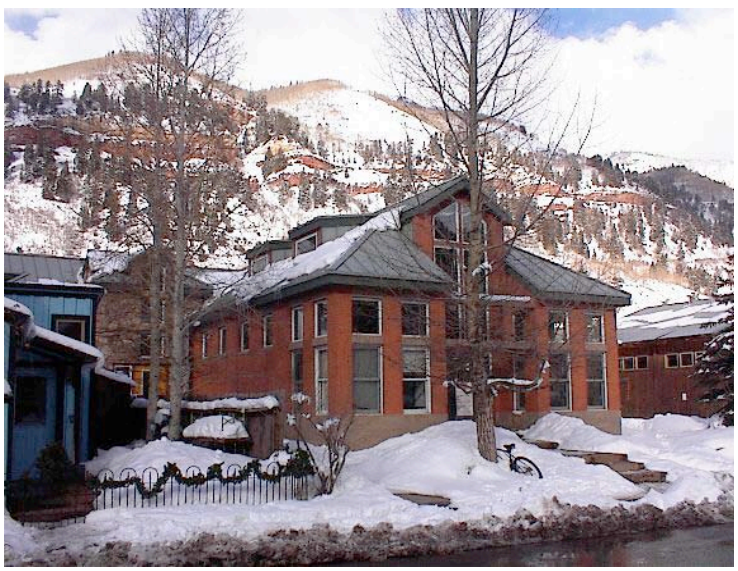
Town of Telluride

Energy and Cost Savings Report:

Municipal buildings and facilities

Final report

Prepared for Telluride Town Council



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11 June 2003

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Notes:

Table of contents

1. Executive summary
2. Scope and goals
3. Summary of existing conditions and retrofit recommendations
4. Summary of costs and savings
5. Energy management plan
6. Appendix A: Existing conditions in the Town of Telluride's buildings and facilities, and energy-saving retrofit measures (details)
7. Appendix B: Computers, other office equipment, and miscellaneous plug loads
8. Appendix C: References
9. Appendix D: Selected spreadsheets and tables

Section 1: Executive summary

An audit of the Town of Telluride's buildings and facilities has revealed rapidly increasing energy costs as well as numerous ways to dramatically cut future energy consumption, energy expenditures, and emissions of climate-altering greenhouse gases. In this preliminary analysis we have identified and described several dozen measures that indicate aggregate energy savings opportunities totaling 33 percent of current energy costs, primarily by saving electricity. Most of the savings are in the Town's wastewater treatment plant, in line with that facility's large share of total energy expenditures. Overall, the Town spent $233,535 for electricity and natural gas to heat and power its buildings, facilities, street lights, and miscellaneous equipment. We estimate that a coordinated, well-designed effort to maximize savings while minimizing costs can cut energy expenses by nearly $75,000 per year. The net present value of the "efficiency path" versus business-as-usual is significant; in one scenario to 2016 the 14-year cumulative differential is $1.1 million. Achieving this aggressive level of savings means a lot of hard but very worthwhile work. This report is a first blueprint of how to meet the objective set by the Town in January 2004: "the ultimate goal … is to realize a 25% reduction in energy use and costs." We have assessed existing buildings only, and have not considered the impacts and opportunities of consolidating the Town's administrative buildings, expanding the demands on existing buildings, or adding facilities such as the under-construction Ice Pavilion.

Section 2: Scope and goals

At the request of the Town of Telluride Council, David Houghton and August Hasz of Resource Engineering Group (REG) and Richard Heede of Climate Mitigation Services (CMS) performed an on-site energy audit of seven of the Town's principal buildings and facilities on March 11-12, 2004. We also compiled energy use data from the electricity and natural gas utilities (San Miguel Power Association and Kinder Morgan). In the audit, we evaluated each building's heating and ventilation system, water heating, lighting, insulation and windows, major plug loads, and, in the case of the Town's wastewater treatment plant, its motors, compressors, and related equipment. The project's objective is to recommend a series of practical and cost-effective energy upgrades and energy management initiatives that will reduce the Town's rapidly growing expenses for energy services while improving the performance of the Town's buildings. Saving energy also decreases the Town's direct and indirect emissions of greenhouse gases.

This is a relatively brief scoping-level study. Detailed retrofit design and specifications may later be performed for high-priority measures identified in this report. Further assessment of energy-saving opportunities and the work of implementing the measures discussed in this report will likely identify additional ways to save energy and money. We have attempted to prioritize the dozens of retrofit opportunities into a cost-effective and comprehensive scheme to minimize total retrofit cost and maximize total savings. We have categorized dozens of identified measures into segments based on cost-effectiveness and payback periods (which is the estimated retrofit cost divided by the expected annual energy cost savings), and use payback periods of less than three years, between three and six years, and greater than six years. The intention in this document is to provide a roadmap to those actions that the Town Council or staff can pursue that will lead to substantial energy savings.

Evaluation of Telluride's use of transportation fuels is not in the scope of this study. However, we know that the Town consumed ~42,000 gallons of transportation fuels at a cost of ~$54,000 in 2003 (this is likely to increase substantially). Fifty-five percent of that cost is for diesel fuel for trucks, plows, and mass transit vehicles, with the remaining 45 percent going to gasoline for patrol cars and other light-duty vehicles. One of the Town's buses is already running on bio-diesel (an alternative fuel typically derived from soy), and the Public Works Department is pursuing a grant from the U.S. Department of Energy to help fund the storage of bio-diesel fuel. Transportation fuel is a good topic for further study and possible additional energy cost savings.

The Town's emerging plans for consolidation are not specifically considered in this report, except to assume that major building renovation is unlikely until Council has decided whether to shift to a new building or stay in its existing buildings.

Section 3: Summary of existing conditions & retrofit recommendations

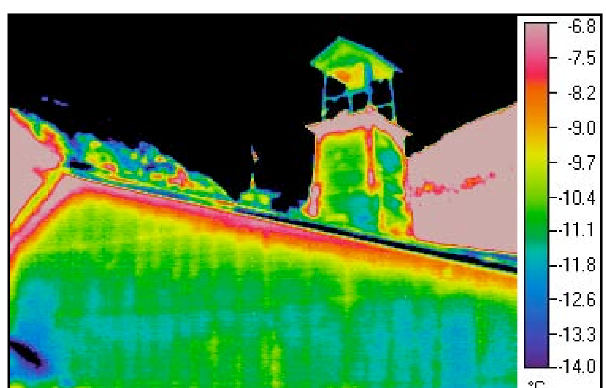
The Town's annual energy bill totaled nearly $234,000 in 2003—a 9.3 percent average annual increase over the last two years. Of this amount, three-quarters is for electricity and one-quarter is for natural gas. Electricity rates now average 9.8 cents per kilowatt-hour (kWh) at in-town buildings (excluding the wastewater treatment plant and such facilities as the bike underpass and street lighting), and gas prices are relatively low at ~$6.00 per million Btu with increases anticipated for the coming years. Direct and indirect emissions of carbon dioxide totaled 3,086 tons in 2003, increasing at a rate of 8.4 percent per year (this excludes fuel consumption by the Town's vehicle fleets, which adds 580 tons of CO_2 in 2003).

Building energy evaluations often use a handy value called Energy Use Intensity, or EUI, in units of energy or dollars per square foot per year. The Town's six principal buildings—Town Hall, Rebekah Hall, Marshal's, Parks & Recreation, old Wilkinson Library, and Public Works[1]—have a collective floor area of 31,246 sq.ft. These buildings have an average EUI of $1.32 per sq.ft.-yr for lights, equipment, water heating , and heating, ventilation, and air conditioning (HVAC). The EUI ranges from a low of $0.97/sq.ft.-yr (Rebekah Hall), to a high of $1.98/sq.ft.-yr (Marshal's). Nationwide, EUIs for office spaces tend to be in the $1-2 range, so Telluride's energy costs are not out of the norm, although residential buildings (which Telluride's offices resemble in design and equipment) average $0.63/sq.ft.-yr.

	Telluride Energy Costs & Carbon Emissions			
	Gas	Electricity	Total	Carbon emissions
	$/yr	$/yr	$/yr	CO2 (tons)
Total 2001	$ 55,222	$ 134,701	$ 189,924	2,565
Total 2002	$ 52,907	$ 158,687	$ 211,594	2,938
Total 2003	$ 59,507	$ 174,027	$ 233,535	3,086
Ave % change	3.60	11.30	9.34	8.44

Building shell, windows, and doors: In general, each building has variable insulation: most have no insulation in some places, whereas other areas are adequately insulated. For example, Town Hall has no crawlspace insulation but blown-in attic insulation. The windows are predominantly single- or double-pane, tend to be fairly leaky, and none appear to have low-E coatings or gas fills between panes. Many doors and garage doors are poorly weatherized and leaky. Many of the building shell measures recommended in this report for energy savings will also improve comfort and productivity and reduce staff complaints related to heat and cold.

Building envelope retrofit measures present a challenge. In older buildings, they cause most of the heat loss, but upgrades to improve the insulation of windows and walls are notoriously costly and with long paybacks. Roof/attic systems are easier to retrofit, but all the attics we visited are already adequately insulated. Basic weatherization measures will greatly reduce cold-air infiltration and energy losses. Nearly all access doors and garage doors need basic maintenance, and many windows as well. Crawlspaces are easier to insulate, and we found some that had not had this measure installed.



Infrared image of Town Hall.

[1] Thus excluding the wastewater treatment plant, water supply facilities, Nordic Center, warming hut, showers and restroom facilities, and the under-construction Ice Rink Pavilion.

We included some envelope upgrade measures in the Appendix B calculations to show their relative cost and savings. Some of these measures may pay back more than just in energy savings, by improving comfort or preventing system damage. For example, in the Marshal's building, poor insulation (and the unfortunate placement of a water line) has caused a pipe to freeze on three occasions.

An important non-energy envelope measure is checking for radon gas in crawlspaces and offices. None of the buildings we audited had any radon mitigation measures, and many had crawlspace furnaces and ducts that can distribute radon throughout the building. If high radon levels are found (the EPA "Action Level" is 4 pC/l), steps should be taken to prevent occupants from breathing the radioactive gas, which is a long-term lung cancer hazard second only to smoking.

Heating and ventilation equipment: We found a wide variety of HVAC equipment, ranging from radiant gas heaters in the Public Works Building to an under-floor hydronic boiler system at the Nordic Center. We also found some relatively modern furnaces and boilers that were apparently retrofitted within the last several years. In particular, the new Lennox units in Rebekah Hall are highly efficient, and cannot be improved on. Its location can be improved, however: Rebekah Hall's crawlspace is completely un-insulated (as are the heating ducts, the water heater tank, and hot water pipes).

Although many of the buildings' HVAC systems are not optimal for their function, we did not find any grossly inappropriate applications. The main opportunities for savings are in upgrading 80-percent efficient furnaces and boilers to modern equipment in the 90–95 percent efficiency range. In many cases the older units are near the end of their service life. There are also opportunities for rebalancing air-flows to improve comfort and energy performance.

Since most of the Town's buildings are low-mass structures with fast-reacting heating systems, setback thermostats can be put to good use in many locations. These devices automatically turn the heating set-point down in the evening to reduce heat losses, then bring temperatures back up in time for the occupied part of the day.

Water heating: Use of hot water is minimal in all Town buildings except the Showerhouse, which also contains the pool heaters. Even with low hot water demand there are good measures to reduce water heating energy consumption, particularly by reducing the energy losses from hot water storage tanks and pipes. Measures include adding insulating water heater jackets to all electric storage tanks, insulating all hot water pipes where accessible, and replacing Town Hall's electric unit with a small gas-fired unit.

Lighting: The Town's buildings offer many opportunities for improved lighting. The vast majority of office areas are lit by 1980's vintage fluorescent technology: the ubiquitous four-foot T12 lamp. Upgrading these to new-generation T8 fluorescents is a classic and proven energy saver. In addition to higher efficiency, T8s have better quality light, no flicker, faster starting, dimming capability (if desired), longer lifetimes, and better lumen maintenance.

There are two ways to accomplish the retrofit: a ballast-and-lamp change-out, in which the fixture is kept intact except for the concealed ballast and the lamps, and a fixture replacement, which comes at a higher cost. The typical T12 fixture has four 4-foot lamps powered by two magnetic line-frequency ballasts. The retrofit is to install new 2-lamp electronic high-frequency ballasts and new F32 735 or 835 series lamps. The new lamps fit in the existing tombstone mounts. The new ballasts must be wired by an electrician, but the retrofit is easy. The costs and paybacks in the tables below assume this retrofit.

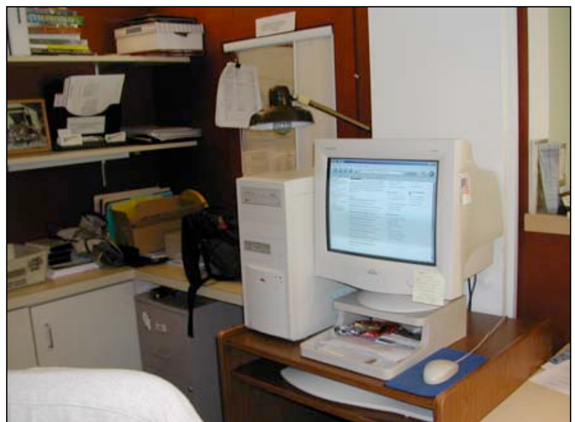
The advantage of a new fixture is that it can be selected specifically for the required task, which may improve visual comfort and reduce glare. Many of the existing T12 fixtures also have poor reflectors and faded, dirty lenses that reduce their efficiency. However, the cost of whole-fixture replacement is about four times higher than the ballast-and-lamp change-out.

We found relatively few incandescent lights—the least efficient of all sources. Notable exceptions are the Marshal's building and the scattered older facilities at the Town Park. These can be retrofitted to screw-in or plug-in compact fluorescents (CFLs) or new fixtures designed for these sources. CFL retrofits are often poorly implemented (for example, we sometimes see CFL tubes sticking an inch or more out of downlight cans), so they need to be thought through.

One easy lighting retrofit is the incandescent EXIT sign. New units operate on light-emitting diodes for a savings of 90 percent or more—especially significant since these lights operate 24/7.

Office equipment and other plug loads: We inventoried 48 computers throughout the Town's offices, connected to 16 printers (mostly networked HP LaserJets). Each building has one or more copiers, servers, and fax machines. Other plug loads include refrigerators, most of which are old and inefficient, and a variety of kitchen loads such as toasters and coffee makers. One notably large plug load is the beverage machine at Public Works, which uses an estimated 3,450 kWh per year (and costs ~$340/yr to run).

We estimate that the Town's office equipment consumed 42,300 kWh in 2003, plus 18,500 kWh for other plug loads such as refrigerators, beverage machines, kitchen widgets, and miscellaneous equipment. Overall, the plug load total of 60,800 kWh is only 2.7 percent of the Town's electric consumption, but is 38.5 percent of electricity consumed in its administrative buildings (Town Hall, Rebekah Hall, Marshal's, Wilkinson, and Parks & Recreation). The remainder is used for lighting, water heating, furnace fans, ventilation, and the like. See Appendix B for details of equipment count, annual per unit electricity consumption, and electricity-saving recommendations.



Rebekah Hall computer, networked to a laser printer.

Reminding staff to turn off equipment during periods of daily inactivity and overnight, gradually replacing old or EnergyStar non-compliant equipment, installing work-station occupancy sensor controls, and purchasing laptops and LCD displays will reduce electricity demand for computers, printers, and copiers. We have not estimated aggregate electricity-savings or overall cost-effectiveness of these measures.

The Town owns 10 refrigerators, mostly residential-sized, and of varying vintages. New refrigerators are so much more energy-efficient that a replacement program is justifiable. For example, replacing the vintage ColdSpot at the Nordic Center with a new $328 GE model of similar size saves about $100 in electricity *annually*, for a simple payback of 3.3 years. Installing a VendingMiser at Public Work's refrigerated beverage vending machine will cut energy use in half (saves 1,725 kWh per year, simple payback of 1 year). The VendingMiser uses an occupancy sensor and software to power down refrigeration and lighting during periods of non-use while measuring ambient conditions and ensuring that product temperatures are maintained.

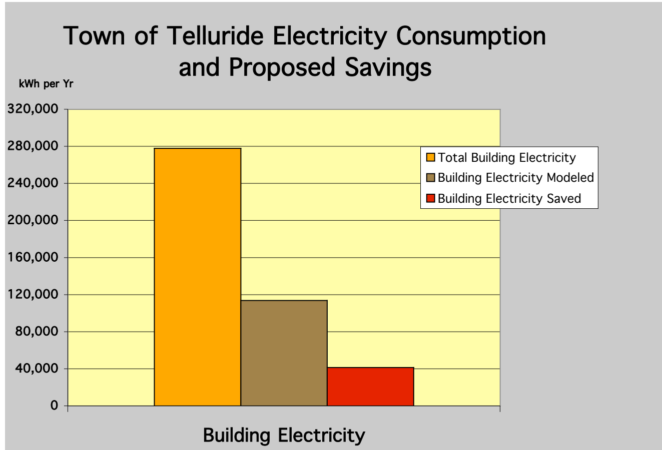
Solar applications: We did not find any passive solar design or active solar collection systems in the Town's buildings. Telluride's canyon location limits the hours per day of direct sun, so the Town's potential is somewhat handicapped compared to locations like Montrose. The Public Works Building captures little winter sun, which is unfortunate, since a solar water heater could help with vehicle washing at that location. Although some buildings are well daylit—Rebekah Hall's upper floor in particular—we did not find any automatic daylighting controls. Our recommendations include active solar water heating systems for the Town Park shower and pool. Of these, the shower heater makes more sense due to its year-around operation. We have not recommended solar electric (photovoltaic, or PV) system installations. Even with today's dramatically reduced panel costs, the payback is extremely long (40+ years). If the Town wants clean, green electricity, it is more cost-effective to purchase windpower blocks from SMPA.

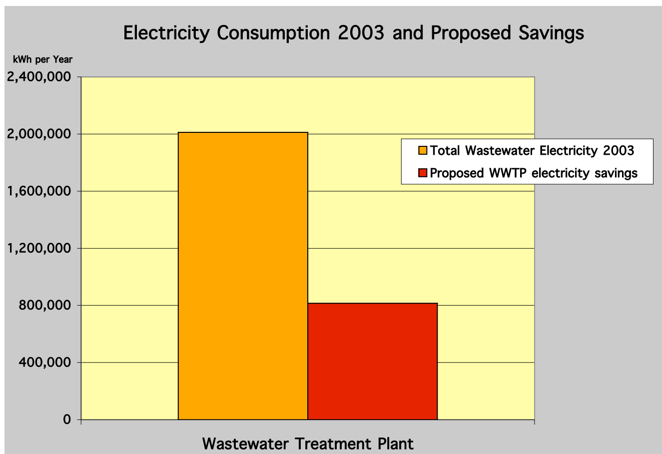
Section 4: Summary of costs and savings

Our analysis suggests that the Town of Telluride can save 23.0 percent of its current energy costs by investing in 40 high-priority electricity- and gas-saving retrofit measures. This would reduce energy bills from the current total of $233,535 by an estimated $53,650 per year, thus reducing costs to $179,885. Two dozen higher-cost but effective measures reduce energy costs by an additional $23,727 (an additional 10.2 percent savings). Retrofit costs to achieve these savings total an estimated $14,000 for building measures with payback periods of less than six years (average of 3.2 years), plus retrofit costs at the wastewater treatment plant totaling $233,000 with average payback of 4.7 years. While retrofit costs are high, they stretch over several years, and are dwarfed by *cumulative net savings*, which is estimated to reach $297,000 in 2011 and exceed $1 million in 2016 (see "A Future Scenario," below). Our analysis assumes today's energy prices without escalation (a significant conservatism); any increases in prices will increase dollar savings and reduce payback periods. Building-by-building details are discussed in Appendix A.

All Buildings Summary

Measure	Base energy (kWh or therm)	Retrofit energy (kWh or therm)	Energy savings (kWh or therm)	Cost savings ($)	Retrofit cost ($)	Payback (Years)
Electric savings payback < 3.0 yrs	61,179	46,755	16,255	$1,351	$2,723	2.02
Elec savings payback 3.0 - 6.0 yrs	39,235	21,704	17,531	$1,718	$7,429	4.32
Elec savings payback > 6.0 yrs	13,390	5,635	7,755	$764	$5,300	6.94
Total electricity-saving measures	113,804	74,094	41,540	$3,832	$15,452	4.03
Gas savings payback < 3.0 yrs	12,277	11,051	1,226	$737	$1,200	1.63
Gas savings payback 3.0 - 6.0 yrs	8,271	7,362	909	$615	$2,700	4.39
Gas savings payback > 6.0 yrs	35,386	30,529	4,857	$2,955	$59,301	20.07
Total gas-saving measures	55,934	48,942	6,992	$4,307	$63,201	14.67
Elec + Gas savings payback< 3.0 yrs	na	na	na	$2,087	$3,923	1.88
Elec + Gas savings payback 3-6 yrs	na	na	na	$2,333	$10,129	4.34
Elec + Gas savings payback > 6.0 yrs	na	na	na	$3,719	$64,601	17.37
Total elec + gas-saving measures	na	na	na	$8,140	$78,653	9.66





Section 4: An Energy Management Plan

Policy and operational recommendations

Town Council can set a progressive tone by committing to reduce the Town's energy use over the next several years. In this report we have recommended dozens of measures, most of which are both effective and profitable, with 21 measures having paybacks of three years or less, plus 14 measures with three- to six-year payback periods. It is reasonable to set an achievable target of reducing energy consumption in administrative and other Town buildings by 20 to 25 percent by 2010. (We are not including new facilities—such as the Pavilion or a new administrative complex—in this goal.) We are confident that the Town, given clear commitment by Council and a modest dose of perseverance, can achieve this target.

Council may wish to consider the merits of developing a climate policy and a plan to reduce emissions of greenhouse gases. Such a policy would encompass the goals of the energy plan we've focused on here. We estimate current emissions from the Town's buildings, facilities, and vehicles at 3,850 tons of carbon dioxide per year, and currently rising at 8.4 percent per year.

Council should seek the advice and collaboration of the Town Building Department. Its staff is knowledgeable about best practices, building codes, and policies to improve the energy-intensity of both new and existing buildings. The Department just adopted a Green Points program that promotes best-design and construction practices that funnel their net savings to residents and businesses. Education of architects, builders, and homeowners can help improve typical practice.

Continued Council communication with San Miguel County Commissioners and the School Board can expand the Town's influence to other local entities that also face rapidly rising costs.

Council can help educate the community to its much larger opportunities to save energy, money, and CO_2 emissions. Exercising leadership in its own operations is a good first step, but in the long run others must follow. For example, the ski company probably has many opportunities for improved energy and environmental performance. Numerous opportunities exist to promote linkages between economic welfare, sustainable practices, and an enhanced image for Telluride.

Council may consider asking the Town Attorney to convene a task force to review its contracts with San Miguel Power Association and Kinder Morgan, its natural gas supplier. SMPA provides reliable electricity at reasonable but rising costs. Specific areas to review include the rate classes its various buildings and facilities are charged, and the trade-offs between lower kilowatt-hour (kWh) rates *vs* higher demand (kW) charges. Natural gas rates appear to be favorable, but we are not privy to the existing contract's clauses, and a review may reveal ways to reduce future costs.

Energy retrofit strategies

The Town needs to budget for the building upgrades that will produce the energy and performance savings discussed in Appendix A. One possibility is to budget an amount equal to the Town's annual energy cost increase, which has averaged $21,800 over the past three years. This might be split up by spending one-third of the money in the high-priority measures in administrative and related buildings & facilities, and two-thirds at the wastewater treatment plant.

Additional funding can be secured by (a) dovetailing energy investments with planned building upgrades and equipment replacement, or at the very least ensuring that such upgrades are made with efficiency designed in, and (b) tagging capital funds toward efficiency, such as capital investment funds already budgeted to the wastewater treatment plant and Public Works. Many of the measures can be done without much further design work: most of the lighting retrofits, furnace upgrades, weatherization, setback thermostats, and so on. Other measures, including most of the work at the wastewater treatment plant, should be verified by further analysis. While we have tried to be as accurate as possible with our projections of energy savings and installation costs, this report is really only the beginning of what should become an ongoing process of making the Town's facilities as efficient as possible.

Regardless of whether retrofits are undertaken in the near future or after a comprehensive energy-savings plan is completed, the emphasis should first be on the no-cost and low-cost measures. While these are frequently not the largest energy-reduction measures, they are often the simplest "no regrets" measures that will get the process moving, gaining experience for Town staff.

Retrofit measures may best be bundled by category or trade. Lighting retrofits, for example, are best done comprehensively. One local lighting contractor is EnLighten, Ltd, 970-728-0500.

Council should consider hiring a building and facilities manager to oversee energy retrofits, strategies, and policies. This could be a part-time contract position, since savings on energy expenditures could not "pay" for a full-time position until 2008, according to our model.

Council should direct staff to contract a weatherization specialist to do a blower-door test of selected buildings, (Town Hall, Rebekah Hall, Parks & Recreation Office, and Marshal's), then contract for follow-up weatherization services guided by our weatherization, draft-proofing, and insulation recommendations. One such service provider is Veritas Energy Efficiency, Norwood, CO (970-327-4995).

Council may wish to nominate or assign an energy champion on staff, or seek a volunteer from Council to oversee the implementation process.

Council should discuss with Bill Goldsworthy, the Wastewater Treatment Plant supervisor, the possibility of allocating a proportion of the plant's capital fund to efficiency investments. Mr. Goldsworthy is extremely knowledgeable, interested in improving the plant's energy performance and reducing future costs, and can provide Council with his assessment of this report's strengths and weaknesses.

The Town Council may also wish to invite a representative of San Miguel Power Association to discuss options for mutually beneficial collaboration on electric efficiency issues. This includes cooperation on technical issues, a review of this report's energy efficiency recommendations, technical assistance, and advice on "green power" contracts. At this time, SMPA does not offer financial incentives for energy efficiency upgrades. SMPA's Key Account Manager is Allen Culver (970-626-5549, aculver@smpa.com) and he has indicated a strong interest in working with the Town.

New building design

Consolidating the Town staff into one or two new buildings would very likely reduce overall energy consumption. Design of a new building offers energy efficiency opportunities that are impossible in retrofits. A highly efficient, well-designed building would most likely be cheaper to own and operate than the current scattering of older buildings, as well as provide higher staff comfort and productivity.

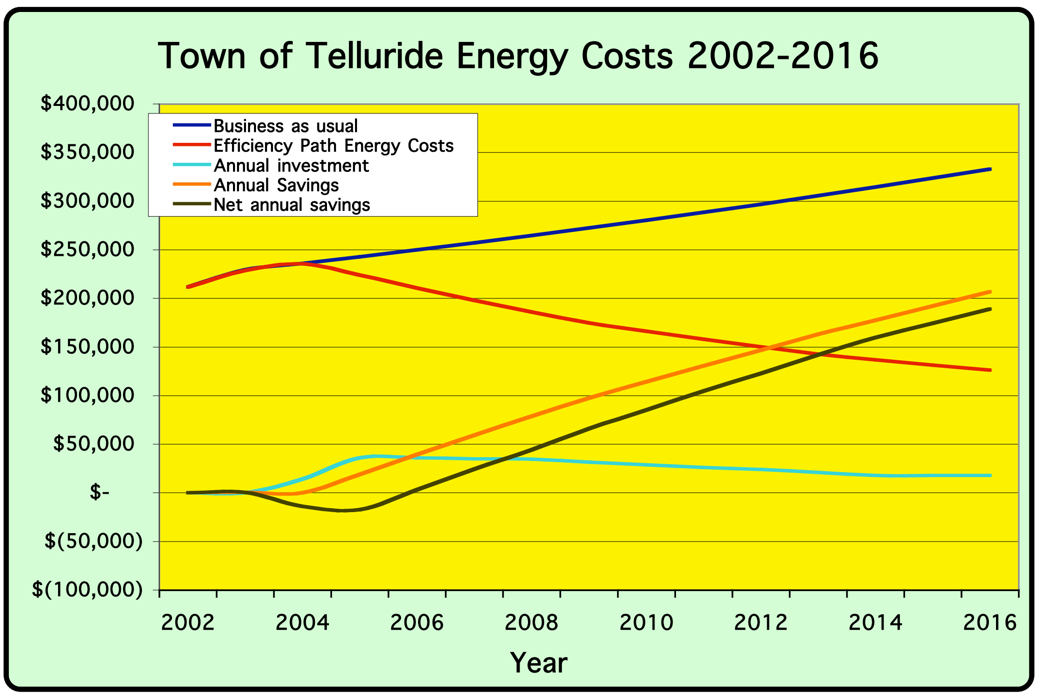
Renewable energy

The final energy savings plan should re-evaluate the feasibility and cost-effectiveness of a solar thermal water heating system at the Town Pool. Its $4,700 annual gas cost can be significantly reduced. Our preliminary estimate shows a system with a small reduction in natural gas consumption at a high cost and long payback. Installing photovoltaics (solar electric panels) on Town buildings is not a cost-effective way to reduce purchased electricity, nor a high-priority way to "green" the Town's electricity supply.

Instead we recommend purchasing renewable energy through SMPA to offset a fraction of the Town's carbon dioxide emissions (note: this reduces emissions, not costs). We recommend buying offsets to cover one new Town building each year. If Town Hall is selected first, the additional cost is $562 per year (marginal 3.5 cents per kWh x 16,047 kWh last year), and will reduce carbon emissions by ~16 tons of CO_2 per year. SMPA also has a small program supporting investments in *local* small hydro and other renewable electricity supply options, and Council should consider the merits of facilitating the implementation of such sustainable energy technologies in or near Telluride. The Town of Crested Butte recently contracted with its local utility for 100% wind power for its electricity at its own buildings. The City of Aspen and the Aspen Skiing Company have made similar albeit smaller commitments.

A future scenario exercise

Investing in energy savings is highly profitable, and an effective program promises to benefit the Town's budget. The chart below shows the results of one scenario exercise that dramatically reduces future energy bills, cuts emissions of carbon dioxide, and pays back energy efficiency investments with positive cash flow starting in 2007. Future "business-as-usual" costs assume real annual increases of three percent per annum, which is conservative compared to the last three years' of observed billing data. We have not simulated the Town's energy savings from consolidating its administrative buildings or costs from new facilities and expansions.



One possible energy scenario. Rick Heede, Climate Mitigation Services, April 2004.

Financing the Energy Efficiency Path

We have not investigated municipal financing options, or the availability of Federal or state grants to aid Telluride's energy-saving and climate mitigation options. We will by happy to do so at the direction of Council.[2]

[2] Some energy consulting firms may be interested in financing the most profitable of the measures we have identified (and possibly leave others unfinanced). Such firms may offer to be paid out of future savings—therefore called "shared savings contracts"—which means that the Town need not raise its own funds, nor operate its own energy-efficiency programs. We caution, however, that many of these programs are based on "cream-skimming" and thus leave many worthy investments and savings undone.

Appendix A

Existing conditions in Town of Telluride's buildings and facilities & energy-saving retrofit measures

Wastewater Treatment Plant

Existing Conditions

Building description: The Town's Wastewater Treatment Plant is a modern facility located west of Telluride next to the San Miguel River near Lawson Hill. The plant's consumption of natural gas and electricity dominates the Town's energy expenses, accounting for 77 percent of total electricity expenditure in 2003 (and 80 percent of kWh consumption). The plant's expenditure for natural gas was 49 percent of the Town's total in 2002. The facility operates 24/7, but is typically staffed from 7 am to 5 pm. The facility also houses the Town Animal Shelter.

Shell: While the shell is poorly insulated, the major contributor to the heating load is the high ventilation rate required for building operations.

- Walls: 8" nominal un-insulated concrete masonry unit walls (CMU's, commonly known as cinder blocks). In the headworks, the space is only heated to 50°F.
- Roof: steel with 6 inches of rigid foam insulation board (above which is a rubber membrane and ~2 ft of dirt for visual amelioration of the plant's large roof).
- Windows: aluminum-frame double-pane fixed windows over operable awning-type windows for ventilation; indeed, many windows were observed to be cracked open about one-half inch for perpetual ventilation. Windows are probably not low-E, and without thermal break. Estimated performance: approximately U = 0.70.

Heating and ventilation and water heating systems:

- All indoor treatment spaces operate with some amount of continuous ventilation (outside air exchange). Headworks, office & lab space and digester have Heat Recovery Ventilators (HRV). The three clarifier rooms do not. We were not able to verify flow amounts, but believe that ventilation rates are approximately 0-2 ACH in office areas, 8 ACH in clarifier, and 12 ACH in the headworks.
- Heat is supplied by two 81% efficient 1 million Btu/hr boilers that feed hot water coils in the air handlers. DHW is supplied by a large (84 gallons, 180 kBtu) 80% (assumed) efficient natural draft hot water heater.

- Lift station at river has rooftop HVAC to control humidity and flammable gases (primarily methane).

Major energy consuming process equipment:

- Pump house lift station: four 20 hp pumps, lead pump is controlled by a variable frequency drive (VFD), with other pumps staged.
- Headworks: four 20 hp pumps (same as the lift station pumps) and two 10 hp blowers for aeration of the thickening tanks (both run almost continuously).
- Oxidation Ditches: all three ditches have two 40 hp aeration rotors (six total), ditch #3 also has two mixing rotors operated by 7 hp motors controlled by a single VFD. At the time of the visit the VFD was set at 30% (the VFD is manually adjusted) and only one of the 40 hp rotors was operating.
- Digesters: there are three 100 hp blowers providing aeration and mixing of the three digestion basins. Only 1 blower operates at a time. When the fourth basin is brought online for additional processing capacity, a second blower will be required.

- Clarifiers: each of the three clarifiers has a relatively small (0.75, 0.5, and 0.5 HP) motor operating the rotary scraper.
- Wasting pumps: 2 pumps, VFD, unknown HP, operated as necessary to waste sludge (average 45,000 gallons per day).
- UV treatment: 32 lamps always on, 55W per lamp max. Ramps relative to gpm (gallons per minute) output of plant.

Lighting is predominantly supplied by T-12 fluorescents and high-pressure sodium (HPS) lighting. The HPS safety/security lights operate constantly—they can only be switched off at the breaker, apparently due to OSHA regulations.

Plug loads in this facility are minimal compared to the motor loads. We did not inventory the chemical analysis equipment (for example, their muffle furnace is used approx 2 hrs 3 days/week and heats to 500ºF) but all the lab equipment is run off a single 20 amp breaker.

Office equipment: One copier (Ricoh 1018), one HP Laser Jet 4000, three desktop computers + one laptop (all due for upgrade). No beverage machine.

SMPA contract: the San Miguel Power Association supplies electricity to the WWTP at $0.045/kWh, plus $12.50/kW monthly demand charge. The plant also has an arrangement with Tri-State, via SMPA, that if Tri-State dispatches the plant's 1000 kW diesel-powered generator—as happened in March 2004 during the blackout caused by an avalanche near Ophir—that month's demand charges are waived.

Retrofit Measures

While the building shell is inefficient (un-insulated CMU walls, metal-frame non-low-e windows), high cost and low savings relative to plant operations argue against and envelope retrofit. Another consideration is that HVAC loads are dominated by ventilation rates rather than shell losses.

Recommendations:

1. Optimize pumps at lift station and headworks. Although we believe there are energy savings possibilities at these pumps, plant superintendent Bill Goldsworthy believes that EPA regulations and reliability considerations for these critical pumps preclude replacement or other changes at this time.
2. Add mixing rotors in oxidation ditch #2. This would allow one of the two 40 hp rotors to be shut off most of the time.
3. Add mixing rotors in oxidation ditch #1. This would require evaluating the structural implications of cutting a hole in the roof of the ditch structure. This will cost more than adding the rotors to ditch #2.
4. Add mixers in three digestion basins. Currently a single 100 hp blower provides mixing and aeration for three digestion basins. Roughly 50+% of this energy mixes the fluid rather than providing oxygen for aerobic reaction, which is the usual reason for having these blowers. According to plant superintendent Bill Goldsworthy, the mixing could be achieved with a single 2 to 5 hp mixer in each basin. The blower could then be controlled by a VFD set to maintain dissolved oxygen (DO) content. This would create substantial savings in blower energy—probably the largest single savings for any retrofit at the plant or in the town facilities.
5. Add mixers in all four digestion basins. A fourth digester, currently unused, is ready to operate as the town's population and wastewater load increases. When that unit is brought on line, the energy penalty for mixing with the blowers will increase significantly, as a second 100-hp blower will have to be operated continuously.
6. Replace existing T12 (and some T10) fluorescent fixtures with T8 or T5.
7. Replace HPS lighting with T8 or T5, and control unoccupied areas with sensors if required by OSHA. These high-power lights are currently operating continuously, usually in unoccupied rooms.
8. Replace the two boilers with high efficiency (90+%) condensing, modulating boilers, and replace the domestic hot water heater with a sidearm unit fed by the boilers.
9. Verify ventilation rates for clarifier rooms and reduce if possible. According to NFPA 820, which governs the design conditions for these spaces, secondary clarifiers are "not classified" and may be ventilated for normal occupancy—on the order of 6 air changes per hour (ACH). We believe existing ventilation rates are 8 ACH or higher.
10. Add a heat-recovery ventilator unit to pre-heat the clarifier supply air with the exhaust air.

Wastewater Treatment Plant

#	Measure	Base energy (kWh or therm)	Retrofit energy (kWh or therm)	Energy savings (kWh or therm)	Cost savings ($)	Retrofit cost ($)	Payback (Years)
1	Evaluate/retrofit lift station pumps (EL)	—	—	—	—	—	—
2	Add mixing rotors in Ox-Ditch #2 (EL)	522,797	284,271	238,526	$ 15,886	$ 90,000	5.67
3	Add mixing rotors in Ox-Ditch #1 (EL)	345,046	187,619	157,427	$ 10,485	$ 120,000	11.45
4	Add mixing rotors in 3 digesters (EL)	653,496	320,371	333,125	$ 22,186	$ 90,000	4.06
5	Add mixing rotors in 4 digesters (EL)	1,306,992	438,053	868,939	$ 57,871	$ 120,000	2.07
6	T12-T8 retrofits (EL)	5,373	3,504	1,869	$ 124	$ 920	7.39
7	Retrofit/control sodium lights (EL)	17,520	400	17,120	$ 1,140	$ 1,000	0.88
8	Boiler upgrade (NG)	38,622	33,584	5,038	$ 2,962	$ 50,000	16.88
9	Instantaneous gas water heater (NG)	2,060	145	1,915	$ 1,126	$ 2,000	1.78
10	Add HRV: clarifier air handler; set to 6 ACH	17,280	2,160	15,120	$ 8,891	$ 50,000	5.62
Sum	Gas savings (measures 8 & 9), therms	40,682	33,729	6,953	$ 4,088	$ 52,000	12.72
Sum	Electric savings (meas. 1-4, 6, 7, 10), kWh	1,561,511	799,404	762,107	$ 58,077	$ 351,920	6.06
Sum	**Total cost, savings($),and payback**	na	na	na	$ 62,165	$ 503,920	8.11

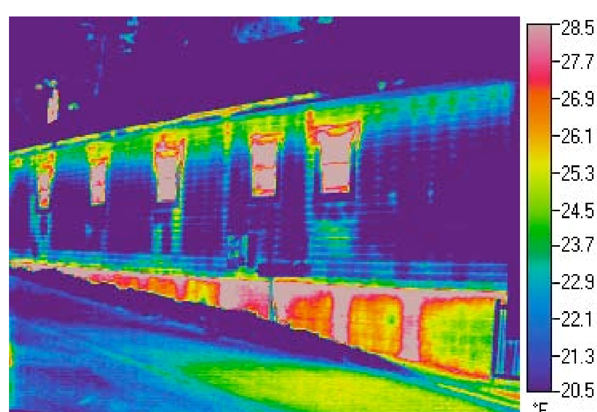
Note: Electricity savings vs total current consumption is shown in a chart in Section 3.

Old Town Hall

Existing Conditions

Building description: Town Hall is an historic 100-year-old wood frame building encompassing 1,686 sq.ft. of office space on one floor and operates on business hours. The building's heating and power consumption totaled $2,553 in 2003, but has relatively high energy-cost-intensity at $1.51 per square foot per year (sq.ft.-yr). See Appendix D for comparative statistics.

Shell: As one might expect of an old mining town building, it is relatively poorly insulated (we did not have access to observe the amount of insulation added to the attic when the roof was replaced a year or two ago). The building sits on a masonry foundation wall, which is not insulated on the interior; nor is the floor above the crawlspace insulated. The 2x6 frame walls are probably insulated to a nominal R-19 (but less effective than R-19 overall, especially if the insulation is old, or has settled). Windows are wood-framed, double-pane, double-hung of below-average performance for Telluride's climate, but weather-stripping prevents excessive infiltration losses. Doors are conventional wood construction, are not insulated, and the front door's glazing is single pane.



Infrared image of Town Hall (W). The warm windows and crawlspace temperatures mean higher heat losses.

Heating and ventilation: A single high-efficiency gas-fired furnace in the crawlspace conditions the entire building. There is concern that the furnace cabinet allows radon gas to infiltrate the conditioned air stream and thus distributed to the occupied areas of the building. (Note: we are in the process of installing a radon detector to sample the crawlspace air, using equipment on loan from the San Miguel County Dept of Environmental Health.) An electric snowmelt system has been retrofitted to the west roof to avoid hazardous ice formation on the west sidewalk.

Town Hall's water heater in a cold, un-insulated crawlspace, with bare copper pipes. Heat loss anyone?

Lighting: Fluorescent surface-mount fixtures with 4xF40/F34 lamps, and occasional incandescent lamps (bathrooms, fire vault). Excellent daylighting in most areas.

Water heating: Rheem electric DHW tank (~35 gallon). Un-insulated pipes in Town Hall's un-insulated crawlspace.

Plug loads: High-volume copier (Ricoh Aficio 1055), 3 HP LaserJets, 1 Fujitsu Duplex, 1 Epson InkJet. 1 facsimile (Ricoh 1900L). 1 postage machine (Pitney Bowes). 10 desktop computers + monitors, 1 IBM document storage server. 1 mini-fridge. Details and recommendations in Appendix B.

Retrofit Measures

A number of simple and cost-effective efficiency measures are available. See the discussion in Section 3:

Recommendations (see calculations in table below):

1. Lighting retrofit.
2. Insulate electric water heater tank and hot water pipes.
3. Insulate and seal heating ducts.
4. Envelope measures: Insulate crawlspace walls to R-10, or insulate floor joists to R-19, weatherize front and rear doors.
5. Ensure that every computer has energy-saving software controls installed and activated, and/or ask staff to turn equipment off every night. Back-up servers cannot be turned off, of course, and all computers are left on one night per week for scheduled file back-up. See Appendix B for general discussion of office equipment efficiency measures.

Additional measures:[3]

6. Measure radon levels in crawlspace and in two of the occupied offices.

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[3] We have noted, for informational purposes, additional measures for which we have not calculated savings and costs. These may be non-energy recommendations, or energy-savings tips that do not have calculable costs.

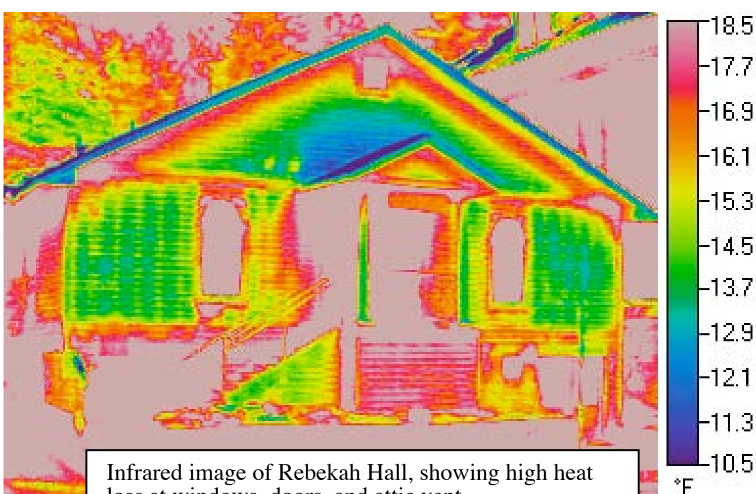
Old Town Hall

#	Measure	Base energy	Retrofit energy	Energy savings	Cost savings	Retrofit cost	Payback
		KWh/therm	KWh/therm	KWh/therm	$	$	Years
1	Lighting retrofit (el)	4,773	2,997	1,776	$ 174	$ 736	4.23
2	Insulate water heater tank and pipes (el)	1,800	1,530	270	$ 26	$ 50	1.89
3	Seal and insulate heating ducts (ng)	1,207	1,026	181	$ 109	$ 200	1.84
4	Insulate crawlspace, tower, Wx doors	1,026	872	154	$ 92	$ 500	5.41
5	Computers and office equipment (el)	8,299	7,469	830	$ 81	$ 200	2.46
Sum	Elec savings (meas. 1, 2, & 5), kWh	14,871	11,995	2,876	$ 282	$ 986	3.50
Sum	Gas savings (measures 3 & 4), therms	2,233	1,898	335	$ 201	$ 700	3.48
Sum	Total cost, savings ($), payback	na	na	na	$ 483	$ 1,686	3.49

Rebekah Hall

Existing Conditions

Building description: This hard-working historic 5,100 sq.ft. building houses town offices upstairs and meeting facilities downstairs, including the Town Council. The building was extensively remodeled in 1996. The upstairs operates on business hours and the downstairs operates according to the schedule of council and other meetings. The building's heating and power consumption totaled $4,964 in 2003, and has average energy-cost-intensity of $0.97 per square foot per year (sq.ft.-yr). See Appendix E for comparative statistics.



Infrared image of Rebekah Hall, showing high heat loss at windows, doors, and attic vent.

Shell: Walls are 2x6 frame, insulated (presumably with R-19 fiberglass batts, but this is uncertain). Roof is also framed, with an attic insulated with 10 to 16 inches of blown-in cellulose insulation. Glazing is wood-framed double-pane double-hung windows of below-average performance for Telluride's climate, and relatively tight against infiltration losses.

Lighting: *Downstairs:* recessed fluorescent troffers, each 4xF40, some delamped to 2 lamps, and downlight cans with 150W incandescent floodlights. Exit signs with 2x20W incandescent lamps. Service areas have incandescents in plain sockets. *Upstairs:* center area fluorescent uplights with 2xF40/F34 lamps, fluorescent under-cabinet lights, and a few incandescent/halogen accent lights. Private offices have surface-mounted wrap-lens fluorescents with 2xF40 lamps. A lone T8 pendant operates in the entry. Much of the upstairs has excellent daylighting, while the down-stairs has almost none.

Heating and ventilation: The main systems are two high-efficiency furnaces with split air conditioning units and outside air intakes. One unit operates for the downstairs and one for the upstairs. Many locations have baseboard or plug-in electric heaters. Occupants on the perimeter reported a lack of heat, while occupants on the interior get too warm.

Water heating: Electric water heater, Day/Night glass tank.

Plug loads: High-volume copier (Ricoh Aficio 1060), 9 HP LaserJets, 1 Fujitsu Duplex, 1 Epson InkJet. 1 facsimile (Sharp FO-4500). 1 large postage machine (Pitney Bowes). 15 desktop computers + monitors, 5 servers and data monitors (primary: MultiTech MultiArray III server). One 10 ft^3 refrigerator (relatively new); coffee maker and food-preparation equipment. Several telephony and communications equipment, email servers, etc. Council chambers and meeting rooms also contain television equipment, projection and presentation equipment, and miscellaneous plug loads (e.g., a mini-fridge, coffee makers).

Retrofit Measures

Recommendations (see calculations in table below):

1. Retrofit lighting. Replace all T12 lamps with T8 lamps. Replace incandescent downlights in council chambers with appropriate CFL downlight. Provide automatic daylighting controls for daylit area in upper floor core zone.
2. Insulate water heater tank and all hot water pipes (where easily accessible) and first 3 feet of cold water inlet pipe.
3. Weatherize all doors and windows to reduce infiltration.
4. Rebalance air systems and provide thermostat/control training for occupants.

Rebekah Hall

#	Measure	Base energy	Retrofit energy	Energy savings	Cost savings	Retrofit cost	Payback
		KWh, therm	KWh, therm	KWh, therm	$	$	Years
1	Lighting retrofit (EL)	15,329	8,152	7,177	$ 703	$ 3,692	5.25
2	Insulate water heater tank and pipes (EL)	1,800	1,620	180	$ 18	$ 50	2.83
3	Weatherize doors and windows (NG)	1,100	1,045	55	$ 33	$ 200	6.05
4	Rebalance interior/exterior zones (NG)	1,045	993	52	$ 31	$ 401	12.77
5	Computers and office equipment (EL)	15,811	14,230	1,581	$ 155	$ 300	1.94
6a	Retrofit water heater to NG (EL)	1,620	-	1,620	$ 159	$ 400	5.83
6b	Retrofit water heater to NG add (NG)	-	150	(150)	$ (90)	$ -	-
6	Retrofit water heater to NG, net savings ($)	-	-	-	$ 69	$ -	-
Sum	Electric savings (meas. 1, 2, 5, 6a), kWh	34,559	24,002	10,558	$ 1,035	$ 4,442	4.29
Sum	Gas savings (meas. 3 & 4, & 6b), therms	2,145	2,188	(43)	(26)	$ 601	(23.39)
Sum	Total cost, savings ($), and payback	na	na	na	$ 1,009	$ 5,043	5.00

5. Ensure that every computer has energy-saving software controls installed and activated, and/or ask staff to turn equipment off every night. Back-up and communication servers cannot be turned off, of course, and all computers are left on one night per week for scheduled file back-up. See Appendix B for general discussion of office equipment efficiency measures.

6. Retrofit electric water heater to natural gas. This will complicate the flue arrangements, and the payback is long since the water use is low.

Additional measures:

7. Thermostat/control training for occupants.
8. Move the MultiTech MultiArray III server off the utility room floor, by at least a couple of inches (it is now sitting on the concrete slab near an exterior wall water leak).

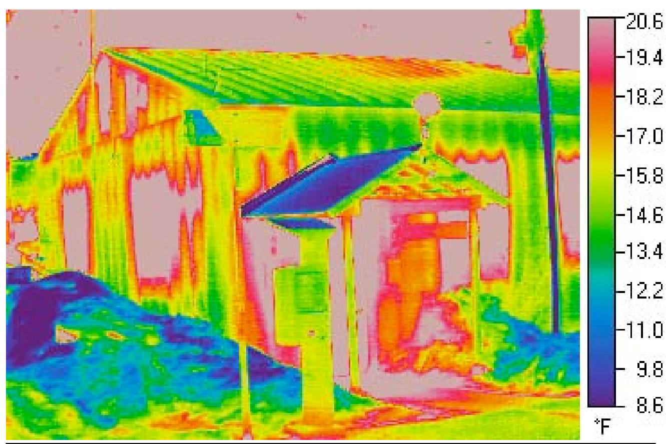
Marshal's Building

Existing Conditions

Building description: This 1,600 sq.ft building is the old SMPA garage structure retrofitted to house the Town Marshal's office. It is in its fourth year as a temporary facility; the Marshal's department will someday move to a new building. Most of the building operates on normal office hours, with after-hours operation as necessary. The building's heating and power consumption totaled $3,240 in 2003, and has a high energy-cost-intensity of $2.02 per square foot per year (sq.ft.-yr). See Appendix E for comparative statistics.

Shell: Walls are 2x4 framing with R-11 fiberglass insulation; the exterior is aluminum clad. Attic has 8-10 inches of blown-in fiberglass insulation. Windows are single-pane with metal frame, and retrofitted with interior storm windows.

Lighting: Pendant downlights, mostly with 100-W incandescent A-lamps. Two lamps have been retrofitted with 30W Circline fluorescent lamps. The retrofit was apparently stopped or undone because of a roof leak that has since been repaired.



Infrared image of Marshal's building showing warm (high heat loss) windows and cold blue snow.

Heating and ventilation: Attic-mounted Lennox furnace with split-system air conditioning. We were unable to get into the attic to get model number and efficiency. This is a single-zone system with one thermostat. The tenants report that in the mornings the east side of the building gets very warm while the west side is cold. A small electric resistance heater is operating in the women's bathroom, positioned to help prevent further pipe freezing, which has happened three times so far.

Water heating: a 5-gallon electric water heater is located in the women's bathroom.

Plug loads: 6 desktop computers + monitors, 1 laptop computer. 1 copier (Ricoh Aficio 1022), Fellowes shredder, 1 Panasonic laser facsimile (KX-FL501). 1 HP LaserJet 4000. 2 servers. Phone chargers and miscellaneous equipment. Details and recommendations in Appendix B.

Retrofit Measures

This building has numerous energy-saving retrofit opportunities, but the uncertain future occupancy by the Marshal's department makes investments in energy upgrades difficult to justify.

Recommendations:

1. Lighting retrofit. Replace 100W incandescent lamps with 30W Circlines.
2. Add water heating insulation blanket and pipe insulation.
3. Weatherize windows and doors.
4. Install a setback thermostat.
5. Exterior edge of concrete slab is exposed and un-insulated. If occupancy appears temporary (2 years), do nothing. Otherwise, add edge insulation.
6. Computers and office equipment savings. See Appendix B and table below for details.

Marshal's building

#	Measure	Base energy	Retrofit energy	Energy savings	Cost savings	Retrofit cost	Payback
		kWh or therm	kWh or therm	kWh or therm	$	$	Years
1	Lighting retrofit (EL)	2,340	772	1,568	$ 154	$ 300	1.95
2	Insulate water heater tank and pipes (EL)	600	540	60	$ 6	$ 50	8.50
3	Weatherize windows and doors (NG)	1,976	1,877	99	$ 59	$ 400	6.74
4	Install a setback thermostat (NG)	1,877	1,768	109	$ 65	$ 50	0.76
5	Exterior slab insulation (NG)	1,768	1,680	88	$ 53	$ 800	15.06
6	Computers and office equipment (EL)	5,623	5,060	562	$ 55	$ 100	1.81
Sum	Electric savings (measures 1, 2, 6), kWh	8,563	6,373	2,190	215	450	2.10
Sum	Gas savings (measures 3, 4, & 5), therms	5,622	5,325	296	178	1,250	7.02
Sum	Total cost, savings ($), and payback	na	na	na	$ 393	$ 1,700	4.33

Public Works building

Existing Conditions

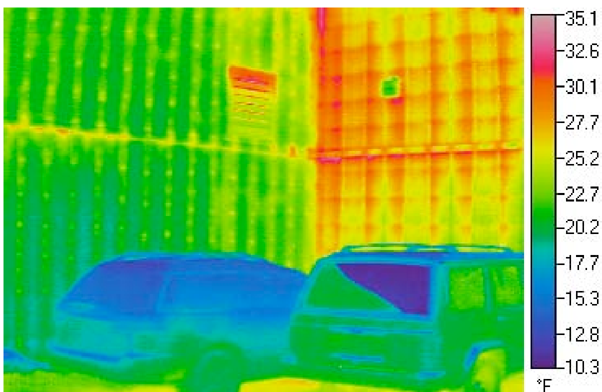
Building description: This collection of attached buildings includes office space, vehicle maintenance bays, and vehicle storage bays. The main building on the west and bus storage tunnel on the south were built in 1988, while the new storage building on the east (with diagonal doors) was added in 1999. The office operates on normal business hours while the storage and work bays are active over a longer part of the day as buses are shuttled in and out of service. The building occupies 12,700 sq.ft., used $21,496 of energy in 2003 (mostly natural gas for heating), and has a high energy intensity of $1.69 per sq.ft-yr.

Shell: Concrete slab floor (probably not insulated under the slab), un-insulated 8" CMU walls with wood exterior (east and north sides only). Windows are primarily fixed double-pane aluminum-framed units, with operable awning windows; tight frames, low air leakage. Roof is framed with web joists and adequate fiberglass batt insulation, although it is sagging in many places, allowing warmed air through the gaps.


Un-insulated south CMU bus barn wall at Public Works.

Lighting: combination of 4-foot T12, many with F34 lamps retrofitted, and metal halide high-bay down-lights, probably 150W. The 1999 garage is lit with metal halides and four-foot T8 fluorescents—some of the only ones we found in town.

Heating and ventilation: The 1988 maintenance garages are heated primarily by gas-fired radiant heaters suspended next to the vehicle bays. Exhaust fans and motorized louvers high in the walls provide ventilation. A single-zone gas-fired furnace provides heating and ventilation to the office areas, controlled by a thermostat in the public works offices. The two offices in the northwest part of the building are heated with electric baseboards, The long 1988 storage tunnel is heated by three gas-fired unit heaters suspended high in the space. A central exhaust fan interlocked with a louvered opening provides ventilation. The 1999 garage also has suspended gas-fired radiant heaters, plus a snowmelt system for the garage entrances.



Infrared image of Public Works, showing adequately and poorly insulated walls (green and red, respectively).

Water heating: 75 gallon AO Smith natural gas water heater.

Plug loads: Beverage machine (Pepsi), which we estimate uses 3,450 kWh per year. 8 desktop computers + monitors. 1 HP LaserJet 2300n, 1 HP DesignJet 430, 1 HP large-format Color InkJet cp1700, 1 Canon i560. 1 copier (Ricoh Aficio 220). 1 facsimile machine. Kenmore 13 cu.ft refrigerator, plus toaster, coffee maker, and 3 microwaves. 1 TV/VCR, and stereo. Details and recommendations in Appendix B.

Other major equipment: 25 kW Kohler Fast Response back-up generator, diesel powered, seldom operated.

Retrofit Measures

The building is very leaky due to the large number of bay doors, some of which have large air gaps, and many of which are opened daily for bringing vehicles in for repair and servicing. While the activity is unavoidable, the bay doors can be fixed and/or weatherized to minimize air gaps and leakage. A number of equipment maintenance or upgrade retrofits are cost-effective.

Recommendations:

1. Lighting upgrades. Convert all T12 fixtures to 4-foot T8s.

2. Replace office furnace unit. Fix filter system.
3. Exhaust fan control. There are six separate exhaust fans in the 1988 garage complex. The carbon monoxide exhaust fans and ventilation fans should be on manual.
4. Replace or control electric resistance heating for two west offices. These are nominally heated by the duct system that serves the eastern offices, but it is a long way in a small duct, so the electric heaters were probably retrofitted to maintain comfort. Replacing with a gas-fired system would be difficult and the savings would be relatively small. Probably the most cost-effective solution is to keep the thermostats down, possibly with setback thermostats.
5. Compressed air control. The compressed air system has a 10-hp compressor and is set at 135psi. The two main opportunities for compressor system savings are pressure setpoint reduction and fixing leaks.
6. Replace or weatherize garage bay doors.
7. Install VendingMiser software control of beverage machine (available from USA Technologies, www.bayviewtech.com/). In the Public Works building, this software will likely reduce electricity consumption by 40 to 60 percent; assuming 50 percent savings and tariff of $0.10 per kWh, annual savings of $173; its $179 cost will be paid back in reduced electricity consumption in 12.4 months.

Image courtesy bayview.com

8. Computers and office equipment measures (see Appendix C and table below for details).
9. Replace furnace filter (this particular filter is exceedingly dirty and ill-fitting). Furnace filters should be inspected and probably replaced on *all* of the Town's furnaces. Cheap, quick, effective, and with rapid payback (savings are only estimated for Public Works).

Public Works Facility

#	Measure	Base energy	Retrofit energy	Energy savings	Cost savings	Retrofit cost	Payback
		kWh or therm	kWh or therm	kWh or therm	$	$	Years
1	Upgrade lighting (EL)	8,619	6,084	2,535	$ 248	$ 1,014	4.08
2	New office furnace unit (NG)	6,250	5,556	694	$ 417	$ 3,000	7.19
3	Exhaust fan control (EL)	-	-	-	$ -	$ -	-
4	Remote office heat control (NG)	-	-	-	$ -	$ -	-
5	Compressed air control (EL)	-	-	-	$ -	$ -	-
6	Garage doors (NG)	1,440	240	1,200	$ 721	$ 30,000	41.59
7	Vending machine control (EL)	3,450	1,725	1,725	$ 169	$ 179	1.06
8	Computers and office equipment (EL)	5,139	4,625	514	$ 50	$ 150	2.98
9	Replace furnace filter (EL)	1,200	1,164	36	$ 4	$ 4	1.13
Sum	Electric savings (meas. 1, 3, 5, 7, 8, 9),kWh	18,408	13,598	4,810	471	1,347	2.86
Sum	Gas savings (measures 2, 4, & 6), therms	7,690	5,795	1,895	1,139	33,000	28.98
Sum	Total cost, savings ($), and payback	na	na	na	$ 1,610	$ 34,347	21.33

Parks and Recreation Office & Parks Garage

Existing Conditions

Parks & Recreation Office building

Building description: This building is a residential-scale single-story framed structure, 1,792 sq.ft in area. The front half is office space and the rear half is garage and work area. It operates on an 8-to-5 schedule. The building occupies 1,770 sq.ft., used $2,266 of energy (mostly natural gas for heating), and has a moderate energy-intensity of $1.23 per sq.ft-yr. (Note: building areas and energy consumption are somewhat uncertain for Parks and Rec buildings due to billing and account inconsistencies, but we think the data is reasonably accurate.)

Shell: Walls are 2x6 framing with batt insulation. Roof is 2x trusses with approximately 10 inches of blown-in cellulose insulation. The attic is vented at each end. There is a single garage door (with a large air gap). Windows are wood-framed double-pane sliders. None of the three doors are weatherized or insulated (the garage door has a large air-gap, as does the garage's rear equipment door). The floor is concrete slab (probably not insulated).

Poorly-fitting garage door at Parks & Recreation.

Lighting: Most lighting fixtures are surface-mounted two-lamp F40 T12 fluorescents, with a few incandescent A-lamps (bathrooms, etc.). The exterior has three shielded down-lights with screw-in compact fluorescents.

Heating and ventilation: A residential Trane XE80 furnace heats the offices and break room. The thermostat is in the middle of the offices; the break room gets more than its share of hot air and was overheated during our visit. The garage is heated by a single Reznor natural gas unit heater, model FT60-H, with powered exhaust.

Water heating: 30-gallon electric A.O. Smith, R-15 insulation (ASHRAE 1980).

Plug loads: 1 copier (Ricoh Aficio 250), 5 desktop computers + monitors, 1 DataStore server, 1 HP color InkJet cp1700, 1 facsimile machine. 2 microwaves, coffee maker, 1 mini-fridge, one 13 cu.ft. White Westinghouse refrigerator. Details and recommendations in Appendix C.

Retrofit Measures

Recommendations:

1. Retrofit T8 lighting.
2. Balance air system: add damper/restrict break room air.

3. Upgrade furnace to 90+ unit
4. Envelope measures: upgrade garage door and back door, weatherization.
5. Install setback thermostat.
6. Replace refrigerator.[4]
7. Computers and office equipment efficiency measures (see Appendix C and table below).
8. Gas water heater to replace electric (long payback, and difficult venting).

Parks & Recreation Office

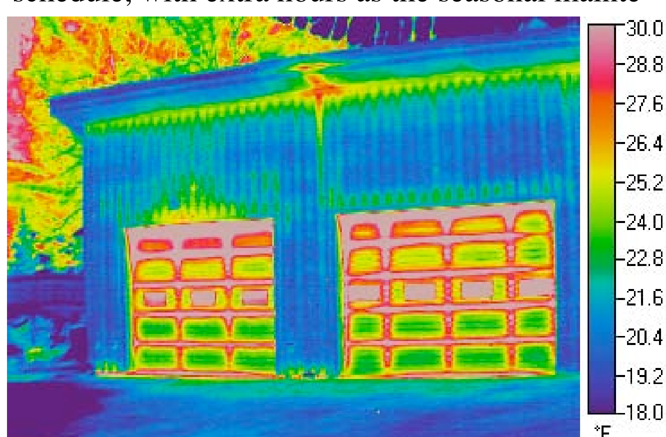
#	Measure	Base energy	Retrofit energy	Energy savings	Cost savings	Retrofit cost	Payback
		kWh or therm	kWh or therm	kWh or therm	$	$	Years
1	T8 lighting (EL)	4,602	3,120	1,482	$ 145	$ 520	3.58
2	Balance air system (NG)	2,046	1,985	61	$ 37	$ 150	4.07
3	Furnace upgrade (NG)	1,985	1,764	221	$ 133	$ 1,500	11.32
4	Envelope upgrades (NG)	1,764	1,676	88	$ 53	$ 2,000	37.73
5	Install a setback thermostat (NG)	1,676	1,579	97	$ 58	$ 50	0.86
6	New refrigerator (EL)	1,300	338	962	$ 94	$ 350	3.71
7	Office equipment & plug loads (EL)	4,697	4,227	470	$ 46	$ 100	2.17
8a	Retrofit water heater to NG (EL)	860	-	860	$ 84	$ 400	11.05
8b	Retrofit water heater to NG add (NG)	-	80	(80)	$ (48)	$ -	-
8	Retrofit water heater to NG, net savings ($)	-	-	-	$ 36	$ -	-
Sum	Electric savings (meas. 1, 6, 7, 8a), kWh	11,459	7,685	3,774	370	$ 1,370	3.70
Sum	Gas savings (meas. 2, 3, 4, 5, 8b), therms	2,046	1,659	387	233	$ 3,700	15.90
Sum	Total cost, savings ($), and payback	na	na	na	$ 603	$ 5,070	8.41

Town Park Garage

Building description: This is a relatively new frame-construction 3-bay garage that houses park maintenance equipment. It operates on an 8-5 schedule, with extra hours as the seasonal maintenance work requires. We do not have separately metered data for this equipment garage.

Shell: walls are 2x6 framing, with no windows and three garage doors. The ceiling is vaulted; we assume that the rafter and wall spaces are filled with conventional batt insulation.

Lighting: The building interior is lit with industrial surface-mounted fluorescent strip lights, with a total of 30 F48T12HO lamps.



Infrared image of un-insulated garage doors at Park Garage.

[4] Replacement options (examples only): GE 14.9 cu.ft. $510, 398 kWh/yr (Sears.com); GE 9.6 cu.ft. $328, 338 kWh/yr (Homedepot.com); Haier 10.5 cu.ft $278 (no kWh spec) (www.walmart.com); mini-fridge replacement: Danby 4.4 cu.ft mini-fridge $269 (no kWh spec) (www.gatelys.com)

Heating and ventilation: There is one suspended, gas-fired unit heater in each space. The single-bay room has a Modine unit and the double-bay room has a Reznor unit. Both have powered exhaust.

Water heating: none.

Plug loads: none.

Retrofit Measures

Recommendations:

1. Retrofit T8 lighting.
2. Upgrade garage doors from R-4 to R-12 plus reduce air infiltration.
3. Install setback thermostat.

Town Park Garage

#	Measure	Base energy	Retrofit energy	Energy savings	Cost savings	Retrofit cost	Payback
		kWh or therm	kWh or therm	kWh or therm	$	$	Years
1	T8 lighting (EL)	4,212	2,340	1,872	$ 183	$ 390	2.13
2	Upgrade garage doors (NG)	259	86	173	$ 104	$ 4,000	38.51
3	Install a setback thermostat (NG)	399	376	23	$ 14	$ 50	3.59
Sum	Electricity savings (measure 1), in kWh	4,212	2,340	1,872	183	$ 390	2.13
Sum	Gas savings (measure 2 & 3), in therms	659	463	196	118	$ 4,050	34.38
Sum	Total cost, savings ($), and payback	na	na	na	$ 301	$ 4,440	14.74

Town Park facilities

(Nordic Center, Park bathroom & shower facility, pool heating, ice rink warming hut)

Existing Conditions

Shower House

Building description: This is a 70s-vintage building with two bath/shower rooms and a small back room that houses pool mechanical and water heating equipment. Although the pool only operates through the summer, the building is open all year for restroom and shower functions. The pool itself is 60’x30’ with 55,000 gallon capacity.

Shell: concrete masonry unit (CMU) main building with framed back room. Small single-pane windows, un-insulated doors, and un-insulated walls (assumed).

Lighting: Incandescents in each bathroom, plus in water heating mechanical room, plus exterior lighting (control function, if any, is unknown).

Heating and ventilation: electric baseboard heat in bathrooms. The pool heater is a 500kBtu/h Raypack natural gas unit, gravity vented and 80% efficient. A 200 kBtu/h, 84-gallon A.O. Smith gravity-vent natural gas water heater handles the bath and shower loads. A pair of interchangeable 2-hp pumps circulate pool water through the heater and filter equipment.

Recommendations:

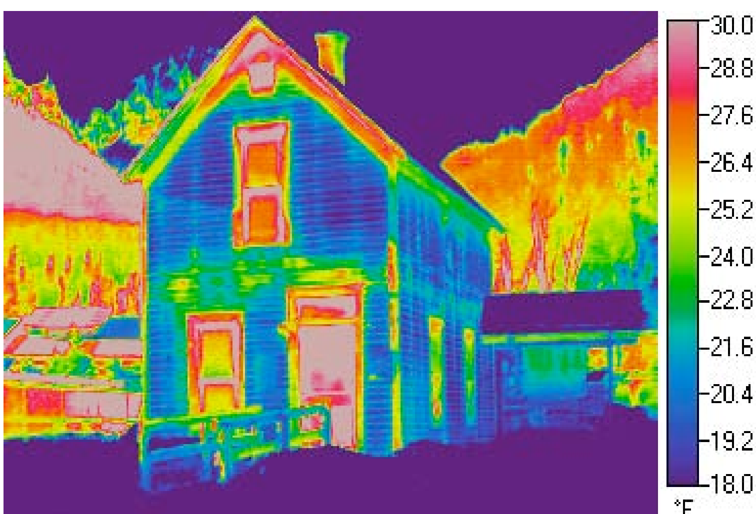
1. Upgrade pool heater.
2. Upgrade hot water heater.
3. Install solar hot water preheat system.
4. Install solar pool heat system.
5. Heat bathrooms with natural gas hydronic units.
6. Install a setback thermostat.

Town Park Shower House

#	Measure	Base energy KWh, therm	Retrofit energy KWh, therm	Energy savings KWh, therm	Cost savings $	Retrofit cost $	Payback Years
1	Upgrade pool heater (NG)	4,725	4,065	660	$ 397	$ 4,000	10.08
2	Solar pool system (NG)	4,065	3,665	400	$ 240	$ 4,000	16.64
3	Upgrade hot water heater (NG)	4,800	4,129	671	$ 403	$ 2,000	4.96
4	Solar hot water system (NG)	4,129	3,545	584	$ 351	$ 5,000	14.25
5	Hydronic NG heat for building (EL)	3,410	125	5,115	$ 259	$ 500	1.93
6	Install a setback thermostat (EL)	125	118	7	$ 4	$ 50	11.47
Sum	Electricity savings (meas. 5 & 6), kWh	3,535	3,545	(10)	(1)	$ 5,000	(5,140)
Sum	Gas savings (measures 1, 2, 3, 4), therms	9,525	8,194	1,331	800	$ 550	0.69
Sum	Total cost, savings ($), and payback	na	na	na	$ 799	$ 5,550	6.94

Nordic Center

Building description: A very small historic residence was moved to the site and substantially upgraded to create the Nordic Center and Park Information Center. The center operates all year.



Infrared image of Nordic Center showing heat loss at windows and house corners and attic vent.

Shell: framed walls with batt insulation; vaulted ceiling with batt insulation. Crawlspace stem walls are not insulated, although the 2x6 floor above is insulated with R-19 batts. Windows are wood-framed double pane, probably not low-e (nor gas-filled), but pretty tight.

Heating and ventilation: The Nordic center has a small and efficient heating system. A Weil-McClain sealed-combustion GV-4 boiler provides hot water to heat the building with staple-up tubing.

The boiler also provides hot water through a sidearm tank. There is little that can be done to improve on this system short of installing a marginally more efficient boiler, which would not be cost-effective.

Lighting: Brass surface-mount stem lights with incandescent A-lamps, for a total of 11 lamps (60-100W, variable).

Water heating: Sidearm tank heated by boiler.

Plug loads: 1 vintage Coldspot refrigerator (consumes ~1,600 kWh per year).

Recommendations:

1. Upgrade lighting.
2. Install a setback thermostat.
3. Replace refrigerator.
4. Weatherize both doors.

Town Park Nordic Center

#	Measure	Base energy	Retrofit energy	Energy savings	Cost savings	Retrofit cost	Payback
		kWh / therm	kWh / therm	kWh / therm	$	$	Years
1	Upgrade lighting (EL)	515	172	343	$ 34	$ 200	5.95
2	Setback thermostats (NG)	739	696	43	$ 26	$ 25	0.97
3	New refrigerator (EL)	1,600	338	1,262	$ 124	$ 350	2.83
4	Weatherize doors (NG)	696	675	21	$ 13	$ 25	1.99
Sum	Electricity savings (me. 1 & 3), kWh	2,115	510	1,605	157	550	3.50
Sum	Gas savings (measures 2 & 4), therms	1,435	1,371	64	38	50	1.31
Sum	Total cost, savings ($), and payback	na	na	na	$ 196	$ 600	3.07

Town Park Warming Hut (near old ice rink)

Building description: This small building near the old ice rink operates year-round. It has two bathrooms, a small mechanical room, and a living room with a fireplace. We do not have separately metered data for this building.

Shell: framed, 1970s vintage, uninsulated, vaulted roof. Large and poorly weatherized single-pane windows in the living room.

Lighting: random incandescents in living room, exterior incandescent floodlights, (6) 3'F30T12 in each bathroom.

Heating and ventilation: electric resistance baseboards, natural gas fireplace,

Water heating: 50-gal electric water heater @4500 watts. This unit apparently only heats water for the mop bucket (only cold water is supplied to the bathrooms).

Plug loads: none.

Recommendations:

1. Evaluate year-round use in light of ice rink changes. If year-round use will continue, renovate with insulated walls and new heating system consisting of small combination hot water/hydronic unit with convectors or fan coils in each of the three zones. Weatherize windows and door. We estimate savings of both natural gas (for the gas fireplace) and electric baseboards.
2. Upgrade lighting.
3. Insulate water heater tank and hot water pipes.

Town Park Warming Hut

#	Measure	Base energy	Retrofit energy	Energy savings	Cost savings	Retrofit cost	Payback
		kWh or therm	kWh or therm	kWh or therm	$	$	Years
1a	Shell: insulation, Wx windows, doors (NG)	1,744	1,221	523	$ 314	$ 800	2.54
1b	Shell: insulation, Wx windows, doors (EL)	2,445	1,467	978	$ 96	$ 800	8.35
2	Upgrade lighting (EL)	1,076	702	374	$ 37	$ 117	3.19
3	Insulate water heater tank and pipes (EL)	1,800	1,530	270	$ 26	$ 50	1.89
Sum	Electricity savings (measures 1b, 2, 3), kWh	5,321	3,699	1,622	$ 159	967	6.08
Sum	Gas savings (measure 1a), in therms	1,744	1,221	523	$ 314	800	2.54
Sum	Total cost, savings ($), and payback	na	na	na	$ 473	$ 1,767	3.73

Youth Center

Existing Conditions

This building has occasional occupancy, but high energy bills on a per-sq ft basis. We did not have a key to inspect this building, but a cursory view from the outside indicated high infiltration rates. Electricity consumption is also high for such a small space (800 sq ft, 10.4 kWh per sq ft-yr), but we were unable to inventory interior equipment and lights. Overall energy consumption cost $1,596 in 2003, and its energy-intensity is high ($2.00 per sq.ft-yr).

Recommendations:

- Replace broken windows.
- Weatherize windows and doors.

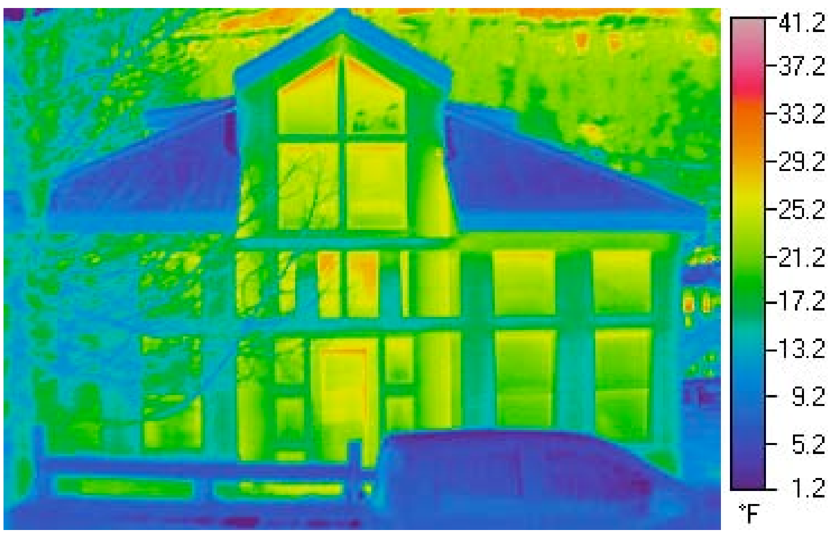
Old Wilkinson Library

Existing Conditions

Building description: The library was built in 1986 and retired from library operations with the opening of the new library down the street. The west half is currently used as a day care/preschool and the east half is vacant. This one-story building of 4,575 sq.ft and consumed $4,808 in energy (mostly for heating), and had a moderate energy-intensity of $1.05 per sq.ft.-yr (which is surprisingly high, considering that half the space is un-occupied; we did not note the thermostat setting for the vacated section of the building).

Shell: Walls: framed with brick exterior. Windows are fixed metal-framed double-pane units with low-e (unconfirmed). Roof is vaulted and meets energy code.

Lighting: Pendant down-lights and wall-mounted luminaires with 300W incandescents cover most of the building. Four-foot T12 fluorescents in service areas and cove lights in west entry. Four exits signs with incandescent or compact fluorescent lamps. Excellent daylighting with sidewall and clerestory glazing.



Infrared mage of old Wilkinson showing a well-insulated roof compared to its walls and windows.

Heating and ventilation: Two furnaces in inaccessible room; could not determine type but probably original 1986 vintage, 80% efficient. Furnaces feed duct networks with one for the east wing and one for the west wing, with one thermostat for each of the two zones.

Cooling: No a/c equipment visible. Ceiling fans in vaulted areas, motorized openers for clerestory windows, no operable windows below.

Water heating: 5-gal electric water heater in the bathroom.

Plug loads: None, except for one mini-fridge. (We did not inventory equipment used by the child-care center occupying the western half of the building).

Retrofit Measures

Recommendations:

Because the function of the library may change dramatically, it is difficult to prescribe specific recommendations. If the space is used as it is now, we recommend the following.

1. Replace 300W incandescents with Circline or globe fluorescents.
2. Upgrade exit signs to LED units.
3. Possible furnace upgrade.
4. Install setback thermostats.
5. Check thermostat setting in un-occupied portion of building (should be set at a maximum of 60°F).

Old Wilkinson Library

#	Measure	Base energy	Retrofit energy	Energy savings	Cost savings	Retrofit cost	Payback
		kWh or therm	kWh or therm	kWh or therm	$	$	Years
1	Lighting retrofit (EL)	9,360	3,510	5,850	$ 573	$ 4,000	6.98
2	LED exit signs (EL)	1,402	140	1,261	$ 124	$ 400	3.24
3	Furnace upgrade (NG)	4,880	4,338	542	$ 326	$ 4,000	12.27
4	Install setback thermostats (NG)	4,338	4,086	252	$ 151	$ 50	0.33
Sum	Electricity savings (measures 1 & 2), kWh	10,762	3,650	7,111	$ 601	4,450	7.41
Sum	Gas savings (measures 3 & 4), in therms	4,880	4,086	794	$ 573	4,000	6.98
Sum	Total cost, savings ($), and payback	na	na	na	$ 1,174	$ 8,450	7.20

Street lighting

Existing Conditions

Street lighting around Telluride consumed more than 65,000 kWh in 2002, and more poles are being added (151 poles in 2002). However, we have not audited the type of globes and lamps used, and we are not making any recommendations to install electricity-saving lamps.

Bike path
(lights and tunnel heater)

Existing Conditions

Lighting: Get lamp type and wattage from REG. Calculated kWh for lighting (based on average summer use, pad-heater off, is 400 kWh per month) annual lighting, but ranges from 216 kWh per month in June to 569 kWh in October. I asked for timer or control info from Paul Ruud, 24Mar04.

Tunnel snowmelt: The bike path's year-round use necessitates clearing snow and ice from the non-solar-gain underpass with electric heating elements embedded in the tunnel's concrete pad. We estimate that this heating system consumes nearly 78,000 kWh over the typical four- to five-month ice-melt season. The Town's street crew manually turns the electric heating system on and off, usually around Thanksgiving and late March/early April, respectively. There are no timer or temperature or other controls on this heating system.

West entrance to the heated bike underpass

Bike path electricity consumption and analysis

kWh:	Data for 2003
2,808	KWh, lighting only (May-Nov). The heater is turned off in early April.
401	KWh, monthly lighting average
4,814	KWh, annualized lighting
77,835	KWh, total pad heating, in 2003 (four months, plus a bit in May)
17,818	KWh per month, average pad heating in four months (Dec - March)
594	kWh per day, assuming 30 day billing cycles
24,748	Wattage, assuming "on" 24 hr/day
1.24	kWh/sq ft/day, approx 8 ft x 60 ft heated pad = 480 sq ft
38.67	Watts per sq ft. (CL49/480 sq ft)
4,224	Btu per sq ft per day
3.56	Equiv to heating X Gallons/sq ft/day of water from 55F to boiling (22.0Hg = 197F)

Recommendations:

1. Photocell to turn off lights during the day.
2. Add timer and/or thermally-responsive controls to set power level to heated pad.

Water supply facilities
(inaccessible in winter)

Existing Conditions

The Mill Creek water supply facility consumed 74,100 kWh in 2003, costing $2,440 per year. We were unable to visit this facility, and do not have an inventory of equipment installed. We presume that the electricity is primarily used for pumps, plus some electric heating.

Appendix B

Computers, other office equipment, and miscellaneous plug loads

B1. Computers

We inventoried 48 computers in Town buildings (see the attached spreadsheet for details on numbers, and estimated electricity consumption per unit and for all computers and related office equipment). We estimated total annual electricity consumption at nearly 42,000 kWh, which translates to an electricity cost of about $4,100. We also inventoried servers, printers, copiers, and other office equipment.

We observed during our audit that roughly one-half of the Town's stock of computers, monitors, servers, printers, and copiers are EPA EnergyStar rated (and thus use less electricity than older or non-compliant equipment while in use, as well as incorporating more efficient stand-by modes). In addition, an informal survey of Town staff indicated a better-than-average practice of simply shutting equipment off at night and weekends. In recognition of these facts we apply an electricity-saving factor to the typical estimates of per unit electricity consumption estimated by Kawamoto *et al* and A.D. Little.

Office Equipment and Other Plug Loads (kWh per year)

Percent Office Equipment and Miscellaneous Plug Loads of Telluride's Total Electricity Consumption							
	Total electricity consumption KWh/yr 2003	Office Equip. (est kWh/yr)	Percent Office Eq. of Total	Misc. plug loads (est kWh/yr)	Percent Misc Loads of Total	Sum of Office Equip & Misc Loads	Percent Sum Off Eq & Misc of Total
Town Hall	16,047	8,299	51.71	870	5.42	9,169	57.14
Rebekah Hall	39,267	15,811	40.26	1,900	4.84	17,711	45.10
Marshal's	19,784	5,623	28.42	1,380	6.98	7,003	35.40
Old Wilkinson	18,000	0	0	390	2.17	390	2.17
Parks & Rec	15,990	4,697	29.37	3,030	18.95	7,727	48.32
Public Works	108,739	5,139	4.73	5,230	4.81	10,369	9.54
Wastewater	2,011,760	2,723	0.14	5,660	0.28	8,383	0.42
Total	**2,229,587**	**42,290**	**1.90**	**18,460**	**0.83**	**60,750**	**2.72**

Recommendations: memo to staff regarding shutting down equipment during periods of non-use (over periods as short as half-hour for monitors and computers), and certainly at the end of each day. Copiers and printers should also be turned off. Some exceptions exist for modern equipment (such as higher-end copiers) that has software controls for shut-down or deep sleep after, say, a half-hour of inactivity. Most staff have personal printers, and additional networked printers in lieu of many dispersed printers would save electricity. In summary, however, the best way to save on office equipment electricity expense, as well as on procurement cost, is to move ahead with the building-consolidation plan that the Council is currently debating.

B2. Miscellaneous plug loads

"Plug loads" refers to electric equipment that is plugged into a normal wall socket, and thus excludes furnace fans, water heaters, stoves, clothes dryers, and other heavier equipment. It does include electric space heaters, and we did note the presence of a few space heaters in Town offices, presumably to improve comfort in cold zones. If individual staff do require additional heat in their work environment, we recommend infrared panels, which use far less electricity and direct the energy toward the occupant, and can be positioned under a desk, rather than having to heat up the whole office.

Our principal concern is the number of refrigerators, many of which are old, or barely used, or both. See Appendix A on retrofit measures for a discussion. Kitchen equipment such as toasters and microwaves and coffee makers do not have good retrofit options, except for a few users' instructions along the following lines: microwaving typically takes less energy than stove-top heating, and using a thermos for coffee saves energy compared to keeping the coffee pot warm all day.

Estimated Electricity Consumption of Miscellaneous Plug Loads

Other plug loads: refrigerators, beverage machines, kitchen equip etc.								
	Full size fridges	**Mini fridges**	**Beverage machines**	**Toasters**	**Micro-waves**	**Coffee makers**	**Misc. plug loads**	**Total other plug loads**
	Estimated kWh/year	Estimated kWh/year	Estimated kWh/year	Estimated kWh/year	Estimated kWh/year	Estimated kWh/year	Estimated kWh/year	
	1,300	**350**	**3,450**	**50**	**110**	**200**	**40**	**kWh/year**
Town Hall	-	350	-	50	110	200	160	**870**
Rebekah Hall	950	350	-	50	110	200	240	**1,900**
Marshal's	1,300	-	-	-	-	-	80	**1,380**
Old Wilkinson	-	350	-	-	-	-	40	**390**
Parks & Recreation	2,600	350	-	-	-	-	80	**3,030**
Public Works	950	350	3,450	50	110	200	120	**5,230**
Wastewater Treatment Plant	1,300	-	-	50	110	200	4,000	**5,660**
Total	**7,100**	**1,750**	**3,450**	**200**	**440**	**800**	**4,720**	**18,460**

Note: the sampling laboratory at the Wastewater Treatment Plant contains numerous pieces of equipment that are occasionally in use, typically a few minutes to a couple of hours per week. We did not inventory or attempt to estimate electricity consumption, inasmuch as such equipment is required, and its use or replacement is not dictated by its power consumption.

B3. Electricity-saving measures for office equipment

1. Most of the equipment installed in Town buildings meet voluntary EPA EnergyStar power consumption criteria, which have greatly reduced power consumption by equipment in use, as well as reduced stand-by power consumption, sleep modes, and software controls of such equipment. However, copiers, printers, computers, and monitors still use considerable amounts of power when in stand-by or sleep mode. While an informal survey of staff revealed a tendency to turn unneeded equipment off over-night and weekends, networked and stand-alone printers and copiers may not routinely be turned

off, and a memo to staff regarding turn-off procedures may result in greater participation. This is especially important for older or non-EnergyStar-compliant computers and monitors; nearly all Town printers are EnergyStar compliant.

2. **Printers:** Further networking of printers may allow the retirement of several of the Town's 16 printers, further facilitated by the Town's possible consolidation in a new building. This would also allow the retirement of some of the Town's 7 copiers. The procurement of new printers are typically dictated by staff requirements, and while inkjet printers use far less electricity (and print-quality is adequate for in-house use), the quality of laser printers is typically preferred.
3. **Procurement:** laptop computers and liquid crystal displays use far less power than desktops and their conventional electricity-intensive CRTs. A 17-inch LCD screen uses one-fifth as much electricity as standard display (17 watts vs 90 watts in active mode), whereas a laptop draws 15 watts and a desktop uses 55 watts.[5] Of course, portable computers and LCD displays have high cost-premia that are not justified by lowered electricity bills (a laptop premium of, say, $1,000 means a simple payback of 38 years). But there are utility benefits of procuring and using laptops—telecommuting, making presentations, taking notes, and working at meetings or on the road—that we will not attempt to put a value on here.

B4. Electricity-saving measures for miscellaneous plug loads

1. Replace the Town's oldest refrigerators with new, efficient EPA EnergyStar compliant units. Start with the Nordic Center and Parks & Recreation buildings.
2. Ensure that every installed refrigerator is actually being used, and/or the possibility of unplugging some units that are either not used or can be combined with in-place mini-fridges.
3. Install VendingMiser software control of beverage machine at Public Works (available from USA Technologies, www.bayviewtech.com/). The VendingMiser is easy to install and will likely reduce electricity consumption by 40 to 60 percent. Assuming 50 percent savings and tariff of $0.10 per kWh, annual savings of $173: its $179 cost will be paid back in reduced electricity bills in 12.4 months.

B5. Paper consumption and savings

1. Recycle office paper.
2. Print and copy on both sides (duplexing): it takes 10 to 15 times as much energy to produce a sheet of paper (~15 watt-hours) as it does to produce an image on a sheet of paper (~1.0 watt-hours). Duplexing instead of single-sided printing thus saves 13 watt-hours per image. Assume 100,000 printed images per year: saves 1.3 million watt-hours = 1,300 kWh @ ~1.99 lbs CO_2 per kWh = ~2.3 tons of saved carbon dioxide. Plus save 50,000 sheets of paper (at $5.00 per ream = $2,500 per year).

[5] Data from A.D. Little (2002), pp. 29 and 49. We use annual Unit Electricity Consumption (UEC) in our power consumption estimates: a desktop consumes an estimated 297 kWh per year, compared to a laptop using 32 kWh/yr.

Appendix C

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Appendix D

Selected Tables and Spreadsheets

Summary of Town of Telluride Buildings and Facilities

Town of Telluride Energy and Cost Savings Report

Rick Heede, Climate Mitigation Services, April 2004

	Square feet	Natural Gas (2003)					Electricity (2003)					Total			
		Consumption		Cost		CO2	Consumption		Cost		CO2	Cost		CO2	
		Therms/yr	kBtu/sf-yr	$ per year	$/sf-yr	Pounds/yr	kWh/year	kWh/sf-yr	$ per year	$/sf-yr	Lb/yr	$ per year	$/sf-yr	Lb/yr	Lb/sf-yr
Town Hall	1,686	956	55.2	**$ 761**	$ 0.45	11,193	**16,047**	9.5	**$ 1,786**	$ 1.06	31,934	**$ 2,547**	$ 1.51	43,126	**26**
Rebekah Hall	5,100	1,030	19.7	**$ 728**	$ 0.14	12,059	**39,267**	7.7	**$ 4,237**	$ 0.83	78,141	**$ 4,965**	$ 0.97	90,201	**18**
Marshal's	1,600	1,750	106.5	**$ 1,122**	$ 0.70	20,489	**19,784**	12.4	**$ 2,045**	$ 1.28	39,370	**$ 3,167**	$ 1.98	59,859	**37**
Old Wilkinson	4,575	4,880	96.6	**$ 2,902**	$ 0.63	57,135	**18,000**	3.9	**$ 1,906**	$ 0.42	35,820	**$ 4,808**	$ 1.05	92,955	**20**
Youth Center	800	964	165.3	**$ 670**	$ 0.84	11,287	**8,286**	10.4	**$ 926**	$ 1.16	16,489	**$ 1,596**	$ 2.00	27,776	**35**
Parks & Rec Office/HQ	1,770	1,087	112.6	**$ 743**	$ 0.42	12,727	**15,990**	9.0	**$ 1,523**	$ 0.86	31,820	**$ 2,266**	$ 1.28	44,547	**25**
Town Park Facilities	3,015	11,041	356.57	**$ 6,655**	$ 2.21	129,268	**39,614**	13.1	**$ 4,363**	$ 1.45	78,832	**$ 11,018**	$ 3.65	208,100	**69**
Park infrastructure	na	na	na	**na**	na	na	**12,121**	na	**$ 1,316**	na	24,121	**$ 1,316**	na	24,121	**na**
Public Works	12,700	21,414	164.2	**$12,333**	$ 0.97	250,715	**108,896**	8.6	**$ 9,163**	$ 0.72	216,703	**$ 21,496**	$ 1.69	467,418	**37**
Wastewater Treatment	25,000	57,111	222.4	**$33,593**	$ 1.34	668,656	**2,011,760**	80.5	**$133,915**	$ 5.36	4,003,402	**$ 167,508**	$ 6.70	4,672,058	**187**
Water supply (Mill Crk)	*get*	na	na	**na**	na	na	**74,100**	na	**$ 2,440**	na	147,459	**$ 2,440**	na	147,459	**na**
Street lighting	151	na	na	**na**	na	na	**65,247**	432	**$ 7,773**	$ 51.47	129,842	**$ 7,773**	$ 51.47	129,842	**860**
Bike path underpass	480	na	na	**na**	na	na	**82,649**	172	**$ 2,635**	$ 5.49	164,472	**$ 2,635**	$ 5.49	164,472	**343**
Total (all buildings & facilities)	56,877	100,233	na	**$59,507**	na	1,173,528	**2,511,761**	na	**$174,027**	na	4,998,404	**$ 233,535**	na	6,171,932	**na**
Average (TownH – ParkHQ only)	15,531	10,667	66.9	**$ 6,926**	$ 0.45	124,889	**117,374**	7.6	**$ 12,423**	$ 0.80	233,574	**$ 19,349**	$ 1.25	358,463	**23**
Average (TownH - ParkInfr only)	18,546	21,708	114.0	**$13,581**	$ 0.73	254,157	**169,109**	9.1	**$ 18,102**	$ 0.98	336,527	**$ 31,683**	$ 1.71	590,684	**32**
Average (TownH - PublWks only)	31,246	43,122	134.4	**$25,914**	$ 0.83	504,872	**278,005**	8.9	**$ 27,265**	$ 0.87	553,230	**$ 53,179**	$ 1.70	1,058,102	**34**
Average (all builds & facilities)	56,877	100,233	171.6	**$59,507**	$ 1.05	1,173,528	**2,511,761**	44.2	**$174,027**	$ 3.06	4,998,404	**$ 233,535**	$ 4.11	6,171,932	**109**

Computers, printers, copiers, and miscellaneous office loads

Town of Telluride Energy and Cost Savings Report

Rick Heede
Climate Mitigation Services
24 March 2004

Telluride equipment statistics: Models and types

Per unit electricity consumption kWh/yr (UEC)	Desktops	Monitors	Laptops	Printers 1	Printers 2	Copiers 1	Copiers 2	Servers	Facsimiles	Misc
UEC estimates (Kawamoto et al 1999)	213	205	25	283	74	874	na	560	119	38
UEC estimates (A.D. Little 2002)	297	333	32	694	92	1,077	na	1,095	132	429
Average of Kawamoto et al and A.D. Little	255	269	28	489	83	976	1,464	828	126	234
Factor for EnergyStar equip + staff turn off eq.	0.8	0.7	1.0	0.8	1.0	0.8	0.8	0.9	0.9	1.0
Final per unit electricity consumption kWh/yr	**204**	**188**	**28**	**391**	**83**	**780**	**1,171**	**745**	**113**	**234**
Town Hall	10	10	0	4	1		1	1	1	3
Rebekah Hall	15	15	0	9			1	5	1	6
Marshal's	6	6	1	1		1		2	1	2
Old Wilkinson			0							0
Parks & Recreation	5	5	0		1	2		1	1	1
Public Works	8	8	0	1	3	1			1	2
Wastewater Treatment Plant	3	3	1	1		1			1	1
Total	47	47	2	16	5	5	2	9	6	15

Estimated office equipment electricity consumption per year, Town of Telluride

Estimated per unit consumption (UEC)	Desktops	Monitors	Laptops	Printers 1	Printers 2	Copiers 1	Copiers 2	Servers	Facsimiles	Misc	Total
	kWh/yr	kWh/yr	kWh/yr	kWh/yr	kWh/yr	kWh/yr	kWh/yr	kWh/yr	kWh/yr	kWh/yr	kWh/yr
kWh/yr	**204**	**188**	**28**	**391**	**83**	**780**	**1,171**	**745**	**113**	**234**	
Town Hall	2,040	1,883	-	1,563	83	-	1,171	745	113	701	**8,299**
Rebekah Hall	3,060	2,825	-	3,517	-	-	1,171	3,724	113	1,401	**15,811**
Marshal's	1,224	1,130	28	391	-	780	-	1,490	113	467	**5,623**
Old Wilkinson	-	-	-	-	-	-	-	-	-	-	**-**
Parks & Recreation	1,020	942	-	-	83	1,561	-	745	113	234	**4,697**
Public Works	1,632	1,506	-	391	249	780	-	-	113	467	**5,139**
Wastewater Treatment Plant	612	565	28	391	-	780	-	-	113	234	**2,723**
Total	**9,588**	**8,850**	**57**	**6,253**	**415**	**3,902**	**2,342**	**6,703**	**678**	**3,503**	**42,290**

One Scenario of Telluride's municipal energy savings potential

Richard Heede Climate Mitigation Services

One Efficiency Scenario	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total 2002 - 2016
Electricity costs	$ 158,687	$ 168,656	$ 173,716	$ 165,030	$ 155,128	$ 145,820	$ 137,071	$ 128,847	$ 122,405	$ 116,284	$ 110,470	$ 104,947	$ 100,749	$ 96,719	$ 92,850	**$ 1,977,379**
Natural gas costs	$ 52,907	$ 60,245	$ 62,052	$ 58,949	$ 55,412	$ 52,088	$ 48,962	$ 46,025	$ 43,723	$ 41,680	$ 39,596	$ 37,616	$ 36,112	$ 34,667	$ 33,281	**$ 703,317**
Total energy costs	$ 211,594	$ 228,901	$ 235,768	$ 223,979	$ 210,541	$ 197,908	$ 186,034	$ 174,872	$ 166,128	$ 157,965	$ 150,066	$ 142,563	$ 136,861	$ 131,386	$ 126,131	**$ 2,680,696**
Business as usual	$ 211,594	$ 229,303	$ 235,977	$ 242,847	$ 249,919	$ 257,199	$ 264,693	$ 272,408	$ 280,349	$ 288,524	$ 296,940	$ 305,603	$ 314,521	$ 323,702	$ 333,153	**$ 4,106,734**
Savings: BAU less Total	$ -	$ 402	$ 209	$ 18,868	$ 39,379	$ 59,291	$ 78,660	$ 97,536	$ 114,221	$ 130,560	$ 146,874	$ 163,040	$ 177,661	$ 192,316	$ 207,023	**$ 1,426,038**
Annual investment, $	$ -	$ -	$ 14,000	$ 36,000	$ 36,000	$ 35,000	$ 34,500	$ 31,500	$ 29,000	$ 26,000	$ 24,000	$ 21,000	$ 18,000	$ 18,000	$ 18,000	**$ 341,000**
Net annual savings	$ -	$ 402	$ (13,791)	$ (17,132)	$ 3,379	$ 24,291	$ 44,160	$ 66,036	$ 85,221	$ 104,560	$ 122,874	$ 142,040	$ 159,661	$ 174,316	$ 189,023	**$ 1,085,038**

Cumulative Net Savings	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total 2002 - 2016
			Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	
Cumulative savings		**$ 402**	**$ (13,389)**	**$ (30,522)**	**$ (27,143)**	**$ (2,852)**	**$ 41,308**	**$ 107,344**	**$ 192,565**	**$ 297,125**	**$ 419,998**	**$ 562,039**	**$ 721,699**	**$ 896,016**	**$ 1,085,038**	$ **1,085,038**

Wastewater Treatment Plant – energy and cost data

Month	Year	Natural Gas Consumption		Electricity Consumption		Flow
		Therms	Dollars	kWh or MWh	Dollars	Million gallons
January	**2001**	5,117	$ 4,286	169,115	$ 9,906	19.7
February		1,944	$ 1,634	173,596	$ 11,199	17.2
March		4,131	$ 3,462	173,920	$ 7,695	23.4
April		2,792	$ 2,343	165,120	$ 10,125	19.0
May		1,822	$ 1,532	144,160	$ 8,960	24.1
June		1,069	$ 903	132,960	$ 8,249	27.1
July		645	$ 549	146,320	$ 8,569	23.4
August		912	$ 772	150,800	$ 9,165	23.4
September		817	$ 685	146,800	$ 9,056	18.6
October		2,621	$ 1,560	125,360	$ 7,660	15.5
November		4,282	$ 2,269	131,280	$ 7,981	13.6
December		5,675	$ 3,057	119,760	$ 7,670	18.9
2001 total		**31,827**	**$ 23,053**	**1,779,191**	**$ 106,234**	**244**
January	**2002**	5,237	$ 2,822	202,720	$ 11,285	20.9
February		3,427	$ 1,850	165,680	$ 10,472	19.6
March		4,288	$ 2,308	181,680	$ 10,608	25.0
April		2,982	$ 1,611	163,440	$ 10,521	18.5
May		3,466	$ 1,871	175,760	$ 10,753	19.3
June		1,657	$ 900	159,680	$ 10,509	21.1
July		1,862	$ 580	161,680	$ 10,162	21.3
August		1,736	$ 942	159,360	$ 10,183	20.2
September		3,373	$ 1,821	162,160	$ 10,292	20.0
October		5,312	$ 2,862	163,920	$ 10,432	15.8
November		6,842	$ 3,331	159,760	$ 10,167	14.1
December		9,355	$ 5,152	166,480	$ 10,794	20.1
2002 total		**49,537**	**$ 26,049**	**2,022,320**	**$ 126,176**	**236**
January	**2003**	7,794	$ 4,293	204,480	$ 12,381	20.8
February		7,050	$ 3,885	181,760	$ 12,202	18.8
March		6,218	$ 3,427	199,200	$ 13,491	23.0
April		5,166	$ 2,849	181,360	$ 12,035	19.2
May		3,414	$ 1,886	143,840	$ 9,527	22.3
June		2,102	$ 1,165	155,360	$ 10,258	25.7
July		711	$ 400	158,080	$ 11,183	22.4
August		1,238	$ 690	158,640	$ 10,416	23.1
September		3,447	$ 1,904	156,480	$ 10,650	20.7
October		4,581	$ 2,528	152,080	$ 10,208	15.5
November		6,037	$ 4,128	151,680	$ 9,986	12.8
December		9,353	$ 6,437	168,800	$ 11,578	19.2
2003 total		**57,111**	**$ 33,593**	**2,011,760**	**$ 133,915**	**244**

		kBtu/10^6 gal	$/million gal	kWh/million gal	$/million gal
Preliminary building energy analysis	**2001**	12,700	$ 94	7,291	$ 435
	2002	20,454	$ 110	8,576	$ 535
	2003	22,837	$ 138	8,262	$ 550

	Wastewater			
	Gas	Electricity	Total	Intensity
	$/yr	$/yr	$/yr	$/million gal
Total 2001	$ 23,053	$ 106,234	$ 129,287	$ 529.84
Total 2002	$ 26,049	$ 126,176	$ 152,225	$ 645.51
Total 2003	$ 33,593	$ 133,915	$ 167,508	$ 687.92

Town Hall — energy and cost data

Month	Year	Natural Gas Consumption		Electricity Consumption	
		Therms	Dollars	kWh or MWh	Dollars
January	2001	242	$ 204	1,683	$ 108
February		144	$ 134	1,639	$ 106
March		129	$ 121	1,388	$ 94
April		86	$ 84	1,306	$ 90
May		46	$ 50	1,480	$ 98
June		11	$ 20	1,227	$ 86
July		-	$ 10	1,083	$ 80
August		3	$ 13	1,149	$ 83
September		19	$ 26	1,175	$ 90
October		38	$ 35	1,254	$ 94
November		97	$ 65	1,454	$ 103
December		288	$ 122	1,512	$ 106
2001 total		**1,103**	**$ 884**	**16,350**	**$ 1,138**
January	2002	223	$ 130	1,509	$ 104
February		218	$ 127	1,417	$ 99
March		165	$ 99	1,281	$ 99
April		99	$ 63	1,328	$ 101
May		78	$ 48	1,208	$ 93
June		29	$ 26	1,236	$ 90
July		-	$ 10	1,023	$ 78
August		7	$ 14	1,137	$ 91
September		20	$ 21	1,107	$ 115
October		70	$ 48	1,214	$ 120
November		119	$ 75	1,205	$ 119
December		179	$ 108	1,271	$ 129
2002 total		**1,207**	**$ 767**	**14,936**	**$ 1,237**
January	2003	237	$ 142	1,391	$ 170
February		5	$ 95	1,366	$ 156
March		145	$ 90	1,301	$ 179
April		118	$ 75	1,180	$ 154
May		89	$ 59	1,219	$ 143
June		22	$ 22	1,255	$ 151
July		2	$ 11	1,306	$ 153
August		-	$ 10	1,120	$ 145
September		16	$ 19	1,147	$ 146
October		44	$ 34	1,219	$ 149
November		94	$ 68	1,424	$ 103
December		184	$ 136	2,119	$ 137
2003 total		**956**	**$ 761**	**16,047**	**$ 1,786**

Year	kBtu/sq ft-yr	$/sq ft-yr	kWh/sq ft-yr	$/sq ft-yr	Total energy cost per sq ft-yr
2001	63.70	$ 0.52	9.70	$ 0.68	$ 1.20
2002	69.71	$ 0.45	8.86	$ 0.73	$ 1.19
2003	55.21	$ 0.45	9.52	$ 1.06	$ 1.51

Rebekah Hall — energy and cost data

Month	Year	Natural Gas Consumption		Electricity Consumption	
		Therms	Dollars	kWh or MWh	Dollars
January	2001	259	$ 218	3,077	$ 262
February		196	$ 179	2,509	$ 213
March		160	$ 148	2,647	$ 225
April		98	$ 95	2,653	$ 226
May		58	$ 60	3,307	$ 281
June		14	$ 22	3,007	$ 256
July		4	$ 14	2,786	$ 237
August		2	$ 12	3,246	$ 276
September		8	$ 17	2,877	$ 256
October		42	$ 39	2,708	$ 241
November		74	$ 51	2,868	$ 255
December		198	$ 116	2,136	$ 182
2001 total		**1,113**	**$ 971**	**33,821**	**$ 2,909**
January	2002	214	$ 124	3,065	$ 273
February		214	$ 124	3,021	$ 269
March		178	$ 101	3,006	$ 267
April		98	$ 63	3,022	$ 289
May		74	$ 50	3,034	$ 291
June		32	$ 27	3,304	$ 317
July		4	$ 12	3,543	$ 339
August		4	$ 12	3,406	$ 326
September		10	$ 15	2,869	$ 275
October		58	$ 41	2,696	$ 258
November		92	$ 50	2,592	$ 248
December		178	$ 108	2,642	$ 253
2002 total		**1,156**	**$ 727**	**36,200**	**$ 3,405**
January	2003	236	$ 142	2,983	$ 324
February		154	$ 95	3,153	$ 342
March		148	$ 91	2,840	$ 309
April		110	$ 70	2,709	$ 297
May		62	$ 56	3,480	$ 374
June		30	$ 26	3,861	$ 413
July		12	$ 17	3,769	$ 403
August		10	$ 16	3,272	$ 353
September		12	$ 17	3,258	$ 351
October		32	$ 28	3,072	$ 333
November		60	$ 47	3,435	$ 369
December		164	$ 123	3,435	$ 369
2003 total		**1,030**	**$ 728**	**39,267**	**$ 4,237**

Year	kBtu/sq ft-yr	$/sq ft-yr	kWh/sq ft-yr	$/sq ft-yr	Total energy cost per sq ft-yr
2001	21.25	$ 0.19	6.63	$ 0.57	$ 0.76
2002	22.07	$ 0.14	7.10	$ 0.67	$ 0.81
2003	19.66	$ 0.14	7.70	$ 0.83	$ 0.97

Marshal's Building — energy and cost data

Month	Year	Natural Gas Consumption		Electricity Consumption	
		Therms or cubic feet	Dollars	kWh or MWh	Dollars
January	2001	331	$ 264	1,943	$ 165
February		265	$ 238	1,798	$ 153
March		174	$ 160	1,597	$ 136
April		142	$ 133	1,425	$ 121
May		82	$ 81	1,567	$ 133
June		8	$ 17	1,296	$ 110
July		2	$ 12	1,504	$ 128
August		1	$ 19	1,571	$ 134
September		3	$ 13	1,736	$ 154
October		25	$ 29	1,672	$ 149
November		138	$ 84	1,281	$ 114
December		271	$ 156	1,563	$ 133
2001 total		**1,442**	**$ 1,205**	**18,953**	**$ 1,630**
January	2002	390	$ 219	1,692	$ 151
February		395	$ 223	1,344	$ 120
March		263	$ 151	1,210	$ 108
April		150	$ 99	1,321	$ 127
May		114	$ 71	1,163	$ 111
June		44	$ 34	1,673	$ 160
July		9	$ 15	1,977	$ 189
August		6	$ 13	1,494	$ 143
September		22	$ 22	1,599	$ 153
October		79	$ 52	1,329	$ 127
November		188	$ 112	1,407	$ 134
December		316	$ 184	1,627	$ 156
2002 total		**1,976**	**$ 1,195**	**17,836**	**$ 1,678**
January	2003	423	$ 244	1,402	$ 146
February		321	$ 186	1,371	$ 143
March		241	$ 142	1,487	$ 155
April		184	$ 111	1,267	$ 133
May		105	$ 68	1,851	$ 190
June		23	$ 23	2,104	$ 215
July		16	$ 19	1,838	$ 189
August		2	$ 11	1,723	$ 178
September		13	$ 17	1,428	$ 149
October		62	$ 44	1,463	$ 152
November		116	$ 79	1,738	$ 179
December		244	$ 178	2,112	$ 216
2003 total		**1,750**	**$ 1,122**	**19,784**	**$ 2,045**

Year	kBtu/sq ft-yr	$/sq ft-yr	kWh/sq ft-yr	$/sq ft-yr	Total energy cost per sq ft-yr
2001	87.75	$ 0.75	11.85	$ 1.02	$ 1.77
2002	120.25	$ 0.75	11.15	$ 1.05	$ 1.80
2003	106.50	$ 0.70	12.37	$ 1.28	$ 1.98

Public Works — energy and cost data

Month	Year	Natural Gas Consumption		Electricity Consumption	
		Therms	Dollars	kWh or MWh	Dollars
January	2001	4,581	$ 3,442	15,353	$ 824
February		4,756	$ 4,104	13,446	$ 632
March		4,048	$ 3,494	10,773	$ 617
April		2,950	$ 2,549	9,343	$ 515
May		1,700	$ 1,473	11,130	$ 620
June		412	$ 365	7,709	$ 425
July		280	$ 251	8,093	$ 457
August		140	$ 131	8,418	$ 458
September		382	$ 329	7,216	$ 459
October		532	$ 494	9,626	$ 591
November		2,096	$ 1,223	8,131	$ 506
December		3,266	$ 1,765	8,344	$ 519
2001 total		**25,143**	**$ 19,622**	**117,582**	**$ 6,622**
January	2002	5,106	$ 2,751	11,802	$ 745
February		4,264	$ 2,299	11,611	$ 729
March		4,170	$ 2,249	9,876	$ 644
April		2,808	$ 1,518	9,103	$ 643
May		1,444	$ 785	8,137	$ 612
June		710	$ 395	7,945	$ 562
July		116	$ 72	8,056	$ 574
August		88	$ 57	6,933	$ 499
September		374	$ 211	7,459	$ 611
October		1,072	$ 586	8,912	$ 688
November		2,206	$ 1,201	7,011	$ 646
December		3,216	$ 1,778	11,894	$ 860
2002 total		**25,574**	**$ 13,902**	**108,739**	**$ 7,812**
January	2003	4,880	$ 2,692	12,764	$ 928
February		3,470	$ 1,917	10,121	$ 835
March		3,158	$ 1,746	10,040	$ 837
April		2,498	$ 1,383	8,809	$ 747
May		1,324	$ 738	7,101	$ 656
June		554	$ 315	7,419	$ 674
July		64	$ 45	7,563	$ 663
August		56	$ 42	6,826	$ 637
September		64	$ 45	8,244	$ 711
October		978	$ 548	8,741	$ 755
November		1,424	$ 829	7,717	$ 702
December		2,944	$ 2,033	13,551	$ 1,018
2003 total		**21,414**	**$ 12,333**	**108,896**	**$ 9,163**

Year	kBtu/sq ft-yr	$/sq ft-yr	kWh/sq ft-yr	$/sq ft-yr	Total energy cost per sq ft-yr
2001	192.77	$ 1.55	9.26	$ 0.52	$ 2.07
2002	196.07	$ 1.09	8.56	$ 0.62	$ 1.71
2003	164.18	$ 0.97	8.57	$ 0.72	$ 1.69

Old Wilkinson Library — energy and cost data

Month	Year	Natural Gas Consumption		Electricity Consumption	
		Therms or cubic feet	Dollars	kWh or MWh	Dollars
	2001				
		This building purchased in mid-2001			
July					
August		-	$ -	1,920	$ 163
September		-	$ -	2,160	$ 192
October		-	$ -	1,120	$ 100
November		432	$ 257	1,120	$ 100
December		438	$ 245	1,280	$ 114
2001 total		**870**	**$ 503**	**7,600**	**$ 669**
January	**2002**	566	$ 315	3,440	$ 306
February		950	$ 528	1,660	$ 142
March		604	$ 334	1,280	$ 114
April		548	$ 304	400	$ 38
May		252	$ 145	320	$ 31
June		20	$ 21	320	$ 31
July		29	$ 10	1,200	$ 115
August		-	$ 10	1,440	$ 138
September		34	$ 28	1,360	$ 130
October		242	$ 140	1,200	$ 115
November		476	$ 269	1,200	$ 115
December		816	$ 458	1,680	$ 161
2002 total		**4,537**	**$ 2,563**	**15,500**	**$ 1,436**
January	**2003**	1,088	$ 610	1,840	$ 193
February		892	$ 500	1,680	$ 177
March		616	$ 349	2,160	$ 225
April		492	$ 280	2,720	$ 282
May		398	$ 229	1,120	$ 121
June		104	$ 67	1,040	$ 113
July		40	$ 32	1,440	$ 153
August		-	$ 10	880	$ 96
September		90	$ 59	880	$ 96
October		226	$ 134	880	$ 96
November		348	$ 218	1,920	$ 201
December		586	$ 414	1,440	$ 153
2003 total		**4,880**	**$ 2,902**	**18,000**	**$ 1,906**

Year	kBtu/sq ft-yr	$/sq ft-yr	kWh/sq ft-yr	$/sq ft-yr	Total energy cost per sq ft-yr
2001	18.52	$ 0.11	1.66	$ 0.15	$ 0.26
2002	96.56	$ 0.56	3.39	$ 0.31	$ 0.87
2003	103.86	$ 0.63	3.93	$ 0.42	$ 1.05

The auditing team (Hasz, Houghton, Heede) on a crisp morning in Telluride, March 2004.

Richard Heede
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