

GREENHOUSE GAS EMISSIONS  
MANAGEMENT PLAN  
FOR THE  
CITY OF BOULDER, COLORADO

**DRAFT INTERIM REPORT  
PRESENTED TO THE CITY OF BOULDER  
ENVIRONMENTAL ADVISORY COMMITTEE**

DEVELOPED BY THE  
BOULDER RENEWABLE ENERGY AND  
ENERGY EFFICIENCY WORKING GROUP

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## **Preface**

This report was prepared by a voluntary team of local energy- and environmental- experts, non-profits, city staff, students, concerned citizens and council members who understand the critical need for energy efficiency and renewable energy options. This group, the Boulder Renewable Energy and Efficiency Working Group (BREE) has met bi-monthly since May 27, 2002 to develop recommendations for a strategy that will assist Boulder's efforts to achieve a more sustainable future.

This report is a working document, reflecting the combined knowledge, expertise and research efforts of 65 individuals working in isolation. BREE will provide further research and recommendations in mid-2003 if this proves useful and as time and member availability allows. However, we request that City Council, County Commissioners and City staff review this Interim Report and give BREE direction on areas needing further clarification, research and action.

Further, recognizing that the accomplishments of the BREE team depend solely upon the voluntary efforts of its members, we strongly encourage the City to begin the process of planning for budget allocations to accomplish its Kyoto Protocol goal. As has been demonstrated with this report, voluntary efforts can contribute substantially to initial planning, research and analysis, however, ultimately to meet the challenging goal set by the City, it will need to establish a paid staff with adequate budget allotments to initiate city-wide programs for reducing greenhouse gas emissions.

Membership time, research and report development are voluntary. All views and recommendations expressed herein are those of BREE and may not reflect the precise views of the organizations to which members of BREE belong.

## **Executive Summary**

In 2001, the Boulder City Council passed a resolution that mandates compliance with the Kyoto Protocol and commits the City to a 7% reduction of overall greenhouse gasses from 1990 levels by 2012. This goal requires a 22.3% reduction in greenhouse gases below 2000 levels.

Yet, the Denver Metro region is one of the fastest growing areas in the Nation in terms of both population and energy demand. From 1990 to 2000, Boulder's population grew 15.3%. As a result, the number of residential units increased by approximately 19% and the commercial sector expanded by 41%. Vehicle miles traveled rose by 19%.

To meet its energy needs, Boulder is currently dependent on fossil fuels as the overwhelming source of electricity, principally coal (about 91%) and to a lesser extent, natural gas (about 6%). Renewable energy programs account for only about 2% of Boulder's electricity consumption. The atmospheric, water resource and human health impacts of such heavy fossil-fuel dependence are well known (see Appendix 2).

Patterns of CO<sub>2</sub> emissions in Boulder follow patterns of energy consumption. In 2000, total city electricity consumption was 1,169,375,741 kWh; average peak demand was about 133 MW.

Boulder’s associated GHG emissions in 1990 of approximately 1,689,501 mtCO<sub>2</sub>e had grown to nearly 2,022,949 mtCO<sub>2</sub>e in 2000. Thus, Boulder must reduce its emissions to 1,571,236 mtCO<sub>2</sub>e/year by 2012, 22.9% below emissions in 2000, in order to meet the Kyoto Protocol goal.

Compounding this is the projection that, even with improvements in new vehicle efficiency and greater use of renewable fuels, transportation sector GHG emissions will likely continue to grow through 2012. Transportation GHG emissions in 2012 will probably exceed the sector target by 100,000 mtCO<sub>2</sub>e per year or by approximately 5% over 2000 emissions. This will need to be accounted for by GHG reductions in other sectors for the City to meet its Kyoto goals.

Energy efficiency and subsequent GHG reduction will not occur without a comprehensive, publicly mandated emissions reduction strategy and energy policy for the City. This report is a first attempt to assess the technical and economic potential of various programs and policy decisions for improving energy use and reducing GHG emissions in Boulder. This first report does not address important legislative and lobbying efforts, which could greatly improve our energy and environmental outlook; however, BREE recommends that the City actively support Renewable Portfolio Standard legislation and other state and national CO<sub>2</sub> reduction measures.

**Recommendations**

BREE has considered numerous options and explored a range of technical, legal, political and practical ramifications for many of those options. We believe that, in order to achieve its Kyoto goal, the City will need to implement specific programs and policy measures aimed at achieving the following broad goals:

- Educate Boulder’s citizenry on the importance of internalizing behaviors that limit GHG emissions;
- Expand current programs and create new programs and initiatives to increase energy efficiency in the City’s residential and commercial building stock;
- Work toward greater control over the City’s sources of electric supply;
- Generate energy from a variety of renewable, zero-emissions sources, such as wind and sunlight; and
- Limit and reduce the emissions impacts associated with the transportation sector.

The following table outlines several specific programmatic, institutional and advocacy measures to reduce greenhouse gases in Boulder that the BREE has examined to date, along with the BREE team’s estimation of each programs importance/impact and comments.

Program/Measure	Importance & potential impacts	Elements/Comments
Establish an energy and climate “team”	High	Necessary to coordinate city efforts, track progress, undertake education, promotion, and training, coordinate programs, organize stakeholders, locate and coordinate funding
Outreach and citizen education	Medium	Important first step in galvanizing the community behind the City’s goal
Purchase GHG Credits	Variable	May be important part of diverse plan

Municipal Utility	High over long term	Opportunity to develop renewable energy resources. Potential benefits beyond GHG reduction.
Renegotiate a franchise renewal with Xcel Energy	Variable	May provide opportunities for efficiency, use of renewables, net metering, etc.
Residential Energy Efficiency Policies and Programs (various)	High	Promotion of compact fluorescent lighting, Energy Star-rated appliances, weatherization, and renewable home-energy staging, etc.
Commercial Energy Efficiency Policies and Programs (various)	High	Commercial building codes, simplified peak shaving, expansion of Rebuild Colorado program, Climate Wise Program, Climate Leaders Program, Landlord licensing initiative
Automated Peak Demand Reduction Program	High	Work with Xcel to promote mandatory and automatic power-reduction during peaks for both residential and commercial users
Utility Partnership for a Cleaner Environment	High if successful	Work with Xcel to reduce emissions through efficiency, fuel switching and renewables
Title 24-Style Building Ordinance	High	Code-related requirements for efficiency and other measures
Renewable Energy Programs (various)	High	Several program options including: develop or co-develop city-owned wind project, increase WindSource participation, purchase green tags, solar and photovoltaic programs, expand hydro capacity, promote hydrogen fuel cells
Carbon Sequestration	Medium to high but temporary	Preserve open space, reforestation, increase soil and vegetative health, improve agricultural practices to support CO <sub>2</sub> storage
Transportation Policies and Programs	Low	GHG analysis should be part of all City planning efforts to account for land use and transportation

At this time, the BREE requests that the Boulder City Council, Environmental Sustainability Working Group, Environmental Advisory Committee and Energy Working Group take the following six immediate actions:

- 1) Establish a “climate team” and provide funding and authority, working with existing advisory boards and task forces, to initiate high priority programs and to evaluate and plan for longer-term recommended initiatives.
- 2) Identify the easiest and quickest funding opportunities:
  - a. Work with Aspen energy ordinance program team to determine an action plan for implementing in Boulder (possibly Boulder County)
  - b. Research all available government and private foundation grant funding opportunities
- 3) Implement an aggressive education and community outreach program.

- 4) Combine the best elements of existing PACE, Rebuild Colorado, Climate Wise, Climate Leaders, etc. programs, with multiple options for participation and analyze incentives. Initiate recruitment immediately across all commercial and industrial business sectors.
- 5) Analyze and identify residential and commercial efficiency programs that capture the “lowest hanging fruit”, i.e., easy to implement, cost-effective and significant CO<sub>2</sub> reductions, and implement them immediately.
- 6) Preserve and maximize open space, wetlands, flood plains and agricultural/rangeland soil and vegetation health for maximum carbon storage potential and implement state of the art soil conservation practices.

## ***Budgets and Funding Sources***

Many of the programs outlined above are reasonably cost effective over a relatively short period of time due to the energy savings they generate. However, in most cases, the costs of promotion, coordination, training, start up and monitoring results would require an initial investment that may or may not be recovered through energy savings. Alternative sources of funding need to be explored. Possible options for generating necessary revenues are discussed below. These ideas are by no means all-inclusive, nor have they been fleshed-out in sufficient detail to enable a firm initiative at this time:

Aspen-Style Energy Use Ordinance -This program assess homeowners a “carbon tax” on residences that exceeds a standard "energy budget" per square foot.

Solar Revenue Bond – The San Francisco \$100 million solar bond to purchase PV panels, wind energy and energy efficiency for municipal buildings passed by 73%. Such an initiative may be less effective in Boulder due to our lower electricity costs but should be evaluated.

Renewable Energy/Efficiency Revenue Measure – The city could propose a measure similar to the 1994 recycling tax to support renewable energy and efficiency programs.

Systems Benefit Charge – A set charge could be placed on the water or other utility bills. Funds collected would be invested in energy efficiency and renewable energy projects.

Solar Source – Capitalize the costs of installing a grid-tied photovoltaic array on city buildings. Citizens could subscribe to get energy from this local solar-electric source.

Increase the franchise fee with Xcel –The City should renegotiate its franchise fee with Xcel if possible or collaborate with other cities negotiating with Xcel for a larger franchise fee.

Voluntary energy tariff – A program similar to WindSource would support an array of efficiency and renewable energy programs in the City.

Financing package – The City would work with underwriters to develop a financing package that would pre-underwrite loans for energy efficient hardware and appliances.

CFL Sales program - Sponsor bulk procurement and sales of compact fluorescent lamps with a slight profit dedicated to renewable energy and energy efficient programs.

Federal and Private Foundation Grants – the City should explore and apply for Federal and foundation grants to support specific initiatives wherever possible.

# Introduction

## *Origins of this report*

Scientists now recognize that the threat of climate change is dire and that the primary contributor to climate change – emissions of greenhouse gases – is anthropogenically caused. Indeed, current scientific thinking indicates that the impacts of climate change could include cataclysmic affects on ecosystems, human health, the global economy, worldwide water supply and agricultural production. In Boulder, the impacts of climate change are likely to affect water supplies, stress natural habitats in open space and impact snow-based recreation and local economies.

The Kyoto Protocol was developed by the 180 members of the United Nations Framework Convention on Climate Change (UNFCCC)<sup>1</sup> to address the threat of climate change. It commits the industrialized nations of the world to reduce their greenhouse gas (GHG) emissions by an average of 5% below 1990 levels in the period 2008 through 2012. When developed nations responsible for 55 percent of these emissions have ratified, the Protocol will be enacted, which now seems likely in the coming months.

Although the United States has opted not to participate in the Kyoto Protocol, many US cities, states, corporations and citizens are moving forward with initiatives to reduce GHGs. The Boulder City Council has passed a resolution whereby the City will meet would-be US compliance with the Kyoto Protocol, committing the City to a 7% reduction of overall GHGs from 1990 levels by 2012<sup>2</sup>. Given that Boulder has experienced significant population and energy demand growth over the past decade, meeting this goal now requires 22.3% reduction in greenhouse gas emissions below 2000 levels. Yet, this goal is tangible. In fact, many municipalities have set similar targets and some businesses have achieved GHG reductions in excess of 60%.

Boulder has the human, research and other resources necessary to become a national and international center for climate-friendly technology and practices. Proactive steps to address climate concerns will bring net economic and environmental benefits to Boulder that will far outweigh the costs. The City has an opportunity to become a leader in sound energy policy and a leader for other cities and municipalities to follow. In this document, we explore elements of a strategy to help Boulder reach – and even exceed this goal.

## **Boulder Renewable Energy and Efficiency Working Group**

The Boulder Renewable Energy and Efficiency Working Group (BREE) is comprised of Boulder energy and environmental experts, non-profits, city staff, students, concerned citizens and council members<sup>3</sup>. This group has met regularly over the past several months in the process of developing a strategy that will help guide Boulder into a more sustainable future. Members of the group share the sense that good planning followed by concrete action are needed to meet Boulder's Kyoto objective.

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1 View the full text of the Framework Convention and the Kyoto Protocol at <http://unfccc.int/>

2 View the full text of Boulder's Kyoto Compliance resolution at ??

3 Contact information on BREE participants is included in Appendix 1

BREE has considered numerous options and explored a range of technical, legal, political and practical ramifications of many of those options. We believe that in order to achieve the goal that the City has set for itself, it will need to:

- Educate Boulder’s citizenry on the importance of internalizing behaviors that limit GHG emissions;
- Expand current programs and create new programs and initiatives to increase energy efficiency in the City’s residential and commercial building stock;
- Work toward greater control over the City’s sources of electric supply;
- Generate energy from a variety of renewable, zero-emissions sources, such as wind and sunlight; and
- Limit and reduce the emissions impacts associated with the transportation sector.

### **The Problem**

Patterns of CO<sub>2</sub> emissions in Boulder follow patterns of energy consumption, especially the consumption of electricity. In 2000, total city electricity consumption was 1,169,375,741 kWh. Average peak demand was about 133 MW. The vast majority (roughly 91%) of Boulder’s electricity comes from the burning of coal – a cheap and abundant resource – but unlike renewables, coal is a finite resource that has particularly deleterious effects on the environment and human health. Mining coal is both water intensive and leads to water pollution. Coal-fired electricity production releases CO<sub>2</sub>, nitrogen and sulfur compounds, mercury, and particulate into the atmosphere. Local deposition of nitrogen and sulfur compounds has been linked to temporary acidification of the Boulder County watershed and changes in the alpine tundra plant communities in Indian Peaks. Mercury, particulates and other emissions can lead to increased incidence of birth defects, asthma and heart attacks.

Given the patterns of population and energy consumption growth in Boulder, it is imperative that we reduce the emissions of CO<sub>2</sub> – the primary greenhouse gas – if we are to meet the goals of the Kyoto Protocol. In fact, there are many opportunities to reduce our “footprint” on our environment while still maintaining a high standard of living. This report is not intended suggest ways in which the community can do without, rather ways that we as a community can do more with less – by becoming more energy efficient and less fossil fuel reliant. It focuses on ways to provide the services our community needs – transportation, communications, lighting, space conditioning, refrigeration and clean bodies, dishes, and clothes – in ways that minimize the impacts to our local and global environments.

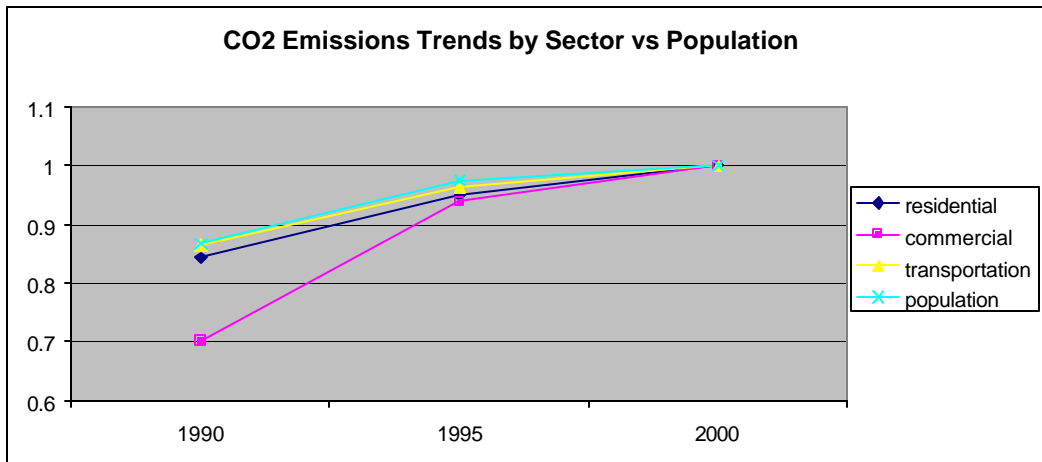
The primary work of the committee has been to gather a menu of specific GHG mitigation options and to estimate their associated costs and benefits. Although there are many other potential opportunities to be explored and many of the points discussed still need further amplification and clarification, this Interim Report introduces several ideas that we believe to be promising for: (1) using energy more efficiently, (2) increasing the use of renewable energy (while decreasing the use of non-renewables), (3) increasing the efficiency and reducing the deleterious impacts of transportation and (4) implementing education programs. Future discussions with City staff, City Council and other stakeholders and committee work will produce more options and yield prioritized recommendations.

# Emission Trends in Boulder

Greenhouse gas emissions in Boulder have increased rapidly between 1990 and 2000, driven by growth across all sectors. Boulder’s population has grown 15.3% since 1990. Likewise, the number of residential units increased by approximately 19%, but was outpaced by expansion in the commercial sector. Vehicle miles traveled rose by 19%. Thus, GHG emissions associated with residential and commercial buildings and transportation grew by 16.7%, 15.7% and 41.2% respectively (detailed report in Appendix 3).

The following graph presents a comparison of historical emissions trends from the residential buildings, commercial buildings, and transportation sectors versus population.

**Figure 1: CO<sub>2</sub> Emissions Trends by Sector vs. Population Trend**



## Boulder’s GHG Emissions Baseline

A completed inventory of 1995 GHG emissions quantified Boulder’s emissions baseline as 1,893,888 metric tons of CO<sub>2</sub>-equivalent (mtCO<sub>2</sub>e)<sup>4</sup>. This equates to 20.1 mtCO<sub>2</sub>e per resident. To meet the City Council’s goal of Kyoto Protocol compliance, Boulder must reduce its greenhouse gas emissions 7% below 1990 levels by the end of the first compliance period, 2012. In 1990, Boulder’s GHG emissions were approximately 1,689,501 mtCO<sub>2</sub>e. Thus, Boulder must reduce its emissions to 1,571,236 mtCO<sub>2</sub>e per year by 2012 to meet the Kyoto Protocol goal. Since Boulder’s emissions in 2000 had grown to 2,022,949 mtCO<sub>2</sub>e, complying with Kyoto will require that annual emissions drop by 22.3%, relative to the 2000 total, by 2012<sup>5</sup>.

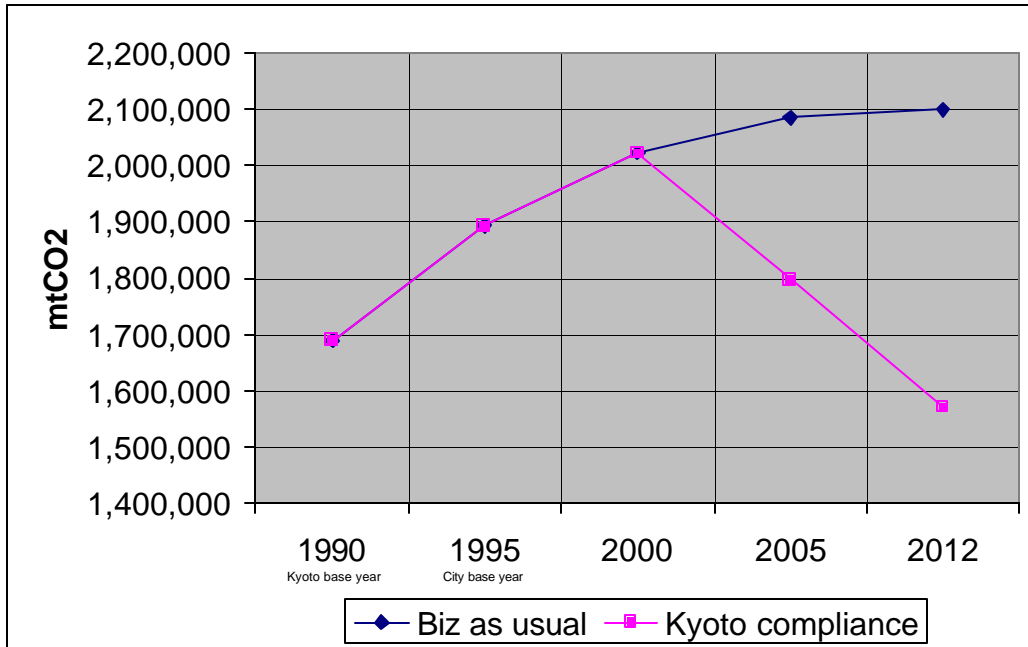
The graph below shows projected business-as-usual emissions versus emissions reductions under the Kyoto standard.<sup>6</sup>

<sup>4</sup> The standard unit of measure used by the United Nations’ Intergovernmental Panel on Climate Change (IPCC).

<sup>5</sup> For the purposes of this study and because of data availability, the City’s Office of Environmental Affairs designated 1995 as the base year for establishing Boulder’s GHG emissions baseline. OEA staff initiated the baseline inventory using software provided by the International Conference on Local Environmental Initiatives (ICLEI). The baseline inventory was completed by members of BREE using calculation methods developed by the IPCC.

<sup>6</sup> This analysis relies on actual historical energy use and consumption data for Boulder to 2000, provided by Xcel Energy, which captures the emissions impacts associated with Boulder’s existing programs, such as Greenpoints and

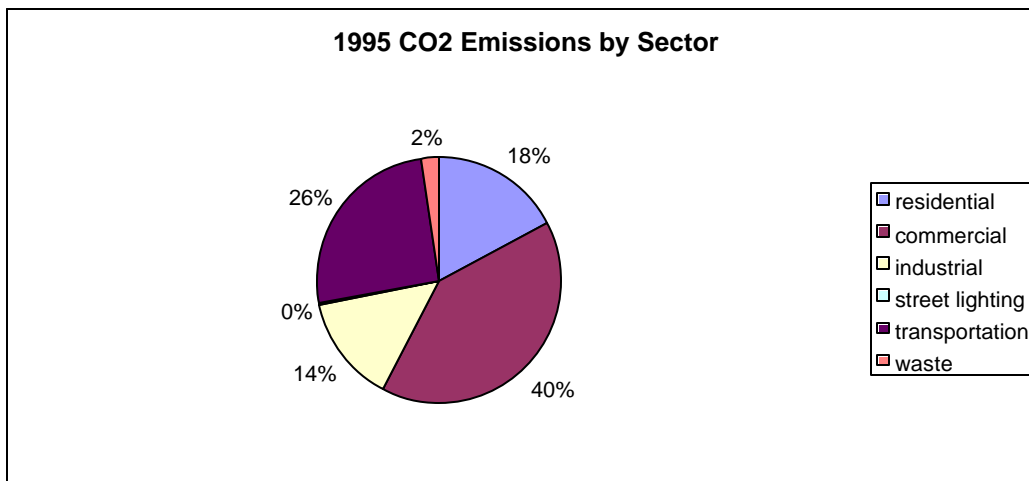
**Figure 2: Business as Usual versus Kyoto Compliance**



### ***Disaggregation of Emissions***

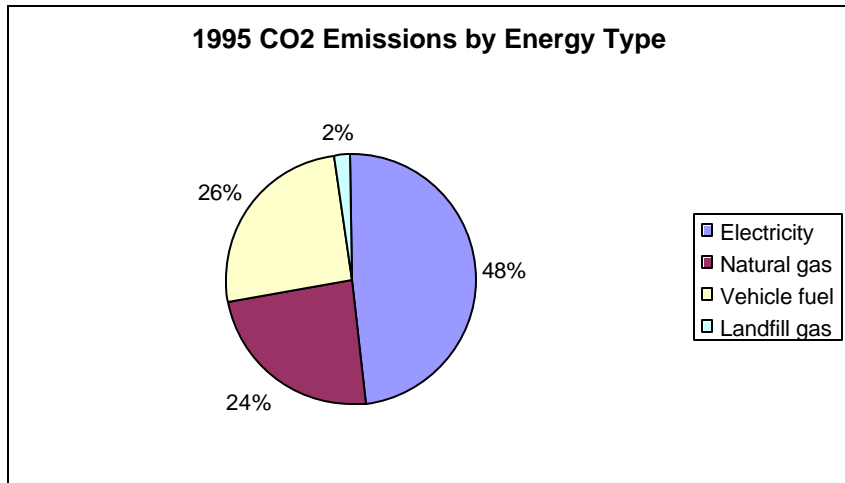
Disaggregation of Boulder’s GHG emissions sources provides important insight into where to focus efforts to develop the most effective GHG reduction strategy for the City. The following two graphs present Boulder’s emissions by economic sector and by type of energy consumption. A more detailed analysis of Boulder’s disaggregated emissions is presented in Appendix 3 and a detailed account of the calculation methodology used in this inventory analysis is provided in Appendix 4.

**Figure 3: 1995 CO<sub>2</sub> emissions by Sector**



WindSource through 2000. A detailed account of the calculation methodology used in this analysis is provided in Appendix 4.

**Figure 4: 1995 CO<sub>2</sub> Emissions by Energy Type**



Several important trends were revealed through this exercise:

- Residential and commercial buildings utilize 77% of the electricity and generate 58% of GHG emissions.
- The commercial building sector is by far the largest GHG producer.
- Electricity usage contributes almost half of total emissions, roughly 91% of this is coal fired.

## Boulder’s Existing Programs

Boulder currently has several programs in place, which contribute to reducing GHGs and will provide an ongoing source of emission reductions. These are briefly outlined in the table below.<sup>7</sup>

**Table 1: Existing Programs that Contribute to GHG Reductions**

Measure	Type	Estimated mtCO <sub>2</sub> e reduced in 2012
Forestry, tree-planting projects	Sequestration	30
Clean wood drop-off site	Solid Waste	44
Alternatively fueled vehicles in fleets	Transportation	50
Decreased city staff VMT from 1996 levels	Transportation	138
Voluntary P2 Program	Solid Waste	191
Open Space Acquisition	Sequestration	3,050
Other recycling*	Solid Waste	4,380
Upgrade Traffic Lights to LEDs	Energy	4,640
City Facilities Dept. energy conservation program results	Energy	10,724
PACE Program	Solid Waste/ Energy	17,800
Wind Power Purchases (WindSource)	Energy	19,150
Installation of Hydroelectric Plants	Fuel Switching	21,000
Curbside recycling	Solid Waste	23,000

<sup>7</sup> Table extracted from the January 24, 2003 Greenhouse Gas Emissions Reduction Report, presented to EAB by OEA

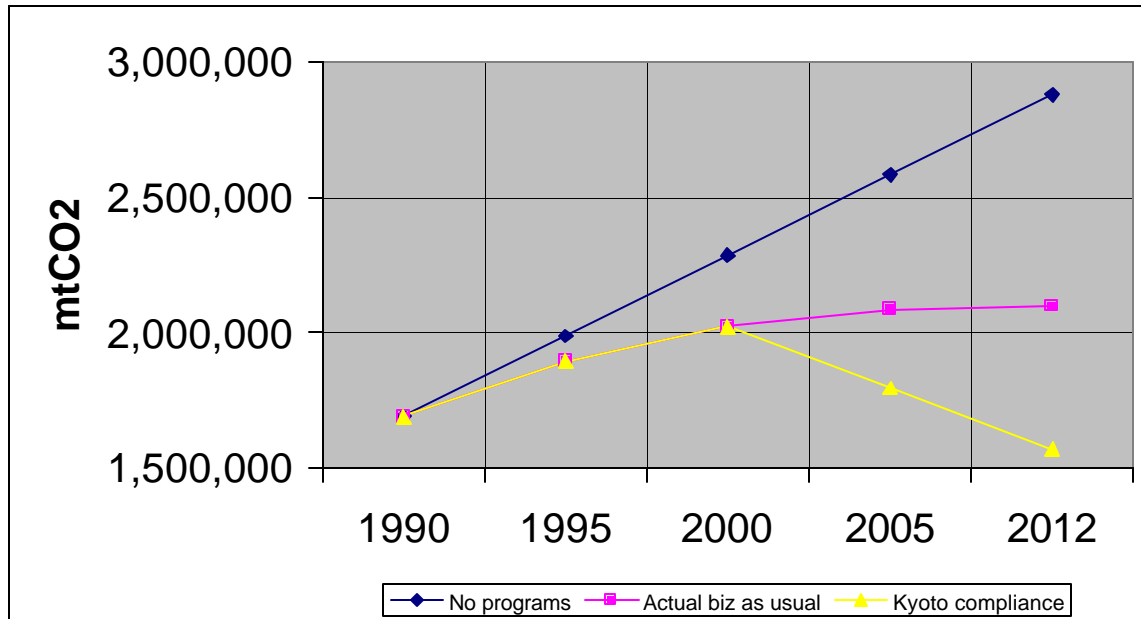
Green Points Program	Energy/Sequestration	58,200
VMT reduction goal (Jump, Leap, Bound, eco-pass, etc.)	Transportation	Pending (high)
Water Conservation Projects	Water	Unknown
Xcel Energy Demand Side Management Programs (see Appendix 6)	Energy	Unknown
Utilities Compost Project	Solid Waste	Unknown
Center for Hard to Recycle Items	Solid Waste	Unknown
Composting Workshops	Solid Waste	Unknown
Load it yourself mulch	Solid Waste	Unknown
Increase City Recycling (data due 12/02)	Solid Waste	Unknown
50% reduction in trash through tax reallocation program (data due 01/03)	Solid Waste	Unknown
100% re-refined oil in City vehicles	Transportation	Unknown
Pottery Lab Kiln Replacement	Energy	Unknown
<b>TOTAL</b>		<b>212,397</b>

\* “Other recycling” excludes curbside recycling, but includes other city programs of Spring Clean-Up, Yard Waste Drop-Off Center, Leaf Drop Off, and Recycling Drop-Off Center.

These existing programs are important sources of GHG emission reductions for the City. However, these programs (implemented prior to 2000) have already been accounted for in the GHG inventory analysis presented in this report (i.e., the “business as usual” scenario in Figure 2). These programs impact on the business-as-usual emissions results in only a 24% higher emissions level in 2012 than in 1990. Along with additional factors such as increasing use of Energy Star-rated appliances, implementation of federal efficiency standards for air conditioning equipment, a trend toward more energy efficient building design, Xcel's efficiency programs, WindSource, and others, these programs result in a flattening trajectory of the GHG emissions trend line presented here.

In the absence of these existing programs, the emissions trend line would be substantially higher than the business-as-usual trajectory. The following graph represents Boulder’s emissions under a “no programs” scenario (presented here for illustrative purposes only as the total absence of any City programs, Energy Star appliances, Federal efficiency standards, etc.), “business as usual” (Boulder’s current trajectory) and “Kyoto Compliance” scenarios.

**Figure 5: Boulder's Emissions Trends Under Three Scenarios**



Thus, the effect of the existing programs is already captured in the business-as-usual emissions trend. New expanded or accelerated programs will be necessary to create a sufficient volume of GHG reductions to meet the City's goals.

## Recommendations: Policy/Program Options

The following sections present the working group's initial ideas for programmatic/institutional and educational measures to reduce greenhouse gases in Boulder. Later sections of the report discuss technical project implementation measures, including efficiency, renewable energy and transportation initiatives.

### ***Climate Team***

To comply with Kyoto, the City should have a staff and a budget dedicated to supporting its climate commitment. The effort being undertaken clearly requires centralized coordination between the many interested parties and stakeholder groups within the city. The "Climate Team" would be the "champion" of the City's efforts and have the primary responsibility for ensuring that actions are taken toward meeting the Kyoto goal. Specifically, the Climate Team would coordinate the city's efforts; act as intermediary between the City Council and various stakeholder groups; conduct fundraising; track progress; undertake education, promotion, and training activities; develop and implement new initiatives and projects; etc.

### ***Climate Impact Review***

As the City moves toward its goal, it will be essential to have an established decision making structure to (1) consider whether and how any policy decisions will affect the City's goal of reducing climate change impacts and (2) evaluate reasonable alternatives that may minimize climate impacts. City decisions regarding vehicle fleet purchase and retirement, wastewater treatment, waste management, maintenance, land use, handling of biomass from fire suppression

efforts, open space management, building codes and other issues can all meaningfully contribute to Boulder's GHG emissions. Many City decisions already account for energy efficiency and use admirably. This review effort would be led by the Climate Team to avoid adding significant burdens on existing City staff.

### ***Outreach and Education***

BREE strongly encourages the implementation of a community outreach and citizen education/advocacy plan immediately, to engage the Boulder Community in support of energy efficiency, renewable energy, and energy-related pollution reduction measures, initiatives and policies. This will be an important first step in galvanizing the community behind the City's goal and its efforts to create a sustainable community in the years to come.

In this effort, BREE recommends holding "planned outreach and education" activities. BREE's initial ideas for outreach follow. Details of the ideas for community outreach and citizen advocacy and education programs can be found in Appendix 5.

- A weekly community education and polling "column" in the Daily Camera on energy, efficiency, renewable energy, and related sustainability issues.
- Serious public discussion sessions via a "Sustainability 101" program series designed to actively engage Boulder's citizenry and business community in discussions about cleaner energy options and other sustainability/quality of life programs.
- A database, monthly newsletter, e-mail alerts and an Internet web page with "chat site" to communicate with and track interested groups, businesses and citizen activists and offer tools for citizen activists to contact elected officials, etc.

## **Recommendations: Energy Efficiency**

In general, implementing energy efficiency measures is a more cost effective way lower CO<sub>2</sub> emissions than developing new energy supply capacity. There are two primary reasons for this, both related to very low costs of energy.

First, savings follows waste--and many of the processes and services we use are quite wasteful. However, focused attention to the energy aspects of the service or design of the process can result in substantially greater energy efficiency. For example, new designs of home refrigerators use 25% less energy than equivalent models in the 1980s. New homes can be designed and built to use 15% less energy, while still maintaining comfort levels in all seasons, and cost little more than conventional dwellings.

Second, the fossil fuel and nuclear energy industries have long enjoyed de facto government subsidies that have kept their costs to generate electricity very low – about \$1.25 or so per million Btu, despite dismal efficiency rates, which results in a cost of generated electricity of about 1.2 cents per kWh. Residential customers in Boulder pay around 7 cents per kWh. Although the cost of generating wind power from large, efficient wind farms is inching below 4 cents per kWh (currently the most cost-effective of renewable technologies), as long as the full transaction and

environmental costs of burning coal are not considered in the economic calculus, coal and other fossil fuels will remain more attractive to utilities such as Xcel.

Given these realities, the committee has focused many of its first tier recommendations on opportunities for energy efficiency. Several specific program options are presented below.

### ***Commercial Policies and Programs***

Growth in the physical size of the commercial building sector and the resulting GHG emissions stemming from this sector during the past decade were considerably greater than any other GHG emissions source in Boulder. BREE therefore, suggests that concerted effort be put into GHG mitigation strategies targeting this sector in order to yield the greatest GHG reductions. Broad initiatives should focus on:

- Limiting the physical size of commercial sector,
- Pursuing aggressive measures to increase the energy efficiency of commercial buildings,
- Pursuing strategies to reduce electricity usage in commercial buildings, and
- Establishing an aggressive commercial building energy code.

The following section describes a building initiative that would reward builders who exceed the IECC 2000 energy code. BREE has identified several additional ideas for initiatives in the commercial buildings sector, but as yet has not been able to fully analyze the approach, costs and impacts of these potential initiatives.

#### **New Commercial Building Initiative**

Although the City of Boulder recently passed the 2000 International Energy Conservation Code (IECC) for new commercial buildings, which will undoubtedly improve the efficiency of commercial buildings in the City, there is still much that can be done to improve the efficiency of Boulder's (and surrounding areas') commercial building stock. Good public policy should recognize (and promulgate) the fact that well-planned and designed energy-efficient buildings perform better economically over their lifetimes than do buildings that are not energy efficient.

In commercial buildings, interactions between building elements can be subtle but quite important. Many elements of commercial building design can leverage these interactions to improve the efficiency of the overall building. For example, good daylighting design coupled with high-efficiency windows can enable downsizing the chiller, thereby saving enough money to pay for the daylighting system.

From a building code perspective, it is difficult to specify characteristics of each of the components of a building to ensure that it optimizes whole-building energy efficiency. The best approach is for codes to specify the overall performance a given class of building (an option with the IECC), leaving the design details to the design team. However, such an approach depends on having skilled design professionals using modern software tools to analyze each element in the design in order to achieve an optimally-efficient, cost-effective building.

## **Approach**

Integrated building design that utilizes advanced building simulation software is becoming quite widespread. Xcel currently provides design assistance services to commercial builders throughout the development process. Perhaps the City could work with Xcel to try to increase participation in this program. Alternatively, in order to promote careful analysis and attention to energy design in the new building, the city may be able to support this program by offering additional incentives (non-financial or financial) to building developers for exceeding the 2000 IECC by 25% or more, as part of the approval process or the commercial Green Points program. For example, owners could receive streamlined approval or design offsets if they meet advanced efficiency standards.

## **Potential impacts**

According to the City's web site, as of Jan 1, 2001, there were 27.4 million square feet of non-residential buildings in Boulder. Moving to the IECC and related incentive program will save a significant amount of energy over the present practice however the amount is unclear for now.

## **Building on Existing Commercial Programs**

There are several programs that are currently working with large commercial and industrial energy users to reduce energy consumption and related GHG emissions. These programs: PACE, Rebuild Colorado, Climate Leaders, Climate Wise, Xcel's DSM initiative and others, are already operating under a variety of funding scenarios, but all share the common goal of positively impacting GHG emissions from this sector. BREE recommends as an immediate action item, that a new program be initiated, which combines the best elements – and existing incentives – of these initiatives into a single comprehensive, user-friendly program, which offers multiple options for participation as well as incentives. Further, the City should begin the work of recruiting companies across all commercial and industrial business sectors to this program immediately.

## **Additional Commercial and Industrial Efficiency Programs**

The following section identifies several additional programs that could be applied to Boulder's commercial building stock. Many of these program ideas could also be applied to industrial facilities. These programs need to be discussed and planned in greater detail than BREE has yet been able to devote in this process.

Simplified Peak Shaving Program – Xcel Energy currently operates a peak shaving program which involves a rather complicated bidding process. Perhaps Boulder could work with Xcel and/or sponsor a program that would simplify the process and help more customers implement peak shaving programs.

Expansion of the Colorado Office of Energy Management and Conservation's (OEMC) Rebuild Colorado Program – This program provides funding for energy audits and sustainable design assistance to municipal and commercial facilities. Perhaps the City could work with OEMC to increase participation in the program by Boulder's commercial building developers or to broaden the program in some other manner to have a larger impact on overall GHG emissions.

Climate Wise Program - Ft. Collins and Seattle currently sponsor a Climate Wise Program that provides energy assessments for businesses. Boulder should implement a similar program. The national program has been consolidated with the Energy Star program and is no longer funded by EPA. Consequently, Boulder would have to arrange some mechanism for funding – the Seattle and Ft. Collins programs are funded by each respective city.

Climate Leaders Program – The Climate Leaders Program is a voluntary initiative of the U.S. Environmental Protection Agency to encourage commercial, industrial and utility companies to: 1) develop a comprehensive inventory of their GHG emissions and 2) set target to reduce GHG emissions over the next ten years. The EPA then pays for GHG inventories for participants. About 30 companies have signed up for this program including leading Colorado companies such as Lockheed Martin, Ball Corporation, and IBM. Boulder could work with key companies in the state to encourage and support their participation in this program. The City could also help to recruit companies and work with them to ensure the goals they set are aggressive enough to make a real impact on Boulder’s overall GHG emissions. In addition, the City could help to coordinate energy assessments through the Climate Wise Program (see above) as well as arranging for local media coverage or other recognition.

Landlord Licensing Initiative - Expand landlord licensing and building inspections to the commercial sector and work to improve requirements and compliance.

Automated Peak Demand Reduction Program – Xcel’s program for peak demand reduction (mandatory automatic turn off some power during peaks) applies to both residential and commercial customers. The City should work with Xcel to promote such a program or some other broader energy efficiency program for commercial facilities.

Utility Partnership for a Cleaner Environment – In working to promote the Automated Peak Demand or other Xcel products (see above) that improve energy efficiency, Boulder could request that Xcel join the City as a partner pledging to reduce its own emissions through energy efficiency, some fuel switching to natural gas, or by expanding the WindSource program. Xcel could also participate by supporting emissions reductions activities at a local school or community center. A lighting initiative or installation of photovoltaic cells would provide an educational showcase for these technologies.

Title 24-Style Building Ordinance – California’s Title 24 goes beyond IECC 2000 in some areas (e.g., requires fluorescent lighting to be use in kitchens, etc.). Boulder should consider a similar type of initiative or other code-related requirements for efficient lighting, reducing plug loads, energy audits for commercial remodels and additions (including audits for HVAC system upgrades and replacements), or cogeneration for appropriately sized facilities.

## ***Residential Policies and Programs***

Four potential programs to help reduce carbon emissions in the residential sector are described below. Two of the programs: promotion of the use of compact fluorescent lighting and promotion of the use of Energy Star-rated appliances can begin immediately and are applicable to almost every property in the Boulder area, including the commercial sector. The third and fourth programs: weatherization and renewable home-energy staging would require coordination with Boulder’s building contractors before they could begin. BREE recommends that the City identify the most cost-effective residential efficiency program that offers the greatest GHG emission reduction potential and initiate it immediately.

### **Promote Compact Fluorescent Lighting**

#### **Approach**

This initiative would promote the use of Compact Fluorescent Lamps (CFLs) by households and the commercial sector through a number of activities including:

- publicizing the benefits (economic and environmental) of CFLs through information dissemination;
- encouraging local hardware stores, lighting supply stores, and supermarkets to increase their stock and promotion of CFLs and CFL light fixtures;
- publicizing stores that carry CFLs and put them on sale;
- possible bulk procurement and sales efforts – sales at cost or at slightly above with profit to go to the Climate Team, BECC, or other organizer, if possible including neighborhood campaigns with door-to-door sales visits;
- torchiere lamp swap days – individuals bring their inefficient halogen torchiere lamps to a designated location and swap them for CFL torchiere lamps, at cost;
- approach CU to buy CFLs for university buildings including dorm rooms,
- approach Xcel to provide coupons or rebates for CFLs, or at least promote CFLs as part of their demand-side management programs.

This effort does not anticipate that the city will provide subsidies for CFLs since such funding is not likely to be available and since CFLs are economically attractive without subsidies. Instead, by simply increasing awareness and availability of CFLs as well as by making it easy for consumers to acquire CFLs, there should be sufficient impact on their use throughout Boulder. This would be an ongoing effort during 2003-2010.

### **Potential impacts and costs**

We anticipate that an ongoing CFL promotion campaign could lead to 75% of households in Boulder acquiring CFLs by the end of the 8-year period, and that each of these households would acquire and use anywhere from 3 to 20 CFLs. If the average participating household uses five CFLs for about 3 hours per day and each CFL saves 40 watts on average, the estimated energy savings would be about 220 kWh per year per participating household. This is about a 23% reduction in the electricity use for lighting in a typical household. Furthermore, it is assumed that 25% of households would switch one halogen torchiere light to a CFL torchiere light, with savings of 160 watts on average and 3 hours per day of use. This leads to electricity savings of 176 kWh per year per participating household.

Given these assumptions and assuming that the housing stock grows 1% per year:

- Aggregate electricity savings resulting from CFL program: about 6.5 GWh/year by 2010.
- Aggregate electricity savings resulting from halogen torchiere replacement: 1.8 GWh/yr by 2010.
- Implementation Cost<sup>8</sup>: \$463,144
- Aggregate net cost for CFLs<sup>9</sup>: \$1.06 million
- Aggregate net cost of CFL torchiere: \$400,000
- Energy cost savings in 2010<sup>10</sup>: \$622,500

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8 Assuming salaried staff working ½ time (\$25,000/year) with material costs of \$30,000/year, each increasing at 2% and 1% respectively.

9 Assuming a net cost of \$7 per CFL and 151,700 CFL purchased by Boulder households during 2003-2010.

10 Assuming consumers pay 7.5 cents per kWh and save 8.3 GWh/year by 2010

- Cumulative energy cost savings from 2003-2010<sup>11</sup>: \$2.5 million
- CO<sub>2</sub> emission reductions (in 2010): 9,687 mtCO<sub>2</sub>e
- CO<sub>2</sub> emission reductions (through 2010): 31,224 mtCO<sub>2</sub>e.
- Cost per ton avoided: \$15

## **Promote Energy Star appliances and retiring of old appliances**

### **Approach**

This initiative would educate the public about Energy Star appliances and other Energy Star products, encourage greater stocking and availability of Energy Star products in local stores, and publicize stores that carry them. This program could be applied to commercial building development as well. Specific activities would include:

- publicize the benefits (economic and environmental) of Energy Star appliances and encourage consumers and apartment building owners to buy Energy Star when they purchase a new appliance or electronic product;
- encourage local/regional stores such as Sears, Home Depot, Lowes, Circuit City, Best Buy, and McGuckin to stock, feature, and promote Energy Star appliances and products, and to put them on sale;
- publicize stores that carry Energy Star appliances and put them on sale,
- maintain city-sponsored rebates on Energy Star appliances, particularly clothes washers, which save a significant amount of energy and water; and
- advocate that Xcel promote and provide rebates for Energy Star appliances as part of their energy efficiency programs in Colorado (they do this in Minnesota).

Furthermore, approximately 20% of households use a second, usually older, inefficient refrigerator (based on national survey data). Some utilities sponsor programs that offer a small incentive (\$25-50) for turning in an older non-essential refrigerator or freezer, which is then picked up by a contractor, the CFCs and HCFCs are destroyed and as much of the material as possible is recycled. Boulder could coordinate a similar program with Xcel or Ecocycle.

The Energy Star appliance promotion would be an ongoing effort during 2003-2010. The old refrigerator recycling and disposal program might be shorter in duration, perhaps a three-year effort, since most households that are willing to get rid of an older, non-essential refrigerator should respond within this time frame.

### **Potential impacts and costs**

It is assumed that promoting Energy Star appliances will lead to a 10% reduction in the electricity use of refrigerators, freezers, air conditioners, and TVs in 75% of households in Boulder by 2010. (Note: there would be energy savings in other products, but it is reasonable to assume the savings are limited to these four products for the sake of analysis.) This leads to:

- Average electricity savings through energy star promotion: 175 kWh/year/household
- Aggregate electricity savings<sup>12</sup>: 7.1 GWh/year by 2010

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<sup>11</sup> Assuming a steady (linear) increase in adoption of CFLs during 2003-2010

- Reduction in electricity use through refrigerator/freezer retirement<sup>13</sup>: 5.3 GWh in 2010
- Combined energy savings: 12.4 GWh/year by 2010
- Total extra cost for Energy Star appliances during 2003-2010<sup>14</sup>: \$2.7 million
- Cost to City for Energy Star promotion program administration<sup>15</sup>: \$80,000/year
- Cost to City for refrigerator/freezer retirement program<sup>16</sup>: \$500,000/year
- Energy cost savings in 2010<sup>17</sup>: \$930,000
- Total energy cost savings during 2003-2010<sup>18</sup>: \$3.7 million

## Weatherization and Efficiency Retrofits for Existing Homes

Great strides are being made to ensure that new homes and new additions in Boulder meet an energy code. However, the majority of the *existing* housing stock in Boulder is quite wasteful particularly those homes that were built a decade or more ago, and there is no systematic way of ensuring that their efficiency is improved. Waste in terms of electricity and the fuel(s) used for space heating is common as are problems with comfort, health and safety of homes.

Many of these problems could be improved with only modest investment however, most homeowners and landlords are not aware of the opportunities that are available for cost-effective energy conservation retrofits on their properties or of the potential dangers associated with deteriorating systems. In addition, there is no professional whole-house diagnostic service available in Boulder and there is inadequate knowledge about how to accomplish effective energy conservation retrofit work on the part of most local contractors.

### Approach

While identifying the source and magnitude of energy waste is sometimes straightforward and obvious, at other times it is quite subtle. However, a number of instruments and testing protocols are now available to help identify the sources of energy waste in homes.

The approach outlined here assumes that only useful, cost effective retrofit measures would be implemented. It is not an appliance/light replacement, duct sealing or insulation approach, although some of these measures may be undertaken in most homes. Rather, it's a thoughtful, instrument-aided examination of a whole range of measures that can be taken and the implementation of those measures that make sense from an economic standpoint.

At present, the craft of "whole house diagnostics" has but few practitioners. Nonetheless, this practice is a powerful, affordable, and extremely useful tool for guiding cost-effective energy

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12 Assumes that the housing stock grows 1% per year and 40,450 households saved 175 kWh per year on average

13 Assumes that 10% of households get rid of an older refrigerator or freezer and that these models consume 1,300 kWh per year on average

14 Assumes the extra cost is approximately \$30 per product and each participating household obtains three Energy Star products and 75% of households participate

15 Assumes that salaried staff working ½ time (\$25,000/year) with material costs of \$30,000/year, each increasing at 2% and 1% respectively

16 Assumes that 3,300 models are picked up each year at a cost of \$150 per model (cost includes promotion, pick-up, recycling, and rebate).

17 Assumes that consumers in Boulder pay 7.5 cents per kWh and save 12.4 GWh per year by 2010

18 Assumes a steady (linear) increase in adoption of Energy Star products and disposal of older refrigerators and freezers during 2003-2010

conserving and safety-improving retrofit work. Accordingly, this initiative entails equipping and training a cadre of weatherization professionals and establishing a program with incentives. Proposed actions follow:

- Train and license individuals from local businesses in the craft of instrumented auditing and the delivery of weatherization services, including energy education. Use of these professionals could be required to qualify for some incentive programs or for some City permits. For example, qualification for low-cost pricing and finance packages could be tied to auditing by the qualified professionals.
- Conduct pilot projects in the single-family, multi-family and mobile home sectors, evaluating costs and savings. Learn from and publicize results.
- Ramp up to 1,500 households per year within three years, aiming at weatherizing 10,000 homes by 2010.

It may be most efficient to divide the work by sector, e.g., mobile homes, single-family detached homes and multi family structures. Toward this end, it is useful to look at statistics on housing structure types in Boulder.<sup>19</sup>

<b>Total Units</b>	<b>Single Family</b>	<b>Multi-Family</b>	<b>Mobile Homes</b>
40,726	20,444 (50.2%)	18,815 (46.2%)	1466 (3.6%)

Note the high percentage of multi-family dwellings in Boulder; this compares with 30.1% in the region and 25.7% in the State, suggesting that targeting landlords for education, sales and installation may be an efficient approach. Additionally, the City may want to consider whether to require that an energy audit/indoor air quality audit be conducted prior to applying for a rental license and whether meeting certain energy codes or appliance standards should be required for building owners to obtain rental license approvals for existing housing stock. Many of these steps are likely to complement the existing requirements and guidelines regarding safety and would substantially impact overall energy efficiency in the sector.

Secondly, targeting mobile homes may be effective as many of the families who occupy them could qualify for the Weatherization Assistance Program, which provides weatherization services to households whose income is below 150% poverty level.

### **Funding**

It is assumed that the Climate Team would undertake coordination and oversight of the program, including performing research on foundation and City funding to cover the cost of initial training, pilot and publicity work.

The Department of Energy offers some funding through its weatherization program for lower-income households. Additionally, utilities, landlords and homeowners would share in the costs of retrofitting homes.

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<sup>19</sup> From “Community Benefits,” Denver Regional Council of Governments (DRCOG), July 29, 2002, produced by the Metro Vision Resource Center, [www.drcog.org](http://www.drcog.org). Contact person Jeff May, 303-480-6746.

## Potential impacts

We have assumed that electricity savings from more rational operation, controls retrofits, CFLs (indoor and out), and refrigerator and freezer replacement averages 200 kWh per month and 2,400 kWh per year and that natural gas savings (for space and water heating) from more rational operation, controls retrofits, envelope sealing and insulating, furnace and distribution system enhancements plus hot water and hot water distribution system improvements averages 25 million Btu or 250 therms per year. If 10,000 dwelling units are weatherized by 2010, the following savings would result.

- Annual electricity savings: 24 GWh/year
- Annual natural gas savings: 250 billion Btu/year. This equates to a
- Annual CO<sub>2</sub> emissions reduction: 32,805 mtCO<sub>2</sub>e/year and
- Twenty-year CO<sub>2</sub> emissions reduction: 696,087 mtCO<sub>2</sub>e
- Electricity cost savings from weatherization program in 2010<sup>20</sup>: \$1.92 million
- Natural gas cost savings from weatherization program in 2010: \$1.75 million
- Total savings: \$3.67 million. Assuming a
- Twenty-year lifetime savings from weatherization<sup>21</sup>: \$44 million.

These savings are two to three times greater than estimated total costs to weatherize 10,000 dwellings.

## Recommendations: Renewable Energy

Renewable energy systems have undergone rapid technological advances over the past few years and some are now cost-competitive with fossil fuel technologies with good resource availability. In addition, renewably generated power is increasingly in demand from consumers and regulators as a means to address both environmental and energy security issues. However, a critical challenge for Boulder is Xcel's control of generation and transmission assets, as well as the utility's apparent lack of interest in significantly increasing renewable energy generation.

Currently, Boulder's residential, commercial and industrial users consume about 1,169,375 kWh of electric power. Boulder generates 1.3% of this with hydropower from facilities in Boulder Canyon. In addition, Boulder residents and businesses currently account for about 1% of total electricity consumption through Xcel's WindSource program. Otherwise, the energy consumed within Boulder is largely generated from coal resources.

BREE considers that increasing Boulder's use of renewable energy resources is critical to developing a diversified portfolio of GHG mitigation activities. The ideas for renewable energy programs discussed below can be integrated nicely with a plan for creating a municipal utility (discussed below), but are not necessarily reliant on this initiative.

### Wind Power

Over the past five years, wind energy technologies have undergone rapid advances and generating costs have fallen drastically, allowing the wind industry to develop at an average of 25% per year,

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<sup>20</sup> Assumes a cost of 8 cents per kWh and \$0.70 per therm.

<sup>21</sup> Assumes a discount factor of 4.7%,

far faster than growth rates for conventional fuel industries. Much of this growth is driven by increasing environmental and energy security concerns. Wind power is clean, reliable, and utilizes an unlimited, renewable resource. It offers long-term price stability without abrupt price spikes, and energy independence. Plus, the cost to generate wind power - around 4¢ per kWh at prime wind sites in 2001 and falling rapidly - makes it comfortably competitive with conventional fuels.

### **Develop or Co-Develop City-Owned Wind Projects using Green Tags**

The City of Boulder could become the owner or part owner of a utility-scale wind project. A wind plant would provide a clean, locally-owned resource base and would make a significant contribution toward the City's Kyoto goal.

The initial investment needed to develop a commercial wind plant is approximately \$1M per MW; a 50-megawatt facility could be developed for about \$50M and could supply about 131,000 MWh of electricity, or enough for about 25,000 homes. The City would have access to low-interest financing as well as Federal funds through the government's Renewable Energy Production Incentive (REPI) if it elects to municipalize. REPI provides incentives to municipal renewable energy projects, in areas that elect to self-municipalize. Passing a bond initiative to provide the capital for such a program could be paid off through the sale of electricity. A typical wind energy generation plant yields a return on investment in the range of 15 to 20% and a pay back in the range of 15 years.

As an alternative, the City may consider partnering with a wind developer to develop a wind project in Colorado. Such an approach would help to promote renewable energy development in Colorado, while giving the community a sense of ownership in the project. In addition, it may mitigate the problem of securing the rights to land with strong wind resources. (Competition is increasing among wind developers and suppliers to acquire prime wind sites.) A contract with the developer would need to establish Boulder's rights to some or all of the GHG benefits from the project and could also be structured to give the City an option to buy out the developer's interest in some or all of the wind turbines in the event that the City elects to municipalize in the future. To increase the size (and therefore the economies of scale) of the project, it may also be possible to collaborate with the City of Ft. Collins or other Colorado municipalities. Alternatively, if the City were to "piggyback" an addition to a wind farm already under development in the state (such as the Gobbler's Knob project near Lamar), it could save substantially on development costs.

The City could either develop its own green marketing program (if it elects to municipalize) or utilize green tags (discussed in greater detail below) to help finance the cost of developing a wind project. Selling green tags is a common practice among developers and can often generate a significant portion of the total project development costs. The city would sell the green tags to Boulder residents, thereby financially supporting the project while retaining the emission reduction benefits to meet its Kyoto commitment, within city limits and helping to foster a sense of community ownership in the project.

Green tags could also be bundled with products sold by area merchants, either to offset the emissions associated with the product being purchased (CO<sub>2</sub> offsets for tank of gas or airline ticket), or marketed separately with other products (coupon books, beers, concert tickets, girl scout cookies, etc.). A Boulder program for marketing GHG emissions reductions need not be limited

to renewable energy development but could apply equally to other GHG emissions reductions measures (e.g., efficiency, carbon sequestration).

The biggest challenges to developing a City wind farm would be raising the initial capital for the project, construction of transmission lines (if necessary) and either becoming a muni or negotiating with Xcel to purchase the power for the City and “wheel” the power to the City for an agreed charge. Historically, due to perceived cost and reliability concerns, Xcel has shown ambivalence towards purchasing wind power beyond that needed to fulfill WindSource subscriptions. In addition, Xcel would need PUC approval to purchase the power, either through the IRP process or under a power purchase agreement. The City could seek to leverage its purchasing power to influence Xcel to buy the wind power when Boulder renegotiates its franchise agreement. Platte River may provide an alternative if we partner with Ft. Collins.

Either of these options would be a comparatively expensive means for the city to reduce its GHG emissions in terms of dollars spent per unit of emissions reduction. As discussed above, a 50MW wind farm would cost in the range of \$50 million and would displace as much as 115,000 mtCO<sub>2</sub>e to 130,000 mtCO<sub>2</sub>e per year. The City may be able to leverage the same amount of dollars for greater emissions reduction benefits by increasing its WindSource purchases and/or purchasing green tags, as discussed below.

### **Increase Windsource Purchases**

Continued support for Xcel’s Windsource program is currently the only option to support Colorado wind energy. The City currently purchases about 1% of its electricity from WindSource. In addition, approximately 12,000 Boulder households participate in the WindSource program. The City may be able to increase the percentage that it buys from WindSource and/or help to promote increased participation from residents and businesses. A detailed economic analysis of this option has not yet been conducted so the total cost vs. emissions impact is unclear. Additionally, it is unclear whether the City would be able to leverage bulk/aggregated purchases from the WindSource program to negotiate a better rate than Xcel currently offers.

The advantages of this option are that it could be undertaken immediately and incrementally (10 to 20 MW excess capacity currently exists in Windsource) and there would be no need for substantial capital investments.

In terms of getting the “credit” for emissions reductions, under any green marketing program, a utility is essentially *selling* the environmental attributes (i.e., emissions credits) associated with generating wind power through the price premium it charges. Thus, Xcel would not be eligible to claim these benefits against its coal generating assets in a future regulated environment and the City of Boulder would be able to claim these emissions reduction benefits against its Kyoto Protocol goals.<sup>22</sup>

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22 NOTE: Future regulations on the emissions of CO<sub>2</sub> may prompt Xcel to make changes to the Windsource program (or discontinue it) to allow it to claim the credits it would likely need to offset coal generation.

## **Purchase Green Tags from Third-Party Marketers or Directly from Regional Wind Farm**

Green tags refer to a contractual marketing device whereby the environmental attributes (including the GHG emissions reductions) associated with renewable energy generation are separated from, and sold independently of, the electricity generated. The customer purchases the green tags but continues to receive electric service from Xcel. Because one can consider that electricity + environmental attribute (i.e., green tag) = renewable energy, the product is marketed as a purchase of wind power.

Renewable Choice Energy currently markets green tags to Boulder residents and businesses from wind power generated and consumed in Wyoming, just north of the Colorado border. The cost of green tags through Renewable Choice is approximately \$25/MWh. The City of Boulder could invest in green tags to support wind power and to generate the emission reduction benefits it requires to offset GHG emissions from its energy usage.

As an alternative, it may be possible for the City to purchase green tags directly from a wind energy developer from the same Wyoming wind farm at a considerably cheaper rate than would be available through Renewable Choice (perhaps \$8 to \$12 per MWh) or from the Texas wind farm (approximately \$5 to \$8 per MWh). Such an option would require that the City coordinate a bulk purchase of tags, for use by city facilities or to then be resold to Boulder residents through a simple marketing campaign or alternatively, conduct a pre-sale campaign to ensure that all purchased green tags are accounted for. In addition, it may be possible to partner with Ft. Collins on a bulk purchase.

The advantages to such an approach would be that it could be implemented immediately and incrementally and it may be considerably cheaper than increasing participation in the WindSource program or developing a City wind farm. A disadvantage is that the wind power is generated and consumed outside Colorado. As mentioned above, there are currently no options beyond WindSource, to support wind energy generated in Colorado. As a result, the concept and benefits can be confusing to customers and the option would do little to encourage renewable energy development in Colorado. Such an approach may be best considered an interim fix if the City decides to invest in its own wind generating capacity and in the event it moves towards municipalization.

## ***Solar and Photovoltaics Programs***

Photovoltaics (PV) are an excellent technology for generating renewable power in Colorado where the sun is a fairly stable resource. Although they are currently quite expensive, costs are coming down rapidly. In Boulder, the unsubsidized installed cost for grid-tied PV is about \$10 per watt, but that price is likely to come down to a level that would make the technology financially attractive – estimated to be about \$4.50 per watt – within a few years time.

Given our low cost of electricity, it is difficult to justify the use of PV versus other green energy options (e.g., wind) on a large scale. However, in smaller applications, such as parking lot lighting and powered traffic signs (e.g., school crossing lights), PV can be cost-effective now – the money saved by not having to trench and install power lines pays for the extra costs. The use of PV for water heating applications is currently cost effective on a life-cycle basis (see following

section). Additionally, new uses for PV technology, such as roof shingles and solar reflective paint, are being developed that could eventually make the technology routinely - and cost effectively - integrated into building design. This next generation technology may be commercially viable by 2015.

### **Approach**

We can facilitate the adoption of PV now, through pilot projects that encourage development of an installation infrastructure, training of installers and suppliers and integration into designs that allow buildings to be "PV-ready" for installation once the panels themselves become cost effective. This approach should apply to both municipal and private projects. Our goal is to make the design, installation and servicing of PV as simple, common and cheap as furnaces are now. To do this, we recommend that the City of Boulder encourage (through Green Points, planning and/or incentives):

That new roofs be oriented within 15 degrees of south,

That conduits be installed to carry electricity from roof and south walls to a conversion closet or the garage,

That a conversion space and wiring be installed in new buildings to house equipment to convert the electricity made by PV into a form acceptable and safe for the grid.

### **Potential impacts and costs**

Unless the financial situation changes (e.g., sudden drop in prices or new significant tax credits), it is unlikely that PV will have a substantial impact on Boulder meeting the Kyoto Protocol. However, in the long term, PV is likely to offer a viable and cost-effective source for renewable power. By encouraging the infrastructure for PV to be installed in buildings during construction (little more than a few conduits and junction boxes, plus some planning) we substantially reduce the costs of installing PV later when panels are more affordable.

At current prices, a 1,200 sq. ft. home could be retrofitted with PVs for around \$30,000. The cost to architects and builders to implement the activities outlined above would be relatively low (some planning costs, and the costs of conduit and junction boxes). Costs to the City will include changing the Green Points program and training building inspectors.

### **Energy Storage**

Unfortunately, energy generation from both wind power and PV sources is intermittent and therefore, less predictable than electricity generated from traditional fuels. In addition, demand may spike above available supply during unusual conditions like heat waves. One strategy to deal with inconsistent supply is to diversify energy sources. Another approach is to develop a pumped storage facility, which would turn the excess energy supply into potential energy by using it to pump water uphill. Then, when energy demand exceeds the readily available supply, the water would be allowed to flow back downhill through a generator. It is unclear whether such a pumped storage facility is feasible or environmentally sensible in the Boulder area.

### ***Domestic Hot Water Heating Initiative***

Heating water with the sun is efficient and elegant but not inexpensive initially. The long life (up to 25 years) and nearly zero cost of operation give these systems a low life-cycle cost. Using the

sun to heat water eliminates the CO<sub>2</sub> emissions associated with heating water using natural gas or electricity. Depending on the capacity, solar water heating systems cost anywhere from \$2,500 to \$9,000. Supplementing an electric water heater with solar will have a simple payback of approximately 10 years.

For example, The North Boulder Recreation Center's new solar water heating system is the largest solar unit installed in the last 20 years in the U.S. The center's water will be pumped through the solar unit to bring it closer to its optimal temperature before being heated by boilers. This will reduce natural gas consumption by 50% (2 billion BTU's per year) and save an estimated \$7,840 per year at today's cost.

Increasing the number of solar systems in Boulder would reduce natural gas use and reduce CO<sub>2</sub> emissions. A program targeting homes with electric water heaters would have a greater effect on CO<sub>2</sub> emissions reductions than those with natural gas heating. Based on Colorado statistics, less than 2% of homes in the state use electricity to heat water, which means that approximately 900 homes in Boulder use electric water heating systems. Targeting even half of those homes for a solar water heating retrofit might be difficult. However, the resulting CO<sub>2</sub> emissions reduction would be 54,000 mtCO<sub>2</sub>e over a 20-year period for the 450 systems

Incorporating solar water heating into new construction is easier and the cost could be included in the mortgage of a new home. The city of Boulder's Green Points program offers 10 points for installing a system. The City may be able to help new home builders and contractors to identify funding support and/or tax incentives to help defray the cost of installing these systems.

### **Potential Impacts and costs**

Two hundred square feet of panel area could provide space heating and domestic hot water for a 1,500 square foot home (72,000,000 BTUs per year). This would generate the following impacts if it replaced a natural gas water heating system:

- Natural gas displaced: 1,100 therms
- Annual emission reduction: 6.5 mtCO<sub>2</sub>e
- Annual cost savings<sup>23</sup>: \$605
- Lifetime cost savings (25 years): \$15,125

A solar domestic water heating system would comprise 64 square feet of collectors and provide about 23 million BTUs per year. It would generate the following results if it replaced an electric domestic water heating system.

- Annual energy savings: 6,750 kWh
- Annual emission reduction: 6 mtCO<sub>2</sub>e /year
- Annual cost savings: \$600
- Lifetime cost savings (25 years): \$15,000

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<sup>23</sup> Assumes natural gas of approximately \$0.55 per therm

## ***Hydroelectric Power***

The City of Boulder currently owns and operates a hydroelectric generating plant that produces 15,396,076 kWh/year, which is equivalent to 7% of residential electricity usage (43,000 single-family homes) or 1.3% of total City consumption.

The City needs to examine its contract with Xcel to determine whether Boulder can legitimately claim 100% of the GHG emissions reductions benefits from this facility. Currently, the City sells the hydropower to Xcel under a long-held power purchase agreement, at which point the power becomes part of Xcel's overall resource mix. More than likely, the PPA does not specify which entity retains the rights to any GHG reduction credits associated with the hydro facility.

As part of its activities to meet its Kyoto commitments, the City may want to explore the possibility of expanding its existing hydro facility. If such an initiative were taken, the PPA would need to be renegotiated with Xcel, at which time the rights to emission reduction credits would be determined and documented. In any case, it would be advisable for the City to retain legal services to clarify this issue and create the necessary documentation to attribute the emission reduction credits among the parties, particularly in light of possible future regulation of CO<sub>2</sub> emissions, when such credits will become significantly more valuable to Xcel and Boulder.

## ***Looking to the Future: Hydrogen Fuel Cells***

Hydrogen fuel cell technology is expected to become increasingly important as an energy storage and delivery mechanism. But, the cost is currently prohibitive for individual, private users. To be environmentally friendly, hydrogen must be separated from water through electrolysis, and the energy required to perform electrolysis must be generated from alternative fuels, such as wind, hydropower or PVs. Eventually, it may be feasible to use home PV systems to store energy on-site using reversible hydrogen fuel cells. This would potentially decrease the need for net metering and could replace the large, heavy batteries traditionally used for home PV power storage. Hydrogen fuel cells may eventually be interchangeable with automotive fuel cells such that home PV systems could generate sufficient energy to charge up the car for the next day's use.

The City of Boulder should evaluate options to promote hydrogen fuel cell use and the infrastructure that will become necessary as this technology is developed and refined. This should include pilot vehicle and fueling infrastructure analysis and pilot programs.

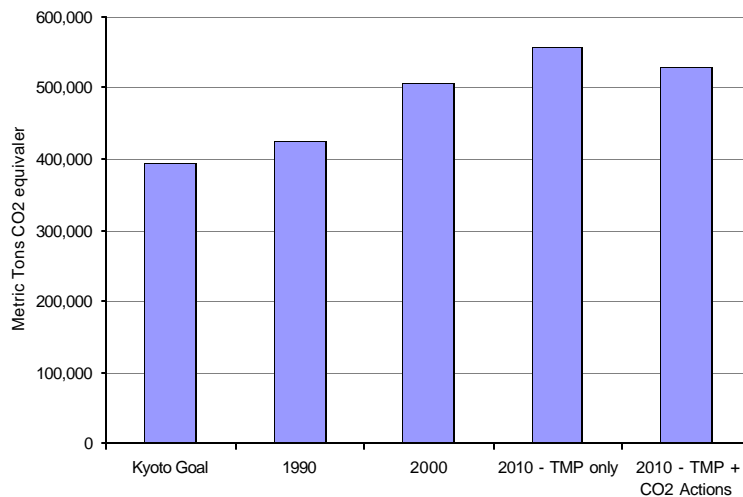
## **Recommendations: Transportation**

Transportation-based GHG emissions are a significant contributor to the City's overall emissions. As the city takes action to meet its Kyoto goals, an integrated approach that includes all of the major GHG sources will be crucial. As this planning process moves forward, it will be important to seek input from the City's transportation planning staff and other interested parties. Likewise, the City's Comprehensive Plan and Transportation Master Plan should consider elements of climate change in any future revisions to ensure that that changes to these plans account for the effects of land use and transportation on the City's ability to meet its climate change goals.

## The Problem

Emissions from this sector in Boulder could *conceivably* be reduced from today's levels however, without any meaningful Federal policy initiatives to reduce GHGs from the transportation sector, achieving any significant reductions by 2012 through the actions of the City alone, seems unlikely. Even with improvements in new vehicle efficiency and greater use of renewable fuels, the City's transportation sector GHG emissions will probably continue to grow. Transportation GHG emissions in 2010 will probably exceed the sector target by 100,000 mtCO<sub>2</sub>e per year or by approximately 5% over 2000 emissions, and will have to be accounted for in other sectors for the City to meet Kyoto compliance. The following graph illustrates historic and projected Boulder transportation sector GHG emissions, derived from measured vehicle miles traveled (VMT) and fleet efficiency assumptions.

**Figure 6: Historic and Projected Boulder transportation sector GHG emissions**



Although the city has subsidized, facilitated, and encouraged alternative transportation, VMT increased from 1990 to 2000, although not as rapidly as some communities. In addition, fleet fuel efficiency has probably decreased in Boulder, reflecting national trends towards larger vehicles.

## Existing and Related Future Transportation Use Policies

The following local planning and transportation policies have reduced the overall VMT growth rate, but in real terms VMT has increased.

- The city has tried to remain centralized, yet demographic shifts, behavioral patterns, housing prices, and employment growth seem to exacerbate sprawl. While some of these trends may have leveled off, reversals seem unlikely in the next several years. Radical changes in planning and zoning might decrease person miles traveled, but would be controversial and probably would not greatly impact the total number of miles traveled.
- Shifting travel miles from single occupant vehicles (SOVs) to alternate modes has been a focus of city transportation policy aimed at reducing emissions of regulated pollutants and also to alleviate traffic and parking congestion. Recently, expenditures on bus, bike and pedestrian improvements have been about 40% of total governmental transportation

spending within the city, yet these modes only still account for less than 5% of person-miles traveled.

The following table presents growth rates in vehicle miles traveled in Boulder since 1990.

**Table 2: Boulder's Vehicle Miles Traveled**

<b>Year</b>	<b>VMT (million miles/year)</b>
1990	2.19
1994	2.45
2000 (Goal projected in 1996 TMP)	2.50
2000 (Measured)	2.61
2010 (Continue 1994-2000 growth)	2.88
2010 (VMT needed to meet CO2 target w/steady vehicle efficiency)	2.04
Amount by which "2010 likely VMT" exceeds "VMT that would meet Kyoto" at steady fuel efficiency	<b>40%</b>

Clearly, without unprecedented changes in behavior, VMT changes cannot be expected to result in significant GHG emission reductions by 2012.

### **Vehicle Efficiency and Low-carbon Fuels**

Other methods to decrease greenhouse gas emissions from the transportation sector would focus on vehicles.

- Increase vehicle efficiency. An increase in fleet vehicle MPG by 40%, an equivalent of going from 25 mpg in 1990 to 35 mpg in 2012, could make a significant contribution to meeting the Kyoto target. Assuming fleet efficiency has been static, all vehicles purchased in the next seven years would need to get over 100 mpg. However, over the past fifteen years, new light-vehicle fleet gas mileage has actually decreased.
- The benefits from using fuels with low net greenhouse gas emissions are limited:
  - ❑ Ethanol distilled from coal is added (up to 10% concentration) to most gasoline sold in Boulder during the winter. Modern ethanol distilleries are relatively efficient, but because coal is used for processing, the GHG emissions associated with this fuel are nearly equivalent to those from standard gasoline.
  - ❑ Biodiesel is a low-GHG diesel replacement fuel derived from soybeans. Use in cold-weather is limited to modest concentrations, but otherwise this fuel can be used in most diesel engines. However it is significantly more expensive than standard diesel fuel and is not currently available in Boulder.
  - ❑ Natural gas has the lowest carbon/energy ratio of all fossil fuels. However, since diesel engines are more efficient and some methane loss is associated with its use, the change to natural gas in heavy vehicles does not reduce overall GHG emissions. Most other emissions are decreased, but fuel storage, handling, and reduced range are limitations.

- Hydrogen (for use in fuel cells) produced from renewable sources is touted as a long-term replacement for petroleum-derived transportation fuels. However, the costs of the fuel and the fuel cells, and the lack of fuel distribution infrastructure will severely limit its use over the next decade.

The graph below illustrates the impacts on CO<sub>2</sub> emissions from the transportation sector in 2010 that would result from city actions to encourage renewable fuels and efficient vehicles.

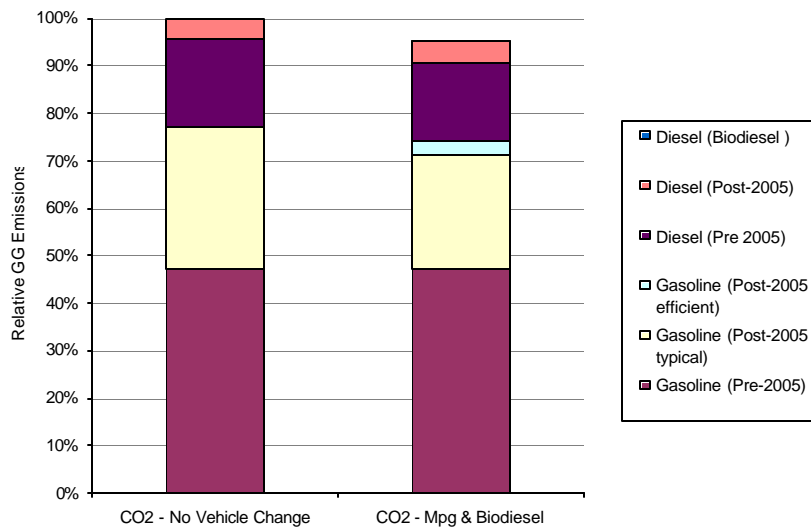
The "No Vehicle Change" scenario assumes that:

- Average light vehicle fleet efficiency holds steady at 22 mpg.
- 7% per year fleet vehicle turnover.
- Ten percent of miles driven are by diesel vehicles with 9 mpg average fuel consumption.

The "Mpg & Bio" scenario shows the effects of a reduction in emissions caused by:

- 25% of new vehicles are 40 mpg vehicles, the rest are "average."
- 10% of diesel fuel used annually is replaced by biodiesel.

**Figure 7: Relative reduction from fuel efficiency and renewable fuels measured by vehicle purchase year and engine type**



## Recommendations: Miscellaneous

The following recommendations fall outside the categories covered thus far in this report, but are equally important to consider in creating a comprehensive emission reduction strategy.

### ***Fuel Switching at the Valmont Power Plant***

According to the Xcel website, the Valmont Power Plant is currently capable of burning natural gas. If the fuel were switched from coal to gas, CO<sub>2</sub> emissions from the plant would be reduced by about 37%. BREE has considered a program that would operate much like Xcel's WindSource Program to support fuel-switching at the Valmont plant. Xcel could sell subscriptions to the

Boulder “CleanSource” Program, which would be used to pay the higher cost of natural gas. Because Xcel would collect a price premium, the individual subscribers to CleanSource would take credit for the emissions reductions associated with the cleaner electricity purchased through the program, thereby providing the City of Boulder up to a 13% reduction in GHG emissions.

However, the Valmont plant sits just outside Boulder City limits. There are questions as to the feasibility of such an initiative as well as the distribution of benefits to the City. This concept should be carefully analyzed before moving toward implementation. Nevertheless, CleanSource could be a useful tool in the City’s emissions management toolbox if it proved to be feasible.

### ***Purchasing GHG Credits***

Purchasing GHG credits that are generated from renewable energy, energy efficiency, fuel switching or sequestration projects would be an easy way to acquire the emissions reductions required to meet Boulder’s goal. A few cities have used similar strategies to meet their GHG reduction goals.

Typically, this process is driven by a public Request for Proposals (RFP) whereby project developers or others wishing to sell GHG credits must respond at their own expense, providing details of the project, amount of GHG emissions available, their required terms of the transaction, etc. The RFP approach would allow the City to specify its exact criteria, schedule, requirements and price preferences for projects and credits.

Seattle City Light has recently issued its second such RFP for the purchase of GHG credits to meet requirements under a City Council resolution requiring that the utility fully mitigate its GHG emissions. The RFP lays out very specific requirements for project proposals as well as clearly establishing the criteria by which it will weigh and select winning projects. These include a clear preference for projects in Seattle, Washington State and the Pacific Northwest respectively, for a diverse portfolio of project types, additionality requirements, desire for strong co-benefits, and its average price range of \$4 per ton of CO<sub>2</sub> equivalent.

For the City of Boulder, such an approach would fit nicely with an Aspen style “carbon tax”. An RFP for GHG credits would provide the City with numerous choices of project investments from which to choose and offer the freedom to select those projects that best fit with the City’s goals and its citizens’ values.

### ***Creating a Boulder Municipal Utility***

In recent months, BREE has discussed the desirability and feasibility of Boulder creating a municipal utility when our current franchise agreement with Xcel expires in 2010. At present, both Xcel and its regulators concentrate on delivering electricity at the lowest possible price, ensuring that the company makes a “reasonable” profit and return on investment. Xcel’s efforts to provide demand-side management programs or clean energy options in Colorado are quite modest. Accordingly, well over 90 percent of the electricity delivered to Xcel’s customers in Colorado will continue to come from coal and gas for many years.

A municipal utility - owned by the citizens of Boulder and operated as a non-profit unit of local government – could offer a more desirable, cleaner energy future. Such an entity, the Boulder

Energy Services Company (BESCo), could provide high-quality, dependable electricity services at a rate reflective of all of the costs—including environmental—of generating electricity for its customer-owners, the citizens of Boulder. Likewise, the utility would offer useful energy services to its customers, such as energy audits and other assistance. The City would also then be able to better manage the portfolio of energy resources being used to supply Boulder’s energy needs, and have the autonomy to choose generating technologies that are gentle on the environment and that would reduce GHG emissions. The City would be able to set its own policies regarding net metering (not currently required in Colorado) and how much it would pay for energy from individual power producers. In the long-term, a municipal utility could help to generate revenues to support other climate programs for the City.

This initiative would require a great deal of sound planning, careful analysis of long-term as well as short-term economics, energy consumption, and environmental consequences under a range of scenarios. For example, it may be possible for the City to buy out its franchise agreement from Xcel prior to expiring in 2010. Creation of BESCo would involve extensive time, attorney’s fees, risk, controversy and political opposition. The likely reality is that it may be many years before such an effort could reduce GHG emissions, because a good deal of BESCo’s income would be initially devoted to setting up the municipal utility. Nonetheless, the potential benefits of allowing Boulder’s citizens to control their own energy destiny could be substantial.

As an alternative, under the threat of municipalization, Xcel may be more inclined to work with the City toward its goals, rather than lose Boulder from its customer base. It may be possible to negotiate a franchise renewal with Xcel Energy that adequately addresses Boulder’s needs and requirements for net metering, more vigorous DSM programming and new renewable energy development. However, this path would require regulatory approval to use rate payers’ money to support initiatives that are seen as favoring the citizens of Boulder.

Whether such a scenario is realistic is yet unclear. Nonetheless, if Boulder takes the initiative to plan for municipalization, incorporating thoughtful, cost-effective conservation and alternative energy measures, there is a substantially greater likelihood of benefits flowing to the City than if nothing were initiated.

### ***Carbon Sequestration***

Storing or “sequestering” carbon in soil as organic matter and in woody vegetation helps reduce the amount of atmospheric CO<sub>2</sub>. In this respect, soil (especially wetlands) and vegetation (especially woody vegetation) are considered carbon “sinks.”

Scientists can readily assess the CO<sub>2</sub>, N<sub>2</sub>O and SO<sub>x</sub> sequestration potential for a given tract of land. Many organizations are actively designing and implementing projects to sequester carbon through reforestation, sustainable forest management practices, wetland rehabilitation, and sustainable agricultural practices. In some cases, carbon sequestration projects can generate a financial return to landowners and municipalities by selling the carbon “credits” that they generate. In this case, the sequestered carbon could not be counted toward Boulder’s goal, but the funds could be used to pay for other programs with greater GHG reduction potential.

The potential for carbon sequestration in open space, wetlands, agricultural lands, urban parks and national forests is quite large in the United States and some local and national programs provide incentives for practices that increase the amount of stored carbon in soils and woody crops. However, carbon sequestration has historically been a controversial issue, both in the context of the Kyoto framework as well as among the environmental community due to the temporary nature of carbon storage in soil vegetation. As a result, sequestration projects are generally considered higher risk due to the uncertainty surrounding their value in a regulated environment. Although sequestered carbon credits are available on the recently opened Chicago Climate Exchange, the private sector market for sequestered carbon credits has been and remains illiquid and credits are considered low value.

Despite this uncertainty, the opportunity to sequester carbon within the City of Boulder may be significant and can provide a solid temporary “fix” until other, more permanent programs are implemented and new technologies are adopted. BREE recently engaged the interest and support of two nationally recognized soil, water conservation *and* CO<sub>2</sub> – sequestration experts, Dr. Keith Paustian and Dr. Yaling Quain, of Colorado State University. These experts are available to assist with our efforts to establish a carbon baseline and a CO<sub>2</sub>-sequestration potential assessment. Additionally, project scientists at Los Alamos recently indicated support for establishing Boulder as a calibration site for Laser Induced Breakdown Spectroscopy (LIBS) for resolving soil carbon.

BREE strongly encourages the City to adopt a diversified GHG program that includes carbon sequestration. Such a program should seek to preserve and maximize open space, wetlands, flood plains and agricultural/rangeland soil and vegetation health for maximum carbon storage potential and implement state of the art soil conservation practices. The potential to contribute to the City’s goal is quite large. More importantly, a sustainable soil, vegetation, and composting-sequestration program within the city can contribute to other environmental goals as well, such as reducing erosion and solid organic waste, supporting sustainable agriculture practices and providing important habitat for local area wildlife.

## **Budgets and Funding**

BREE recognizes that many of the programs and initiatives outlined in this report will require funds that, as yet, have not been allocated or planned for in City budgets and that this may represent a barrier to reaching the City’s goals moving forward.

Although many of the programs presented here would be cost-effective over a relatively short period of time due to the energy savings they generate, the costs of promotion, coordination, training, start up and monitoring of results would require an initial investment that may not be recovered through energy savings. Alternative sources of funding would need to be explored. Possible options for generating the necessary revenues are discussed below. These ideas are by no means all-inclusive of possible funding sources, nor have they been fleshed-out with enough detail to enable a firm initiative at this time. Some of these mechanisms would require voter approval under the Taxpayer Bill of Rights. As an immediate next step, the City should begin to analyze the easiest and quickest potential funding sources to begin program implementation.

## ***Aspen-Style Energy Use Ordinance***

A two-and-a-half year old program in Aspen charges homeowners a “carbon tax” of up to \$100,000 if they exceed the “energy budget” of 40,000 Btus per square foot. If a new home is larger than the energy budget allows, a one-time fee is assessed, based on calculations of how much carbon that excess energy demand will generate over the next 20 years. The “Carbon Tax” is calculated from the average energy baseline within Aspen proper, which is equivalent to about \$340/mtCO<sub>2</sub>e.

In addition, if a planned home is 5,000 square feet or larger, the homeowner must install a photovoltaic or solar hot water system, or pay a \$5,000 fee. If the home is larger than 10,000 square feet, the system -- or the fee -- doubles in size.

The money collected under Aspen’s Renewable Energy Mitigation Program (REMP) is invested in energy efficiency and renewable-energy projects. In its first two years, REMP generated \$1.5 million, 10 times the revenues that administrators expected. REMP funds are administered by the non-profit Community Office for Resource Efficiency, which works with city and county officials who must approve REMP investments. So far, the program has invested \$667,000 on 15 different projects that will keep about 12,000 tons of greenhouse gases out of the air annually.

BREE strongly recommends that the Boulder’s City Council consider a similar measure in Boulder. Given the success of the program in Aspen and the fact that it is relatively well-received by its citizens, such a program could generate a substantial portion of the funding that will be necessary to implement the programs outlined in this report while also creating disincentives for wasteful, unsustainable development. A similar measure for wasteful commercial development should also be considered.

## ***Other Potential Funding Mechanisms***

Several additional ideas for generating revenues to support energy efficiency and renewable energy programs were developed by BREE, as follows.

Government and Private Foundation Grants – the Climate Team should immediately begin to investigate the availability of funds for specific programs, through a variety of government grant programs and private foundations, and submit applications.

Solar Revenue Bond - San Francisco recently passed, by 73%, a \$100 million solar bond to purchase PV panels, wind energy and energy efficiency for municipal buildings at no cost to taxpayers -- all costs will be paid from savings on electricity bills. Unfortunately this repayment schedule may not work in Boulder because we pay about half as much as San Francisco per unit of electricity. Thus Boulder could only generate about half of the necessary electricity savings to repay the bond. As an alternative, perhaps the City could install a larger (i.e., 10kW) system and sell the environmental benefit to Boulder residents via green tags to support its installation.

Propose (and pass) a revenue measure similar to the recycling tax - In 1994, the county narrowly passed a revenue bond of a .10% sales tax to support recycling. The tax ran for five years and generated about \$20 million. The city could propose a similar measure to support renewable energy and efficiency programs, perhaps tying the amount spent to the actual revenue from the renewable energy tax plus take out a loan, which ties repayment to energy savings.

Energy Consumption Tax – Implement a tax, which would be levied on CO<sub>2</sub> emissions above a ceiling level for energy use, transportation and commercial and industrial pollution. This program needs further analysis and would be medium- to long-term.

Systems Benefit Charge - A set charge would be added to water or other utility bills. The funds collected would be invested in energy efficiency and renewable energy projects for residents and businesses.

Solar Source – The City and County could capitalize the costs of installing a grid-tied photovoltaic array on city and county buildings. Citizens could opt to pay more each month to get a portion of their energy from this local solar-electric source. This could be accomplished in one of two ways: 1) residents purchase green tags to support the project or 2) negotiate a power purchase contract with Xcel whereby Xcel would pass the price premium through to citizens.

Increase the franchise fee - Currently the fees from the City's franchise agreement with Xcel amounts to 3% of our power bills. Getting permission to raise the franchise fee from Xcel will require an enormous amount of effort and may not even be possible. However this option should be thoroughly vetted. It may be possible to work with one of the cities that are in negotiation now with Xcel (Berthoud, Denver, Lakewood and/or Carbondale) to get a larger franchise fee.

Voluntary energy tariff - Arrange a voluntary fee (perhaps a percentage of the total bill) that a customer would agree to pay to support efficiency and renewable energy programs in the City. This would require negotiating with Xcel for their agreement. The program would be voluntary both for the cities that would offer the tariff as well as for the Xcel customers to pay. Costs to Xcel would be minimal.

The City, BECC or others could work with lenders to develop a financing package that would pre-underwrite loans for Energy Star appliances or building materials, home energy audits, lighting and insulation/weatherization efforts. Xcel and other utilities have had similar programs in the past and perhaps Xcel could be leveraged for additional funds to support such efforts.

Sponsor bulk procurement and sales of compact fluorescent lamps or other energy efficient products with a slight profit dedicated to renewable energy and energy efficiency programs.

## **Conclusion**

The scientific consensus is clear. Climate change is occurring and is attributable to human activity. Without aggressive actions to limit and reduce greenhouse gases, the effects and costs associated with climate change will continue to increase and are projected to have devastating effects on the world's ecosystems, economies and human health.

The political climate is also clear. Lacking leadership from the Federal Government, it is up to proactive cities and states to lead efforts to reduce GHG emissions. Furthermore, unless and until we reduce our dependence on non-renewable energy resources and especially foreign oil, war in the Middle East and environmental disasters like those in recent years in Yemen and Spain will continue to dominate US domestic and foreign policy and expenditures.

It is time to invest in programs that will ensure our energy sustainability and quality of life. The City of Boulder has an opportunity to take a leadership role in promoting sustainable energy use and to become a model for other Cities to follow. Investments in energy and environmental

programs now, will lead to a stronger economy, a cleaner local and global environment, a healthier population and sustainable growth over the years to come. If, as predicted, world consumption of fossil fuel starts to outstrip the discovery of new supplies, then sound energy policy will become an economic as well as an environmental obligation. Communities that control their energy production and use, with a diverse strategy that includes efficiency, alternative fuels, and clean transportation technologies, will lead the way toward a sustainable future.

At this time, the BREE requests that the Boulder City Council, Environmental Sustainability Working Group, Environmental Advisory Committee and Energy Working Group take the following six immediate actions:

- 1) Establish a “climate team” and provide funding and authority, working with existing advisory boards and task forces, to initiate high priority programs and to evaluate and plan for longer-term recommended initiatives.
- 2) Identify the easiest and quickest funding opportunities:
  - a. Work with Aspen energy ordinance program team to determine an action plan for implementing in Boulder (possibly Boulder County)
  - b. Research all available government and private foundation grant funding opportunities
- 3) Implement an aggressive education and community outreach program.
- 4) Combine the best elements of existing PACE, Rebuild Colorado, Climate Wise, Climate Leaders, etc. programs, with multiple options for participation and analyze incentives. Initiate recruitment immediately across all commercial and industrial business sectors.
- 5) Analyze and identify residential and commercial efficiency programs that represent the “lowest hanging fruit”, i.e., easy to implement, cost effective and significant CO<sub>2</sub> reduction and implement them immediately.
- 6) Preserve and maximize open space, wetlands, flood plains and agricultural/rangeland soil and vegetation health for maximum carbon storage potential and implement state of the art soil conservation practices.

The choice is ours – the time for action is now.

# Appendices

## Appendix 1: Participants

The following is a list of participants in the BREE who have attended and participated in the meetings and the development of the report and recommendations. Note that this list may not be all inclusive and omissions were made in error not by intention.

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## ***Appendix 2: Background on Climate Change and the Kyoto Protocol***

The scientific consensus is clear. Climate change is occurring and is attributable to human activity. Already we have seen X percent of melting of glaciers, and ten of the warmest years on record in the past decade. Concentrations of CO<sub>2</sub> in the atmosphere have risen by X %, CH<sub>4</sub> by x%, NO<sub>2</sub> by x%, and fluorocarbons by x% just in the past 100 years (Figure). These gases collectively are referred to as greenhouse gases (GHG), because they increase the potential heat trapping capacity of our atmosphere.

Although the complexity of the earth system has challenged scientists' efforts to predict localized impacts of climate change, there is high certainty of widespread impacts such as: flooding of coastal areas, disappearance of species and ecosystems, increases in infectious mosquito-borne disease, greater incidence of natural disasters such as floods and hurricanes, and a large-scale change in global climatic patterns affecting worldwide water supply and agricultural production. While the distribution and scope of these changes is not well quantified, the threats of climate change are real and the potential for threshold effects are concerning.

One-third of humans live in areas where water is a scarcity, extinction of species is the sixth largest in planetary history, and land-use change eliminates X% of extant ecosystems annually. The human population is expected to grow to 11 billion by the end of the century, and the current population of 6.1 billion is already utilizing resources on this planet 20% faster than they can be replaced. Clearly, we as a global population need to address these imbalances now.

More to come...

## **Appendix 3: Disaggregation of Boulder's Emissions by Sector and Energy Type**

### **Emissions by Economic Sector**

The following table presents sectors responsible for Boulder's GHG emissions for the years 1990, 1995 and 2000.

Sectoral Emissions, metric tons/yr of CO<sub>2</sub>-equivalent

	1990	1995	2000	% increase 1990-2000
Residential	295,729	332,134	345,047	16.7%
Commercial	562,733	760,221	794,803	41.2%
Industrial	349,846	269,879	330,700	-5.5%
Street lighting	3,321	3,611	6,106	83.8%
Transportation	437,142	487,314	505,564	15.7%
Waste	40,729	40,729	40,729	0.0%
<b>Totals</b>	<b>1,689,501</b>	<b>1,893,888</b>	<b>2,022,949</b>	<b>19.7%</b>

The commercial buildings sector was responsible for by far the most GHG emissions in 1995. This fact, combined with the historical trend of the commercial sector producing the largest rate of growth in GHG emissions, strongly suggests that aggressive measures should be taken to increase the energy efficiency of commercial buildings.

This suggests policy initiatives including:

Strategies to reduce electricity usage, particularly in commercial buildings

Establishing an aggressive commercial building energy code

### **Emissions by Energy Type**

When Boulder's GHG emissions are disaggregated by energy type, electricity usage emerges as the overwhelming source of emissions, contributing about 48% of total emissions. The reason for this is the fact that the primary energy source serving the Boulder market is coal.

The following table presents emissions by energy type for the years 1990, 1995, and 2000.

NOTE: emissions from waste (i.e. landfill gas) are only rough estimates; this sector needs to be analyzed.

Emissions by Energy Type, metric tons/yr of CO<sub>2</sub>-equivalent

	1990	1995	2000	% increase 1990-2000
Electricity	867,565	913,631	1,029,821	18.7%
Natural gas	344,064	452,214	446,835	29.9%
Vehicle fuel	437,142	487,314	505,564	15.7%
Landfill gas	44,904	44,904	44,904	0.0%
<b>Totals</b>	<b>1,689,501</b>	<b>1,893,888</b>	<b>2,022,949</b>	<b>19.7%</b>

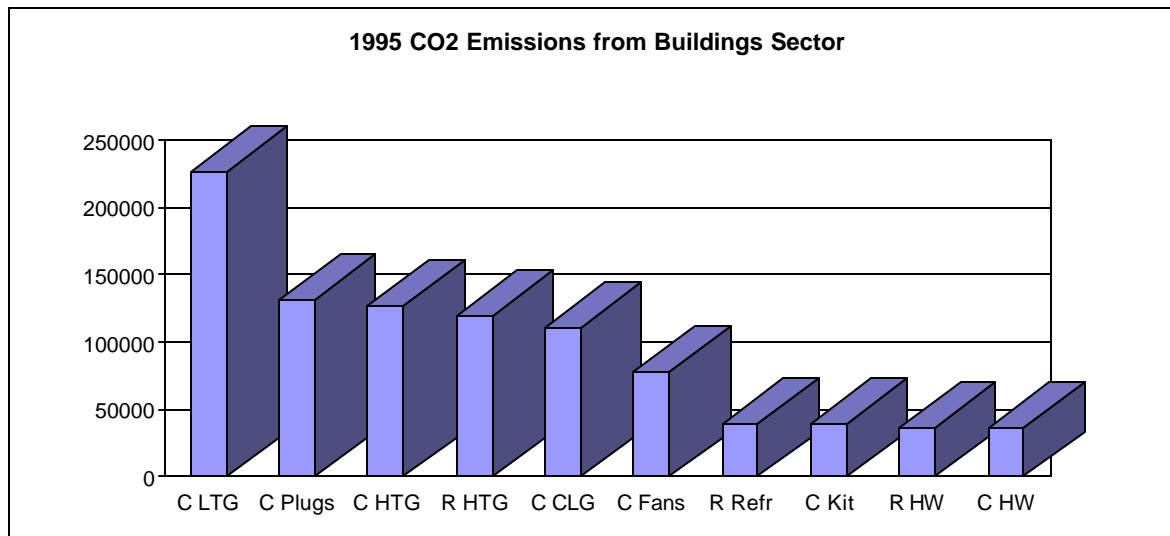
Changing the fuel or source of electrical generation for Boulder could significantly reduce GHG emissions attributable to Boulder.

### Emissions by Energy End Use in the Buildings Sector

Having established that the buildings sector (residential + commercial buildings) is responsible for nearly two-thirds of Boulder’s total GHG emissions, further disaggregation of emissions sources within this sector is instructive.

The approximate level of GHG emissions attributable to various energy end uses within the buildings sector were established as a means to gain additional insight into how this sector uses energy and what specific strategies might be effective in curbing associated emissions. The following table compares emissions associated with each of several specific energy end uses in the buildings sector. The units of the Y-axis are metric tons/year of CO<sub>2</sub>-equivalent.

**Figure 8: 1995 CO<sub>2</sub> Emissions from the Buildings Sector**



Where C LTG: Commercial lighting  
 C HTG: Commercial spaced heating  
 C Plugs: Commercial plug loads  
 C CLG: Commercial space cooling  
 R HTG: Residential space heating  
 C Fans: Fans and pumps in commercial bldgs  
 C Kit: Commercial kitchen  
 C HW: Commercial service hot water  
 R HW: Residential hot water  
 R LTG: Residential lighting  
 R Refr: Residential refrigerators

These results suggest specific strategies for cutting GHG emissions associated with the buildings sector that would offer the greatest emission reduction benefits. Again, an improved energy code for commercial buildings is indicated. This and other specific GHG management strategies are discussed in the body of this report.

## ***Appendix 4: Summary of Calculation Methodology for Boulder's GHG Inventory***

The City's Office of Environmental Affairs initiated development of Boulder's GHG inventory using a software package provided by the International Conference on Local Environmental Initiatives (ICLEI). After reviewing the capabilities of the ICLEI software, BREE came to the conclusion that a more rigorous approach was needed for BREE's purposes.

The ICLEI software is quite satisfactory for accomplishing what it is designed for. It is intentionally simplistic and easy-to-use so that cities would be likely to employ it as a tool for establishing an approximate GHG inventory. The aim was to get large numbers of cities to engage in the inventory process. ICLEI, to its credit, has been successful in accomplishing this goal.

However, BREE recognized early on that it wanted a much more rigorous approach to inventory development; a methodology that would provide substantially more details about Boulder's emissions sources and would thus provide deeper insight into identifying the specific emissions reduction strategies that would give Boulder the "biggest bang for the buck".

Consequently, the decision was made to abandon the ICLEI software as the inventory tool and to instead use tools previously developed by Econergy International Corporation that are based on the calculational methodologies of the International Panel on Climate Change (IPCC), the technical advisory body that guides technical issues under the Kyoto Protocol.

In general, the inventory is based upon measured historical data. Energy sales data, provided by Xcel for the Boulder market, comprise electricity and natural gas sales in 1990, 1995, and 2000. Natural gas sales data include transport gas purchased by large users such as CU from non-Xcel suppliers and delivered to the end-user by Xcel's distribution network.

Vehicle fuel consumption is the other major source of GHGs. Fuel consumption within the Boulder market is estimated based upon City of Boulder VMT data and vehicle fleet fuel efficiency data for the Rocky Mountain region acquired from the Energy Information Administration (EIA) of USDOE. VMT data and fleet efficiency data for 1990, 1995, and 2000 were the basis for estimating vehicle fuel consumption in these years.

Calculating GHG emissions associated with natural gas consumption is quite straight-forward. Emissions are simply the volume of gas consumed multiplied by the well-known amount of carbon dioxide associated with each million Btu of natural gas.

Calculating the emissions from vehicle fuel usage is not quite as straight-forward since fuel usage must be estimated from the measured VMT data on the basis of average fuel efficiency of the vehicle fleet and the split between gasoline-powered and diesel-powered vehicles. Fleet fuel efficiency changes over time. In 1990, EIA estimates the average fuel efficiency of the Rocky Mountain region fleet of vehicles was 16.4 mpg. The values for 1995 and 2000 were respectively 16.8 mpg and 16.9 mpg. Based on EIA data, it was assumed that 86% of the vehicle fleet burns gasoline and 14% burns diesel fuel. CO<sub>2</sub> emissions are calculated as VMT divided by average

fuel efficiency multiplied by the well-known amount of CO<sub>2</sub> associated with each gallon of gasoline or diesel as the case may be.

Calculating GHG emissions associated with electricity usage is not at all straight-forward. The mix of electricity sources supplying Boulder includes the coal-fired Valmont power plant, the natural gas-fired combustion turbine at CU, hydroelectricity generated by City-owned facilities in Boulder Canyon, and wind-generated electricity associated with WindSource subscriptions held by Boulder residents. In 2000, this generating mix consisted of 91.4% coal, 6.3% natural gas, 1.3% hydro, and 1% wind. This mix has changed over time. In 1990 the mix was approximately 95% coal, 3.7% gas, 1.3% hydro, and 0% wind. In 1995 the mix was approximately 92.4% coal, 6.3% gas, 1.3% hydro, and 0% wind.

Electricity emissions are calculated as the fraction of the mix provided by coal, multiplied by total electricity consumption, divided by the power plant efficiency, multiplied by the well-known amount of carbon dioxide associated with each million Btu of coal; plus the fraction of the mix provided by natural gas, multiplied by total electricity consumption, divided by the power plant efficiency, multiplied by the well-known amount of carbon dioxide associated with each million Btu of natural gas. Emissions from hydro and wind generation are zero. Electricity emissions have changed over time due to the changing generating mix and changing electricity consumption. Despite the CO<sub>2</sub> intensity of the generating mix steadily dropping during the 1990 – 2000 period, as more natural gas was introduced into the mix when CU's power plant went online and as wind energy was added to the mix, total emissions from electricity usage have steadily increased due to the growth in electricity consumption.

## ***Appendix 5: Outreach and Citizen Education and Advocacy Plan***

### **Who**

Initially, organization of this campaign will be a joint effort with local government (city and county), BREE and the organizations BREE members represent. Eventually, these efforts would be led by the Climate Team with assistance provided by the City, BREE and/or BECC as well as lender(s) and service suppliers using available channels to disseminate information regarding cost-effective improvements, suppliers and financing to the public.

### **Why**

The outreach and citizen advocacy plan is an important first step in galvanizing the community behind the City's goal and its efforts to create a sustainable community in the years to come. Recognizing that the City's contract with Xcel Energy expires in 2010, the City has as an opportunity to create positive changes in the energy market and put pressure on Colorado's PUC to move towards cleaner, more sustainable sources of energy. In the coming years, electricity rates are expected to increase; however, the cost of renewable energy technologies is coming down rapidly. Wind is expected to be cost competitive with fossil-based fuels in the near term. In addition, there are numerous grants, subsidies and other sources of funding available to support renewable energy programs.

Reducing the impacts of electricity generation by implementing economically-sound efficiency and renewable energy programs will not only improve the global environment, but will have dramatic positive impacts on local air quality and health.

### **How**

In general:

This initiative would utilize a database, e-mail and a simple Internet web page with "chat site" to communicate with and track interested groups, businesses and citizen activists. This infrastructure would include a sign-up form for new citizen activists, email alerts, monthly newsletter or update archives, general information about goals & reasons for this work, tools for citizen activists to contact elected officials, etc. and would be overseen by the Climate Team with extensive support from BREE members and other volunteers. Budget support for such an initiative could potentially come from local business or non-profit activist group "members" or "sponsors" whose names would be displayed on the website and featured in events and publications.

Additional recruiting for the program would focus on at events & public gatherings such as farmers market and Boulder City and County fairs, political events, campus events, etc. It is recognized that web site sign-up is not likely to be a majority of the signups.

Those who sign up would be sent an action item that requests a general "support energy efficiency and renewable energy" message, following up with a new action item perhaps once a month including policy proposals and updates on the PUC and State Legislature decision-making process. This should drive the frequency and content of e-mail alerts. Other monthly correspondence could include interesting news updates and news of the impact this group is

having on the local effort. This effort could later extend to other programs such as organizing CFL bulk buys, promoting the effort in the, lobbying, Sustainability 101, etc.

This effort could also facilitate the development of a special “technical advisory” sub working group to support the implementation of specific projects and programs, to help develop a technical understanding of the feasibility of the City’s goals and to affect significant progress towards these goals and the policies developed by BREE (or BET?)

### **Planned outreach:**

A weekly community education and polling project "column" in the Daily Camera on energy/renewable energy, renewable energy co-benefits and related sustainability issues.

(Note: By "educational poll" we mean one that:

- a) reports on (or features) a specific energy/ renewable energy/ related sustainability issue, presents relevant facts or interesting factoids about that issue, discusses how the issue is being dealt with in other cities, etc,
- b) presents a related opinion question for public response (public response will likely be limited to a web-site and a mail-in address), and
- c) reports to the community the results of the previous weeks polling question as well as presents a new community/education/information question and encourages citizens to get involved in the bigger EWG (energy working group) project --with the idea that the community will (hopefully) be better educated and better prepared to vote on a possible alternative energy ballot initiative ... IF the poll indicates the community might support such an effort. This would probably be the final question of the series.)

Serious public discussions via a "Sustainability 101" program series designed to actively engage Boulder’s citizenry and business community in the need for and an analysis of ideas for cleaner energy options and other sustainability/quality of life programs.

Format: A public course along the lines of the popular "Planning 101". This is still being developed – but there are some models out there. It will be open to the entire community. Participants will get a City of Boulder/ OEA/BECC "certificate of graduation" when they complete the course. The course would include a possible field trip to a major wind farm and an operational coal mine (for comparison).

Possible supporting participants: U.S.G.S., RMI, NREL, NCAR, WAPA, FEMA, several local energy experts, various CRES members, BECC, Don Mock, Mayor Toor, SWEEP, and several others have expressed interest.

### **Timeline**

January 2003:

Establish “formal” name.

Set up simple web site with web form-based signup, very general information about the campaign, and initial thank you with suggested action items.

Set up database for tracking/communication.

Need active members to contact businesses, organization, individuals – now, get the word out. BECC to contact PACE. The LAW Fund to contact CO Wind Power Campaign to help broaden the response to this effort, etc.

Need active members to give input for the web site and initial letter.

January (and beyond) 2003:

Begin to gather signups via tabling, web site, and cross-marketing to sympathetic organizations (Eco-Cycle? Sierra Club? PLAN Boulder County? etc.) Prepare hard-copy signup materials for use at tabling events & the like.

February 2003:

Develop first news update/e-mail alert (probably a general picture of what's happened so far, where we would like to go, and a suggestion to contact city council with a generally pro-EE, pro-RE message).

Tap local candidates for their support.

Develop “talking points” for the Media (ex: Every day 2 long coal trains carrying xxx tons of coal burned and breathed right here in our own valley. 451 million Americans complained of smoke and pollution related breathing problems in 2001 – 2002. The energy saved by eliminating one aluminum can will operate a TV set for 3 hours, etc. BECC, NREL, Larry and ECO-Cycle have lots of these factoids)

February and beyond, 2003:

Continue gathering signups, generate news updates/e-mail alerts as needed (at least once every other month), refine web site, etc.

Communicate with and update local about similar efforts ongoing in other communities/states (e.g.: Ft. Collins, Pennsylvania).

Council updates.

Infomercials on the local channels and in the local news papers --- perhaps a monthly column or a monthly update with Clay Evans or Clint Talbot?

June/July 2003:

Recommendations to Council

July 2003

Sustainability 101

July 2003

Step-up lobbying and active citizen awareness campaign.

November 2003

Ballot or Bond initiative if appropriate

## Appendix 6: Xcel Energy Demand Side Management Programs

In July 2000, the Colorado Public Utilities Commission (CPUC) adopted a Stipulation and Settlement Agreement for the DSM portion of Xcel Energy's 1999 Integrated Resource Plan (IRP). According to the Agreement, Xcel Energy will seek 124 MW of cost-effective DSM resources by the end of 2005. Xcel Energy is authorized to spend up to \$75 million to achieve the goal. These DSM programs are designed to reduce Xcel Energy's summer peak demand, which is defined as weekdays M-F, 3-7pm, June-August. Through DSM programs, Xcel Energy customers receive a financial incentive for installing measures that reduce summer peak demand. While Xcel Energy's main objective is to achieve demand savings, participating customers reduce building energy use as well. Some of these DSM programs, which are in affect through 2005, relevant to reducing carbon emissions in Boulder are:

- Summer Savings Plan (Residential A/C Rebates)
- Commercial & Industrial Bid Program / Custom Efficiency
- Recommissioning Program
- Energy Design Assistance Program

The Summer Savings Plan pays cash rebates directly to residential customers who install energy efficiency air conditioners with SEER ratings greater than 13. The 2005 demand savings goal for the Summer Savings Plan is 8.1 MW. In 2002, the Small AC Rebate pilot Program impacts, include:

- Rebates paid for approximately 8,200 installations
- \$2.5M in incentives
- 3.5 MW of coincident summer peak demand savings
- 3,200 MWh of annual energy savings
- Data on impacts of program on Boulder customers are not available

The Custom Efficiency Program is available to commercial and industrial customers. Building owners or energy service companies submit bids to Xcel Energy to install energy efficiency projects that reduce peak demand. Bids are accepted during program bid cycles that occur 4 times each year. The program savings goal for 2005 is 23 MW of summer peak demand savings. Approximately \$11.7 million are available for incentives. The Program completed 3 bid cycles as of October 1, 2002. At that time, Xcel awarded contracts to 28 different entities including 19 third party vendors and 9 facility owners. To date, the program has achieved:

- 28 MW in demand savings
- 84,000 MWh of annual energy savings
- 120 kW in demand savings for projects in Boulder

The Recommissioning Program is available to commercial and industrial customers. The program objective is to reduce peak demand by improving system integration and building operation and maintenance. DSM incentives cover 100% of recommissioning costs, which are provided by a pre-approved service provider. The program also offers implementation incentives to reduce simple

payback of installed measures to 1 year. The program savings goal for 2005 is 7.1 MW of peak demand reduction and 24,600 MWh of annual energy savings. Of the 5 program projects to date, 1 is in Boulder. However, its floor area represents less than one percent of the total floor area recommissioned in the 5 projects.

The Energy Design Assistance Program was launched in 2nd Quarter 2002. The program provides free energy modeling and decisions support services for incorporating energy efficiency into commercial, new construction projects. The program also provides financial incentives to offset the cost of purchasing energy efficient equipment. that reduce the building energy consumption The program goal is to reduce 13.1 MW of peak demand reduction through 2005. Currently 5 projects are underway, none of which are in Boulder.

#### Recommendations

Based on the available data, Boulder buildings are poorly represented in the Xcel Energy DSM programs. While Xcel Energy does not perform targeted marketing, they are available to present program information to interested groups. Boulder should organize meetings for the business community and request Xcel Energy to make presentations on its relevant programs.

# Appendix 7: Resources for Further Information

## ***Climate Change Websites***

United Nations Framework Convention on Climate Change: <http://unfccc.int/>  
Intergovernmental Panel on Climate Change: <http://www.ipcc.ch/>  
United Nations Environment Program – Climate Change Portal: <http://climatechange.unep.net/>  
Climate Change Knowledge Network: <http://www.cckn.net/>  
World Business Council for Sustainable Development – GHG Protocol Initiative: <http://www.ghgprotocol.org/>  
Climate Action Network: <http://www.climateactionnetwork.org/>  
Earth Council: <http://www.ecouncil.ac.cr/>  
World Resources Institute – Climate Change: <http://climate.wri.org/>  
PEW Center on Global Climate Change: <http://www.pewclimate.org/>  
Climate Ark (climate change and renewable energy portal): <http://www.climateark.org/>  
Earth Policy Institute: <http://www.earth-policy.org/>  
Worldwatch Institute: <http://www.worldwatch.org/>  
International Council for Local Environmental Initiatives (ICLEI): <http://www.iclei.org/>  
EPA Global Warming Site: <http://yosemite.epa.gov/oar/globalwarming.nsf/content/index.html>  
National Climatic Data Center: <http://lwf.ncdc.noaa.gov/oa/ncdc.html>  
Global Change Data and Information System: <http://www.globalchange.gov/>  
Climate Trust: <http://www.climatetrust.org/>  
Greenhouse Network: <http://www.greenhousenet.org/>

## ***Alternative Energy Websites***

Energy Information Administration: <http://www.eia.doe.gov/>  
Renewable Energy Atlas of the West: <http://www.energyatlas.org/>  
Renewable Energy Policy Project: <http://www.repp.org/>  
Green Power Network: <http://www.eren.doe.gov/greenpower/home.shtml>  
National Renewable Energy Laboratory: <http://www.nrel.gov>  
National Wind Coordinating Committee: <http://www.nationalwind.org/>  
Rocky Mountain Institute: <http://www.rmi.org/>  
Alternative Fuels Data Center (DOE): <http://www.afdc.doe.gov/>  
Department of Energy Office of Energy Efficiency and Renewable Energy: <http://www.eren.doe.gov/>  
EPA Energy Star Program: <http://www.energystar.gov/default.shtml>  
Alliance to Save Energy: <http://www.ase.org/>  
American Solar Energy Society: <http://www.ases.org/>  
Center for Energy and Climate Solutions: <http://www.energyandclimate.org/>  
Center for Energy Efficiency and Renewable Energy Technologies: <http://www.ceert.org/>

## ***Miscellaneous***

Sustainability Institute: <http://www.sustainer.org/>