Energy Engineering Study for Recreation Center

for

Town of Avon, Colorado

Developed by:

Colorado Governor's Energy Office

February 2008

The Colorado Governor's Energy Office (GEO), offers technical assistance to help Colorado facility owners improve buildings through energy efficiency. For more information or continued assistance please feel free to contact us.

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For this project, Trident Energy Services is providing services under contract to the GEO.

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DISCLAIMER

This report is preliminary and general in nature. Results are intended to identify potential, cost-effective, energy-saving measures and the potential for proceeding with a large-scale, comprehensive project to upgrade your facilities through energy efficiency.

EXECUTIVE SUMMARY

The Town of Avon wishes to improve the energy efficiency of its Recreation Center. To this end, Ms Jenny Strehler, the town's Director of Public Works and Transportation, contacted the Governor's Energy Office to obtain information on program and support services to assist in assessing the building's energy efficiency improvement opportunities. John Canfield of Trident Energy Services, Inc., an independent energy consultant and engineer providing consulting services to the GEO, conducted a walk-through survey and developed this feasibility-level study for the Recreation Center.

Because this building will undergo a major renovation in the near future, this report provides recommendations that can be implemented with no effect on the renovation. Several longer term recommendations are presented for consideration for implementation at the time of the renovation.

Energy-saving and capital improvement opportunities identified:

- Lighting upgrades.
- Install occupancy lighting controls.
- Utilize an insulated cover for the spa during unoccupied times.
- Recommission HVAC/boiler/controls equipment.
- Insulate domestic hot water pipes adjacent to boiler.
- Weatherstrip and caulk all doors and windows as necessary.
- Install a VendingMizer™ on each vending machine.
- For refrigerated water fountains, a simple plug-in time clock programmed to keep these units off during unoccupied times will save close to 50% of their overall energy use.
- Reschedule janitorial schedules to minimize nighttime use of building.
- Develop an energy education and awareness program for all town personnel.

Other measures to be further evaluated:

- Install solar pool water heating system.
- Install solar outside makeup air preheat system.
- Install demand ventilation controls.
- Reconfigure pool filter backwash process.
- Install electric and natural gas meter monitoring points.
- When replacing motors, install premium efficiency motors.

The following tables provide estimated annual utility use and cost savings that may be realized if the recommended measures are implemented. Further development is necessary to provide estimated costs for the measures.

ESTIMATED Annual Energy Savings by Percentage					
	Est. Elec Savings (kWh)		Est. Gas Savings (Ccf)		Total Est. Savings (mmBtu)
Recreation Center	10%	103,180	15%	17,105	2,063

ESTIMATED Annual Cost Savings by Percentage					
	Est. Elec Savings.		Est. Gas Savings		Total Est. Savings
Recreation Center	10%	$ 6,517	15%	$ 12,567	$ 19,084

The Governor's Energy Office offers continued free services from a team of specialists to help you follow-through with high performance design assistance for the town's planned new building construction and renovations. For more information go to www.colorado.gov/energy.

ENERGY AND COST SAVING IMPROVEMENTS

Following are descriptions of existing conditions and recommended efficiency improvements for the town's Recreation Center. Because the building will be undertaking a major renovation in the not too distant future, the recommendations provided reflect low/no cost and others with shorter economic paybacks. Also presented are some first-cut ideas on measures that may be incorporated into the renovation project.

Town of Avon Recreation Center

The 37,000 square foot Recreation Center opened for business in 1995. The building consists of three heated swimming pools and an indoor hot tub, locker and restrooms, weight workout areas, a cardio area, administrative offices, child care, and the main entry/lobby. The facility is open to the public 6:00 AM to 9:00 PM Monday through Friday and on weekends, 8:00 AM to 9:00 PM. The building will undergo a major renovation in the near future.

Utility Use

According to the calendar year 2007 utility data, the building energy utilization index (EUI) is 95,200 and 308,300 Btu per square foot per year (KBtu/sf/yr) for electricity and natural gas, respectively, totaling 403,500 Btu/sf/yr. Based on the year's utility rates, this resulted in a cost of $4.03 per square foot. Because the cost will vary as a function of utility rates, the EUI is the best metric to assess the energy efficiency of the facility. This Recreation Center's use is significantly higher than average for other rec centers in the Colorado area. This is most likely due to the fact that the building's area is relatively small but it contains the high energy using natatorium. (See Appendix A for utility information.)

Existing Energy Efficiency and Comfort Improvements

Since the building was built, the town has invested significantly in improving the efficiency and comfort of the facility. Energy and comfort improvement measures include:

- Installed new, high efficiency water heating boilers
- Installed a building-wide energy management system
- Efficiency improvements on HVAC equipment
- Water efficiency upgrades

Recommended Energy Efficiency Improvements

The following provides brief descriptions of some the existing energy using systems and recommendations for improving their operation and energy efficiency that should be considered for implementation.

Lighting

Existing Condition

Overall, the general lighting throughout the building consists of 2' x 4' fluorescent fixtures that use older, less efficient T-12 lamps and magnetic ballasts. In the cardio and pool areas, 250 watt and 400 and 175 watt metal halide fixtures, respectively, provide adequate lighting. In the lobby area, a number of decorative, inefficient tungsten halogen lights are used. Most lights are turned on when the building opens in the morning and remain on until the building closes at the end of the day. The main reason for this is that the metal halide technology requires a long cool down and warm up period before reaching full light output, so they are never turned off during the day. There are a number of high efficiency compact fluorescent lights throughout the building and the exit lights have all been upgraded to high efficiency, long-life LED signs.

Recommendations

- Upgrade existing fluorescent lights with high efficiency T-8 lamps and electronic ballasts. This simple re-lamp/-reballast will reduce lighting energy in these fixtures by about 30%. In areas that may be over lit, reduce the number of lamps in each fixture. This retrofit typically results in a 5 to 7 year simple payback.

- Replace the 250 watt metal halide fixtures that currently light the cardio areas with fluorescent fixtures that use six high efficiency T-8 lamps and 2 electronic ballasts. This measure will provide higher quality lighting and typically pays back in less than 10 years.
    - Install manual/occupancy switches and daylight sensing controls that will automatically dim or turn off the new fluorescent lights as daylight levels increase and will automatically turn them back on as daylight levels reduce.
- In the pool areas replace the 400 watt metal halide fixtures that with fluorescent fixtures that use six high efficiency T-8 lamps and 2 electronic ballasts. A similar replacement for the 175 watt metal halide fixtures would use 4-lamp fluorescent fixtures. NOTE: This retrofit should be thoroughly evaluated to ensure the lights provide adequate quality lighting for overall pool safety.
    - Install daylight sensing controls on the west side that will automatically dim or turn off the new fluorescent lights as daylight levels increase and will automatically turn them back on as daylight levels reduce.
- Install occupancy sensors in other appropriate areas to automatically turn lights off when spaces become unoccupied such as offices, conference rooms, and restrooms. The typical payback for this measure is usually between two and five years.
- During the renovation, the high lobby ceiling will be substantially lowered to accommodate the new second floor area. At this time, the inefficient halogen lights should be replaced with recessed high efficiency compact fluorescent fixtures. Additionally, any architectural lighting that will be installed, such as wall sconces, should also employ this technology.

Pool Water Heating

Existing Condition

Presently, the pools and spa remain uncovered when the pools are unoccupied. Pool covers are the single most cost effective method to reduce water heating energy, chemical use, and water use. However, the logistical limitations of pool cover handling and daytime storage present problems. It appears that the pool deck areas are too small to accommodate daytime storage of pool covers. However, it would be feasible to provide an insulating cover for the spa. The spa water temperature is maintained at 102 to 104 degrees F which results in higher amounts of evaporation and heat loss.

Recommendations

- Purchase and diligently employ an insulated cover for the spa. This cover would be relatively small and easy to handle and store out of the area. In addition, even though the spa's water heating boiler is turned off at night, the cover would save significant natural gas energy. A simple payback for this measure is less than 5 years.

Longer Term Recommendations

- Install a solar pool water heating system to offset rising costs of natural gas. In Colorado, it is likely that seasonal use of a simple, unglazed, low-temperature (80 – 90 degrees) pool water heating system can significantly offset the use of natural gas to heat pool water. The benefit of an unglazed collector system is its initial cost and its on-going maintenance is small. However, unglazed systems work well only above certain outdoor temperatures. But with proper temperature controls, the available energy production capability of the system can easily be maximized. This measure should be more fully analyzed as the town proceeds with the building renovation.

  - This is a fairly capital intensive project and should be analyzed in further detail. However, outside funding sources such as renewable energy grants will improve the economics of this measure. Additionally, the use of solar energy by the town is a step to meet its energy and environmental goals.

- Backwash pool filters with unheated, untreated town water. Presently, the pools' filters are backwashed with heated and chemically treated pool water. Water use for this task approaches 185,000 gallons of HEATED AND TREATED water or more annually. Through this process, heated and chemically conditioned water are used for this purpose and sent to the sewer each year. It is recommended that reconfiguring water piping so that "raw" town water may be used for filter backwashing purposes should be further investigated when the town proceeds with the upcoming renovation. Intuitively, significant pool water heating energy and chemical use will be further reduced.

- Consideration should be given to solar pre-heating of pool area ventilation air. A low-technology approach is using transpired solar collectors. Transpired collectors are relatively simple dark colored perforated metal panels installed to the exterior of a south-facing wall through which outdoor make-up or ventilation air is drawn and preheated prior to entering the building through the air handling unit. Effectively, the preheating reduces the amount of natural gas heating energy necessary to temper the ventilation air. Again, as the town proceeds with designing its renovation, this measure should be further analyzed in conjunction with all other measures for its feasibility.

Building HVAC and Controls

The town's facilities personnel presently do an excellent job in controlling and maintaining this building's equipment to ensure efficiency and comfort. However, it is typical that, over time, controls equipment and HVAC equipment "fall out of calibration" and begin to operate less efficiently than what is possible.

Recommendations

- Recommission all BAS and HVAC heating and cooling equipment. Even though facilities personnel provide good on-going maintenance on the units, a formal recommissioning of the controls and HVAC will provide an additional increase in their efficiency and ability to provide a comfortable environment. This measure typically will payback in 2 to 3 years.

  - Recommissioning should ensure that all controls are programmed as designed including proper time-of-day scheduling, proper temperature setpoints, and proper operation of damper economizers.

- Thoroughly weatherstrip and caulk all doors and windows.

- Insulate the presently uninsulated pipes adjacent to the domestic hot water boiler.

Longer Term Recommendations

- Install demand ventilation controls. During a typical day, occupancy levels fluctuate. However, the HVAC units providing outside ventilation air continue to bring in certain amounts of unconditioned ventilation air that needs to be either heated or cooled whether the ventilation need exists or not. During reduced or unoccupied times, less or no ventilation air is needed. Demand ventilation is a system that uses CO2 sensors in the ventilation units' return air stream to sense the demand for ventilation air. If the space is less than fully occupied or empty, the sensors will modulate or close the outside air dampers to reduce unconditioned outside ventilation to the minimum necessary level thereby reducing the heating or cooling energy requirements. However, as users enter the space, the

CO2 generated from there respiration is sensed by the sensors and the outside air dampers automatically open only to the level to where proper ventilation/CO2 levels are achieved and maintained.

Other Recommendations

The Recreation Center has refrigerated vending machines, each rated at an estimated 200 - 400 watts, and refrigerated water fountains estimated at 100 - 200 watts. These devices are enabled to operate at all times.

- Install a VendingMizer™ on each vending machine to ensure that vending machines operate only when necessary while keeping their product at the correct temperature. VendingMizers™ are approved by both Coca Cola and Pepsi Cola companies for retrofits on their vending machines. These devices typically save 30 to 70 percent of a vending machine's energy use and cost and pay back in around 3 years. Additional energy savings may be achieved by removing the lamps from the machine.
- For refrigerated water fountains, a simple plug-in time clock programmed to keep these units off during unoccupied times will save close to 50% of their overall energy use.
- To improve the management of the energy use in the building, install monitoring points on the electric, natural gas, and water meters and tie them directly into the building automation system. Having easily accessible real-time energy use information will allow building operations personnel to see exactly how much energy is being used and take measures to further control its use as necessary. Additionally, through the BAS, trend logs may be developed that will automatically track this important information over periods of time.
- Presently, janitors are in the building each night cleaning until midnight. Nighttime cleaning requires lights and HVAC operation to accommodate the workers. The town should consider revising cleaning schedules that reduce nighttime cleaning hours.
- When motors are in need of replacement, install premium efficiency motors. The incremental additional cost will quickly pay back due to energy cost savings.
- Turn off all lights when leaving an area for over 10 minutes.
- Turn off (or initiate "sleep" or standby mode) all computers, monitors, and personal equipment when not in use, such as over lunchtime and at the end of each day. If computers MUST be left on, turn off the just the monitors.
    - Consider replacing any remaining CRT monitors with efficient LCD monitors.
- **Initiate an energy education and awareness program with town staff to ensure equipment, such as lights and computers, are operated only when necessary. This should also apply to water use and conservation. The Governor's Energy Office can provide assistance and support for this program if the town desires.**

Summary of Estimated Savings and Potential Project Implementation Cost

The following tables provide estimated annual utility use and cost savings that may be realized if the recommended measures are implemented. Further development is necessary to provide estimated costs for the measures.

ESTIMATED Annual Energy Savings by Percentage					
	Est. Elec Savings (kWh)		Est. Gas Savings (Ccf)		Total Est. Savings (mmBtu)
Recreation Center	10%	103,180	15%	17,105	2,063

ESTIMATED Annual Cost Savings by Percentage					
	Est. Elec Savings.		Est. Gas Savings		Total Est. Savings
Recreation Center	10%	$ 6,517	15%	$ 12,567	$ 19,084

APPENDIX A
Utility Bill Analysis

Town of Avon Rec Center

January - December 2007

Building Name	Area (sf)	Electricity Cost ($/yr)	Natural Gas Cost ($/yr)	Total Energy Cost ($/yr)	Total Energy Cost per SF ($/sf/yr)
Recreation Center	36,987	$65,170	$83,779	$148,949	$4.03

January - December 2007

Building Name	Electricity (kBtu/SF/yr)	Electricity ($/SF/yr)	Natural Gas (kBtu/SF/yr)	Natural Gas ($/SF/yr)	Total (kBtu/SF/yr)	Total ($/SF/yr)
Recreation Center	95.2	$ 1.76	308.3	$ 2.27	403.5	$ 4.03

Annual Energy Usage January - December 2007

Building Name	Area (sf)	Electricity use (kWh)	Natural Gas use (ccf)
Recreation Center	36,987	1,031,800	114,030

January - December 2007

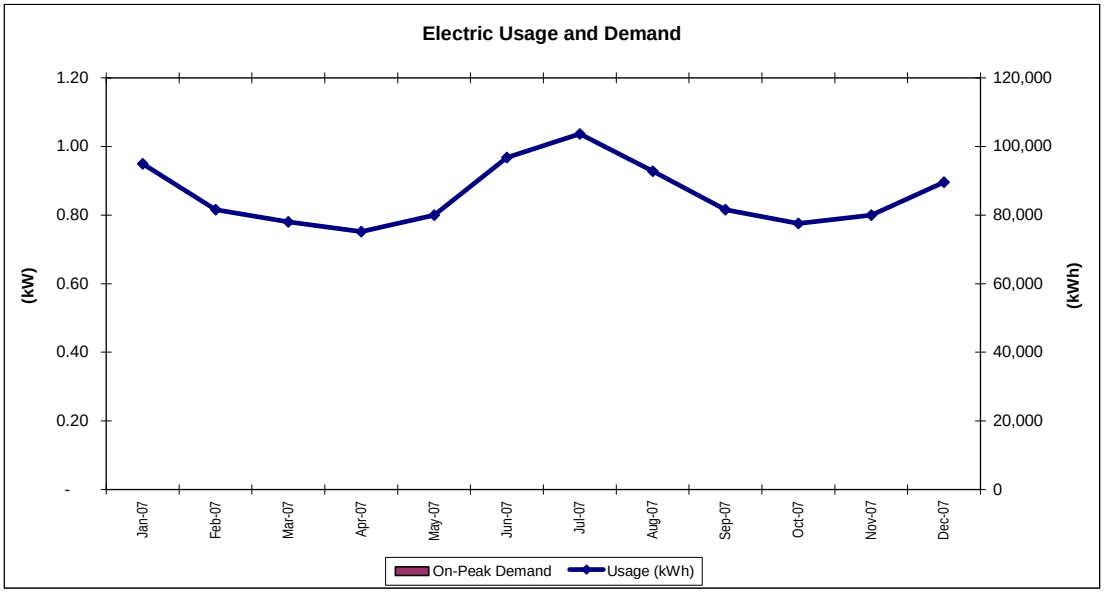
Building Name	Blended electricity cost ($/kWh)	Average Natural Gas cost ($/ccf)
Recreation Center	$0.063	$0.735

Utility History - Electric
Town of Avon Rec Center
Recreation Center
January - December 2007

Utility	Holy Cross Energy		
Location			
Meter No.	95626	**Premise #:**	
Account/Rate	500024702	Rate: Secondary General	
Bldg. Sq. Ft.	36,987		

Average cost per kWh	$0.063
Electricity $ / ft^2-yr	$1.76
Elec. & Natural Gas $ / ft2-yr	$4.03
Electricity kBtu / ft2-yr	95.2
Elec. & Natural Gas kBtu / ft2-yr	403.5

Use Month	Usage (kWh)	kWh Cost	On-Peak Demand	On-Peak Demand ($)	Cost/kWh ($)	Demand Cost/kW ($)	Total Demand ($)	Total Cost	Blended Cost ($/kWh)
Jan-07	95,000				$ -	#DIV/0!	#DIV/0!	$ 6,321.00	$ 0.0665
Feb-07	81,600				$ -	#DIV/0!	#DIV/0!	$ 5,510.00	$ 0.0675
Mar-07	78,000				$ -	#DIV/0!	#DIV/0!	$ 4,919.00	$ 0.0631
Apr-07	75,200				$ -	#DIV/0!	#DIV/0!	$ 4,789.00	$ 0.0637
May-07	80,000				$ -	#DIV/0!	#DIV/0!	$ 5,125.00	$ 0.0641
Jun-07	96,800				$ -	#DIV/0!	#DIV/0!	$ 5,898.00	$ 0.0609
Jul-07	103,600				$ -	#DIV/0!	#DIV/0!	$ 6,248.00	$ 0.0603
Aug-07	92,800				$ -	#DIV/0!	#DIV/0!	$ 5,744.00	$ 0.0619
Sep-07	81,600				$ -	#DIV/0!	#DIV/0!	$ 5,202.00	$ 0.0638
Oct-07	77,600				$ -	#DIV/0!	#DIV/0!	$ 4,538.00	$ 0.0585
Nov-07	80,000				$ -	#DIV/0!	#DIV/0!	$ 6,095.00	$ 0.0762
Dec-07	89,600				$ -	#DIV/0!	#DIV/0!	$ 4,781.00	$ 0.0534
Total	1,031,800	$ -	-	$ -	$ -	#DIV/0!	#DIV/0!	$ 65,170.00	$ 0.0632



Utility History - Natural Gas
Town of Avon Rec Center
Recreation Center
January - December 2007

Utility			
Location	0		
Meter No.		**Premise #:**	
Account/Rate			
Bldg. Sq. Ft.	36,987		

Avg. cost per ccf	$0.73
Natural Gas $ / ft2-yr	$2.27
Elec. & Natural Gas $ / ft2-yr	$4.03
Natural Gas kBtu / ft2-yr	308.3
Elec. & Natural Gas kBtu / ft2-yr	403.5

Usage Month	**Usage (ccf)**		**Total Cost**		**Cost/ccf**
Jan-07	14,140	$	13,906	$	0.98
Feb-07	12,450	$	9,513	$	0.76
Mar-07	12,540	$	8,936	$	0.71
Apr-07	9,630	$	6,398	$	0.66
May-07	7,940	$	5,364	$	0.68
Jun-07	6,260	$	3,771	$	0.60
Jul-07	5,540	$	3,499	$	0.63
Aug-07	6,050	$	4,268	$	0.71
Sep-07	7,610	$	4,603	$	0.60
Oct-07	8,190	$	5,896	$	0.72
Nov-07	10,400	$	8,252	$	0.79
Dec-07	13,280	$	9,373	$	0.71
	114,030	$	83,779.00	$	0.73

Note: Btu content of Natural Gas is 100 kBtu/ccf