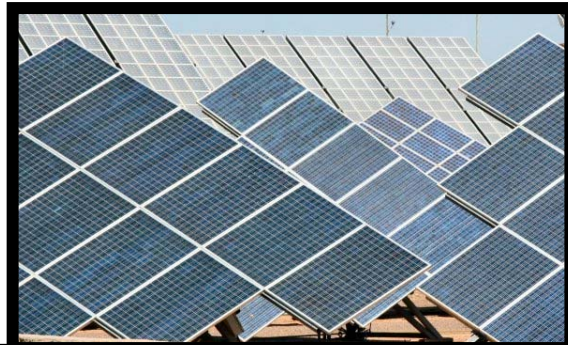


City of Golden
RENEWABLE ENERGY TECHNICAL
ADVISORY COMMITTEE
(RETAC)

Final Recommendations Report
May 2012



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Chris Gaul, NREL Biomass Plant Manager

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Will Stambaugh, City of Golden Water Resource Specialist

RETAC Members

- Scott Morrissey, City of Golden Sustainability Advisory Board and Senior Buildings Program Manager, State of Colorado Governor's Energy Office
- Dr. Dag Nummedal, Director, Colorado Energy Research Institute, Colorado School of Mines
- Whitney Painter, City of Golden Sustainability Advisory Board and Owner, Buglet Solar Electric Installation
- Dave Peterson, Project Leader in Deployment and Market Transformation, National Renewable Energy Laboratory
- Dave Renne, National Renewable Energy Laboratory and President of the International Solar Energy Society
- Alex Schroeder, Senior Manager for Transportation Fuels , State of Colorado Governor's Energy Office
- Paul Schwabe, Renewable Energy Finance Analyst, National Renewable Energy Laboratory

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Executive Summary

Solutions to meeting City of Golden’s renewable energy goals lie in a combination of investment in green power and physical renewable projects, as well as a focus on energy efficiency in order to reduce demand—therefore reducing the amount of renewable energy implementation required to meet the target.

The 17 May 2012 discussion between Golden’s City Council and members of the Renewable Energy Technical Advisory Committee (RETAC) was very helpful in driving the direction of this report. Messages put forth by Council members included:

“This is important to our community.” • “We want to know how to get to the goals as they exist.” • “As a city, we must continue to walk our talk on sustainability and step up to this challenge.” • “The process of setting these goals was exciting, and not because the citizens setting the goals were focused on the price of energy.” • “We need to provide leadership and inspiration as we consider how to approach these goals.”

In this spirit, the following report provides recommendations and suggested triggers for meeting the City’s sustainability and related energy efficiency goals as crafted in 2007 and described in detail in the Introduction of this report.

Although there are distinct goals laid out for Golden’s municipal government and for the broader community, this report focuses in large part on strategies for meeting the City’s municipal goals—based on the assumption that local citizens and businesses will be inspired by the City’s public pursuit of its goals. This report does not provide specific structures for collaborating with National Renewable Energy Laboratory (NREL) and Colorado School of Mines (CSM), but the process has been highly cooperative and these entities remain interested and willing to offer continued support and consultation as possible.

It should be noted that City of Golden’s goals for renewable energy implementation are remarkably ambitious and supersede those set by other communities with which we are familiar. The intent expressed by the citizens who crafted these goals is impressive, and the goals are challenging by any standard.

In order to achieve these goals, it will be important for the City Council to determine an energy price threshold under which the City will be comfortable in securing the renewable resources. From a technical perspective, it is clear that Golden has

sufficient renewable resources, but funds will be required in order to utilize these resources.

It is important to agree upon an acceptable incremental cost to achieve these goals, develop a long-term funding strategy, and continually monitor advances in technologies, incentives, grants, and financing models that will allow the City to procure new resources when they are most cost-effective. This is a strategy based on the assumption of City Council and City staff working together on an ongoing basis to integrate sustainability in decision-making, and to consider long-term financial benefits associated with investments in renewable energy and energy efficient equipment and technology.

For Golden's climate and location, solar photovoltaic and thermal technologies, as well as energy efficiency measures, provide the greatest productivity and potential for Return on Investment. However, many good opportunities exist with other technologies such as vehicle fuels.

If any future effort is undertaken to refine the City's renewable energy and energy efficiency goals, we recommend keeping as paramount concern the rigorous intent expressed by the citizens who crafted these goals. As with most effective community efforts, the time, energy and enthusiasm contributed by citizens and City leaders toward this effort are fundamental to Golden's success in pursuing sustainability.

These ambitious renewable energy and energy efficiency goals provide Golden with an outstanding opportunity for forward-thinking policy making. Although the goals are remarkably ambitious for the established time frame, in coming decades it will become inevitably imperative for Golden to implement renewables and efficiency measures on the scale prescribed by the goals, due to declining availability and increasing cost for fossil fuel energy sources. Considerable resources can be saved by moving early to implement the infrastructure and progressive planning changes required to build the foundation for this transition.

The most important variables in accomplishing the goals are financial planning and time horizon. We applaud the City's first step toward implementing renewable energy with a solar thermal system on the Golden Community Center. With this as the main effort toward the goals in the first five of the ten years, the City should consider refining the timeline for the renewable energy and energy efficiency goals, along with establishing a defined financial strategy for meeting the goals under a new timeline. Given the broad nature of the goals, as part of a new timeline we recommend including incremental milestones toward the overall goals.

Introduction

Under City of Golden Resolution No. 1798, Golden citizens set out goals in several areas, including an impressive increase in the community's energy efficiency and utilization of renewable sources of energy. The goals were defined in 2007 for a 2017 ten-year horizon. Based on a 2007 baseline, the goals include:

- 1) Reduce the City of Golden's energy usage by 25% and increase to 50% the proportion of the City of Golden's energy use derived from renewable energy sources within ten years; and
- 2) Reduce overall community energy usage in Golden by 20% and increase to 20% the proportion of overall community energy usage in Golden derived from renewable energy sources within ten years;
- 3) Reduce the community's total Vehicle Miles Traveled by 15% in ten years.

In 2010, some additional metrics were established for measuring progress on these goals. Progress on the municipal energy goals is measured in annual consumption of electricity (MWh), natural gas (therms), and transportation fuel (gallons). Progress for the community goals is measured in percentage of MWhs and therms derived from renewable sources, as well as fuel efficiency in Miles per Gallon (mpg).

Under City of Golden Resolution No. 2174, the Renewable Energy Technical Advisory Panel (RETAC) was established. The purpose of the RETAC is to: a) identify a range of potential strategies for achieving the city's renewable energy goals, for consideration by the Sustainability Advisory Board and City Council; and b) provide advice about leveraging the city's relationships with the U.S. Department of Energy, the National Renewable Energy Laboratory, and Colorado School of Mines and about potential collaborations with these institutions to aid in achieving the city's renewable energy goals.

The final report includes: a) a range of potential strategies for achieving the City's renewable energy goals, including an assessment of technical and financial feasibility and likely effectiveness toward achieving the renewable energy goals; b) recommendations about which of these strategies appear to be the most promising for achieving the city's renewable energy goals at a reasonable cost; and c) advice about leveraging the city's relationships with the U.S. Department of Energy, the National Renewable Energy Laboratory, and Colorado School of Mines and about potential collaborations with these institutions to aid in achieving the city's renewable energy goals.

For the purposes of this report, RETAC decided not to address nuclear energy strategies due to the extensive permitting, funding, and political impacts.

Current Progress

The most current data available from Xcel Energy for both municipal and community-wide consumption compared to Golden's energy goals is shown here:

Municipal Usage	Natural Gas (Therms)	% of baseline	Electricity (KwH)	% of baseline
2007 (baseline year)	235,416	N/A	10,120,649	N/A
2008	180,310	76.6%	13,248,306	130.9%
2009	122,483	52.0%	10,274,735	101.5%
2010	113,919	48.4%	10,051,599	99.3%
2011	Not Available			

Community Usage	Natural Gas (DTherms)	% of baseline	Electricity (MwH)	% of baseline
2007 (baseline year)	1,614,526	N/A	259,081	N/A
2008	1,938,759	120%	259,083	100%
2009	1,963,736	121%	250,912	96.8%
2010	Not Available			
2011	Not Available			

Electricity

The cost of electricity in our region has seen a 10% increase every year over the past ten years and increases are expected to continue--while natural gas prices have dropped and are expected to continue declining in the near term. Therefore, much of Golden's near-term opportunities reside with renewable electricity generation.

Within the context of Golden's renewable energy generation, an important point to consider is the City's priorities in achieving these goals. Based on these priorities, the various options have inherent costs vs. benefits tradeoffs. For example, is the least-cost option the paramount concern? That priority may indicate a desire to delve into the Renewable Energy Credit (REC) market, or more locally, Xcel Energy's WindSource program, which funds the operation of Colorado wind farms for a fixed per-kilowatt hour fee. Alternatively, if the City's preference is to only pursue resources that are sited within Golden, then fewer technologies may be available and the installations will likely come at a higher cost. Also, is the City committed to demonstrating a variety of technologies for an educational benefit? This too, may increase costs if the City pursues technologies that do not have as significant a resource potential within Golden, or that are only now emerging in the marketplace.

City of Golden's current electricity usage is about 10,000 megawatt-hours per year and the community's electricity consumption is about 250,000 megawatt-hours per year. This level of demand illustrates the importance of energy efficiency as the City moves forward in pursuing its renewable energy goals, as discussed in the Energy Efficiency section on page 21.

WindSource

Xcel Energy offers a program called WindSource, which provides an opportunity to support renewable energy generation on Xcel's utility grid. Under this program, a premium is paid for each kilowatt-hour of electricity demand, and these additional funds are channeled by Xcel Energy into its program for acquisition of RECs from wind farms in Colorado and other states. Currently, there is a proposal before the Public Utilities Commission to allow long-term WindSource contracts for large electricity consumers such as City of Golden a per-kilowatt hour rate not to exceed 1.2 cents.

Although WindSource provides a connection between electricity purchases and renewable generation, utilizing this program does not provide renewable energy installations on site within City of Golden, nor does it result in the purchase of Renewable Energy Credits (REC) by City of Golden. For citizens and City government, this is an essential question in considering whether to participate in the WindSource program on any scale.

For Golden’s government, the per-kilowatt hour rate for WindSource is 1.2 cents. As an example, in order to utilize WindSource for 50% of the current kilowatt-hour demand of the City, an annual expenditure of about \$100,000 would be required. Of course, WindSource can be utilized incrementally for a portion of this offset—or it can be disregarded altogether as a divergence of funds that can be used for on-site renewables.

Photovoltaic Solar

While several great strategies exist for generating on-site renewable electricity, photovoltaic (PV) solar is the most obvious option for Golden.

PV systems, build on time-tested technology, generate electricity by utilizing the energy in sunlight. Colorado benefits from an excellent solar resource, and our climate helps to maximize this technology, which performs best in climates with fewer very hot days. In fact, the breezes particular to Golden help to increase productivity for PV modules by keeping the panels cooler on many of our sunniest days.

Currently, Colorado has the most competitive pricing of any PV market in the country. And across the US market, prices for PV have seen a remarkable drop to the lowest level in history—both factors that favor the outlook for Golden’s sustainability initiative.

However, availability of financing for large solar systems, leases and Power Purchase Agreements (PPAs) faces limits due to regulatory and political concerns. Leading up to the nationwide economic recession in 2008—with the combination of available financing mechanisms and a favorable rebate offer from Xcel Energy for purchasing Renewable Energy Credits (RECs)—many municipal and county jurisdictions were able to negotiate highly advantageous financing arrangements for implementing PV power. While this economic climate has changed in many regards, there remains a generous 30% federal tax credit with valuable equipment depreciation deductions for business-owned solar systems upon which many lease and PPA agreements are structured.

PPAs remain the dominant means for local governments to procure solar, because private sector partners are required to monetize these incentives. While the City would not own the solar system under a PPA or lease arrangement, the City could opt to keep control of the Renewable Energy Credits (RECs) under a PPA arrangement.

In today’s market, the estimated cost for a PPA of about 3 – 4 MW would be sufficient to generate enough electricity to meet City of Golden’s 50% electricity requirement. Estimated cost for a PPA of this size is about \$150,000 per year. As utility costs increase and markets ease for REC payments and financing, however, a PPA of this scope will become less costly.

The factor most affecting Golden's options is Xcel Energy's reduced participation in large-scale solar REC purchases. There are several strategies that can be employed in this regard:

- Seek to decrease Golden's costs by negotiating an aggregate PPA including City of Golden with other entities such as Colorado School of Mines or Jefferson County. Timing to investigate this approach is good, as Colorado School of Mines is likely to pursue solar PV implementation in 2012.
- Consider the approach taken in Santa Clara, California, which involved negotiating a third party PPA with several government agencies.
- Test the market by promulgating an RFP for a smaller solar PPA, in order to gauge the market and capture any latent opportunity in the market.
- Set aside funds and maintain vigilance for future opportunities, such as the approach of the 2016 sunset of the federal tax credit, when financing is likely to become more fluid and pricing may accommodate a large-scale PPA.
- Provide financial backing and/or a City-owned site for a Community Solar Garden. When Xcel Energy releases its Community program, it is likely that one or more developers will respond enthusiastically to a City of Golden RFP for a project of this nature. If a Community Solar Garden is implemented—given that some of the kilowatt-hours will be subscribed by the City and some will be subscribed by Golden residents and local businesses—it is important to consider which of the kilowatt-hours generated will count toward the municipal renewable energy goal, and which will count toward the community renewable energy goal.
- Consider issuing a community bond to assist in financing PV or other renewable energy projects. Although the City does not benefit directly from federal tax benefits, this financing structure could provide the City with access to better financing based on these benefits.
- Although this report focuses mostly on strategies for meeting the City's municipal renewable energy goals—based on the assumption that citizens will be inspired by the City's public pursuit of its goals—it is worthwhile to consider incentives for residents and local businesses to implement PV technology.

At this time, researching even a small investment in PV would be a step forward for City of Golden's renewable energy goal—and for providing citizens with a tangible example of Golden's intent to reach for its goals. But given the likelihood of more advantageous financial opportunities in the near-to-medium-term future, now may not be the best time for taking on the entire 50% in a sole investment. In the near term, a more thorough analysis of PV procurement opportunities—including pricing, siting, and fatal flaw analyses—is encouraged.

We suggest that City of Golden invest time and funds in order to line up the best possible renewable energy facilities as opportunities unfold. City of Golden should

establish a coordinated strategy to be ready to act in a timely manner, which will require extensive preparation and market vigilance from City staff, in cooperation with partners at NREL and CSM.

Hydroelectric

Another good technology for generating renewable electricity in our region involves turbines and the gravitational force applied to falling or flowing water. The Upper and Lower Urad reservoirs owned by City of Golden have been considered for this technology.

At this time, with limited information provided by the Henderson Mine, it appears that the results of a feasibility study for a pumped-storage type system utilizing the Upper and Lower Urad reservoirs and a backup wind turbine is unfavorable at this time.

Small hydro projects can be pursued to identify cost-benefits, but realistically, small hydro opportunities represent a small portion of the City's overall consumption.

If a demonstration project near the Henderson Mine is desirable, the City can fund a feasibility study for the two main small-hydro opportunities: a 10kW turbine and 50kW turbine for the outfall between Upper and Lower Urad reservoirs. Like solar PV, private market companies may be able to offer financing for the development of these small hydro demonstration projects.

Wind Turbines

Although Golden often experiences significantly windy conditions, the city's location is unfeasible for large utility-scale wind turbines due to the relatively low resource and lack of suitable sites for large-scale projects. Large wind turbines are most effective at sites where there is a relatively constant supply of wind within a certain range of speed at a certain height above ground. Mapping and testing conducted by NREL confirms that Golden's wind resource is unsuitable at the heights above ground required for large turbines.

Because small-scale wind turbines operate at significantly lower heights above ground and slower wind speeds than large turbines, there are some areas in the Golden area where small turbines might be workable. The amount of electricity generated by small turbines will be limited by the availability of desirable sites and the technology itself, so small wind turbines are likely to provide only a partial offset of the electricity demand of any of the area's commercial, municipal or residential buildings.

We applaud efforts commenced by Golden's Community Sustainability Advisory Board to measure the wind resource at heights above ground appropriate to smaller turbines in several areas around the city. The results of this anemometer testing project may reveal feasible locations where small turbines can be implemented by the City or by community members. While there is no rebate or REC payment

program available via Xcel Energy for small-scale wind power at this time, these systems qualify for the generous federal tax benefits described in the solar PV section of this report.

Natural Gas

In our region, natural gas is the most commonly utilized fuel for heating space and water. City of Golden's natural gas consumption is about 114,000 BTUs per year.

Whereas the City's electricity demand has remained relatively constant in recent years, this is an area where City of Golden's energy efficiency efforts have shown impressive progress. This number is down from about 235,000 BTUs per year in 2007, the baseline year for the City's sustainability initiative.

It is important to note the roles that natural gas and coal electricity play in the economic evaluation of renewable electricity as well as energy efficiency measures. Because coal burned for electricity generation and natural gas form the bulk of Colorado's electricity mix, the cost premium/savings and payback of renewables and efficiency are typically measured against expenditures for fossil fuel-derived energy. And while natural gas in particular is enjoying a renaissance and low prices in the U.S. currently, current forecasts are uncertain and price volatility remains an ongoing issue.

Solar Thermal

Solar Thermal represents a solid option for Golden's heating systems—especially in the case of water heating demand, as reinforced by the successful utilization of solar thermal technology for the swimming pools at the Golden Community Center. Solar thermal systems generate heat by utilizing and transferring the heat in sunlight.

Solar thermal systems are relatively more affordable than PV systems, although financing and incremental purchase opportunities are not as common as with PV.

Solar thermal technology is most effective in settings where plumbing already is utilized for heat—such as hot water systems, or radiant space heating. Buildings with existing radiant systems or high demand for hot water are the best candidates for thermal. While generally cost effective, solar thermal is likely to play at smaller role in the overall energy reduction strategy.

Geothermal

In our region, the term “geothermal” often applies to the utilization of ground source heat pump (GSHP) systems, rather than the utilization of geothermal energy from naturally occurring heat sources such as hot springs and rocks.

Based on utilizing the earth's consistent underground temperatures, ground source heat pumps offset natural gas demand for space heating. Heat pumps rely on the thermal conductivity of the surrounding ground and operate at temperatures between 30°-150°, but are optimized between 40°-80°. The Front Range's extremes of heating and cooling make ground source heat pumps favorable.

Although ground source heat pumps decrease natural gas demand, there is an increase in electricity demand due to the pumps inherent to these systems. Given the nature of Golden's sustainability goals, this tradeoff should be evaluated in combination with the possibility of offsetting additional electricity demand with PV or other renewable electricity generation. . On a common MMBTu basis, however, successful GSHP systems should save significantly more natural gas energy (therms) than the increase in electricity (kWh) used to operate the system.

In our region, horizontally drilled systems are more feasible than vertically drilled systems because vertical systems in Colorado are approximately 150 - 500 feet deep. With Colorado's hard geologic layers, the costs of drilling usually make vertical drilling less cost-effective than horizontal drilling. Other challenges for vertical systems include the presence of gravel underground, which offers less thermal conductivity.

The biggest benefit of heat pumps is that they allow a lower average energy draw from the grid, minimizing utility bills for natural gas. Ground source heat pump systems include a long warranty period (usually 50+ years) and minimal repair costs for the main heat exchanger. Another consideration for ground source heat pumps is the price of natural gas, which affects long-term investment.

The average price for geothermal heat pumps ranges from \$18-\$21/square foot and has an estimated 10-14 year return on investment. . As described above, ground source heat pumps directly offset natural gas or heating fuel usage and their paybacks are determined by the price of the fuel being offset. The current environment of low natural gas prices has generally extended the payback of most ground source heat pumps systems. Conversely, if natural gas rates were to rise, this increase would reduce the time to payback a GSHP. This tradeoff could offer an attractive pricing hedge for natural gas heating.

Like PV and other energy systems, GSHPs can be included in energy savings performance contracts (ESPCs) or some installers offer direct financing. Advantages of utilizing the private sector own and maintain the system is that as a tax-paying entity, they can utilize a 10% federal tax credit and depreciation deductions.

When ground source heat pumps are considered for existing buildings, rather than new construction, several factors are important. If an existing building has a parking lot of significant size and age, the replacement of the parking lot may provide an opportunity for drilling. If a building owner is accruing significant annual costs to maintain HVAC systems, chillers and/or rooftop equipment that is at least 10 or 15 years old, this may also present an opportunity for appropriate retrofit.

Because significant infrastructure is required for ground source heat pump systems, they are often most ideal for new commercial, municipal and industrial buildings, or for buildings undergoing significant remodeling or retrofitting. Although the technology is suitable for residential buildings, few homeowners currently are able

to benefit from tax credits. However, opportunity exists for multi-family home developers that may benefit from purchasing heat pump systems on a larger scale.

Therefore, it is most advantageous to plan for and encourage ground source heat pumps for municipal and private-sector commercial buildings as an effective energy reduction strategy. City of Golden also should research PPA opportunities where a third party may take advantage of the existing tax credits and in turn, offer a ground source heat pump system at a lower cost. Performance contracting may also be an option in this regard.

In terms of geothermal systems designed to utilize naturally occurring heat sources, it is possible to consider utilization of the heat generated by the effluent ponds associated with the Coors water treatment operation, as well as PVC racking placed in the City's water treatment ponds or water treatment plant bays. At 35°-50°, Clear Creek's water temperature is ideally suited for a system of this nature. Also, sewage mains controlled by the City may be used to place a spiral.

Biomass

Biomass technology is based upon the concept of converting biological material as an energy source for fuel. While NREL currently has in operation a working biomass plant designed to take advantage of our state's pine beetle stock, it is not cost-effective due to transportation costs for the fuel—in this case, the trees killed by the pine beetle epidemic.

Biomass tends to be a more effective approach in regions more verdant than the Front Range, where biological fuels are plentiful and do not require transportation over long distances. It is likely that low natural gas prices will continue to make biomass plant investments unfavorable in our region for the foreseeable future.

A few options for evaluating possible opportunities with biomass exist. Several brewers around the state utilize waste products for on-site biomass generation, and a partnership with Coors in this regard bears some investigation. . Currently, however, much of the organic waste material from Coors is used in agriculture feedstock, thus economic barriers may exist. If a workable supply of biomass material can be located in the City's vicinity, a biomass project would be much more feasible.

Biomass strategies can be effectively employed to leverage the methane production of landfill. The City may want to evaluate this possibility for the Foothills or Rooney Road landfill sites. While these systems take advantage of the availability of "free" methane, engines running on electricity are required for the systems to work, so this tradeoff in energy must be considered as part of a methane-capture system.

Student researchers from Colorado School of Mines have discovered a promising sign for the future feasibility of biomass projects in our area. Research involving algae sources from around the globe revealed that one of the world's most productive species is found in Clear Creek. As technology develops for taking advantage of algae's energy potential, Golden may be in a very good position to be on the cutting edge of implementation.

Transportation

The City's sustainability goals call for an overall reduction of Vehicle Miles Traveled (VMT) by 15%.

In addition, the metrics established for evaluating City of Golden's sustainability goals includes the following measures:

- Implementation of fuel alternatives for the municipal vehicle fleet;
- Increased vehicle efficiency for citizen vehicles in Miles per Gallon (mpg)

As a fundamental change to the goals is not required to shift this metric, we recommend measuring progress on both the municipal and community goals based on reduction in Vehicle Miles Traveled (VMT). This step will remove the mpg measurement for the community, helping to streamline pursuit of the goals without precluding the inclusion of alternative fuels for the City's municipal fleet as well.

Needs of citizens across the Front Range will continue to increase in terms of access to biofuels and renewable-energy electric car charging stations. For Golden citizens, implementation of Light Rail and a circulator bus is likely to contribute to a reduction in VMT and there are strategic opportunities to co-locate these services with alternative fueling infrastructure such as electric vehicle charging with solar PV.

In addition, the City should consider a pilot project for a local program involving car-sharing and/or bicycles (traditional or electric), similar in some ways to Denver's B-Cycle program, but fully adapted to Golden's unique requirements. Given the potential usefulness to the student population and high utilization rate that can be achieved from being in a densely populated area, Golden may wish to work with the Colorado School of Mines in a joint venture on a pilot project of this nature.

Fuel Alternatives

A number of alternative fueling options exist for both the local government and citizens of Golden. Consumer vehicles and conversion options are currently commercially available for biofuels, electric, natural gas, and propane. Each of these fuels has unique availability, operational, and environmental characteristics that will be important for the City to prioritize in determining which fuels make sense for particular markets, applications, and policy priorities.

For example, one fuel alternative currently enjoying popularity is compressed natural gas (CNG). Although this option provides reduced emissions over diesel fuel, it is generated with natural gas—one of the energy sources City of Golden seeks to reduce under its sustainability goals. This is a subject of consideration for City Council because most fuel alternatives—other than electric cars charged with renewable electricity—rely on fossil fuel sources in varying proportions.

As alternative fuel vehicles become more readily available and cost-effective, the need for alternative fueling infrastructure is expected to increase. According to the U.S. Department of Energy, there are 6 alternative fuel stations within 5 miles of downtown Golden including 4 electric vehicle charging stations, 1 compressed natural gas (CNG) station (private), and 1 liquefied propane gas (LPG) station.

Golden should seek grant funding and other financial opportunities to provide regional leadership by increasing availability of alternative fueling infrastructure for citizens and visitors to Golden. The City also should seek to leverage public-private partnerships and resources that can ultimately lead to the greater use of alternative fuels. There may also be strategic opportunities to explore a partnership with the National Renewable Energy Laboratory in promoting alternative fueling infrastructure.

Most of City of Golden’s fleet runs on diesel fuel, and the City purchases an average of 82,000 gallons of diesel fuel per year.

	2007	2008	2009	2010
Total gallons	80,089	91,808	73,508	83,984
percent from 2007 baseline	n/a	14.63%	-8.22%	4.86%

Golden’s significant diesel fleet provides an opportunity to utilize biodiesel. Most blends of biodiesel can be utilized in diesel engines without the need for modification.

Biodiesel can be derived from a variety of different feed stocks, which affect the relative emissions reduction compared to diesel. It will be important to understand the options and ensure that all fuels include relevant purity certifications.

Golden should also look for opportunities to make bulk or long-term biodiesel purchases to decrease volatility in fleet operating expenses. Golden may choose to approach other local jurisdictions about negotiating jointly with fuel distributors in order to achieve the best possible pricing.

City of Golden also should consider issuing an RFP for a procurement contract for biodiesel. This approach provides a strategy for managing a fuel transition and keeping a known cap on the cost.

At this time, biodiesel has a cost premium compared with petroleum diesel, and efforts are underway to bring to market biodiesel formulations offering reduced cost and improved fuel sources such as algae.

New Belgium brewery is currently utilizing waste products to grow algae for biofuels. The City of Golden might approach MillerCoors regarding a partnership to evaluate opportunities to utilize waste streams to produce energy.

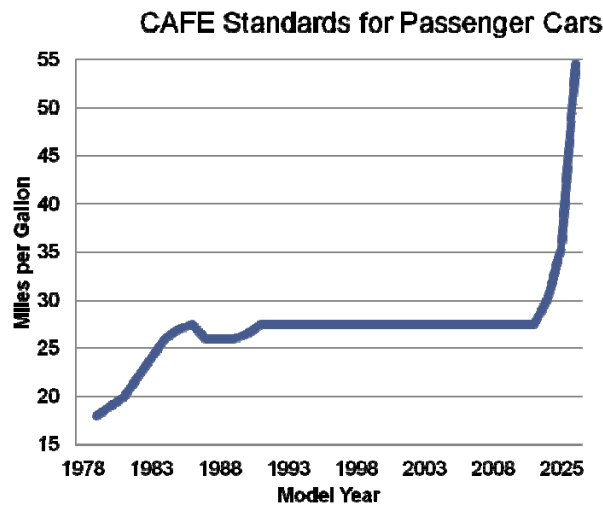
As mentioned above, it also is possible for Golden to implement CNG, which typically requires either a vehicle purchase or conversion, as well as significant new infrastructure for filling stations, but can provide substantial economic savings due to the low price of natural gas. As mentioned earlier in this report, current forecasts regarding sustained natural gas prices are uncertain and price volatility remains an ongoing issue.

Golden should seek knowledgeable guidance from jurisdictions already implementing biodiesel and CNG, such as Denver and the State of Colorado.

The Regional Air Quality Council is launching a project designed to help implement electric vehicles and reduce diesel emissions. City of Golden should pursue funding through this project.

Increased Vehicle Efficiency

There are a number of opportunities to improve efficiency of Golden’s vehicle fleet. Federal corporate average fuel economy standards (CAFE) for light-duty passenger vehicles will be dramatically increasing between now and 2025 to an average of 54.5 MPG. By purchasing vehicles that meet or exceed these standards, Golden can ensure that its fleet will be leveraging new fuel efficient technologies.



Additional opportunities for efficiency such as hydraulic hybrids also may be explored for larger, heavy-duty vehicles. More broadly, optimized routing can be beneficial to fleet vehicles with consistent travel patterns.

The City of Golden should also review its procurement policy to ensure that there are no artificial barriers to leveraging fuel efficiency or the use of alternative fuels. This may include the evaluation of total lifecycle costs when making purchasing decisions and developing policies for “right-sizing” the vehicle and limiting 4WD vehicles solely to applications where needed. Significant efficiency gains can be made by utilizing 2WD trucks for most purposes.

Energy Efficiency

As noted in several areas of this report, energy efficiency measures are integral to an overall renewable energy strategy. The estimates for a 3 – 4 MW solar system needed for the municipal use assumes a 20% reduction in energy consumption, as dictated by the goals. If the City is unable to meet the energy reduction goal, it will require a larger investment in renewable systems to meet Golden’s goals.

Buildings consume a disproportionate amount of energy over time, so more efficient buildings pay dividends in reduced lifetime costs for energy--as well as moving the Golden toward its energy efficiency goals. As part of the City’s energy reduction strategies, we urge Golden’s City Council to adopt the latest version of International Building Codes, including the 2012 International Energy Conservation Code.

Energy efficiency opportunities often are best identified and implemented by those managing the day-to-day operations of any entity. City staff can be the most effective advocates for measures to help meet the municipal energy efficiency goal.

In terms of the community goal, the City’s completion of its first LEED-certified municipal building provides an important opportunity to demonstrate leadership and to promote leading energy efficiency best practices.

In addition, energy concierge programs designed to provide support and education for citizens regarding energy efficiency rebates and technology have helped other communities to increase citizen implementation with basic measures such as improved insulation, windows, and lighting.

The City and its citizens also will benefit from measureable savings generated by investments in energy efficient features—which is likely to inspire more widespread implementation. City of Golden can track and publicize the effectiveness of energy efficiency measures implemented by the City, as well as by citizens.

Strategies and Opportunities

While it is by no means a comprehensive index, this section summarizes many of the recommendations offered in this report.

Executive Summary

It is important to agree upon an acceptable incremental cost to achieve these goals, develop a long-term funding strategy, and continually monitor advances in technologies, incentives, grants and financing models that will allow the City to procure new resources when they are most cost-effective.

If any future effort is undertaken to refine the City's renewable energy and energy efficiency goals, we recommend keeping as paramount concern the rigorous intent expressed by the citizens who crafted these goals.

The City should consider refining the timeline for the renewable energy and energy efficiency goals, along with establishing a defined financial strategy for meeting the goals under a new timeline. Given the broad nature of the goals, as part of a new timeline we recommend including incremental milestones toward the overall goals.

Electricity

Within the context of Golden's renewable energy generation, an important point to consider is the City's priorities in achieving these goals.

At this time, researching even a small investment in PV would be a step forward for City of Golden's renewable energy goal—and for providing citizens with a tangible example of Golden's intent to reach for its goals. In the near term, a more thorough analysis of PV procurement opportunities—including pricing, siting, and fatal flaw analyses—is encouraged.

We suggest that City of Golden invest time and funds in order to line up the best possible renewable energy facilities as opportunities unfold. City of Golden should establish a coordinated strategy to be ready to act in a timely manner, which will require extensive preparation and market vigilance from City staff, in cooperation with partners at NREL and CSM.

Additional options mentioned with regard to solar PV:

- Seek to decrease Golden's costs by negotiating an aggregate PPA including City of Golden with other entities such as Colorado School of Mines or Jefferson County. Timing to investigate this approach is good, as Colorado School of Mines is likely to pursue solar PV implementation in 2012.

- Consider the approach taken in Santa Clara, California, which involved negotiating a third party PPA with several government agencies.
- Test the market by promulgating an RFP for a smaller solar PPA, in order to gauge the market and capture any latent opportunity in the market.
- Set aside funds and maintain vigilance for future opportunities, such as the approach of the 2016 sunset of the federal tax credit, when financing is likely to become more fluid and pricing may accommodate a large-scale PPA.
- Provide financial backing and/or a City-owned site for a Community Solar Garden. When Xcel Energy releases its Community program, it is likely that one or more developers will respond enthusiastically to a City of Golden RFP for a project of this nature. If a Community Solar Garden is implemented—given that some of the kilowatt-hours will be subscribed by the City and some will be subscribed by Golden residents and local businesses--it is important to consider which of the kilowatt-hours generated will count toward the municipal renewable energy goal, and which will count toward the community renewable energy goal.
- Consider issuing a community bond to assist in financing PV or other renewable energy projects. Although the City does not benefit directly from federal tax benefits, this financing structure could provide the City with access to better financing based on these benefits.
- Although this report focuses mostly on strategies for meeting the City’s municipal renewable energy goals—based on the assumption that citizens will be inspired by the City’s public pursuit of its goals--it is worthwhile to consider incentives for residents and local businesses to implement PV technology.

Natural Gas

Solar thermal technology is most effective in settings where plumbing already is utilized for heat—such as hot water systems, or radiant space heating. Buildings with existing radiant systems or high demand for hot water are the best candidates for thermal.

It is most advantageous to plan for and encourage ground source heat pumps for municipal and private-sector commercial buildings as an effective energy reduction strategy.

City of Golden also should research PPA opportunities where a third party may take advantage of the existing tax credits and in turn, offer a ground source heat pump system at a lower cost. Performance contracting may also be an option in this regard.

Transportation

The Regional Air Quality Council is launching a project designed to help implement electric vehicles and reduce diesel emissions. City of Golden should pursue funding through this project.

By purchasing municipal vehicles that meet or exceed increasing CAFE standards for light-duty passenger vehicles, Golden can ensure that its fleet will be leveraging new fuel efficient technologies.

Additional opportunities for efficiency such as hydraulic hybrids also may be explored for larger, heavy-duty vehicles.

The City of Golden also should review its procurement policy to ensure there are no artificial barriers to leveraging fuel efficiency or the use of alternative fuels. This may include the evaluation of total lifecycle costs when making purchasing decisions and developing policies for “right sizing” the vehicle and limiting 4WD vehicles solely to applications where needed.

We recommend measuring progress on both the municipal and community goals based on reduction in Vehicle Miles Traveled (VMT). This will remove the mpg measurement for the community, helping to streamline pursuit of the goals without precluding the inclusion of alternative fuels for the City’s municipal fleet as well.

There are strategic opportunities to co-locate the new Light Rail station with alternative fueling infrastructure such as electric vehicle charging with solar PV. In addition, the City should consider a pilot project for a local program involving car-sharing and/or bicycles (traditional or electric). Golden should seek grant funding, public-private partnerships and other financial opportunities to provide regional leadership by increasing availability of alternative fueling options for citizens and visitors to Golden.

Golden should look for opportunities to make bulk or long-term biodiesel purchases to decrease volatility in fleet operating expenses. Golden may choose to approach other jurisdictions about negotiating jointly with fuel distributors in order to achieve the best possible pricing. City of Golden also should consider issuing an RFP for a procurement contract for biodiesel.

Golden should seek knowledgeable guidance from jurisdictions already implementing biodiesel and CNG, such as Denver and the State of Colorado.

Energy Efficiency

We urge Golden’s City Council to adopt the latest version of the International Building Codes, including the 2012 International Energy Conservation Code (IECC).

City staff can be the most effective advocates for measures to help meet the municipal energy efficiency goal.

The City's completion of its first LEED-certified municipal building provides an important opportunity to demonstrate leadership and to promote leading energy efficiency best practices.

Energy concierge programs designed to provide support and education for citizens regarding energy efficiency rebates and technology have helped other communities to increase citizen implementation.

City of Golden can track and publicize the effectiveness of energy efficiency measures implemented by the City, as well as by citizens.