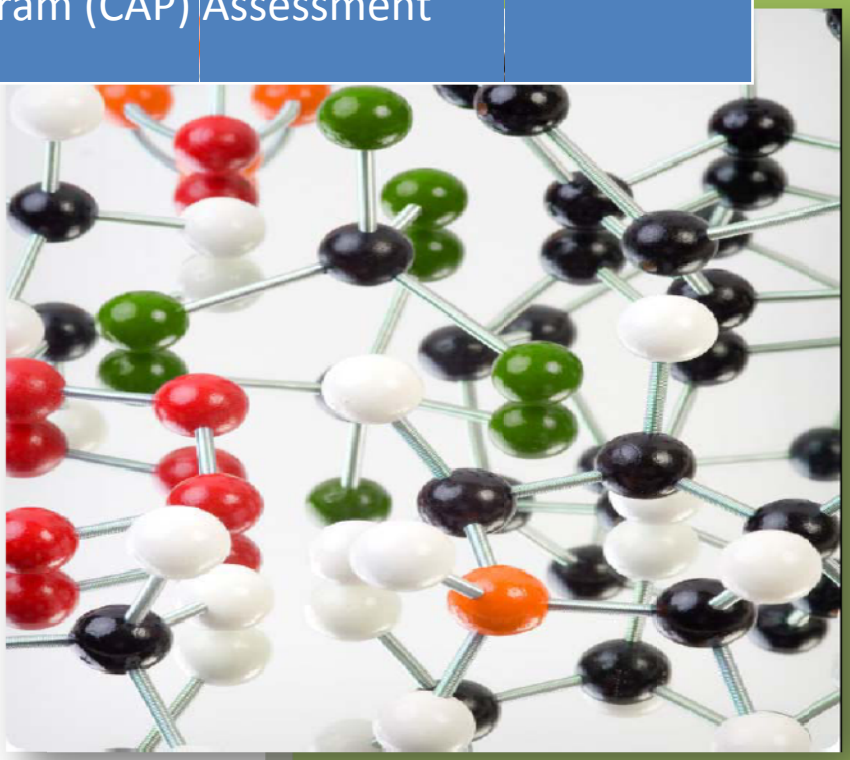
Final

2009

City of Boulder – Office of Environmental Affairs
Climate Action Program (CAP) Assessment



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Introduction and Scope of Work

A Note on Syntax

A specific convention is used throughout this report to govern the use of the word "city". When the municipal government of Boulder is referenced, it is referred to as "the City of Boulder" or "the City". When the word *city* is not capitalized, it refers to the Boulder economy, the Boulder community, or the physical geographic realm over which the municipal government has jurisdiction.

WSP Environment & Energy (formerly Econergy) has assisted the City for several years in establishing Boulder's economy-wide greenhouse gas inventory, analyzing emissions mitigation strategies, and assisting the development of a climate action plan by which the City can achieve its goal to be compliant with the US greenhouse gas (GHG) emissions reduction target under the Kyoto Protocol. This climate action plan (CAP) led to the City's development of multiple programmatic initiatives to promote the realization of the Kyoto target.

The scope of work specific to this report was an assessment of the effectiveness of the CAP. Most of this work was done in the fall of 2008. Further adjustments were made in early 2009, reflecting responses to and comments on the evaluation work received from City staff. Finally, in June of 2009, WSP added an evaluation of the Climate Smart Loan Program, which had been implemented by Boulder County after the earlier WSP CAP assessment work had been completed. Specifically the work scope performed by WSP is that reproduced below, taken directly from the contract documents:

Overview of GHG inventory baseline, trends analysis, business as usual. This work will include (i) a concise description of how the Inventory Maintenance System was originally developed and structured by Econergy (components, information, assumptions); (ii) any update that WSP will deem necessary; and (iii) expanded normalization of the data according to additional indicators (namely: square foot of total or commercial/residential space, population, employed population, past and forecasted economic growth), with comparison of trends to business as usual and results also shown in graphs and tables.

The objective of this task is to allow the Office of Environmental Affairs (OEA) to address any issue raised by the City Council on the IMS tool, enhancing the ability to understand and visualize its results.

Evaluation of current CAP strategies and programs. The review will assess the effectiveness and appropriateness of current (2008) CAP activities, and consider their successes and challenges, focusing in particular on programs specified by OEA. The assessment should cover the criteria used in designing the programs, results, and emissions reductions obtained in 2007 and 2008 (addressing, where appropriate, the issue of programs that require more time to generate appreciable results), methodologies used to monitor program results, and any lesson learned in program implementation.

Evaluation of and recommendations for meaningful metrics to report CAP program results. This task will suggest metrics to characterize programs based on abatement potential and cost effectiveness, as well as to evaluate programs implemented and assess their results over time. It is important that metrics suggested be of easy use in data collection and reporting by OEA staff, as well as of easy understanding by City Council and the Boulder

community. Guidance on metrics commonly used to evaluate marketing and outreach programs will also be provided.

Program and strategy recommendations for meeting the city's 2012 goal. Based on the previous analyses, this task will provide recommendations on programs and strategies to be adopted to meet (or approach to the greatest possible extent) the emission reduction goal set for 2012. The task will focus in particular on the work program for the coming year 2009, also in consideration of Xcel Energy's proposed Demand Side Management Program, with a view of complementing the Utility's offerings and maximizing participation in them. Recommendations may include options considered in Boulder County's Sustainable Energy Plan, and will cover the areas of energy efficiency, renewable energy, transportation, and marketing/outreach.

WSP will estimate emissions reductions from recommended strategies and programs on an annual basis and up to 2012.

Recommendations should be summarized in the form of options or "packages" of measures to meet the 2012 target, in response to the City Council's desire to evaluate various options.

WSP will present results of its analysis to the City Council during the session to be held on Tuesday, November 18th 2008 (6-9 pm).

Incorporate city staff edits and other requested information to refine and finalize reports completed for the original contract.

Confirm that correct renewable portfolio standard data are used throughout report.

Adjust description of commercial, industrial and University of Colorado energy data to reflect that recent and future data, while less detailed than prior years, will still serve as adequate data for the greenhouse gas inventory.

Ensure that updated inventory data are used throughout all sections.

Describe and quantify impact of ClimateSmart loans for existing commercial and residential buildings.

Prepare a summary table for entire report.

The work focused primarily on evaluation of CAP strategies to increase energy efficiency in buildings and vehicles, to increase solar water heaters in residential buildings, and to increase the use of low-carbon fuels. The reasons for this CAP focus will become clear throughout the report. In summary they are 1) Building and vehicle energy consumption is the primary driver of emissions. Therefore, increasing energy efficiency is the most direct action available to reduce these emissions. Also, energy efficiency and solar water heaters often provide an attractive financial return on investment. 2) Education, marketing, conservation (as distinct from efficiency), and solar-electric technologies can also contribute toward meeting Kyoto goal, but are not the primary focus of the recommended CAP. While these strategies can be useful, especially in raising awareness, the emissions reductions they create are not on the level of magnitude necessary to achieve the Kyoto goal. Specifically with respect to

solar PV, the unattractive financial performance of this technology coupled with its relatively small GHG benefit led to WSP's recommendations focusing primarily on energy efficiency and, to a lesser extent, solar water heaters.

Based on the outcomes of the evaluation of existing CAP programs, WSP has analyzed several new initiatives that are proposed to help building owners overcome financial barriers, primarily those hampering energy efficiency.

The magnitude of the challenge of reaching the city's GHG emissions reduction goal by 2012 is a sobering one and becomes greater every day that decisive action is delayed. The market effects of fuel price increases for electricity, natural gas, and gasoline will likely have a bigger impact on emissions reductions than what CAP strategies can hope to achieve. Likewise, more and more renewable electricity added to the mix on the electrical grid will probably have a greater effect than the City's CAP can hope to achieve by itself. That being said, the City has created much of the necessary and fundamental program management infrastructure that will enable the CAP to successfully function as a conduit through which market forces can be channeled to maximally benefit the economy-wide carbon footprint.

Below we present the City with CAP program assessments and recommendations that could have significant and lasting effects if acted upon swiftly.

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Section 1 –City of Boulder GHG Inventory

Overview of GHG inventory baseline, trends analysis, business as usual

Greenhouse Gas Emissions Inventory

In 2004, Econergy International worked with the City of Boulder to develop an economy-wide greenhouse gas (GHG) inventory. For the current evaluation of the Climate Action Program (CAP), the 2004 inventory has been updated to reflect actual energy usage from 2003-2007, changes in Inventory methodologies, and changes in the factors used to quantify GHG emissions. Based on these changes, WSP Environment & Energy updated the Business-As-Usual (BAU) forecast of the city's GHG inventory through 2012. This forecast represents the future GHG Inventory emissions trajectory for the city's economy if no additional mitigation efforts are undertaken.

The purpose of the inventory is to establish the context within which to assess GHG emissions reduction opportunities in the city of Boulder. Emissions were disaggregated on both a sector and emissions source basis. Seven individual sector inventories were constructed: Residential Buildings, Commercial Buildings, Industrial Facilities, Transportation, Street Lighting, Solid Waste, and the University of Colorado. The Residential, Commercial, Industrial, and University of Colorado sectors were further broken down into the emissions from electricity from and natural gas consumption. The Transportation sector was divided into emissions resulting from vehicle gasoline and diesel fuel consumption. The Street Lighting sector quantifies emissions from electricity usage. Finally, the Solid Waste sector quantifies methane emissions resulting from disposal in landfills of solid waste generated within the Boulder economy.

Beginning in 2005, Xcel changed the way it classifies commercial and industrial customers, and, consequently, most of the industrial customers became classified as commercial. As a result, the commercial and industrial sectors have been combined in this report.

The Inventory is based on accepted international protocols and keeps with a similar approach that other cities with climate change objectives have used. The inventory is not meant to be precise GHG accounting, but it does provide a high-level examination of the city's economy-wide GHG emissions. Utilizing the results of the inventory, the City can develop policies and programs that will create the greatest reductions in emissions, while simultaneously stimulating local economic activity and thereby generating increased sales tax revenue.

The primary basis for the GHG inventory was the historical consumption of electricity and natural gas, disaggregated by sector. The necessary historical energy consumption data were acquired from City of Boulder, University of Colorado Boulder, and Xcel Energy. For the most part, annual data for the consumption of electricity and natural gas were available for the 1990 – 2007 period. The completeness of the data set puts the City of Boulder in a good position to make informed decisions regarding the design of programs and policies that aim to manage the city's GHG future.

Using standard methodologies provided by the Intergovernmental Panel on Climate Change (IPCC) of the United Nations Framework Convention on Climate Change (UNFCCC), historical data were translated into GHG emissions on an annual basis. Thus an annual GHG inventory was created for the city's economy for the 1990 through 2007 period. Year 2007 data for CU was not available. Therefore, CU Boulder is included in the commercial/industrial

sector in the 2007 pie charts. City of Boulder staff will retroactively enter CU data for the 2007 inventory and continue to enter CU data for future inventories. As a signatory to the American College and University Presidents Climate Commitment, CU is committed to reduce its campus-wide GHG emissions to net zero by some target year, typically 2025 or 2030. Because details on CU's plan to meet the goal are not available, it is not incorporated into the forecast of CU emissions

The inventory considers only the predominant greenhouse gases, carbon dioxide and methane, together represented as metric tons of CO_2-equivalent[1] (tCO2e), that result from the combustion of fossil fuel and from anaerobic decay of solid waste. The inventory does not take into account the other GHGs (N_2O, HFCs, PFCs, and SF6) covered by the Kyoto Protocol. The reasoning behind this omission is that, in the bigger picture, fossil fuel-related CO_2 and solid waste-related CH_4 comprise the vast majority of the city's climate change-inducing emissions, with the other GHGs contributing only marginally to the overall inventory. Also, it is generally more difficult to acquire the data underlying quantification of the other GHG emissions.

Additionally, the inventory does not cover emission sources considered to be insignificant and/or not readily controlled by local government actions. These excluded emission sources include aviation and locomotive transportation, agricultural enteric and manure sources, solvent use, land use and forestry, and industrial process emissions not associated with energy usage. Finally the inventory does not include the emissions related to the production of most goods bought or consumed[2] in the city.

The Inventory does credit the city for reductions achieved through the generation and purchase of renewable electricity. These credits are realized through the City's hydroelectric generation, public and private subscription to Xcel Energy's Windsource Program, and renewable energy certificates (RECs) purchased through other retailers.

Figure 1 shows the Boulder GHG Inventory for 2007 broken down by sector and source. As described above, CU Boulder is included in the Commercial/Industrial sector for the 2007 inventory. These sectors are disaggregated for the 2006 inventory, as shown in Figure 2, which may be a better representation of Boulder's GHG inventory by sector and source.

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[1] The Global Warming Potential (GWP) for carbon dioxide and methane has been calculated to make possible relative comparisons between the two gases. Since methane is 21 times more potent a greenhouse gas than carbon dioxide, the relative global warming potential of carbon dioxide = 1, and methane = 21. When GHG emissions are summed for an inventory, they are commonly referred to as CO_2e , indicating that the gases have been converted to CO_2-equivalent.

[2] To avoid double counting, emissions from goods bought or consumed in the city should be included in inventories associated with the communities in which the goods were made.

Figure 1: Boulder GHG Inventory for 2007, disaggregated by sector and source (emissions tCO2-e and % of total).

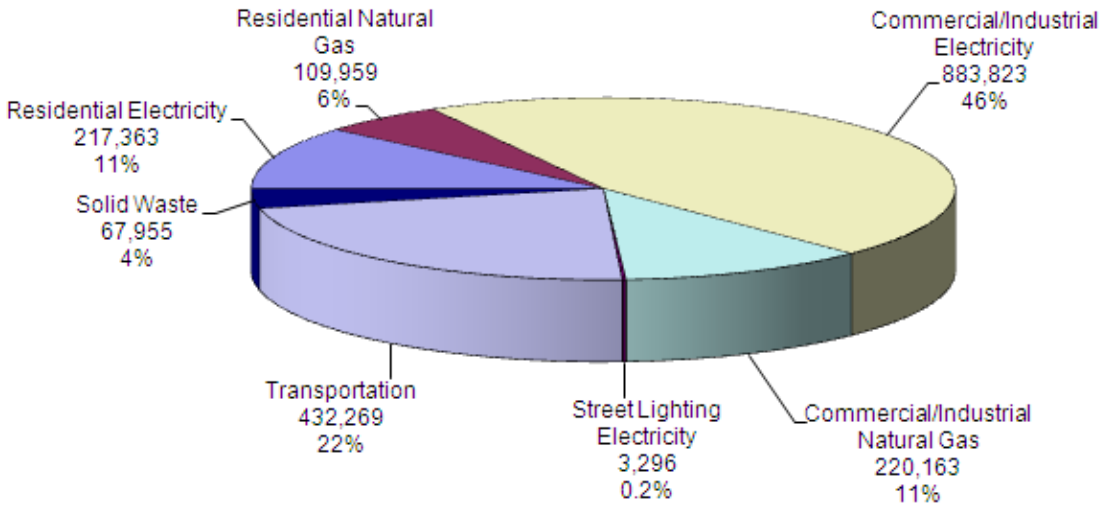
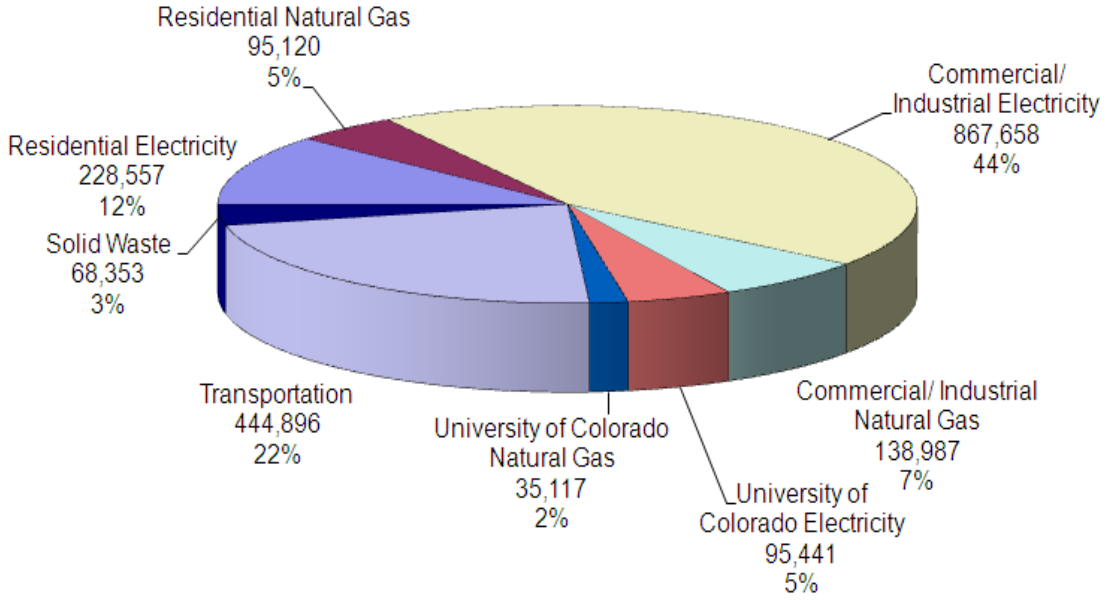


Figure 2: Boulder GHG Inventory for 2006, disaggregated by sector and source (emissions tCO2-e and % of total).



Baseline GHG Emissions

The 1990 baseline for GHG emissions, originally established by Econergy's work in 2004, was reexamined to ensure that it was still an accurate portrayal of the city's 1990 GHG Inventory. The updated baseline is based on the same historical usage data obtained in the process of creating the initial inventory. However, some methodology adjustments, such as updated EPA emissions factors for the direct combustion of various fossil fuels, were retroactively extended to the baseline year. Emissions factors for electricity consumption were not modified retroactively to the base year because these emissions factors reflect the actual emissions associated with electricity drawn from the grid serving the city of Boulder. These actual historical emissions factors are obtained from the EPA's eGrid database. It should be noted that the grid which serves Boulder has the highest emissions factor of all grids in the United States.

The baseline year was also adjusted to reflect a new data source characterizing the fleet of private and public vehicles operating within city limits. Subsequent to Econergy's 2004 work, the Boulder Office of Environmental Affairs (OEA) staff replaced a data set obtained from Cities for Climate Protection (CCP) with a data set obtained from the Colorado Department of Public Health and Environment (CDPHE). WSP E&E has extended this new data set retroactively through the baseline inventory to allow for greater consistency with future inventories. The CDPHE data set has a much higher fuel economy rating for 1990 than the CCP data set, thus significantly decreasing the calculated transportation sector GHG emissions in 1990. As a result, the updated 1990 baseline for GHG emissions is roughly 80,000 tCO2e below the baseline established in the 2004 work.

The City's GHG goal is to reduce economy-wide emissions to a level that is 7% below the net 1990 baseline GHG emissions, by the end of 2012. After making the adjustments to the 1990 baseline year described above, the updated 2012 economy-wide target for emissions reductions is 1,375,000 tCO2e. Additionally, the target was apportioned to each sector based on that sector's contribution to the 1990 inventory in order to provide a specific reduction goal for each sector. These reduction goals and the approaches used to achieve them are addressed later in the report.

GHG Data Since 1990

In Econergy's 2004 work, historical data used to establish the 1990 baseline was also used to develop the GHG inventory through 2003. For 2004 through 2007, the inventory is based on data input by OEA staff. Both data sets were used by WSP to create an updated forecast of emissions for the 2008 – 2012 period. The forecast is discussed in the following section.

GHG Forecasts to Capture Colorado RPS Effects

It should be noted that when Econergy performed the 2004 work, Amendment 37 had not yet been approved by Colorado voters and thus there was not yet a Renewable Portfolio Standard (RPS) in Colorado. The updated forecast shown in Figure 3 takes into account the effect on the carbon intensity of the electricity grid that the RPS is expected to produce during the 2008 – 2012 period.

Figure 3 shows the results of the updated inventory, disaggregated by emissions source. Emissions from 1990 through 2007 are based on actual data, whereas the emissions for 2008 and beyond are based on projections. Electricity is clearly the largest source, and it is also has the greatest incremental increases. Please note that the

top-most layer of the inventory, “Offsets”, represents decreased net emissions through City-owned hydropower, community participation in Xcel’s Windsource program, and community REC purchases.

Figure 3: Updated Forecast Boulder GHG Inventory by Source, 1990 – 2012 with RPS Effects

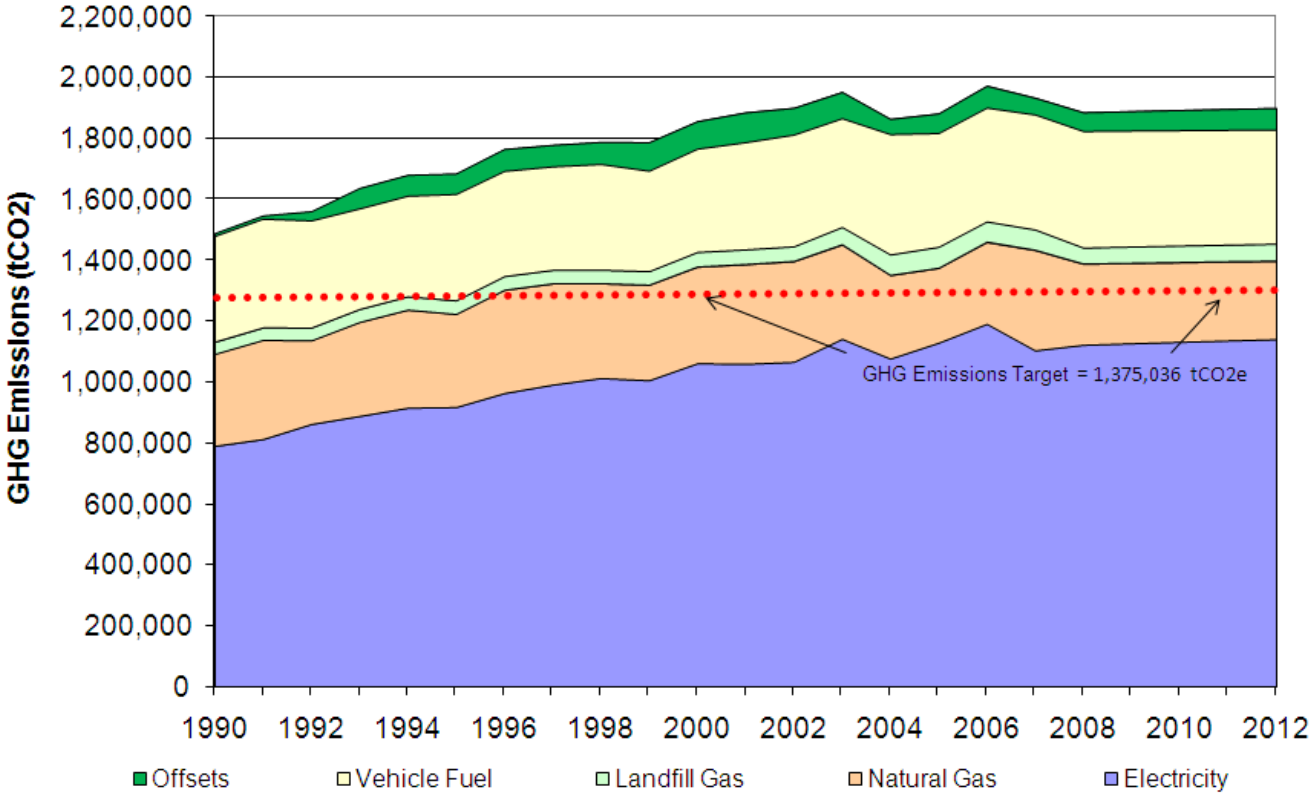
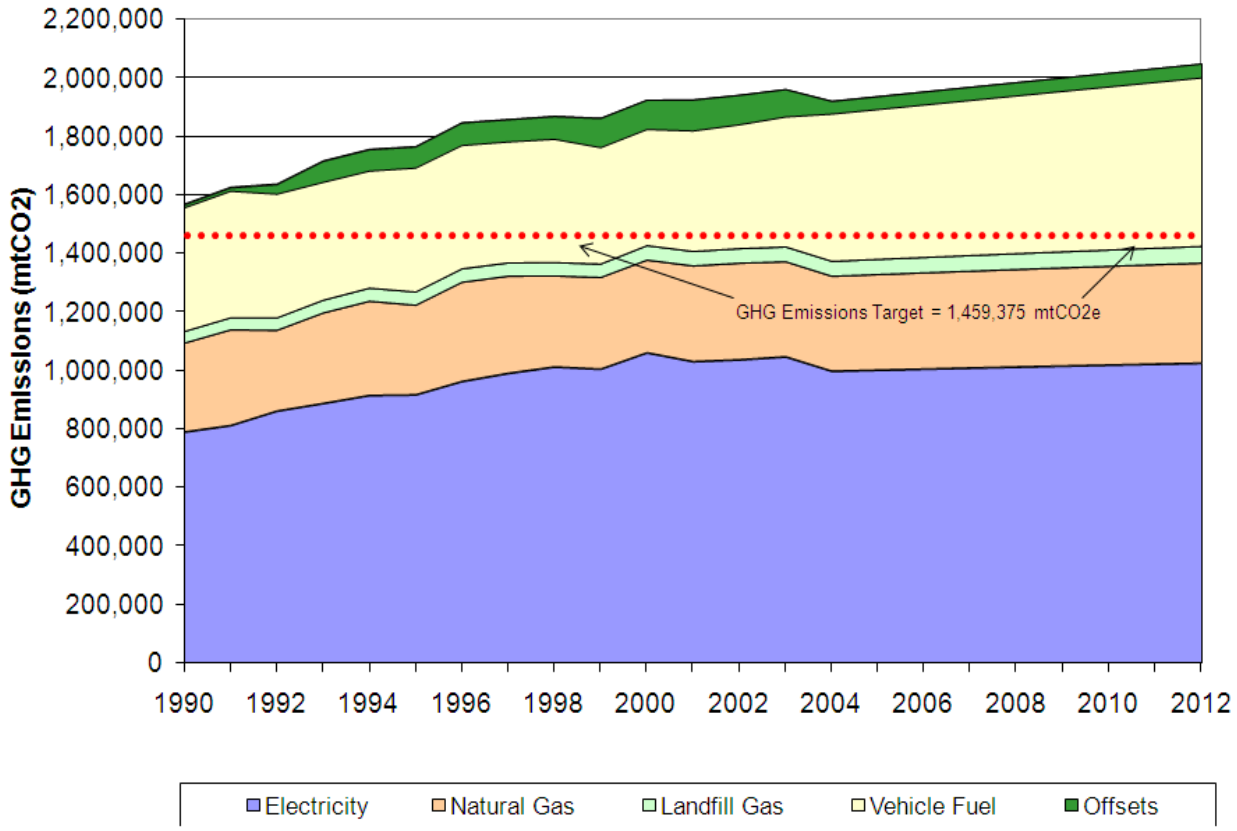


Figure 4 shows the original inventory and forecast created by Econergy in 2004. The actual inventories for 2004-2007 (Figure 3) are similar to what was forecast in 2004 for those years.

Figure 4: Original Forecast Boulder GHG Inventory by Source, 1990-2012 (from the original work in 2004; no RPS effects)[3]



The forecast for the 2008 through 2012 period was based on the pre-2008 historical energy use within the city's economy. The energy use for each sector and source was projected independently to capture divergent trends. The effect of Colorado's RPS on forecast electricity emissions is described below.

The emissions factor for the grid from which the city draws its electricity was forecast through 2012 to reflect Colorado's RPS schedule. The RPS requires certain utilities to purchase or produce enough eligible renewable electricity to provide a given percentage of their retail sales in the state. Table 1 presents the scheduled 2012 percentage by utility type, the *actual* 2012 percentage by utility type, and the sector percentage translated into percentage of all retail power sold in Colorado. The *actual* percentage reflects the fact that certain renewable energy projects are eligible for *compliance multipliers*, meaning the electricity they generate receives an inflated

[3] The City's GHG target in the original 2004 work is higher than the current target because of the baseline adjustment made to the Transportation sector and described earlier in S*ubsection b*.

credit, for RPS-compliance purposes, that is greater than the actual amount of electricity produced by these projects.

Investor-owned utilities may use a multiplier of 1.25 for renewable electricity generated in the state of Colorado and cooperative and municipal utilities may use multipliers of 1.5 and 3.0 for community-based projects and solar projects installed before July 2015, respectively. It was assumed that 80% of investor-owned utility retail sales would qualify for the 1.25 multiplier and that 10% and 5% of cooperative and municipal retail sales would qualify for the 1.5 and 3 multipliers, respectively.

Under the above-mentioned assumptions, only 5.86% of retail electricity sales in Colorado will have to be RPS-qualified renewable electricity in 2012. Several other assumptions were made in the forecasting model, namely that all electricity generated in Colorado is sold in Colorado, and that all new renewable electricity generated as a consequence of the RPS will be sold in Colorado, regardless of where it was generated.

Colorado's power consumption makes up roughly 75% of the power consumed in the regional grid, so the effects of Colorado's RPS are diluted. The end result is that the RPS will only cause an increase of 2.41% in renewable electricity in the regional grid (as of 2005, 2.69% of grid electricity already counted toward the RPS). This causes a 2.7% decrease in the emissions factor associated with the grid electricity consumed by the city's economy. Figure 3 shows emissions from electricity decreasing after 2007.

Table 1. RPS requirements by utility type.

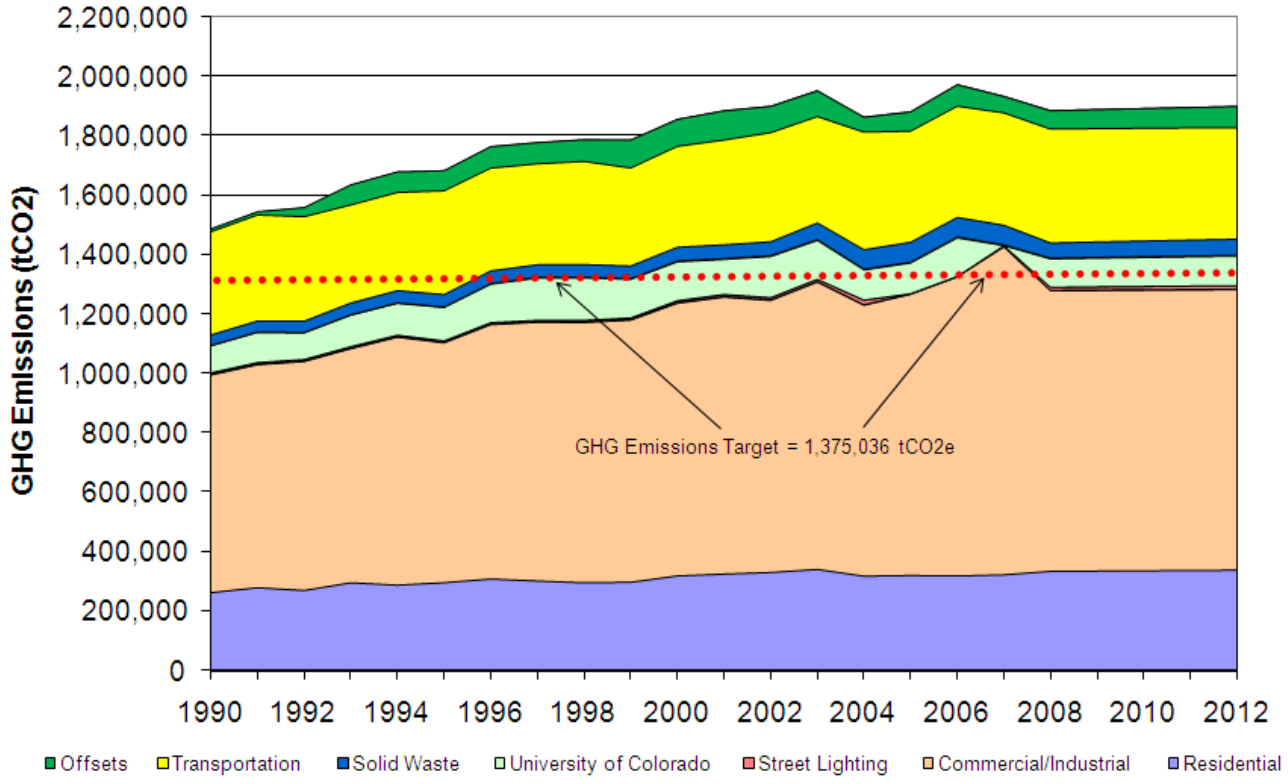
Utility type	# of Customers served in CO in 2005	# of Customers as % of tot	Sched. renewable electricity for sector	Actual renewable electricity for sector	Actual renewable electricity for CO
Investor-Owned utilities	1,415,784	59.04%	10%	8.33%	4.92%
Consumer-Owned utilities	548,814	22.89%	3%	2.61%	0.60%
Municipal Utilities > 40,000 customers	319,330	13.32%	3%	2.61%	0.35%
Municipal Utilities < 40,000 customers	113,880	4.75%	0%	0.00%	0.00%
TOTALS	2,397,808	100.00%			**5.86%**

Figure 3 demonstrates that, because Colorado's RPS reduces the emissions factor of grid-supplied electricity, incremental increases in forecast electricity emissions (2008 and beyond) are dampened. Because electricity-related emissions are so dominant in Boulder's inventory, the net result on Boulder's overall GHG inventory is a leveling trend after 2007. The original inventory and forecast created in 2004 (Figure 4) shows the original inventory and forecast created by Econergy in 2004. The actual inventories for 2004-2007 (Figure 3) are similar to what was forecast in 2004 for those years.

Figure 4, before the RPS existed, demonstrates that electricity emissions would increase significantly without Colorado's RPS. Reducing consumption of electricity is pivotal in moving toward the emissions reduction target. The forecast shows that GHG emissions from vehicle fuel, natural gas, and landfill gas are holding relatively constant. In fact, natural gas use is forecast to decrease slightly. Figure 5 shows the relative importance of each sector in the city's GHG inventory. Please note that emissions from CU Boulder for the year 2007 are recorded as zero because data from CU were not available. However, the emissions from CU Boulder are included in the Xcel

data and are distributed throughout other sectors (most likely the industrial and commercial sectors). The post-2007 forecast for CU Boulder is based on CU's historical energy consumption.

Figure 5: Boulder GHG Inventory Trajectory by Sector, 1990 – 2012



The commercial/industrial, transportation, and residential sectors are, sequentially, the most carbon intensive. While the residential and transportation sectors have remained relatively constant, the commercial/industrial sector has shown significant historical growth. The commercial/industrial sector also consumes a much greater percentage of its energy as electricity than the other sectors (Figure), so emissions from the commercial/ industrial sector are more affected by changes in the resource mix of the electric grid. The forecasted leveling in GHG emissions from the commercial/industrial sector after 2007 can be attributed to Colorado's RPS.

Inventory Trends

Several metrics were considered for the normalization of carbon emissions. These metrics are city of Boulder population, employment, and commercial/industrial building space. Population data was available for all years from 1990 to 2012. Employment data was available for five actual years and five projected years. Square footage data for commercial/industrial buildings was available for only two years. Because population was the most complete data set and is probably the best metric to represent the actual size of the city, this trends analysis focuses primarily on population.

Figure 6 shows that while population growth has slowed since the early nineties, the population of Boulder is still increasing by roughly 500 persons per year.

Figure 6: Residential population of Boulder 1990-2012 (data supplied by the City)

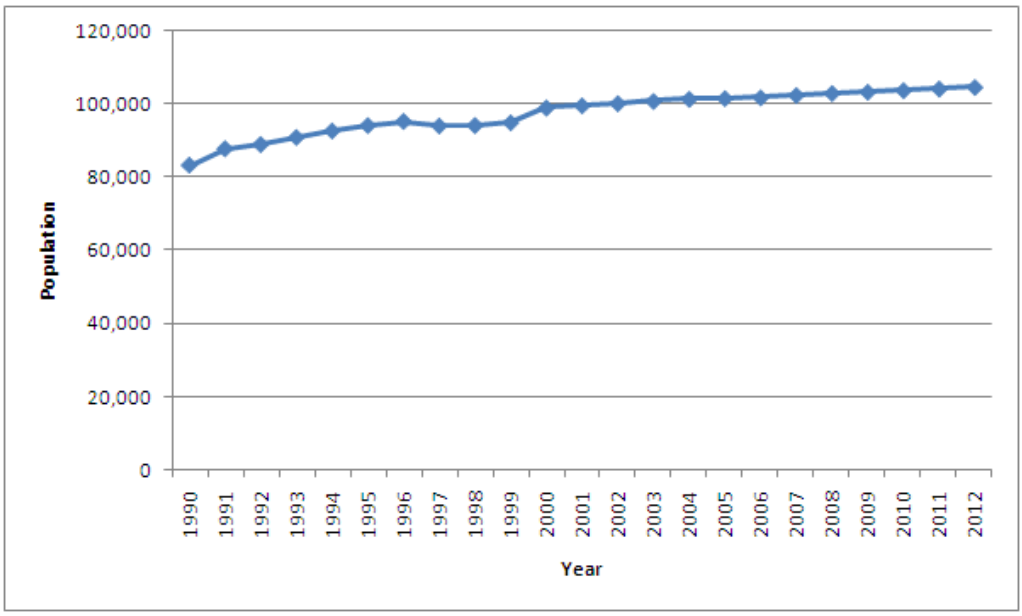


Figure 7 shows the economy-wide electricity and natural gas use in MMBtus (million Btus), normalized to the residential population of Boulder. It is important to note that this figure shows only the end-point energy use and does not include the inefficiencies involved in producing and delivering natural gas and electricity to the consumer. Figure 8 illustrates this point by showing that, while electricity constitutes less than half of the end-point energy use, it accounts for over 80% of the total GHG emissions associated with consumption of electricity and natural gas. Increasing population and "per-person carbon intensity" combine to drive the city of Boulder's carbon inventory upward over the 1990 – 2007 period.

Figure 7: City-wide electricity and natural gas use per resident, 1990-2012

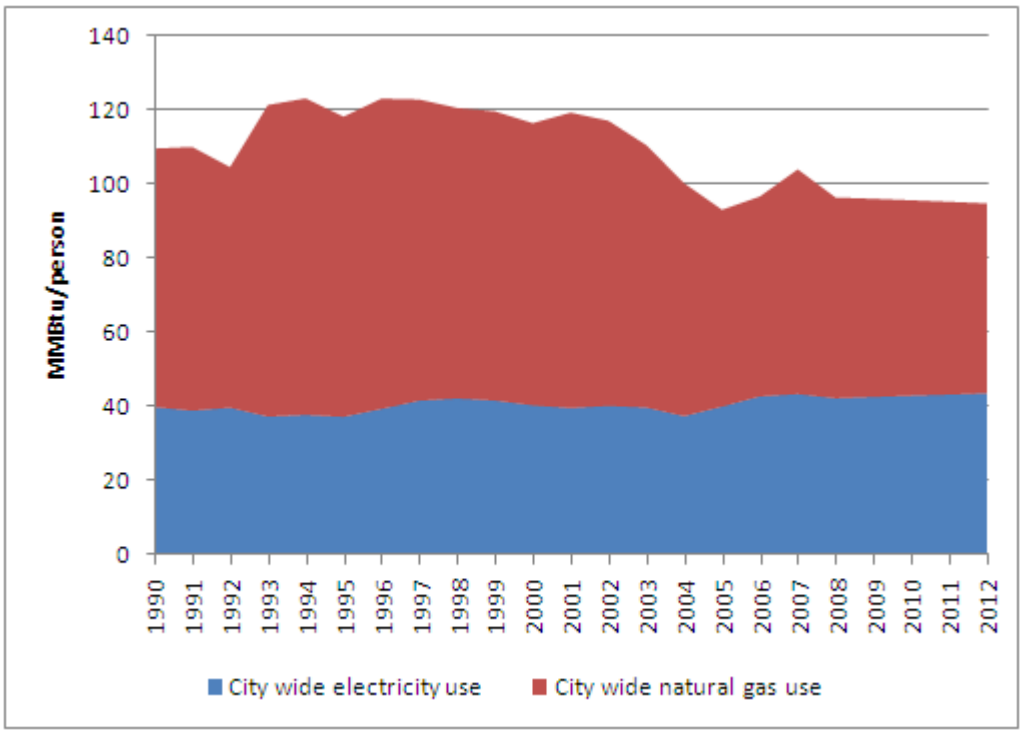
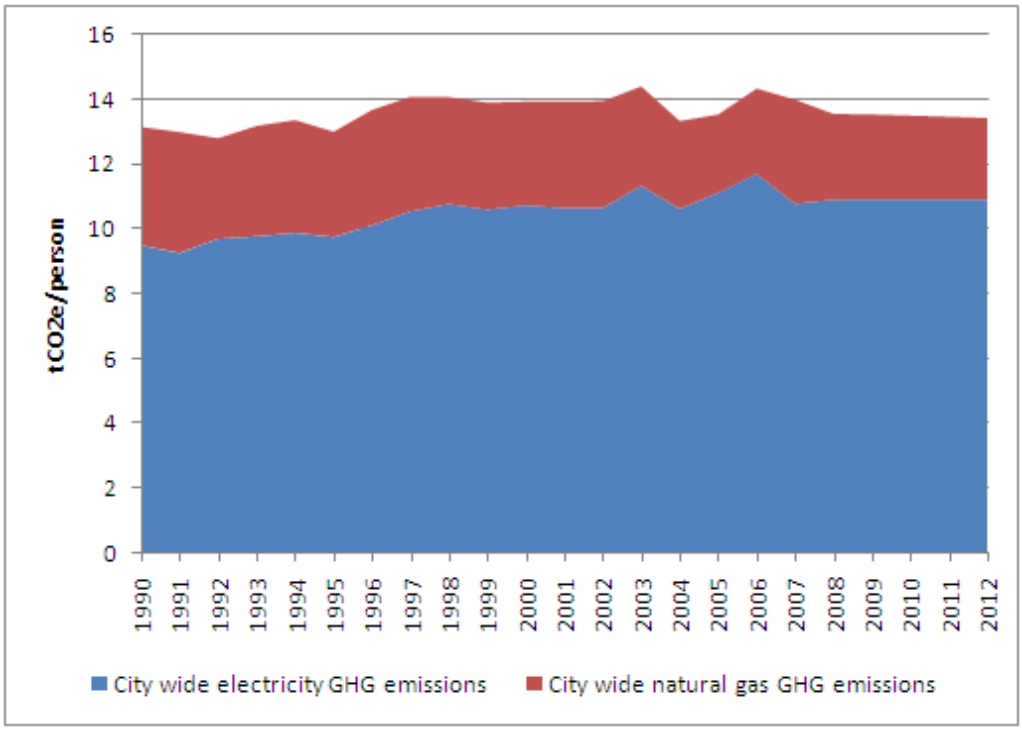


Figure 8: City wide electricity and natural gas GHG emissions per person, 1990-2012



Because population data for Boulder is the most complete data set, and presumably representative of the city's size, it is recommended as the most complete normalizing factor. The lack of data for both industrial/commercial square footage and employment exclude them from serving as meaningful normalizing factors for the city of Boulder GHG Inventory.

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Section 2: Evaluation of Current CAP Strategies and Programs

Most of WSP's work to evaluate current CAP residential, commercial, and transportation programs was conducted in the autumn of 2008. Only very limited follow-on assessment work was performed – in early 2009 and in June 2009. This report was finalized in July 2009. Unless otherwise stated, WSP's CAP impact evaluation is based on the results of GHG impact estimates developed by other parties, either by City staff or by third-party consultants engaged by the City. WSP has taken these quantitative estimates as-is and has used them to inform our qualitative assessment of CAP program effectiveness.

Residential Programs

The Residential Buildings Sector presents a challenge in terms of designing effective programs that will deliver substantial energy savings and associated greenhouse gas emissions reductions (ERs). The table below summarizes the magnitude of the challenge the Residential Sector presents to the city's CAP.

Table 2. Projected emissions and target for the residential sector.

Residential Sector 2012 BAU Emissions (tCO2)	342,895
Residential Sector 2012 Target (tCO2)	248,703
Required Residential Sector Emissions Reduction (tCO2)	94,192

Overall Summary

The current residential programs have created a strong foundation and program management infrastructure which are necessary for a successful CAP. These programs are making headway in positioning the City of Boulder as a leader in energy efficiency (EE) programs. About 1,500 homes were affected by the residential programs listed below. While the results are still being measured, it was clear that the overall effect of existing residential program strategies in reducing carbon emissions was not sufficient to meet the City's target. The GHG reductions have fallen short because the majority of the residential programs focused on performing building audits but not on implementation of EE measures. Figure 9 and

Figure 10 show the percentage of CAP budget allocated to the main residential programs and the percentage of GHG reductions attributed to each program. This shows the relative effectiveness of each program in achieving GHG reductions. However, these impact estimates are based on *potential* savings as opposed to *actual* savings since many of the programs are in their infancy with few results to report as yet.

Figure 9. 2008 Residential Program Total Budget (including Matching Funds)

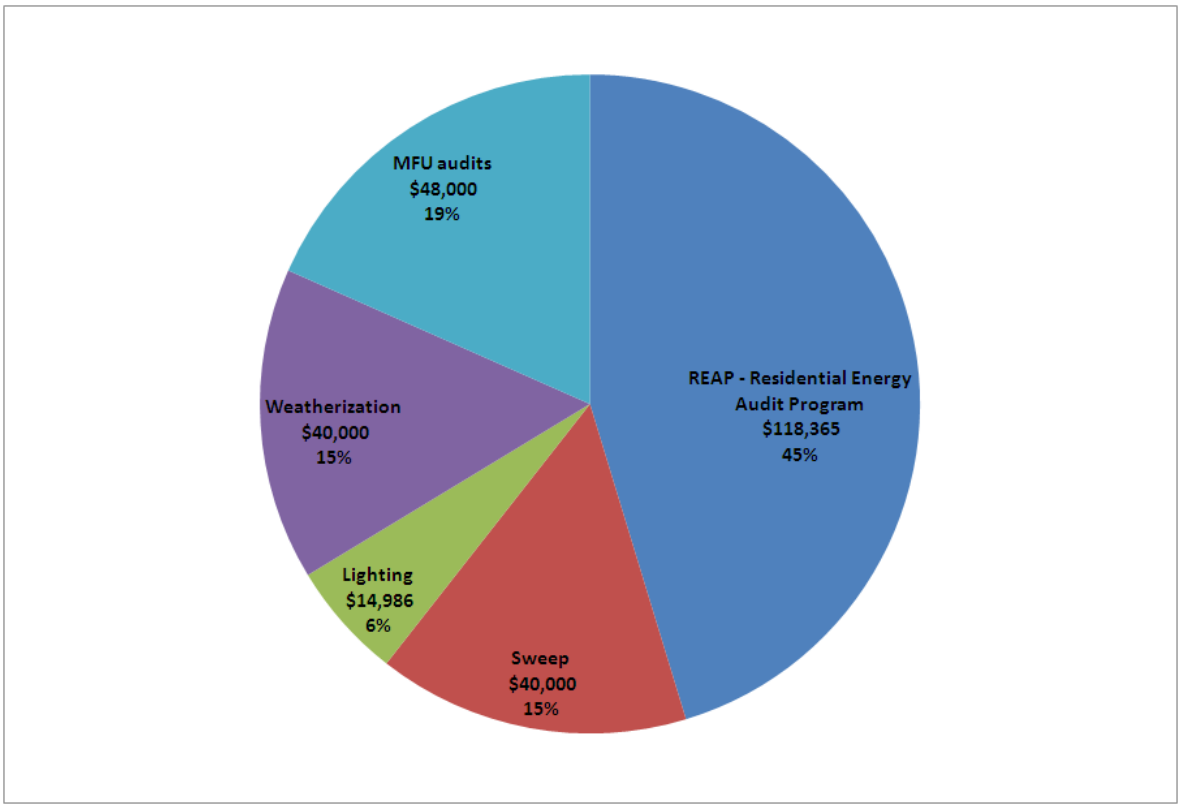
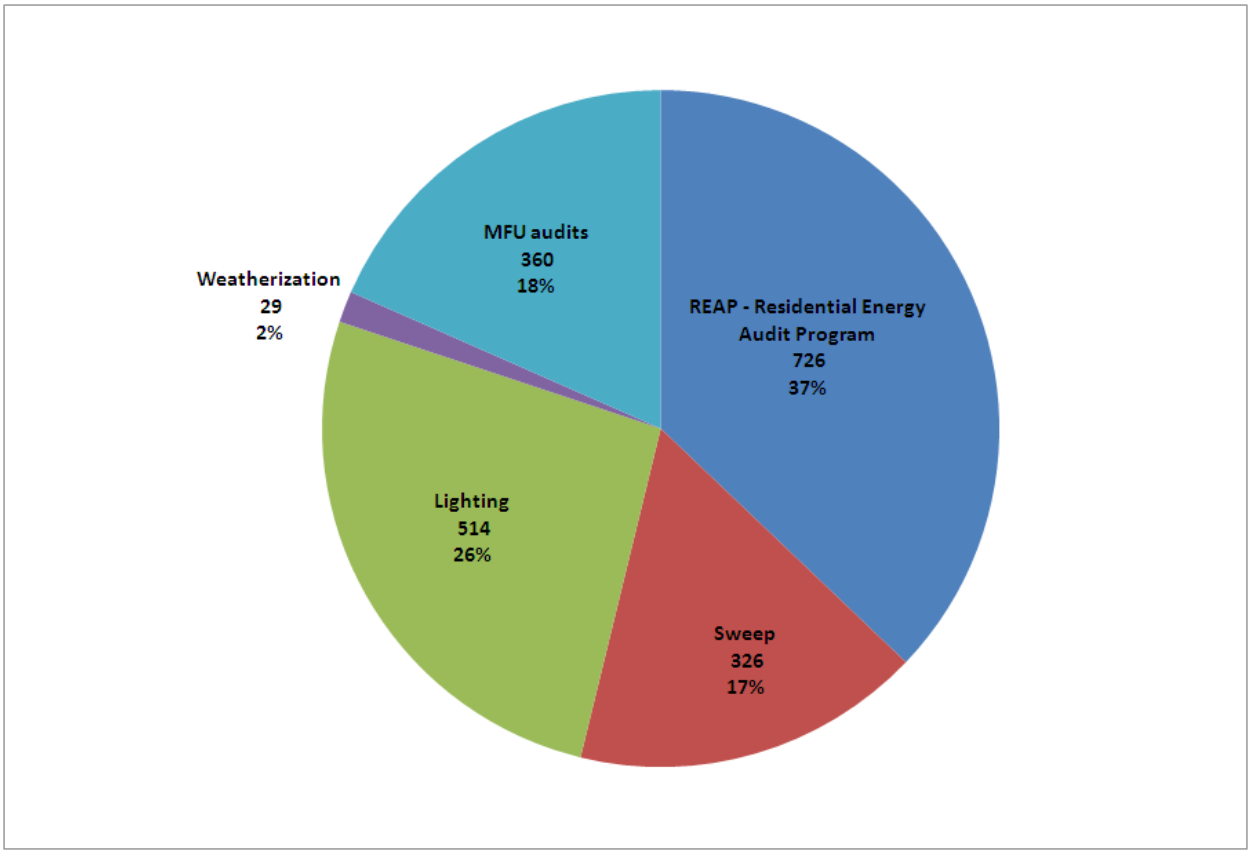


Figure 10. 2008 Residential Program Expected GHG Reductions (tCO2)



REAP Audits

Summary. The Residential Energy Audit Program (REAP) was created to provide the homeowner with an understanding of their home's energy use and to provide recommendations for energy use reduction. The REAP program is administered by the Center for Resource Conservation, and provides low-cost, professional energy audits. The City of Boulder and Boulder County each provide a $100 subsidy for the audits. The homeowner receives a report presenting results of an analysis of the energy data gathered, a series of recommendations, and a list of qualified contractors that can install the recommended EE measures. An insulation rebate was rolled into this program, because in order to qualify for insulation rebates, a household must have performed an audit through the REAP program.

The REAP program comprised about 37% of the entire budget allocated to the CAP residential program.

Selection criteria and methodology for measuring program results. The program was established to help homeowners understand their energy use and to educate them on ways they can reduce their energy use. It was thought that such an audit program would lead to voluntary action by residents to reduce their energy use, by educating residents on their energy consumption and thereby empowering them to take action to reduce it.

The City hired an independent consultant to analyze results of the REAP program. The 2008 REAP program results were measured using potential savings and assumptions made from the pilot program. The results were calculated using an assumed electricity and natural gas reduction per audit. Neither the consultant's report nor spreadsheet calculations elaborated on specific implementation of energy efficiency measures and associated reductions. However, tracking of actual implementation of REAP audit recommendations is planned for 2009.

Program results were measured by number of audits accomplished and potential GHG reductions from each audit. A follow-up was performed for a portion of the 2006/2007 participants by an independent consultant in partnership with the Center for Resource Conservation. This follow-up used utility bill data to compare one year's energy use to the next.

Results. The cost of the REAP program was $85,000, plus $33,400 of matching funds. If insulation rebates are counted towards the REAP program, an additional $10,000 was spent by the City with an additional $25,000 of matching and external funds. Between 2007 and 2008, around 580 households were audited through REAP. The findings from the 2006/2007 REAP program evaluation revealed mixed results: some homes reduced energy use while others did not. There were difficulties in finding data from some households in which the audits were performed. The main results from the REAP program can be found in the independent report mentioned earlier. The REAP program received positive feedback from households that found the audit helpful and learned specific techniques for conserving energy in their homes. Also encouraging is the fact that the program had full enrollment with a waiting list at the end of 2007.

Lessons learned in the analysis. Energy audits are a necessary element of an energy efficiency program to identify potential reduction opportunities. However, there needs to be a dramatically stronger CAP focus on reducing barriers to implementation. While some implementation incentives were offered by the current residential program, implementation was not a primary focus, and therefore, program effectiveness in achieving actual reductions in GHG emissions was very limited. Follow-up with the recent participants in the REAP program offering new program incentives focused on implementation needs to be swift and comprehensive to translate potential into tangible GHG reductions.

MFU Audits

Summary. The Multi-Family Unit (MFU) Audit program was created to provide understanding of an MFU's energy use and to provide recommendations for reducing energy usage. The MFU program, also called the Multifamily Performance Program, offers free energy and water assessments. The program had a 2007 goal of performing these assessments on 15 properties.

The MFU program comprised about 18% of the entire budget allocated to the CAP residential program.

Selection criteria and methodology for measuring program results. This program was created because approximately 55% of Boulder residents live in multi-family dwellings.

The MFU audits targeted buildings with multiple households—this targets a slightly different sector than the homeowner, as MFU's are often rental property. Between 2006 and 2007, 17 audits were performed and the estimated impact was based on potential savings for electricity, natural gas, and water. Average values for simple payback and GHG reduction potential were calculated for MFUs by City staff.

Like REAP, the program results were measured by number of audits accomplished and potential GHG reductions from each audit. A follow-up, including utility bill analysis, was performed for a portion of the 2006/2007 participants by an independent consultant.

Results. The total cost of the MFU audits was $24,000, plus $24,000 of matching funds. The results from the 17 audits performed in 2006 and 2007 MFU showed approximately 1,000 tCO2 reduction potential. It is unclear what portion of these potential reductions was actually achieved through implementation.

Lessons learned in the analysis. As with the REAP Program, there needs to be a dramatically stronger focus on reducing barriers to implementation. The primary barrier in the MFU subsector is the disconnect between the cost of implementing EE measures, which falls on the building owner, and the benefit of reduced energy costs, which typically accrues to the renter. Another key barrier in this subsector is the up-front capital cost of EE installations.

Lighting

Summary. This program provided coupons that were redeemable at local hardware stores toward the purchase of efficient lighting equipment. The City collaborated with McGuckin Hardware, Sutherlands, Ace Hardware, and Table Mesa Liberty Hardware to provide an in-store coupon for purchase of Compact Fluorescent Lamps (CFLs). This program was modeled after a number of similar programs in place throughout the country.

Selection criteria and methodology for measuring program results. A CFL distribution program is a common and, at times, effective first step to promote residential energy efficiency programs. The overhead costs are low and the energy savings can be substantial with short payback times. For this program, the results were measured in number of CFLs distributed, with potential electricity and tCO2 savings, assuming all CFLs were installed.

Results. This program cost the City approximately $6,000 with a matching grant of about $8,000 from Boulder County. In 2007, nearly 8,000 light bulbs were distributed. The lighting program costs about 6% of the total residential program budget. This program is expected to continue each year, incrementally distributing up to 13,000 light bulbs each year until 2012. The program has little capital or administrative cost to the City, but has a relatively large GHG reduction impact if all CFLs are actually installed in uses that involve long operating hours.

Lessons learned in the analysis. A light bulb program can be a good first step for a suite of energy efficiency programs. As will be discussed further, implementing a bundle of energy efficiency measures in each participating home is much more effective than a single-technology approach at achieving significant emissions reductions. Since the City needs *big* impacts in order to meet its 2012 goal, further examination needs to be made to see whether lighting efficiency could be better applied as a high-financial-performance component of a comprehensive package of EE measures, leveraging the less financially attractive package components to achieve an acceptable overall financial performance for the entire EE package.

Weatherization

Summary. The City contracts with Longs Peak Energy Conservation (LPEC) to offer free weatherization services to income-qualifying households. This program targets those households (both renter and owner-occupied) that are not served under county-wide weatherization programs. Efficiency measures include CFLs, insulation,

programmable thermostats, duct sealing, furnace repair/replacement, refrigerator replacement, and combustion safety inspection.

Selection criteria and methodology for measuring program results. The weatherization program was included in the CAP to address rising energy costs for low-income households. This program is financed entirely by the City of Boulder. The methods for measuring results included a utility bill analysis with economic analyses such as simple payback. Every installed efficiency measure was accounted for so that savings could be estimated.

Results. The program cost to the City was $40,000. The results have shown that the weatherization program, while fulfilling a positive role in the City's obligation to serve income-qualifying residents, has a high cost of implementation and a low return on GHG reductions. With 21 houses treated in 2007, the City staff calculated GHG savings of about 30 tCO2.

Lessons learned in the analysis. Because the City of Boulder implemented the efficiency measures from its own budget, costs for this program were high, with few GHG reductions expected. The impact analyses were performed using utility bill analysis which may not provide a clear understanding of the impacts related to specific energy efficiency measures. The utility bill analysis did not allow for quantification of energy-use changes due to weatherization as opposed to changes due to other factors such as occupant behavior and weather patterns. Alternatively, building and appliance models can be created to more accurately estimate the impact of specific EE measures. Both can be useful in analyzing the emissions reductions from the weatherization program.

As the income-qualifying levels are raised next year to incorporate more Boulder households into the Boulder County weatherization program, CAP funding may be reduced in size. The CAP may only address those households that fall in between the Boulder County weatherization program and Xcel's Demand Side Management (DSM) program.

Neighborhood Sweep

Summary. In 2007, the Sweep program distributed free energy and water conservation kits to the Martin Acres neighborhood targeting an 800-household area. This program enlisted help from students and volunteers to distribute the kits, which contained CFLs, water use reduction aids, and energy/water conservation information. The kit also offered a coupon for a free ClimateSmart Visit (CSV) which is a simplified home energy audit.

Selection criteria and methodology for measuring program results. The program was created because it was thought to boost community efforts in reducing energy. It was modeled after similar direct-install programs throughout the country. The impact of the program was estimated by assuming that the entire content of each kit was installed. In 2008, the program did a direct install, actually installing up to 25 CFLs per home along with other energy efficiency measures.

Results. At a cost to the CAP budget of $20,000 per year with another $20,000 provided in matching funds, this program offered good results in comparison to other residential programs. The City staff analysis shows that about 225 kits were distributed in 2008 after an initial 350 kits were distributed in 2007. While some light bulbs were installed directly, it is unclear how many kits were actually installed by the residents. The potential for energy efficiency reductions is high but actual savings are difficult to discern from the data provided. The City

conducted a survey which aimed to measure the effectiveness of the program, based on the number of CFLs installed and participants' overall impressions of the program. Survey results were not available as of this writing.

Lessons learned in the analysis. A neighborhood sweep is considered a good way to get community members involved in making energy reduction changes in their neighborhoods. This can be an effective marketing approach but will not achieve the required GHG emissions reductions unless an in-depth home energy audit is combined with a comprehensive package of efficiency measures and a mechanism for actually implementing those measures.

Home Performance with Energy Star

Summary. The program provides local contractors with training that holistically addresses the building envelope, heating and cooling systems, and appliances. The City hired a third-party to offer five classroom training days and four field training days. Certification by Building Performance Institute (BPI) was incorporated into the program.

Selection criteria and methodology for measuring program results. The program was established to increase the number of local contractors available in the area that are well-qualified to implement whole-house efficiency measures. The program was measured in number of contractors trained.

Results. Thirty-four contractors were in attendance. This program cost approximately $20,000 to conduct the training in 2007 and an additional $10,000 dedicated to evaluation and follow-up in 2008. The City staff state that, with difficulty, they have been attempting to follow up with contractors to see if they have used techniques learned in the training.

Lessons learned in the analysis. This program is deemed necessary to implement many of the EE measures suggested. However, there was little analysis on the effectiveness of the program. A pre-and post- survey, or a reporting scheme for contractors trained through the program, should be conducted with specific questions related to the implementation of EE measures.

Utility Bill Analysis Pilot

Summary. This program provided utility bill analysis to Boulder households using data gathered from the Home Energy Makeover Contest. The data was analyzed to provide a comparison of natural gas and electricity use patterns, ranking them with other households. A guide was given to participating households with a list of resources to reduce energy consumption.

Selection criteria and methodology for measuring program results. This pilot was a follow-up to the Home Energy Makeover Contest, to provide households with a better understanding of their energy use. The program was measured by number of participating households.

Results. About 366 households participated in this analysis, as stated in a third-party report. The results were mainly qualitative interpretations of the surveys, related to how participants felt about receiving such an analysis and whether they thought it was useful.

Lessons learned in the analysis. This information is useful, but does not have significant GHG ER impacts. It is interesting to compare one household's energy use to another, but this program does not offer the means to make substantial reductions. As many of the respondents noted, the information is "useful" but only small change came about from understanding their energy use.

ClimateSmart Loan Program

Summary. The ClimateSmart Loan Program is financed by a $40 million bond issue that allows Boulder County to make loans for eligible EE and RE projects. The loans will be paid back through an incremental increase in the property tax at the sites where the projects are implemented. Of the $40 million, $28 million is designated for residential property owners and $12 is designated for commercial property owners. During the first round of loan administration in 2009, $6.6 million worth of loans were approved county-wide, all in the residential sector. The remaining residential balance and the entire commercial balance will be loaned in 2010. WSP performed an analysis of program impacts on the residential portion.

Selection criteria and methodology for measuring program results. This program was designed to help Boulder County property owners overcome financial barriers to EE and RE projects. So far, Boulder County has measured the program by number of participating households and dollar amount of loans approved.

Results. Of the $6.6 million in loans approved for 2009, $2.9 million was loaned for projects within the city of Boulder. By allocating these dollars among project types, based on a high-level analysis provided by the County, it was estimated that within Boulder $1.67 million of loan proceeds was invested in energy efficiency, $1.04 million in solar photovoltaics, and $0.19 million in solar water heaters.

A preliminary WSP analysis, incorporating anticipated Xcel DSM rebates and federal tax credits, estimates that the projects spawned by these loans will account for 1,700 tCO2e of annual GHG reductions for Boulder's residential sector. When the additional $21.4 million currently available for the residential sector is loaned out in 2010, annual GHG reductions will increase to 7,200 tCO2e. This is roughly 8% of the reductions required for the residential sector to hit its nominal target in 2012.

Lessons learned in the analysis. The ClimateSmart Loan Program appears to have tremendous potential to foment very substantial GHG ERs in the Boulder residential sector. It is strongly recommended that this program be expanded to the maximum extent possible, as rapidly as possible.

Commercial/Industrial Programs

Unless otherwise stated, WSP's impact evaluation is based on the results of GHG impact estimates developed by other parties, either by City staff or by third-party consultants engaged by the City. WSP has taken these quantitative estimates as-is and has used them to inform our qualitative assessment of CAP program effectiveness.

The Commercial/Industrial sector presents a challenge in terms of designing effective programs that will deliver substantial energy savings and associated greenhouse gas emissions reductions (ERs). The table below summarizes the magnitude of the challenge the Commercial Sector presents to the City's CAP.

Table 3. Projected emissions and target for the commercial/industrial sector.

Commercial/Industrial Sector 2012 BAU Emissions (tCO2)	944,694
Commercial/Industrial Sector 2012 Target (tCO2)	681,400
Required Commercial/Industrial Sector Reduction (tCO2)	263,294

Building Performance Program

Summary. The Building Performance Program (BPP) has three components. The main component consists of (i) walk-through audits in commercial and industrial facilities to assess energy savings opportunities and increase awareness about rebate programs. Audits are performed by a contractor (Nexant), which also performs services for the BPP's two other minor components, (ii) the Trade Ally Network (TAN), which unites various energy efficiency and renewable energy (RE) contractors in the Boulder area, providing their contact information to facilities and, (iii) outreach activities specifically directed to the business community (workshops, newsletters, etc.).

The BPP is directed at facilities larger than 15,000 ft^2; smaller facilities are directed to the ClimateSmart at Work program for small businesses (see following section). The annual budget for the BPP was $125,000 for both 2007 and 2008. This included audits, follow-up services with audited facilities, additional services as requested by customers, TAN and outreach activities, and program administration.

Audits involve an average unit cost of $2,000: in 2007, audits were offered only by the BPP and not by Xcel, so that the available budget allowed audits of 35 facilities, which were all carried out. In 2008, Xcel offered similar audits using the same contractor. Under the new agreement between the City and Nexant, 57 audits were targeted in 2008, with just 7 of them being offered as BPP-only services (at an average unit cost of $2,000 for the CAP) and the remaining 50 being offered as a joint BPP-Xcel combined service (at an average CAP unit cost of $850). Audits, requiring a 16-hour level of effort, include a walk-through site survey and the preparation of a report, which indicates EE measures identified (including information on potential Xcel rebates and RE measures), implementation costs, and potential savings. BPP-Xcel combined audits for 2008 generated two separate reports

because only the BPP audits covered natural gas measures; this will change in 2009 when Xcel's Energy Analysis Program will also cover natural gas measures.

In addition, the contractor provides follow-up services consisting of a meeting with the client to review the report three weeks after its delivery, and ongoing follow-up with previous participants to encourage implementation of recommended measures. The yearly estimated cost of this amounts to $37,000, or about $650 per client if only the 57 audits during 2008 are considered.

Selection criteria, targets and methodology for measuring results. The Building Performance Program was created based on the following criteria: (i) the CAP's general focus on awareness and education; (ii) a positive experience with pilot audits conducted in 2005-2006; (iii) the specific need to increase the business community's awareness of EE measures and rebates offered by Xcel; and (iv) the fact that no other entity offered similar services. When, in 2008, Excel also began offering walk-through audits, the BPP was continued because Xcel's offering did not focus on natural gas (only on electricity) and did not provide any follow-up to the audit report.

Based on available budget and average unit costs for audits, 35 and 57 audits were targeted in 2007 and 2008, respectively. An electricity savings target of 500,000 kWh was set for both 2007 and 2008. This, however, was only an indicative figure not based on any particular calculation, and it did not change from 2007 to 2008 in spite of a ~60% increase in the number of audits targeted. The kWh savings target was held constant because, during 2006, ~400,000 kWh in expected savings had been implemented by a single audit recipient, creating an artificially high benchmark for targeted programmatic savings in subsequent years.

The methodology, schedule, and format for measuring results are not described in detail in the contract with Nexant. The contract, as noted, only indicates a lump sum of $37,000 to conduct the follow-up meeting on all audit reports three weeks after their delivery, and a continued follow-up with all previous program participants to encourage and monitor implementation. Measurement of results is based on a procedure by which the contractor, on an undefined schedule, calls program participants for a conversation on the status of implementation of recommended measures. While report follow-up has been conducted for all 42 audits carried out thus far in 2008, no implementation monitoring report has been delivered, and is expected only by year-end. Results for 2007, on the other hand, have been measured and reported.

In summary, while actual implementation and emissions reductions are objectives of the BPP, they were not included as a reference to set the program's goals, nor were they a well-defined priority in the scope of work of the selected contractor. This does not necessarily suggest that the selection criteria, targets, and measuring methodology adopted were not adequate (with the exception of results monitoring, which might have been defined in a more precise way with the contractor as to schedule). However, it does indicate that they were molded more around education than achieving actual emissions reductions towards the 2012 target. Education is an appropriate objective for the initial phase of an emissions reduction plan, as it addresses the key barrier of lack of awareness and creates the preconditions for subsequent direct-impact measures to succeed.

As already discussed with OEA staff, the CAP must focus on aggressive implementation of mitigation projects in order to attain significant emissions reductions towards the 2012 target. Criteria for the BPP's original design are either no longer valid, or are to be superseded by the pressing priority to reduce the city's GHG footprint.

Supporting Xcel DSM programs (audits and rebates) and providing follow-up to audits (still not provided by Xcel) remain valid objectives. However, these objectives may be achieved through specific activities carried out around Xcel's programs, rather than through an audit program, which would be duplicative.

Results. If results are to be measured against the targets set, which consist of a number of audits to be carried out yearly, the BPP may be considered (as the 2007 Progress Report states) a success: 35/35 completed in 2007, and 42/57 completed during the first three quarters of 2008 (i.e. on target for ~14 per quarter).

Table 4. Building Performance Program results.

BPP results	Budget (US$)	Audits targeted[1]	Audits completed[2]	Audits leading to implem.[3]	Savings potential (kWh)[4]	Savings achieved (kWh)[4]	Savings potential (therms)[4]	Savings achieved (therms)[4]	Reductions potential (tCO_2)[4]	Reductions achieved (tCO_2)[4]
Year 2007	125,000	35	35	8	4,296,469	746,249	16,145	747	4,053	693
Year 2008	125,000	57	42	*13*	*6,997,107*	*1,215,320*	*26,293*	*1,217*	*6,601*	*1,129*

1) Audits targeted pro-rated for Q3-2008: 42.75 (14.25 per trimester)

2) Audits completed for 2008: as of Q3 (on target, pro-rated)

3) 2008 audits leading to implementation estimated (no reporting available yet) based on the % achieved in 2007, equal to ***22.9%***

4) 2008 savings potential and achieved, and 2008 emissions reduction potential and achieved, based on a ***62.9%*** *increase in audits targeted from 07 to 08 (on schedule Q3)*

If actual CO_2 reductions resulting from measures implemented are to be taken into account, however, results are very limited. Achievement of the entire GHG reduction potential identified[4] would reduce the commercial/industrial sector's footprint by only 0.37% in 2007 and (estimated) 0.70% in 2008. Reductions actually achieved account for an even lower share and, when compared to the reductions required to reach the 2012 target, they would contribute only 0.16% for 2007 and 0.43% for 2008 (estimated) for the commercial/industrial sector, and 0.14% and 0.25% (estimated) of the economy-wide target. The cost of abating one ton of CO_2 under the BPP may be a deceptive indicator, especially for indirect-impact programs, but it is worth noting that it amounts to $180 for 2007 and well above $100 for 2008 (estimated).

The effectiveness of conducted audits in reducing CO_2 reductions (measured as the ratio between actual reductions achieved through measures implemented, and potential reductions identified) is about 17% for the program as a whole. About 17% of potential electricity savings were implemented, and less than 5% of potential natural gas savings were.

[4] The figure for the 2008 potential, lacking specific and updated information, is calculated based on the increase in audits conducted with respect to 2007. Similarly, actual savings and emissions reductions in 2008 were based on the increase in audits conducted, and audits leading to implementation in 2008 were based on the rate observed in the previous year.

Table 5 below summarizes the main indicators for the BPP.

Table 5. Building Performance Program indicators.

BPP Indicators	Reductions potential as % of City required	Reductions achieved as % of City required	Reductions potential as % of Sector BAU footprint	Reductions achieved as % of Sector BAU footprint	Reductions potential as % of Sector required	Reductions achieved as % of Sector required	Reductions achieved as % of potential identified	Avg abatement cost ($/tCO$_2$)	Electric savings achieved as a % of potential	Gas savings achieved as % of potential
Year 2007	0.80%	0.14%	0.37%	0.06%	0.96%	0.16%	17.10%	180	17.37%	4.63%
Year 2008	*1.47%*	*0.25%*	*0.70%*	*0.12%*	*2.51%*	*0.43%*	*17.10%*	*111*	17.37%	4.63%

Note: indicators for 2008 (in italics) based on projections and estimates

Lessons learned in the analysis. The program, as noted, had a very small impact on measures actually implemented and, consequently, on emissions reductions achieved. It is unrealistic to expect a greater impact from a program, such as the BPP, offering walk-through audits. This, based on consolidated experience in all markets, is not the kind of audit that yields results of any significance. BPP relevance is that of a general introduction to EE measures. Also known as "level-zero" audits, they serve the purpose of establishing a contact with the client, to be followed by a more detailed audit carrying a higher level of effort and resulting in an implementation plan that may constitute the basis of a performance contract. Xcel's Energy Analysis Program, which is classified as an indirect-impact program, designed to offer walk-through audits, is precisely intended to be an "initial selling point for [other] energy efficiency programs".

Given these premises, the BPP can be considered effective in reaching its original objectives of raising businesses' awareness in EE, and of introducing key concepts previously overlooked in the commercial and industrial community. It is likely that the BPP will eventually enhance the success of future EE programs, having contributed to the creation of preconditions necessary for their implementation, although such deferred effect will be difficult to measure.

The BPP audits were not immediately effective in drawing the city nearer to the 2012 target, but they could not be expected do so by design. This is a matter relevant to the design of the program, and not to its effectiveness. Such design, as noted above, was made based on criteria that are no longer valid. The CAP must be immediately taken to a level beyond the initial one and must focus aggressively on direct-impact programs. Therefore, and as already discussed with the OEA, it is advised that the BPP audits be discontinued in year 2009, freeing up resources for EE project implementation.

The main barriers to implementation observed while carrying out the BPP audits were, based on conversations with the OEA, the high cost and long payback period of measures, the lack of time that facilities may devote specifically to energy management, and tenant/landlord issues. New programmatic initiatives proposed in Section 4 of the report are specifically intended to deal with such barriers. In particular, the proposed Guarantee Facility will aim at allowing a direct linkage between audits and project implementation via performance contracting by ESCOs, thus addressing the issue of high project costs/payback period and lack of time allowed for energy management. It is expected that the facilities that have already participated in the BPP will constitute a pool of pre-qualified customers that are relatively more receptive to project implementation via new CAP programs.

Finally, with regard to the BPP's smaller components, the OEA mentioned its desire to enhance the Trade Ally Network as well as targeted outreach events, in particular workshops. Consistent with this intent, WSP

recommends activities that will continue supporting awareness and encouraging implementation around audits to be conducted by Xcel, without duplicating the utility's services.

Small Business Energy Performance Program / PACE EnergySmart for Business Program

Summary. The Small Business Energy Performance Program (EPP), which in 2008 became the PACE EnergySmart for Business Program, was devised as an initiative to provide free audits to the smaller industrial and commercial facilities that the BPP does not treat. These are usually businesses whose facilities are less than 10,000 ft^2 and in any case less than 15,000 ft^2.

The same contractor used for the BPP provides, in addition to the general administration of the program (including the management of applications and their direction to the appropriate program), the following services: (i) a walk-through audit of facilities, focusing on heating, lighting, and cooling end-use systems; (ii) a report identifying savings opportunities (with a particular focus on no/low-cost measures), estimates of costs and savings, information on applicable utility rebates, and an implementation plan; (iii) a follow-up meeting with customers to review the report within three weeks from its delivery, and to provide further information for implementation; and finally, as an additional element provided with respect to the BPP, (iv) services of agency and representation to facilities that wish to implement recommended measures, where Nexant acts as a general contractor in charge of the procurement, oversight, and complete close-out of EE projects with selected sub-contractors.

The Program is conducted in partnership with Boulder County and the City of Longmont. Budget provided by City of Boulder amounts to $20,000 (for PACE in 2008 and EPP in 2007), while Boulder County and Longmont contribute $25,000 and $10,000 respectively. The average cost of an audit is $1,000. In 2007, eight audits were carried out under the EPP. For 2008, thanks to an overall budget of $55,000, as well as to a portion of the audits being conducted at a reduced price ($850) jointly with Xcel's program using the same contractor, 23 audits were targeted. As of Q3 2008, 13 audits have been carried out under the PACE Program, below the pro-rated amount of ~17 for nine months.

The City of Boulder reimburses the $200 that facilities pay for the joint PACE/Xcel audit service, based on the rationale that the EPP provided such services for free in 2007, and as an incentive to participate.

The follow-up is a separate item in the contractor's budget, and amounts to up to $11,220 for 2008 to cover post-report meetings with the current year's 23 facilities, as well as further follow-up with 2007 participants. This means an average cost of $487 per company if only those for 2008 are considered.

Selection criteria, targets and methodology for measuring results. The decision to introduce the EPP involved criteria similar to those considered for the BPP: (i) the CAP's general focus on education and awareness; (ii) the lack of similar services in the market; (iii) the need to enhance awareness on EE and rebates available; and, additionally, (iv) the need to provide a service specifically focused on smaller facilities involving lower costs and timeframes as well as greater support for implementation through the general contractor service.

As with the BPP, targets for the EPP/PACE were set in terms of amount of audits feasible given a certain budget and average cost of service per customer. No target was set in terms of savings or emissions reductions.

Again as for the case of the BPP, the agreement with the contractor describes the post-report follow-up with customers. However, the methodology to measure results is not described. Monitoring for facilities audited in 2007 has been carried out, finding that none has so far implemented any measure. Thirteen audits have been completed in 2008 as of early October, and monitoring and measurement of results is expected be completed by the end of the year.

Although the EPP/PACE program's end-objective was project implementation and emissions reductions, like the BPP, the program did not lead to significant project implementation or emissions reductions. Targets and measurement of results reflect the nature of the program: an indirect-impact program, designed with criteria responding to considerations of awareness enhancement, which are appropriate for a CAP's introductory phase but which do not support actual implementation of ER measures.

Results. No implementation-based results were reported from any of the audits conducted under the EPP/PACE Program in either 2007 or 2008. A total emissions reduction potential of 161 tCO_2 was identified for the audits conducted in 2007. This amounts to 0.01% of that year's forecast commercial/industrial sector footprint, and 0.04% of the commercial/industrial sector's required reductions to meet the 2012 target. As stated above, however, it would have been unrealistic to expect any impact on emissions reductions from a Program offering walk-through audits, especially when targeting smaller businesses.

Table 6. EPP/PACE Program results and indicators.

EPP/PACE results & indicators	Budget (US$)	Audits targeted[1]	Audits completed	Reductions potential (tCO_2)	As a % of sector BAU footprint	As a % of sector required	Reductions achieved (tCO_2)
Year 2007	20,000	8	8	161	0.01%	0.04%	0
Year 2008	20,000	23	13	0	0.00%	0.00%	0

1) Includes unincorporated Boulder County and City of Longmont. Budget shown for City of Boulder only

The EPP/PACE succeeded in establishing preliminary contact with a selected group among Boulder's smallest facilities, which represent a notoriously difficult market segment to penetrate, and may constitute a ready preferential pool for the future introduction of direct-impact programs.

Lessons learned in the analysis. The lack of implementation to date reflects the fact that barriers encountered while carrying out the BPP audits – high costs and low payback periods, lack of time to dedicate to energy management, tenant/landlord issue – are present to an even higher degree in the sub-sector of the smallest commercial and industrial facilities.

Although resources devoted to the EPP/PACE represented less than 3% of CAP's budget for both 2007 and 2008, the program, as already discussed with the OEA, should be discontinued, freeing up resources for ER project implementation. The focus on this market segment, which represents a large portion of the city's emissions, should shift from indirect-impact to direct-impact programs, as will be discussed in greater detail in Chapter 4.

Exit Sign Replacement Program

Program summary. The program, launched in 2008, consists of the replacement of businesses' incandescent exit signs with high-efficiency LED signs. At a cost to the CAP of $50 per sign, including installation, and at no cost to businesses, a budget of $5,000 will allow installing 100 signs. Most businesses involved replace more than two signs.

Selection criteria, targets and methodology for measuring results. The program was established because it is an attractive, free measure offering rapid implementation, immediate impact, and an introductory approach to small facilities that could potentially lead to future more comprehensive measures.

Results. As of autumn 2008, 48 signs have been installed thus far in 17 facilities, but the program is fully subscribed and on track to install all 100 signs by the end of 2008. Once installation is complete, the 100 signs will generate annual emissions reductions of 30 tCO_2. Abatement costs amount to $167/$tCO_2$, a figure comparable to the BPP audits with a 17% implementation rate. These reductions correspond to a minimal fraction of the commercial/industrial sector's 2008 footprint and gap from the 2012 target, as may be expected given the program's small budget.

Table 7. Exit Sign replacement program performance and indicators.

Exit Signs results & indicators	Budget (US$)	Unit cost (US$)	Signs targeted	Signs replaced (Q3 2008)	Reductions potential (tCO_2)	Reductions achieved (tCO_2)	Abatement cost ($/$tCO_2$)	Reductions achieved as a % of sector footprint	Reductions achieved as a % of sector required
Year 2008	5,000	50	100	48	30	15	167	0.003%	0.011%

Note: abatement cost and reductions as a % of sector footprint/gap from 2012 target calculated on full CO_2 savings, given the program is fully subscribed

Lessons learned in the analysis. The exit sign replacement program was a successful initiative with a direct impact on savings and emissions reductions, carried out with a minor budget. Although it focused on a single technology, contrary to a general recommendation of promoting comprehensive packages of measures, the one selected for this program is unlikely to compromise the participants' desire to engage in other EE measures at a later stage. On the contrary, it is hoped that the program may have instilled some curiosity among participants in EE devices for future initiatives.

ClimateSmart Loan Program

Under Boulder County's ClimateSmart Loan Program, $12 million is currently allocated to providing loans to the commercial buildings sector. However, as of this writing, only residential loans have been made by this program. The commercial building loans are anticipated to be made late in 2009 or early in 2010.

Conclusions on the Commercial/Industrial Sector's Current Programs

While all programs for the commercial/industrial sector were carried out effectively and were successful with regard to their awareness of objectives, they were not successful in achieving significant emissions reductions towards the 2012 target. Walk-through audits fulfilled a role that was not played by any other entity at the time of program design. These audits contributed to creating the preconditions necessary for Xcel's future DSM programs. When Xcel began offering similar services in 2008, the commercial/industrial sector programs were

successfully combined with the utility's to extend market penetration, aided by both programs sharing the same contractor. Xcel states that its renewed walk-through audit program, to be offered by the utility under its upcoming DSM Plan, "will rely heavily on the trade and related programs, such as City of Boulder's Building Performance Program (…), to increase awareness in the Energy Analysis Program and partner in the audit process".

It is strongly advised that such expected reliance on awareness be satisfied through targeted outreach and/or follow-up initiatives by the City, and not by a duplication of walk-through audit services, which should be discontinued. Walk-through audit services do not produce significant real energy savings and emissions reductions: the combined impact of commercial/industrial programs on the emissions reductions required for the sector was less than 0.5%. The commercial/industrial sector consistently represents over 50% of the city's emissions (59% in 2007) and requires more significant reductions if the city is to achieve the 2012 target.

Table 8. Commercial/industrial programs – combined results.

Comm/Ind Sector Programs	Reductions potential (tCO_2)	Reductions achieved (tCO_2)	Reductions potential as a % of sector footprint	Reductions potential as a % of sector required	Reductions achieved as a % of sector footprint	Reductions achieved as a % of sector required
Year 2007	4,214	693	0.38%	1.00%	0.06%	0.16%
Year 2008	6,631	1,159	0.70%	2.52%	0.12%	0.44%

The general contractor services offered under the EPP/PACE Program, designed to encourage project implementation, have not yet been successful, with no record of any business having used them. This reflects the scarce inclination of the smallest facilities to implement EE measures and the significant time lag that can occur between audit and implementation. It also means that new and different initiatives must be designed to achieve the necessary impact in a sector that represents a difficult business environment for EE and accounts for such a large share of the city's emissions. New programmatic initiatives, outlined below, will need to address barriers other than the lack of awareness, and will need to engage directly and aggressively in implementation of projects that deliver actual emissions reductions.

Section 3: Meaningful Metrics to Report CAP Program Results

Potential versus Realized Savings.

When analyzing GHG reductions and energy savings, it is important to apply a consistent methodology to measure a program's effectiveness. While the *potential* savings of a project can be useful to understand what can be achieved if implemented, this number should not necessarily be used in evaluating a program's effectiveness. As stated earlier in this report, in order to achieve the 2012 goal, the City of Boulder must begin to focus on realizing actual energy savings and associated GHG ERs, rather than analyzing the potential. This translates into installing aggressive efficiency measures and rapidly changing fuel mixes.

Metrics for Understanding a Program's Effectiveness.

In the future, there must be a stronger program design and a more rigorous follow-up. As stated in Section 2, it is inappropriate to only measure results from audits, because audits are an enumeration of *potential* savings. Therefore, we recommend that program effectiveness be measured based on realized savings from *installed* efficiency measures, through the methodology described below.

There are several methods to monitor or quantify realized savings. Ideally, realized savings will demonstrate themselves as an overall reduction in energy consumption on the economy-wide or sector level. However, it is often difficult to quantify these actual reductions and attribute them to a specific cause or action. Alternatively, realized savings can be "backed into" by multiplying the energy savings of a specific action (such as replacing an incandescent light bulb with a CFL) by the number of actions effected (e.g., light bulbs replaced). This method is applicable when the following can be quantified or estimated: the difference in energy consumption before and after an action, and the number of these actions effected. For those measures which are difficult to analyze, such as insulation, it is acceptable to use a generalization of rule-of-thumb energy reductions derived from that EE measure.

Alternatively, utility bill analysis can be used to evaluate the effectiveness of a program. Utility bill analysis has the advantage of evaluating changes in actual energy consumption. However, it is difficult to assign changes in energy to a specific cause. Many outside factors, such as weather and behavioral patterns, can affect energy use. Thus, if utility bill analysis is used, we recommend performing the analysis on a control group (not touched by the program) as well to capture non-program effects on energy use.

Metrics for Evaluating Marketing and Outreach.

Marketing and Outreach (M&O) is a necessary part of the CAP. It provides the means to recruit participants to the programs and to educate the general public about pertinent energy and environmental issues. However, M&O is difficult to measure because oftentimes it does not directly cause behavior change or specific actions. Moreover, controlling for other variables, such as other media sources or word of mouth, make understanding the causality of behavior change that much more difficult. The final action taken may not be directly related to the outreach efforts but rather a conglomeration of numerous influences.

Pre- and Post- Surveys.

This is a methodology that attempts to control for some variables, such as house size, income, baseline energy use, and/or neighborhood. Every program implemented should have an initial "pre-program survey" to measure participants' baseline level of understanding or familiarity with the program or initiative. A post-program survey, performed a short time after completion of the program, provides a measurement upon which to analyze the understanding or action taken by a program participant.

To perform a more rigorous survey, the City of Boulder could use classical experimental design. Using two neighborhoods that have common characteristics, the city would implement a program (marketing or direct action) for just one of the similar neighborhoods while the other neighborhood serves as the control group. *Both* neighborhoods would respond to pre- and post-surveys and results would be analyzed to understand the difference between the two groups.

Marketing Analysis.

The marketing analysis study provided by the City of Boulder makes very aggressive assumptions about the behavior change caused by a marketing action. The analysis makes aggressive assumptions on program impact growth and associated emissions reductions. It does not take into consideration double-counting of impacts that involving people that had multiple modes of contact with the marketing program. These issues highlight the difficulty of quantifying reductions from marketing campaigns without collecting any actual outcome data. A pre- and post-survey may provide the basis to make realistic assumptions on behavior change in Boulder.

Section 4 – CAP Programmatic Recommendations

Residential Sector Recommendations

In order to meet this sector's GHG reduction goal of about 94,000 tCO2 in 2012, aggressive action must be taken. The programs of the past two years have only achieved approximately 2,000 tCO2 of realized savings; the task in the coming four years is an enormous one. The following recommendations stress swift and aggressive action.

Recommendations:

Discontinue the Residential Energy Assessment Program (REAP), the Multi-family Unit (MFU) audit program and the Utility Bill Analysis program**,** freeing up resources for implementation of ER measures. Xcel will be targeting residential customers in their DSM audit program. As stated above, the actions that need to be taken by the City to get closer to its GHG emission target need to focus on implementation of audit recommendations, not only the audits themselves. The funds that have been previously allocated for these programs can be reprogrammed to incentivize implementation of comprehensive whole-house EE packages using financial mechanisms defined below. The City has already followed this recommendation and has discontinued the audit programs.

Provide increased marketing and outreach to raise awareness of Xcel's Residential Rebate programs. As stated above, Xcel's DSM program can be maximized in Boulder through targeted marketing towards the residential customer. The marketing materials should be strongly focused on steps Boulder residents can take toward actual implementation of the recommendations made in the Xcel audits. Marketing tools should be monitored and evaluated continuously for effectiveness. Section 3 of this report covers marketing and outreach metrics in more detail.

Establish a Property Tax Assessment (PTA) program (for building owners) and Grant Program (for rental units) to provide a financial mechanism that incentivizes building owner investment in energy efficiency measures and solar water heaters. NOTE: This report was drafted before Boulder County established the ClimateSmart Loan Program. This program is a PTA program and should be maximized going forward.

The PTA voluntary program entails the public financing of sustainable energy measures for residential property owners, with repayment through a special long-term property tax assessment that transfers to the new owner upon the sale of a property. As stated above, we recommend applying this program for a bundle or package of carbon emissions reduction measures. This will maximize the savings and assure that aggressive packages of efficiency measures are being implemented while providing the funding mechanism to do so with little risk to the investor/homeowner and at zero cost to the City of Boulder.

GHG reductions achieved through the program will become even more significant if the County continues to increase program funding. WSP recommends that the City encourage the Boulder County to aggressively expand this program to provide funding of $280 million for the residential sector through 2012. Assuming that the loans are distributed in similar proportions to the 2009 approvals, this would

create substantial reductions of about 72,000 tCO2e. WSP also recommends that the City create mechanisms to encourage participation in ClimateSmart. Possibilities include designating staff to help property owners file loan applications, reimbursing property owners for the $75 application fee, and creating incentives to further encourage property owners to participate in the program.

For city residents that do not qualify for the PTA as a homeowner, but would still like to reduce payback time on energy efficiency measures, we recommend a Grant Program using similarly aggressive bundles of efficiency measures for non-owner occupied rental units. Currently, approximately 57% of housing units in Boulder are renter-occupied. The Grant Program could be administered by the City of Boulder, possibly using similar methods of disbursement as the Commercial Grant Program (described later in this section) with a bank or other financial institution managing the funds.

Establish a Cost Buy-Down Program, which targets a bundle of efficiency measures as well as a solar domestic hot water (DHW) system. In Econergy's CAP Strategies Recommendations of 2004 and their Boulder County GHG Analysis Report, three bundles of efficiency measures were analyzed. WSP analyzed similar preliminary recommendations for purposes of this current assessment. These bundles stress the importance and effectiveness of an approach that emphasizes implementation of a package of energy efficiency measures.

Table 9. Energy Reduction Bundles Considered.

	Single-family	Multi-Family
Bundle 1	Lighting efficiency upgrades – 75% of home lighting with CFLs Programmable Thermostats – Temperature Setback Energy Star refrigerator Energy Star washer	Lighting efficiency upgrades – 75% of home lighting with CFLs Programmable Thermostats Energy Star refrigerator Energy Star washer
Bundle 2	Lighting efficiency upgrades - – 75% of lighting with CFLs Programmable T-stats Energy Star refrigerator Energy Star washer Energy Star dishwasher	Lighting efficiency upgrades - – 75% of lighting with CFLs Programmable T-stats Energy Star refrigerator Energy Star washer Energy Star dishwasher
Bundle 3	Lighting efficiency upgrades - – 75% of lighting with CFLs Programmable T-stats Energy Star refrigerator Energy Star washer Energy Star dishwasher Insulate ducts	Lighting efficiency upgrades - – 75% of lighting with CFLs Programmable T-stats Energy Star refrigerator Energy Star washer Energy Star dishwasher Insulate ducts

In order to swiftly move toward the 2012 goals, we only considered Bundle 2 or Bundle 3 in our analyses, as outlined in Table 1 below. We did not consider Bundle 1 in this analysis simply because it will not achieve enough impact. Similarly, while we analyzed Bundle 3, which differentiates itself from Bundle 2 through the addition of evaporative cooling and PV panels, we found that Bundle 3 does not provide optimal results. Due to the high costs and relatively low effectiveness of PV systems (compared to more cost-effective ER measures), we do not recommend Bundle 3. Our analysis shows that for the amount of CAP budget expended on PV systems, the comparative return on GHG reduction is far less than using those funds to increase market penetration for Bundle 2, which costs less.

Assuming ClimateSmart Loans achieve the results described above, the remaining gap to the residential sector target can be closed by Bundle 2 being deployed at an 11% market penetration level.

Table 10. Bundle 2 at 11% market penetration achieved in 2012.

Bundle 2 (@11% market penetration)		
	Total Energy	GHG Reduction (tCO2)
Annual Electricity Savings (kWh)	19,118,719	15,895
Annual Natural Gas Savings from EE (therms)	616,289	3,270
Annual Natural Gas Savings from Solar DHW (therms)	612,315	3,249
TOTAL (kWh)	37,909,986	22,414

We recommend that the City design and deploy a program that will facilitate the deployment of an 11% market penetration of EE packages that, on average, achieve the GHG impact associated with Bundle 2. The costs to the CAP for such a program will be substantial. To buy down the simple payback time to 8 years (an 8 year simple payback is judged to be a good target for creating a financially attractive investment for property owners, based on WSP's many years of experience in the field) and to achieve a penetration rate of 11%, we estimate the cumulative cost to the CAP budget will be approximately $16,000,000 by the end of 2012. These numbers do not include the cost of purchasing RECs and offsets. Note that the Xcel DSM program is expected to allocate approximately $2,000,000 to the efficiency projects undertaken by Boulder Xcel customers.

Establish a Residential Energy Conservation Ordinance. The RECO, an energy efficiency mandate, can be implemented at the point of sale of a residential unit or through the renewal/application of rental license (required every 4 years). The PTA (ClimateSmart Loans), Grant program, and Buy-Down program could provide some of the financing required for RECO compliance.

Continue Home Performance with Energy Star (HPwES) *or similar contractor training programs.* This program can become the foundation for increasing the number of qualified home energy retrofit contractors in the Boulder area. These programs should stress comprehensive home energy efficiency measures and should include marketing/outreach promoting available rebates from Xcel and the CAP. A pre-and-post survey will help gauge the effectiveness of the training programs.

The HPwES program should target as many contractors in the area as possible, providing them with classroom and field training opportunities. Evaluation of the program should include surveys completed in the beginning of the program to gauge baseline knowledge. Follow-up and evaluation is needed to ensure effectiveness of the program. Follow-up surveys should attempt to evaluate the program's effects on the contractors' actions to understand how their work is attributable to what they learned in the training program. Moreover, there should be good communications/marketing to ensure that these contractors have first priority when building owners hire a contractor to implement energy reduction measures.

Xcel DSM Plan. City staff performed a preliminary analysis of the prorated impacts achieved by Xcel's DSM Plan, which is set to begin in January 2009. The prorated energy savings were translated into energy reduction measures. These energy savings were translated into GHG reductions. This is expected to affect Boulder in the years 2009 and 2010. We do not know Xcel's plans for post-2010. We can assume that similar actions will be taken. The most substantial unknown in this analysis is whether the DSM Plan will affect the Boulder in the same proportions as the ratio of Boulder's total energy use to Xcel territory's total energy use.

Table 11. Impacts of Xcel's DSM Plan (Xcel Service Territory Statewide).

		Energy Savings (kWh or Dth)	% Allocation to CoB	Energy Savings CoB (kWh or Dth)	GHG Savings
2009	Electric Conservation	181,360,530	7.85%	14,242,165	10,386
2009	Gas Conservation	318,141	6.71%	21,357	1,133
2010	Electric Conservation	244,104,586	7.85%	19,169,429	16,154
2010	Gas Conservation	402,808	6.71%	27,041	1,435
				Total	29,108

Commercial/Industrial Sector Recommendations

This section provides (a) a picture of the commercial/industrial sector's BAU emissions and required emissions reductions, followed by a general overview of strategies recommended for the sector, as discussed with the OEA; (b) an analysis of the energy efficiency measures needed in the commercial/industrial sector towards the 2012 goal, with an estimate of their required implementation costs as well as of their potential cost savings and associated emissions reductions; and (c) an overview of the key financial mechanisms recommended to support the energy savings needed. The commercial sector, CU Boulder, and the industrial sector are combined into one to reflect changes in how Xcel Energy classifies each sector. However, because historic data provides insight into the relative energy profile of each sector, they are analyzed individually and combined in this section. CU Boulder is excluded from most of the analysis because of its relatively minor contribution to overall emissions.

Overview of the sector's emissions and strategies recommended

The table below, with data consistent with the updated Inventory Maintenance System (IMS), shows the commercial/industrial sector's BAU emissions, the sector-specific target level of emissions for 2012, and the sector-specific emissions reductions required to meet the target. Figures are also broken down by sub-sector, showing BAU emissions, targets and reductions for the commercial, industrial, and CU Boulder segments separately. City's overall BAU projected emissions and 2012 target are also shown on top for reference.

Table 12. BAU Emissions Forecast, 2012 target and required reductions

BAU Emissions (tCO2)	2008	2009	2010	2011	2012	Target 2012
Commercial	**673,755**	**678,304**	**682,745**	**687,078**	**691,304**	**386,039**
	572,147	576,434	580,614	584,686	588,650	300,963
	101,608	101,870	102,131	102,393	102,654	85,076
Industrial	**270,774**	**266,392**	**262,033**	**257,699**	**253,390**	**295,361**
	224,448	221,126	217,828	214,555	211,306	237,616
	46,327	45,266	44,205	43,145	42,084	57,744
Commercial/Industrial	**944,530**	**944,696**	**944,778**	**944,778**	**944,694**	**681,400**
	796,595	797,560	798,442	799,240	799,956	538,579
	147,935	147,136	146,336	145,537	144,738	142,820
Reductions required (tCO_2)	**2008**	**2009**	**2010**	**2011**	**2012**	**% gap 2012**
Commercial	**287,716**	**292,265**	**296,706**	**301,039**	**305,265**	**79%**
	271,184	275,471	279,651	283,723	287,687	96%
	16,532	16,793	17,055	17,316	17,578	21%
Industrial	**(24,586)**	**(28,969)**	**(33,327)**	**(37,661)**	**(41,971)**	**-14%**
	(13,169)	(16,491)	(19,788)	(23,062)	(26,310)	-11%
	(11,418)	(12,478)	(13,539)	(14,600)	(15,660)	-27%
Commercial/Industrial	**263,130**	**263,296**	**263,378**	**263,378**	**263,294**	**39%**
	258,016	258,981	259,862	260,661	261,377	49%
	5,114	4,315	3,516	2,717	1,917	1%

As discussed in Section 1, the commercial and industrial sectors are grouped together due to inconsistencies in how Xcel classifies different utility customers. Regardless, the above figure demonstrates that commercial

buildings are the biggest emissions reduction challenge. As such, the financial mechanisms recommended in the present report, namely a Guarantee Fund and a Grant Facility, are intended to focus on the commercial sub-sector. The rationale for this is to concentrate financial resources in the sub-sector where they are most needed, and to rely on private initiatives to achieve emissions reductions autonomously in the other. Such an approach is also consistent with trends observed in most markets, where difficulties encountered by the Energy Service Company (ESCO) industry in trying to penetrate the commercial sector are different from those it encounters in the industrial sector:

In the commercial sector, ESCOs are usually unable to reach the smaller businesses, the size of which does not justify the transaction costs involved in performance contracting, nor does it provide for an acceptable degree of risk. The result is, in most cases, that smaller companies do not implement almost any significant energy saving measure, given that they in turn face an upfront-cost barrier but cannot enjoy the support that ESCOs provide to larger businesses.

Conversely, difficulties encountered by ESCOs in approaching industrial companies is that these, both large and small, tend to engage autonomously in energy-saving measures embedded in their production processes and in investments made periodically to upgrade their equipment.

Recommendations for the commercial/industrial sector:

Discontinue both the Building Performance Program and the PACE EnergySmart for Business Program**,** freeing up resources for project implementation. As noted in Chapter 2, programs that offer walk-through audits but no resources for implementation yield very limited impact in terms of emissions reductions. In addition, the Energy Analysis Program proposed by Xcel in its DSM Plan will provide adequate services of this kind. Consequently, it is also recommended that reimbursements provided to smaller businesses participating in joint City/Xcel audit offerings be discontinued too, and that they not be considered for Xcel's Energy Analysis Program: a small co-payment is likely, on the contrary, to lead customers to recognize the value of services offered at already favorable conditions.

Establish a Property Tax Assessment program aimed at the commercial/industrial sector. The Boulder County ClimateSmart Loan Program currently available to the residential sector is planned to be extended to the commercial/industrial sector in the near future. This program should be expanded to the greatest extent possible, as rapidly as possible.

Establish a Guarantee Fund that will back ESCO performance contracting in commercial buildings that are too small for the conventional ESCO model to treat. This measure will use public resources to address the critical barrier that is preventing private sector capital from entering the market segment representing the highest share of emissions in the City's footprint, as well as the market segment offering among the highest potential for reductions. The ESCO industry is eager and ready to enter this new market if only the risk conditions allow it. This measure will be targeted towards medium-sized businesses, with a size threshold to be established after the City receives feedback from the ESCO industry.

Establish a Grant Facility to support project implementation in the even smaller commercial buildings that the Guarantee Fund Program cannot treat. Some businesses are so small, (generally those under 10,000 ft2) that, even in the presence of guarantees, no ESCO would have any interest in serving under a performance contracting model. A grant facility could buy-down the capital cost to businesses for implementing measures, reducing the payback period to more acceptable levels.

Establish a Commercial Energy Conservation Ordinance. The CECO, an energy efficiency mandate, can be implemented at the point of sale of a commercial building. The PTA (ClimateSmart Loans), Grant program, and Guarantee Fund could provide some of the financing required for CECO compliance.

Carry out targeted outreach events to raise awareness of Xcel DSM initiatives (Energy Analysis Program, Standard Offer Program and rebates), in cooperation with the Chambers. As noted in Chapter 2, Xcel's proposed DSM Program shows that there is an expectation for City of Boulder Programs to increase awareness in the utility's initiatives. This would be done more effectively through specific outreach events, such as workshops, than through an audit partnership that would be duplicative. The share of the ClimateSmart at Work budget devoted to specific commercial/industrial sector outreach activities should be enhanced.

Analysis of measures needed and of associated savings, costs and emissions reductions

Consistent with what was discussed with the OEA, the analysis considers "bundles" of several energy efficiency measures to be implemented in existing buildings. These bundles' characteristics (measures included, energy intensities and savings over base case, implementation costs) are those shown in the analysis conducted by Econergy for City of Boulder in 2004. Implementation costs correspond to a weighted average of costs considered for office, retail, and restaurant space, and are escalated from 2004 to 2008 using an annual 3% inflation rate (also used for projections in future years).

Two bundles are considered. The tables below show the energy intensity of each bundle, as well as the savings they achieve over the base case of a typical existing building.

Bundle 1 is a collection of aggressive yet technically mature energy efficiency upgrades. The implementation cost of this bundle, adjusted to 2008 prices, is estimated at $3.09/ft^2. Implementation costs are calculated only for the incremental area covered each year.

EE Bundle characteristics	Base case	EE Bundle	Difference	Savings (%)
Electric usage intensity (kWh/sf/yr)	13.97	8.94	5.03	36%
Gas usage intensity (therm/sf/yr)	0.42	0.31	0.11	26%

Bundle 2 aims for more aggressive energy savings, building on measures included in Bundle 1 and expanding on them, as well as through the use of evaporative cooling technologies. This bundle carries a higher cost, estimated at $9.93/ft^2 (adjusted to 2008 prices).

EE Bundle characteristics	Base case	EE Bundle	Difference	Savings (%)
Electric usage intensity (kWh/sf/yr)	13.97	7.12	6.85	49%
Gas usage intensity (therm/sf/yr)	0.42	0.31	0.11	27%

Energy savings are calculated by multiplying electricity (kWh) and natural gas (therms) savings per square foot by the area corresponding to a year's total (cumulative) market penetration.

The implementation of the measures included in the bundles is assumed to generate cost savings estimated at $100/MWh for electricity, and at $10/MMBtu for natural gas ($34.1/MWh$_{thermal}$). For this purpose, electricity and gas tariffs are assumed to grow by 2% annually.

Emissions reductions are calculated by multiplying energy savings by the grid emissions factor for electricity (corresponding to figures calculated in the IMS), and by an emissions factor of 0.00531 tCO_2/therm for natural gas (0.18 tCO2/ MWh$_{thermal}$).

Based on the type of measures to be implemented (Bundle 1 or 2) and the market penetration rate to be considered, the analysis considers three options:

Option A includes the implementation of a Bundle 1 of measures with a market penetration that reaches 35% by 2012, that is in four years (which is in itself an optimistic assumption: the study conducted in 2004 assumed that it would take eight years to reach a similar market penetration). While such a scenario is not sufficient to cover the entire amount of required emissions to achieve the sector-specific target for 2012, this option also quantifies the amount of Renewable Energy Certificates (RECs) and carbon offsets that would be required to be purchased in order to successfully close the gap, and the expenditure to do so. For purposes of this and the other options below, it is assumed that 50% of the required emissions are covered by RECs at a unit price of $18/ton of CO2e ($15/MWh @ 0.83 grid emissions factor), and the other 50% by carbon offsets at a unit price of $15/ton.[5]

[5] Both RECs and offsets are analyzed separately because of their distinctive characteristics; RECs are to be used for offsetting carbon emissions associated with electricity usage, while carbon offsets are to be used to offset carbon emissions from non-electricity sources. This distinction is important to make because RECs and offsets target different aspects of Boulder's carbon footprint.

Table 13. Option A: EE Bundle 1 and 35% market penetration by 2012

Assumptions (market)	**2008**	**2009**	**2010**	**2011**	**2012**
Market penetration rate (%)	0%	5%	15%	25%	35%
Total area covered (sf)	0	1,990,000	5,970,000	9,950,000	13,930,000
Incremental area covered (sf)	0	1,990,000	3,980,000	3,980,000	3,980,000
EE Bundle implem costs ($/sf)	3.09	3.2	3.3	3.4	3.5
Electricity savings (USD/MWh)	100	102.0	104.0	106.1	108.2
Natural gas savings (USD/MWh)	34.1	34.8	35.5	36.2	36.9
City Grid Emission Factor (tCO_2/MWh)	0.854	0.848	0.843	0.837	0.831
Natural Gas EF (tCO_2/MWh)	0.18				
Energy savings (MWh)	**2008**	**2009**	**2010**	**2011**	**2012**
Electricity	0	10,008	30,024	50,041	70,057
Natural gas	0	6,367	19,101	31,836	44,570
Cost savings ($)	**2008**	**2009**	**2010**	**2011**	**2012**
Electricity	0	1,020,827	3,123,731	5,310,342	7,583,169
Natural gas	0	221,654	678,262	1,153,045	1,646,548
Total (annual)	0	1,242,481	3,801,992	6,463,387	9,229,717
Total (cumulative)	0	1,242,481	5,044,474	11,507,861	20,737,577
GHG reductions achieved (tCO_2)	**2008**	**2009**	**2010**	**2011**	**2012**
Electricity Grid displacement	0	8,490	25,302	41,887	58,245
Natural gas displacement	0	1,152	3,457	5,762	8,067
Total (tCO_2)	0	9,643	28,759	47,649	66,312
As a % reduction from comb. sector BAU	*0.0%*	*1.0%*	*3.0%*	*5.0%*	*7.0%*
As a % of comb. sector required reductions	*0.0%*	*3.7%*	*10.9%*	*18.1%*	*25.2%*
As a % of City required reductions	*0.0%*	*2.1%*	*6.4%*	*10.5%*	*14.6%*
GHG reductions still required (tCO_2)	**2008**	**2009**	**2010**	**2011**	**2012**
Still required for comb. sector	263,130	253,653	234,619	215,729	196,982
Attributable to electricity	258,016	250,490	234,561	218,775	203,132
Attributable to natural gas	5,114	3,163	59	-3,046	-6,150
As a % of sector required reductions	100.0%	96.3%	89.1%	81.9%	74.8%
EE bundle implementation costs ($)	**2008**	**2009**	**2010**	**2011**	**2012**
Implementation cost (annual)	0	6,333,573	13,047,160	13,438,575	13,841,732
Implementation cost (cumulative)	0	6,333,573	19,380,733	32,819,309	46,661,041
Simple payback (years)		5.10			
Costs for purchase of offsets/RECs ($)	**2008**	**2009**	**2010**	**2011**	**2012**
Carbon offsets		0	0	0	1,477,363
RECs		0	0	0	1,772,836
Total ($)		0	0	0	3,250,199

This option would generate 66,312 tCO_2 in emissions reductions by 2012, corresponding to 25% of those required for the combined commercial/industrial sector by that year. This result would carry a cumulative implementation cost of $46.6 million through 2012.

The RECs/offsets cost for the sector's remaining 75% required reductions by 2012 (or 196,982 tCO_2) would amount to $3.25 million, and would continue in the following years as a recurring annual cost, likely decreasing.

> ***Option B*** represents a very aggressive scenario where a more aggressive bundle of measures would be implemented with a complete market penetration (100%) by 2012. This is an unrealistic scenario (also given a payback period of 12 years) and it is run for demonstrative purposes only. It shows that, even under these extreme assumptions, the target emissions reductions would still not be achieved and purchases of RECs/offsets would be required.

Table 14. Option B: EE Bundle 2 and 100% market penetration by 2012

Assumptions (market)	**2008**	**2009**	**2010**	**2011**	**2012**
Market penetration rate (%)	0%	25%	50%	75%	100%
Total area covered (sf)	0	9,950,000	19,900,000	29,850,000	39,800,000
Incremental area covered (sf)	0	9,950,000	9,950,000	9,950,000	9,950,000
EE Bundle implem costs ($/sf)	9.93	10.2	10.5	10.9	11.2
Electricity savings (USD/MWh)	100	102.0	104.0	106.1	108.2
Natural gas savings (USD/MWh)	34.1	34.8	35.5	36.2	36.9
City Grid Emission Factor (tCO_2/MWh)	0.854	0.848	0.843	0.837	0.831
Natural Gas EF (tCO_2/MWh)	0.18				
Energy savings (MWh)	**2008**	**2009**	**2010**	**2011**	**2012**
Electricity	0	68,111	136,221	204,332	272,443
Natural gas	0	33,060	66,120	99,180	132,240
Cost savings ($)	**2008**	**2009**	**2010**	**2011**	**2012**
Electricity	0	6,947,295	14,172,482	21,683,897	29,490,100
Natural gas	0	1,150,897	2,347,829	3,592,178	4,885,363
Total (annual)	0	8,098,192	16,520,311	25,276,076	34,375,463
Total (cumulative)	0	8,098,192	24,618,502	49,894,578	84,270,041
GHG reductions achieved (tCO_2)	**2008**	**2009**	**2010**	**2011**	**2012**
Electricity Grid displacement	0	57,782	114,794	171,037	226,509
Natural gas displacement	0	5,984	11,968	17,952	23,935
Total (tCO_2)	0	63,766	126,762	188,988	250,445
As a % reduction from comb. sector BAU	*0.0%*	*6.7%*	*13.4%*	*20.0%*	*26.5%*
As a % of comb. sector required reductions	*0.0%*	*24.2%*	*48.1%*	*71.8%*	*95.1%*
As a % of City required reductions	*0.0%*	*14.1%*	*28.0%*	*41.6%*	*55.1%*
GHG reductions still required (tCO_2)	**2008**	**2009**	**2010**	**2011**	**2012**
Still required for comb. sector	263,130	199,530	136,616	74,390	12,849
Attributable to electricity	258,016	201,199	145,068	89,625	34,868
Attributable to natural gas	5,114	-1,669	-8,452	-15,235	-22,018
As a % of sector required reductions	100.0%	75.8%	51.9%	28.2%	4.9%
EE bundle implementation costs ($)	**2008**	**2009**	**2010**	**2011**	**2012**
Implementation cost (annual)	0	101,767,605	104,820,633	107,965,252	111,204,210
Implementation cost (cumulative)	0	101,767,605	206,588,238	314,553,490	425,757,700
Simple payback (years)		12.57			
Costs for purchase of offsets/RECs ($)	**2008**	**2009**	**2010**	**2011**	**2012**
Carbon offsets		0	0	0	96,371
RECs		0	0	0	115,645
Total ($)		0	0	0	212,016

Under this option, 95% (250,445 tCO_2) of the required emissions reductions for the combined commercial/industrial sector would be achieved by 2012, at a cumulative implementation cost of $425.8 million by the end of that year. The remaining 5% in 2012 (12,849 tCO_2) would need to be covered with RECs/carbon offsets, at a recurring annual cost of $212,016 (post-2012).

Option C represents an alternative scenario with respect to Option A, in that it assumes that an EE Bundle 1 of measures (that has a more acceptable payback period of 5.1 years) would be implemented achieving a 35% market penetration in 2012, and a complete market penetration by year 2020. It should be noted that market penetration would, increase at a slower pace after 2013 with respect to the first four years considered. This affects the trend of annual implementation costs, which (unlike savings) are calculated only on the additional (incremental) market coverage achieved each year, and not on the total one. Contrary to the trend observable in projections for the last few years covered by the IMS (and therefore adopting a conservative approach), BAU emissions are assumed to remain constant through 2020, as are, consequently, emissions reductions required and the grid emission factor (which is also actually projected to decrease).

Table 15. Option C: EE Bundle 1 and 100% market penetration by 2020

Assumptions (market)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Market penetration rate (%)	0%	5%	15%	25%	35%	40%	45%	52%	59%	67%	77%	88%	100%
Total area covered (sf)	0	1,990,000	5,970,000	9,950,000	13,930,000	15,880,200	18,103,428	20,637,908	23,527,215	26,821,025	30,575,969	34,856,604	39,736,529
Incremental area covered (sf)	0	1,990,000	3,980,000	3,980,000	3,980,000	1,950,200	2,223,228	2,534,480	2,889,307	3,293,810	3,754,944	4,280,636	4,879,925
EE Bundle implem costs ($/sf)	3.09	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0	4.2	4.3	4.4
Electricity savings (USD/MWh)	100	102.0	104.0	106.1	108.2	110.4	112.6	114.9	117.2	119.5	121.9	124.3	126.8
Natural gas savings (USD/MWh)	34.1	34.8	35.5	36.2	36.9	37.7	38.4	39.2	40.0	40.8	41.6	42.4	43.3
City Grid Emission Factor (tCO_2/MWh)	0.854	0.848	0.843	0.837	0.831	0.831	0.831	0.831	0.831	0.831	0.831	0.831	0.831
Natural Gas EF (tCO_2/MWh)	0.18												
Energy savings (MWh)	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Electricity	0	10,008	30,024	50,041	70,057	79,865	91,046	103,792	118,323	134,888	153,773	175,301	199,843
Natural gas	0	6,367	19,101	31,836	44,570	50,810	57,923	66,032	75,277	85,815	97,830	111,526	127,139
Cost savings ($)	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Electricity	0	1,020,827	3,123,731	5,310,342	7,583,169	8,817,708	10,253,231	11,922,457	13,863,433	16,120,400	18,744,802	21,796,455	25,344,918
Natural gas	0	221,654	678,262	1,153,045	1,646,548	1,914,606	2,226,304	2,588,746	3,010,194	3,500,254	4,070,095	4,732,707	5,503,192
Total (annual)	0	1,242,481	3,801,992	6,463,387	9,229,717	10,732,315	12,479,535	14,511,204	16,873,628	19,620,654	22,814,897	26,529,162	30,848,110
Total (cumulative)	0	1,242,481	5,044,474	11,507,861	20,737,577	31,469,892	43,949,427	58,460,631	75,334,259	94,954,914	117,769,811	144,298,973	175,147,082
GHG reductions achieved (tCO_2)	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Electricity Grid displacement	0	8,490	25,302	41,887	58,245	66,400	75,695	86,293	98,374	112,146	127,847	145,745	166,150
Natural gas displacement	0	1,152	3,457	5,762	8,067	9,197	10,484	11,952	13,625	15,533	17,707	20,186	23,012
Total (tCO_2)	0	9,643	28,759	47,649	66,312	75,596	86,180	98,245	111,999	127,679	145,554	165,931	189,162
As a % reduction from comb. sector BAU	*0.0%*	*0.9%*	*2.8%*	*4.6%*	*6.3%*	*7.2%*	*8.2%*	*9.4%*	*10.7%*	*12.2%*	*13.9%*	*15.9%*	*18.1%*
As a % of comb. sector required reductions	*0.0%*	*3.5%*	*10.4%*	*17.2%*	*23.9%*	*27.2%*	*31.0%*	*35.3%*	*40.3%*	*45.9%*	*52.4%*	*59.7%*	*68.0%*
As a % of City required reductions	*0.0%*	*2.1%*	*6.4%*	*10.5%*	*14.6%*	*16.6%*	*18.9%*	*21.6%*	*24.6%*	*28.1%*	*32.0%*	*36.5%*	*41.6%*
GHG reductions still required (tCO_2)	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Still required for comb. sector	274,098	265,585	247,494	229,527	211,683	202,399	191,816	179,750	165,996	150,316	132,441	112,064	88,833
Attributable to electricity	285,443	278,798	263,735	248,800	233,994	225,839	216,544	205,946	193,865	180,093	164,392	146,494	126,089
Attributable to natural gas	-11,344	-13,213	-16,240	-19,273	-22,311	-23,440	-24,728	-26,196	-27,869	-29,776	-31,951	-34,430	-37,256
As a % of sector required reductions	100.0%	96.5%	89.6%	82.8%	76.1%	72.8%	69.0%	64.7%	59.7%	54.1%	47.6%	40.3%	32.0%
EE bundle implementation costs ($)	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Implementation cost (annual)	0	6,333,573	13,047,160	13,438,575	13,841,732	6,985,922	8,202,870	9,631,810	11,309,671	13,279,816	15,593,160	18,309,488	21,499,001
Implementation cost (cumulative)	0	6,333,573	19,380,733	32,819,309	46,661,041	53,646,963	61,849,833	71,481,643	82,791,315	96,071,131	111,664,291	129,973,779	151,472,781
Simple payback (years)		5.10											
Costs for purchase of offsets/RECs ($)	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Carbon offsets		0	0	0	1,587,621	1,517,993	1,438,617	1,348,128	1,244,971	1,127,372	993,310	840,478	666,250
RECs		0	0	0	1,905,145	1,821,591	1,726,340	1,617,754	1,493,965	1,352,847	1,191,971	1,008,574	799,500
Total ($)		0	0	0	3,492,765	3,339,584	3,164,957	2,965,882	2,738,937	2,480,219	2,185,281	1,849,052	1,465,750

Under this option (as in Option A), 66,312 tCO_2 in emissions reductions would be achieved in 2012, corresponding to 24% of those required in the sector by that date, at a cumulative cost of $46.7 million up to 2012. With a complete market penetration achieved in 2020, 189,162 tCO_2 in emissions reductions would be generated in that year, corresponding to about 68% of those required according to the target set for the sector for 2012, at a cumulative cost of $151 million by 2020. The annual recurring RECs/offsets costs would decrease from $3.5 million in 2012 to $1.5 million in 2020.

Recommended Financial Mechanisms

Implementation costs for all three options considered are prohibitive for public finances. Even under option A, the most conservative and realistic one, during the first year and with a mere 5% market penetration rate, implementation costs would amount to over $6 million.

Nonetheless, if the City wishes to advance towards its emissions reduction target, direct-impact measures for commercial buildings need to be addressed, given the share they represent in City's footprint and the potential reduction they offer. If public resources available will never be sufficient to provide financing for the direct implementation of measures, they can be used to provide leverage and attract additional private capital in the energy savings performance contracting market.

This could be done, as noted, by establishing (i) a Guarantee Fund that would support the extension of the performance contracting model to a new market segment represented by small businesses, and (ii) a Grant Facility that would subsidize the capital cost to end-users implementing measures in the market segment represented by the even smaller businesses where the performance contracting model would not be viable even in the presence of a guarantee mechanism.

The complete design and modeling of these two financial mechanisms would require extensive research and analysis, ***which are beyond the current work scope***. The proposed mechanisms are outlined in a preliminary way below.

The ClimateSmart Loan Program discussed earlier in the Residential Section will also be applied to the commercial/industrial sector in the near future. Preliminary results provided by Boulder County for the residential program to date have provided a basis for WSP to make a very preliminary estimate the impact this program has potential to achieve in the commercial/industrial sector. Further analysis should be done to assess the potential impact of the ClimateSmart Loan Program on the commercial/industrial sector as soon as sector-specific program data become available.

WSP's preliminary analysis of ClimateSmart's potential suggests that it can achieve a very substantial fraction of the total ERs required from the commercial sector in 2012. This, in turn, suggests that the combination of appropriately designed and adequately funded ClimateSmart loans, Guarantee Fund, and Grant Facility has the potential to achieve the sector's ER target.

Guarantee Fund

Rationale. ESCOs are traditionally unwilling to enter the market segment represented by smaller businesses, given (i) the high default rate in small companies, which exposes the performance contracting scheme at an unacceptable degree of risk; and (ii) the high transaction costs of engaging with small companies relative to the potential savings (and thus earnings) achievable from them.

A Guarantee Fund supporting performance contracting could address both barriers:

> It could be designed as a mechanism covering either the credit risk taken by ESCOs that obtain loans to finance the project development costs, or the performance risk from the expected savings of ESCOs' customers.
> It could be associated with a program framework that groups several end-users with similar needs of EE measures.

The effect of the Guarantee Fund would be that of opening to the ESCO industry an entirely new market that offers among the highest potential for energy savings and emissions reductions for City. If effective, it could support a real market transformation in a market segment that, given its large size, would not be materially affected by the Standard Offer Program proposed by Xcel in its DSM Plan.

Description and projections. The preliminary analysis of the Fund (as well as that of the Grant Facility below) will consider market assumptions of Options A and C: the reference EE measures to be implemented will be those of Bundle 1, with a market penetration of 35% by 2012 and 100% by 2020.

The Guarantee Fund could support ESCO activities in commercial buildings larger than 10,000 ft^2. Based on the City database of commercial building space, and consistent with what assumed in the study conducted in 2004, it is estimated that this would represent 80% of the total commercial space.

For purposes of this preliminary analysis, it is assumed that the Guarantee Fund could be designed as a mechanism providing guarantees for loans obtained by ESCOs from banks to implement EE projects in the indicated sub-sector of commercial buildings. Given that ESCOs would be repaying back the loans (at least in part) with earnings obtained from energy savings of their building-owner clients, the Fund would in effect ultimately provide guarantees on the stream of payments resulting from the buildings' energy savings. If ESCO clients defaulted, the stream of payments would be interrupted, and this would affect the ESCOs' ability to honor the loans obtained to implement EE measures in their clients' facilities. At that point, the loan guarantee would kick in to cover the interrupted payment stream.

In order to construct a preliminary model of the Fund, the following assumptions were made: (i) a 20% average default rate among participating building owners; (ii) a guarantee provided on 90% of the face value of loans (which is very high, given that most loan guarantee funds cover a maximum of 75%); (iii) a loan tenor of 5 years; (iv) a multiplier for the face value of loans covered with the Fund's resources (exposure of the Fund's year-end balance) of 2x for the first year, escalating to 3x by the third year and constant thereafter; (v) a guarantee reserve ratio on guarantees outstanding of 100% for the Fund's first year, decreasing to 40% in year 2 and to 10% for years 3 onwards; (vi) a 6% interest income obtained on the uncommitted capital represented by reserve requirements: 80% of interest payments would be re-injected into the Fund, while the rest would be provided as a fee to the

institution (such as a bank) that would administer the Fund under City's oversight; (vii) the participating building owner's energy cost savings stream during the performance contract period, about 10% of total cost savings, would be directed to the fund.

The fund's resources therefore would be (a) a part of the interest obtained from uncommitted capital; (b) a portion of the energy savings obtained; and, in addition, (c) resources to be allocated by the City.

Given the assumptions made, two scenarios may be considered:

> ***High allocation scenario (backing for all loans required for a 35% market penetration by 2012)***. In order to guarantee loans covering the complete amount of funding required to implement an EE Bundle 1 of measures in commercial buildings larger than 10,000 ft^2, with a market penetration rate of 35% by 2012, resources to be allocated by the City would amount to $2.2 million for the Fund's first year (5% market penetration). Allocations could decrease by about 15% annually through 2012, and still maintain a sufficient level of backing as market penetration increases. For the period 2013-2020, as noted, market penetration was assumed to grow at a slower pace with respect to the first four years considered: allocations by City could be reduced at a higher rate (25%) in 2013 and 2014, and then remain constant during subsequent years, in order to reach year 2020 achieving a complete backing of loans required to implement all projects, with a 100% market penetration by this final year. Resources to be allocated by City would decrease from $2.2 million to $1.3 million during the first four years, decrease further to $760,000 by year 6 (2014), and remain constant for subsequent years (complete tables up to year 2020 are provided in Annex A)
>
> ***Reduced allocation scenario (50% reduction in allocations)***. If City's allocations were to start from a sum representing 50% of the one indicated above (i.e. $1.1 million), this could provide resource sufficient to cover, during the first two years, just over half of the loan guarantees required (or, half of the market segment considered for this program), and it could take up to about four-five years to reach coverage of the full amount of loans required (complete tables up to year 2020 provided in Annex A). During the early years, with high annual market penetration, there would be a "queue" of projects that would have to be put on hold until the fund had a large enough balance to back loan guarantees for these projects. Thus, while fewer than 100% of the annual scheduled EE implementations would occur during the funds early years, over 100% would occur once market penetration decreased in later years and queued projects could be backed.

The face value of loans that may be covered by the fund may increase as years go by even with decreasing allocations. The reason for this is that, after the Fund is successfully established, exposure of its resources, as noted in the assumptions, may be allowed to increase slightly (up to a multiplier of 3x by year 3), and reserve requirements may be allowed to decrease significantly (down to 10% by year 3). All parameters for the Fund's management may be adjusted to market conditions observed during the Fund's lifetime. In the event that the City cannot make allocations to the fund past 2012, an adjusted, less aggressive implementation schedule could be designed so that the guarantee fund could continue to function past 2012 without contributions from the City.

Table 16. Guarantee Fund projections (high allocation scenario)

Guarantee Fund balance sheet	2008	2009	2010	2011	2012
Fund inflows					
City annual allocations		2,200,000	1,870,000	1,589,500	1,351,075
Interest on uncommitted capital		0	175,111	195,949	73,020
Share of customers' savings		99,398	302,314	520,116	738,377
Total		2,299,398	2,347,425	2,305,565	2,162,472
Fund outflows					
Guarantees liquidated (losses)		0	912,035	1,867,394	1,946,551
Balance (inflows-outflows)		**2,299,398**	**1,435,390**	**438,171**	**215,921**
Closing balance, year end		**2,299,398**	**3,734,789**	**4,172,960**	**4,388,880**
Check (closing balance - reserve req)		**2,299,398**	**86,651**	**90,687**	**2,867,635**
Guarantee reserve requirements		**0**	**3,648,138**	**4,082,273**	**1,521,246**

Guarantee Fund performance	2008	2009	2010	2011	2012
Loan amounts, face value		5,066,858	10,374,414	10,814,175	11,073,386
EE implementation costs (annual)		5,066,858	10,437,728	10,750,860	11,073,386
Difference		0	-63,314	63,314	0
Covered by fund as % of total required		***100%***	***99%***	***101%***	***100%***
Guarantees liquidated, during year		0	912,035	1,867,394	1,946,551
Guarantees outstanding, year end		3,648,138	10,205,682	15,212,458	18,459,316
Principal outstanding, year end (total)		4,053,487	11,339,646	16,902,731	20,510,351

Table 17. Guarantee Fund projections (reduced allocation scenario)

Guarantee Fund balance sheet	2008	2009	2010	2011	2012
Fund inflows					
City annual allocations		1,100,000	935,000	794,750	675,538
Interest on uncommitted capital		0	88,331	98,089	42,878
Share of customers' savings		50,139	150,909	348,445	453,775
Total		1,150,139	1,174,239	1,241,284	1,172,190
Fund outflows					
Guarantees liquidated (losses)		0	460,056	932,161	1,304,068
Balance (inflows-outflows)		**1,150,139**	**714,184**	**309,123**	**-131,877**
Closing balance, year end		**1,150,139**	**1,864,323**	**2,173,446**	**2,041,569**
Check (closing balance - reserve req)		**1,150,139**	**24,100**	**129,921**	**1,148,282**
Guarantee reserve requirements		**0**	**1,840,223**	**2,043,525**	**893,287**
Guarantee Fund performance	**2008**	**2009**	**2010**	**2011**	**2012**
Loan amounts, face value		2,555,865	5,178,675	7,244,820	6,805,229
EE implementation costs (annual)		5,066,858	10,437,728	10,750,860	11,073,386
Difference		-2,510,993	-5,259,054	-3,506,041	-4,268,157
Covered by fund as % of total required		***50%***	***50%***	***67%***	***61%***
Guarantees liquidated, during year		0	460,056	932,161	1,304,068
Guarantees outstanding, year end		1,840,223	5,108,813	8,932,866	11,136,346
Principal outstanding, year end (total)		2,044,692	5,676,459	9,925,407	12,373,718

Grant Facility

Rationale. The energy consumption of some businesses is so small that, even in the presence of guarantees against default risk, they would not justify any ESCOs' engagement under a performance contracting scheme. The key barriers to implementation in these cases are represented by (i) the high capital cost of projects relative to the small amount of savings achievable, with consequently long payback periods; and (ii) high transaction costs involved in engaging with end-users.

A grant facility directed to the smallest businesses could address both barriers:

> It could provide a partial subsidy that buys down the capital cost of project implementation to be incurred by private end-users, thus reducing the payback period to more acceptable levels; and
> It could be associated with a program framework that groups several end-users with similar needs of EE measures; this could also be the same program associated with the Guarantee Fund, and end-users could be directed to either one or the other mechanism depending on their size and/or energy usage.

Description and projections. The Grant Facility could support those businesses smaller than 10,000 ft^2, which do not fall under the incentive provided by the Guarantee Fund. Given assumptions made above, it is estimated that such businesses would represent 20% of City's total commercial building space.

The payback period of Bundle 1 is 5.1 years (decreasing slightly over the years due to increasing energy costs, net of the effect of increasing implementation costs for EE measures). It is assumed that, in order to become

acceptable to small businesses and induce these to implement the measures of Bundle 1, the Bundle's payback period should be bought down to 3 years through cash grants provided by this program.

Annual resources to be allocated by City as subsidies to private small businesses implementing such measures in order to obtain a 3 year payback period (PBP) are shown in the table below, and would range from about $500,000 in 2009 to $1.1 million in 2012, assuming that (according to Option A outlined above) by 2012 a 35% market penetration rate is obtained for the implementation of Bundle 1.

Table 18. Grant Facility projections (up to 2012)

Cost savings ($)	2008	2009	2010	2011	2012
Electricity	0	204,165	624,746	1,062,068	1,516,634
Natural gas	0	44,331	135,652	230,609	329,310
Total (annual)	0	248,496	760,398	1,292,677	1,845,943
Total (cumulative)	0	248,496	1,008,895	2,301,572	4,147,515
EE bundle implementation costs ($)	**2008**	**2009**	**2010**	**2011**	**2012**
Implementation cost (annual)	0	1,266,715	2,609,432	2,687,715	2,768,346
Implementation cost (cumulative)	0	1,266,715	3,876,147	6,563,862	9,332,208
Simple payback (years)		5.10	5.10	5.08	5.06
Grant Facility required resources	**2008**	**2009**	**2010**	**2011**	**2012**
Desired PBP		3	3	3	3
Desired PBP as a % of actual		59%	59%	59%	59%
Resources required to buy-down PBP		521,226	1,073,725	1,099,771	1,125,581
Subs implementation cost (annual)		745,489	1,535,707	1,587,944	1,642,766
Subs implementation cost (cumulative)		745,489	2,281,195	3,869,140	5,511,905
Subs PBP		3	3	3	3

Extending the timeline to 2020, and assuming a 100% market penetration for Bundle 1 reached by then (according to Option C), annual resources to be allocated to the Grant Facility would ultimately reach $1.6 million. It should be remembered that market penetration is assumed to grow at a slower pace after year 2012, affecting the trend of EE implementation costs and, therefore, also affecting the trend of City allocations. Complete tables up to year 2020 are provided in Annex A.

As a final note, it may be observed that public resources to be allocated for the Guarantee Fund may decrease over time, while those to be allocated for the Grant Facility increase. This is due to the fundamental difference between the two financial mechanisms. The former is a credit-enhancing measure, intended to provide backing to loans obtained in the market, and designed to create increased leverage over time. The second one is a direct subsidy provided to the cost of project implementation.

ClimateSmart Loans

Rationale. A Property Tax Assessment programmatic approach, as embodied in Boulder County's ClimateSmart Loan Program, provides a "carrot" to commercial building owners to complement the "stick" of the recommended Commercial Energy Conservation Ordinance (CECO).

Based on the preliminary results ClimateSmart Loans are expected to achieve in the residential sector, we believe that this program has tremendous potential to overcome financial barriers to implementation in the commercial buildings sector, thereby fomenting substantial market penetrations of aggressive EE packages at zero cost to the City of Boulder. Minimal expenditures by the city could leverage the program by encouraging a high rate of participation within the city.

Description and projections. The basic assumption underlying projected impacts of this program on the commercial buildings sector is that total funding will grow from the current $12 million earmarked for commercial buildings to $120 million in 2012. Furthermore, it is assumed that commercial building ClimateSmart loans will be used to install bundles of EE measures that, on average, produce the impacts of those associated with the hypothetical Bundle 1 of WSP's analysis. No solar PV or solar water heaters are assumed to be installed with loan proceeds due to the much better financial performance of EE prompting commercial building owners to focus solely on EE. About 43% of loans for the residential sector were disbursed to properties within the city of Boulder. It was assumed that this same ratio would apply for commercial loans.

Table 19 shows the market penetration, and reductions achievable, through the ClimateSmart Loan implementation schedule defined above. Please note that this is sufficient to achieve the 35% market penetration target identified in Option A.

Table 19. ClimateSmart Loans emissions reductions and market penetration.

Assumptions	**2008**	**2009**	**2010**	**2011**	**2012**
Incremental ClimateSmart Loans disbursed (USD)	0	0	12,000,000	48,000,000	60,000,000
Disbursals for properties in city of Boulder (USD)	0	0	5,249,426	20,997,704	26,247,130
Market penetration rate (%)	0%	0%	4%	20%	35%
Total area covered (sf)	0	0	1,601,323	7,820,052	13,765,731
Incremental area covered (sf)	0	0	1,601,323	6,218,729	7,547,001
EE Bundle implem costs ($/sf)	3.09	3.2	3.3	3.4	3.5
Electricity savings (USD/MWh)	100	102.0	104.0	106.1	108.2
Natural gas savings (USD/MWh)	34.1	34.8	35.5	36.2	36.9
City Grid Emission Factor (tCO_2/MWh)	0.854	0.848	0.843	0.837	0.831
Natural Gas EF (tCO_2/MWh)	0.18				
Energy savings (MWh)	**2008**	**2009**	**2010**	**2011**	**2012**
Electricity	0	0	8,053	39,329	69,231
Natural gas	0	0	5,124	25,021	44,044
Cost savings ($)	**2008**	**2009**	**2010**	**2011**	**2012**
Electricity	0	0	837,873	4,173,583	7,493,744
Natural gas	0	0	181,929	906,218	1,627,131
Total (annual)	0	0	1,019,802	5,079,801	9,120,875
Total (cumulative)	0	0	1,019,802	6,099,603	15,220,479
GHG reductions achieved (tCO_2)	**2008**	**2009**	**2010**	**2011**	**2012**
Electricity Grid displacement	0	0	6,787	32,920	57,558
Natural gas displacement	0	0	927	4,529	7,972
Total (tCO_2)	0	0	7,714	37,449	65,530

Transportation Sector Recommendations

There are three types of strategies for achieving emissions reductions (ERs) in the transportation sector: increase vehicle fuel efficiency, switch to a less carbon-intensive fuel, and reduce vehicle miles traveled (VMT). While it is important to have programs that aim to reduce VMT, this approach relies on changes in motorists' behavior. As such, it is very difficult to achieve success via programmatic initiatives alone, absent larger forces that can elicit behavior changes. The prime example of that latter is the price of conventional motor fuel. Recent experience with the effects of high gasoline and diesel prices provides strong evidence that motorists will drive less, and use RTD and other modes more, as fuel prices escalate. The market effects of fuel price increases will likely have a bigger impact on emissions reductions than what CAP strategies can hope to achieve.

Nevertheless, VMT reduction programs need to be part of the City's mix of strategies. Due to the difficulty in changing behavior, an aggressive focus on improving vehicle efficiency and on switching to lower-carbon fuels must be the primary goal of the transportation sector carbon management plan. Ethanol fuel blends must be a central strategy.

There is a distinction between carbon accounting for GHG inventory purposes and life-cycle carbon accounting for a product supply chain. The city's carbon footprint (GHG inventory) is based on inventory carbon-accounting principles. With respect to carbon emissions emanating from the transportation sector, the city's GHG inventory does not include emissions produced upstream in the motor fuels product supply chain but only the carbon emissions from vehicle tailpipes. Thus, ethanol is a potent tool in the transportation sector emissions management toolbox for shrinking the city's GHG inventory.

While it is true that traditional corn starch ethanol is not a sustainable motor fuel, it is also true that corn ethanol is a necessary bridge to the future in which truly sustainable ethanol will be produced via next-generation technologies using non-food biomass feedstocks. Furthermore, it is also true that not all of today's corn ethanol is created equal. Using existing technology, it is possible today to manufacture ethanol from corn that achieves parity with the sustainability of Brazilian sugarcane ethanol, which is widely viewed as currently the planet's most sustainable biofuel. Taking a product supply-chain perspective of ethanol, and all other prospective transportation sector solutions, will be the appropriate perspective once truly sustainable ethanol is being produced by next-generation technologies. In the interim, the City must embrace the greenest corn ethanol available and use it aggressively toward the 2012 GHG goal. Otherwise, there is no hope for achieving this goal. Despite resistance to ethanol by some City Council members and citizens, due to concerns about the life-cycle emissions of the ethanol product supply chain, WSP recommends that ethanol fuel strategies remain a tool in the City's emissions mitigation toolbox until such time as is achieved sufficient scientific understanding of the very complicated indirect land-use change element of the ethanol life cycle and, if that scientific understanding advises against biofuels, then the City can take another approach.

WSP has performed preliminary analysis of several emissions mitigation programmatic approaches that are available to the City. The results of this analysis are summarized below.

Provide administrative support to Boulder County to enact a feebate program for vehicles. A feebate program can be designed to be self-financing in its implementation. However, it does involve costs for its administration,

which may be done most effectively at vehicle registration. The legal hurdles faced by a feebate program must be addressed before the City can move forward with this potentially significant emissions mitigation tool. The City, in conjunction with Boulder County, should do everything it can to convince the Governor and the Legislature that legislation must be expedited to facilitate feebate implementation as soon as possible.

If a feebate program were fully operational in January 2009, such that four full years of new vehicle purchasing decisions are influenced by the feebate incentive, it is estimated that 2012 carbon emissions reductions could be about 11,200 mtCO2e. Optimistically assuming that the feebate captures 100% of new vehicle purchasing decisions, this represents 7% of the ERs that are needed in the transportation sector to hit the nominal target for this sector.

Develop grant program to promote the retail availability of E85 (85% ethanol/15% gasoline blend) and biodiesel at participating gas stations. It is estimated that several thousand flex-fuel vehicles (FFVs), designed to run on E85 fuel, are currently registered in Boulder. The tailpipe carbon emissions of an individual FFV are about 85% lower when it is running on E85, compared to running on straight gasoline. Clearly, an ethanol fuels program is an important policy instrument for the City in the context of shrinking the Boulder economy's carbon footprint. Maximum carbon management benefit derived from ethanol fuels can be realized either by dramatically increasing the number of FFVs (each running on E85), or making mid-level blends of ethanol (E20 or E30) widely available, or both. Currently, a number of gas stations in Kansas and South Dakota offer E30 (30% ethanol/70% gasoline). While the sale of E30 is not currently officially sanctioned by the EPA, USDOE is now actively promoting E20, because of the national energy security and balance-of-payments imperative to reduce foreign oil imports. . From a legal perspective, as long as the retail fuel outlet provides adequate labeling, warning motorists that exceeding an E30 blend in a non-FFV could result in vehicle damage, it can legally sell E30. However, the fuel retailer may have exposure to liability risk in the event of a customer failing to follow the warning labels. It should be noted that a motorist risks vehicle damage if he/she were to put E85 in a non-FFV, yet E85 is officially sanctioned for retail sale.

Because of its unmatched potential to reduce transportation sector carbon emissions, WSP believes that Council should serious investigate the advisability of an E30 program. By providing the E30 alternative, every motorist is a potential partner in the CAP since every vehicle can use E30 with no modifications and without incurring any damage to the engine and fuel system. This grant program would buy down the cost to fuel retailers of installing the necessary equipment to enable the retail sale of E85, E30, and biodiesel. By making E30 available at retail, the transportation sector portion of the economy-wide carbon footprint could potentially be substantially reduced.

If an ethanol and biodiesel fuels program were aggressively implemented, such that by the end of 2012 sales of pure ethanol (sold in the form of E30 and E85) represented 30% of Boulder's total gasoline vehicle fuel sales and sales of pure biodiesel (sold as B20 and B100) captured 17% of the total diesel vehicle fuel sales, it is estimated that 2012 carbon emissions could be reduced by about 65,600 mtCO2e. This represents 42% of the ERs that are needed in the transportation sector to hit the sector's nominal target.

Develop a Battery Leasing Program. This program would alleviate concerns about the high cost of batteries for Plug-In Hybrid Electric Vehicles (PHEVs) and electric vehicles (EVs), and thereby facilitate market transformation toward widespread adoption of these types of vehicles. The batteries would be owned and managed by an ESCO

or equipment leasing company, or possibly Xcel, and leased to PHEV/EV owners. When a battery reaches the end of its life, the program would recycle the battery in an environmentally responsible manner and lease another battery to the car owner. While PHEVs and EVs are currently unavailable on a commercial scale in the United States, the development of this program should begin today in order to prepare for quick implementation once mass-production vehicles are available, starting in 2010.

An individual PHEV, charged with Xcel baseload electricity (mostly coal-fired electricity), can achieve net ERs of 35% in 2012 (at the tailpipe, which is the GHG inventory boundary for the Boulder transportation sector), compared to a similarly sized gasoline-fueled vehicle, if the backup fuel of the PHEV is gasoline. Net tailpipe ERs of 43% can be achieved by an individual PHEV if its backup fuel is E85. These ERs reflect the assumption that Xcel bseload electricity in 2012 will be about 8% less carbon-intensive than today, as a result of the Colorado RPS.

If a PHEV/EV battery leasing program were aggressively implemented, such that by the end of 2012, 57% of Boulder's private vehicle fleet were PHEVs or EVs, it is estimated that 2012 carbon emissions reductions could be about 79,400 mtCO2e. This represents 51% of the ERs that are needed in the transportation sector to hit the nominal sector target. Even greater impacts can be achieved if Vehicle-to-Grid (V2G) technology were significantly deployed and exploited via the Smart Grid. The very aggressive market penetration rates assumed here reflect the fact that the motorist's energy cost per mile driven is about ***77% lower*** with a PHEV relative to a comparable conventional gasoline-fueled vehicle (at $60/barrel of petroleum). Such a dramatic cost savings provides an exceptionally strong incentive for a motorist to switch to a PHEV.

Develop an Ethanol-Rating System Based on Supply-Chain Carbon Emissions. WSP is currently performing work in support of refinements of the federal Renewable Fuels Standard that would create a sliding-scale incentive structure that rewards ethanol producers that implement aggressive actions to increase the "greenness" of their ethanol product. The greener the ethanol, the greater the subsidy. Under this scheme, much of the ethanol produced today would earn zero subsidy. This incentivizes ethanol producers to move rapidly away from traditional corn ethanol – first to greener corn ethanol and, as next-generation technology becomes available, to extreme-green ethanol. WSP's work in this arena can provide the basis for the City to develop an ethanol fuels program that employs an ethanol rating system that encourages only the greenest-available ethanol to be dispensed in the Boulder retail market. Emissions reductions achieved via ethanol, for purposes of shrinking Boulder's carbon footprint, would be accounted for within the impacts produced by the E30/Biodiesel program outlined above.

The following tables summarize the estimated impacts of transportation sector strategies under various market penetration scenarios and show the magnitude of each scenario's contribution toward meeting the nominal carbon emissions goal for the transportation sector. Tier 1, Tier 2, and Tier 3 scenarios are progressively more aggressive.

Table 20. Tier 1 Scenario

	tCO2e	Market Penetration	% of Required Reduction
Transportation Sector 2012 BAU Emissions	485,072	------	------
Transportation Sector 2012 Target	328,864	------	------
Required Emissions Reduction	156,208	------	------
Feebate Emissions Reduction	11,200	100% for new vehicles	7%
Biofuels Emissions Reduction	------	------	------
PHEV/EV Battery Leasing	27,999	20%	18%
Total ERs	39,199	------	25%
Required carbon offsets to close gap	117,009	------	------

Table 21. Tier 2 Scenario

	tCO2e	Market Penetration	% of Required Reduction
Feebate Emissions Reduction	11,200	100% for new vehicles	7%
Biofuels Emissions Reduction	65,563	30% ethanol/17% biodiesel	42%
PHEV/EV Battery Leasing	27,999	20%	18%
Total ERs	104,762	------	67%
Required carbon offsets to close gap	51,446	------	------

Table 22. Tier 3 Scenario

	tCO2e	Market Penetration	% of Required Reduction
Feebate Emissions Reduction	11,200	100% for new vehicles	7%
E30/Biodiesel Emissions Reduction	65,600	30% ethanol/17% biodiesel	42%
PHEV/EV Battery Leasing	79,400	57%	51%
Total ERs	156,208	------	100%
Required carbon offsets to close gap	0	------	------

Program costs are assumed to be those associated with administration and promotion for the Feebate program. The Biofuels program is assumed to cost $450,000/year over four years to buy down the cost of installing biofuels equipment at 30 retail outlets, plus the cost of administration and promotion. Costs borne by motorists are assumed to be the same per mile driven using biofuels as using gasoline or petrodiesel. For the Battery Leasing program, costs are assumed to be only those associated with administration and promotion. The participating

motorist's energy cost savings under the battery leasing program are assumed to equal the incrementally higher cost of lease payments such that the motorist experiences a net-zero cost impact from program participation.

Section 5: Summary

Boulder has made great strides in the past four years to create the foundations for reducing its energy consumption. The City has become a leader among local governments in creating an aggressive Climate Action Program and working to achieve a substantial goal to reduce its GHG emissions as defined by the Kyoto Protocol. Yet the greatest challenge still lies ahead. As Table 23 shows, the gaps between the 2012 target and Business As Usual (BAU) are significant, and with each year that passes without aggressive and comprehensive actions to acquire actual emissions reductions, the challenge of eliminating that gap grows.

Table 23. Projected BAU versus Target Emissions.

Sector	Sector 2012 BAU Emissions (tCO2)	Sector 2012 target (tCO2)	Required Emissions Reductions (tCO2)
Commercial/Industrial	944,694	681,400	263,294
Residential	342,895	248,703	94,192
Transportation	445,256	328,864	116,392
Total	1,732,845	1,258,967	473,878

In this report, we have summarized the results and findings accumulated in the programs implemented by the City in the past four years. Many of the programs will be discontinued as Xcel begins to administer many of the auditing programs for residential, commercial/industrial and industrial sectors. Thus, the City has an opportunity to be more aggressive in fomenting the actual implementation of ER measures. WSP has made the following recommendations for the City:

General Recommendations

Increase the carbon tax rate to its maximum allowed, and allocate all additional resources collected to actual installation of measures that reduce emissions (direct-impact programs).

When supporting direct-impact programs, promote comprehensive programs or “packages” of measures rather than single-technology programs.

Encourage Boulder County to aggressively and rapidly increase funding available from the ClimateSmart Loan Program and leverage the financial mechanisms to achieve maximum emissions reductions within the city of Boulder.

Provide financial and awareness support to individual customers’ connection to the Smart Grid.

Implement RECO and CECO as part of a carrot and stick approach to reducing GHG emissions.

Residential Recommendations

Discontinue the Residential Energy Assessment Program (REAP), the Multi-family Unit (MFU) audit program and the Utility Bill Analysis program, freeing up resources for project implementation.

Provide increased marketing and outreach to raise awareness of Xcel's Residential rebate.

Maximize ClimateSmart Loan Program to the greatest extent possible, as quickly as possible.

Establish a Grant Program (for rental units).

Establish a buy-down program to complement ClimateSmart Loans. This program, ClimateSmart Loans, and the grant program will provide significant financing for compliance with RECO.

Continue Home Performance with Energy Star (HPwES) or similar contractor training programs.

Commercial/Industrial Recommendations

Discontinue both the Building Performance Program and the PACE EnergySmart for Business Program, freeing up resources for project implementation.

Maximize ClimateSmart Loan Program to the greatest extent possible, as quickly as possible.

Establish a Guarantee Fund that will back ESCO performance contracting in commercial/industrial buildings that are too small for the conventional ESCO model to treat.

Establish a Grant Facility to support project implementation in the even smaller commercial/industrial buildings that the Guarantee Fund Program cannot treat. This program, ClimateSmart Loans, and the ESCO program will provide significant financing for compliance with CECO.

Carry out targeted outreach events to raise awareness of commercial/industrial Xcel DSM initiatives (Energy Analysis Program, Standard Offer Program and rebates), in cooperation with the Boulder Chamber of Commerce.

Transportation Recommendations

Provide administrative support to Boulder County to enact a feebate program for vehicles.

Develop grant program to promote the sale of E30 (30% ethanol/70% gasoline blend) and biodiesel at participating gas stations.

Develop a Battery Leasing Program.

Develop an Ethanol-Rating System Based on Supply-Chain Carbon Emissions.

Summary of three program options for achieving the emissions reductions target

We have developed the following three programmatic options by which the City can achieve the volume of GHG ERs embodied in the economy-wide GHG reduction goal. These options are based on varying combinations of the recommendations given above. The costs associated with each option are the costs to the CAP budget, not the cost of implementation.

Option A: Increase ClimateSmart Loans funding for residential to $280 million and for commercial/industrial to $120 million, cumulative; implement transportation programs to achieve a market penetration of 35%, all of which will result in GHG emission reductions that still fall short of the overall 2012 goal. The balance of GHG emissions can be achieved by purchasing RECs or carbon offsets. The City must bear in mind that purchasing RECs/Offsets represents a substantial and recurring annual cost that has zero financial return.

> Option A will cost the CAP nothing (cumulative investment through 2012) for the residential and commercial/industrial sectors (except for administration costs), and $1,800,000 for the transportation sector. This ClimateSmart Loans level for residential will close the gap for that sector to about 22,000 tCO2, at no cost to the CAP budget. Market penetration of 35% by Bundle 1 EE measures in the commercial/industrial sector will be achieved through the ClimateSmart Loan Program at zero cost to the CAP budget, leaving a gap for that sector of about 200,000 tCO2. Option A also necessitates an annual recurring cost post-2012 for purchased RECs and Offsets to meet the 2012 goal, which we estimate at $350,000 for residential, $3,500,000 for commercial/industrial, and $771,270 for transportation.

Option B: Increase ClimateSmart Loans funding for residential to $280 million and for commercial/industrial to $120 million, cumulative; implement a new Buy-Down program for residential; implement new programs for commercial/industrial; and implement more aggressive transportation programs to achieve varying market penetration (depending on the program) which will result in GHG emission reductions that do reach the 2012 goal. In this option, the Buy-Down program will yield 11% market penetration and close the residential gap remaining after accounting for ClimateSmart Loans impact. The commercial/industrial Bundle 2 EE measures, which are more expensive and have a longer payback period, are implemented in the commercial/industrial sector. As such, the ClimateSmart Loan Program only covers 11% of the commercial/industrial market. Financing for the remaining 89% of the market is provided through the Guarantee Fund and Grant Facility. This option will provide the reductions needed to achieve the 2012 goal and eliminates the need to purchase RECs or offsets, but will require a substantially greater effort and investment to achieve the requisite higher levels of market penetration.

> Option B will cost $16,000,000 for the residential sector, $151,000,000 for the commercial/industrial sector, and $1,800,000 for the transportation sector. The costs for the commercial/industrial sector are much higher in Option B because the goal is 100% implementation of Bundle 2 EE measures, which is triple the cost of Bundle 1 used in Option A. In this scenario, the Guarantee Fund and Grant Facility also require significantly higher cash injections because of the extremely rapid implementation schedule (89% of the market in four years).

Option C: A combination of Options A and B, aiming for a relaxed target date by extending the 2012 deadline to 2020 in order to achieve the requisite market penetration levels under a more realistic timeline.

Option C uses the Option B approach for the residential and transportation sectors, but will be spread out over a longer period of time. For the commercial/industrial sector, this option uses the Bundle 1 EE measures from Option A, achieving a market penetration of 100% by 2020. Of this, the ClimateSmart Loan Program provides financial mechanisms for 35% of the commercial/industrial market and the Guarantee Fund and Grant Facility provide financial mechanisms for the remaining 65% of the market.

Table 24. Summary of Programmatic Option Impacts.

Sector	Option A		Option B		Option C (2020)	
	Reductions (tCO2)	Cumulative cost to CAP (Mil. $)	Reductions (tCO2)	Cumulative cost to CAP (Mil. $)	Reductions (tCO2)	Cumulative cost to CAP (Mil. $)
Commercial/Industrial	66,500	0	250,000	151	250,000	120
Residential	72,000	0	94,000	16	94,000	16
Transportation	40,000	1.8	105,000	1.8	105,000	1.8
Total	178,500	1.8	449,000	168.8	449,000	137.8

Figures 11 and 12 (next pages) present Options A and B in graphical form. Option C has the same emissions reduction profile as Option B, only with the endpoint in the year 2020.

Figure 11: Option A.

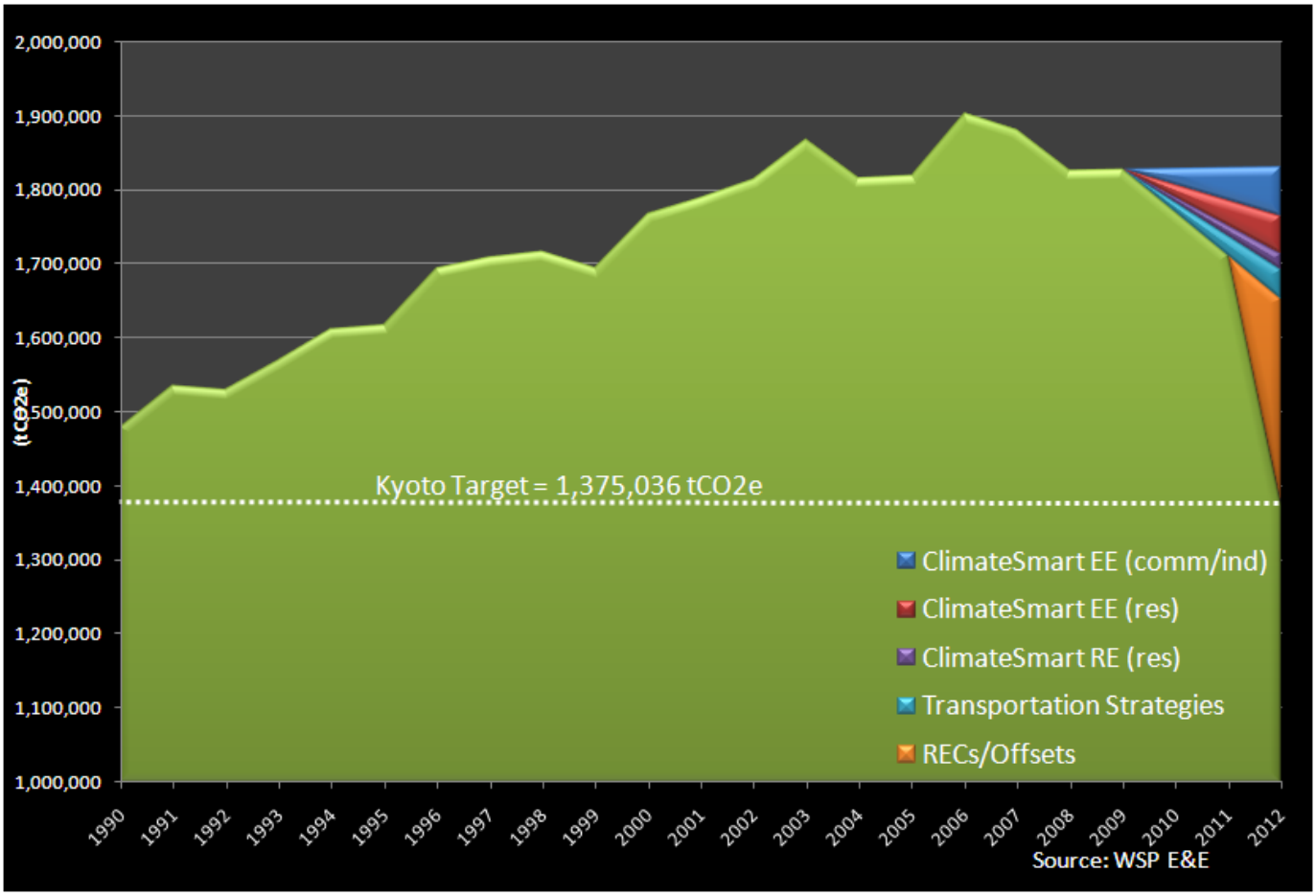
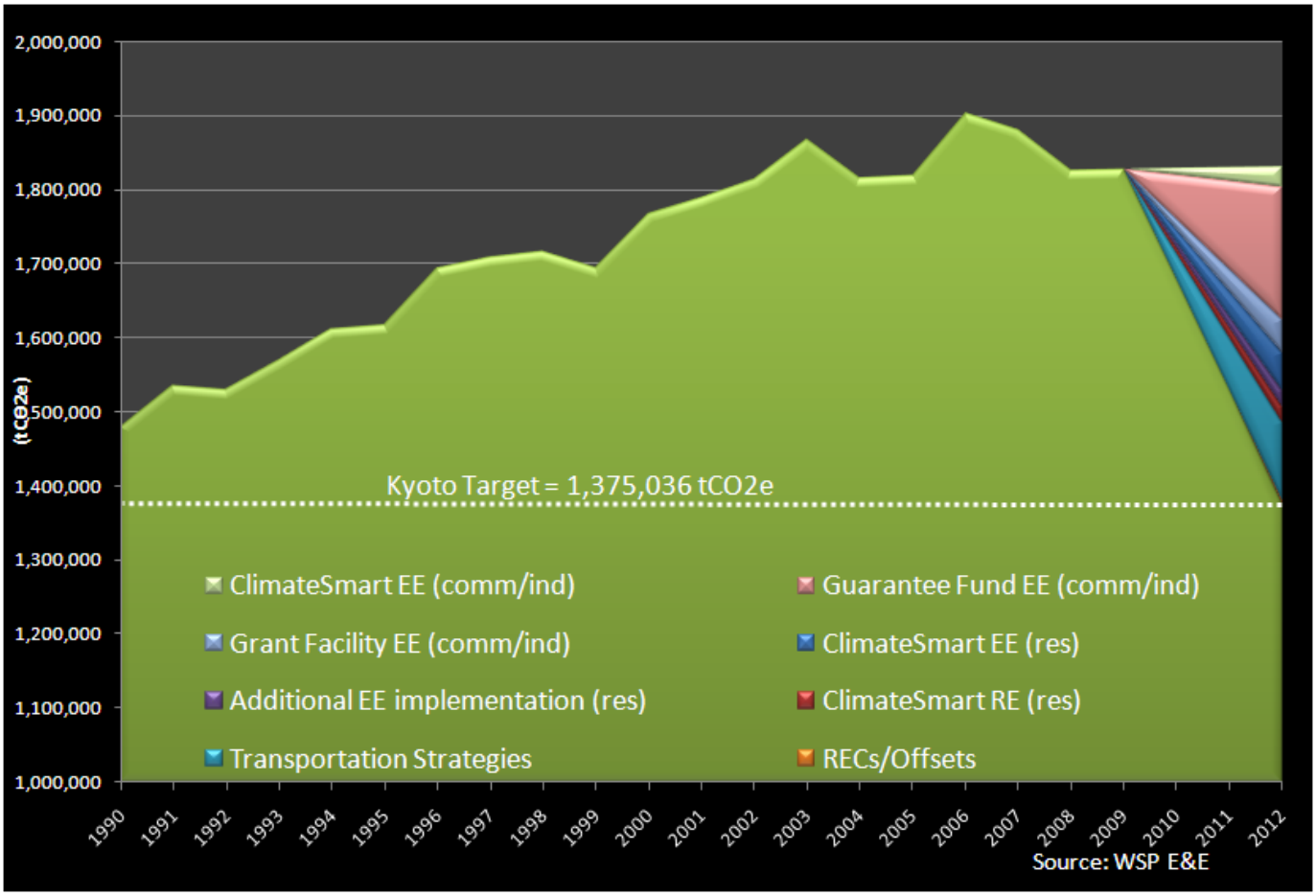


Figure 12: Option B. (Note – Option C has the same profile, with the endpoint extended to 2020)



Annex A. Guarantee Fund and Grant Facility – Complete tables (2009-2020)

Guarantee Fund projections (high allocation scenario)

Guarantee Fund balance sheet	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Fund inflows													
City annual allocations		2,200,000	1,870,000	1,589,500	1,351,075	1,013,306	759,980	759,980	759,980	759,980	759,980	759,980	759,980
Interest on uncommitted capital		0	175,111	195,949	73,020	88,605	75,667	65,644	62,864	67,410	79,153	91,342	104,056
Share of customers' savings		99,398	302,314	520,116	738,377	858,585	998,363	1,160,896	1,349,890	1,569,652	1,825,192	2,122,333	2,467,849
Total		2,299,398	2,347,425	2,305,565	2,162,472	1,960,496	1,834,010	1,986,520	2,172,734	2,397,042	2,664,324	2,973,655	3,331,884
Fund outflows													
Guarantees liquidated (losses)		0	912,035	1,867,394	1,946,551	1,993,209	1,005,973	1,181,213	1,386,981	1,628,593	1,912,294	2,245,415	2,636,566
Balance (inflows-outflows)		**2,299,398**	**1,435,390**	**438,171**	**215,921**	**-32,713**	**828,037**	**805,306**	**785,754**	**768,449**	**752,031**	**728,240**	**695,318**
Closing balance, year end		**2,299,398**	**3,734,789**	**4,172,960**	**4,388,880**	**4,356,167**	**5,184,204**	**5,989,510**	**6,775,264**	**7,543,713**	**8,295,744**	**9,023,983**	**9,719,301**
Check (closing balance - reserve req)		**2,299,398**	**86,651**	**90,687**	**2,867,635**	**2,510,236**	**3,607,802**	**4,621,936**	**5,465,592**	**6,139,342**	**6,646,731**	**7,121,025**	**7,551,472**
Guarantee reserve requirements		**0**	**3,648,138**	**4,082,273**	**1,521,246**	**1,845,932**	**1,576,402**	**1,367,574**	**1,309,672**	**1,404,371**	**1,649,013**	**1,902,959**	**2,167,830**
Guarantee Fund performance	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Loan amounts, face value		5,066,858	10,374,414	10,814,175	11,073,386	5,588,738	6,562,296	7,705,448	9,047,737	10,623,853	12,474,528	14,647,591	17,199,201
EE implementation costs (annual)		5,066,858	10,437,728	10,750,860	11,073,386	5,588,738	6,562,296	7,705,448	9,047,737	10,623,853	12,474,528	14,647,591	17,199,201
Difference		0	-63,314	63,314	0	0	0	0	0	0	0	0	0
Covered by fund as % of total required		***100%***	***99%***	***101%***	***100%***	***100%***	***100%***	***100%***	***100%***	***100%***	***100%***	***100%***	***100%***
Guarantees liquidated, during year		0	912,035	1,867,394	1,946,551	1,993,209	1,005,973	1,181,213	1,386,981	1,628,593	1,912,294	2,245,415	2,636,566
Guarantees outstanding, year end		3,648,138	10,205,682	15,212,458	18,459,316	15,764,017	13,675,742	13,096,718	14,043,712	16,490,127	19,029,585	21,678,296	24,914,580
Principal outstanding, year end (total)		4,053,487	11,339,646	16,902,731	20,510,351	17,515,574	15,195,269	14,551,908	15,604,124	18,322,363	21,143,983	24,086,995	27,682,867
Energy savings (MWh)	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Electricity	0	8,006	23,874	40,268	56,045	63,892	72,837	83,034	94,658	107,911	123,018	140,241	159,874
Natural gas	0	5,094	15,188	25,618	35,656	40,648	46,338	52,826	60,221	68,652	78,264	89,221	101,712
Cost savings ($)	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Electricity	0	816,662	2,483,826	4,273,293	6,066,535	7,054,167	8,202,585	9,537,966	11,090,747	12,896,320	14,995,841	17,437,164	20,275,935
Natural gas	0	177,323	539,318	927,868	1,317,239	1,531,685	1,781,043	2,070,997	2,408,155	2,800,203	3,256,076	3,786,165	4,402,553
Total (annual)	0	993,985	3,023,144	5,201,161	7,383,773	8,585,852	9,983,628	11,608,963	13,498,902	15,696,524	18,251,918	21,223,330	24,678,488
Total (cumulative)	0	993,985	4,017,129	9,218,290	16,602,063	8,585,852	18,569,480	30,178,443	43,677,345	59,373,869	77,625,786	98,849,116	123,527,604
GHG reductions achieved (tCO_2)	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Electricity Grid displacement	0	6,792	20,118	33,707	46,596	53,120	60,556	69,034	78,699	89,717	102,277	116,596	132,920
Natural gas displacement	0	922	2,749	4,637	6,454	7,357	8,387	9,561	10,900	12,426	14,166	16,149	18,410
Total (tCO_2)	0	7,714	22,868	38,343	53,050	60,477	68,944	78,596	89,599	102,143	116,443	132,745	151,329

Guarantee Fund projections (reduced allocation scenario)

Guarantee Fund balance sheet	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Fund inflows													
City annual allocations		1,100,000	935,000	794,750	675,538	506,653	379,990	379,990	379,990	379,990	379,990	379,990	379,990
Interest on uncommitted capital		0	88,331	98,089	42,878	53,454	67,139	79,230	89,978	99,485	99,395	101,772	106,192
Share of customers' savings		50,139	150,909	348,445	453,775	1,444,978	1,621,346	1,753,427	1,846,680	1,624,272	1,825,192	2,009,480	1,971,435
Total		1,150,139	1,174,239	1,241,284	1,172,190	2,005,086	2,068,474	2,212,646	2,316,649	2,103,747	2,304,577	2,491,241	2,457,617
Fund outflows													
Guarantees liquidated (losses)		0	460,056	932,161	1,304,068	1,224,941	1,693,028	1,918,296	2,094,906	2,227,952	1,978,836	2,245,415	2,496,369
Balance (inflows-outflows)		**1,150,139**	**714,184**	**309,123**	**-131,877**	**780,144**	**375,446**	**294,350**	**221,743**	**-124,205**	**325,741**	**245,826**	**-38,752**
Closing balance, year end		**1,150,139**	**1,864,323**	**2,173,446**	**2,041,569**	**2,821,713**	**3,197,160**	**3,491,510**	**3,713,253**	**3,589,048**	**3,914,789**	**4,160,615**	**4,121,863**
Check (closing balance - reserve req)		**1,150,139**	**24,100**	**129,921**	**1,148,282**	**1,708,078**	**1,798,436**	**1,840,888**	**1,838,702**	**1,516,434**	**1,844,058**	**2,040,375**	**1,909,539**
Guarantee reserve requirements		**0**	**1,840,223**	**2,043,525**	**893,287**	**1,113,635**	**1,398,723**	**1,650,622**	**1,874,551**	**2,072,614**	**2,070,731**	**2,120,240**	**2,212,323**
Guarantee Fund performance	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Loan amounts, face value		2,555,865	5,178,675	7,244,820	6,805,229	9,405,710	10,657,199	11,638,367	12,377,509	10,993,531	12,474,528	13,868,716	13,739,542
EE implementation costs (annual)		5,066,858	10,437,728	10,750,860	11,073,386	5,588,738	6,562,296	7,705,448	9,047,737	10,623,853	12,474,528	14,647,591	17,199,201
Difference		-2,510,993	-5,259,054	-3,506,041	-4,268,157	3,816,972	4,094,903	3,932,919	3,329,772	369,678	0	-778,875	-3,459,659
Covered by fund as % of total required		***50%***	***50%***	***67%***	***61%***	***168%***	***162%***	***151%***	***137%***	***103%***	***100%***	***95%***	***80%***
Guarantees liquidated, during year		0	460,056	932,161	1,304,068	1,224,941	1,693,028	1,918,296	2,094,906	2,227,952	1,978,836	2,245,415	2,496,369
Guarantees outstanding, year end		1,840,223	5,108,813	8,932,866	11,136,346	13,987,232	16,506,217	18,745,508	20,726,144	20,707,305	21,202,397	22,123,231	22,549,597
Principal outstanding, year end (total)		2,044,692	5,676,459	9,925,407	12,373,718	15,541,368	18,340,241	20,828,343	23,029,049	23,008,117	23,558,219	24,581,368	25,055,107
Energy savings (MWh)	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Electricity	0	4,039	11,917	26,977	34,443	107,528	118,287	125,415	129,495	111,666	123,018	132,783	127,715
Natural gas	0	2,569	7,582	17,163	21,913	68,409	75,254	79,788	82,384	71,041	78,264	84,476	81,252
Cost savings ($)	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Electricity	0	411,947	1,239,870	2,862,839	3,728,233	11,871,991	13,321,035	14,406,216	15,172,392	13,345,074	14,995,841	16,509,956	16,197,383
Natural gas	0	89,447	269,215	621,614	809,518	2,577,789	2,892,422	3,128,050	3,294,411	2,897,642	3,256,076	3,584,839	3,516,969
Total (annual)	0	501,394	1,509,086	3,484,452	4,537,751	14,449,780	16,213,458	17,534,266	18,466,804	16,242,716	18,251,918	20,094,795	19,714,353
Total (cumulative)	0	501,394	2,010,479	5,494,932	10,032,683	14,449,780	30,663,238	48,197,503	66,664,307	82,907,023	101,158,940	121,253,735	140,968,088
GHG reductions achieved (tCO_2)	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Electricity Grid displacement	0	3,426	10,043	22,581	28,636	89,399	98,344	104,270	107,662	92,839	102,277	110,396	106,183
Natural gas displacement	0	465	1,372	3,106	3,966	12,382	13,621	14,442	14,912	12,858	14,166	15,290	14,707
Total (tCO_2)	0	3,891	11,415	25,688	32,602	101,781	111,965	118,712	122,574	105,697	116,443	125,686	120,889

Grant Facility projections (up to 2020)

Cost savings ($)	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Electricity	0	204,165	624,746	1,062,068	1,516,634	1,763,542	2,050,646	2,384,491	2,772,687	3,224,080	3,748,960	4,359,291	5,068,984
Natural gas	0	44,331	135,652	230,609	329,310	382,921	445,261	517,749	602,039	700,051	814,019	946,541	1,100,638
Total (annual)	0	248,496	760,398	1,292,677	1,845,943	2,146,463	2,495,907	2,902,241	3,374,726	3,924,131	4,562,979	5,305,832	6,169,622
Total (cumulative)	0	248,496	1,008,895	2,301,572	4,147,515	6,293,978	8,789,885	11,692,126	15,066,852	18,990,983	23,553,962	28,859,795	35,029,416
EE bundle implementation costs ($)	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Implementation cost (annual)	0	1,266,715	2,609,432	2,687,715	2,768,346	1,397,184	1,640,574	1,926,362	2,261,934	2,655,963	3,118,632	3,661,898	4,299,800
Implementation cost (cumulative)	0	1,266,715	3,876,147	6,563,862	9,332,208	10,729,393	12,369,967	14,296,329	16,558,263	19,214,226	22,332,858	25,994,756	30,294,556
Simple payback (years)		5.10	5.10	5.08	5.06	5.00	4.96	4.93	4.91	4.90	4.89	4.90	4.91
Grant Facility required resources	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Desired PBP		3	3	3	3	3	3	3	3	3	3	3	3
Desired PBP as a % of actual		59%	59%	59%	59%	60%	61%	61%	61%	61%	61%	61%	61%
Resources required to buy-down PBP		521,226	1,073,725	1,099,771	1,125,581	558,645	647,511	753,173	878,926	1,028,677	1,207,065	1,419,590	1,672,780
Subs implementation cost (annual)		745,489	1,535,707	1,587,944	1,642,766	838,539	993,063	1,173,189	1,383,009	1,627,286	1,911,567	2,242,308	2,627,021
Subs implementation cost (cumulative)		745,489	2,281,195	3,869,140	5,511,905	6,350,444	7,343,508	8,516,697	9,899,706	11,526,992	13,438,559	15,680,867	18,307,888
Subs PBP		3	3	3	3	3	3	3	3	3	3	3	3