2013 ANNUAL CONFERENCE SUSTAINABILITY PROJECT

DENVER RESCUE MISSION | LAWRENCE STREET SHELTER

Overview

As is custom, the city selected to host the annual conference has a goal to support sustainability. This year Rocky Mountain ASHRAE has committed to overhauling the Denver Rescue Mission's aged and deteriorating systems and replacing them systems to improve efficiency and increase occupant comfort.

The Lawrence Street Shelter is the Denver Rescue Mission's central outreach location. Tens of thousands of poor and needy people come to this facility each year for shelter, food, clothing, medical care, client services, and chapel services. At the Lawrence Street Shelter, all who are hungry: families, seniors, men, women, and children are welcome for a nutritious meal. The Lawrence Street Shelter serves three meals a day, seven days a week, three hundred sixty five days a year. With 200 shelter beds and 100 emergency overflow cots, up to 300 men can find a warm bed and a safe place to sleep each night. Families and individuals come to their "closet" for everything from warm gloves to business attire for job interviews. Case managers help up to 2,000 individuals each month with needs such as food boxes, baby diapers, furniture, clothing, household goods, and referrals to other agencies. Program participants can receive free medical, dental, optical, and chiropractic treatment at the Mission's clinic.

The Lawrence Street Shelter is an existing 3-story masonry structure located in downtown Denver. The building was constructed decades ago and is approximately 24,000 square feet in size. The lower level of the building contains a dining room and, commercial kitchen serving 1,000 meals per day, a commercial laundry, building library, boiler room and support areas. The second level of the building contains a chapel area, operation offices, medical clinic and support areas. The third level of the building contains has a large open dormitory that can house up to 200 occupants, a shower room, a restroom and support areas

HISTORY

History of the Annual Conference Sustainability Project

The Annual Conference Sustainability Project was launched in 2008 prior to the June conference held in Salt Lake City, Utah. The goal of the first demonstration project was to leave a legacy representing ASHRAE's commitment to sustainability and to offset the environmental impact from holding the Annual Conference. The project founders also hoped that this would provide an opportunity to highlight the association's standards, certifications, and new technology that are used or implemented within the project.

Each year it is now custom for the Annual Conference host city to select a sustainability project. These projects have become an ongoing way for ASHRAE to give back to the community where its meeting is held. It has also provided educational opportunities for the local chapter and visiting national members to learn more about the system that are installed.

The project technical and financial support is provided by both the ASHRAE local and national membership community. Typically the chapter members, representing many companies, team up to donate the design, materials, and installation work while many others contributed financially to the project.

PAST PROJECTS

- **2008 – Salt Lake City, UT**
  The first sustainability project included installation of a solar domestic water heating system at the Lolie Eccles Teen Home at the Salt Lake City YWCA. This residential facility has the capacity to serve 12 pregnant or parenting teen girls who are homeless or in state custody. The system helped to reduce the annual operating costs of the facility and reduce the environmental impact of the current heating system.
- 2009 – Louisville, KY
- 2010 – Albuquerque, NM
- 2011 – Montreal, Canada
- 2012 – San Antonio, TX

SPONSORS

A special thank you to the companies and individuals that have already pledged to donate material, labor or funds to the 2013 Sustainability Project! These supporters include:

Platinum ($25,000 +)		
annexAir	MTECH MECHANICAL TECHNOLOGIES GROUP	DENVER OFFICE OF STRATEGIC PARTNERSHIPS

C & D Builders Inc.

Xcel Energy®

Gold ($10,000 to $24,999)

ALERTON

US ENGINEERING

ROCKY MTN

ASHRAE Rocky Mountain Chapter

FERGUSON

mcnevin co. manufacturers representative more than product alone

GREINER electric LLC

Silver ($5,000 to $9,999)

Apricus SOLAR HOT WATER

CAMUS hydronics Ltd.

COOPER Lighting

McKinstry

Lohmiller & Company

Carrier West

Rocky Mountain Bryant

Johnson Controls

EATON Powering Business Worldwide

Patron ($1,000 to $2,499)

AP	CFM COMPANY	Davenport Family Gift Fund	IDEAL ELECTRIC, INC.
CURB ELECTROLUX	TRANE	RMH GROUP engineering a greener future	INVESTIVE BUILDING PROJECTS
SLATTERY & COMPANY	Tolin Mechanical Building Efficiency and Sustainability A Service Logic Company	WESTCO SYSTEMS INC.	Hercules INDUSTRIES Sheet, Coil & Specialty Metals Division
TracPipe	INTEGRITY Electrical Solutions	ASHRAE Nebraska Chapter	WINSLOW CRANE SERVICE CO. SAFETY.SERVICE.SOLUTIONS.

Bronze ($2,500 to $4,999)

WESTERN MAINTENANCE & CONSTRUCTION	TracPipe		

Partner ($500 to $999)

MKK Consulting Engineers, Inc.	M-E Engineers, Inc.	Denver Water	Western Mechanical Solutions
ASHRAE - Utah Chapter	Water Technology Group		

Associate ($200 to $499)			
James Waechter	ASHRAE - Black Hills Chapter	Shaffer Baucom Engineering & Consulting	P.V.C. Specialties Company
TM Sales	Purdy-McGuire		

Supporter ($100 to $199)		
C&D Insulation Inc.	Aaron Zimmerman	Brian Lynch

TEAM

Denver Rescue Mission

www.denverrescuemission.org/lawrenceshelter

The Denver Rescue Mission is a non-profit organization dedicated to serving the needs of the homeless and needy in the Denver metro area.

Energy Outreach Colorado

www.energyoutreach.org

Since 1989, Energy Outreach Colorado has raised more than $136 million to help Colorado's neediest families and seniors afford home energy. This has been distributed across the state for energy assistance to limited income households and for energy efficiency upgrades for affordable housing and nonprofit facilities.

Rocky Mountain ASHRAE

www.rockymtnashrae.com

The Rocky Mountain Chapter of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE) represents the states of Colorado, Wyoming, Utah and Idaho.

The following sustainability project team members have been integral to the project process and success:

Technical Team:

- Energy Outreach Colorado – Program Support
- Eaton Energy Solutions – Project Management and Energy Support
- MKK Consulting Engineers, Inc – MEP Design
- Investive Building Projects (formerly LONG Energy Solutions) – Energy Audit
- US Engineering – Pricing and Contractor Liaison
- Group 14 – Measurement and Verification
- Shamrock Sales – Solar Assessment
- Dick Scott - Steam System Assessment

- Jirsa Hedrick & Associates - Structural Assessment
- Illumination Systems - Lighting Assessment

Fundraising:

- Western Mechanical Solutions – Fundraising Lead
- Mtech – Finance and Sponsor Tracking

Publicity and Promotions:

- Shaffer Baucom – Promotions, materials
- IMS – Promotions, fundraising
- John Eisel – Website

DENVER RESCUE MISSION

Energy Outreach Colorado

ASHRAE

ENERGY AUDIT

An energy audit of the Denver Rescue Mission Lawrence Street facility was conducted from October through January. This included two site visits to collect information, document facility operation and understand potential improvements. The following provides a summary of the findings from the energy audit.

Facility Operation

The Denver Rescue Mission facility is a three-story building completed in 1928 and serves as the flagship ministry and central outreach location for the Denver Rescue Mission. Tens of thousands of people come to this facility each year for shelter, food, clothing, medical care, client services and chapel services. The building comprises 23,343 square feet including offices, two chapel, a library, a kitchen, a clinic, a dormitory and other ancillary spaces. The building is constantly occupied throughout the entire year; however the dorm is normally occupied from 9:00 pm to 5:00 am, the kitchen from 5:30 am to 8:00pm and the office area from 8:00 am to 5:00 pm. The reception operates 24 hours 7 days a week.

Building Envelope

The building envelope is comprised of a wood frame with a brick façade and unknown insulation. The roof is flat with a wood frame and urethane coating. Most of the exterior windows are single-pane operable fixtures and show visible signs of wear and tear. All exterior doors appear to close tightly and are well sealed. Overall, the building envelope appears to be in fair condition, with no major indications of infiltration.

HVAC System

One large Well-McLain steam gas-fired boiler provides low pressure steam to the perimeter radiators throughout the entire building. Each radiator is locally controlled by a thermostatic valve with no unoccupied set point.

One large Greenheck gas-fired constant-volume make-up air unit (MAU) provides further heating for the large dorm space on the second floor. This unit is also locally controlled by a programmable thermostat without any night setback.

According to the drawings, the dormitory showers and rest rooms are heated by two electric air handling units (AHU) rated at 5 kW each, probably located in the ceiling deck. A tamper resistant timer and temperature setting control system, located in the observation room on the second floor, is used for the second floor HVAC system. This space is normally occupied at night or during maintenance hours.

A second large Reznor gas-fired constant-volume MAU provides the space heating for the kitchen and is interlocked with the kitchen hood exhaust fan. The combined system is controlled by a tamper resistant temperature setting and timer located in the observation room. Four split system air conditioners assisted by an air cooled condensing unit (CU)provide conditioned air to the following zones: two offices, the library and prep room in the basement, the west side of the 1st floor and the clinic. Each fan coil unit (FCU) is locally controlled by a programmable thermostat. Each thermostat was inspected and there did not appear to be an unoccupied schedule programmed into the units.

Four direct evaporative cooling (DEC) units provide cooling to the spaces not served by the FCUs. This includes the dorm area on the second floor, which is served by two units, as well as the chapel on the first floor and the dining room in the basement. These units are controlled by simple thermostats.

HVAC Controls

There is no centralized control system at the Denver Rescue Mission facility.

Domestic Hot Water and Miscellaneous

Two 81 gallon gas-fired water heaters provide hot water for domestic use. The laundry facility has two large electric dryers, two industrial washers as well as several smaller commercial washers and dryers. Additionally, there are two walk-in refrigerators and freezers within the building.

Lighting

The lighting is primarily comprised of two- and four-lamp four-foot T-12 fixtures with magnetic ballasts. There are also several compact fluorescent fixtures, incandescent exit signs and exterior metal halide wall packs. The lighting fixtures in two classrooms are controlled by wall mounted occupancy sensors. The rest of the lighting fixtures are manually controlled.


15 3:26PM


15 3:30PM

ENERGY AND FACILITY IMPROVEMENT MEASURES

Overview

Potential energy and facility improvement measures were identified for the Denver Rescue Mission Lawrence Street facility to decrease building energy use and increase occupant comfort. These measures are a result of needs identified by the Denver Rescue Mission and items identified during the energy audit.

Energy Conservation Measures

The following table summarizes the energy saving opportunities identified for implementation at the Denver Rescue Mission:

ECM#	Energy Conservation Measure	Estimated Annual Electric Savings (kWh/yr)	Estimated Demand Savings (kW/peak month)	Estimated Annual Gas Savings (therms/yr)	Estimated Annual Energy Savings ($/yr)
1	Retrofit Lighting - Upgrade T12 to T8, occ sensors, exterior lights, exit signs	45,712	7.1	-328	$ 3,857
2	Replace Split System Air Conditioning Units	9,842	4.4	0	$ 1,314
3	Upgrade HVAC Controls - Central DDC Control	14,942	0.0	3,697	$ 3,655
4	Reduce Steam Leakage and Replace Steam Control Valves	0	0.0	957	$ 634
5	Replace 3rd Floor MAU with HRV (Dorm/Shower/Restroom)	0	0.0	4,324	$ 2,863
6	Replace Domestic Hot Water Heaters, Low Flow Shower Heads	0	0.0	4,704	$ 3,114
7	Install Solar Domestic Hot Water	0	0.0	1,892	$ 1,253
			Total Annual Estimated Savings ($/yr):		$16,689
			Current Annual Utility Cost ($/yr):		$ 51,477.68
			% Savings from Current Annual Cost:		32%

1. ECM 1: Retrofit Lighting
2. ECM 2: Replace Split System Air Conditioning Units
3. ECM 3: Upgrade HVAC Controls - Central DDC Control
4. ECM 4: Reduce Steam Leakage and Replace Steam Control Valves
5. ECM 5: Replace 3rd Floor MAU with HRV
6. ECM 6: Replace Domestic Hot Water Heaters, Low Flow Shower Heads
7. ECM 7: Install Solar Domestic Hot Water

1. **ECM 1: Retrofit Lighting**

The DRML facility lighting is primarily comprised of four-foot, four-lamp and two-lamp T-12 fluorescent fixtures with magnetic ballasts. It is recommended to retrofit all T-12 fixtures with magnetic ballasts to T-8 fixtures with electronic ballasts. The ballast is a current limiting device that must be retrofit with the lamps. Additionally, it is recommended that exterior lighting and exit signs are upgraded.

The lighting fixtures throughout the building are controlled manually by the occupants via wall switches. While some spaces that were unoccupied during the site visit had their lighting fixtures switched off, other spaces did not. This measure involves installing wall and ceiling mounted infrared occupancy sensors in the dormitory, the clinic rooms, the cafeteria, the Spanish chapel and private offices, as well as in some support spaces such as the restrooms, the showers, the laundry and the storage areas, to turn off these fixtures during unoccupied periods. The occupancy sensor controls

can be programmed with an adjustable delay to allow lighting fixtures to remain on for a set amount of time after the space is unoccupied (typically 15 minutes).

2. **ECM 2: Replace Split System Air Conditioning Units**

DRML split system condensing units are older models and the management is considering replacing them with high seasonal energy efficiency rated (SEER) units. ENERGY STAR qualified units have a higher SEER rating than standard models, making them about 35% more energy efficient. An alternative replacement option is to install a Variable Refrigerant Flow system with a new central condensing unit and VRF concealed ducted units, wall mounted units or ceiling cassettes units in the zones.

3. **ECM 3: Upgrade HVAC Controls - Central DDC Control**

The HVAC equipment is currently controlled by programmable and manual thermostats. The DRM management would like to improve the building HVAC control by installing a direct digital control (DDC) system. This measure would include tying all primary HVAC equipment, zone thermostats, electric damper operators, and other terminal heating and cooling equipment to the central DDC system. The new control system would also allow for and include control strategies, such as equipment scheduling, temperature control, unoccupied setback, heating/cooling enable, temperature reset, and remote access.

4. **ECM 4: Reduce Steam Leakage and Replace Steam Control Valves**

The building steam radiators have thermostatic valves and steam traps that are not in good repair. This results in unnecessary steam leakage and uncontrolled zone temperatures. It is recommended that DRML replace all radiators and baseboard thermostatic valves with tamper resistant units. In addition, all old steam traps should be replaced with new parts to reduce steam leaks.

5. **ECM 5: Replace 3rd Floor MAU with Heat Recovery Ventilator**

The DMRL dormitory is heated by steam radiant heaters and a 600 MBH gas-fired make-up air unit (MAU). The nearby restrooms and shower are heated by electric air handling units and the whole area uses exhaust fans for the space ventilation. During occupied periods, all exhaust fans reject conditioned air continuously, as long as the MAU or the two evaporative coolers serving the area are running. The management would like to replace the existing MAU with a heat recovery ventilator (HRV) to recover some of the exhausted heat. In case more heat is needed, the HRV is provided with an indirect gas fired furnace with modulation to supplement the heating capacity. It is recommended that DRML replace the existing MAU with an HRV to recover most of the heat otherwise rejected outside by the dormitory, restroom and shower exhaust fans. The HRV is provided with supply and exhaust motors controlled by variable frequency drives (VFD) to match the airflow rate to the area load requirements.

6. **ECM 6: Replace Domestic Hot Water Heaters, Low Flow Shower Heads**

The two domestic hot water (DHW) heaters serving the DRM are old and inefficient, and should be replaced. According to the facility manager, there is an increasing need for hot water, and it is recommended that the existing water heaters be replaced with condensing water heaters that have a greater capacity. Condensing water heaters are more energy efficient in that they recuperate much of the exhaust combustion gases' heat otherwise lost in non-condensing water heaters. Conventional gas-fired tank water heater's average efficiency is about 60%, while condensing tank water heaters are about 86% efficient.

In addition, replacing shower head aerators is an effective way to reduce water and energy consumption associated with domestic hot water. Replacing the faucet aerators reduces water flow rate to appropriate levels. This measure will yield savings in water usage and natural gas usage due to heating the water; however, only natural gas usage savings are included in this analysis.

7. **ECM 7: Install Solor Domestic Hot Water**

DRML would like to install (8) evacuated tube solar collectors and (4) 120 gallon solar buffer tanks to supplement the hot water heating. Solar hot water heaters, sometimes called solar domestic hot water systems, use the sun to heat either water or a heat-transfer fluid, such as a water-glycol antifreeze mixture, in collectors generally mounted on a roof. The heated water is then stored in a tank similar to a conventional gas or electric water tank, with an electric pump to circulate the fluid through the collectors. Solar water heaters are made up of collectors, storage tanks, and pumps.

CONSTRUCTION

Construction Nears Completion!

With sunnier weather in the forecast this week, construction is expected to wrap up with the installation of the solar panels for the new domestic how water system. All of the other projects have been completed and the Rescue Mission reports the new equipment is operating well. The construction update and photos are below for each Energy Conservation Measure.

1. Retrofit Lighting
2. Replace Split System Air Conditioning Units
3. Upgrade HVAC Controls – Central DDC Control
4. Reduce Steam Leakage and Replace Steam Control Valves
5. Replace 3rd Floor MAU with HRV
6. Replace Domestic Hot Water Heaters, Low Flow Shower Heads
7. Install Solar Domestic Hot Water

ECM 1: **Lighting Retrofit**

The lighting fixture upgrade and installation of occupancy sensors is complete. Several Rescue Mission staff members have already noted the improved light quality and levels. During site visits, the project team also noticed the improved light quality.

ECM 2: **Replace Split System Air Conditioning Units**

The split systems have been replaced and are currently providing both ventilation and heating to the spaces. As part of this upgrade, an existing electrical panel was also successfully replaced to accommodate the addition of the electric heat.

ECM 3: **Upgrade HVAC Controls – Central DDC Control**

Design and programming for the new control system is complete. Control wiring has installed and many control components are already functional.

ECM 4: **Reduce Steam Leakage and Replace Steam Control Valves**

The steam radiator traps and control valves have been replaced throughout the building. During construction a significant amount of debris was found between the radiator fins, reducing the radiator effectiveness. All debris was removed and the radiators and staff at the Mission have commented on the increased heat in the building.

ECM 5: **Replace 3rd Floor MAU with HRV**

Installation of the HRV serving the 3rd Floor dormitory is complete. Construction went smoothly, even with the very cold winter temperatures during installation of the HRV on the root and start-up of the unit. Mission maintenance staff noted that the unit is operating well.

ECM 6: **Replace Domestic Hot Water Heaters, Low Flow Shower Heads**

Installation of the low flow shower heads is complete. The two new high efficiency DHW heaters have been installed and after replacing a broken component on one water heater, they are both operational. The water heaters are providing the hot water needs at the Mission for showers and cooking that were not previously met.

ECM 7: **Install Solar Domestic Hot Water**

The solar DHW system installation is underway and is scheduled to be complete this week. Only the installation of (8) evacuated tube solar collectors on the roof remains to be completed.

More Construction Photos

Lighting Retrofit

Replace 3rd Floor MAU with Heat Recovery Ventilator

Replace 3rd Floor MAU with Heat Recovery Ventilator

Replace 3rd Floor MAU with Heat Recovery Ventilator

Replace Domestic Hot Water Heaters, Low Flow Shower Heads

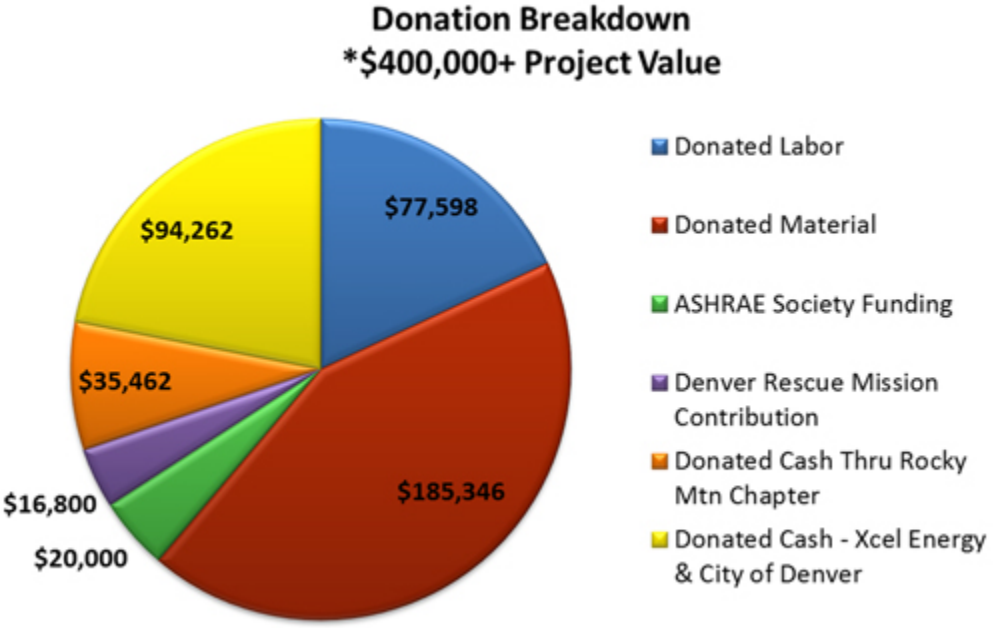
Replace Domestic Hot Water Heaters, Low Flow Shower Heads

Replace Domestic Hot Water Heaters, Low Flow Shower Heads

FUNDRAISING

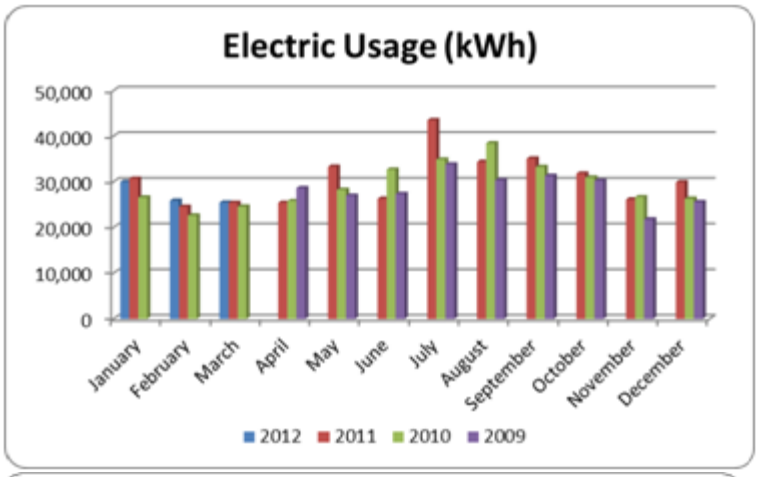
Fundraising Summary

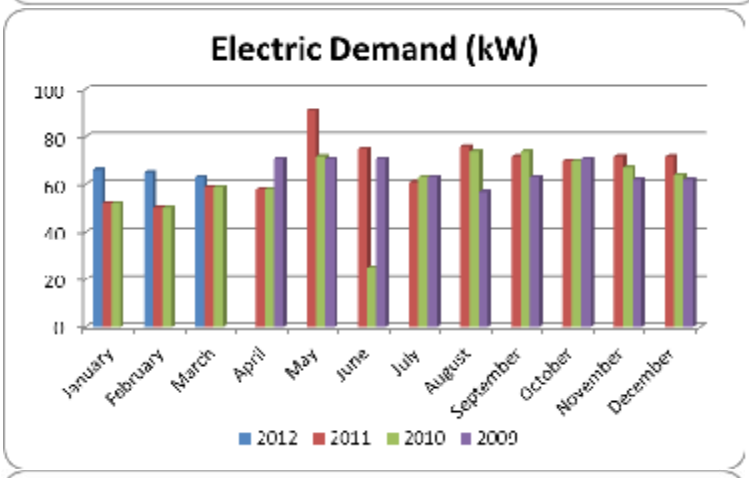
The 2013 Sustainability Project goal of fundraising over $400,000 in services, material or funds was achieved through generous support by the local Denver community, Rocky Mountain ASHRAE Chapter members and many others. An unprecedented level of donations was raise for the 2013 Sustainability Project. A breakdown of the donations is presented below. The breakdown does not included a significant amount of services and time donated by the project team.

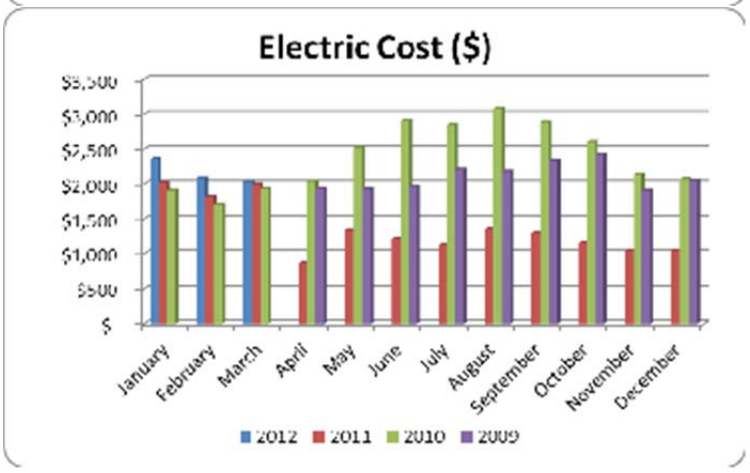


BASELINE ENERGY USE

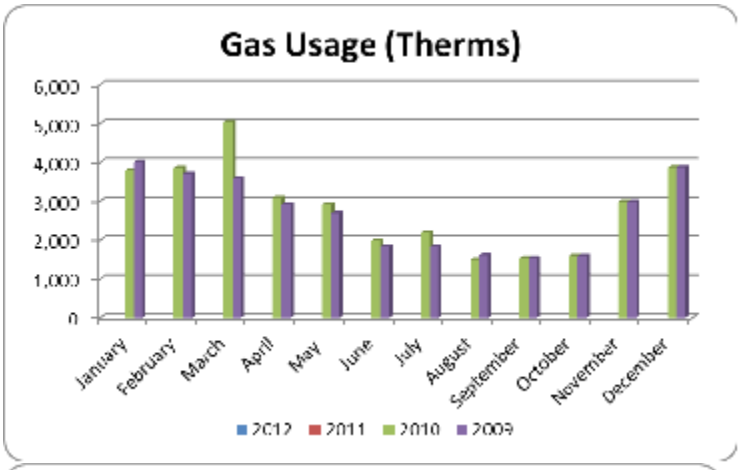
The Denver Rescue Mission is under the Xcel Energy Secondary General (SG) electric rate schedule. Utility bills were provided for the years of 2009 thru 2012. Both the energy use and demand have remained fairly constant from 2009 thru 2012. The electric energy and demand costs have varied from year to year with the highest costs seen in 2010. As expected, the electric energy use and demand peaks in the warm summer months of July, August and September when mechanical cooling is used.

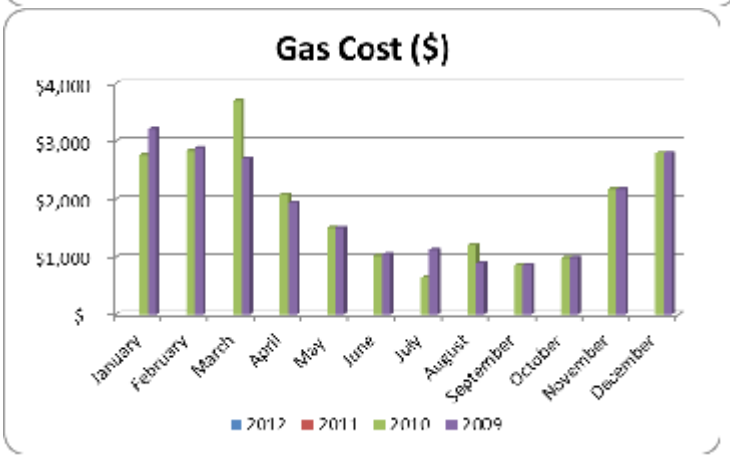




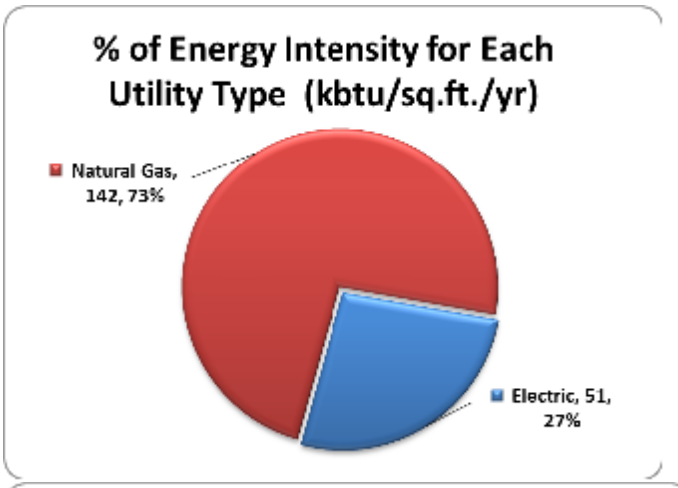


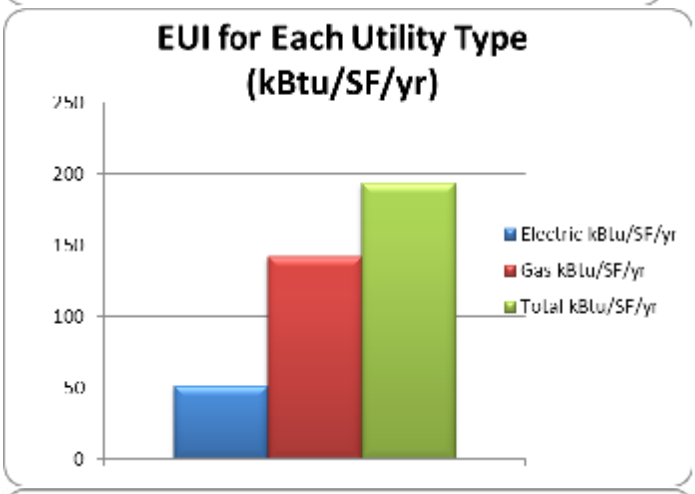
Natural gas has been supplied by Spark Energy since 2011 and prior to that time natural gas was provided by Xcel Energy. Utility bills were provided for 2009 and 2010. The natural has use and costs remained constant in both years. The natural gas use is highest during the colder winter months of December, January, February and March. During the summer months the natural gas use represents the domestic hot water load used for showers and cooking.

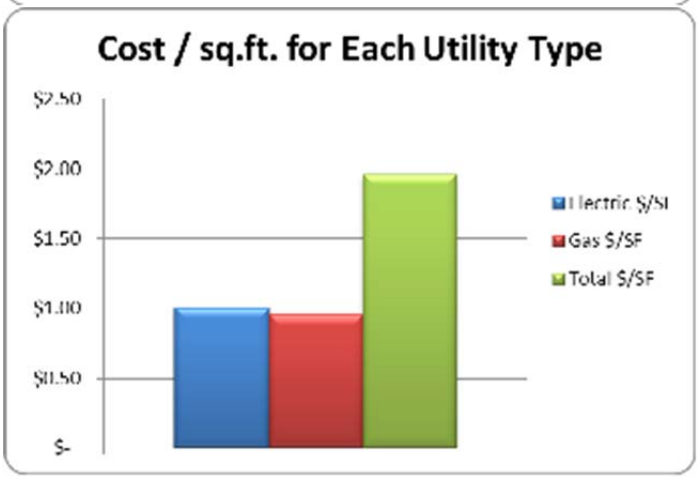




The graphs below illustrate the energy use intensity and cost breakdown between each utility type. Reducing the natural gas energy use will have the largest overall impact on energy reduction.


% of Energy Intensity for Each Utility Type (kbtu/sq.ft./yr)
Natural Gas, 142, 73%
Electric, 51, 27%


EUI for Each Utility Type (kBtu/SF/yr)
250
200
150
100
50
0
Electric kBtu/SF/yr
Gas kBtu/SF/yr
Total kBtu/SF/yr


Cost / sq.ft. for Each Utility Type
$2.50
$2.00
$1.50
$1.00
$0.50
$-
Electric $/SF
Gas $/SF
Total $/SF