CB South POA
Energy Audit
61 Teocalli Road
Crested Butte South, Colorado

Report prepared by:
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Section 1: Scope and goals

As part of the Gunnison County Electric Association's (GCEA) commercial energy audit program Resource Engineering Group, Inc. performed this audit at the request of Chris Behan to investigate upgrades to improve the energy performance and comfort of the CB South POA building. Chris reports that the heating system keeps the POA building comfortable, but he would like to save energy and money.

David Houghton and I visited the site on November 30, 2010, for approximately 1.5 hours. The day was sunny and afternoon temperature was approximately 30ºF. We have access to recent electricity bills and building plans were available onsite.

This report describes the building's current condition and provides recommendations for improving its energy and comfort performance. Additional follow-up tasks may include more detailed specifications for upgrades and oversight of the actual installation of upgrades. Bart Laemmel performed a previous audit, which we reviewed

Section 2: Project information

General project information
- Location: Crested Butte South, Colorado
- Elevation: Approximately 8,500'
- Jurisdiction with code authority: Gunnison County
- Building area: 1,336 ft2 of main level (including ~500 ft2 of heated garage) and 833 ft2 of upper level

Occupancy:
- 3 offices with daily 8-5 use on weekdays. The meeting room is used about once per month.

Utility service:
- Electricity: GCEA, approx. $0.11279/kWh plus taxes and availability charges

Section 3: Site observations

General description and building envelope
The building was built in 2003 and is built to then-current Gunnison County Codes. The crawlspace insulation detailing has been improved since construction and some interior walls have been moved.
- Foundation: concrete footer & stem wall, interior foam board insulation, full vapor barrier, mechanically ventilated crawlspace.
- Floor system: 2x construction with R-19 batt insulation (poorly installed).
- Walls: 2x construction with R-21batt insulation.
- Windows: double-pane with blinds. Most windows are slider type, aluminum frames with aluminum tracks.
- Roof: 2x construction with R-38 batt construction.
- Lighting: The majority of the lighting is screw-in compact fluorescent lights. There are some T-12 fluorescent fixtures in the garage with low run hours and incandescent bulbs in the closet and crawlspace.

HVAC system
The main spaces are heated with electric baseboard heaters. An electric unit heater provides heating for the garage and a small plug-in electric heater is located in the garage for spot heating the Zamboni machine.

There is a bathroom exhaust fan and a second exhaust fan operates to remove air from the crawlspace. Otherwise the building is unventilated.

An insulated electric hot water tank provides water heating.

Section 4: Retrofit recommendations

The retrofit recommendations below are divided into two sections. Section I includes changes that can be done now and Section II provides larger scale suggestions.

Section I: Immediate changes

The changes below can be implemented immediately for improved building efficiency.

- **Replace the weather stripping** around all doors and windows. Light was visible through some of the exterior doors and in particular the garage door should be better sealed.
- **Caulk around the meeting room beam ends** to reduce infiltration.
- **Control the crawlspace exhaust fan** with a 20-minute on/40-minute off timer to limit the fan runtime.
- **Improve crawlspace batt insulation installation**. The performance of batt insulation is improved when the insulation is able to take its full shape rather than being scrunched and squeezed into place. Remove and reinstall crawlspace insulation so that it occupies the entire joist cavity.

- **Construct an exhaust duct for the Hotsy water heater** so that the garage door can be shut during operation. We recommend installing an insulated damper at the duct outlet to improve the efficiency of the system and an exhaust fan may be required to pull the exhaust air from the room.
- **Replace the garage lighting** with a T-8 fluorescent fixtures. The T-8 bulbs produce more light, fade less over time and use almost 25% less energy that the installed T-12 bulbs.
- **Rewire the baseboard heaters** with the appropriate thermostats. The building heating zones are mixed up due to the office remodel and this will help to ensure comfort within the building.
- **Install programmable thermostats** with daily and weekly settings to ensure that the heating requirements are reduced over weekends as well as nights.
- **Install a heat or energy recovery ventilator**. The measures already taken to limit the infiltration to the building makes it important to provide adequate ventilation to the building for the health of the occupants. Both heat and energy recovery ventilators will provide fresh air to the occupants without dramatically increasing the utilities. An energy recovery ventilator has the added benefit of retaining moisture within the building, which could help to limit the use of plug in humidifiers.
- **Upgrade window coverings** to improve window insulation value. In residences this can produce condensation on the windows, but this building is drier and should not have condensation issues. Window quilt insulated shades are a cost effective way to improve the window insulation (http://windowquilt.com/).

Section II: Long term upgrades

These changes are larger scale changes that would improve the efficiency of the building and reduce energy costs.

- **Replace the heating system** with an efficient, condensing gas boiler system and staple-up tubing or low temperature radiator system. This system will cost less to operate than the existing heating system.
- **Upgrade windows** to reduce building energy use. Glazing is the biggest component of building energy consumption and heat travels through the path of least resistance. In terms of major building envelope improvements the windows will make the biggest impact on the building energy bills.
- **Upgrade the building envelope** with high-density spray foam insulation. Spray foam has better insulative properties than fiberglass batt insulation and greatly reduces the infiltration of the building.
- **Add a 4 panel solar thermal array.** With the addition of a hydronic heating system a 4 panel solar thermal array can be installed to help offset some of the building heating loads and DHW. A drain back system will be good for this building because it is unnecessary to dump heat from the panels during summer months when heating requirements are low.

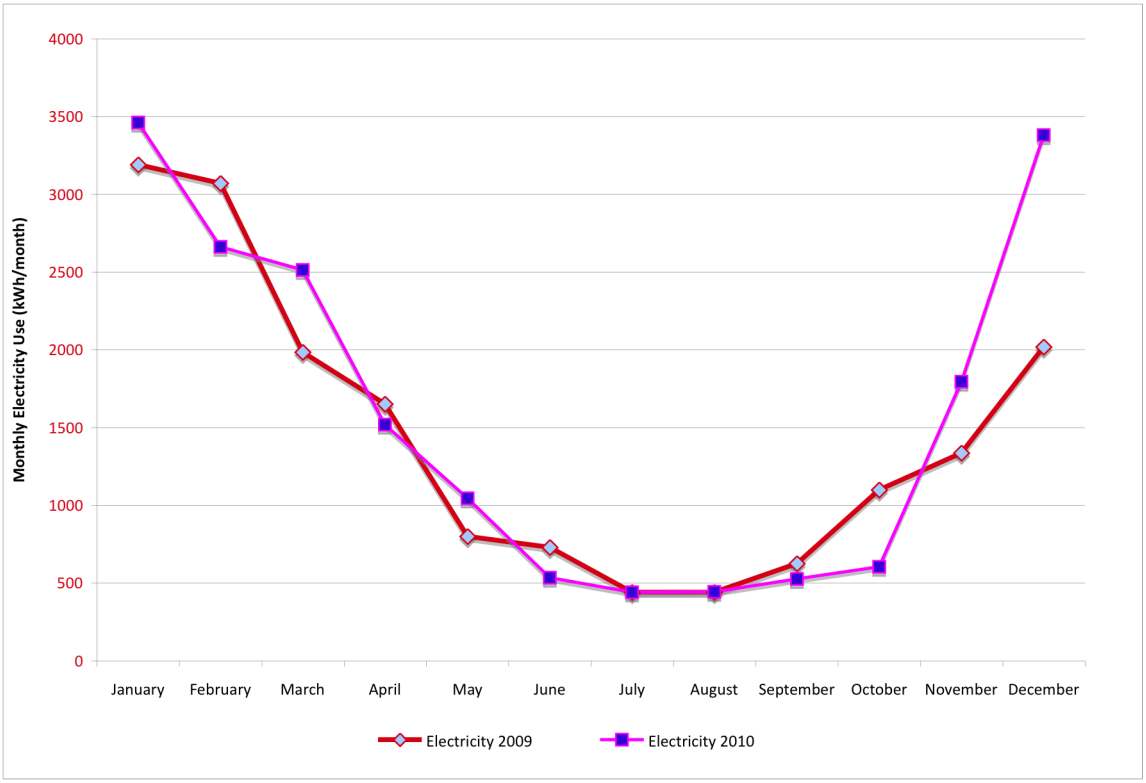
Discussion

We took your electric bill information and entered it into our spreadsheet to generate the following graphs, each explained briefly with a caption below. Finally, the last page shows our estimates of the costs, savings, and simple payback for the recommendations in this report.

The descriptions of the proposed upgrades are brief and intended to point you in a direction that you could follow with a contractor or plumber. Our firm also provides complete engineering for heating systems and we can help as you move forward, either by designing the system or by reviewing what you and your plumber propose to install.

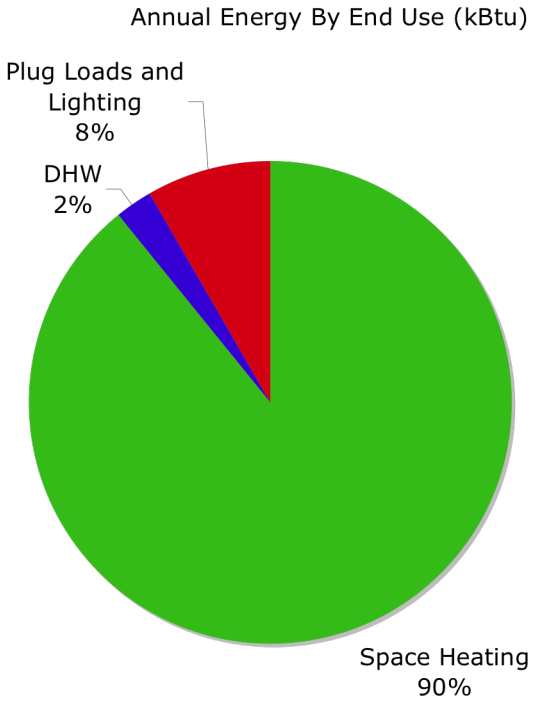
Thanks for the opportunity to audit your building and please contact us if we can be of further assistance.

Appendix A: 2009-2010 Electricity use graphs



This graph is a time series showing electricity use for 2009 and 2010

Appendix B: Building energy use



This graph shows where the building energy is being used.

Appendix C: Retrofit calculation worksheet

Retrofit Calculation Worksheet
CB South POA
Crested Butte, Colorado
Resource Engineering Group, Inc.
December 10, 2010

Electric demand rate	$0.00	$/kW
Electric energy rate	$0.11279	$/kWh
Annual electricity cost	$2,217	
Annual electricity consumption	18152	kWh
Natural gas rate	$1.23	$/CCF

				Base		Retrofit				
#	Immediate changes	Notes	Fuel type (gas/elec)	elec. Energy (kWh)	gas Energy (CCF)	elec. Energy (kWh)	gas Energy (CCF)	Cost savings $	Retrofit cost $	Payback Years
1	Weather stripping at doors/windows	1	Electric	18152	0	17607	0	$61	$100	1.6
2	Caulk beam ends	2	Electric	17607	0	17590	0	$2	$10	5.0
3	Crawl exhaust fan controls	3	Electric	17590	0	17537	0	$6	$40	6.7
4	Hotsy exhaust duct	4	Electric	17537	0	17186	0	$40	$500	12.6
5	Garage lighting	5	Electric	17186	0	16980	0	$23	$200	8.6
6	Programmable thermostats	6	Electric	16980	0	16810	0	$19	$200	10.4
7	Heat/energy recovery ventilator	7	Electric	16810	0	16810	0	$0	$1,500	-
8	Window coverings	8	Electric	16810	0	15970	0	$95	$1,500	15.8
	Long term upgrades									
9	Convert heating system to natural gas	9	Gas/Electric	15970	0	3992	592.27	$622	$20,000	32.1
10	Upgrade windows	10	Gas/Electric	3992	592.27	3992	574.50	$22	$10,000	457.6
11	Upgrade building envelope	11	Gas/Electric	3992	574.50	3992	557.27	$21	$10,000	471.7
12	Install 4 panel solar thermal array	12	Gas/Electric	3992	557.27	3992	411.27	$180	$10,000	55.7
						Totals		$1,091	$54,050	
						% reduction		49.22%		

Notes and Assumptions

1 Assumption: 3% reduction in heating energy
2 Assumption: 0.1% reduction in heating energy
3 Assumption: 0.3% reduction in electrical energy
4 Assumption: 2% reduction in heating energy
5 Assumption: 1.2% reduction in lighting energy
6 Assumption: 1% reduction in heating energy
7 Assumption: Improved air quality and no change in heating energy
8 Assumption: 5% reduction in heating energy
9 Assumption: shifts heating bills from electric to gas
10 Assumption: 3% reduction in heating energy
11 Assumption: 3% reduction in heating energy
12 Assumption: 4 4x10 panels, 25kbtu/panel-day, 40% utilization