14,633	13,303	15,299	13,458	11,589	9,671	9,906	143,818	Pumps & Aux.
Ext. Usage	0	0	0	0	0	0	0	0	0	0	0	0	0	Ext. Usage
Misc. Equip.	18,645	17,565	20,976	19,307	19,429	20,091	18,645	20,967	19,307	18,655	18,533	19,419	231,539	Misc. Equip.
Task Lights	0	0	0	0	0	0	0	0	0	0	0	0	0	Task Lights
Area Lights	33,409	31,659	38,171	34,935	35,000	36,526	33,409	38,166	34,935	33,415	33,349	34,995	417,969	Area Lights
Total	111,700	95,869	107,217	99,590	115,768	131,586	139,203	143,029	111,776	92,411	94,586	110,246	1,352,979	

Post Retrofit

Electric	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total kWh	
Space Cool	457	923	2,719	8,721	27,791	39,451	44,324	41,945	24,861	7,223	829	643	199,885	Space Cool
Heat Reject.	0	0	0	0	0	0	0	0	0	0	0	0	0	Heat Reject.
Refrigeration	0	0	0	0	0	0	0	0	0	0	0	0	0	Refrigeration
Space Heat	31,485	21,896	17,092	7,921	597	19	0	1	1,180	4,862	19,187	31,377	135,616	Space Heat
HP Supp.	0	0	0	0	0	0	0	0	0	0	0	0	0	HP Supp.
Hot Water	0	0	0	0	0	0	0	0	0	0	0	0	0	Hot Water
Vent. Fans	16,386	15,567	18,878	17,171	17,240	18,025	16,386	18,844	17,171	16,420	16,352	17,205	205,646	Vent. Fans
Pumps & Aux.	8,520	10,019	15,395	12,836	9,917	10,660	9,455	10,235	9,153	11,375	13,823	12,293	133,682	Pumps & Aux.
Ext. Usage	0	0	0	0	0	0	0	0	0	0	0	0	0	Ext. Usage
Misc. Equip.	18,645	17,565	20,976	19,307	19,429	20,091	18,645	20,967	19,307	18,655	18,533	19,419	231,539	Misc. Equip.
Task Lights	0	0	0	0	0	0	0	0	0	0	0	0	0	Task Lights
Area Lights	33,409	31,659	38,171	34,935	35,000	36,526	33,409	38,166	34,935	33,415	33,349	34,995	417,969	Area Lights
Total	108,902	97,628	113,232	100,891	109,974	124,771	122,219	130,157	106,607	91,950	102,072	115,932	1,324,337	Total



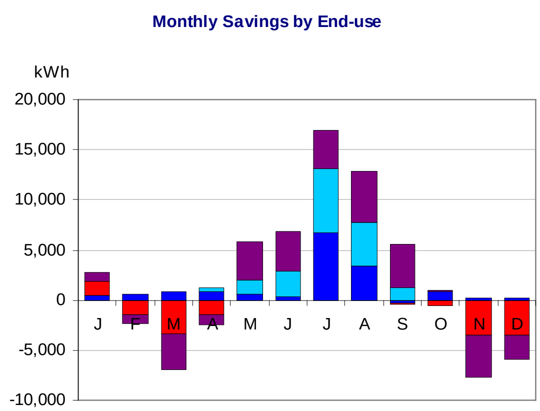


Figure 23 - Electricity Consumption Comparison, Minneapolis, Minnesota

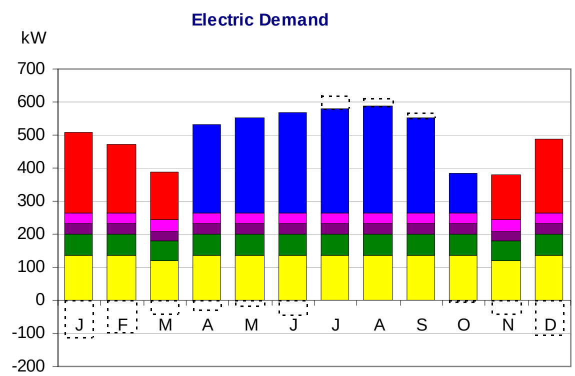
Electrical Demand

Baseline

Electric													kW	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	
Space Cool	0	0	84	211	234	225	287	271	252	115	0	0	1,679	Space Cool
Heat Reject.	0	0	0	31	40	38	71	79	54	0	0	0	312	Heat Reject.
Refrigeration	0	0	0	0	0	0	0	0	0	0	0	0	0	Refrigeration
Space Heat	141	119	0	0	0	0	0	0	0	0	86	150	496	Space Heat
HP Supp.	0	0	0	0	0	0	0	0	0	0	0	0	0	HP Supp.
Hot Water	0	0	0	0	0	0	0	0	0	0	0	0	0	Hot Water
Vent. Fans	34	34	34	34	34	34	34	34	34	34	34	34	410	Vent. Fans
Pumps & Aux.	20	20	28	28	28	28	28	28	28	28	20	21	301	Pumps & Aux.
Ext. Usage	0	0	0	0	0	0	0	0	0	0	0	0	0	Ext. Usage
Misc. Equip.	64	64	64	64	64	64	64	64	64	64	64	57	763	Misc. Equip.
Task Lights	0	0	0	0	0	0	0	0	0	0	0	0	0	Task Lights
Area Lights	137	137	137	137	137	137	137	137	137	137	137	121	1,627	Area Lights
Total	396	373	346	505	536	526	621	613	569	378	340	383	5,588	

Post Retrofit

Electric													kW	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	
Space Cool	0	0	0	268	287	305	316	323	288	118	0	0	1,905	Space Cool
Heat Reject.	0	0	0	0	0	0	0	0	0	0	0	0	0	Heat Reject.
Refrigeration	0	0	0	0	0	0	0	0	0	0	0	0	0	Refrigeration
Space Heat	242	206	145	0	0	0	0	0	0	0	138	222	952	Space Heat
HP Supp.	0	0	0	0	0	0	0	0	0	0	0	0	0	HP Supp.
Hot Water	0	0	0	0	0	0	0	0	0	0	0	0	0	Hot Water
Vent. Fans	34	34	34	34	34	34	34	34	34	34	34	34	410	Vent. Fans
Pumps & Aux.	30	30	30	30	30	30	30	30	30	30	30	30	358	Pumps & Aux.
Ext. Usage	0	0	0	0	0	0	0	0	0	0	0	0	0	Ext. Usage
Misc. Equip.	64	64	57	64	64	64	64	64	64	64	57	64	756	Misc. Equip.
Task Lights	0	0	0	0	0	0	0	0	0	0	0	0	0	Task Lights
Area Lights	137	137	121	137	137	137	137	137	137	137	121	137	1,611	Area Lights
Total	507	471	387	533	552	570	581	588	553	383	380	487	5,992	Total



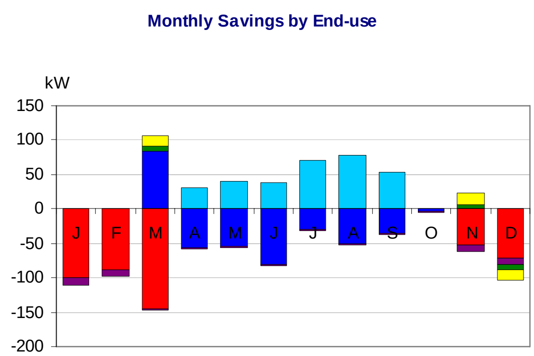


Figure 24 - Electricity Demand Comparison, Minneapolis, Minnesota

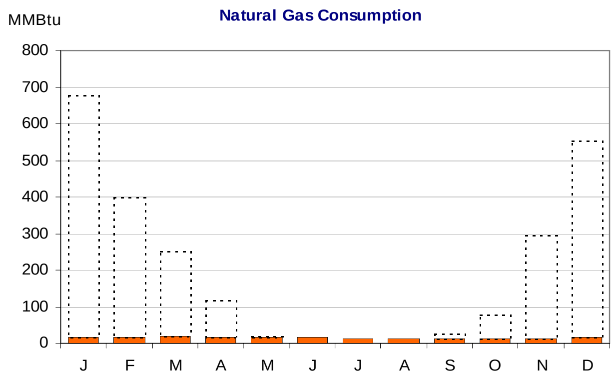
Natural Gas Consumption

Baseline

Natural Gas													kBtu	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	
Space Cool	0	0	0	0	0	0	0	0	0	0	0	0	0	Space Cool
Heat Reject.	0	0	0	0	0	0	0	0	0	0	0	0	0	Heat Reject.
Refrigeration	0	0	0	0	0	0	0	0	0	0	0	0	0	Refrigeration
Space Heat	661,579	382,772	234,560	101,990	5,000	0	0	0	15,207	65,681	282,950	538,491	2,288,230	Space Heat
HP Supp.	0	0	0	0	0	0	0	0	0	0	0	0	0	HP Supp.
Hot Water	16,255	16,018	19,262	17,297	15,859	14,934	12,547	13,344	12,222	12,427	13,573	15,653	179,391	Hot Water
Vent. Fans	0	0	0	0	0	0	0	0	0	0	0	0	0	Vent. Fans
Pumps & Aux.	0	0	0	0	0	0	0	0	0	0	0	0	0	Pumps & Aux.
Ext. Usage	0	0	0	0	0	0	0	0	0	0	0	0	0	Ext. Usage
Misc. Equip.	0	0	0	0	0	0	0	0	0	0	0	0	0	Misc. Equip.
Task Lights	0	0	0	0	0	0	0	0	0	0	0	0	0	Task Lights
Area Lights	0	0	0	0	0	0	0	0	0	0	0	0	0	Area Lights
Total	677,834	398,791	253,822	119,287	20,859	14,934	12,547	13,344	27,429	78,109	296,522	554,144	2,467,621	

Post Retrofit

Natural Gas													kBtu	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	
Space Cool	0	0	0	0	0	0	0	0	0	0	0	0	0	Space Cool
Heat Reject.	0	0	0	0	0	0	0	0	0	0	0	0	0	Heat Reject.
Refrigeration	0	0	0	0	0	0	0	0	0	0	0	0	0	Refrigeration
Space Heat	0	0	0	0	0	0	0	0	0	0	0	0	0	Space Heat
HP Supp.	0	0	0	0	0	0	0	0	0	0	0	0	0	HP Supp.
Hot Water	16,289	16,035	19,263	17,297	15,854	14,925	12,521	13,325	12,215	12,427	13,573	15,666	179,391	Hot Water
Vent. Fans	0	0	0	0	0	0	0	0	0	0	0	0	0	Vent. Fans
Pumps & Aux.	0	0	0	0	0	0	0	0	0	0	0	0	0	Pumps & Aux.
Ext. Usage	0	0	0	0	0	0	0	0	0	0	0	0	0	Ext. Usage
Misc. Equip.	0	0	0	0	0	0	0	0	0	0	0	0	0	Misc. Equip.
Task Lights	0	0	0	0	0	0	0	0	0	0	0	0	0	Task Lights
Area Lights	0	0	0	0	0	0	0	0	0	0	0	0	0	Area Lights
Total	16,289	16,035	19,263	17,297	15,854	14,925	12,521	13,325	12,215	12,427	13,573	15,666	179,391	Total



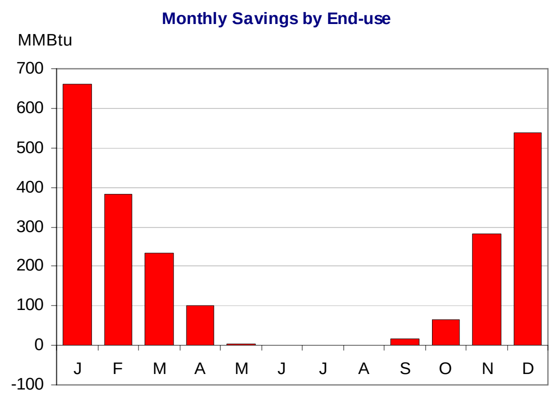
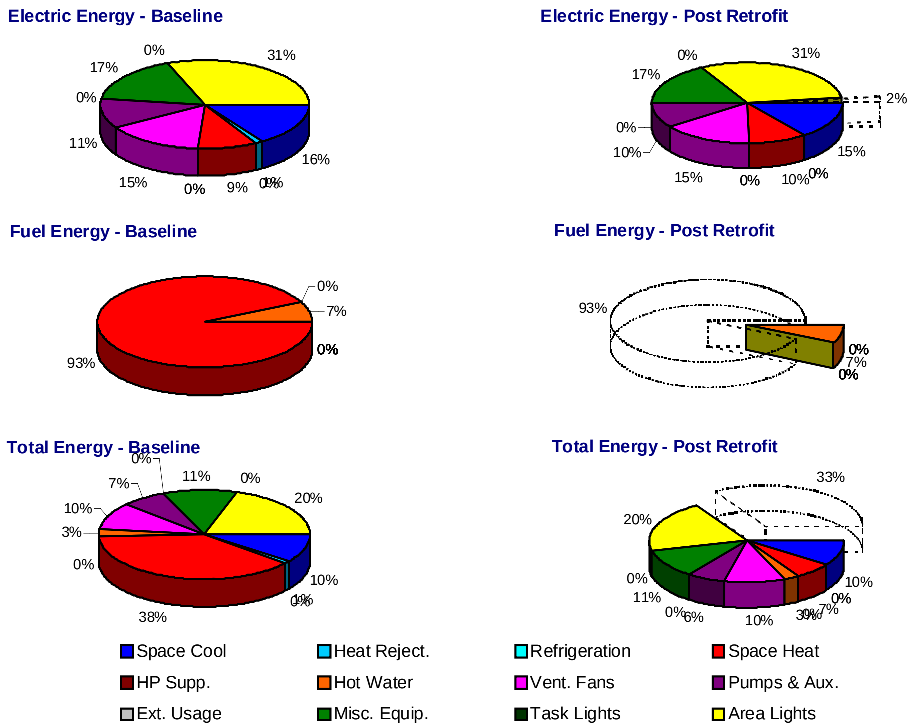


Figure 25 - Natural Gas Consumption Comparison, Minneapolis, Minnesota

Energy Comparison

Annual Total Energy Consumption



Monthly Total Energy Consumption

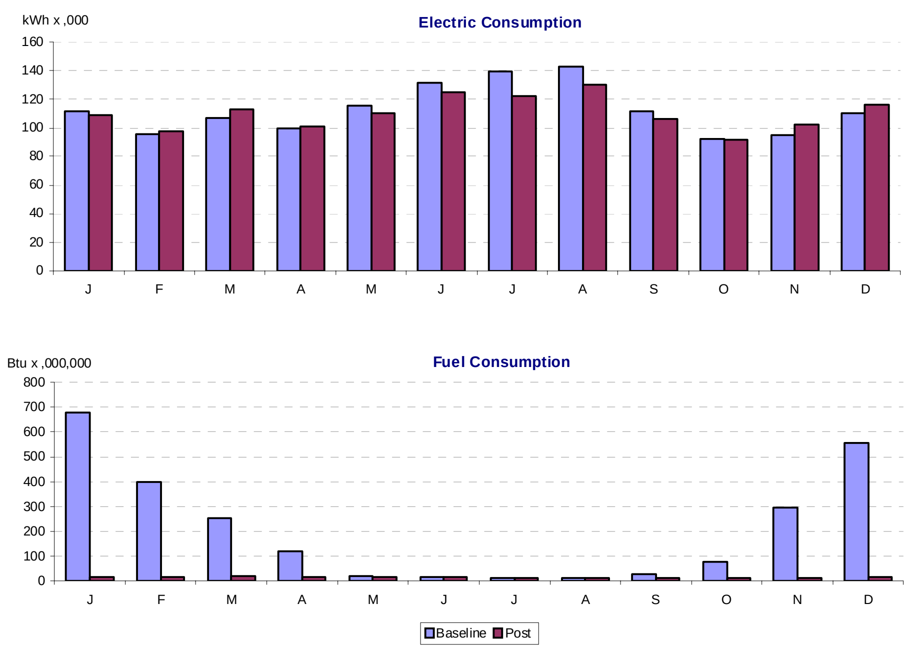
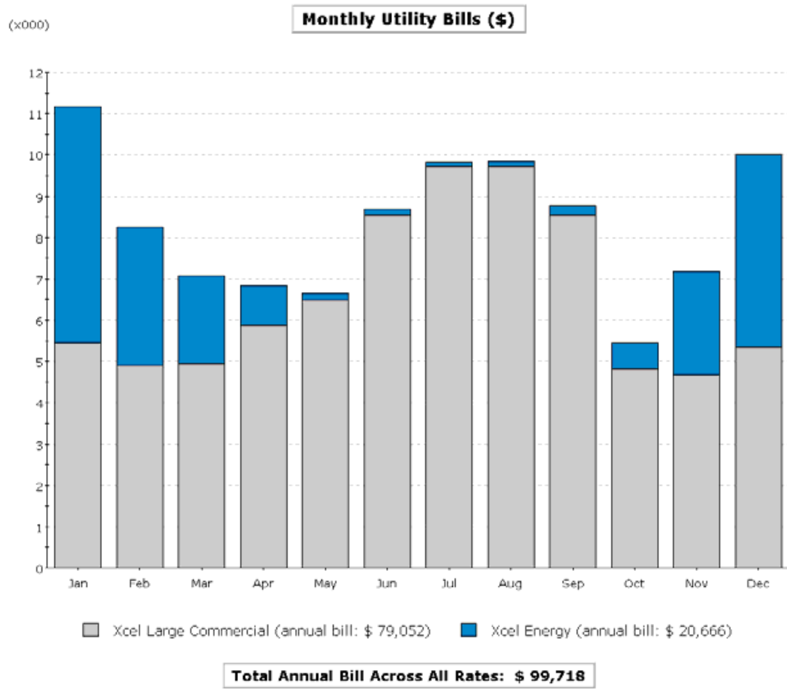


Figure 26 - Energy Summary, Minneapolis, Minnesota

Energy Costs

Baseline



Post Retrofit

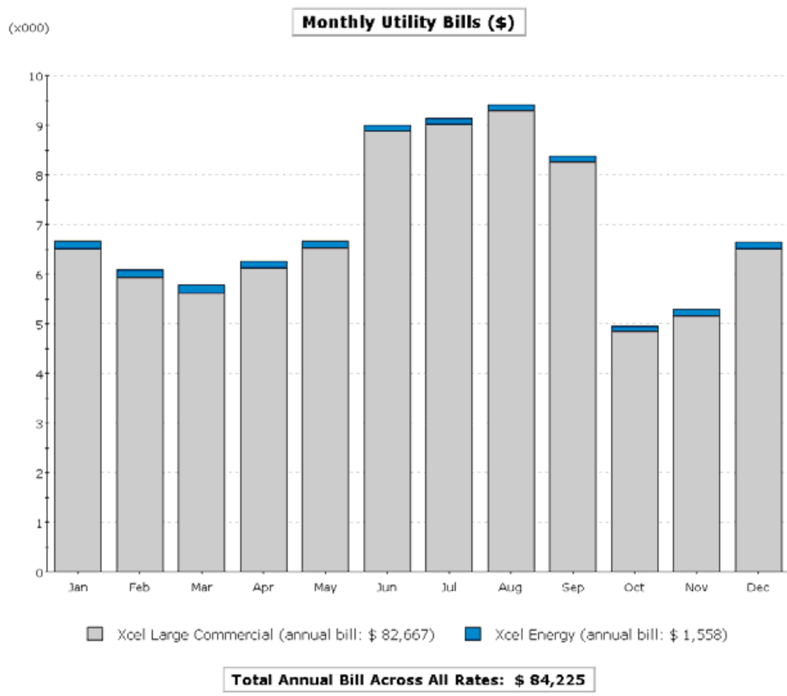


Figure 27 - Utility Comparison, Minneapolis, Minnesota

Appendix D: Richmond Virginia Model Results

Electrical Consumption

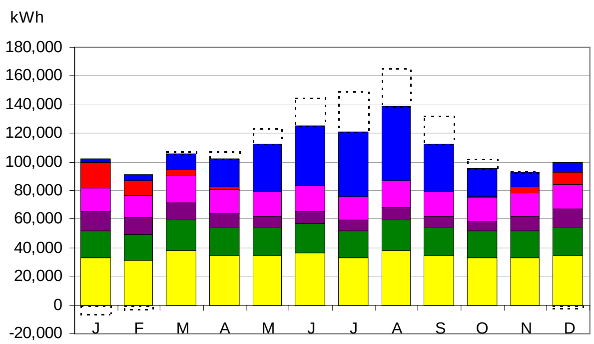
Baseline

Electric	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (kWh)	
Space Cool	2,763	5,106	11,846	20,819	35,725	50,769	57,808	63,897	42,082	19,840	9,933	6,536	327,123	Space Cool
Heat Reject.	0	7	346	983	2,701	6,015	10,270	9,506	5,518	537	86	92	36,060	Heat Reject.
Refrigeration	0	0	0	0	0	0	0	0	0	0	0	0	0	Refrigeration
Space Heat	15,219	8,914	4,028	1,456	35	1	0	0	14	718	4,034	8,484	42,901	Space Heat
HP Supp.	0	0	0	0	0	0	0	0	0	0	0	0	0	HP Supp.
Hot Water	0	0	0	0	0	0	0	0	0	0	0	0	0	Hot Water
Vent. Fans	16,249	15,436	18,720	17,027	17,095	17,874	16,249	18,686	17,027	16,283	16,215	17,061	203,923	Vent. Fans
Pumps & Aux.	9,614	9,852	13,028	12,788	13,403	14,023	12,748	14,660	13,350	12,461	11,350	11,028	148,306	Pumps & Aux.
Ext. Usage	0	0	0	0	0	0	0	0	0	0	0	0	0	Ext. Usage
Misc. Equip.	18,645	17,565	20,976	19,307	19,429	20,091	18,645	20,967	19,307	18,655	18,533	19,419	231,539	Misc. Equip.
Task Lights	0	0	0	0	0	0	0	0	0	0	0	0	0	Task Lights
Area Lights	33,409	31,659	38,171	34,935	35,000	36,526	33,409	38,166	34,935	33,415	33,349	34,995	417,969	Area Lights
Total	95,899	88,540	107,115	107,315	123,388	145,297	149,129	165,881	132,233	101,908	93,502	97,614	1,407,821	

Post Retrofit

Electric	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (kWh)	
Space Cool	2,275	4,393	11,466	19,890	33,121	42,120	45,202	51,873	33,138	19,349	10,901	6,823	280,551	Space Cool
Heat Reject.	0	0	0	0	0	0	0	0	0	0	0	0	0	Heat Reject.
Refrigeration	0	0	0	0	0	0	0	0	0	0	0	0	0	Refrigeration
Space Heat	18,179	10,363	4,454	1,553	30	0	0	0	8	600	4,064	8,948	48,199	Space Heat
HP Supp.	0	0	0	0	0	0	0	0	0	0	0	0	0	HP Supp.
Hot Water	0	0	0	0	0	0	0	0	0	0	0	0	0	Hot Water
Vent. Fans	16,249	15,436	18,720	17,027	17,095	17,874	16,249	18,686	17,027	16,283	16,215	17,061	203,923	Vent. Fans
Pumps & Aux.	13,296	11,797	12,089	9,585	7,736	9,047	7,811	9,160	7,818	6,879	9,988	12,554	117,760	Pumps & Aux.
Ext. Usage	0	0	0	0	0	0	0	0	0	0	0	0	0	Ext. Usage
Misc. Equip.	18,645	17,565	20,976	19,307	19,429	20,091	18,645	20,967	19,307	18,655	18,533	19,419	231,539	Misc. Equip.
Task Lights	0	0	0	0	0	0	0	0	0	0	0	0	0	Task Lights
Area Lights	33,409	31,659	38,171	34,935	35,000	36,526	33,409	38,166	34,935	33,415	33,349	34,995	417,969	Area Lights
Total	102,053	91,213	105,877	102,297	112,411	125,657	121,316	138,852	112,233	95,180	93,049	99,800	1,299,940	Total

Electric Consumption



Monthly Savings by End-use

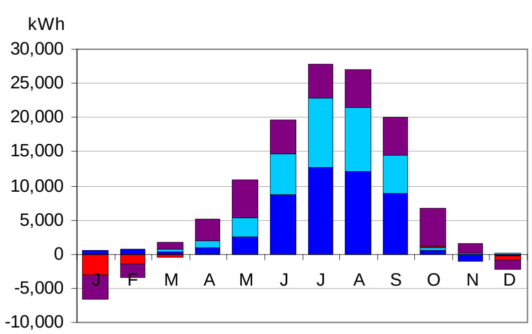


Figure 28- Electricity Consumption Comparison, Richmond, Virginia

Electrical Demand

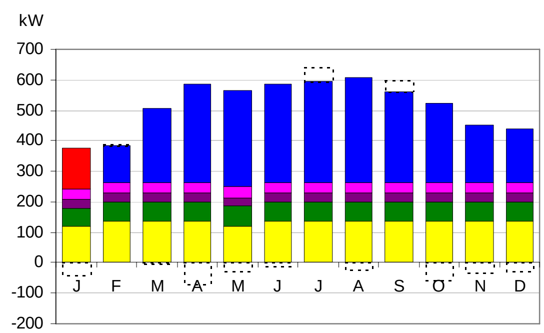
Baseline

Electric													kW	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	
Space Cool	0	123	211	227	232	253	300	266	262	187	148	138	2,347	Space Cool
Heat Reject.	0	4	31	30	46	60	82	56	76	17	10	15	427	Heat Reject.
Refrigeration	0	0	0	0	0	0	0	0	0	0	0	0	0	Refrigeration
Space Heat	106	0	0	0	0	0	0	0	0	0	0	0	106	Space Heat
HP Supp.	0	0	0	0	0	0	0	0	0	0	0	0	0	HP Supp.
Hot Water	0	0	0	0	0	0	0	0	0	0	0	0	0	Hot Water
Vent. Fans	34	34	34	34	34	34	34	34	34	34	34	34	406	Vent. Fans
Pumps & Aux.	19	27	27	27	27	27	27	27	27	27	27	27	311	Pumps & Aux.
Ext. Usage	0	0	0	0	0	0	0	0	0	0	0	0	0	Ext. Usage
Misc. Equip.	57	64	64	64	64	64	64	64	64	64	64	64	763	Misc. Equip.
Task Lights	0	0	0	0	0	0	0	0	0	0	0	0	0	Task Lights
Area Lights	121	137	137	137	137	137	137	137	137	137	137	137	1,627	Area Lights
Total	337	389	503	518	540	575	643	584	599	466	420	414	5,987	

Post Retrofit

Electric													kW	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	
Space Cool	0	121	243	325	318	321	333	343	298	258	190	178	2,928	Space Cool
Heat Reject.	0	0	0	0	0	0	0	0	0	0	0	0	0	Heat Reject.
Refrigeration	0	0	0	0	0	0	0	0	0	0	0	0	0	Refrigeration
Space Heat	135	0	0	0	0	0	0	0	0	0	0	0	135	Space Heat
HP Supp.	0	0	0	0	0	0	0	0	0	0	0	0	0	HP Supp.
Hot Water	0	0	0	0	0	0	0	0	0	0	0	0	0	Hot Water
Vent. Fans	34	34	34	34	34	34	34	34	34	34	34	34	406	Vent. Fans
Pumps & Aux.	29	29	29	29	29	29	29	29	29	29	29	29	343	Pumps & Aux.
Ext. Usage	0	0	0	0	0	0	0	0	0	0	0	0	0	Ext. Usage
Misc. Equip.	57	64	64	64	64	64	64	64	64	64	64	64	763	Misc. Equip.
Task Lights	0	0	0	0	0	0	0	0	0	0	0	0	0	Task Lights
Area Lights	121	137	137	137	121	137	137	137	137	137	137	137	1,611	Area Lights
Total	376	384	507	588	566	585	597	607	561	522	454	441	6,186	Total

Electric Demand



Monthly Savings by End-use

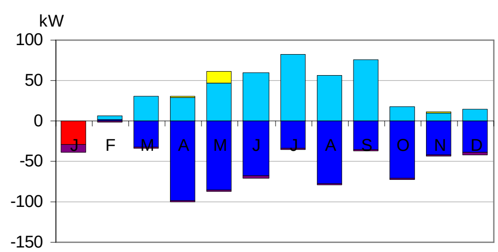


Figure 29 - Electricity Demand Comparison, Richmond, Virginia

Natural Gas Consumption

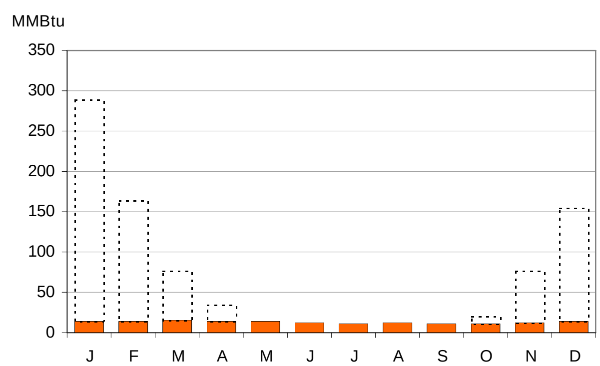
Baseline

Natural Gas													kBtu		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total		
Space Cool	0	0	0	0	0	0	0	0	0	0	0	0	0		Space Cool
Heat Reject.	0	0	0	0	0	0	0	0	0	0	0	0	0		Heat Reject.
Refrigeration	0	0	0	0	0	0	0	0	0	0	0	0	0		Refrigeration
Space Heat	275,547	150,332	60,148	19,378	0	0	0	0	0	8,815	64,030	141,210	719,460		Space Heat
HP Supp.	0	0	0	0	0	0	0	0	0	0	0	0	0		HP Supp.
Hot Water	13,801	13,502	16,208	14,605	13,594	13,025	11,156	12,008	11,003	11,071	11,880	13,464	155,317		Hot Water
Vent. Fans	0	0	0	0	0	0	0	0	0	0	0	0	0		Vent. Fans
Pumps & Aux.	0	0	0	0	0	0	0	0	0	0	0	0	0		Pumps & Aux.
Ext. Usage	0	0	0	0	0	0	0	0	0	0	0	0	0		Ext. Usage
Misc. Equip.	0	0	0	0	0	0	0	0	0	0	0	0	0		Misc. Equip.
Task Lights	0	0	0	0	0	0	0	0	0	0	0	0	0		Task Lights
Area Lights	0	0	0	0	0	0	0	0	0	0	0	0	0		Area Lights
Total	289,348	163,834	76,355	33,983	13,594	13,025	11,156	12,008	11,003	19,886	75,910	154,675	874,777		

Post Retrofit

Natural Gas													kBtu		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total		
Space Cool	0	0	0	0	0	0	0	0	0	0	0	0	0		Space Cool
Heat Reject.	0	0	0	0	0	0	0	0	0	0	0	0	0		Heat Reject.
Refrigeration	0	0	0	0	0	0	0	0	0	0	0	0	0		Refrigeration
Space Heat	0	0	0	0	0	0	0	0	0	0	0	0	0		Space Heat
HP Supp.	0	0	0	0	0	0	0	0	0	0	0	0	0		HP Supp.
Hot Water	13,801	13,502	16,207	14,600	13,574	12,995	11,115	11,970	10,968	11,059	11,878	13,464	155,135		Hot Water
Vent. Fans	0	0	0	0	0	0	0	0	0	0	0	0	0		Vent. Fans
Pumps & Aux.	0	0	0	0	0	0	0	0	0	0	0	0	0		Pumps & Aux.
Ext. Usage	0	0	0	0	0	0	0	0	0	0	0	0	0		Ext. Usage
Misc. Equip.	0	0	0	0	0	0	0	0	0	0	0	0	0		Misc. Equip.
Task Lights	0	0	0	0	0	0	0	0	0	0	0	0	0		Task Lights
Area Lights	0	0	0	0	0	0	0	0	0	0	0	0	0		Area Lights
Total	13,801	13,502	16,207	14,600	13,574	12,995	11,115	11,970	10,968	11,059	11,878	13,464	155,135		Total

Natural Gas Consumption



Monthly Savings by End-use

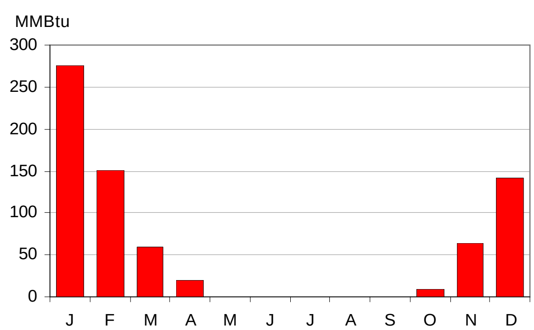
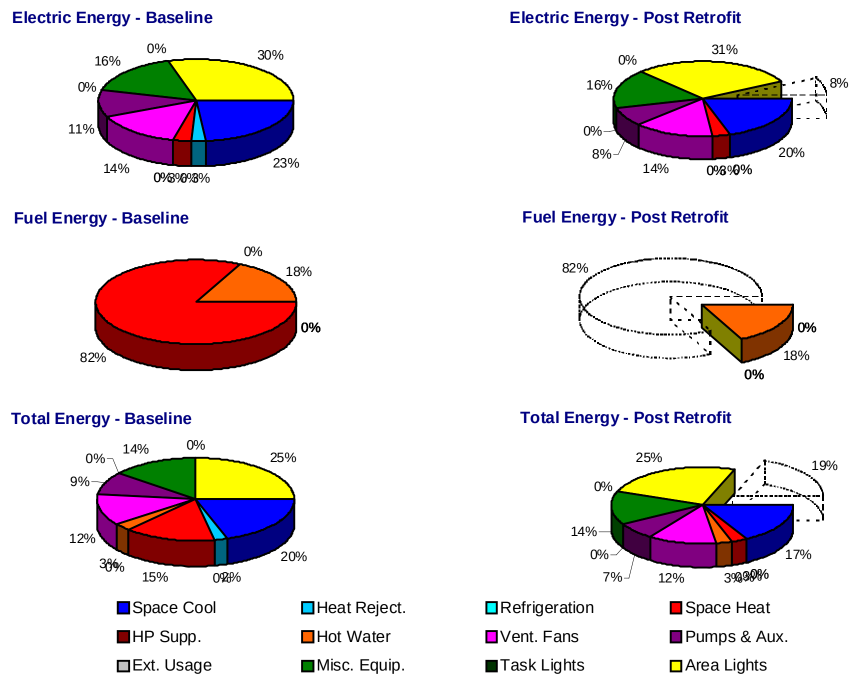


Figure 30 - Natural Gas Consumption Comparison, Richmond, Virginia

Energy Comparison

Annual Total Energy Consumption



Monthly Total Energy Consumption

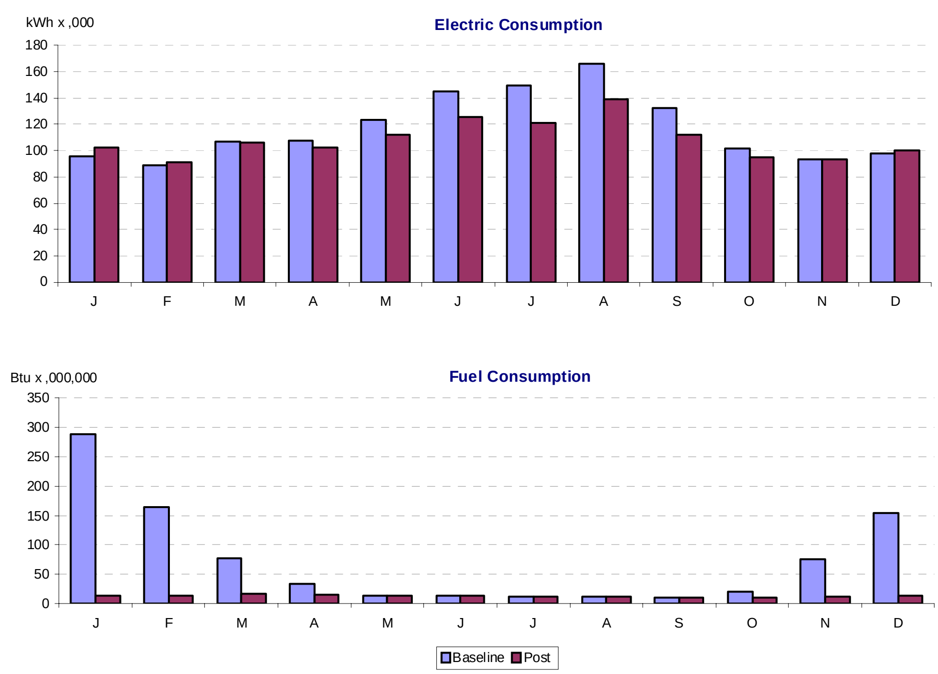
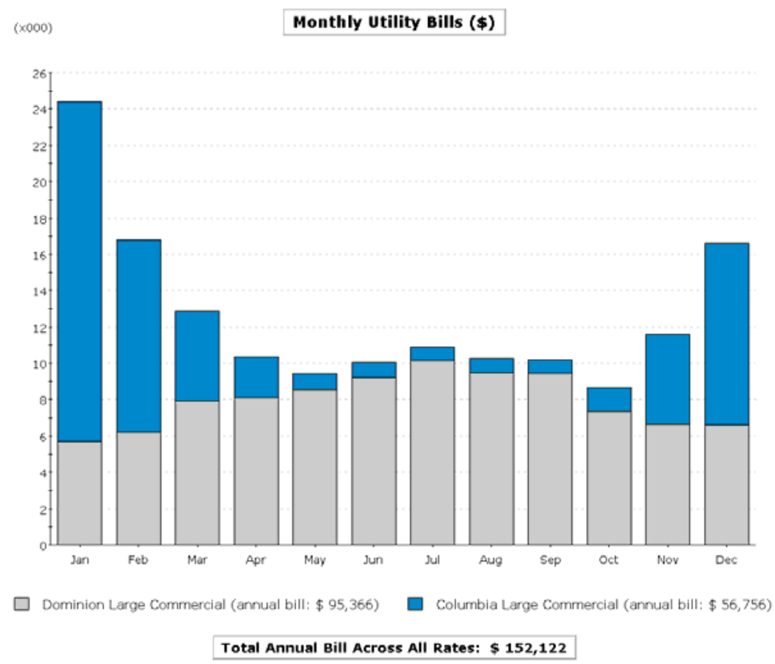


Figure 31 -Energy Summary, Richmond, Virginia

Energy Costs
Baseline



Post Retrofit

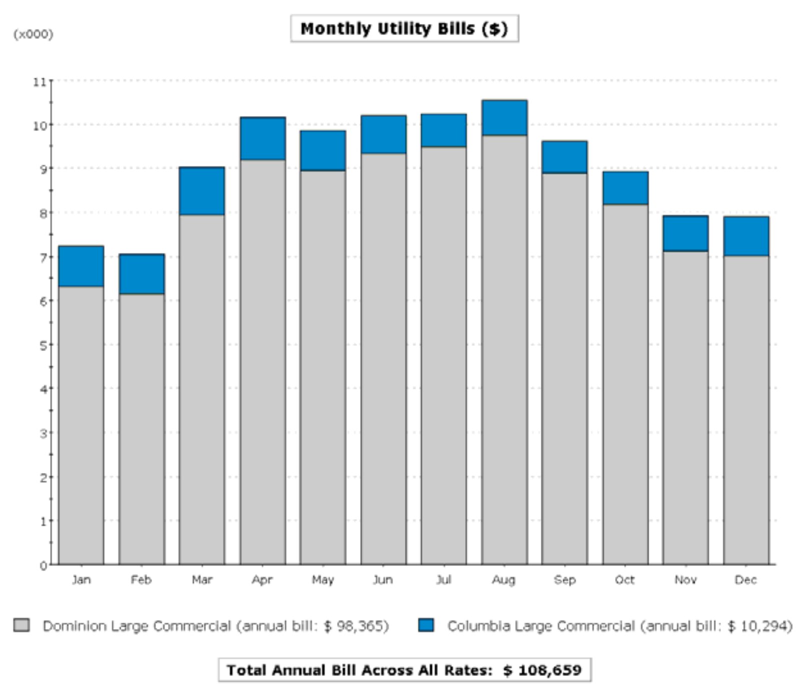


Figure 32 –Utility Comparison, Richmond, Virginia

Appendix E: Building Model Specifications

NUMBER OF SPACES 78 EXTERIOR 73 INTERIOR 5

Spaces on floor: EL1 Ground Flr

SPACE	SPACE*FLOOR MULTIPLIER	SPACE TYPE	AZIM	LIGHTS (WATT / SQFT)	PEOPLE	EQUIP (WATT / SQFT)	INFILTRATION METHOD	ACH	AREA (SQFT)	VOLUME (CUFT)
EL1 South Perim Spc (G.S1)	1.0	EXT	0.0	1.48	7.3	0.56	AIR-CHANGE	0.18	1041.0	9369.0
EL1 East Perim Spc (G.E2)	1.0	EXT	-90.0	1.48	6.8	0.56	AIR-CHANGE	0.15	969.8	8727.8
EL1 South Perim Spc (G.S3)	1.0	EXT	0.0	1.48	8.5	0.56	AIR-CHANGE	0.12	1218.8	10968.8
EL1 West Perim Spc (G.W4)	1.0	EXT	90.0	1.48	6.8	0.56	AIR-CHANGE	0.15	969.8	8727.8
EL1 South Perim Spc (G.S5)	1.0	EXT	0.0	1.48	7.3	0.56	AIR-CHANGE	0.18	1041.0	9369.0
EL1 East Perim Spc (G.E6)	1.0	EXT	-90.0	1.48	20.9	0.56	AIR-CHANGE	0.16	2980.5	26824.5
EL1 North Perim Spc (G.N7)	1.0	EXT	180.0	1.48	7.3	0.56	AIR-CHANGE	0.18	1041.0	9369.0
EL1 West Perim Spc (G.W8)	1.0	EXT	90.0	1.48	6.8	0.56	AIR-CHANGE	0.15	969.8	8727.8
EL1 North Perim Spc (G.N9)	1.0	EXT	180.0	1.48	8.5	0.56	AIR-CHANGE	0.12	1218.8	10968.8
EL1 East Perim Spc (G.E10)	1.0	EXT	-90.0	1.48	6.8	0.56	AIR-CHANGE	0.15	969.8	8727.8
EL1 North Perim Spc (G.N11)	1.0	EXT	180.0	1.48	7.3	0.56	AIR-CHANGE	0.18	1041.0	9369.0
EL1 West Perim Spc (G.W12)	1.0	EXT	90.0	1.48	20.9	0.56	AIR-CHANGE	0.16	2980.5	26824.5
EL1 Core Spc (G.C13)	1.0	INT	0.0	1.02	105.6	0.44	AIR-CHANGE	0.01	25222.6	227003.0
EL1 South Perim Plnm (G.S14)	1.0	EXT	0.0	0.00	0.0	0.00	AIR-CHANGE	0.18	1041.0	4164.0
EL1 East Perim Plnm (G.E15)	1.0	EXT	-90.0	0.00	0.0	0.00	AIR-CHANGE	0.15	969.8	3879.0
EL1 South Perim Plnm (G.S16)	1.0	EXT	0.0	0.00	0.0	0.00	AIR-CHANGE	0.12	1218.8	4875.0
EL1 West Perim Plnm (G.W17)	1.0	EXT	90.0	0.00	0.0	0.00	AIR-CHANGE	0.15	969.8	3879.0
EL1 South Perim Plnm (G.S18)	1.0	EXT	0.0	0.00	0.0	0.00	AIR-CHANGE	0.18	1041.0	4164.0
EL1 East Perim Plnm (G.E19)	1.0	EXT	-90.0	0.00	0.0	0.00	AIR-CHANGE	0.16	2980.5	11922.0
EL1 North Perim Plnm (G.N20)	1.0	EXT	180.0	0.00	0.0	0.00	AIR-CHANGE	0.18	1041.0	4164.0
EL1 West Perim Plnm (G.W21)	1.0	EXT	90.0	0.00	0.0	0.00	AIR-CHANGE	0.15	969.8	3879.0
EL1 North Perim Plnm (G.N22)	1.0	EXT	180.0	0.00	0.0	0.00	AIR-CHANGE	0.12	1218.8	4875.0
EL1 East Perim Plnm (G.E23)	1.0	EXT	-90.0	0.00	0.0	0.00	AIR-CHANGE	0.15	969.8	3879.0
EL1 North Perim Plnm (G.N24)	1.0	EXT	180.0	0.00	0.0	0.00	AIR-CHANGE	0.18	1041.0	4164.0
EL1 West Perim Plnm (G.W25)	1.0	EXT	90.0	0.00	0.0	0.00	AIR-CHANGE	0.16	2980.5	11922.0
EL1 Core Plnm (G.C26)	1.0	INT	0.0	0.00	0.0	0.00	AIR-CHANGE	0.02	25222.6	100890.2

Spaces on floor: EL1 Mid Flr

SPACE	SPACE*FLOOR MULTIPLIER	SPACE TYPE	AZIM	LIGHTS (WATT / SQFT)	PEOPLE	EQUIP (WATT / SQFT)	INFILTRATION METHOD	ACH	AREA (SQFT)	VOLUME (CUFT)
EL1 South Perim Spc (M.S27)	1.0	EXT	0.0	1.45	5.4	0.74	AIR-CHANGE	0.18	1041.0	9369.0
EL1 East Perim Spc (M.E28)	1.0	EXT	-90.0	1.45	5.0	0.74	AIR-CHANGE	0.15	969.8	8727.8
EL1 South Perim Spc (M.S29)	1.0	EXT	0.0	1.45	6.3	0.74	AIR-CHANGE	0.12	1218.8	10968.8
EL1 West Perim Spc (M.W30)	1.0	EXT	90.0	1.45	5.0	0.74	AIR-CHANGE	0.15	969.8	8727.8
EL1 South Perim Spc (M.S31)	1.0	EXT	0.0	1.45	5.4	0.74	AIR-CHANGE	0.18	1041.0	9369.0
EL1 East Perim Spc (M.E32)	1.0	EXT	-90.0	1.45	15.4	0.74	AIR-CHANGE	0.16	2980.5	26824.5
EL1 North Perim Spc (M.N33)	1.0	EXT	180.0	1.45	5.4	0.74	AIR-CHANGE	0.18	1041.0	9369.0
EL1 West Perim Spc (M.W34)	1.0	EXT	90.0	1.45	5.0	0.74	AIR-CHANGE	0.15	969.8	8727.8
EL1 North Perim Spc (M.N35)	1.0	EXT	180.0	1.45	6.3	0.74	AIR-CHANGE	0.12	1218.8	10968.8
EL1 East Perim Spc (M.E36)	1.0	EXT	-90.0	1.45	5.0	0.74	AIR-CHANGE	0.15	969.8	8727.8

EL1 North Perim Spc (M.N37)	1.0	EXT	180.0	1.45	5.4	0.74	AIR-CHANGE	0.18	1041.0	9369.0
EL1 West Perim Spc (M.W38)	1.0	EXT	90.0	1.45	15.4	0.74	AIR-CHANGE	0.16	2980.5	26824.5
EL1 Core Spc (M.C39)	1.0	INT	0.0	1.07	128.6	0.53	AIR-CHANGE	0.01	25222.6	227003.0
EL1 South Perim Plnm (M.S40)	1.0	EXT	0.0	0.00	0.0	0.00	AIR-CHANGE	0.18	1041.0	4164.0
EL1 East Perim Plnm (M.E41)	1.0	EXT	-90.0	0.00	0.0	0.00	AIR-CHANGE	0.15	969.8	3879.0

REPORT- LV-B Summary of Spaces WEATHER FILE- DALLAS LOVE FIELD TX

(CONTINUED)--------

EL1 South Perim Plnm (M.S42)	1.0	EXT	0.0	0.00	0.0	0.00	AIR-CHANGE	0.12	1218.8	4875.0
EL1 West Perim Plnm (M.W43)	1.0	EXT	90.0	0.00	0.0	0.00	AIR-CHANGE	0.15	969.8	3879.0
EL1 South Perim Plnm (M.S44)	1.0	EXT	0.0	0.00	0.0	0.00	AIR-CHANGE	0.18	1041.0	4164.0
EL1 East Perim Plnm (M.E45)	1.0	EXT	-90.0	0.00	0.0	0.00	AIR-CHANGE	0.16	2980.5	11922.0
EL1 North Perim Plnm (M.N46)	1.0	EXT	180.0	0.00	0.0	0.00	AIR-CHANGE	0.18	1041.0	4164.0
EL1 West Perim Plnm (M.W47)	1.0	EXT	90.0	0.00	0.0	0.00	AIR-CHANGE	0.15	969.8	3879.0
EL1 North Perim Plnm (M.N48)	1.0	EXT	180.0	0.00	0.0	0.00	AIR-CHANGE	0.12	1218.8	4875.0
EL1 East Perim Plnm (M.E49)	1.0	EXT	-90.0	0.00	0.0	0.00	AIR-CHANGE	0.15	969.8	3879.0
EL1 North Perim Plnm (M.N50)	1.0	EXT	180.0	0.00	0.0	0.00	AIR-CHANGE	0.18	1041.0	4164.0
EL1 West Perim Plnm (M.W51)	1.0	EXT	90.0	0.00	0.0	0.00	AIR-CHANGE	0.16	2980.5	11922.0
EL1 Core Plnm (M.C52)	1.0	INT	0.0	0.00	0.0	0.00	AIR-CHANGE	0.02	25222.6	100890.2
Spaces on floor: EL1 Top Flr										
EL1 South Perim Spc (T.S53)	1.0	EXT	0.0	1.45	5.4	0.74	AIR-CHANGE	0.18	1041.0	9369.0
EL1 East Perim Spc (T.E54)	1.0	EXT	-90.0	1.45	5.0	0.74	AIR-CHANGE	0.15	969.8	8727.8
EL1 South Perim Spc (T.S55)	1.0	EXT	0.0	1.45	6.3	0.74	AIR-CHANGE	0.12	1218.8	10968.8
EL1 West Perim Spc (T.W56)	1.0	EXT	90.0	1.45	5.0	0.74	AIR-CHANGE	0.15	969.8	8727.8
EL1 South Perim Spc (T.S57)	1.0	EXT	0.0	1.45	5.4	0.74	AIR-CHANGE	0.18	1041.0	9369.0
EL1 East Perim Spc (T.E58)	1.0	EXT	-90.0	1.45	15.4	0.74	AIR-CHANGE	0.16	2980.5	26824.5
EL1 North Perim Spc (T.N59)	1.0	EXT	180.0	1.45	5.4	0.74	AIR-CHANGE	0.18	1041.0	9369.0
EL1 West Perim Spc (T.W60)	1.0	EXT	90.0	1.45	5.0	0.74	AIR-CHANGE	0.15	969.8	8727.8
EL1 North Perim Spc (T.N61)	1.0	EXT	180.0	1.45	6.3	0.74	AIR-CHANGE	0.12	1218.8	10968.8
EL1 East Perim Spc (T.E62)	1.0	EXT	-90.0	1.45	5.0	0.74	AIR-CHANGE	0.15	969.8	8727.8
EL1 North Perim Spc (T.N63)	1.0	EXT	180.0	1.45	5.4	0.74	AIR-CHANGE	0.18	1041.0	9369.0
EL1 West Perim Spc (T.W64)	1.0	EXT	90.0	1.45	15.4	0.74	AIR-CHANGE	0.16	2980.5	26824.5
EL1 Core Spc (T.C65)	1.0	INT	0.0	1.07	128.6	0.53	AIR-CHANGE	0.01	25222.6	227003.0
EL1 South Perim Plnm (T.S66)	1.0	EXT	0.0	0.00	0.0	0.00	AIR-CHANGE	0.18	1041.0	4164.0
EL1 East Perim Plnm (T.E67)	1.0	EXT	-90.0	0.00	0.0	0.00	AIR-CHANGE	0.15	969.8	3879.0
EL1 South Perim Plnm (T.S68)	1.0	EXT	0.0	0.00	0.0	0.00	AIR-CHANGE	0.12	1218.8	4875.0
EL1 West Perim Plnm (T.W69)	1.0	EXT	90.0	0.00	0.0	0.00	AIR-CHANGE	0.15	969.8	3879.0
EL1 South Perim Plnm (T.S70)	1.0	EXT	0.0	0.00	0.0	0.00	AIR-CHANGE	0.18	1041.0	4164.0
EL1 East Perim Plnm (T.E71)	1.0	EXT	-90.0	0.00	0.0	0.00	AIR-CHANGE	0.16	2980.5	11922.0
EL1 North Perim Plnm (T.N72)	1.0	EXT	180.0	0.00	0.0	0.00	AIR-CHANGE	0.18	1041.0	4164.0
EL1 West Perim Plnm (T.W73)	1.0	EXT	90.0	0.00	0.0	0.00	AIR-CHANGE	0.15	969.8	3879.0
EL1 North Perim Plnm (T.N74)	1.0	EXT	180.0	0.00	0.0	0.00	AIR-CHANGE	0.12	1218.8	4875.0
EL1 East Perim Plnm (T.E75)	1.0	EXT	-90.0	0.00	0.0	0.00	AIR-CHANGE	0.15	969.8	3879.0
EL1 North Perim Plnm (T.N76)	1.0	EXT	180.0	0.00	0.0	0.00	AIR-CHANGE	0.18	1041.0	4164.0
EL1 West Perim Plnm (T.W77)	1.0	EXT	90.0	0.00	0.0	0.00	AIR-CHANGE	0.16	2980.5	11922.0
EL1 Core Plnm (T.C78)	1.0	EXT	0.0	0.00	0.0	0.00	AIR-CHANGE	0.02	25222.6	100890.2
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BUILDING TOTALS					648.3				249984.4	1624898.3

NUMBER OF EXTERIOR SURFACES 85
(U-VALUE INCLUDES OUTSIDE FILM; WINDOW INCLUDES FRAME AND CURB, IF DEFINED)

SURFACE AZIMUTH	- - - W I N D O W S - - - U-VALUE (BTU/HR-SQFT-F)	AREA (SQFT)	- - - - W A L L - - - - U-VALUE (BTU/HR-SQFT-F)	AREA (SQFT)	-W A L L + W I N D O W S- U-VALUE (BTU/HR-SQFT-F)	AREA (SQFT)
EL1 North Wall (G.N7.E7) NORTH in space: EL1 North Perim Spc (G.N7)	0.571	436.31	0.078	323.29	0.361	759.60
EL1 North Wall (G.N9.E9) NORTH in space: EL1 North Perim Spc (G.N9)	0.515	341.92	0.078	254.33	0.328	596.25
EL1 North Wall (G.N11.E11) NORTH in space: EL1 North Perim Spc (G.N11)	0.514	435.59	0.078	324.01	0.328	759.60
EL1 North Wall (G.N20.E19) NORTH in space: EL1 North Perim Plnm (G.N20)	0.000	0.00	0.078	337.60	0.078	337.60
EL1 North Wall (G.N22.E21) NORTH in space: EL1 North Perim Plnm (G.N22)	0.000	0.00	0.078	265.00	0.078	265.00
EL1 North Wall (G.N24.E23) NORTH in space: EL1 North Perim Plnm (G.N24)	0.000	0.00	0.078	337.60	0.078	337.60
EL1 North Wall (M.N33.E31) NORTH in space: EL1 North Perim Spc (M.N33)	0.514	435.59	0.078	324.01	0.328	759.60
EL1 North Wall (M.N35.E33) NORTH in space: EL1 North Perim Spc (M.N35)	0.515	341.92	0.078	254.33	0.328	596.25
EL1 North Wall (M.N37.E35) NORTH in space: EL1 North Perim Spc (M.N37)	0.514	435.59	0.078	324.01	0.328	759.60
EL1 North Wall (M.N46.E43) NORTH in space: EL1 North Perim Plnm (M.N46)	0.000	0.00	0.078	337.60	0.078	337.60
EL1 North Wall (M.N48.E45) NORTH in space: EL1 North Perim Plnm (M.N48)	0.000	0.00	0.078	265.00	0.078	265.00
EL1 North Wall (M.N50.E47) NORTH in space: EL1 North Perim Plnm (M.N50)	0.000	0.00	0.078	337.60	0.078	337.60
EL1 North Wall (T.N59.E55) NORTH in space: EL1 North Perim Spc (T.N59)	0.514	435.59	0.078	324.01	0.328	759.60
EL1 North Wall (T.N61.E57) NORTH in space: EL1 North Perim Spc (T.N61)	0.515	341.92	0.078	254.33	0.328	596.25
EL1 North Wall (T.N63.E59) NORTH in space: EL1 North Perim Spc (T.N63)	0.514	435.59	0.078	324.01	0.328	759.60
EL1 North Wall (T.N72.E73) NORTH in space: EL1 North Perim Plnm (T.N72)	0.000	0.00	0.078	337.60	0.078	337.60
EL1 North Wall (T.N74.E77) NORTH in space: EL1 North Perim Plnm (T.N74)	0.000	0.00	0.078	265.00	0.078	265.00
EL1 North Wall (T.N76.E81) NORTH in space: EL1 North Perim Plnm (T.N76)	0.000	0.00	0.078	337.60	0.078	337.60
EL1 East Wall (M.E41.E38) EAST in space: EL1 East Perim Plnm (M.E41)	0.000	0.00	0.078	258.60	0.078	258.60
EL1 East Wall (M.E45.E42) EAST in space: EL1 East Perim Plnm (M.E45)	0.000	0.00	0.078	854.80	0.078	854.80
EL1 East Wall (G.E10.E10) EAST in space: EL1 East Perim Spc (G.E10)	0.580	333.66	0.078	248.19	0.365	581.85
EL1 East Wall (G.E23.E22) EAST in space: EL1 East Perim Plnm (G.E23)	0.000	0.00	0.078	258.60	0.078	258.60
EL1 East Wall (M.E49.E46) EAST in space: EL1 East Perim Plnm (M.E49)	0.000	0.00	0.078	258.60	0.078	258.60
EL1 East Wall (G.E2.E2) EAST in space: EL1 East Perim Spc (G.E2)	0.580	333.66	0.078	248.19	0.365	581.85

(CONTINUED)--------

EL1 East Wall (T.E54.E50)	EAST	in space: EL1 East Perim Spc (T.E54)	0.580	333.66	0.078	248.19	0.365	581.85
EL1 East Wall (T.E58.E54)	EAST	in space: EL1 East Perim Spc (T.E58)	0.577	1102.91	0.078	820.39	0.364	1923.30
EL1 East Wall (M.E28.E26)	EAST	in space: EL1 East Perim Spc (M.E28)	0.580	333.66	0.078	248.19	0.365	581.85
EL1 East Wall (M.E32.E30)	EAST	in space: EL1 East Perim Spc (M.E32)	0.577	1102.91	0.078	820.39	0.364	1923.30
EL1 East Wall (T.E62.E58)	EAST	in space: EL1 East Perim Spc (T.E62)	0.580	333.66	0.078	248.19	0.365	581.85
EL1 East Wall (G.E15.E14)	EAST	in space: EL1 East Perim Plnm (G.E15)	0.000	0.00	0.078	258.60	0.078	258.60
EL1 East Wall (T.E67.E63)	EAST	in space: EL1 East Perim Plnm (T.E67)	0.000	0.00	0.078	258.60	0.078	258.60
EL1 East Wall (T.E71.E71)	EAST	in space: EL1 East Perim Plnm (T.E71)	0.000	0.00	0.078	854.80	0.078	854.80
EL1 East Wall (G.E19.E18)	EAST	in space: EL1 East Perim Plnm (G.E19)	0.000	0.00	0.078	854.80	0.078	854.80
EL1 East Wall (M.E36.E34)	EAST	in space: EL1 East Perim Spc (M.E36)	0.580	333.66	0.078	248.19	0.365	581.85
EL1 East Wall (T.E75.E79)	EAST	in space: EL1 East Perim Plnm (T.E75)	0.000	0.00	0.078	258.60	0.078	258.60
EL1 East Wall (G.E6.E6)	EAST	in space: EL1 East Perim Spc (G.E6)	0.597	1095.42	0.078	827.88	0.374	1923.30
EL1 South Wall (T.S53.E49)	SOUTH	in space: EL1 South Perim Spc (T.S53)	0.579	435.59	0.078	324.01	0.365	759.60
EL1 South Wall (G.S14.E13)	SOUTH	in space: EL1 South Perim Plnm (G.S14)	0.000	0.00	0.078	337.60	0.078	337.60
EL1 South Wall (T.S55.E51)	SOUTH	in space: EL1 South Perim Spc (T.S55)	0.579	341.92	0.078	254.33	0.365	596.25
EL1 South Wall (T.S57.E53)	SOUTH	in space: EL1 South Perim Spc (T.S57)	0.579	435.59	0.078	324.01	0.365	759.60
EL1 South Wall (G.S5.E5)	SOUTH	in space: EL1 South Perim Spc (G.S5)	0.579	435.59	0.078	324.01	0.365	759.60
EL1 South Wall (G.S16.E15)	SOUTH	in space: EL1 South Perim Plnm (G.S16)	0.000	0.00	0.078	265.00	0.078	265.00
EL1 South Wall (M.S40.E37)	SOUTH	in space: EL1 South Perim Plnm (M.S40)	0.000	0.00	0.078	337.60	0.078	337.60
EL1 South Wall (M.S27.E25)	SOUTH	in space: EL1 South Perim Spc (M.S27)	0.579	435.59	0.078	324.01	0.365	759.60
EL1 South Wall (M.S42.E39)	SOUTH	in space: EL1 South Perim Plnm (M.S42)	0.000	0.00	0.078	265.00	0.078	265.00
EL1 South Wall (T.S66.E61)	SOUTH	in space: EL1 South Perim Plnm (T.S66)	0.000	0.00	0.078	337.60	0.078	337.60
EL1 South Wall (M.S44.E41)	SOUTH	in space: EL1 South Perim Plnm (M.S44)	0.000	0.00	0.078	337.60	0.078	337.60
EL1 South Wall (T.S68.E65)	SOUTH	in space: EL1 South Perim Plnm (T.S68)	0.000	0.00	0.078	265.00	0.078	265.00
EL1 South Wall (T.S70.E69)	SOUTH	in space: EL1 South Perim Plnm (T.S70)	0.000	0.00	0.078	337.60	0.078	337.60
EL1 South Wall (G.S18.E17)	SOUTH	in space: EL1 South Perim Plnm (G.S18)	0.000	0.00	0.078	337.60	0.078	337.60
EL1 South Wall (M.S29.E27)	SOUTH	in space: EL1 South Perim Spc (M.S29)	0.579	341.92	0.078	254.33	0.365	596.25
EL1 South Wall (M.S31.E29)	SOUTH	in space: EL1 South Perim Spc (M.S31)	0.579	435.59	0.078	324.01	0.365	759.60
EL1 South Wall (G.S1.E1)	SOUTH	in space: EL1 South Perim Spc (G.S1)	0.629	436.31	0.078	323.29	0.394	759.60

(CONTINUED)--------

EL1 South Wall (G.S3.E3)	0.579	341.92	0.078	254.33	0.365	596.25
SOUTH						
in space: EL1 South Perim Spc (G.S3)						
EL1 West Wall (M.W34.E32)	0.580	333.66	0.078	248.19	0.365	581.85
WEST						
in space: EL1 West Perim Spc (M.W34)						
EL1 West Wall (T.W60.E56)	0.580	333.66	0.078	248.19	0.365	581.85
WEST						
in space: EL1 West Perim Spc (T.W60)						
EL1 West Wall (G.W12.E12)	0.597	1095.42	0.078	827.88	0.374	1923.30
WEST						
in space: EL1 West Perim Spc (G.W12)						
EL1 West Wall (M.W47.E44)	0.000	0.00	0.078	258.60	0.078	258.60
WEST						
in space: EL1 West Perim Plnm (M.W47)						
EL1 West Wall (G.W21.E20)	0.000	0.00	0.078	258.60	0.078	258.60
WEST						
in space: EL1 West Perim Plnm (G.W21)						
EL1 West Wall (T.W64.E60)	0.577	1102.91	0.078	820.39	0.364	1923.30
WEST						
in space: EL1 West Perim Spc (T.W64)						
EL1 West Wall (G.W17.E16)	0.000	0.00	0.078	258.60	0.078	258.60
WEST						
in space: EL1 West Perim Plnm (G.W17)						
EL1 West Wall (M.W38.E36)	0.577	1102.91	0.078	820.39	0.364	1923.30
WEST						
in space: EL1 West Perim Spc (M.W38)						
EL1 West Wall (M.W51.E48)	0.000	0.00	0.078	854.80	0.078	854.80
WEST						
in space: EL1 West Perim Plnm (M.W51)						
EL1 West Wall (T.W69.E67)	0.000	0.00	0.078	258.60	0.078	258.60
WEST						
in space: EL1 West Perim Plnm (T.W69)						
EL1 West Wall (M.W30.E28)	0.580	333.66	0.078	248.19	0.365	581.85
WEST						
in space: EL1 West Perim Spc (M.W30)						
EL1 West Wall (G.W8.E8)	0.580	333.66	0.078	248.19	0.365	581.85
WEST						
in space: EL1 West Perim Spc (G.W8)						
EL1 West Wall (G.W4.E4)	0.580	333.66	0.078	248.19	0.365	581.85
WEST						
in space: EL1 West Perim Spc (G.W4)						
EL1 West Wall (T.W73.E75)	0.000	0.00	0.078	258.60	0.078	258.60
WEST						
in space: EL1 West Perim Plnm (T.W73)						
EL1 West Wall (T.W56.E52)	0.580	333.66	0.078	248.19	0.365	581.85
WEST						
in space: EL1 West Perim Spc (T.W56)						
EL1 West Wall (M.W43.E40)	0.000	0.00	0.078	258.60	0.078	258.60
WEST						
in space: EL1 West Perim Plnm (M.W43)						
EL1 West Wall (G.W25.E24)	0.000	0.00	0.078	854.80	0.078	854.80
WEST						
in space: EL1 West Perim Plnm (G.W25)						
EL1 West Wall (T.W77.E83)	0.000	0.00	0.078	854.80	0.078	854.80
WEST						
in space: EL1 West Perim Plnm (T.W77)						
EL1 Roof (T.E67.E64)	0.000	0.00	0.042	969.75	0.042	969.75
ROOF						
in space: EL1 East Perim Plnm (T.E67)						
EL1 Roof (T.N72.E74)	0.000	0.00	0.042	1041.00	0.042	1041.00
ROOF						
in space: EL1 North Perim Plnm (T.N72)						
EL1 Roof (T.W69.E68)	0.000	0.00	0.042	969.75	0.042	969.75
ROOF						
in space: EL1 West Perim Plnm (T.W69)						
EL1 Roof (T.W73.E76)	0.000	0.00	0.042	969.75	0.042	969.75
ROOF						
in space: EL1 West Perim Plnm (T.W73)						
EL1 Roof (T.S66.E62)	0.000	0.00	0.042	1041.00	0.042	1041.00
ROOF						
in space: EL1 South Perim Plnm (T.S66)						
EL1 Roof (T.N74.E78)	0.000	0.00	0.042	1218.75	0.042	1218.75
ROOF						
in space: EL1 North Perim Plnm (T.N74)						
EL1 Roof (T.S70.E70)	0.000	0.00	0.042	1041.00	0.042	1041.00
ROOF						
in space: EL1 South Perim Plnm (T.S70)						
EL1 Roof (T.E75.E80)	0.000	0.00	0.042	969.75	0.042	969.75
ROOF						
in space: EL1 East Perim Plnm (T.E75)						
EL1 Roof (T.S68.E66)	0.000	0.00	0.042	1218.75	0.042	1218.75
ROOF						
in space: EL1 South Perim Plnm (T.S68)						
EL1 Roof (T.N76.E82)	0.000	0.00	0.042	1041.00	0.042	1041.00
ROOF						
in space: EL1 North Perim Plnm (T.N76)						

REPORT- LV-D Details of Exterior Surfaces WEATHER FILE- DALLAS LOVE FIELD TX

(CONTINUED)--------

EL1 Roof (T.E71.E72) ROOF in space: EL1 East Perim Plnm (T.E71)	0.000	0.00	0.042	2980.50	0.042	2980.50
EL1 Roof (T.W77.E84) ROOF in space: EL1 West Perim Plnm (T.W77)	0.000	0.00	0.042	2980.50	0.042	2980.50
EL1 Roof (T.C78.E85) ROOF in space: EL1 Core Plnm (T.C78)	0.000	0.00	0.042	25222.56	0.042	25222.56
EL1 Flr (G.S1.U1) UNDERGRND in space: EL1 South Perim Spc (G.S1)	0.000	0.00	0.063	1041.00	0.063	1041.00
EL1 Flr (G.E2.U2) UNDERGRND in space: EL1 East Perim Spc (G.E2)	0.000	0.00	0.052	969.75	0.052	969.75
EL1 Flr (G.S3.U3) UNDERGRND in space: EL1 South Perim Spc (G.S3)	0.000	0.00	0.042	1218.75	0.042	1218.75
EL1 Flr (G.W4.U4) UNDERGRND in space: EL1 West Perim Spc (G.W4)	0.000	0.00	0.052	969.75	0.052	969.75
EL1 Flr (G.S5.U5) UNDERGRND in space: EL1 South Perim Spc (G.S5)	0.000	0.00	0.063	1041.00	0.063	1041.00
EL1 Flr (G.E6.U6) UNDERGRND in space: EL1 East Perim Spc (G.E6)	0.000	0.00	0.056	2980.50	0.056	2980.50
EL1 Flr (G.N7.U7) UNDERGRND in space: EL1 North Perim Spc (G.N7)	0.000	0.00	0.063	1041.00	0.063	1041.00
EL1 Flr (G.W8.U8) UNDERGRND in space: EL1 West Perim Spc (G.W8)	0.000	0.00	0.052	969.75	0.052	969.75
EL1 Flr (G.N9.U9) UNDERGRND in space: EL1 North Perim Spc (G.N9)	0.000	0.00	0.042	1218.75	0.042	1218.75
EL1 Flr (G.E10.U10) UNDERGRND in space: EL1 East Perim Spc (G.E10)	0.000	0.00	0.052	969.75	0.052	969.75
EL1 Flr (G.N11.U11) UNDERGRND in space: EL1 North Perim Spc (G.N11)	0.000	0.00	0.063	1041.00	0.063	1041.00
EL1 Flr (G.W12.U12) UNDERGRND in space: EL1 West Perim Spc (G.W12)	0.000	0.00	0.056	2980.50	0.056	2980.50
EL1 Flr (G.C13.U13) UNDERGRND in space: EL1 Core Spc (G.C13)	0.000	0.00	0.010	25222.56	0.010	25222.56

REPORT- LV-D Details of Exterior Surfaces WEATHER FILE- DALLAS LOVE FIELD TX

(CONTINUED)--------

	AVERAGE U-VALUE/WINDOWS (BTU/HR-SQFT-F)	AVERAGE U-VALUE/WALLS (BTU/HR-SQFT-F)	AVERAGE U-VALUE WALLS+WINDOWS (BTU/HR-SQFT-F)	WINDOW AREA (SQFT)	WALL AREA (SQFT)	WINDOW+WALL AREA (SQFT)
NORTH	0.521	0.078	0.254	3640.00	5526.95	9166.95
EAST	0.582	0.078	0.278	5303.18	8073.82	13377.00
SOUTH	0.585	0.078	0.279	3640.00	5526.95	9166.95
WEST	0.582	0.078	0.278	5303.18	8073.82	13377.00
ROOF	0.000	0.042	0.042	0.00	41664.06	41664.06
ALL WALLS	0.570	0.078	0.273	17886.36	27201.53	45087.91
WALLS+ROOFS	0.570	0.056	0.162	17886.36	68865.59	86751.98
UNDERGRND	0.000	0.027	0.027	0.00	41664.06	41664.06
BUILDING	0.570	0.045	0.118	17886.36	110529.66	128416.03

REPORT- LV-E Details of Underground Surfaces WEATHER FILE- DALLAS LOVE FIELD TX

NUMBER OF UNDERGROUND SURFACES 13

SURFACE NAME	MULTIPLIER	AREA (SQFT)	CONSTRUCTION NAME	U-VALUE (BTU/HR-SQFT-F)
EL1 Flr (G.S1.U1)	1.0	1041.00	EL1 UFCons (G.S1.U2)	0.063
EL1 Flr (G.E2.U2)	1.0	969.75	EL1 UFCons (G.E2.U3)	0.052
EL1 Flr (G.S3.U3)	1.0	1218.75	EL1 UFCons (G.S3.U4)	0.042
EL1 Flr (G.W4.U4)	1.0	969.75	EL1 UFCons (G.E2.U3)	0.052
EL1 Flr (G.S5.U5)	1.0	1041.00	EL1 UFCons (G.S1.U2)	0.063
EL1 Flr (G.E6.U6)	1.0	2980.50	EL1 UFCons (G.E6.U7)	0.056
EL1 Flr (G.N7.U7)	1.0	1041.00	EL1 UFCons (G.S1.U2)	0.063
EL1 Flr (G.W8.U8)	1.0	969.75	EL1 UFCons (G.E2.U3)	0.052
EL1 Flr (G.N9.U9)	1.0	1218.75	EL1 UFCons (G.S3.U4)	0.042
EL1 Flr (G.E10.U10)	1.0	969.75	EL1 UFCons (G.E2.U3)	0.052
EL1 Flr (G.N11.U11)	1.0	1041.00	EL1 UFCons (G.S1.U2)	0.063
EL1 Flr (G.W12.U12)	1.0	2980.50	EL1 UFCons (G.E6.U7)	0.056
EL1 Flr (G.C13.U13)	1.0	25222.56	EL1 UFCons (G.C13.U14)	0.010

REPORT- LV-F Details of Interior Surfaces WEATHER FILE- DALLAS LOVE FIELD TX

Number of Interior Surfaces 209
(U-VALUE includes both air films)

SURFACE NAME	AREA (SQFT)	CONSTRUCTION NAME	SURFACE TYPE	U-VALUE (BTU/HR-SQFT-F)
EL1 NE Wall (G.S1.I1)	190.92	EL1 IWall Construction	DELAYED STANDARD	0.402
EL1 NW Wall (G.S1.I2)	190.92	EL1 IWall Construction	DELAYED STANDARD	0.402
EL1 Ceiling (G.S1.I3)	1041.00	EL1 Ceilg Construction	DELAYED STANDARD	0.514
EL1 NE Wall (G.E2.I4)	190.92	EL1 IWall Construction	DELAYED STANDARD	0.402
EL1 Ceiling (G.E2.I5)	969.75	EL1 Ceilg Construction	DELAYED STANDARD	0.514
EL1 SE Wall (G.S3.I6)	190.92	EL1 IWall Construction	DELAYED STANDARD	0.402
EL1 Ceiling (G.S3.I7)	1218.75	EL1 Ceilg Construction	DELAYED STANDARD	0.514
EL1 SE Wall (G.W4.I8)	190.92	EL1 IWall Construction	DELAYED STANDARD	0.402
EL1 Ceiling (G.W4.I9)	969.75	EL1 Ceilg Construction	DELAYED STANDARD	0.514
EL1 NE Wall (G.S5.I10)	190.92	EL1 IWall Construction	DELAYED STANDARD	0.402
EL1 Ceiling (G.S5.I11)	1041.00	EL1 Ceilg Construction	DELAYED STANDARD	0.514
EL1 NW Wall (G.E6.I12)	190.92	EL1 IWall Construction	DELAYED STANDARD	0.402
EL1 Ceiling (G.E6.I13)	2980.50	EL1 Ceilg Construction	DELAYED STANDARD	0.514
EL1 SW Wall (G.N7.I14)	190.92	EL1 IWall Construction	DELAYED STANDARD	0.402
EL1 Ceiling (G.N7.I15)	1041.00	EL1 Ceilg Construction	DELAYED STANDARD	0.514
EL1 SW Wall (G.W8.I16)	190.92	EL1 IWall Construction	DELAYED STANDARD	0.402
EL1 Ceiling (G.W8.I17)	969.75	EL1 Ceilg Construction	DELAYED STANDARD	0.514
EL1 NW Wall (G.N9.I18)	190.92	EL1 IWall Construction	DELAYED STANDARD	0.402
EL1 Ceiling (G.N9.I19)	1218.75	EL1 Ceilg Construction	DELAYED STANDARD	0.514
EL1 NW Wall (G.E10.I20)	190.92	EL1 IWall Construction	DELAYED STANDARD	0.402
EL1 Ceiling (G.E10.I21)	969.75	EL1 Ceilg Construction	DELAYED STANDARD	0.514
EL1 SW Wall (G.N11.I22)	190.92	EL1 IWall Construction	DELAYED STANDARD	0.402
EL1 Ceiling (G.N11.I23)	1041.00	EL1 Ceilg Construction	DELAYED STANDARD	0.514
EL1 Ceiling (G.W12.I24)	2980.50	EL1 Ceilg Construction	DELAYED STANDARD	0.514
EL1 South Wall (G.C13.I25)	489.60	EL1 IWall Construction	DELAYED STANDARD	0.402
EL1 East Wall (G.C13.I26)	581.85	EL1 IWall Construction	DELAYED STANDARD	0.402
EL1 South Wall (G.C13.I27)	866.25	EL1 IWall Construction	DELAYED STANDARD	0.402
EL1 West Wall (G.C13.I28)	581.85	EL1 IWall Construction	DELAYED STANDARD	0.402
EL1 South Wall (G.C13.I29)	489.60	EL1 IWall Construction	DELAYED STANDARD	0.402
EL1 East Wall (G.C13.I30)	1653.30	EL1 IWall Construction	DELAYED STANDARD	0.402
EL1 North Wall (G.C13.I31)	489.60	EL1 IWall Construction	DELAYED STANDARD	0.402
EL1 West Wall (G.C13.I32)	581.85	EL1 IWall Construction	DELAYED STANDARD	0.402
EL1 North Wall (G.C13.I33)	866.25	EL1 IWall Construction	DELAYED STANDARD	0.402
EL1 East Wall (G.C13.I34)	581.85	EL1 IWall Construction	DELAYED STANDARD	0.402
EL1 North Wall (G.C13.I35)	489.60	EL1 IWall Construction	DELAYED STANDARD	0.402
EL1 West Wall (G.C13.I36)	1653.30	EL1 IWall Construction	DELAYED STANDARD	0.402
EL1 Ceiling (G.C13.I37)	25222.56	EL1 Ceilg Construction	DELAYED STANDARD	0.514
EL1 NE Wall (G.S14.I38)	84.85	EL1 IWall Construction	DELAYED STANDARD	0.402

EL1 NW Wall (G.S14.I39)	84.85	EL1 IWall Construction	DELAYED STANDARD	0.402
EL1 NE Wall (G.E15.I40)	84.85	EL1 IWall Construction	DELAYED STANDARD	0.402
EL1 SE Wall (G.S16.I41)	84.85	EL1 IWall Construction	DELAYED STANDARD	0.402
EL1 SE Wall (G.W17.I42)	84.85	EL1 IWall Construction	DELAYED STANDARD	0.402
EL1 NE Wall (G.S18.I43)	84.85	EL1 IWall Construction	DELAYED STANDARD	0.402
EL1 NW Wall (G.E19.I44)	84.85	EL1 IWall Construction	DELAYED STANDARD	0.402
EL1 SW Wall (G.N20.I45)	84.85	EL1 IWall Construction	DELAYED STANDARD	0.402
EL1 SW Wall (G.W21.I46)	84.85	EL1 IWall Construction	DELAYED STANDARD	0.402
EL1 NW Wall (G.N22.I47)	84.85	EL1 IWall Construction	DELAYED STANDARD	0.402
EL1 NW Wall (G.E23.I48)	84.85	EL1 IWall Construction	DELAYED STANDARD	0.402
EL1 SW Wall (G.N24.I49)	84.85	EL1 IWall Construction	DELAYED STANDARD	0.402
EL1 South Wall (G.C26.I50)	217.60	EL1 IWall Construction	DELAYED STANDARD	0.402
EL1 East Wall (G.C26.I51)	258.60	EL1 IWall Construction	DELAYED STANDARD	0.402

Appendix F: Utility Rates Used for Calculations

Dallas, Texas

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      RESOURCE:  ELECTRICITY        DEMAND-INTERVAL  15                 3413. BTU/KWH
   BILLING-DAY:  31               RATE-LIMITATION:   0.0000
        METERS:  EM1
  POWER-FACTOR:  0.80           EXCESS-KVAR-FRAC:  0.75            EXCESS-KVAR-CHG:   0.0000

 RATE-QUALIFICATIONS        BLOCK-CHARGES                   DEMAND-RATCHETS                  MIN-MON-RATCHETS
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   MIN-ENERGY:          0.0  Cust 1 Elec Uniform Blk1
   MAX-ENERGY:          0.0  Cust 1 Elec Uniform Blk2
   MIN-DEMAND:          0.0
   MAX-DEMAND:          0.0
 QUALIFY-RATE:     ALL YEAR
 USE-MIN-QUAL:           NO
```

MONTH	METERED ENERGY KWH	BILLING ENERGY KWH	METERED DEMAND KW	BILLING DEMAND KW	ENERGY CHARGE ($)	DEMAND CHARGE ($)	ENERGY CST ADJ ($)	TAXES ($)	SURCHRG ($)	FIXED CHARGE ($)	MINIMUM CHARGE ($)	VIRTUAL RATE ($/UNIT)	TOTAL CHARGE ($)
JAN	95725	95725	438.0	438.0	5669	1953	0	0	0	26	0	0.0799	7648
FEB	88967	88967	400.3	400.3	5268	1785	0	0	0	26	0	0.0796	7080
MAR	117559	117559	502.0	502.0	6961	2239	0	0	0	26	0	0.0785	9226
APR	122071	122071	547.1	547.1	7229	2440	0	0	0	26	0	0.0794	9695
MAY	154976	154976	652.0	652.0	9177	2910	0	0	0	26	0	0.0782	12113
JUN	169749	169749	629.9	629.9	10015	4069	0	0	0	26	0	0.0831	14110
JUL	175791	175791	643.7	643.7	10372	4158	0	0	0	26	0	0.0828	14556
AUG	206747	206747	666.9	666.9	12198	4308	0	0	0	26	0	0.0800	16532
SEP	173117	173117	720.3	720.3	10214	4651	0	0	0	26	0	0.0860	14891
OCT	126675	126675	601.2	601.2	7501	2681	0	0	0	26	0	0.0806	10208
NOV	101810	101810	498.7	498.7	6029	2224	0	0	0	26	0	0.0813	8279
DEC	102394	102394	469.5	469.5	6063	2094	0	0	0	26	0	0.0799	8183
TOTAL	1635582	1635582	720.3		96697	35514	0	0	0	311		0.0810	132522

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BDL RUN 3

REPORT- ES-F Block-Charges and Ratchets for Custom Elec Rate WEATHER FILE- DALLAS LOVE FIELD TX

RESOURCE: ELECTRICITY
ENERGY-UNITS: KWH
DEMAND-UNITS: KW
DEMAND-WINDOW: 15

BLOCK-CHARGES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Cust 1 Elec Uniform Blk1													
USE: SEASONAL													
METERED ENERGY:	95725	88967	117559	122071	154813	0	0	0	7	126675	101810	102394	
BILLING ENERGY:	95725	88967	117559	122071	154976	0	0	0	173117	126675	101810	102394	910210
METERED DEMAND:	438.0	400.3	502.0	547.1	652.0	0.0	0.0	0.0	6.5	601.2	498.7	469.5	
BILLING DEMAND:	438.0	400.3	502.0	547.1	652.0	0.0	0.0	0.0	720.3	601.2	498.7	469.5	
PRORATE FACTOR:	1.0000	1.0000	1.0000	1.0000	0.9987	0.0000	0.0000	0.0000	0.0014	1.0000	1.0000	1.0000	
ENERGY CHGS($):	5669	5268	6961	7229	9165	0	0	0	14	7501	6029	6063	53900
DEMAND CHGS($):	1953	1785	2239	2440	2904	0	0	0	4	2681	2224	2094	18326
TOTAL CHGS($):	7622	7054	9200	9669	12069	0	0	0	19	10183	8253	8157	72226
Cust 1 Elec Uniform Blk2													
USE: SEASONAL													
METERED ENERGY:	0	0	0	0	163	169749	175791	206747	173110	0	0	0	
BILLING ENERGY:	0	0	0	0	154976	169749	175791	206747	173117	0	0	0	725372
METERED DEMAND:	0.0	0.0	0.0	0.0	162.7	629.9	643.7	666.9	720.3	0.0	0.0	0.0	
BILLING DEMAND:	0.0	0.0	0.0	0.0	652.0	629.9	643.7	666.9	720.3	0.0	0.0	0.0	
PRORATE FACTOR:	0.0000	0.0000	0.0000	0.0000	0.0013	1.0000	1.0000	1.0000	0.9986	0.0000	0.0000	0.0000	
ENERGY CHGS($):	0	0	0	0	12	10015	10372	12198	10200	0	0	0	42797
DEMAND CHGS($):	0	0	0	0	6	4069	4158	4308	4647	0	0	0	17189
TOTAL CHGS($):	0	0	0	0	18	14085	14530	16506	14847	0	0	0	59986
TOTAL ENERGY:	95725	88967	117559	122071	154976	169749	175791	206747	173117	126675	101810	102394	1635582
TOTAL CHARGES ($):	7622	7054	9200	9669	12087	14085	14530	16506	14865	10183	8253	8157	132211

Dallas Building DOE-2.2-47h2 9/18/2011 11:50:23
BDL RUN 3

REPORT- ES-E Summary of Utility-Rate: Custom Gas Rate WEATHER FILE- DALLAS LOVE FIELD TX

RESOURCE: NATURAL-GAS DEMAND-INTERVAL 60 100000. BTU/THERM
BILLING-DAY: 31 RATE-LIMITATION: 0.0000
METERS: FM1

RATE-QUALIFICATIONS		BLOCK-CHARGES	DEMAND-RATCHETS	MIN-MON-RATCHETS
MIN-ENERGY:	0.0	Custom Gas Uniform Blk1		
MAX-ENERGY:	0.0			
MIN-DEMAND:	0.0			
MAX-DEMAND:	0.0			
QUALIFY-RATE:	ALL YEAR			
USE-MIN-QUAL:	NO			

MONTH	METERED ENERGY THERM	BILLING ENERGY THERM	METERED DEMAND THERM/HR	BILLING DEMAND THERM/HR	ENERGY CHARGE ($)	DEMAND CHARGE ($)	ENERGY CST ADJ ($)	TAXES ($)	SURCHRG ($)	FIXED CHARGE ($)	MINIMUM CHARGE ($)	VIRTUAL RATE ($/UNIT)	TOTAL CHARGE ($)
JAN	1047	1047	40.8	40.8	701	0	0	0	0	25	0	0.6939	726
FEB	660	660	14.0	14.0	442	0	0	0	0	25	0	0.7079	467
MAR	531	531	12.4	12.4	356	0	0	0	0	25	0	0.7170	381
APR	163	163	7.5	7.5	109	0	0	0	0	25	0	0.8238	134
MAY	121	121	0.5	0.5	81	0	0	0	0	25	0	0.8767	106
JUN	115	115	0.5	0.5	77	0	0	0	0	25	0	0.8873	102
JUL	98	98	0.4	0.4	66	0	0	0	0	25	0	0.9255	91
AUG	105	105	0.4	0.4	70	0	0	0	0	25	0	0.9090	95
SEP	96	96	0.4	0.4	64	0	0	0	0	25	0	0.9311	89
OCT	105	105	8.1	8.1	70	0	0	0	0	25	0	0.9089	95
NOV	212	212	10.2	10.2	142	0	0	0	0	25	0	0.7881	167
DEC	1012	1012	17.7	17.7	678	0	0	0	0	25	0	0.6947	703
TOTAL	4263	4263	40.8		2856	0	0	0	0	300		0.7404	3156

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BDL RUN 3

REPORT- ES-F Block-Charges and Ratchets for Custom Gas Rate WEATHER FILE- DALLAS LOVE FIELD TX

RESOURCE: NATURAL-GAS
ENERGY-UNITS: THERM
DEMAND-UNITS: THERM/HR
DEMAND-WINDOW: 60

BLOCK-CHARGES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Custom Gas Uniform Blk1													
USE: YEARLY													
METERED ENERGY:	1047	660	531	163	121	115	98	105	96	105	212	1012	
BILLING ENERGY:	1047	660	531	163	121	115	98	105	96	105	212	1012	4263
METERED DEMAND:	40.8	14.0	12.4	7.5	0.5	0.5	0.4	0.4	0.4	8.1	10.2	17.7	
BILLING DEMAND:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
ENERGY CHGS($):	701	442	356	109	81	77	66	70	64	70	142	678	2856
TOTAL ENERGY:	1047	660	531	163	121	115	98	105	96	105	212	1012	4263
TOTAL CHARGES ($):	701	442	356	109	81	77	66	70	64	70	142	678	2856

Los Angeles, California

REPORT- ES-E Summary of Utility-Rate: PG&E Sch-A6-3 Elec Rate WEATHER FILE- LOS ANGELES INTL CA

RESOURCE: ELECTRICITY DEMAND-INTERVAL 15 3413. BTU/KWH
BILLING-DAY: 31 RATE-LIMITATION: 0.0000
METERS: EM1
POWER-FACTOR: 0.80 EXCESS-KVAR-FRAC: 0.75 EXCESS-KVAR-CHG: 0.0000

RATE-QUALIFICATIONS		BLOCK-CHARGES	DEMAND-RATCHETS	MIN-MON-RATCHETS
MIN-ENERGY:	0.0	PG&E Sch-A6-3 Summer Peak Block		
MAX-ENERGY:	0.0	PG&E Sch-A6-3 Summer Mid Block		
MIN-DEMAND:	0.0	PG&E Sch-A6-3 Winter Mid Block		
MAX-DEMAND:	0.0	PG&E Sch-A6-3 Summer Off Block		
QUALIFY-RATE:	ALL YEAR	PG&E Sch-A6-3 Winter Off Block		
USE-MIN-QUAL:	NO			

MONTH	METERED ENERGY KWH	BILLING ENERGY KWH	METERED DEMAND KW	BILLING DEMAND KW	ENERGY CHARGE ($)	DEMAND CHARGE ($)	ENERGY CST ADJ ($)	TAXES ($)	SURCHRG ($)	FIXED CHARGE ($)	MINIMUM CHARGE ($)	VIRTUAL RATE ($/UNIT)	TOTAL CHARGE ($)
JAN	93638	93638	400.5	400.5	14541	0	0	0	0	19	0	0.1555	14559
FEB	91055	91055	419.7	419.7	14178	0	0	0	0	19	0	0.1559	14197
MAR	111224	111224	411.2	411.2	17356	0	0	0	0	19	0	0.1562	17375
APR	106951	106951	462.3	462.3	16715	0	0	0	0	19	0	0.1565	16733
MAY	112444	112444	435.7	435.7	24814	0	0	0	0	19	0	0.2208	24833
JUN	122450	122450	449.1	449.1	27214	0	0	0	0	19	0	0.2224	27232
JUL	117670	117670	475.9	475.9	26074	0	0	0	0	19	0	0.2217	26093
AUG	135690	135690	480.5	480.5	30128	0	0	0	0	19	0	0.2222	30147
SEP	122744	122744	497.1	497.1	27436	0	0	0	0	19	0	0.2237	27454
OCT	108345	108345	462.6	462.6	24043	0	0	0	0	19	0	0.2221	24062
NOV	100978	100978	437.1	437.1	15747	0	0	0	0	19	0	0.1561	15766
DEC	99799	99799	404.4	404.4	15543	0	0	0	0	19	0	0.1559	15562
TOTAL	1322985	1322985	497.1		253789	0	0	0	0	226		0.1920	254014

LA Building_PRE DOE-2.2-47h2 9/18/2011 14:17:05
BDL RUN 2

REPORT- ES-F Block-Charges and Ratchets for PG&E Sch-A6-3 Elec Rate WEATHER FILE- LOS ANGELES INTL CA

RESOURCE: ELECTRICITY
ENERGY-UNITS: KWH
DEMAND-UNITS: KW
DEMAND-WINDOW: 15

BLOCK-CHARGES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
PG&E Sch-A6-3 Summer Peak Block													
USE: TIME-OF-USE													
METERED ENERGY:	0	0	0	0	47500	52467	50116	57985	53356	46382	0	0	
BILLING ENERGY:	0	0	0	0	47500	52467	50116	57985	53356	46382	0	0	307806
METERED DEMAND:	0.0	0.0	0.0	0.0	435.7	448.2	471.2	469.2	491.3	462.6	0.0	0.0	
BILLING DEMAND:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
ENERGY CHGS($):	0	0	0	0	16303	18008	17201	19902	18313	15919	0	0	105645
PG&E Sch-A6-3 Summer Mid Block													
USE: TIME-OF-USE													
METERED ENERGY:	0	0	0	0	33629	36847	35341	41003	36449	32133	0	0	
BILLING ENERGY:	0	0	0	0	33629	36847	35341	41003	36449	32133	0	0	215402
METERED DEMAND:	0.0	0.0	0.0	0.0	427.0	449.1	475.9	480.5	497.1	450.1	0.0	0.0	
BILLING DEMAND:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
ENERGY CHGS($):	0	0	0	0	5327	5836	5598	6495	5773	5090	0	0	34118
PG&E Sch-A6-3 Winter Mid Block													
USE: TIME-OF-USE													
METERED ENERGY:	66129	65011	80116	77507	0	0	0	0	0	0	72553	71330	
BILLING ENERGY:	66129	65011	80116	77507	0	0	0	0	0	0	72553	71330	432646
METERED DEMAND:	400.5	419.7	411.2	462.3	0.0	0.0	0.0	0.0	0.0	0.0	437.1	404.4	
BILLING DEMAND:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
ENERGY CHGS($):	11317	11125	13710	13264	0	0	0	0	0	0	12416	12207	74039
PG&E Sch-A6-3 Summer Off Block													
USE: TIME-OF-USE													
METERED ENERGY:	0	0	0	7	31315	33136	32213	36701	32939	29752	0	0	
BILLING ENERGY:	0	0	0	7	31315	33136	32213	36701	32939	29752	0	0	196064
METERED DEMAND:	0.0	0.0	0.0	6.5	402.5	433.3	460.8	467.7	475.9	397.6	0.0	0.0	
BILLING DEMAND:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
ENERGY CHGS($):	0	0	0	1	3184	3370	3276	3732	3350	3026	0	0	19938
PG&E Sch-A6-3 Winter Off Block													
USE: TIME-OF-USE													
METERED ENERGY:	27509	26044	31109	29437	0	0	0	0	0	78	28426	28469	
BILLING ENERGY:	27509	26044	31109	29437	0	0	0	0	0	78	28426	28469	171071
METERED DEMAND:	325.8	359.8	344.2	401.6	0.0	0.0	0.0	0.0	0.0	77.5	377.3	321.5	
BILLING DEMAND:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
ENERGY CHGS($):	3224	3052	3646	3450	0	0	0	0	0	9	3332	3337	20050
TOTAL ENERGY:	93638	91055	111224	106951	112444	122450	117670	135690	122744	108345	100979	99799	1322989
TOTAL CHARGES ($):	14541	14178	17356	16715	24814	27214	26074	30128	27436	24043	15747	15543	253789

REPORT- ES-E Summary of Utility-Rate: PG&E GNR-1 Gas Rate WEATHER FILE- LOS ANGELES INTL CA

RESOURCE: NATURAL-GAS DEMAND-INTERVAL 60 100000. BTU/THERM
BILLING-DAY: 31 RATE-LIMITATION: 0.0000
METERS: FM1

RATE-QUALIFICATIONS		BLOCK-CHARGES	DEMAND-RATCHETS	MIN-MON-RATCHETS
MIN-ENERGY:	0.0	PG&E GNR-1 Summer Block		
MAX-ENERGY:	0.0	PG&E GNR-1 Winter Block		
MIN-DEMAND:	0.0			
MAX-DEMAND:	0.0			
QUALIFY-RATE:	ALL YEAR			
USE-MIN-QUAL:	NO			

MONTH	METERED ENERGY THERM	BILLING ENERGY THERM	METERED DEMAND THERM/HR	BILLING DEMAND THERM/HR	ENERGY CHARGE ($)	DEMAND CHARGE ($)	ENERGY CST ADJ ($)	TAXES ($)	SURCHRG ($)	FIXED CHARGE ($)	MINIMUM CHARGE ($)	VIRTUAL RATE ($/UNIT)	TOTAL CHARGE ($)
JAN	204	204	7.2	7.2	117	0	0	0	0	13	0	0.6365	130
FEB	134	134	5.9	5.9	77	0	0	0	0	13	0	0.6708	90
MAR	145	145	6.1	6.1	83	0	0	0	0	13	0	0.6631	96
APR	127	127	0.6	0.6	64	0	0	0	0	13	0	0.6075	77
MAY	125	125	0.6	0.6	63	0	0	0	0	13	0	0.6093	76
JUN	127	127	0.5	0.5	64	0	0	0	0	13	0	0.6077	77
JUL	115	115	0.5	0.5	58	0	0	0	0	13	0	0.6187	71
AUG	129	129	0.5	0.5	65	0	0	0	0	13	0	0.6065	78
SEP	118	118	0.5	0.5	59	0	0	0	0	13	0	0.6158	73
OCT	115	115	0.5	0.5	58	0	0	0	0	13	0	0.6190	71
NOV	117	117	0.5	0.5	67	0	0	0	0	13	0	0.6859	80
DEC	125	125	0.6	0.6	71	0	0	0	0	13	0	0.6783	85
TOTAL	1582	1582	7.2		844	0	0	0	0	161		0.6354	1005

LA Building_PRE DOE-2.2-47h2 9/18/2011 14:17:05
BDL RUN 2

REPORT- ES-F Block-Charges and Ratchets for PG&E GNR-1 Gas Rate WEATHER FILE- LOS ANGELES INTL CA

RESOURCE: NATURAL-GAS
ENERGY-UNITS: THERM
DEMAND-UNITS: THERM/HR
DEMAND-WINDOW: 60

BLOCK-CHARGES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
PG&E GNR-1 Summer Block													
USE: SEASONAL													
METERED ENERGY:	0	0	0	127	125	127	115	129	118	115	0	0	
BILLING ENERGY:	0	0	145	127	125	127	115	129	118	115	0	0	857
METERED DEMAND:	0.0	0.0	0.0	0.6	0.6	0.5	0.5	0.5	0.5	0.5	0.0	0.0	
BILLING DEMAND:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
PRORATE FACTOR:	0.0000	0.0000	0.0013	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9987	0.0000	0.0000	
ENERGY CHGS($):	0	0	0	64	63	64	58	65	59	58	0	0	430
PG&E GNR-1 Winter Block													
USE: SEASONAL													
METERED ENERGY:	204	134	145	0	0	0	0	0	0	0	117	125	
BILLING ENERGY:	204	134	145	0	0	0	0	0	0	115	117	125	725
METERED DEMAND:	7.2	5.9	6.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.6	
BILLING DEMAND:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
PRORATE FACTOR:	1.0000	1.0000	0.9987	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0013	1.0000	1.0000	
ENERGY CHGS($):	117	77	83	0	0	0	0	0	0	0	67	71	414
	=======	=======	=======	=======	=======	=======	=======	=======	=======	=======	=======	=======	=======
TOTAL ENERGY:	204	134	145	127	125	127	115	129	118	115	117	125	1582
TOTAL CHARGES ($):	117	77	83	64	63	64	58	65	59	58	67	71	844

Minneapolis, Minnesota

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REPORT- ES-E Summary of Utility-Rate:       Xcel Large Commercial                        WEATHER FILE- MINNEAPOLIS-
ST PA MN
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       RESOURCE:  ELECTRICITY         DEMAND-INTERVAL  15                  3413. BTU/KWH
    BILLING-DAY:  31                RATE-LIMITATION:   0.0000
         METERS:  EM1
   POWER-FACTOR:  0.80             EXCESS-KVAR-FRAC:  0.75            EXCESS-KVAR-CHG:   0.0000

 RATE-QUALIFICATIONS        BLOCK-CHARGES                   DEMAND-RATCHETS                  MIN-MON-RATCHETS
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   MIN-ENERGY:         0.0  Cust 1 Elec Uniform Blk1
   MAX-ENERGY:         0.0  Cust 1 Elec Uniform Blk2
   MIN-DEMAND:         0.0  Cust 1 Elec Energy Blk1
   MAX-DEMAND:         0.0  Cust 1 Elec Energy Blk2
 QUALIFY-RATE:    ALL YEAR
 USE-MIN-QUAL:          NO
```

MONTH	METERED ENERGY KWH	BILLING ENERGY KWH	METERED DEMAND KW	BILLING DEMAND KW	ENERGY CHARGE ($)	DEMAND CHARGE ($)	ENERGY CST ADJ ($)	TAXES ($)	SURCHRG ($)	FIXED CHARGE ($)	MINIMUM CHARGE ($)	VIRTUAL RATE ($/UNIT)	TOTAL CHARGE ($)
JAN	111700	111700	404.8	404.8	2564	2866	0	0	0	25	0	0.0488	5454
FEB	95868	95868	378.2	378.2	2200	2678	0	0	0	25	0	0.0511	4903
MAR	107217	107217	346.5	346.5	2461	2453	0	0	0	25	0	0.0461	4939
APR	99589	99589	504.8	504.8	2286	3574	0	0	0	25	0	0.0591	5885
MAY	115767	115767	536.3	536.3	2657	3799	0	0	0	25	0	0.0560	6481
JUN	131585	131585	525.9	525.9	3013	5511	0	0	0	25	0	0.0650	8549
JUL	139203	139203	621.0	621.0	3188	6508	0	0	0	25	0	0.0698	9720
AUG	143028	143028	613.3	613.3	3275	6428	0	0	0	25	0	0.0680	9728
SEP	111776	111776	568.8	568.8	2560	5959	0	0	0	25	0	0.0764	8543
OCT	92411	92411	378.3	378.3	2121	2678	0	0	0	25	0	0.0522	4824
NOV	94586	94586	350.1	350.1	2171	2479	0	0	0	25	0	0.0494	4675
DEC	110246	110246	394.8	394.8	2530	2795	0	0	0	25	0	0.0485	5350
TOTAL	1352977	1352977	621.0		31025	47728	0	0	0	300		0.0584	79052

Minneapolis Building_PRE DOE-2.2-47h2 9/21/2011 20:21:46
BDL RUN 3

REPORT- ES-F Block-Charges and Ratchets for Xcel Large Commercial WEATHER FILE- MINNEAPOLIS-ST PA MN

RESOURCE: ELECTRICITY
ENERGY-UNITS: KWH
DEMAND-UNITS: KW
DEMAND-WINDOW: 15

BLOCK-CHARGES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Cust 1 Elec Uniform Blk1													
USE: SEASONAL													
METERED ENERGY:	111700	95868	107217	99589	115684	0	0	0	7	92411	94586	110246	
BILLING ENERGY:	111700	95868	107217	99589	115767	0	0	0	111776	92411	94586	110246	827385
METERED DEMAND:	404.8	378.2	346.5	504.8	536.3	0.0	0.0	0.0	6.5	378.3	350.1	394.8	
BILLING DEMAND:	404.8	378.2	346.5	504.8	536.3	0.0	0.0	0.0	568.8	378.3	350.1	394.8	
PRORATE FACTOR:	1.0000	1.0000	1.0000	1.0000	0.9987	0.0000	0.0000	0.0000	0.0014	1.0000	1.0000	1.0000	
ENERGY CHGS($):	2564	2200	2461	2286	2653	0	0	0	4	2121	2171	2530	18988
DEMAND CHGS($):	2866	2678	2453	3574	3792	0	0	0	6	2678	2479	2795	23321
TOTAL CHGS($):	5429	4878	4914	5860	6445	0	0	0	9	4799	4650	5325	42309
Cust 1 Elec Uniform Blk2													
USE: SEASONAL													
METERED ENERGY:	0	0	0	0	84	131585	139203	143028	111769	0	0	0	
BILLING ENERGY:	0	0	0	0	115767	131585	139203	143028	111776	0	0	0	525592
METERED DEMAND:	0.0	0.0	0.0	0.0	83.7	525.9	621.0	613.3	568.8	0.0	0.0	0.0	
BILLING DEMAND:	0.0	0.0	0.0	0.0	536.3	525.9	621.0	613.3	568.8	0.0	0.0	0.0	
PRORATE FACTOR:	0.0000	0.0000	0.0000	0.0000	0.0013	1.0000	1.0000	1.0000	0.9986	0.0000	0.0000	0.0000	
ENERGY CHGS($):	0	0	0	0	4	3013	3188	3275	2556	0	0	0	12036
DEMAND CHGS($):	0	0	0	0	8	5511	6508	6428	5953	0	0	0	24407
TOTAL CHGS($):	0	0	0	0	11	8524	9695	9703	8509	0	0	0	36443
Cust 1 Elec Energy Blk1													
USE: SEASONAL													
METERED ENERGY:	111700	95868	107217	99589	115684	0	0	0	7	92411	94586	110246	
BILLING ENERGY:	0	0	0	0	0	0	0	0	0	0	0	0	827385
METERED DEMAND:	404.8	378.2	346.5	504.8	536.3	0.0	0.0	0.0	6.5	378.3	350.1	394.8	
BILLING DEMAND:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
PRORATE FACTOR:	1.0000	1.0000	1.0000	1.0000	0.9987	0.0000	0.0000	0.0000	0.0014	1.0000	1.0000	1.0000	
Cust 1 Elec Energy Blk2													
USE: SEASONAL													
METERED ENERGY:	0	0	0	0	84	131585	139203	143028	111769	0	0	0	
BILLING ENERGY:	0	0	0	0	0	0	0	0	0	0	0	0	525592
METERED DEMAND:	0.0	0.0	0.0	0.0	83.7	525.9	621.0	613.3	568.8	0.0	0.0	0.0	
BILLING DEMAND:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
PRORATE FACTOR:	0.0000	0.0000	0.0000	0.0000	0.0013	1.0000	1.0000	1.0000	0.9986	0.0000	0.0000	0.0000	
	=======	=======	=======	=======	=======	=======	=======	=======	=======	=======	=======	=======	=======
TOTAL ENERGY:	111700	95868	107217	99589	115767	131585	139203	143028	111776	92411	94586	110246	1352977
TOTAL CHARGES ($):	5429	4878	4914	5860	6456	8524	9695	9703	8518	4799	4650	5325	78752

Minneapolis Building_PRE DOE-2.2-47h2 9/21/2011 20:21:46
BDL RUN 3

REPORT- ES-E Summary of Utility-Rate: Xcel Energy WEATHER FILE- MINNEAPOLIS-ST PA MN

RESOURCE: NATURAL-GAS DEMAND-INTERVAL 60 100000. BTU/THERM
BILLING-DAY: 31 RATE-LIMITATION: 0.0000
METERS: FM1

RATE-QUALIFICATIONS		BLOCK-CHARGES	DEMAND-RATCHETS	MIN-MON-RATCHETS
MIN-ENERGY:	0.0	Custom Gas Uniform Blk1		
MAX-ENERGY:	0.0	Custom Gas Uniform Blk2		
MIN-DEMAND:	0.0	Custom Gas Energy Blk1		
MAX-DEMAND:	0.0	Custom Gas Energy Blk2		
QUALIFY-RATE:	ALL YEAR			
USE-MIN-QUAL:	NO			

MONTH	METERED ENERGY THERM	BILLING ENERGY THERM	METERED DEMAND THERM/HR	BILLING DEMAND THERM/HR	ENERGY CHARGE ($)	DEMAND CHARGE ($)	ENERGY CST ADJ ($)	TAXES ($)	SURCHRG ($)	FIXED CHARGE ($)	MINIMUM CHARGE ($)	VIRTUAL RATE ($/UNIT)	TOTAL CHARGE ($)
JAN	6778	6778	57.5	57.5	5693	0	0	0	0	9	0	0.8412	5702
FEB	3988	3988	47.3	47.3	3349	0	0	0	0	9	0	0.8421	3358
MAR	2538	2538	23.2	23.2	2131	0	0	0	0	9	0	0.8433	2140
APR	1193	1193	22.9	22.9	933	0	0	0	0	9	0	0.7896	942
MAY	209	209	6.7	6.7	163	0	0	0	0	9	0	0.8252	172
JUN	149	149	0.6	0.6	117	0	0	0	0	9	0	0.8423	126
JUL	125	125	0.6	0.6	98	0	0	0	0	9	0	0.8538	107
AUG	133	133	0.5	0.5	104	0	0	0	0	9	0	0.8495	113
SEP	274	274	10.4	10.4	214	0	0	0	0	9	0	0.8148	223
OCT	781	781	17.8	17.8	611	0	0	0	0	9	0	0.7936	620
NOV	2965	2965	27.7	27.7	2490	0	0	0	0	9	0	0.8429	2499
DEC	5541	5541	54.9	54.9	4654	0	0	0	0	9	0	0.8415	4663
TOTAL	24676	24676	57.5		20558	0	0	0	0	108		0.8375	20666

Minneapolis Building_PRE DOE-2.2-47h2 9/21/2011 20:21:46
BDL RUN 3

REPORT- ES-F Block-Charges and Ratchets for Xcel Energy WEATHER FILE- MINNEAPOLIS-ST PA MN

RESOURCE: NATURAL-GAS
ENERGY-UNITS: THERM
DEMAND-UNITS: THERM/HR
DEMAND-WINDOW: 60

BLOCK-CHARGES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Custom Gas Uniform Blk1													
USE: SEASONAL													
METERED ENERGY:	6778	3988	2538	0	0	0	0	0	0	0	2965	5541	
BILLING ENERGY:	6778	3988	2538	0	0	0	0	0	0	781	2965	5541	21809
METERED DEMAND:	57.5	47.3	23.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.7	54.9	
BILLING DEMAND:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
PRORATE FACTOR:	1.0000	1.0000	0.9987	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0013	1.0000	1.0000	
ENERGY CHGS($):	1260	741	471	0	0	0	0	0	0	0	551	1030	4055
Custom Gas Uniform Blk2													
USE: SEASONAL													
METERED ENERGY:	0	0	0	1193	209	149	125	133	274	781	0	0	
BILLING ENERGY:	0	0	2538	1193	209	149	125	133	274	781	0	0	2867
METERED DEMAND:	0.0	0.0	0.1	22.9	6.7	0.6	0.6	0.5	10.4	17.8	0.0	0.0	
BILLING DEMAND:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
PRORATE FACTOR:	0.0000	0.0000	0.0013	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9987	0.0000	0.0000	
ENERGY CHGS($):	0	0	1	222	39	28	23	25	51	145	0	0	533
Custom Gas Energy Blk1													
USE: SEASONAL													
METERED ENERGY:	6778	3988	2538	0	0	0	0	0	0	0	2965	5541	
BILLING ENERGY:	6778	3988	2538	0	0	0	0	0	0	781	2965	5541	21809
METERED DEMAND:	57.5	47.3	23.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.7	54.9	
BILLING DEMAND:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
PRORATE FACTOR:	1.0000	1.0000	0.9987	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0013	1.0000	1.0000	
ENERGY CHGS($):	4432	2608	1658	0	0	0	0	0	0	1	1939	3624	14261
Custom Gas Energy Blk2													
USE: SEASONAL													
METERED ENERGY:	0	0	0	1193	209	149	125	133	274	781	0	0	
BILLING ENERGY:	0	0	2538	1193	209	149	125	133	274	781	0	0	2867
METERED DEMAND:	0.0	0.0	0.1	22.9	6.7	0.6	0.6	0.5	10.4	17.8	0.0	0.0	
BILLING DEMAND:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
PRORATE FACTOR:	0.0000	0.0000	0.0013	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9987	0.0000	0.0000	
ENERGY CHGS($):	0	0	2	711	124	89	75	80	164	465	0	0	1709
TOTAL ENERGY:	13557	7976	5076	2386	417	299	251	267	549	1562	5930	11083	49352
TOTAL CHARGES ($):	5693	3349	2131	933	163	117	98	104	214	611	2490	4654	20558

Richmond, Virginia

REPORT- ES-E Summary of Utility-Rate: Dominion Large Commercial WEATHER FILE- RICHMOND INTERNAT VA

RESOURCE: ELECTRICITY DEMAND-INTERVAL 15 3413. BTU/KWH
BILLING-DAY: 31 RATE-LIMITATION: 0.0000
METERS: EM1
POWER-FACTOR: 0.80 EXCESS-KVAR-FRAC: 0.75 EXCESS-KVAR-CHG: 0.0000

RATE-QUALIFICATIONS		BLOCK-CHARGES	DEMAND-RATCHETS	MIN-MON-RATCHETS
MIN-ENERGY:	0.0	Cust 1 Elec Uniform Blk1		
MAX-ENERGY:	0.0	Cust 1 Elec Energy Blk1		
MIN-DEMAND:	0.0	Cust 1 Elec Demand Blk1		
MAX-DEMAND:	0.0			
QUALIFY-RATE:	ALL YEAR			
USE-MIN-QUAL:	NO			

MONTH	METERED ENERGY KWH	BILLING ENERGY KWH	METERED DEMAND KW	BILLING DEMAND KW	ENERGY CHARGE ($)	DEMAND CHARGE ($)	ENERGY CST ADJ ($)	TAXES ($)	SURCHRG ($)	FIXED CHARGE ($)	MINIMUM CHARGE ($)	VIRTUAL RATE ($/UNIT)	TOTAL CHARGE ($)
JAN	95899	95899	348.2	348.2	873	4754	0	0	0	79	0	0.0595	5706
FEB	88540	88540	388.9	388.9	814	5310	0	0	0	79	0	0.0701	6203
MAR	107115	107115	503.2	503.2	962	6870	0	0	0	79	0	0.0739	7911
APR	107314	107314	518.0	518.0	964	7072	0	0	0	79	0	0.0756	8115
MAY	123388	123388	539.6	539.6	1092	7367	0	0	0	79	0	0.0692	8538
JUN	145297	145297	574.8	574.8	1266	7847	0	0	0	79	0	0.0633	9193
JUL	149129	149129	643.0	643.0	1297	8778	0	0	0	79	0	0.0681	10154
AUG	165881	165881	583.6	583.6	1430	7967	0	0	0	79	0	0.0571	9476
SEP	132233	132233	599.5	599.5	1162	8184	0	0	0	79	0	0.0713	9425
OCT	101908	101908	465.6	465.6	921	6357	0	0	0	79	0	0.0722	7357
NOV	93502	93502	420.2	420.2	854	5737	0	0	0	79	0	0.0713	6670
DEC	97614	97614	414.1	414.1	886	5653	0	0	0	79	0	0.0678	6619
TOTAL	1407820	1407820	643.0		12520	81896	0	0	0	950		0.0677	95366

Richmond Building_PRE DOE-2.2-47h2 9/26/2011 18:32:18
BDL RUN 2

REPORT- ES-F Block-Charges and Ratchets for Dominion Large Commercial WEATHER FILE- RICHMOND INTERNAT VA

RESOURCE: ELECTRICITY
ENERGY-UNITS: KWH
DEMAND-UNITS: KW
DEMAND-WINDOW: 15

BLOCK-CHARGES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Cust 1 Elec Uniform Blk1													
USE: YEARLY													
METERED ENERGY:	95899	88540	107115	107314	123388	145297	149129	165881	132233	101908	93502	97614	
BILLING ENERGY:	0	0	0	0	0	0	0	0	0	0	0	0	1407820
METERED DEMAND:	348.2	388.9	503.2	518.0	539.6	574.8	643.0	583.6	599.5	465.6	420.2	414.1	
BILLING DEMAND:	348.2	388.9	503.2	518.0	539.6	574.8	643.0	583.6	599.5	465.6	420.2	414.1	
DEMAND CHGS($):	3825	4272	5527	5690	5927	6314	7063	6410	6585	5115	4616	4548	65891
Cust 1 Elec Energy Blk1													
USE: YEARLY													
METERED ENERGY:	95899	88540	107115	107314	123388	145297	149129	165881	132233	101908	93502	97614	
BILLING ENERGY:	95899	88540	107115	107314	123388	145297	149129	165881	132233	101908	93502	97614	1407820
METERED DEMAND:	348.2	388.9	503.2	518.0	539.6	574.8	643.0	583.6	599.5	465.6	420.2	414.1	
BILLING DEMAND:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
ENERGY CHGS($):	873	814	962	964	1092	1266	1297	1430	1162	921	854	886	12520
Cust 1 Elec Demand Blk1													
USE: YEARLY													
METERED ENERGY:	95899	88540	107115	107314	123388	145297	149129	165881	132233	101908	93502	97614	
BILLING ENERGY:	0	0	0	0	0	0	0	0	0	0	0	0	1407820
METERED DEMAND:	348.2	388.9	503.2	518.0	539.6	574.8	643.0	583.6	599.5	465.6	420.2	414.1	
BILLING DEMAND:	348.2	388.9	503.2	518.0	539.6	574.8	643.0	583.6	599.5	465.6	420.2	414.1	
DEMAND CHGS($):	929	1038	1343	1382	1440	1534	1716	1557	1599	1242	1121	1105	16005
TOTAL ENERGY:	95899	88540	107115	107314	123388	145297	149129	165881	132233	101908	93502	97614	1407820
TOTAL CHARGES ($):	5627	6124	7832	8035	8458	9113	10075	9396	9346	7278	6591	6540	94416

REPORT- ES-E Summary of Utility-Rate: Columbia Large Commercial WEATHER FILE- RICHMOND INTERNAT VA

RESOURCE: NATURAL-GAS DEMAND-INTERVAL 60 100000. BTU/THERM
BILLING-DAY: 31 RATE-LIMITATION: 0.0000
METERS: FM1

RATE-QUALIFICATIONS		BLOCK-CHARGES	DEMAND-RATCHETS	MIN-MON-RATCHETS
MIN-ENERGY:	0.0	Custom Gas Energy Blk1		
MAX-ENERGY:	0.0	Custom Gas Demand Blk1		
MIN-DEMAND:	0.0			
MAX-DEMAND:	0.0			
QUALIFY-RATE:	ALL YEAR			
USE-MIN-QUAL:	NO			

MONTH	METERED ENERGY THERM	BILLING ENERGY THERM	METERED DEMAND THERM/HR	BILLING DEMAND THERM/HR	ENERGY CHARGE ($)	DEMAND CHARGE ($)	ENERGY CST ADJ ($)	TAXES ($)	SURCHRG ($)	FIXED CHARGE ($)	MINIMUM CHARGE ($)	VIRTUAL RATE ($/UNIT)	TOTAL CHARGE ($)
JAN	2893	2893	41.5	41.5	18628	43	0	0	0	25	0	6.4613	18696
FEB	1638	1638	23.9	23.9	10547	25	0	0	0	25	0	6.4682	10597
MAR	764	764	12.6	12.6	4916	13	0	0	0	25	0	6.4877	4954
APR	340	340	10.6	10.6	2188	11	0	0	0	25	0	6.5437	2224
MAY	136	136	0.6	0.6	875	1	0	0	0	25	0	6.6263	901
JUN	130	130	0.6	0.6	839	1	0	0	0	25	0	6.6342	864
JUL	112	112	0.5	0.5	718	1	0	0	0	25	0	6.6667	744
AUG	120	120	0.5	0.5	773	1	0	0	0	25	0	6.6502	799
SEP	110	110	0.5	0.5	708	1	0	0	0	25	0	6.6696	734
OCT	199	199	9.5	9.5	1280	10	0	0	0	25	0	6.6128	1315
NOV	759	759	16.6	16.6	4887	17	0	0	0	25	0	6.4933	4929
DEC	1547	1547	17.3	17.3	9958	18	0	0	0	25	0	6.4655	10001
TOTAL	8748	8748	41.5		56316	139	0	0	0	300		6.4880	56756

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BDL RUN 2

REPORT- ES-F Block-Charges and Ratchets for Columbia Large Commercial WEATHER FILE- RICHMOND INTERNAT VA

RESOURCE: NATURAL-GAS
ENERGY-UNITS: THERM
DEMAND-UNITS: THERM/HR
DEMAND-WINDOW: 60

BLOCK-CHARGES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Custom Gas Energy Blk1													
USE: YEARLY													
METERED ENERGY:	2893	1638	764	340	136	130	112	120	110	199	759	1547	
BILLING ENERGY:	2893	1638	764	340	136	130	112	120	110	199	759	1547	8748
METERED DEMAND:	41.5	23.9	12.6	10.6	0.6	0.6	0.5	0.5	0.5	9.5	16.6	17.3	
BILLING DEMAND:	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
ENERGY CHGS($):	18628	10547	4916	2188	875	839	718	773	708	1280	4887	9958	56316
Custom Gas Demand Blk1													
USE: YEARLY													
METERED ENERGY:	2893	1638	764	340	136	130	112	120	110	199	759	1547	
BILLING ENERGY:	0	0	0	0	0	0	0	0	0	0	0	0	8748
METERED DEMAND:	41.5	23.9	12.6	10.6	0.6	0.6	0.5	0.5	0.5	9.5	16.6	17.3	
BILLING DEMAND:	41.5	23.9	12.6	10.6	0.6	0.6	0.5	0.5	0.5	9.5	16.6	17.3	
DEMAND CHGS($):	43	25	13	11	1	1	1	1	1	10	17	18	139
TOTAL ENERGY:	2893	1638	764	340	136	130	112	120	110	199	759	1547	8748
TOTAL CHARGES ($):	18671	10572	4929	2199	876	839	719	774	709	1290	4904	9976	56456