Energy Efficiency

Bottom Line Opportunities for Metro Denver Companies
June 2006

Metro Denver
Economic Development Corporation

www.metrodenver.org

Executive Summary

The Rocky Mountain region has traditionally been known for its fossil fuel reserves, due to significant concentrations of natural gas, clean coal and oil shale. The Colorado School of Mines is a center of excellence in fossil fuel study and research. A lesser-known fact is that the region is also rich in renewable energy resources and home to the country's top energy research institute, the National Renewable Energy Laboratory (NREL).

That convergence of energy resources effectively establishes the Metro Denver region as the "Balanced Energy Capital of the West." Affordable, reliable and clean energy produced from diverse, domestic sources is critical to America's prosperity and security, and Metro Denver's energy industry is leveraging the region's rich technological, human and natural resources to help meet an increasingly critical need.

Recognizing energy's importance to the economy, the Metro Denver Economic Development Corporation (Metro Denver EDC) commissioned the Colorado Energy Science Center (a local nonprofit formed by the managing partners of NREL) to assess the potential for energy efficiency in the Metro Denver region. Implementing energy efficiency initiatives in Metro Denver's commercial markets will help reduce the adverse economic impact from rising energy prices, supply shortfalls, and price volatility.

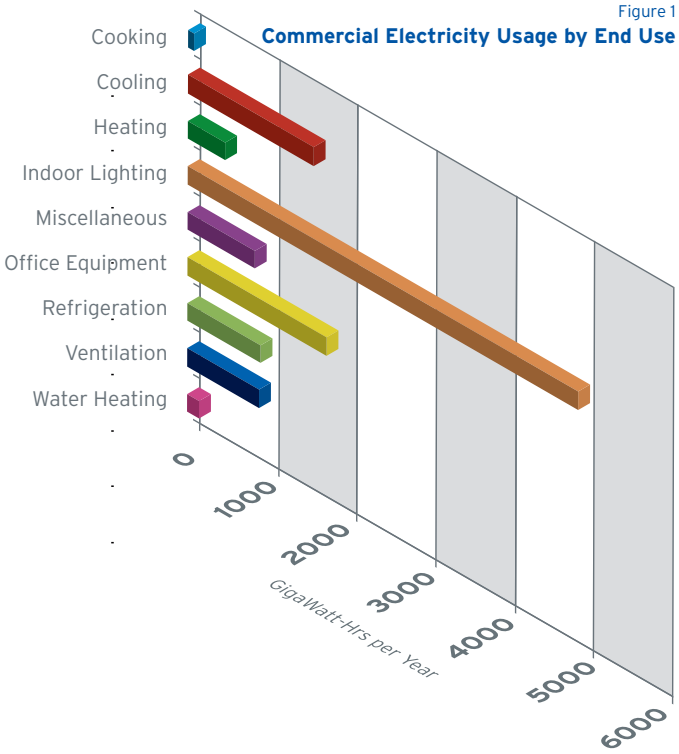
Historically, energy conservation has been promoted in the residential market, yet lacked strategy focused on commercial sectors. With rising energy prices, the "business case" for energy efficiency programs in the commercial building sector has created a viable economic opportunity.

The Metro Denver EDC, serving the nine-county business community (Adams, Arapahoe, Boulder, Broomfield, Denver, Douglas, Jefferson, Larimer, and Weld Counties) focuses its efforts on helping companies relocate and expand to the area. Therefore, this study focuses on the commercial sector to generate the greatest overall economic impact.

The Energy Efficiency Study applies market principals that focus on return on investment to businesses choosing to invest in straightforward energy efficiency programs. The study also proposes voluntary initiatives based on best practices throughout the United States.

Electricity fuels nearly two-thirds of commercial energy use. The largest end-use of electricity is indoor lighting, which uses nearly three times as much electricity as air conditioning or office equipment, the next largest end-uses. This report concentrates on energy savings in these largest end-uses, each of which offer promising opportunities for energy efficiency. The analysis focuses on the most common types of commercial buildings—office and retail.

Figure 1
Commercial Electricity Usage by End Use



The Potential Economic Impact of Implementing Energy Efficiency

Energy efficiency reduces utility bills, freeing up money that can be invested in the local economy. Two important studies were used to quantify energy efficiency's economic impact. The first study, Xcel Energy's 2006 Colorado Demand-Side Management Market Potential Assessment, incorporated new data and was combined with The New Mother Lode: The Potential for More Efficient Electricity Use in the Southwest, authored by The Southwest Energy Efficiency Project, with funding from foundations, the U.S. Environmental Protection Agency and the U.S. Department of Energy.

Energy efficiency is a resource, realized by installing efficient equipment or controlling its use in a more efficient manner. Table 1 shows the costs and savings that could be realized in the most common commercial building types. In many cases, energy efficiency measures pay for themselves in a relatively short period of time.

Table 1: Energy Efficiency Costs and Savings by Building Type

Building Type	Incremental Cost ($/ft^2)	Energy Savings ($/ft^2/yr)	Payback Period (years)
Existing Retail	1.97	.83	2.4
New Retail	1.53	.61	2.5
Existing Office	1.59	.59	2.7
New Office	1.58	.44	3.6

If energy efficiency measures were installed in just half of Metro Denver's existing buildings throughout the next 20 years, and if use of energy efficient design in new buildings was to increase gradually so that 80 percent of new buildings were built efficiently by 2026, the impact would be dramatic. A $600-million cumulative investment would produce nearly $1.9 billion in energy savings. By 2026, that savings could also result in the creation of more than 12,000 jobs and an increase in wages and salaries by more than $300 million.

Table 2: Costs and Savings of Energy Efficiency Over 20 Years (in millions of dollars (2006))

	2007	2010	2016	2022	2026	Total
Implementation Costs	14.5	18.1	27.3	39.8	50.6	595
Energy Savings	5.7	25.4	77.5	152.2	218.3	1,870
Benefit-Cost Ratio	0.4	1.4	2.8	3.8	4.3	3.1

Commercial Programs in Colorado and Elsewhere

The potential economic benefits of implementing energy efficiency measures are significant. Understanding the efforts already in place to implement energy efficiency can enhance plans to accelerate commercial energy efficiency implementation.

Programs Addressing Commercial Efficiency Programs

National Programs

- ENERGY STAR®
- Leadership in Energy and Environmental Design Green Building Rating System™
- Building Owners and Managers Association (BOMA)
- EcoBroker™

State Programs

- Rebuild Colorado
- ColoradoEnergy.org

Utility Programs

- Xcel Energy's Demand-Side Management Program
- Fort Collins Utilities
- Platte River Power Authority

Local Programs

- Building Performance with ENERGY STAR®
- Northeast Metro Pollution Prevention Alliance

Model Commercial Energy- Energy-Efficiency

Austin

- Austin Energy, the municipal utility, offers rebates and has reduced electric demand by over 500 Megawatts.
- A pioneer green building program
- Approach combines free services with mandatory standards

Portland

- Promotes commercial efficiency through its Office of Sustainable Development
- Invested $68.5 million in commercial and institutional buildings
- Offers two different awards programs
- Climate trust buys greenhouse gas emission reductions

Seattle

- Seattle City Light, a municipal utility, offers free design assistance and rebates
- Evaluation unit has produced extensive reports on the program's effectiveness

A Proposal for an Energy Efficiency Initiative

What efforts can the Metro Denver EDC undertake to establish the Metro Denver region as an energy efficiency leader?

Energy efficiency and building energy management experts were consulted and possibilities for an efficiency initiative were explored through a series of meetings and interviews. Consultation with energy engineering firms and energy service companies was especially helpful because the energy analyses these firms produce is essential to a comprehensive energy efficiency project. These firms, surprisingly, do most of their business with public agencies. For years, the public sector has benefited from laws and policies that encourage energy efficiency implementation and enable public agencies to utilize third-party financing offered by energy service companies.

Energy engineering firms and service companies note that potential private-sector energy efficiency projects often stall even

though the return on investment is very attractive. These unimplemented projects tend to be stand-alone energy efficiency projects, which can be time consuming and disruptive for facility managers.

A better way to implement energy efficiency, experts say, is to incorporate the measures into the construction or renovation of a building:

- These types of projects proceed regardless of the merits of the energy efficiency measures.
- The cost of installing energy efficiency measures is lower because energy-related systems are already being installed.
- The parties involved in these types of projects tend to have a longer term financial perspective. An energy efficiency project that produces a positive cash flow throughout the five- or ten-year term of purchase or lease (monthly energy savings greater than the monthly payment to repay the construction loan or tenant improvement) enhances the project's benefits.

Energy engineering firms and service company representatives recommended that the Metro Denver EDC energy efficiency initiative should encourage companies to consider making energy efficiency improvements when they purchase a building or sign a long-term lease.

Subsequent meetings with the Metro Denver EDC Energy Committee and with professionals involved with these types of transactions have confirmed that such an initiative could produce substantial economic benefits.

Recommendations

The proposed initiative is a voluntary program in which Metro Denver businesses would consider energy efficiency as they plan to purchase, lease or construct commercial space. This initiative would accomplish several goals:

- To build demand for energy efficient commercial space
- To encourage the inclusion of energy efficiency measures when constructing or renovating commercial buildings
- To help building owners and property managers obtain a thorough energy analysis of their building
- To help building owners and property managers secure utility rebates and tax incentives

Implementation Plan

Voluntary programs historically have experienced varied success. Some consist of little more than a program concept and a brochure or website. However, several voluntary programs worldwide have achieved tremendous results. The ability of a voluntary program to achieve results is mostly determined by the effort invested.

Next steps to developing an ongoing voluntary Energy Efficiency Program:

1. Establish the Colorado Energy Coalition, a consortium of private sector energy companies, research institutions, existing energy associations, and higher education.

2. Metro Denver EDC recruits 5-10 companies, possibly Metro Denver EDC investors, to voluntarily commit to making energy efficiency a factor in their next office space decision.

3. The participating companies would formalize their participation by issuing a letter of intent or press release, and/or by establishing an internal policy to ensure that energy efficiency is considered in their next office space decision.

4. The Metro Denver EDC or a subsequent energy organization will establish a program website to serve as a convenient program information source.

5. The Metro Denver EDC or a subsequent organization will maintain regular communications with the participating

6. Participating companies consult with energy engineering firms as they begin their search for a building to purchase or lease.

7. The Metro Denver EDC or a subsequent organization will publicize the commitment of participating companies to property owners and managers, encouraging them to upgrade the efficiency of their buildings.

8. The Metro Denver EDC or a subsequent organization will work with local governments and with the Metro Mayors Caucus' Energy Committee to enlist their support for this effort.

9. The Metro Denver EDC or a subsequent organization will explore the possibility of a small administrative fee being paid by the participating companies on each energy efficiency project to fund an ongoing communication and outreach effort. Modest ongoing funding is essential to grow and maintain an effective voluntary program.

10. Complete energy analyses would be provided to the participating companies in a prompt fashion, so the purchase or lease transaction is not delayed.

11. Energy efficiency measures identified as cost-effective are incorporated into the design of the building or building renovation.

12. Energy efficiency measures are implemented.

13. The Metro Denver EDC or a subsequent organization promotes the success of the initial projects and expands the effort to more companies.

If you would like more information regarding the Metro Denver EDC's voluntary Energy Efficiency Program, contact **Holli Baumunk**, vice president of Economic Development for the Metro Denver EDC at **303.620.8025. (holli.baumunk@metrodenver.org)**

Acknowledgments

This report, researched and written by Patrick Keegan, Executive Director of the Colorado Energy Science Center (CESC), and Project Engineer Xochitl Zamora-Thompson, is the result of the direction set by the Metro Denver Economic Development Corporation (Metro Denver EDC), an affiliate of the Denver Metro Chamber of Commerce. Special acknowledgements go to Executive Vice President Tom Clark, Vice President of Economic Development Holli Baumunk, Director of Marketing Janet Fritz, and the Energy Committee chaired by Peter Dea, President and CEO of Western Gas Resources.

Others contributing research or technical advice include:

- Three graduate engineering students from the University of Colorado: Daniel Tuhus-Dubrow, Michael Eardley and Iwen Tseng, who completed a report that helped estimate the energy efficiency potential in the nine-county Metro Denver area.
- Lloyd Levy, a local economist, who provided advice on qualifying the estimate of economic impacts.
- Morey Wolfson, a local energy expert, who assisted with Chapter 3.
- Patricia Silverstein, chief economist for the Metro Denver EDC, who provided advice and demographic information.
- The International Consortium of Local Environmental Initiatives (ICLEI), which provided information and consul that helped with the development of Chapter 4.

This report's estimate of energy efficiency potential is based on two important studies:

- *The New Mother Lode*, a 2001 study by the Southwest Energy Efficiency Project, a Colorado nonprofit organization that works on energy efficiency issues throughout the six-state southwest region of the United States.
- *The Colorado Demand-Side Management Market Assessment*, produced by the KEMA consulting firm for Xcel Energy, released in April 2006.

To produce the report, the CESC consulted with the region's top experts in energy efficiency, energy management and building management, including: Bill Gruen, Xcel Energy; Jim Crossman, Financial Energy Management; Jim Knutson, URS; Carl Hurst, Johnson Controls; Kittie Hook, Fuller and Company; Lori Carter, Amerimar Realty Management; Michael Miller, Bluenergy; Jack Tate, Long Energy Solutions; Steve Grund, Aardex; and Patty Crow, USEPA.

Special thanks and recognition also go to the members of the Metro Denver EDC's Energy Committee: Tom Ashburn, Xcel Energy; Drew Bolin, Colorado Office of Energy Management; Michelle Claymore, Jefferson Economic Council; Beth Conover, City and County of Denver; Craig Cox, Colorado Coalition for New Energy Technologies; Don Clague, Petro-Canada; Peter Dea, Western Gas Resources, Inc.; Martin Eiss, RNL Design; Don Fitzmartin, CB Richard Ellis; Bill Gruen, Xcel Energy; Steve Grund, Aardex; Kittie Hook, Fuller and Company; Patrick Keegan, Colorado Energy Science Center; Jim Kirchheimer, Downtown Denver Partnership; Jim Knutson, URS; Jim Long, CRESA Partners; Tim Martinez, Denver Office of Economic Development; David Morrison, CB Richard Ellis; Stan Pence, Consulate General of Canada; Tom Rackley, Kiewit Construction; Janice Rooney, National Renewable Energy Laboratory; Greg Schnacke, Colorado Oil & Gas Association; Kris Smith, Suncor; Don Ulrich, CH2M HILL; Steve Wagner, Merrick & Company; and Pete West, Xcel Energy.

Forward

By Peter Dea, President and CEO, Western Gas Resources and Chair of the Metro Denver EDC's Energy Committee

This report outlines many significant yet relatively easy steps to initiate or expand energy efficiency programs in the Metro Denver area. These steps can be applied by the public and private sectors.

Broader application of energy efficiency in Metro Denver is more than a sustainable and environmentally responsible direction; it is a smart investment. Furthermore, energy efficiency is essential given the tight supply/demand of nonrenewable resources and the limited supply and reliability of renewable resources for the foreseeable future. Given the significant cost and effort to find and deliver energy to consumers, the business community must do its part to use energy wisely through greater efficiency and conservation.

Each of you reading this report plays a big role as a business or community leader in the Metro Denver area. Your actions and your leadership, at the local level, are the single most significant catalyst in achieving greater energy efficiency. The Metro Denver EDC looks forward to partnering with you on this endeavor.

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Introduction

The Rocky Mountain region has traditionally been known as the fossil fuel production corridor of the United States due to large concentrations of natural gas reserves, clean coal and oil shale. A lesser known fact is that the region is also rich in renewable energy resources and home to some of the country's top energy research institutes, such as the National Renewable Energy Laboratory (NREL) and the Colorado Energy Research Institute located at the Colorado School of Mines.

The Metro Denver region is rich in both fossil fuels and renewable energy, establishing it as the "Balanced Energy Capital of the West." Metro Denver's energy industry is leveraging the region's rich technological and natural resources to overcome many of the energy challenges facing the world today. Affordable, reliable and clean energy produced from diverse, domestic sources is critical to America's prosperity and security. Ever-increasing energy demands from consumers require new energy efficiency and new renewable energy technologies as part of a larger energy supply solution.

Recognizing energy's importance to the economy, the Metro Denver EDC commissioned the Colorado Energy Science Center (a local nonprofit formed by the managing partners of NREL) to produce an Energy Efficiency Study for Metro Denver. The study evaluated Metro Denver's commercial and retail real estate markets in an effort to reduce the adverse economic impact from rising energy prices, supply shortfalls, and price volatility to business.

Historically, energy conservation has been promoted in the residential market, yet lacked a strategy focused on commercial sectors. With rising energy prices, the "business case" for energy efficiency programs in the commercial building sector has created a viable economic opportunity.

The Metro Denver EDC, serving the nine-county business community (Adams, Arapahoe, Boulder, Broomfield, Denver, Douglas, Jefferson, Larimer and Weld Counties) focuses its efforts on helping companies relocate and expand to the area. Therefore, this study focuses on the commercial sector to generate the greatest overall economic impact:

- Presenting an analysis of how significant the opportunities are in terms of investment, return on investment and job growth.
- Summarizing the programs, organizations and other resources that are available to assist commercial businesses in their efforts to implement energy efficiency.
- Listing examples of best practices in commercial energy efficiency throughout the country.
- Proposing an initiative that can be undertaken by the Metro Denver EDC and subsequent organizations to capitalize on energy efficiency opportunities, along with a website to market and sustain a focus on energy efficiency.

For the purposes of this study, the Metro Denver EDC's Energy Committee acknowledged four main sectors of energy use: commercial, residential, industrial and transportation. The committee decided to focus this study on the commercial sector because it is here that the Metro Denver EDC can realize the largest economic impact. The committee also recognized that much progress was being made in other sectors:

- Xcel Energy addresses residential and industrial in its demand-side program;
- Industrial energy users may also benefit from this proposed initiative;
- Voters approved FasTracks in 2004, the nation's most ambitious new mass transportation system; and,
- The City of Denver's Sustainability Council is focused on transportation efficiency, including a biodiesel Green Fleets Program.

Commercial Energy Use in Colorado

The commercial and industrial sectors use similar amounts of energy, each representing a little less than a quarter of the state's energy consumption (Figure 1). The commercial sector is the focus of this report because this sector is part of the Metro Denver EDC's overall economic development strategy. However, the industrial sector could also benefit from the energy efficiency initiative outlined at the end of this report.

Figure 1
Colorado Energy Consumption by Sector

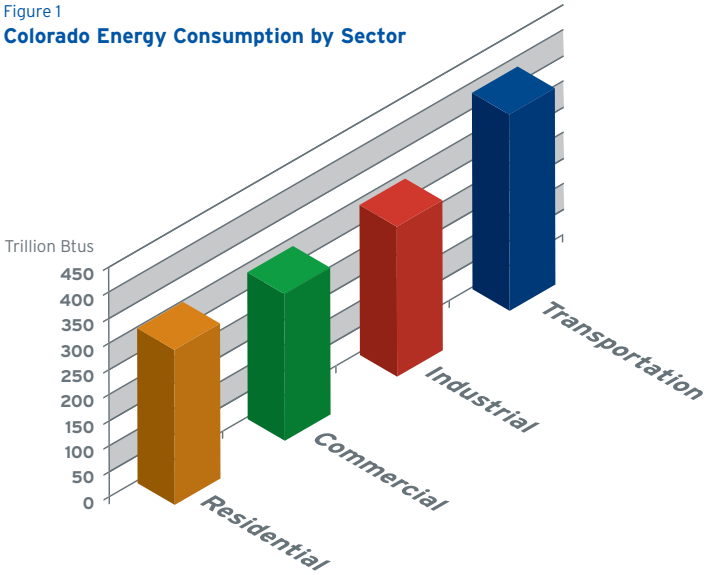
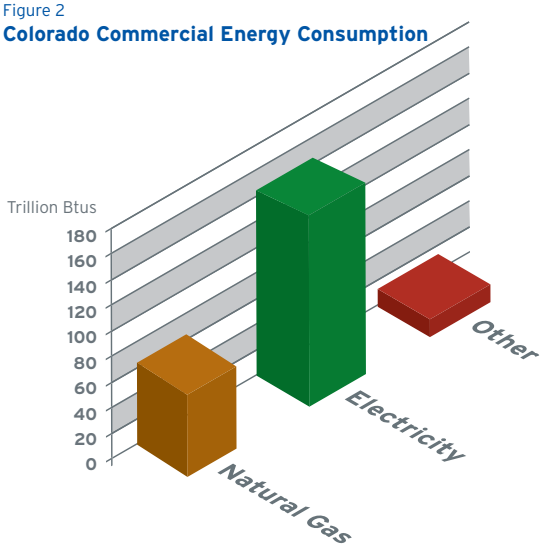


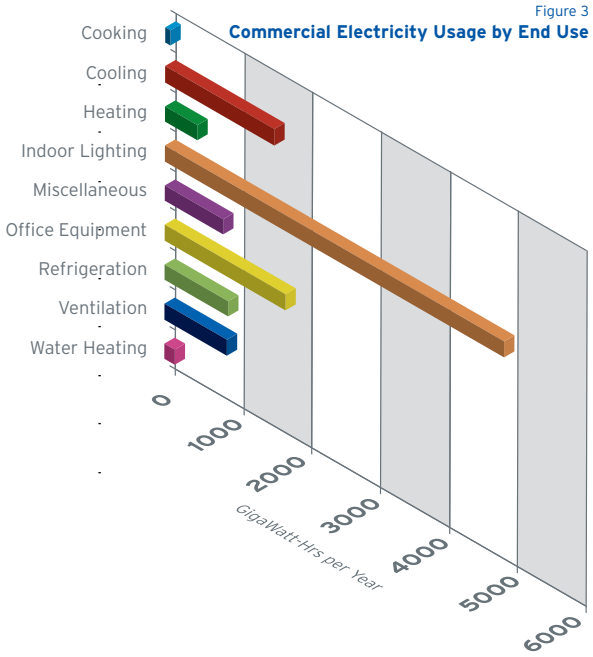
Figure 2
Colorado Commercial Energy Consumption



Buildings have become more dependent on electricity throughout the last several decades. More than 65 percent of the energy provided to commercial buildings in Colorado is in the form of electricity (Figure 2). The source of most electricity for the Metro Denver area continues to be coal, a resource plentiful in Colorado and neighboring states, which generated 79 percent of Colorado's electricity in 2001. Natural gas, which is also plentiful in the Rocky Mountain West, generated 18 percent and will increase in subsequent years as hundreds of megawatts of natural-gas generation come on line, mostly to meet rapidly growing peak demand. Renewable energy provided only about 3 percent of electric generation in 2001, but this share will grow. Wind farms have been built in Eastern Colorado in the last several years as wind has become a cost-effective source of electric generation. Colorado voters passed Amendment 37 in 2004, which directs the largest utilities in the state to generate 10 percent of their electricity from renewable sources by 2015. Most of Metro Denver's electricity will come from nonrenewable sources for many years, underscoring the need to focus on all aspects of efficiency.

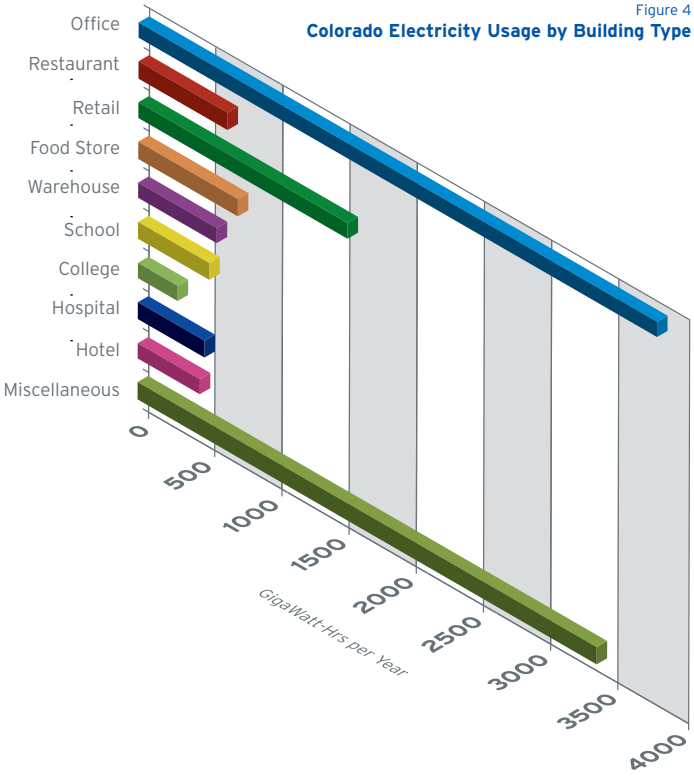
Indoor lighting uses more electricity in commercial buildings than any other single use (Figure 3). Xcel Energy's Demand-Side Management (DSM) Market Potential Assessment shows indoor-lighting load is about 5,000 gigawatt-hours/yr (1 GWh = 1,000,000 kilowatt-hours), nearly three times as much as air conditioning or office equipment, the next largest end uses. The energy efficiency potential quantified in this report concentrates on energy savings in these largest end uses.

Figure 3
Commercial Electricity Usage by End Use



The same Xcel Energy study includes the best recent characterization of building types in the Metro Denver area. Although the commercial sector is diverse, office and retail buildings dominate the sector (Figure 4).

Figure 4
Colorado Electricity Usage by Building Type



What is energy efficiency?

The purpose of energy efficiency programs is to reduce the amount of energy used without affecting the systems used or the quality of the services or products provided. The efficiency with which energy is used can be increased by implementing specific technologies and measures (see Table 1 on the following page) and managing energy demand more effectively, potentially reducing both energy and demand requirements without reducing the end-use benefits.

Figure 5 shows the drop in energy use that occurs for a series of energy efficiency measures related to lighting. The bar on the left is the energy used by 12 typical light fixtures containing "T12" lamps, which are the thicker, 1½-inch fluorescent tubes. By switching to the thinner "T8" lamps and electronic ballasts, the energy use for these lamps drops one-third, from nearly 9,000 kilowatt-hours(kWh)/year to less than 6,000 kWh/year. Adding better reflectors, occupancy sensors and regular maintenance drops the usage to less than 2,000 kWh/year, a reduction of more than 80 percent. Many large office buildings already have T8 lamps installed, but as this figure shows, there are savings to be gained by improving other areas of the T8 system beyond the lamps and ballasts.

Figure 5
Lighting Efficiency: kWh's/yr for 12 Fixtures

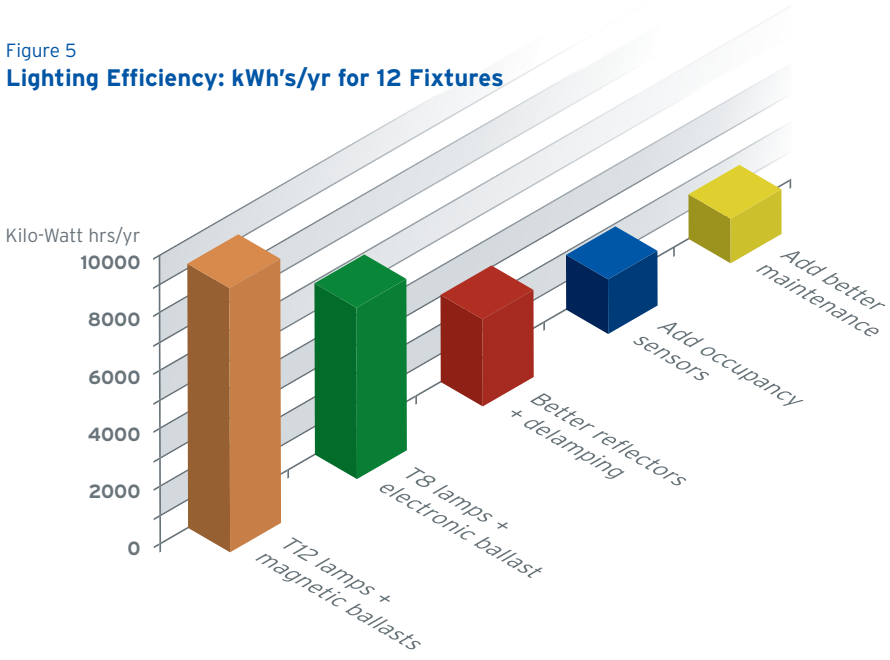


Table 1: Major Commercial Energy Efficiency Measures*			
System	Description	Example Measures	Potential Savings[a]
Lighting	Lamps, fixtures and ballasts	Replacing T12 fluorescent lamps Using sensors/controls	Total = 50+% Cost = 20–45%
Heating, Ventilating and Air Conditioning (HVAC)	Fans, chillers, boilers, ducts, pumps, cooling towers, etc.	Replacing low-efficiency equipment Sealing air distribution ducts Increasing building insulation Reducing infiltration	Total = 9–15% (25% of natural gas use)
Office Equipment	Computers, printers, copiers, fax machines, etc.	Replacing low-efficiency equipment Utilizing energy-saving features Turning off equipment when not used	Total = 15–20%

* Southwest Energy Efficiency Project, 2002

The Impacts of Energy Efficiency

Simply put, cost-effective investments in energy efficiency reduce utility costs. That cost savings pays for the energy efficiency investments and continues to accrue throughout the life of the investments. Savings may then be reinvested in the business or realized as profit.

Reducing energy demand also reduces investment by utilities in the development of new generation capacity and transmission facilities or in the importing of electricity. Efficiency is a resource for utilities that helps them meet energy demand just as new generation resources do. For this reason, Xcel Energy and other electric utilities initiate demand-side management (DSM) programs that pay rebates to end users who invest in energy efficiency products or technologies.

As energy users reduce their utility bills, they begin spending this money elsewhere, creating a positive economic impact that will ripple through the economy.

In addition to the financial benefits, improvements in business energy efficiency reduce the environmental effects of energy generation, distribution and consumption.

Energy on the Inside: Efficiency in Commercial Buildings

Energy efficiency reduces utility bills, freeing up money that can be invested in the economy. The economic impact of energy efficiency can be quantified by answering a series of questions:

- How much energy efficiency potential is available in commercial buildings in the Metro Denver area?
- How much investment will be required?
- By how much will energy bills be reduced?
- What economic effect will result from this investment and energy savings?

These questions have been addressed many times throughout the last few decades, in different areas of the country and for different types of energy use. Two analyses that address these questions in Colorado form much of the basis of this report. The first study, *The New Mother Lode: The Potential for More Efficient Electricity Use in the Southwest*, was completed by the Southwest Energy Efficiency Project, with funding from foundations, the U.S. Environmental Protection Agency and the U.S. Department of Energy.

The second analysis used in this report is the recent *Colorado Demand-Side Management Market Potential Assessment*, commissioned by Xcel Energy and written by KEMA, a consulting firm. This study was a more extensive undertaking that involved detailed surveying of energy users and energy experts. The report focuses on Xcel's service territory in Colorado, most of which is within the nine-county Metro Denver area. A majority of the energy savings identified by the Xcel Energy assessment are in the commercial sector.

Energy efficiency is a resource. It can be quantified much like fossil fuel reserves. But it is a demand-side resource, residing within every commercial building. The amount of energy efficiency potential in a building depends upon the quantity and the efficiency of the end uses, such as lighting and cooling. Weather conditions, the efficiency of the building envelope and the behavior of the occupants are also important factors.

Energy efficiency is realized by installing efficient equipment or controlling its use in a more efficient manner. The product is unused energy, which is quantified by monitoring efforts and an engineering analysis. This report focuses on the "economic potential," which is the amount of energy efficiency that can be economically implemented.

The analysis focused on the following factors:

- We considered three commercial building types—non-mall retail, mall and strip retail, and office—to reduce the complexity of the analysis and because these three building types are responsible for the majority of commercial energy use.
- We considered electricity and natural gas savings. About two-thirds of energy use in commercial buildings is electricity, most of which is generated from coal or natural gas.
- We used the Energy Information Administration's Commercial Building Energy Consumption Survey (CBECS) data for the Mountain Census Division to characterize these commercial building types in Colorado.
- We considered only measures deemed cost-effective. A measure is cost-effective when its cost, amortized over its expected life, is less than the retail electricity price.
- We used an incremental cost approach—energy efficiency measures are assumed to be implemented when a building is built or equipment is replaced. The cost of the measure is the difference between the cost to install a typical, minimum-efficiency measure and the cost to install the higher-efficiency measure.
- We assumed that energy efficiency measures would be implemented throughout a 20-year period ending in 2026.

Detailed calculations, assumptions and process flow are documented in Appendix A.

The New Mother Lode study and the Xcel Energy DSM Market Assessment study were both used as sources of data regarding the performance of energy efficiency measures. The economic impacts are highly dependent on the costs of the measures, so this report selected a conservative approach. For two separate measures, Xcel Energy cost data was used because it was higher; for one measure, *The New Mother Lode* cost data was used because it was higher. All other values taken from *The New Mother Lode* are updated to 2006 *(see Appendix A for a discussion of the methodology used).*

Efficiency measures are assumed to be implemented when equipment has worn out or when new construction or renovation is underway. The cost of efficiency is the incremental cost of choosing the higher efficiency. It is at this moment that the return on an energy efficiency investment is most positive. A package of energy efficiency measures was selected for each building type based on the building energy simulations that were conducted for *The New Mother Lode* report *(see Appendix A)*. Table 2 shows the costs and savings for the package of measures that would be implemented in each building type.

Table 2:
Energy Efficiency Costs and Savings by Building Type

Building Type	Incremental Cost ($/ft^2)	Energy Savings ($/ft^2/yr)	Payback Period (years)
Existing Retail	1.97	.83	2.4
New Retail	1.53	.61	2.5
Existing Office	1.59	.59	2.7
New Office	1.58	.44	3.6

If an existing 10,000-square-foot office building were to employ all of these measures—either during construction or renovation—and all equipment was replaced with efficient equipment as needed during a 20-year period, the net present value of the initial investment would be $58,124 (2006 dollars).

Table 3:
Efficiency Investment and Return on a Sample 10,000-sq.-ft. Building

Energy costs/year before efficiency project (electricity and gas)	$17,779
Investment in energy efficiency	$15,921
Energy costs/year after efficiency project	$11,838
Energy savings/year	$5,942
Energy efficiency investment/year, amortized over 10 yrs @ 10%	$2,525
Positive cash flow each year until investment is paid for	$3,417

The economic potential for energy efficiency can be viewed in different ways. One perspective is to look at the total economic potential for energy efficiency improvements. This is useful in the illustrative sense, since it is not possible to implement every energy efficiency measure in the region in a single year.

Table 4 shows the reduction in energy-use costs that could occur if all energy efficiency measures were implemented. All existing buildings are producing the full amount of savings in 2007 and the savings continue through 2026. The savings in new buildings escalate as all new buildings receive energy efficiency measures each year and then produce those savings over the life of the measure. Total electric energy consumption in Metro Denver office and retail was about 5,189 GWh in 2005.

Table 4: Total Economic Potential for Electric Energy Efficiency Improvements in Metro Denver Office and Retail (GWh)

Building Type/ Energy Consumption	2005 Actual	2007	2010	2016	2022	2026	Total
Existing		2,191	2,191	2,191	2,191	2,191	43,817
New		72	303	842	1,506	2,031	19,016
Total Annual (GWh/yr)	5,189	2,263	2,493	3,033	3,697	4,221	62,833

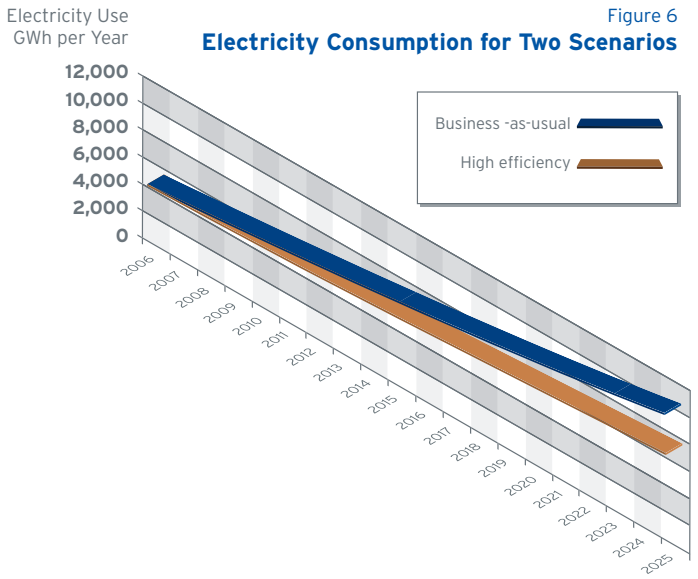
Another view of the economic potential can be seen by creating a more realistic scenario of how energy efficiency might be implemented. In order to estimate the economic impacts of implementing energy efficiency, we have assumed that 50 percent of the economic potential of existing commercial buildings was implemented over a 20-year time period beginning in 2007. The saturation of energy efficiency in new buildings increases gradually, reaching 80 percent by the end of this period. The costs of the measures and the electric energy savings for this scenario—both annually for selected years and over a 20-year project lifetime—are given in Table 5. Total cost for implementation of these cost-effective, energy efficiency measures as described is about $600 million. If commercial electricity and gas rates do not change throughout the 20-year period, energy cost savings for retail and office buildings are expected to be about $1.9 billion.

Table 5: Costs and Savings of Energy Efficiency Over 20 Years (in millions of dollars-2006)

	2007	2010	2016	2022	2026	Total
Implementation Costs	14.5	18.1	27.3	39.8	50.6	595
Energy Savings	5.7	25.4	77.5	152.2	218.3	1,870
Benefit-Cost Ratio	0.4	1.4	2.8	3.8	4.3	3.1

If commercial electric demand continues to grow at 3.5 percent per year, implementing energy efficiency on this schedule substantially reduces commercial electric demand growth, as shown in Figure 6. In the "business-as-usual" case, energy use nearly doubles throughout the next 20 years. However, in the "high-efficiency" case, annual energy use will increase by approximately 40 percent, growing from a baseline of about 5,400 GWh in 2006 to about 7,600 GWh in 2026. The efficiency path reduces electric demand growth by about 60 percent, and would supply nearly enough energy savings to avoid construction of one 500-megawatt power plant.

Figure 6
Electricity Consumption for Two Scenarios



Effects of Increased Commercial Energy Efficiency

In order to estimate the economic impacts of a massive implementation of energy efficiency, we again turned to *The New Mother Lode* study, which based its findings on an input-output analysis to estimate the effect of implementing the previously described energy efficiency improvements on employment, wage and salary compensation, and gross state product. The economic impacts projected across Colorado in this study are prorated down to the nine-county area throughout the 20-year timeframe (Table 6).

Table 6: Macro-economic Impact of "High-Efficiency" Scenario 2026

Macro-economic Factor	Impact
Net Increase in Jobs (FTE)*	12,097
Increase in Wage and Salary Compensation (2006$)	$322,000,000

* Full-time equivalent

Case Study: Denver Place North and South Towers

The economic impacts of energy efficiency are perhaps best illustrated by a case study. Denver Place is the site of the single-largest commercial energy efficiency project in the history of Denver. It has 23- and 34-story towers encompassing 815,000 square feet and a 370,000-square-foot, three-level subterranean parking garage.

Amerimar Realty Management Co. initiated the $1.35 million energy retrofit in 1996, with $550,000 from Public Service Company of Colorado's (now Xcel Energy) demand-side management program. The remaining project costs were financed over a seven-year period. With energy savings of approximately $300,000 per year, the investment made by the building owners was repaid in less than three years, and they are now realizing a more than 20 percent return on investment. Based on a detailed energy analysis of the buildings, several major equipment upgrades were made, including:

- Adding natural gas-fired boilers, greatly reducing electric resistance heating, and installing a new direct-digital energy-management system.
- Upgrading all fluorescent lighting from T12 lamps with magnetic ballasts to T8 lamps with electronic ballasts.
- Converting variable-pitch fans to fixed-pitch fans with variable frequency drives.
- Upgrading to high-efficiency motors on all central plant equipment.
- Converting the garage ramp snow-melting systems from electric to natural gas.
- Installing two 550-ton heat exchangers, eliminating the operation of the electric chiller on warm non-summer days.
- Cooling the building using 40°F condenser water from existing cooling towers.

A number of low-cost or no-cost measures were also implemented, including:

- Having janitors turn off lights and asking tenants to turn off equipment at night.
- Reducing after-hours HVAC operation.
- Using outside air to pre-cool the building.
- Pre-cooling or pre-heating at night during low energy use/cost periods.
- Installing utility management software.
- Maintaining positive pressure to prevent cold air infiltration.
- Reviewing utility bills monthly for peak demand and energy use.

The energy retrofit and operational modifications implemented are saving Denver Place approximately $300,000 annually compared to its 1997 energy costs. Scoring 81 out of 100 in the ENERGY STAR building rating system, Denver Place was the first building in Colorado to receive the ENERGY STAR label in 1999. Denver Place has also achieved LEED-EB Gold certification, and was the first existing building in Colorado to be certified.

Commercial Energy Efficiency Programs

Commercial energy efficiency programs in Colorado are provided by four types of entities: national, state, local and utility. Most of these programs are essentially informational—providing varying levels of technical and organizational resources. Others promote and recognize achievements in reducing energy consumption. Only a few of the programs already available to the commercial sector are more comprehensive, providing technical, organizational and financial resources for energy efficiency projects. This chapter of the report is a summary. More details, including contact information, can be found in Appendix B.

National Programs

- Federal Energy Tax Credits are available for 2006 and 2007 as part of the Energy Policy Act of 2005. A tax deduction of up to $1.80 per square foot is available for investments in "energy-efficient commercial building property" designed to save at least 50 percent of the heating, cooling, water heating and interior lighting energy cost of a new or existing building. Special provisions allow deductions for efficient lighting systems. The deduction is usually taken by the building owner, but it may be possible for the tenant or even the person in charge of the energy system design to claim it. Information on the tax credits is available at www.energystar.gov and www.energytaxincentives.org.
- ENERGY STAR® for Business Improvement (www.energystar.gov) is a program of the U.S. Environmental Protection Agency to encourage energy efficiency across a broad range of commercial building energy end uses. The program supports commercial building energy efficiency by providing technical, organizational and financial resources for improving energy efficiency:
  - A set of Guidelines for Energy Management shows building owners and professionals how to develop and implement a proven energy-management strategy based on the successful practices of ENERGY STAR partners.
  - Energy-efficient purchasing decisions are simplified due to ENERGY STAR's product rating system. ENERGY STAR-qualified products available for commercial applications include appliances, food-service equipment, heating and cooling systems, lighting, construction materials and office products.
  - Savings calculators for all types of equipment and appliances allow businesses to determine the financial ramifications of their purchases.
  - Benchmarking—rating a building's energy performance relative to similar buildings nationwide—enables organizations to establish current energy performance and goals.
  - ENERGY STAR Challenge calls on businesses and institutions to benchmark energy performance, establish efficiency-improvement goals, and make these improvements to reduce energy use by 10 percent. The EPA provides recognition of businesses that make energy efficiency improvements and share their results.

  By the end of 2005, 135 buildings in Colorado had qualified as ENERGY STAR. Most of these are schools, but several high-profile office buildings are also on the list, such as Denver Place, Qwest Tower, the Wellington Webb Municipal Office Building and the World Trade Center.

- Leadership in Energy and Environmental Design (LEED) was developed by the U.S. Green Building Council (www.usgbc.org) in 1994 to transform the U.S. building market by defining and promoting green building, recognizing environmental leadership and encouraging competition in the building industry. Three green building rating systems—plus a fourth in the pilot phase—are applicable to commercial buildings: New Construction and Major Renovation, Existing Buildings, Commercial Interiors and Core and Shell (under development). LEED certification is based on building performance and accomplishment of various levels of sustainability goals in site development, energy use (including energy efficiency and building energy performance), water use, materials selection and indoor environmental quality. Although not as familiar as the ENERGY STAR label, LEED certification is recognized nationally. The local chapter of the Green Building Council has grown rapidly into a thriving support network.

- Building Owners and Managers Association (BOMA) Programs (www.boma.org). BOMA members represent more than 125-million square feet of Colorado real estate. The BOMA Energy Efficiency Program (BEEP) is an operational excellence program for property owners, managers and operators focusing on educating the commercial real estate industry about the potential to reduce energy consumption with no- and low-cost solutions. BOMA estimates that BEEP will help buildings achieve a 30 percent reduction in energy consumption. BOMA International's Earth Award, created in 2001, focuses on employee safety and preparation for building emergencies and environmental risks, and includes several environmental categories, from energy efficiency to recycling to water efficiency.
- EcoBroker™. The Association of Energy and Environmental Real Estate Professionals encourages energy and environmental education for real estate professionals through its EcoBroker program (www.ecobroker.com). This program promotes energy efficiency and sustainable design in real estate properties, provides training and certification of real estate professionals, referral of green products and services providers (EcoBroker Affiliates™), and a website with energy and environmental information.

State Programs

- Rebuild Colorado (www.colorado.gov/rebuildco). This Governor's Office of Energy Management and Conservation (OEMC) program is primarily directed to state and local governments, but provides a number of resources that are accessible to the private sector. Partners in Rebuild Colorado include OEMC staff, energy professionals, many state organizations, various national organizations, and EPA's ENERGY STAR program. Rebuild Colorado provides technical support to assist state and local governments to identify and follow through with large-scale, comprehensive energy-saving projects. Services relate to every phase of an institutional building's life: 1) for new construction, LEED's new construction approach and commissioning are recommended strategies; 2) for existing building upgrades, performance contracting is offered; and 3) for day-to-day energy management. Rebuild Colorado is launching an expanded program to include utility bill data auditing and tracking. Rebuild Colorado has been involved in $140 million of performance contracting projects completed or underway. The private sector can access informational and referral services, such as website resources and guidebooks.

- ColoradoEnergy.org. OEMC was a founding sponsor of this online resource for Colorado builders, businesses and consumers. Coloradoenergy.org is a clearinghouse for energy information in Colorado, including energy efficiency information. This website is being transformed as part of a new OEMC initiative to provide energy information to building professionals. The new website will be accessible through the OEMC website.

- State Partners for Energy Efficiency and the Environment (E3) (www.state.co.us/oemc/programs). A joint program of OEMC and the Colorado Department of Public Health and Environment (CDPHE), the E3 program promoted energy efficiency directly to small and medium-sized businesses from 2002 through 2005. CDPHE permit writers and inspectors were trained to recognize opportunities to improve energy efficiency during facility inspections, promote energy efficiency, distribute program promotional materials, and encourage facility managers to sign up for additional technical assistance. Throughout its four-year lifetime, the program spent $76,000 and conducted 76 free energy assessments—primarily along the Front Range—resulting in an estimated annual energy savings of $31,640. This is a return on investment of more than 40 percent.

- Additional state association support. Several state associations promote commercial energy efficiency: the Colorado Alliance for a Sustainable Future, the Colorado Alliance of Sustainable Business Associations, the Colorado Environmental Partnership, CEBA/P3 (Colorado Environmental Business Alliance and People, Planet, Profit), the Alliance for Sustainable Colorado, and the Colorado Energy Partnership (formerly the Colorado Business Energy Partnership). These organizations and others are discussed in Appendix B.

Local Programs

- Building Performance with ENERGY STAR® (BPwES). The City of Boulder (www.ci.boulder.co.us/environmentalaffairs/energy) is offering a pilot program to reduce commercial energy and water consumption and costs, improve building performance and comfort, and increase profitability for Boulder businesses. Participating businesses will receive no-cost ENERGY STAR benchmarking and free energy and water audits. Energy audits will include recommendations for no- and low-cost measures for saving energy, operation and maintenance strategies, and retrofit opportunities, as well as assistance in reviewing contractor bids and receiving utility or City of Boulder rebates. This program is intended to help the city determine the most needed and effective services to offer to the commercial sector as part of a long-term program.

- Northeast Metro Pollution Prevention Alliance (NEMPPA). NEMPPA is a nonprofit organization promoting the adoption of pollution-prevention and energy-efficiency strategies by small businesses—fewer than 100 employees—in Commerce City. NEMPPA has just completed a Small Business Energy Efficiency program that provided eligible businesses with a free facility energy audit, recommendations for energy efficiency improvement, a cost-benefit analysis, and up to $3,000 to implement energy efficiency measures. NEMPPA has just received funding to continue another phase of this program.

Table 8: National Programs Addressing Commercial Energy Efficiency

Program		Description	Eligibility
ENERGY STAR® (www.energystar.gov)		Technical resources (Energy Management Guidelines and benchmarking), financial and organizational tools and resources, purchasing guidance, and recognition.	All
Leadership in Energy and Environmental Design Green Building Rating System™ (www.usgbc.org)		Guidelines and certification for increasing sustainability of new and existing buildings. Performance in six categories is assessed—energy and atmosphere, indoor environmental quality, sustainable sites, materials and resources, water efficiency, and innovation.	Builders, building owners, managers, or occupants, depending on rating system
Building Owners and Managers Association (www.boma.org)	Energy Efficiency Program	Training for commercial real estate brokers in energy-performance fundamentals, benchmarking, no- and low-cost operational adjustments for energy-performance improvement, value and financial return of energy-efficiency investments, and energy-awareness program development.	Real estate served by a BOMA member at time of lease or sale
	Earth Award	Category in TOBY awards for excellence in preserving both the internal and external environments of a property.	Members of BOMA
EcoBroker™ (www.ecobroker.com)		Energy, environmental, and marketing training for real estate professionals. EcoBroker.com provides energy and environmental information, property listings, and listings for EcoBrokers™ and EcoBroker Affiliates™.	Real estate served by an EcoBroker at time of lease or sale*

* Referral services and information available to all

Table 9: State Programs Addressing Commercial Energy Efficiency

Program	Description	Eligibility
Rebuild Colorado (www.colorado.gov/rebuildco)	A program for state and local government, but provides access to informational and referral services for commercial businesses (i.e., online Energy Efficiency Guide for Colorado Businesses).	All*
ColoradoEnergy.org	Online resource for energy-related activities and organizations, legislation, building codes, and green building information. Includes a directory of companies.	All

* Nonprofit organizations are eligible for standard services. See Appendix B.

Table 10: Utility Commercial Energy Efficiency Programs		
Name	Description	Eligibility
Xcel Energy's Demand-Side Management Program (www.xcelenergy.com)	Comprehensive program offering design assistance for new construction, rebates for energy efficiency upgrades of lighting, HVAC systems, motors, and recommissioning for existing buildings. Website provides an energy-analysis tool allowing customers to evaluate energy use and costs and determine potential savings and applicable rebates.	Businesses served by Xcel Energy
Fort Collins Utilities (www.fcgov.com/powertosave)	Comprehensive program offering free energy assessments and technical assistance, Business Environmental Program Series, incentives and rebates through Platte River Power Authority, integrated design assistance for new buildings, and online informational resources (including e-newsletter, library, and Ask-an-Expert service).	Businesses served by Fort Collins Utilities
Platte River Power Authority (www.prpa.org)	Cooling Rebates Program; Electric Efficiency Program provides incentives for upgrades of lighting, air conditioning, motors, drive systems and process equipment; Energy Monitoring service provides load profiling and sub-metering; Energy and Process Efficiency Facility Audits include billing data review, benchmarking, and efficiency opportunity evaluation.	Businesses served by Fort Collins Utilities, Town of Estes Park Light & Power, Loveland Water and Power, or Longmont Power & Communications

Table 11: Local Commercial Energy Efficiency Programs		
Name	Description	Eligibility
Building Performance with ENERGY STAR™ (www.ci.boulder.co.us)	Free ENERGY STAR benchmarking and free energy and water audits performed by professional engineers. Promotes utility rebates and ENERGY STAR resources.	Businesses in Boulder
Northeast Metro Pollution Prevention Alliance	Free energy audit, recommendations for energy efficiency improvement, cost-benefit analysis, up to $3,000 to implement measures, and assistance in securing additional capital.	Small businesses in Commerce City

Utility Programs

- Xcel Energy's Demand-Side Management (DSM) Program (www.xcelenergy.com). In 2006, Xcel Energy completed a five-year DSM program that reduced peak electric demand by more than 120 megawatts (MW). A new DSM program is underway that will reduce peak electrical demand by 320 MW and conserve 800 GWh of electrical energy over its eight-year lifetime (2006–2013). Most of these savings will result from seven commercial programs: Lighting Efficiency, Cooling Efficiency, Motor Efficiency, Recommissioning, Energy Design Assistance, Energy Management Systems and Custom Efficiency. Some of the programs provide rebates for purchase of energy-efficiency equipment in building retrofit or new construction. Energy Design Assistance and Recommissioning provide funding for energy studies for buildings 50,000 square feet or larger. While the Energy Design Assistance and Recommissioning programs primarily target larger projects, the rebates provided for energy efficiency improvements for lighting, cooling systems and motors are available to all businesses.

- Fort Collins Utilities (www.fcgov.com/powertosave). Fort Collins Utilities offers a wide range of programs and services for commercial and industrial customers, including demand and energy-based efficiency incentives, cooling equipment rebates, integrated design assistance for new buildings, energy assessments, an e-newsletter, a business educational program series, and an online interval data tool. The Electric Efficiency Program, a partnership with Platte River Power

Authority, provides incentives to commercial and industrial customers for qualified efficiency upgrades of lighting, air conditioning, motors, drive systems and process equipment. The air-conditioning equipment rebates are offered to Fort Collins Utilities customers by the Platte River Power Authority.

- Platte River Power Authority. The Platte River Power Authority offers the Electric Efficiency Program to its four member cities: Fort Collins, Loveland, Longmont and Estes Park. The program varies somewhat by city. Platte River also offers air-conditioning rebates for high-efficiency equipment in each city.

Pursuing Energy Efficiency: Three Models

Innovative and effective commercial energy efficiency programs have been in operation around the country for more than two decades. Three examples, each based in a municipality and including some effort to stimulate energy efficiency in the private sector, are described below. These cities provide insight into the makeup of an effective commercial energy efficiency program for municipalities in Metro Denver.

Austin, Texas (www.austinenergy.com)

The City of Austin has promoted energy efficiency through its municipal utility, Austin Energy, for more than 20 years. Austin Energy, which was one of the first municipal utilities to establish a demand-side management program, has one of the most comprehensive commercial energy efficiency programs in the nation. Austin Energy has reduced demand through energy efficiency improvements by more than 500 megawatts since 1982, offsetting the need to build the equivalent of a 500-megawatt power plant. In 2003, the utility's commercial energy efficiency programs had more than 1,300 participants. Grants for commercial and municipal building energy efficiency from the Texas Public Utility Commission—matched by Austin Energy—are expected to save 6.6 TWh annually.

Austin Energy has two options to reduce lighting upgrade costs in commercial buildings, including 0 percent financing for all businesses and discounts of up to 70 percent for small business customers through the Small Business Lighting Program. Austin Energy provides a number of resources online, including a load profiler for facility energy monitoring, the Business Energy Analysis Energy Audit, and a newsletter for small business customers. Austin Energy also reduces the cost of energy efficiency upgrades through three initiatives:

- The Commercial Energy Rebate Program provides a free energy audit and recommendations, technical assistance for retrofit or new construction, and rebates for eligible technologies.
- The Power Partner Free Thermostat Program provides a free programmable thermostat plus free installation and warranty in return for permission to cycle air conditioning briefly during peak demand periods.
- The SmartVendor Program provides free EnergyMiser™ products and installation.

The Austin Energy Green Building Program offers consulting and informational services to residential, commercial, multifamily and municipal projects. Commercial building owners who work with the Green Building Program's staff can realize lower operating costs, increased employee productivity and higher indoor air quality. The staff consults with designers, engineers and construction professionals to provide information on resource-efficient building materials and systems, ways to reduce construction and operations waste, as well as environmental and financial issues to consider during the design and construction process. Many services are free to Austin businesses. The current rating system awards one to five stars to projects. The City of Austin now requires that every commercial project within the central business district receive a minimum one-star rating by fulfilling eight basic requirements. Since 1999, when the commercial program was added, 15 projects have documented energy savings of 3,140 KW (11,435 MWh annually) due to better design and material choices. The Green Building Program has won numerous awards for developing ecological building agendas, and for establishing precedent-setting guidelines, ordinances and market strategies. It has also been recognized as a top "success story" by the U.S. Department of Energy.

Austin Energy has been dedicated to reducing electricity consumption through both commercial and residential energy efficiency programs for more than 20 years, providing free services, rebates, and a commercial program structured to address the needs of a diversity of businesses.

Portland, Oregon (www.sustainableportland.org)

Portland promotes commercial energy efficiency mainly through its Office of Sustainable Development (OSD), the Oregon Department of Energy and the EnergyTrust of Oregon, Inc. During Portland's five-year Rebuild America: Portland Partners for Energy Efficiency (P2E2) program, Portland exceeded its goals of providing 25 percent energy savings in 24 million square feet of commercial and institutional space. Through an investment of $68.5 million in energy efficiency upgrades in commercial and institutional buildings, P2E2 achieved approximately a 31 percent energy savings in 64 million square feet. Portland General Electric provides three options for monitoring facility energy use—an important tool for improving building energy efficiency. The Energy Trust Inc. provides several programs:

- Building Efficiency offers incentives for retrofit of lighting, HVAC systems and electric motors.
- New Building Efficiency offers energy modeling and design assistance, plus incentives for high-efficiency lighting and controls, motors, drives, and HVAC and gas equipment.
- Building Tune-up and Operations—a joint program with the nonprofit Portland Energy Conservation, Inc.—offers incentives for boiler tune-up, energy assessments, building tune-up and retro commissioning.

In order to promote sustainable business practices, OSD created the Businesses for an Environmentally Sustainable Tomorrow (BEST) program in 1993. The BEST annual awards program recognizes businesses with significant achievements in areas such as energy efficiency, water conservation, waste reduction/pollution prevention, and sustainable product development. OSD offers technical assistance and information to businesses to help them achieve economic and environmental efficiency. Between 30 and 40 award applications are received each year. A committee of OSD staff, staff of related city and state agencies, and private green business leaders choose the winners based on savings and innovation. One to three awards are presented in each of eight categories. BEST award winners annually save $11.7 million through efficiencies and upgrades. BEST also offers a library of case studies demonstrating effective resource conservation strategies.

Portland also participates in the BetterBricks Award—administered by the Northwest Energy Efficiency Alliance—a program recognizing architects, designers and corporations that are leaders in energy-efficient design. The Energy Loan Program (SELP), administered by the Oregon Department of Energy, provides low-interest loans for projects that save energy or use renewable energy, recycled materials or alternative fuels. For businesses investing in energy conservation, renewable energy, recycling and alternative fuels, the Oregon Department of Energy offers the Business Energy Tax Credit, which covers 35 percent of the incremental cost of nonstandard equipment.

The Climate Trust, begun in August 2002, is a five-year program contracted to buy offsets from two City of Portland building energy efficiency programs—the Multifamily Assistance Program (MAP) and the Commercial Green Buildings Program (CGBP). The City of Portland is retrofitting buildings for floor and wall insulation, high-efficiency lighting and ENERGY STAR window installation. MAP increases weatherization activity in multifamily housing units by serving as a one-stop shop for project coordination, technical and financial advice, and incentives. CGBP encourages building designers and owners to construct to Portland's highly efficient LEED Green Building Standards. After the efficiency measures have been installed, the Climate Trust pays a fixed price per ton based upon the anticipated carbon dioxide reductions over the lives of the measures. The Green Investment Fund is a competitive grant program that awards highly innovative and comprehensive residential, commercial and industrial green building projects within the Portland city limits. Annually, $500,000 is granted to multiple projects.

Leadership, commitment and synergy of programs on the local and state levels, plus the collective availability of funding, are just some of the characteristics that make Portland's energy efficiency strategy so effective.

Seattle, Washington (www.ci.seattle.wa.us/light)

In Seattle, nearly all commercial energy efficiency programs are offered through the municipal electric utility, Seattle City Light. The Seattle building code also contains a progressive energy code for residential and nonresidential buildings. Two of Seattle City Light's programs provide vital services free of charge: efficient lighting design assistance through the Lighting Design Lab and Facility Assessment Audits for medium-to-large commercial (and industrial) buildings. Seattle City Light offers rebates for several products, including energy-efficient lighting for small businesses through its $mart Business Program, high-efficiency commercial solid-door refrigerators and freezers, and energy-saving controls for vending machines. Its Demonstration Technology Bonus increases incentives by 10 percent for use of selected "new" technologies in conservation projects. Seattle City Light's Energy Smart Services resources include:

- Financial incentives and technical resources for new construction and existing medium-to-large commercial (and industrial) buildings.
- Energy Analysis Assistance and Building Commissioning to incorporate energy efficiency for new construction and major remodels.
- Online resources for improving energy performance, including a funding calculator.
- Participation in the BetterBricks Award programs.

Seattle City Light's Energy Management Services Division has an Evaluation Unit, which has produced extensive reports on the effectiveness and accomplishments of individual commercial-industrial efficiency programs for the last 28 years.

Common characteristics of comprehensive commercial energy efficiency programs:

- Easily accessed energy efficiency resources—often available online—such as energy-use monitoring and analysis tools and detailed case studies
- Availability of resources—technical and financial—and programs from state, local and utility sources
- Availability of financial incentives, rebates or free services
- A mix of targeted and general programs (i.e., lighting programs for small businesses and energy-analysis programs for any business)
- Multifamily building programs
- Clear, concise and informative websites
- A mix of free and low-cost services
- Clear, comprehensive goals

Opportunities for Energy Efficiency in Metro Denver:

- A coordinated program connecting businesses to all available resources on the national, state and local levels
- A system for promoting and recognizing excellence in energy efficiency in new and existing buildings
- Programs targeting specific groups that may be underrepresented otherwise (i.e., lighting programs for small business owners, vending machine or commercial refrigeration programs, etc.)
- Free or low-cost services for small and medium-sized businesses (i.e., free lighting assessment and design assistance)
- Specific energy efficiency goals
- State and local incentives, low-interest loan programs and other funding options for all businesses for energy efficiency investments
- Targeting multifamily buildings
- Clear, concise and informative websites
- Regular evaluation of results to better manage programs

A Voluntary Energy Efficiency Initiative for Metro Denver

Uncovering an Opportunity

This report has described the potential of the energy efficiency resource in Metro Denver office and retail buildings. It has summarized the organizations and programs already underway in the metro area, and provided some highlights from a few of the country's most comprehensive municipality-based energy efficiency programs.

A few conclusions can be drawn from the information provided thus far:

- A large amount of energy efficiency potential is untapped in Metro Denver office and retail markets.
- If this efficiency were implemented, it would produce substantial economic benefit.
- Some of this potential will be realized from successful implementation of Xcel Energy's expanding energy efficiency program.
- Many other local organizations and programs already involved in some way with energy efficiency provide additional capacity for energy efficiency implementation.
- A number of successful municipality-based energy efficiency programs around the country can serve as models to emulate and provide a track record of accomplishment that can serve as a goal for the Metro Denver area.

What can the Metro Denver EDC do to help establish the Metro Denver region as a leader in the implementation of energy efficiency?

Local energy efficiency and building energy-management experts were consulted and possibilities for an initiative were explored through a series of meetings and interviews. Consultation with energy engineering firms and energy service companies was especially revealing. The energy analyses these firms produce is essential to a comprehensive energy efficiency project. Few commercial businesses have the capability to conduct this type of analysis. Surprisingly, these engineering firms do most of their business with public agencies. For years, the public sector has benefited from laws and policies that encourage implementation of energy efficiency and enable public agencies to utilize the third-party financing offered by energy service companies. Relatively little business comes from private commercial businesses, where most of the commercial energy efficiency potential resides.

Energy engineering firms and energy service companies note that potential energy efficiency projects often do not proceed even when the return on investment is very attractive. These unimplemented projects tend to be stand-alone projects, which can be time-consuming for facility managers and can disrupt day-to-day operations.

A better approach, the experts say, is to incorporate the energy efficiency measures into the construction or renovation of a building. These types of projects are going ahead anyway and do not depend solely upon the merits of the energy efficiency measures to proceed.

The cost of installing energy efficiency measures is lower when it occurs as part of the construction or renovation of a building, because the building's energy-related systems are being installed anyway. The cost of energy efficiency is the incremental cost of selecting and installing the higher efficiency level equipment.

Another advantage of this approach is the financial perspective of the parties involved. Construction or renovation typically occurs when a company purchases land or a building, or signs a long-term lease. This is the moment when a company has a longer-term perspective, and is likely considering a number of different construction or renovation options. An energy efficiency project that produced a positive cash flow (monthly energy savings greater than the monthly payment to repay the construction loan or tenant improvement) would enhance the benefits of the project for at least one party to the transaction.

The consensus from energy engineering firms and energy service company representatives was that the Metro Denver EDC energy efficiency initiative should encourage companies to consider making energy efficiency improvements when they are purchasing a building or signing a long-term lease. Subsequent meetings with the Metro Denver EDC Energy Committee and with professionals involved with these types of transactions have confirmed that such an initiative could produce substantial benefits.

Lessons from Two Cities

The biggest challenge to successful implementation of this initiative will be to identify the energy efficiency measures quickly and implement them without creating any delay to the construction or renovation project. There are at least two programs that meet this challenge. They are not purely voluntary, as is this proposed initiative, but they present relevant case studies nonetheless.

- Berkeley's Commercial Energy Conservation Ordinance (CECO) (www.ci.berkeley.ca.us). The City of Berkeley, California implemented its Commercial Energy Conservation Ordinance in 1993. Under CECO, all commercial buildings are required to meet minimum energy efficiency standards upon change of ownership or significant renovation or addition to the property. In the first case, energy efficiency upgrades must be made before the title transfers to the new owner; otherwise, compliance responsibility transfers to the buyer. In the latter case, upgrades are triggered through the building permit application process—the applicant is required to install conservation measures to the entire building if the renovation or addition increases the conditioned area of the building by more than 10 percent or if the value of the renovation exceeds $50,000.

  The owner of the building commissions an energy audit in order to determine the potential energy savings and costs. CECO lists specific energy-conservation measures such as HVAC system upgrades, water heater insulation, lighting upgrades, cleaning and tuning of refrigeration systems, adding ceiling insulation, etc. Investment caps ensure that energy upgrades can be made without jeopardizing the financial health of the business. The building owner must implement all required measures up to the expenditure limit for their building. The maximum total cost of the energy conservation measures required to be installed upon sale of a commercial building is the lesser of 1 percent of the assessed value of the property, or $150,000. For major renovations, the maximum total cost of conservation measures required is the lesser of 5 percent of the total renovation construction cost or 1 percent of the assessed value of the entire building.

  The City Manager oversees implementation of the CECO program. The Codes and Inspections department enforces compliance through building inspections. The City's Office of Energy and Sustainable Development tracks the energy and financial savings resulting from implementation of CECO. Since its inception, more than 130 commercial buildings (10 percent of the city's total) have been improved.

- Tucson Sustainable Energy Building Standard (www.tucsonmec.org). Tucson, Arizona established a standard requiring all construction and major renovation of municipal buildings to meet energy efficiency standards 50 percent greater than those of the national Model Energy Code. That benchmark also serves as a voluntary standard for commercial buildings throughout Tucson and Pima County. The Sustainable Energy Building Standard suggests various conservation measures but allows architects freedom in choosing how to meet the higher efficiency requirements. Designers must detail conservation strategies and perform an energy analysis early in the design process. The City then monitors energy efficiency throughout the contracting, inspection and testing phases.

  The Tucson-Pima County Metropolitan Energy Commission developed the Sustainable Energy Building Code through the Tucson/Pima County Energy Codes Committee. It provides a quantifiable standard against which building plans can be measured to ensure that the finished buildings can be expected to use substantially less energy than under the national Model Energy Code. The building code initiatives were achieved through community-wide support to create

new market opportunities that would reduce the negative environmental impacts of construction. So far, the program has achieved a $200,000 reduction in annual energy costs.

Recommendation

The initiative we propose is a voluntary program in which Metro Denver businesses would agree to consider energy efficiency as they plan to purchase, lease or construct commercial space. This initiative would accomplish several goals:

- To build demand for energy-efficient commercial space
- To encourage the inclusion of energy efficiency measures in the construction or renovation of commercial buildings
- To help building owners and property managers obtain a thorough energy analysis of their building
- To help building owners and property managers secure utility rebates and tax incentives

Implementation Plan

Voluntary programs have a checkered history. There are examples around the world of voluntary programs that have achieved tremendous results. But there are also many examples of voluntary programs that consist of little more than a program concept and a brochure or website. The ability of a voluntary program to achieve results is mostly determined by the effort invested.

Basic steps to establishing an ongoing voluntary program:

1. Establish the Colorado Energy Coalition, a consortium of private sector energy companies, research institutions, existing energy associations, and higher education.
2. The Metro Denver EDC recruits 5-10 companies, possibly Metro Denver EDC investors, to voluntarily commit to making energy efficiency a factor in their next office space decision.
3. The participating companies would formalize their participation by issuing a letter of intent or a press release, and/or by establishing an internal policy to ensure that energy efficiency is considered in their next office space decision.
4. The Metro Denver EDC or a subsequent energy organization will establish a program website to serve as a convenient program information source.
5. The Metro Denver EDC or a subsequent organization will maintain regular communications with the participating companies to help reinforce commitment.
6. Participating companies consult with energy engineering firms as they begin their search for a building to purchase or lease.
7. The Metro Denver EDC or a subsequent organization will publicize the commitment of participating companies to property owners and managers, encouraging them to upgrade the efficiency of their buildings.
8. The Metro Denver EDC or a subsequent organization will work with local governments and with the Metro Mayors Caucus' Energy Committee to enlist their support for this effort.
9. The Metro Denver EDC or a subsequent organization will explore the possibility of a small administrative fee being paid by the participating companies on each energy efficiency project to fund an ongoing communication and outreach effort. Modest ongoing funding is essential to grow and maintain an effective voluntary program.
10. Complete energy analyses would be provided to the participating companies in a prompt fashion so the purchase or lease transaction is not delayed.

11. Energy efficiency measures identified as cost-effective are incorporated into the design of the building or building renovation.
12. Energy efficiency measures are implemented.
13. The Metro Denver EDC or a subsequent organization promotes the success of the initial projects and expands the effort to more companies.

If you would like more information regarding Metro Denver EDC's voluntary energy efficiency program, please contact **Holli Baumunk** at **303-620-8025** or **holli.baumunk@metrodenver.org**.

Appendix A
Calculations for Technical and Economic Potential and Economic Impact

This appendix details estimates for the technical and economic potential of cost-effective electrical energy efficiency improvements in the commercial sector for nine Metro Denver–area counties. Three types of commercial building are considered: office, non-mall retail, and mall retail—to reduce the complexity of the analysis and because these building types are responsible for the majority of commercial energy consumption.

Technical, Economic and Achievable Potential. The technical potential for energy efficiency improvement is the amount that it is possible to achieve given existing technologies available on the market. That portion of the technical potential that is economically feasible at a given time—using a specified definition of feasibility—is the economic potential. Although 100 percent of the economically feasible potential is achievable, this maximum is unlikely to be met by a given energy efficiency program. Some fraction of this achievable potential will always be naturally occurring, regardless of incentives or regulations.

Characterizing Building Stock. Office and retail building stock for the study are characterized using Mountain Census Division data from the 2002 economic census and from the 1999 and 2003 Commercial Building Energy Consumption Survey (CBECS). Data from the 2002 census are used to determine the number of each of the three building types in the nine counties. Average building square-footage data for each of the building types are from the 2003 CBECS. Energy use depends on the type (see Table A-1) and purpose—principal building activity in the CBECS—of each building.

Table A-1: CBECS building types used in this report[a]

Building Type	Description	Examples
Office	Buildings used for general office space, professional office or administrative offices	administrative or professional office, government office, mixed-use office, bank or other financial institution, medical office[b], sales office, contractor's office (e.g., construction, plumbing, HVAC), nonprofit or social services, research and development, city hall or city center, religious office, call center
Non-mall Retail	Buildings used for the sale and display of goods other than food	retail store, beer, wine, or liquor store, rental center, dealership or showroom for vehicles or boats, studio/gallery
Mall Retail	Shopping malls comprised of multiple connected establishments	enclosed mall, strip shopping center

a: EIA CBECS

b: Medical offices are included only if they don't use any type of diagnostic medical equipment. Otherwise, they are categorized as an outpatient health-care building.

Commercial buildings in the Metro Denver area from the 2002 census are listed in Table A-2 by NAICS code title and county.

Table A-2: Commercial building distribution in the nine metro area counties

Business Type	Adams	Arapahoe	Boulder	Broomfield	Denver	Douglas	Jefferson	Larimer	Weld	Total
Wholesale trade	720	995	496	76	1,598	313	761	344	215	5,518
Retail trade	986	2,155	1,279	206	2,313	622	1,843	1,251	582	11,237
Information	103	586	285	44	646	115	293	155	59	2,286
Real estate, rental and leasing	404	1,003	591	71	1,314	314	867	459	192	5,215
Professional, scientific and technical services	553	2,577	2,162	202	3,662	941	2,551	1,055	346	14,049
Administrative, support, waste management and remediation service	432	952	525	73	1,123	266	883	439	237	4,930
Educational services	42	169	156	15	233	60	159	83	33	950
Health care and social assistance	480	1,512	957	79	1,930	311	1,251	751	312	7,583
Arts, entertainment and recreation	81	155	162	12	252	60	237	134	53	1,146
Accommodation and food services	559	1,052	720	95	1,641	286	951	702	320	6,326
Other services (except public administration)	627	1,115	666	84	1,673	328	1,148	566	288	6,495
Total	4,987	12,271	7,999	957	16,385	3,616	10,944	5,939	2,637	65,735

Primary Building Activity (PBA) designations were designed to group buildings having similar patterns of energy consumption and are, therefore, much broader than the NAICS or SIC codes. Many NAICS codes have more than one possible CBECS PBA. It is also somewhat difficult to compare these since CBECS deals with buildings, whereas NAICS deals with industries. However, CBECS provides a correspondence between NAICS codes and PBA (see Table A-3).

Note: Table A-2 shows that nearly 40 percent of the commercial buildings in the metro area are used in the retail trade (17.1 percent) or for professional, scientific and technical services (21.4 percent). The third-largest number of buildings is dedicated to health care and social assistance (11.5 percent). By evaluating the NAICS codes, it was noted that a large proportion of the buildings used for the professional, scientific and technical services, along with information, real estate and social assistance, are office-type buildings. This means that retail- and office-type buildings make up the most significant portion of commercial buildings in the metro area.

Table A-3: Correspondence between 2002 NAICS code and CBECS PBA[a]			
Industry Sector	2002 NAICS 2-digit Code	2002 NAICS 3-digit Code	CBECS Primary Building Activity
Retail Trade	44-45	441-444, 451-453	Retail (non-mall)
		446, 448	Retail (mall)
		445	Food Sales
		447	Service
Transportation and Warehousing	48-49	481, 482, 485, 487	Public Assembly
		483, 484, 488, 491, 492	Service
		486	Office
		493	Warehouse/Storage
Information	51	511, 516-519	Office
		512, 515	Public Assembly
Finance and Insurance	52	521-525	Office
Real Estate, Rental and Leasing	53	531, 533	Office
		532	Retail (non-mall)
Professional, Scientific and Technical Services	54	541	Office
Management of Companies and Enterprises	55	551	Office
Administrative and Support and Waste Management and Remediation Services	56	561	Office
		562	Office
Health Care and Social Assistance	62	621	Outpatient Health Care
		622	Inpatient Health Care
		623	Lodging
		624	Office

a: EIA CBECS

It is important to note that CBECS estimates are based on data reported by a sample of the entire commercial building population in the United States. These estimates differ from the true population values and should be considered as estimates with a certain associated error. Although CBECS provides standard error data for all values, we did not use them in developing this report in order to minimize the complexity of calculations.

Estimating Baseline Commercial Electricity Use. The most recent electrical energy-use data available are from the 1999 CBECS and are given in kWh/ft^2 of building area for each type of business. A comparison of potential values is given in Table A-4. Values for the CBECS Mountain Census Division were used in this study. Electrical energy use for the nine counties is updated using projections of commercial energy-consumption growth. These three datasets—number of each type of building, average building area for each type, and electrical energy consumption per area—are used to estimate commercial electricity use for office and retail

Table A-4: Electricity consumption by building type for different studies			
Building Type	Baseline Electricity Consumption (kWh/ft^2)		
	CBECS Mountain Census Division Average	CBECS National Average	*New Mother Lode*[a]
Existing Retail: Non-mall	16.5	13.6	14.25
Existing Retail: Mall	18.6	15.6	14.25
Existing Medium Office	17.6	18.7	23.42

a: *The New Mother Lode* does not consider differences in type of retail building.

buildings for 2006—the starting point for estimating technical and economic potential for improvements in commercial energy efficiency for the nine Metro Denver area counties over the next 20 years. Most of the assumptions used in this report are based on *The New Mother Lode: The Potential for More Efficient Electricity Use in the Southwest* by the Southwest Energy Efficiency Project.

Energy Use Scenarios. Given the estimate of base-year electricity consumption for commercial buildings in the nine counties, two energy-use scenarios are developed for the next 20 years. A "business-as-usual" scenario details the likely growth in electricity consumption if current policies and trends continue unchanged, producing a projected growth rate of 3.5 percent (Southwest Energy Efficiency Project, 2002). A "high-efficiency" scenario details the trend for commercial electricity use during 2006–2026 given widespread adoption of cost-effective energy efficiency measures. Costs for implementing cost-effective measures and potential energy cost savings are estimated for this "high-efficiency" scenario. Finally, energy consumption projections for the two scenarios are compared.

Bringing Energy Use to the Present. To find the baseline commercial electricity consumption for 2005, we use the 3.5 percent growth rate for Colorado and assume that it is entirely due to building growth in order to avoid making assumptions about changes in baseline energy intensity. Using data from the 2002 Colorado Economic Census and the Energy Information Administration, office and retail sector electricity use for 2005 is estimated to be about 5.2 TWh/yr (5.2 million MWh/yr).

Energy Use of New Construction. Electricity use in kWh/ft^2 for each building type is given in Table A-5. Note that we chose to calculate baseline energy intensity for retail buildings as the average of the non-mall and mall baseline values from Table A-4 because retail space in the nine-county area is almost equally split between mall and non-mall types. Energy intensity for newly constructed buildings in this study is, again, based on values from *The New Mother Lode* study. The difference between energy intensity for existing and newly constructed retail buildings in *The New Mother Lode* study is 13.5 percent. This difference is used to calculate the energy intensity values for newly constructed retail buildings (again, see Table A-5).

Since the energy intensity of office buildings from the EIA CBECS is 25 percent less than in *The New Mother Lode*, the energy intensity of already existing offices is reduced by 25 percent of their potential energy savings (59 percent) to get the baseline energy intensity for newly constructed office buildings. This deviation from the technique used in *The New Mother Lode* was made in order to use recent data for the region and to provide a conservative estimate of the energy intensity of new office buildings for this study. Note that energy-intensity values for newly constructed buildings—office or retail—are only used in this study for 2006 and beyond, since it is impossible to retroactively change building codes and the already existing building stock.

Table A-5: Determining baseline electricity use for new buildings

Building Type	NML[a] Baseline Energy Intensity (kWh/ft^2)	NML[a] Efficient Energy Intensity (kWh/ft^2)	Difference: NML[a] Baseline & NML[a] Efficient	CESC Baseline Energy Intensity (kWh/ft^2)	Difference: NML[a] Efficient & CESC Baseline
Existing Retail	14.25	5.89	59%	17.6	-64%
New Retail	12.32	5.96	52%	15.2[b]	-58%
Existing Office	23.42	9.66	59%	17.6	-45%
New Office	19.19	8.88	54%	15.0[b]	-41%

a: Values from *The New Mother Lode* study.
b: Derived values.

Defining Cost Effectiveness. The cost effectiveness of a particular measure depends on site-specific variables, including building construction and use, operating hours, and labor and materials costs. While the measures used in this study are cost-effective in general, each measure is considered cost-effective if the cost of saved energy due to use of the measure is less than the retail electricity price. In this study, for each measure, the incremental energy savings due to that measure and a real discount rate of 5 percent (i.e., above inflation) are used to calculate the cost of saved energy. Only those energy efficiency measures considered "cost-effective" by the above definition for the three building types are applied in the high-efficiency scenario. Although it should be noted that energy efficiency retrofits performed at any point in equipment lifetime may be cost-effective, the threshold for cost effectiveness is higher under such circumstances and therefore more difficult to attain.

For this study, we assume that energy efficiency measures are implemented either at replacement of existing equipment—at the end of equipment life or due to equipment failure—or for initial installation (as in a new building). Therefore, the relevant cost of each implemented measure is the incremental cost—the difference in cost between the high-efficiency equipment and the baseline equipment—rather than the total cost of the efficient equipment. The only exception is for increasing insulation in existing buildings, which is seen as an adjunct to increasing the efficiency of HVAC systems.

Building Systems Considered for Upgrade. The majority of the potential for energy savings in commercial buildings is in 1) lighting systems, 2) heating, ventilating, and air-conditioning (HVAC) systems, and 3) office equipment. Lighting may account for 10 percent (Xcel Energy, 2005) to more than half of total commercial building electricity use depending on building type, with offices typically spending an average of 27 percent of their electricity bill on lighting, and retail buildings spending 44 percent (Xcel Energy, 2005). Replacing lighting system components (i.e., lamps, fixtures and ballasts) and improving system controls—potentially halving lighting system energy use—can produce total electricity savings of 20–45 percent. Replacing HVAC equipment (i.e., fans, chillers, air conditioners, etc.) yields electricity savings of about 14 percent of total use for commercial buildings in the Denver area. For commercial buildings heated with natural gas, as is typical in Colorado, sealing leaky air-distribution ducts saves both electricity (9–15 percent of total consumption) and natural gas (25 percent). Increasing insulation in the roof—and sometimes walls—of commercial buildings in order to minimize the load on an HVAC system is also a cost-effective energy efficiency measure. Office plug loads (e.g., computers, printers, copiers, fax machines, etc.) are significant electricity consumers and contribute to building cooling load throughout the year.

Therefore, for office buildings, upgrading to ENERGY STAR-rated office equipment and enabling all energy-saving features can reduce total electricity use by 15–20 percent, although building heating load will increase.

Costs and Savings of Energy Efficiency Upgrades. Incremental costs and energy-savings estimates used in this report (Table A-5) are based on *The New Mother Lode* and costs used in the Xcel Energy 2006 DSM Market Potential Assessment. *The New Mother Lode* energy savings, incremental measure cost and energy-cost savings are derived from simulations of buildings with either baseline or high-efficiency equipment. In order to calculate costs and savings values, assumptions concerning building and equipment configuration and energy costs were made. For example, to determine the incremental cost of installing high-efficiency lighting, an assumption regarding distribution of lighting elements throughout the space is required. Different packages of energy efficiency measures are used in each building type. Table A-6 through Table A-9 give a detailed breakdown of energy savings and energy costs. Each of these tables also gives incremental costs for energy efficiency measures from *The New Mother Lode* and final incremental costs used in this report. Table A-10 summarizes efficiency costs and savings by building type.

Table A-6: Savings and costs by efficiency measure: Existing retail								
Measure	Cum. Electric Savings (%)	Cum. Gas Savings (%)	Total Electric (kWh/ft²)	Total Gas (kBtu/ft²)	Total Electric Cost ($/ft²)	Total Gas Cost ($/ft²)	NML Measure Cost $/ft² (2005)	Modified per KEMA $/ft² (2006)
Baseline	0	0	17.6	40.51	1.40	0.46		
Efficient lighting	43	-38	10.0	55.9	0.80	0.63	0.55	0.73
Commercial Duct Testing & Sealing	49	2	9.0	39.7	0.72	0.45	0.41	0.42
Efficient HVAC	53	2	8.2	39.7	0.66	0.45	0.28	0.42
Increased insulation	54	16	8.1	34.0	0.65	0.39	0.39	0.39
Total	54	16	8.1	34.0	0.65	0.39	1.63	1.97
Savings			9.5	6.5	0.76	0.07		

Table A-7: Savings and costs by efficiency measure: New retail								
Measure	Cum. Electric Savings (%)	Cum. Gas Savings (%)	Total Electric (kWh/ft²)	Total Gas (kBtu/ft²)	Total Electric Cost ($/ft²)	Total Gas Cost ($/ft²)	Measure Cost $/ft² (2005)	Modified per KEMA $/ft² (2006)
Baseline	0	0	15.2	19.20	1.21	0.22		
Efficient lighting	38	-46	9.4	28.0	0.75	0.32	0.43	0.57
Increased insulation	38	-18	9.4	22.7	0.75	0.26	0.18	0.18
Efficient HVAC	43	-18	8.6	22.7	0.69	0.26	0.28	0.42
Commercial Duct Testing & Sealing	48	11	7.9	17.1	0.63	0.19	0.34	0.35
Total	48	11	7.9	17.1	0.63	0.19	1.23	1.53
Savings			7.3	2.1	0.58	0.02		

Table A-8: Savings and costs by efficiency measure: Existing office								
Measure	Cum. Electric Savings (%)	Cum. Gas Savings (%)	Total Electric (kWh/ft²)	Total Gas (kBtu/ft²)	Total Electric Cost ($/ft²)	Total Gas Cost ($/ft²)	Measure Cost $/ft² (2005)	Modified per KEMA $/ft² (2006)
Baseline	0	0	17.6	32.7	1.41	0.37		
Efficient lighting	19	-9	14.3	35.6	1.14	0.40	0.55	0.73
Efficient office equipment	31	-16	12.2	37.8	0.97	0.43	0.12	0.12
Efficient HVAC	39	-3	10.7	33.6	0.86	0.38	0.39	0.60
Increased insulation	40	9	10.6	29.7	0.85	0.34	0.14	0.14
Total	40	9	10.6	29.7	0.85	0.34	1.20	1.59
Savings			7.0	2.9	0.56	0.03		

Table A-9: Savings and costs by efficiency measure: New office								
Measure	Cum. Electric Savings (%)	Cum. Gas Savings (%)	Total Electric (kWh/ft²)	Total Gas (kBtu/ft²)	Total Electric Cost ($/ft²)	Total Gas Cost ($/ft²)	Measure Cost $/ft² (2005)	Modified per KEMA $/ft² (2006)
Baseline	0	0	15.0	14.7	1.20	0.17		
Efficient lighting	21	-25	11.8	18.4	0.95	0.21	0.55	0.73
Efficient office equipment	36	-47	9.6	21.6	0.77	0.24	0.12	0.12
Increased insulation	37	-25	9.5	18.4	0.76	0.21	0.39	0.40
Efficient HVAC	40	-25	9.0	18.4	0.72	0.21	0.21	0.32
Total	40	-25	9.0	18.4	0.72	0.21	1.27	1.58
Savings			6.0	-3.7	0.48	-0.042		

Table A-10: Costs and savings for implementing energy efficiency measures			
Building Type	Incremental Cost (2006$/ft²)	Energy Cost Savings (2006$/ft²)	Simple Payback Period (years)
Existing Retail	1.97	0.83	2.4
New Retail	1.53	0.61	2.5
Existing Office	1.59	0.59	2.7
New Office	1.58	0.44	3.6

To arrive at the most conservative values for the costs of implementing the energy efficiency measures considered in this study, we made a comparison of measures used in *The New Mother Lode* and the Xcel Energy DSM Market Potential Assessment. Table A-11 describes similar energy efficiency measures used in the two studies and gives their costs. Note that very few of the measures in the two studies are identical, so the comparison is very rough. Without more detailed information on the technologies considered in both *The New Mother Lode* and the DSM Market Potential Assessment, it is impossible to guarantee the accuracy of the results of the comparison. However, there was enough correspondence between measures to make a rough comparison of costs (Table A-12). Note in Table A-12 that costs taken from *The New Mother Lode* range on both sides of costs used by Xcel Energy. Lighting cost values from *The New Mother Lode* were increased by 30 percent for our study while HVAC equipment and duct-sealing costs were increased by 49 percent to take into account the differences in cost between *The New Mother Lode* and the DSM Market Potential Assessment. This ensures that our calculations use the most conservative values in determining the costs of implementing the chosen energy efficiency measures.

Table A-11: Comparison of measures used in *The New Mother Lode* and the Xcel Energy DSM Market Potential Assessment				
Measure	NML[a] Incremental Cost	Notes on *New Mother Lode* Measures	Xcel Energy Cost (2005 $)	Notes on Xcel Energy Measures
T-8 lamps, specular reflector, and electronic ballast	$37/fixture (2001) $29/fixture (2001)	• In existing construction • In new construction	$35–50/fixture $50–67/fixture	• RET 4L4' Premium T8, 1 EB • RET 2L4' Premium T8, 1EB, reflector
VSD fan control	$125/hp (2001)	• Adding a variable-speed controller to fan motor	$157–385/hp	
High-efficiency fan motor	$8/hp (2001)	• Overall efficiency is improved from 55% to 70%.	$10–20/hp	• 1800 rpm
High-efficiency chiller	$53/ton (2000)	• Hermetic centrifugal chiller for office building prototypes are 6.3 COP (0.56 kW/ton)	$35/ton	• Centrifugal chiller (0.51 kW/ton), 500 tons
DX Packaged Air Conditioner	$100/ton (2000)	• EER=11.5, incremental cost compared to an EER=8.9	$27/ton	• EER=10.9, 10 tons
Office equipment	$30/workstation (2001)	• Plug load sensor/control	$24–28/workstation	• PC, monitor, and network power management enabling
Retro-commissioning	$0.19/sf	• Check/correct fan controls and dampers, economizer controls, HVAC temperature controls, Energy Management Controls, and balance airflow	$0.16–0.20/sf	• Air conditioner tune-up/ advanced diagnostics or chiller tune-up/diagnostics and optimization, and air handler optimization
Window film	$3.45/sf (1996)		$3/sf	
Cool roof	$0.50/sf-roof b (2001)	• For retrofit of roof not at time of replacement • Negligible for new construction or retrofit at time of replacement	$0.35/sf-roof[b]	

a: *The New Mother Lode*

b: Total cost

Table A-12: Energy efficiency measure cost comparison: The New Mother Lode and the Xcel Energy DSM Market Potential Assessment					
End Use	Measure	NML Incremental Cost Estimate (2001 $)	Updated *New Mother Lode* Cost Estimate (2005 $)	Xcel Energy Average Cost (2005 $)	Difference in Cost From Average Xcel Energy Value (%)
Lighting	T8 with electronic ballast[a]	37	40.80	43	-4
	T8, electronic ballast, and reflector	37	40.80	59	-30
Cooling	VSD fan control	125	137.85	271	-49
	High-efficiency fan motor	8	8.82	15	-41
	High-efficiency chiller[b]	53	60.11	35	72
	Packaged air conditioner[c]	100	113.41	27	270
Office Equipment	Computer and monitor	30	33.08	26	27
Retro-commissioning	Various	0.19	0.21	0.18	17
Envelope	Window film	3.45	4.29	3	43
	Cool roof	0.50	0.57	0.35	63

a: Energy savings for this combination are comparable between the New Mother Lode and Xcel Energy studies.
b: Costs for chillers may not be comparable between the studies due to size differences.
c: Costs for packaged air conditioners are not comparable between the studies due to differences in efficiency and size.

Implementation rates for cost-effective energy efficiency measures. For existing buildings, the annual implementation rate of cost-effective energy efficiency measures is 2.5 percent (Table A-13). For new buildings, we assume an annual implementation rate of 4 percent.

Costs to Implement Energy Efficiency Measures. Costs to implement the energy efficiency measures given the rate of implementation in Table A-13—both annually for selected years and over a 20-year project lifetime—are shown in Table A-14. Total costs for implementation of these cost-effective energy efficiency measures as described are approximately $600 million.

Energy Costs Avoided Due to Increased Efficiency. Operational costs avoided due to reductions in electricity and gas consumption—both annually for selected years and over a 20-year project lifetime—are shown in Table A-15. If commercial electricity rates do not change over the 20-year period, electricity cost savings for retail and office buildings are expected to be about $1.9 billion.

Based on the costs of implementing energy efficiency measures in the manner described previously and the reduction in operational costs due to installing these measures, the benefit-cost ratio for each year of the project and over the 20-year project lifetime can be calculated. Table A-16 shows the benefit-cost ratio for selected years and the overall value.

Table A-13: Energy efficiency measure implementation rates (%)

Building Type	2007	2008	2009	2010	2015	2022	2026
Existing	2.5	5	7.5	10	22.5	40	50
New	4	8	12	16	36	64	80

Table A-14: Cost to implement energy efficiency upgrades (2006 $M)

Building Type	2007	2010	2016	2022	2026	Total
Existing	13.8	13.8	13.8	13.8	13.8	276
New	0.7	4.3	13.5	26.1	36.8	320
Total	14.5	18.1	27.3	39.8	50.6	595

Table A-15: Energy cost savings (2006 $M)

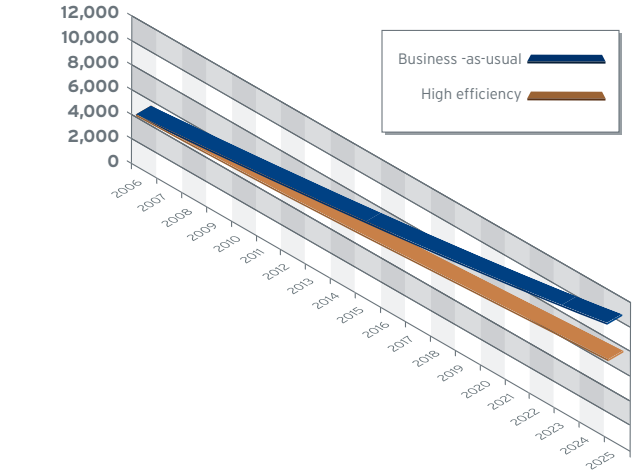
Building Type	2007	2010	2016	2022	2026	Total
Existing	5.5	22.9	62.2	108.4	143.8	1,381
New	0.2	2.4	15.3	43.8	74.4	489
Total	5.7	25.4	77.5	152.2	218.3	1,870

Table A-16: Annual and total benefit-cost ratio

Building Type	2007	2010	2016	2022	2026	Total
Retail	0.42	1.52	3.16	4.33	4.93	3.51
Office	0.37	1.27	2.48	3.27	3.66	2.73
Total	0.40	1.41	2.84	3.82	4.31	3.14

Energy Use Scenarios. In the "high-efficiency" case, annual retail and office energy use would increase about 40 percent, growing from 5.4 TWh in 2006 to 7.6 TWh in 2026, while in the "business-as-usual" case, energy use would nearly double to 10.7 TWh, as shown in Figure A-1.

Figure A-1
Electricity Consumption for Two Scenarios



Energy Efficiency Case Studies. In energy efficiency upgrades to buildings, any portion of the cost-effective fraction of the technical energy efficiency potential may be implemented, depending on the financial health and goals of the business. For each of the case studies in Table A-17, cost-effectiveness has different implications. The North Boulder Recreation Center is a government facility and therefore has a long expected lifetime with a single occupant, so energy efficiency investments with much longer payback periods can still be cost-effective. However, many businesses will require a quicker return on their investment and therefore will want to have a different definition of cost-effectiveness. Although Timken Aerospace replaced all light fixtures simultaneously—rather than at replacement and therefore increasing the payback period—cost savings due to this upgrade were large enough to justify the increased investment.

Table A-17: Examples of energy efficiency upgrades: costs and benefits

Case Study	Measures Implemented	Investment	Benefits
North Boulder Recreation Center[a], Boulder, CO	Renovation & Expansion: ENERGY STAR-certified cool roof, 90% efficient boilers, solar water preheat, daylighting, low-energy lighting, lighting sensors, double-paned low-E windows	Incremental = $540k	Energy = $56k Payback = 9.6 years[b]
Thrivent Financial for Lutherans	Recommissioning: Fix air distribution system including sealing ductwork, modify HVAC pump control, and optimize HVAC system controls	Total = $186k Rebate = $33k	Peak demand = 260 kW Energy = $190k Electricity = 2.15 TWh/yr Payback = 0.9 years
Timken Aerospace, Lebanon, NH	Lighting: Replace 543 400 W metal halide fixtures (actually using 455 W each) with T5 fixtures (232 W)	Total = $268k Rebate = $91.5k	Demand = 120 kW Energy > 1 TWh/yr= $70k Payback = 2.5 years
Wells Fargo	Energy Design Assistance: High-performance lighting systems, low-E window glazing, efficient motors, and increased wall insulation	Total = $188k Incentives = $73k	Demand = 430 kW Energy = 1.9 GWh/yr= $23k Payback = 5 years

a: First LEED-silver certified building in Colorado

b: Relatively long payback period is due to inclusion of solar water-heating system

The investment each of these companies made in energy-efficiency measures is capital directed away from use for current operating requirements or expansion. However, this investment directly and indirectly finances construction, manufacture and distribution of energy-efficient equipment, energy service companies, engineers and loan servicing. Economic benefits begin upon installation of energy efficiency measures and continue to accrue in each of following years.

Economic Impact Analysis. To assess the economic impacts likely to occur in Colorado due to the implementation of this particular energy efficiency program, we use an economic impact analysis (EIA). Economic impact modeling is based on mapping the economic linkages between and among various industry sectors. The basic premise of EIA, or input-output analysis, is that any change in production levels of an economy's basic industries will change the production levels of other directly and indirectly related industries. Modeling this input-output process produces multipliers describing the total economic effect for a unit of change to a given industry sector. Note that economic impact analysis assumes a constant, or linear, relationship between inputs and outputs, and multipliers are valid for only a single point in time, so the technique provides more reliable results for near-term impacts.

We followed a methodology similar to that used in *The New Mother Lode* study throughout this analysis. In this case, we based our values on results from *The New Mother Lode* study because a full economic impact analysis was outside the scope of the project. Therefore, values shown are derived by prorating the EIA results for Colorado in *The New Mother Lode*. Table A-18 shows values from *The New Mother Lode* that were pro-rated and the results. Four ratios are used in prorating *The New Mother Lode* values for net job increase, change in wage/salary compensation, and change in gross state product. These are the ratio of energy efficiency investment values for the two projects, the ratio of benefit-cost ratios for the two projects, the ratio of project lifetimes, and an estimate of the change in the value of the dollar from 2000 to 2006 based on the consumer price index.

Table A-18:
Economic impact of energy efficiency improvements

Category	*New Mother Lode* Value	CESC Value
Energy efficiency investment period	2003-2020	2006-2026
Energy efficiency investment	2000 $430M	2006 $595M
Benefit-cost ratio	4.2	3.1
Net job increase[a]	12,200	12,097
Change in wage/salary compensation	280	322
Change in gross state product	2000 -$100M	2006 -$115M

a: Number of full-time equivalent (FTE) jobs in person-years

The accuracy of the values given above for implementing energy efficiency measures as described in this study is limited due to the calculation method used. Changes in the costs of energy efficiency measures and implementation rate made in our study compared to *The New Mother Lode* study have the most potential to compromise the accuracy of the economic impact values. The multipliers used in input-output analysis are very sensitive to the distribution of costs between materials and labor. Therefore, changing the costs of energy efficiency measures based on costs reported for the KEMA/Xcel Energy DSM report necessarily limits the accuracy of the final values for changes in number of jobs, wage/salary compensation and GSP. While labor costs stay in the state, materials costs are more likely to flow out of the state. Without knowing how the distribution of labor and equipment costs in the KEMA/Xcel Energy estimates, it is impossible to validate their comparability to costs used in *The New Mother Lode.*

Appendix B
Energy Efficiency-Related Organizations in the Metro Denver Area

Federal Programs

ENERGY STAR®

The ENERGY STAR business improvement program by EPA offers businesses technical guidance and financial and organizational resources for improving energy efficiency. Guidelines for Energy Management provides tools and resources to develop and implement an energy-management strategy. Benchmarking energy consumption—whether as part of a formal energy-management program or not—and use of the national building energy-performance rating system enables organizations to establish current energy performance and goals. ENERGY STAR specifications can be used in guiding purchasing decisions. Businesses achieving the ENERGY STAR designation are distinguished for their energy performance by the familiar symbol and national and regional recognition.

Energy-Management Guidelines

- A proven strategy based on ENERGY STAR partners' successful practices
- Provides programmatic and technical tools and resources for each phase in developing an energy-management plan, from developing commitment to assessing performance, from communicating and motivating team members to recognizing achievement
- Explanation of development of energy-performance ratings available for: offices, banks, financial centers, hospitals and medical offices, supermarkets/grocery stores, hotels/motels, K–12 schools, residence halls and warehouses

Benchmarking

- Used to rate performance of building relative to similar buildings nationwide using the national energy performance rating system
- Accounts for building location and size, inter-annual weather variations and several operating characteristics
- Buildings rating 75 or greater on a 100-point scale may qualify for ENERGY STAR
- Online tool—Portfolio Manager—enables businesses to track and benchmark energy use
- Web-based automated benchmarking through five commercial energy information and bill-handling service providers

Financial Strategies

- Financial Value Calculator presents energy investment opportunities in terms of key financial metrics (e.g., profits, earnings per share, etc.)
- QuickScope allows asset and property managers to calculate costs and benefits and determine financial viability of energy-performance improvements
- Cash Flow Opportunity Calculator determines the amount of new energy efficiency equipment that can be purchased from anticipated savings and financial effects of purchase timing

Purchasing and Procurement

- ENERGY STAR®-qualified products available for commercial applications consist of appliances, food service equipment, heating and cooling systems, lighting (compact fluorescent lamps and exit signs), transformers, windows, roofing, consumer electronics and office products
- Savings calculators available for all types of equipment and appliances covered
- For products not covered by ENERGY STAR, Department of Energy's Federal Energy Management Program (FEMP)-recommended products are available
- Online training for procurement officials provided

ENERGY STAR Challenge

- Targets businesses and institutions to achieve reductions in energy use of 10 percent or more through proven methods such as replacing old equipment with energy-efficient equipment, upgrading lighting systems, and low-cost building upgrades
- Promotes energy benchmarking, establishing efficiency improvement goals of 10 percent or more, and making energy efficiency improvements
- Participants who meet or beat their goals and share their results are recognized by the EPA
- ENERGY STAR Challenge participants have joined with the EPA to encourage 10 percent reductions in energy use by businesses and organizations across the country
- ENERGY STAR Leaders have taken the ENERGY STAR Challenge and achieved energy efficiency improvements across their entire building portfolios
- Denver rollout in spring 2006

Website: www.energystar.gov/index.cfm?c=business.bus_index

Contact:
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US EPA Region 8
ENERGY STAR®
999 18th Street, Suite 300
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303-312-6464
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National Renewable Energy Laboratory (NREL) Federal Energy Management Program (FEMP)

The FEMP team at NREL helps government agencies implement projects that increase energy and water efficiency, or use renewable energy or distributed power technologies, helping them to achieve national goals in these areas. The FEMP team includes professional engineers, architects, utility and contracting experts, and training specialists who provide technical assistance, project management, energy contracting services, project evaluation and guidance in project financing. Design assistance for new construction includes energy-use modeling, developing engineer or architect work statements, and providing support in using LEED in the design process or in obtaining LEED certification. The FEMP team provides training in renewable energy and low-energy and sustainable design. Projects often make use of Energy Savings Performance Contracts (ESPC), Utility Energy Services Contracts and Renewable Power purchases. In addition, the FEMP team is developing a business case for sustainable design.

Website: www.nrel.gov/femp/

Contact:
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National Renewable Energy Laboratory
Mary_Colvin@nrel.gov

Nationwide Programs

Leadership in Energy and Environmental Design (LEED) Green Building Rating System™

The U.S. Green Building Council developed LEED™ in 1994 to transform the U.S. building market by establishing a definition for and promoting green building, recognizing environmental leadership and encouraging competition in the building industry, and increasing awareness of the benefits of green building within both the building industry and market. LEED certification is based on building performance and accomplishment of various levels of sustainability goals in site development, energy use, water use, materials selection and indoor environmental quality. Three LEED rating systems—plus a fourth in the pilot phase—are applicable to commercial buildings: LEED-NC, LEED-EB, LEED-CI and LEED-CS (under development).

Four levels of project certification—certified, silver, gold, and platinum—are based on the number of points earned for criteria in six categories: energy and atmosphere, indoor environmental quality, sustainable sites, materials and resources, water efficiency, and innovation and design/innovation in upgrades, operations and maintenance (LEED-EB). Energy efficiency and building energy performance are typically addressed in potential credits in two to four categories. Participation in LEED certification is voluntary. The fee for the registration and certification process depends on building size.

LEED-NC New Construction and Major Renovation

- For commercial and institutional projects, with a focus on office buildings
- May be applied to multiple-building projects (e.g., corporate campuses)
- Guide to application process for low-rise (maximum four stories) lodging projects available
- Guide to application process for retail projects in pilot phase
- Rating system version 2.2 currently in effect

LEED-EB Existing Buildings

- For building owners and facility managers
- For operations and systems upgrades where majority of surfaces (interior or exterior) remain unchanged
- Can be used for buildings already certified under LEED-NC
- Low- or no-cost strategies for improving facility performance

LEED-CI Commercial Interiors

- For tenants and designers (i.e., those who may not have control over building operations)
- Includes energy performance of equipment and appliances

LEED-CS Core and Shell (in pilot phase)

- For designers, builders, developers and new building owners
- Covers structure, envelope and building-level systems (HVAC, plumbing, etc.)
- Recognizes differences in building market for owner and tenant responsibility (i.e., where owner does not control design and construction of building interior)
- Most buildings expected to be designed and/or built without specific client commitment, where LEED certification is used in marketing
- Projects may be “pre-certified” prior to building and officially certified upon completion
- Ranges from $2000 for buildings under 75,000 square feet to $3500 for buildings over 300,000 square feet

Website: www.usgbc.org/DisplayPage.aspx?CategoryID=19

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annette@associates3.com
303-534-4444
www.usgbc.org/Chapters/colorado/

BOMA Energy Efficiency Program (BEEP)

Developed by the BOMA Foundation in cooperation with the U.S. Environmental Protection Agency ENERGY STAR® Program, BEEP is an operational excellence program for property owners, managers and operators. The focus of the program is educating the commercial real estate industry about the potential to reduce energy consumption with no- and low-cost solutions. BEEP's goals include developing an industry standard for operational excellence, improving tenant comfort and optimizing financial performance of energy investments. BEEP-trained real estate practitioners will be positioned to provide solutions to tenant or owner energy-related concerns. BEEP will also provide recognition for energy-reduction achievements, to include acknowledging property rating improvements, creating an honor roll on the BEEP Web portal, publishing of case studies and earning ENERGY STAR.

BEEP's training programs—available through both live and Web-supported audio seminars—qualifies for continuing professional development credits. The six courses in the BOMA Energy Efficiency Program and their contents are:

- Introduction to Energy Performance: fundamental concepts, energy management plan and policy development, case studies
- How to Benchmark Energy Performance: overview and value of energy-performance benchmarking using EPA's energy performance rating system, benchmarking resources
- Energy Efficient Audit Concepts and Economic Benefits: benefits of energy audits, equipment inventory, sequence of operations, record management, loads, performance verification, best practices
- No- and Low-cost Operational Adjustments to Improve Energy Performance: best practices (janitorial, lighting, maintenance and preventive maintenance), metering, data loggers, optimizing energy management systems/BAS, recommissioning, best practices
- Valuing Energy Enhancement Projects and Financial Returns: concepts (NPV, IRR, ROI, payback), selling energy-performance enhancements to owners/asset managers/tenants, case studies
- Building an Energy Awareness Program: potential for BEEP and ENERGY STAR recognition; creating case studies; communications plans; energy awareness programs for tenants, brokers and leasing agents; other tools and resources

Website: www.boma.org/AboutBOMA/BEEP/

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Building Owners & Managers Association (BOMA), Int'l
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Washington, DC 20005
202-326-6320
pareno@boma.org

BOMA International's Earth Award

BOMA International created the Earth Award in 2001 as a category in its The Office Building of the Year (TOBY) Awards to recognize property owners and managers that demonstrate excellence in preserving both the internal and external environments of their properties. While the Earth Award focuses on employee safety and preparation for building emergencies and environmental risks, several environmental categories are also considered, from energy efficiency to recycling to water efficiency.

Website: boma.org/Membership/Awards/earthawards/

Contact:
Jon Hadley
BOMA International's Communications Department
jhadley@boma.org

Ecobroker®

The Association of Energy and Environmental Real Estate Professionals (AEEREP) encourages energy and environmental education for real estate professionals through its EcoBroker program. The EcoBroker program promotes energy efficiency and sustainable design in real estate properties, provides training and certification of real estate professionals, referral of green products and services providers (EcoBroker Affiliates™), and a website with energy and environmental information.

Website: www.ecobroker.com

Contact:
1-800-706-4321
customerservice@ecobroker.com

Utility Initiatives

Xcel Energy Commercial Demand-Side Management (DSM) Program

The new Xcel Energy DSM program will reduce peak electrical demand by 320 MW and conserve 800 GWh of electrical energy over its eight-year lifetime. All seven commercial programs are now offered to commercial customers. Xcel Energy offers an energy analysis and assessment tool on its website that allows customers to evaluate facility energy use and costs and determine potential savings and applicable rebates.

Lighting Efficiency Program

- For retrofit and new construction
- Offers rebates for purchasing and installing energy-efficient lighting equipment
- Rebates cover lamps, ballasts, reflectors, automatic controls/sensors and LED exit signs

Cooling Efficiency Program

- Provides rebates for replacing or updating cooling systems for energy efficiency

- For new construction or existing facilities
- Qualifying equipment includes rooftop air-conditioning units, condensing units, split systems, chillers (scroll, rotary screw, and centrifugal), oversized cooling towers, variable air volume boxes, packaged terminal air conditioners, and water-source heat pumps

Motor Efficiency Program

- Provides rebates for purchasing and installing NEMA Premium™ efficiency motors meeting specific requirements in new or existing facilities
- Provides rebates for adding variable frequency drives (VFDs) to existing motors
- Rebate levels a function of horsepower rating
- For applications such as pumps, blowers and fans

Recommissioning

- Reduces energy consumption by improving energy efficiency of existing mechanical systems and controls
- Xcel Energy pays up to 50 percent of cost of recommissioning study (not to exceed $15,000)
- Study funding available for buildings starting at 50,000 square feet
- Incentives are customized for implementation of recommended measures reducing peak kW and/or kWh
- Pre-approval required for projects

Energy Design Assistance

- For new construction, additions and major renovations
- Offers free design assistance
- Provides custom incentives for energy-conservation strategies employed
- Commercial projects qualify starting at 50,000 square feet
- Pre-approval required for projects

Website: www.xcelenergy.com

Contact:
Bill Gruen
Xcel Energy
william.gruen@xcelenergy.com

Fort Collins Utilities

Fort Collins Utilities offers a wide range of programs and services for commercial and industrial customers, including demand and energy-based efficiency incentives, cooling equipment rebates, integrated design assistance for new buildings, energy assessments, an e-newsletter, a business educational program series, and an online interval data tool.

Descriptions of each program are as follows:

- Electric Efficiency Program (EEP): EEP is a collaboration between Fort Collins Utilities and Platte River Power Authority. The program provides incentives to commercial and industrial customers for qualified efficiency upgrades of lighting, air conditioning, motors, drive systems and process equipment. Incentives are the greater of $500 per summer kilowatt reduced or $0.10 per annual kilowatt-hour saved.

- Cooling Rebate Program (CRP): CRP is offered to Fort Collins Utilities customers by the Platte River Power Authority. Rebates for small commercial equipment are fixed depending on the SEER rating, while larger packaged equipment incentives are based on the size of the unit.
- Integrated Design Assistance Program (IDAP): IDAP supports owners, designers and contractors in delivering high-performance buildings that are more energy-efficient than required by the building code. The program is based on the ASHRAE energy code and defines two options for participating: a comprehensive whole-building modeling approach and a simpler prescriptive approach based on building components. Design incentives are available for projects that apply prior to schematic design, and performance incentives are based on electricity savings, calculated with either a Whole Building or Prescriptive approach. Fort Collins Utilities Energy Services staff also provides technical assistance.
- Energy Assessments and Technical Assistance: Fort Collins Utilities provides free energy assessments to commercial and industrial customers, which includes a billing and rate information review, a walk-through energy audit, and recommendations for efficiency measures and program participation.
- Keep Current Electronic Newsletter: The Keep Current newsletter is offered at no cost to commercial customers and is published every other month. The service includes the e-newsletter, an online information library and customized ask-an-expert service.
- Business Environmental Program Series: The Business Environmental Program Series runs in the late summer and fall, offering a range of free morning workshops on energy and environmental topics from a business perspective.
- Electri-Connect: Electri-Connect offers Fort Collins Utilities' larger commercial and industrial customers online access to interval billing meter data for energy-management purposes.

Website: www.fcgov.com/powertosave

Contact:
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Fort Collins Utilities
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Platte River Power Authority

Platte River Power Authority offers energy efficiency services to its four member cities, Fort Collins, Loveland, Longmont and Estes Park. The programs vary somewhat by city because each also offers their own services to customers.

- Electric Efficiency Program (EEP): EEP provides incentives to commercial and industrial customers for qualified efficiency upgrades of lighting, air conditioning, motors, drive systems and process equipment. Incentives vary by city, with Platte River contributing $350 per summer kilowatt reduced.
- Cooling Rebate Program (CRP): Rebates for small commercial equipment are fixed depending on the SEER rating, while larger packaged equipment incentives are based on the size of the unit.
- Energy Monitoring allows customers to better understand facility energy-use patterns and address opportunities for increased energy efficiency by providing load profiling and sub-metering.
- Energy and Process Efficiency Facility Audits for commercial and industrial customers include billing data review, benchmarking, and an efficiency opportunity evaluation (including lighting, motors and HVAC systems).

Website: www.prpa.org/productservices/dsmmain.htm

Contact:
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University Programs

Colorado Energy Research Institute (CERI)

CERI is responsible for coordinating and integrating energy-related research, economic and technical development, and education and outreach for the state. A wide range of energy sector topics are addressed, from conventional fossil energy exploration to renewable energy technologies and energy efficiency. The Colorado Energy Research Institute is hosted at the Colorado School of Mines and works with other universities, colleges, independent research labs, state and federal government, the private sector, and nonprofit and nongovernmental organizations.

Website: www.ceri-mines.org/

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Golden, CO 80401-1887
303-273-3506
nummedal@mines.edu

Colorado State University Industrial Assessment Center (CSU IAC)

The U.S. Department of Energy's Industrial Assessment Center at Colorado State University (CSU IAC) provides free, comprehensive, on-site industrial assessments—including facilities, services and manufacturing operations—to eligible small and medium-sized manufacturers while training students. The IAC assessment team performs a detailed technical and economic analysis for specific energy efficiency, waste minimization and productivity-improvement recommendations including implementation cost estimates and expected payback period. After six to nine months, the IAC team verifies which recommendations will be implemented within two years with a follow-up survey. The CSU IAC and its predecessor programs serve Colorado and eight other western states and have provided assessments and recommendations to more than 560 manufacturing plants since 1984, with approximately 50 percent of recommendations successfully implemented.

Website: www.engr.colostate.edu/IAC/

Contact:
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1374 Campus Delivery
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The Energy Program of the Wirth Chair

The Energy Program of the Wirth Chair at the University of Colorado at Denver was created to advance energy management and carbon emission-reduction initiatives throughout Colorado. The program assists both the public and private sectors—including nonprofit organizations—in developing cost-effective energy efficiency strategies.

Website: www.cudenver.edu/cbep

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Campus Box 133
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Denver, CO 80217-3364
303-820-5676 or 303-352-3768
heidivg@cudenver.edu

State Initiatives

Rebuild Colorado

This Governor's Office of Energy Management and Conservation (OEMC) program is primarily directed to state and local governments, but provides a number of resources that are accessible to the private sector. Partners in Rebuild Colorado include OEMC staff, energy professionals, many state organizations, various national organizations, and EPA's ENERGY STAR program. Rebuild Colorado provides technical support to assist state and local governments to identify and follow through with large-scale, comprehensive energy-saving projects. Services relate to every phase of an institutional building's life: 1) for new construction, LEED's new construction approach and commissioning are recommended strategies; 2) for existing building upgrades, performance contracting is offered; and 3) for day-to-day energy management. Rebuild Colorado is launching an expanded program to include utility bill data auditing and tracking. Rebuild Colorado has been involved in $140 million of performance contracting projects completed or underway. The private sector can access informational and referral services, such as website resources and guidebooks.

Website: www.colorado.gov/rebuildco

Contact:
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Rebuild Colorado
Governor's Office of Energy Management and Conservation
225 East 16th Avenue, Suite 650
Denver, CO 80203
303-866-2264
rebuildco@state.co.us

State Partners for Energy and the Environment

A joint program of OEMC and the Colorado Department of Public Health and the Environment (CDPHE) funded by a U.S. Department of Energy grant, the State Partners for Energy and the Environment program promoted energy efficiency directly to small and medium-sized businesses. CDPHE permit writers and inspectors were trained to recognize opportunities to

improve energy efficiency and use renewable energy sources during facility inspection, promote energy efficiency, distribute program promotional materials, and encourage facility managers to sign up for additional technical assistance from OEMC. OEMC provided free energy audits to any small or medium-sized business, made energy efficiency improvement recommendations, and assisted with measure implementation through a follow-up phone call.

Website: http://www.state.co.us/oemc/programs/commercial/statepartners.htm

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ColoradoEnergy.org

ColoradoEnergy.org is an online resource for Colorado builders, businesses and consumers. The website covers energy-related activities and organizations in Colorado, energy-related laws and legislation, building codes, green building information, and a directory of energy-efficiency and renewable-energy companies, energy-focused architects and designers, and green builders.

Website: www.coloradoenergy.org

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Local Initiatives

Building Performance with ENERGY STAR®

The City of Boulder is offering a pilot program providing free ENERGY STAR benchmarking and no-cost energy and water audits—performed by professional engineers—to the commercial sector. Energy audits will include recommendations for no- or low-cost energy-conservation measures, including operations and maintenance strategies, retrofit opportunities, and assistance in obtaining utility rebates. While a variety of commercial buildings qualify for the program, general offices and other spaces must be larger than 5000 square feet and bank branches must be larger than 1000 square feet. Eligible buildings must be located within the City of Boulder, and services are provided on a first-come, first-served basis through 2006. Special recognition from the City of Boulder and ENERGY STAR is available to qualifying high-performance buildings. In addition to improving building energy and water efficiency and building marketability, the pilot program will promote utility rebates and ENERGY STAR resources, and assist the city in determining services it should offer its commercial sector.

In addition, the city has added energy audits to its water conservation program targeting the largest water users in the Boulder Water District. In the past, the city gave out lighting rebates from Xcel Energy by directly approaching business customers to determine opportunities for lighting-efficiency improvements and using lighting contractors.

Website: www.ci.boulder.co.us/environmentalaffairs/energy/BPES.html

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Northeast Metro Pollution Prevention Alliance (NEMPPA) Energy Efficiency Project

NEMPPA is a nonprofit organization promoting the adoption of pollution-prevention and energy efficiency strategies by small businesses in the Commerce City area. Businesses with fewer than 100 employees in northeast Denver—an area defined by 36th Avenue, Pecos Street, 120th Avenue and Tower Road—are qualified to receive up to $3,000 to implement energy efficiency measures. These businesses receive a free detailed facility energy audit, recommendations for energy efficiency improvement, and a cost-benefit analysis. NEMPPA also assists businesses in securing additional capital for larger energy efficiency projects. In the NEMPPA service area, computer equipment, food and food service products, commercial and industrial machinery, metal fabrication, and printing, publishing and related businesses have been identified as ideal candidates for the program. This program is no longer active due to lack of funding.

Contact:
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c/o Tri-County Health Department
4201 East 72nd Avenue, Suite D
Commerce City, CO 80022
720-322-1541
jlaboe@tchd.org

Professional Organizations

Alliance for Sustainable Colorado

The Alliance for Sustainable Colorado promotes environmental, economic and social sustainability in Colorado. The Alliance Center houses 28 nonprofit organizations representing a range of interests, including environmental protection, in two LEED-certified buildings. Besides providing a space for sustainability-related exhibits and conferences, the Alliance Center demonstrates the many benefits, including reductions in environmental impact, of the use of green building design and technologies.

Website: www.allianceforcolorado.org/

Contact:
Alliance for Sustainable Colorado
1536 Wynkoop St.
Denver, CO 80202
303-572-1536

Rocky Mountain Association of Energy Engineers (RMAEE)

RMAEE is the western chapter of the national Association of Energy Engineers, an organization dedicated to educating its members through monthly meetings about efficient energy usage and energy-savings technologies already available in the marketplace. RMAEE offers energy engineers learning and networking opportunities, as well as promoting "the effective use of all types of energy solutions."

Website: www.rmaee.org/

Contact:
Dan Sachse
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Energy Services Coalition—Colorado Chapter

The Colorado chapter of the national educational nonprofit organization Energy Services Coalition is dedicated to increasing awareness and use of energy-performance contracting. The ESC Colorado chapter provides a forum for energy service companies and the state to develop relevant legislation, and the chapter's alliance with the state energy office increases exposure of energy service companies. The Energy Services Coalition targets schools, universities, hospitals, health-care facilities, multifamily buildings, industrial facilities, public buildings, office buildings and other large commercial facilities.

Website: www.energyservicescoalition.org/chapters/CO/index.html

Contact:
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Energy Services Coalition, Colorado Chapter
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Environmentally Oriented Business Organizations

Colorado Environmental Partnership (CEP)

The oldest business environmental organization in the state, CEP provides events on environmental performance and sustainability for businesses, aids companies in implementing practical environmental strategies, cultivates environmental leadership, and works with stakeholders to develop relevant public policies. In 1995, CEP sponsored a one-day energy-efficiency workshop to assist member companies in developing specific projects. In the same year, members of the Energy Subcommittee established benchmarks for energy efficiency for manufacturing companies, and CEP held a program on energy efficiency and its economic and environmental benefits with more than 100 public and private managers attending. In 1996–1997, CEP cosponsored the study "Colorado's Energy Future: Energy Efficiency and Renewable Energy Technologies as an Economic Development Strategy," which determined the outcomes of a 14 percent increase in energy efficiency compared to current trends by the year 2010. Energy Subcommittee member companies adopted this goal and developed a

plan to achieve this target, including initiating development of a "Colorado Best Energy Management Practices" benchmark program. Energy was the primary focus for CEP in 2004.

Website: www.coloradop2.org

Contact:
Colorado Environmental Partnership
P.O. Box 934
Denver, CO 80201-0934
303-460-5222
info@coloradoenvironmentalpartnership.org

Colorado Alliance for a Sustainable Future (CASF)

CASF is a network of business owners and nonprofit organizations dedicated to "best business practices and ethical conduct" and "Colorado's sustainability." All members are vetted through the Better Business Bureau, the State Attorney General's Office and the Colorado Environmental Coalition's environmental network. Business owners support member nonprofit organizations by participating in their community outreach projects.

Website: www.sustainablecolorado.com

Contact:
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Colorado Alliance for a Sustainable Future (CASF)
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Colorado Alliance of Sustainable Business Associations (CASBA)

CASBA is an association of nonprofit sustainable business organizations that facilitates communication, collaboration and coordination among these groups to support the fulfillment of their missions. CASBA's website includes a directory of mostly Colorado organizations providing information and services, a discussion of sustainable and socially responsible business practices, and a calendar of related events.

Website: www.coloradosustainablebusiness.org

Contact:
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Denver, CO 80202
303-572-1536 or 303-530-2222
jsix@frii.com

Colorado Environmental Business Alliance and People, Planet, Profit (CEBA/P3)

CEBA/P3 is a trade association promoting environmentally and socially responsible business practices. Services for members and sponsors include training and educational programs, member-to-member referrals, trade leads and networking events.

Website: www.ceba.org or p3colorado.org

Contact: CEBA/P3
Advanced Colorado Center
1625 Broadway, Suite 950
Denver, CO 80202
303-592-4066

Appendix C
Model Commercial Energy Efficiency Programs

Austin's Green Building Program

The City of Austin's Green Building Program is administered through the municipally owned utility, Austin Energy. The program was established in 1991 as a part of the Department of Public Works. Since Austin Energy is the primary funder, the program was transferred to their direct direction. The program offers consulting and informational services to residential, commercial, multifamily and municipal development projects. Commercial building owners who work with the Green Building Program's commercial staff can realize lower operating costs, increased employee productivity and higher indoor air quality. The staff consult with designers, engineers and construction professionals to provide information on resources for efficient building materials and systems, how to reduce construction and operations waste, as well as environmental and financial issues to consider during the design and construction process. Many services are free to Austin businesses.

The program began as a checklist of items to be considered, but as participants became more involved, they wanted a rating system to measure achievement. The current rating system awards between one and five stars to projects. Since 1999, when the commercial program was added, 15 projects have documented a total energy savings of 3,140 KW (11,435 MWh) annually. These calculations only include savings due to better design and material choices. The City of Austin now requires that every commercial project within the central business district receive a minimum one-star rating by fulfilling eight basic requirements. Concurrently, the Austin Independent School District requires all schools to achieve a two-star rating. As a result, more than 40 projects are currently enrolled in the program. The Green Building Program has won numerous awards for developing ecological building agendas, and for establishing precedent-setting guidelines, ordinances and market strategies. In addition, it has been recognized as a top "success story" by the U.S. Department of Energy.

Berkeley's Commercial Energy Conservation Ordinance (CECO)

The City of Berkeley implemented the Commercial Energy Conservation Ordinance in 1993. Under CECO, all commercial buildings are required to meet minimum energy efficiency standards upon change of ownership or significant renovation or addition to the property. In the first case, energy efficiency upgrades must be made before the title transfers to the new owner; otherwise, compliance responsibility transfers to the buyer. In the latter case, upgrades are triggered through the building permit application process—the applicant is required to install conservation measures to the entire building if the renovation or addition increases the conditioned area of the building by more than 10 percent or if the value of the renovation exceeds $50,000.

CECO lists specific energy-conservation measures from which building owners may choose to upgrade their properties. These measures include: HVAC system upgrades, water heater insulation, lighting upgrades, cleaning and tuning of refrigeration systems, and ceiling insulation, etc. The building owner must implement all required measures up to the expenditure limit for their building. The City Manager oversees implementation of the CECO program. The Codes and Inspections department enforces compliance through building inspections. The City's Office of Energy and Sustainable Development tracks the energy and financial savings resulting from implementation of CECO. Since its inception, over 130 commercial buildings (10 percent of the city's total) have been improved.

Prior to sale, renovation or the start of new construction, the building owner commissions an energy audit to determine the potential energy savings and financial costs of each energy-conservation measure listed under the ordinance. Investment caps ensure that energy upgrades can be made without jeopardizing the financial health of the business. The maximum total cost of the energy-conservation measures required to be installed upon sale of a commercial building is the lesser of 1 percent of the assessed value of the property, or $150,000. For major renovations, the maximum total cost of conservation measures required is the lesser of 5 percent of the total construction cost of the renovation or 1 percent of the assessed value of the entire building.

Chicago Commercial Energy Efficiency Programs

Chicago uses multiple approaches—from recognition to regulation—to promote energy efficiency in its residential, commercial and municipal sectors. In 2001, the Chicago Building Code was amended to include the Chicago Energy Conservation Code, which was modeled after the 2000 International Energy Conservation Code. The Chicago Energy Conservation Code establishes minimum energy-conservation standards for new and renovated buildings and encourages technologies and construction methods that will increase building energy efficiency by 10–20 percent. The Chicago Department of Environment provides training for boiler operators in energy-efficient operation and maintenance practices in its Boiler Efficiency workshops. Motor Master workshops teach utility auditors, industrial plant energy coordinators and consulting engineers how to reduce energy use, operating costs and downtime of electric motors. In addition, the city recognizes outstanding nonresidential green building projects with its biannual GreenWorks Award.

Oakland Commercial Energy Efficiency Programs

Commercial energy efficiency in Oakland has been addressed recently by programs on the state, city and utility level. The California Energy Commission provided grants for peak demand reduction. These grants offered up to $250 per peak kilowatt saved and required a minimum project size of 20 kW of average peak demand reduction with a maximum grant of $4 million. Energy efficiency loans for small businesses in new or existing facilities were available through the State Assistance Fund for Enterprise, Business and Industrial Development Corporation. Qualifying businesses could receive up to $250,000 at 5 percent interest. Currently, the city's Sustainable Development Initiative is developing an energy efficiency program targeting new and existing businesses. However, the most significant business energy efficiency opportunity in Oakland is the East Bay Energy Partnership, a joint program between the City of Oakland and Pacific Gas and Electric Company. The East Bay Energy Partnership offers energy efficiency products and services, with special programs designed for small and large businesses:

- The Business Energy Services Team (BEST) provides free business energy-use assessment, custom energy-saving recommendations, rebates, and installation of approved equipment.
- The Smart Lights Program offers free, no-obligation lighting assessment, free start-to-finish technical assistance, and subsidies for equipment and installation costs for small businesses.
- The Building Tune-Up Program provides free energy analysis and evaluation to larger businesses to optimize control, HVAC and lighting systems, customized operational guidelines and funding for recommissioning.
- The Energy-Efficiency Design Assistance Program provides free energy audits of existing commercial buildings, and free, customized energy efficiency design assistance to property owners, developers and building designers for new construction or renovation of existing commercial buildings.

Portland's Businesses for an Environmentally Sustainable Tomorrow Program

In order to promote and encourage sustainable business practices, the City of Portland's Office of Sustainable Development (OSD) created the Businesses for an Environmentally Sustainable Tomorrow (BEST) program in 1993. The BEST awards recognize businesses with significant and unique achievements in the following categories: Energy, Water Efficiency, Stormwater Management, Waste Reduction/Pollution Prevention, Transportation Alternatives, Sustainable Food Systems Development, Sustainable Product Development and BEST Practices for Sustainability. OSD offers technical assistance and information to businesses to help them achieve economic and environmental efficiency. Once businesses have taken steps to achieve sustainability, they are eligible to apply for an award. The awards are meant to recognize those businesses that are the highest achievers and leaders in sustainability in the Portland metropolitan area. Between 30 and 40 applications for awards are received each year. A committee comprised of OSD staff, staff of related city and state agencies, and private green business leaders choose the winners based on savings and innovation. One or two awards are presented for each category. BEST award winners annually save $11.7 million through efficiencies and upgrades.

Tucson Sustainable Energy Building Standard

The City of Tucson, Arizona, established a "Sustainable Energy Standard" that requires all construction and major renovation of municipal buildings to meet energy efficiency standards 50 percent greater than those of the national Model Energy Code. The Sustainable Energy Standard suggests various conservation measures but allows architects freedom in choosing exactly how to meet the higher efficiency requirements. Designers must detail conservation strategies and perform an energy analysis early in the design process. The city then monitors energy efficiency throughout the contracting, inspection and testing phases. Builders have found the savings surprisingly easy to achieve.

The Tucson-Pima County Metropolitan Energy Commission developed the Sustainable Energy Standard through the Tucson/Pima County Energy Codes Committee. The Sustainable Energy Standard also serves as a voluntary standard for commercial buildings throughout Tucson and Pima County. It provides a quantifiable standard against which building plans can be measured to ensure that the finished buildings can be expected to enjoy substantially less energy usage than would have been the case under the national Model Energy Code. The building code initiatives were achieved through community-wide support to create new market opportunities that would reduce the negative environmental impacts of construction. The Sustainable Energy Building Standard has reduced annual energy costs by $200,000 and annual carbon dioxide emissions by 1600 tons.

Appendix D
Acronyms, Definitions and Units

Acronyms

AEEREP: Association of Energy and Environmental Real Estate Professionals

BEEP: BOMA Energy Efficiency Program

BOMA: Building Owners and Managers Association

BPw/ES: Building Performance with ENERGY STAR®

CECO: commercial energy conservation ordinance

DSM: demand-side management

E3: State Partners for Energy Efficiency and the Environment

EPA: Environmental Protection Agency

HVAC: heating, ventilation and air-conditioning

LEED: Leadership in Energy and Environmental Design

NREL: National Renewable Energy Laboratory

NEMPPA: Northeast Metro Pollution Prevention Alliance

OEMC: Office of Energy Management and Conservation

Definitions

benchmarking: The process of setting "benchmarks" or identifying accurate historical data against which a data set can be compared. Comparing, for example, the electricity use of one facility devoted to a particular industrial sector with other such facilities throughout the country. Benchmarking is performed in order to identify potential areas for improvement in a particular facility or across an industry and best practices.

commissioning: A process intended to ensure that a facility's major systems operate correctly when they are first installed and perform according to the design intent and occupants needs. Commissioning involves testing, monitoring and adjusting a facility's HVAC systems and controls to ensure efficient operation.

energy services company (ESCo): A business that provides services reducing a client's electricity consumption—by installing energy efficiency and other demand-side management measures in facilities—and divides the cost savings with the client. Also called efficiency services company, energy service providers, and energy efficiency contractors.

energy performance contract: Financing or operating leases provided by an energy services company or equipment manufacturer guaranteeing energy and maintenance efficiency savings from the installed measures and typically offering a range of associated design and engineering, financing, installation and maintenance services.

recommissioning: The process of determining how to improve a building's operations and systems to ensure they are functioning as they were designed to through the systematic evaluation of energy-using systems and the subsequent implementation of no- and low-cost measures. Recommissioning involves revisiting building systems at regular intervals and retesting them using the checklists and test procedures used during the original commissioning (or retro-commissioning) project. The intent of recommissioning is to help ensure that the benefits of the initial commissioning process endure.

retro-commissioning: Commissioning an existing building that was not commissioned when it was constructed and that is not performing satisfactorily.

Units

Wh: watt-hour

kWh: kilowatt-hour = 1000 Wh

MWh: megawatt-hour = 1000 kWh = 1,000,000 Wh

GWh: gigawatt-hour = 1000 MWh = 1,000,000 kWh = 1,000,000,000 Wh

TWh: terawatt-hour = 1000 GWh = 1,000,000 MWh = 1,000,000,000 kWh = 1,000,000,000,000 Wh

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