2012 Community Greenhouse Gas Inventory Results

EXECUTIVE SUMMARY

The City of Boulder has completed an update to the communitywide greenhouse gas (GHG) inventory for the 2012 calendar year. This update was calculated in a new data reporting tool custom designed for the city by SWCA Environmental Consultants. The tool calculates emissions using ICLEI Local Governments for Sustainability U.S. Community Protocol, the new national standard for GHG emissions reporting. This protocol uses slightly different calculations and includes several new emissions sources as compared to previous inventories done by the city.[i] The data sources for this inventory are not consistent with past inventories as the city no longer receives franchise reports from its electric and natural gas utility, Xcel Energy. Using the new tool and omitting 2012 data sources for which data was not available in 2005, staff recreated Boulder's 2005 GHG baseline to create as accurate a comparison as possible between the baseline inventory and the current inventory.

Notwithstanding imperfect data, there are several key conclusions that can be drawn from the 2012 inventory. Since 2005, community emissions have remained fairly constant despite growth in population, jobs and economic activity. Boulder's biggest success in stabilizing emissions has been in the areas of waste, vehicle transportation and per capita residential energy use—all areas targeted by the city's climate programs and related initiatives between 2005 and 2012. The commercial and industrial sector (C&I)[ii] represents the greatest opportunity for reductions, thus reinforcing the city's targeted approach in designing policies and programs for this sector. Several new policies and programs for the C&I sector are in development and will be implemented in 2016.

Moving forward, the city hopes that improved data availability, either through action with the Public Utilities Commission (PUC) to introduce a standardized Community Energy Report from energy utilities, or through municipalization efforts, will support more accurate and detailed future inventories using the new ICLEI Protocol and the SWCA tool. In any inventory year, factors such as heating and cooling degree days, economic trends, and significant local developments impact emissions, requiring careful attention to and consideration of these factors in mapping overall emission trajectories to measure progress and inform next steps in policy and action.

BACKGROUND

Importance of a Greenhouse Gas Inventory

In 2002, the Boulder City Council passed Resolution 906, committing the community to reducing its GHG emissions to the target established by the Kyoto Protocol, a 1997 international agreement to combat global climate change. As a result, Boulder launched a series of climate action efforts in 2002 with the goal of reducing community emissions 7 percent by 2012. Boulder's first GHG inventory was conducted in 2006 and was updated again in 2010. In 2013, the city adopted the ICLEI Local Governments for Sustainability U.S. Community Protocol for communitywide emissions reporting and built an inventory tool to compile and report emissions congruent with this new national standard. This report provides the results of the completion of the first full inventory conducted using the tool, for emissions generated in the 2012 calendar year.

What are emissions and why do they matter?

A greenhouse gas is defined as any gas that traps heat in the atmosphere. These heat trapping gases, including carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), are essential to life on earth, maintaining the temperature of the planet and sustaining life. They are produced and released into the atmosphere through the everyday activities of the planet and its inhabitants: plants, animals and people. Since the Industrial Revolution, global GHG emissions have increased exponentially through the production and burning of fossil fuels and generated waste products. More than 70% of global emissions come from cities such as Boulder. The impacts of this exponential increase, referred to as "climate change," present significant current and projected, local and global issues.

In Colorado, the biggest concern is a shift in precipitation patterns, with more falling in the form of rain than snow. This results in smaller snow packs and thus increases the chance of drought, especially in late summer, as well as the likelihood of wildfires. More severe rain events could also increase the frequency of major flooding and landslides. On a global scale, it is predicted that areas subject to storms and flooding could see increases in intensity, frequency and duration of these events; that arid deserts could grow due to lack of available water; and that rising sea levels could inundate many coastal areas, including major population centers.

What can we learn from measuring emissions?

In 1992, the United Nations Framework Convention on Climate Change, an international environmental treaty, was negotiated with the objective to "stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.[iii] In order to stabilize GHG concentrations to a manageable level, it is helpful to create an emissions baseline against which to set reduction targets. Based on data quality and availability, as well as consistency with other Front Range communities, Boulder has adopted a 2005 baseline. This baseline will be used for the communitywide emissions inventory as well as for the city's municipal GHG inventory (i.e., emissions from city operations). By measuring emissions and monitoring trends such as economic activity, weather patterns and technology shifts, Boulder can track its progress toward emission reduction goals, determine impacts of certain programs, policies and community efforts, and identify areas of largest opportunity for reductions. This creates a valuable feedback loop for fine-tuning the estimated impact of existing policies and programs on emissions trends as well as the estimated impact of prospective climate action efforts. It is also a helpful reminder of the areas in which the city and Boulder community have direct control and the areas which rely upon more external factors. Such a reminder played a key role in the city's decision to seek to change its energy source and council's vote in 2010 not to renew a 20-year franchise with Xcel Energy. The emissions measurement process with the updated data continues to support the path of finding cleaner ways to supply customers with electricity.

Accountability and leadership

The City of Boulder continues to be a viewed as a sustainability thought leader, with its innovative climate programs and policies. These include the Climate Action Plan tax, approved by voters in 2006 and renewed in 2012; SmartRegs, a program to establish a minimum level of energy efficiency in the city's roughly 20,000 rental units; and new construction and building energy codes that are among the most aggressive in the country. Recently, the city has worked to define a path toward a new, ambitious climate goal: an 80 percent emissions reduction from 2005 levels by 2050. The city has also begun to embed emission reduction strategies in key areas of planning, such as the recently updated

Transportation Master Plan. By measuring progress on emissions reductions, developing new approaches to climate action policies and programs, engaging with community partners, and sharing efforts and best practices with others, the city hopes to catalyze climate action throughout Boulder and beyond. The city has a responsibility to lead by example and demonstrate innovation such as by piloting projects within city operations that may show promise for the community at large. To this end, in 2009 the city hired an energy service company (ESCo) to recommend energy efficiency improvements and calculate payback costs and time. Projects implemented between 2009 and 2012 have reduced emissions from city buildings and facilities by 34 percent.

History of inventories

The city established 2005 as the baseline year against which to measure emissions reduction progress. This was the year for which inventory data was available to calculate community emissions in 2006 when WSP Environment & Energy was hired to create the first community emissions inventory for the city. In 2010, an update to the inventory was performed and results were published in a comprehensive report titled "Community Guide to Boulder's Climate Action Plan, 2010/2011 Progress Report." With the end of franchise reporting from Xcel Energy in 2010 and the introduction of new data privacy rules, it has become much more difficult to obtain the data necessary to perform ongoing inventories, resulting in a significant lag in time to generate the updated inventory for 2012. A franchise report provides standardized data formatting and currently offers the most accurate energy data to a franchisee. A Community Energy Report docket currently filed with the PUC and sponsored by a regional working group of municipalities interested in data reporting may provide the necessary reporting structure and data access to support more timely future inventories. Updates are intended to continue on a three year cycle. Contingent upon receiving the necessary data, the next update to the inventory is expected to be conducted in 2016 for the 2015 reporting year. Should the PUC docket be delayed or not adopted, however, it may be necessary to postpone the 2015 inventory until accurate data is available.

METHODOLOGY

In October of 2012, ICLEI Local Governments for Sustainability released the U.S. Community Protocol, the first national standard for municipalities to report on community greenhouse gas emissions. This standard was the result of collaboration between ICLEI and a number of local governments, and focuses on the categories of emissions that local governments have the most likelihood of influencing through programs or policies. In addition to measuring progress against community goals, this standardized methodology allows cities to benchmark against one another and avoids double counting by clarifying jurisdictional boundaries for emissions accounting, particularly within the transportation category. The ICLEI protocol expands on the five emissions source categories that Boulder had previously measured under the Greenhouse Gas Protocol Initiative's GHG Protocol Corporate Standard: electricity, natural gas, vehicle transportation, landfill and offsets. See **Table 1** for a comparison of categories reported in the 2010 update to the inventory versus those reported in the 2012 inventory under the new protocol.

Table 1. Categorical Comparison of Protocols 2010 v. 2012

Category	2010	2012
Electricity	Included	Included
Natural Gas	Included	Included
Vehicle Transportation	Included	Included
Solid Waste	Included	Included

Offsets	Included	Not included
Air travel	Not included	Included
Refrigerant and Fire Suppression Equipment Leakages	Not included	Included
Recycling and Compost	Not included	Included

The protocol also calculates emissions for several sources that are duplicated in another category or informational only (not included in total emissions), with the express purpose of allowing a municipality to better identify emissions reduction opportunities in areas that may otherwise go unnoticed. These sources include regional travel, water treatment and transport, and recycling and compost. It is important to note that the ICLEI protocol also requires the calculation of emissions from electricity lost in transmission and distribution, which is then included in electricity totals. The protocol also separates emissions by sources and activities, rather than compiling all emissions into one comprehensive community summary. In order to compare the 2012 inventory and future inventories against pre-2012 inventories, a community summary report has been built into the city's greenhouse gas accounting software tool.

As a leader in the climate community, the city seeks to ensure that the Boulder community acknowledges and takes responsibility for the emissions it generates. Through this standardization of reported emissions data, Boulder can fully participate in several benchmarking efforts, including the Urban Sustainability Directors Network (USDN) and the Carbon Disclosure Project, the reporting platform of the Compact of Mayors and Carbon Neutral Cities Alliance.

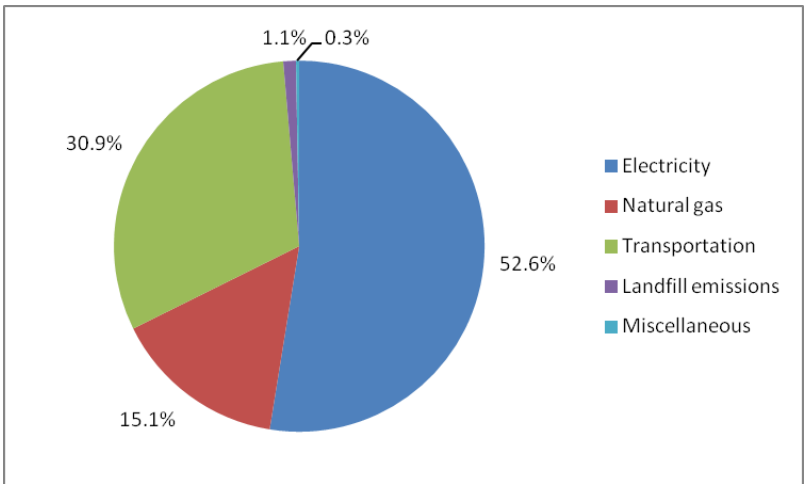
It is also important to note that with the change in methodology and the adoption of the new ICLEI protocol, the city has taken the opportunity to update some of its existing assumptions and conversion factors. For example, the city previously calculated CO_2 using the Environmental Protection Agency (EPA) eGrid carbon factor, a regional average of carbon emissions from power plants serving Colorado and portions of Wyoming, Nebraska and South Dakota. Due to the effort to calculate this carbon factor, the factor is updated every few years. By contrast, the city has now adopted Xcel Energy's Colorado emissions factor, which is calculated by Xcel every year and more accurately reflects the carbon intensity of electricity used in Boulder. Due to Colorado's Renewable Portfolio Standard, Xcel Energy's resource mix includes a higher percentage of renewables compared to the broader region, and thus is less carbon intensive. This is reflected in the results of the inventory and will be covered in more detail below.

EMISSIONS ANALYSIS

2012 Update to the Greenhouse Gas Inventory

The leading sources of emissions in Boulder's 2012 inventory remain consistent with previous inventories. These high-emissions sources include electricity and natural gas used in buildings and fuel used for transportation. Other sources worth noting include landfill emissions and emissions from the wastewater treatment process and from refrigerant and fire suppression system leakages.

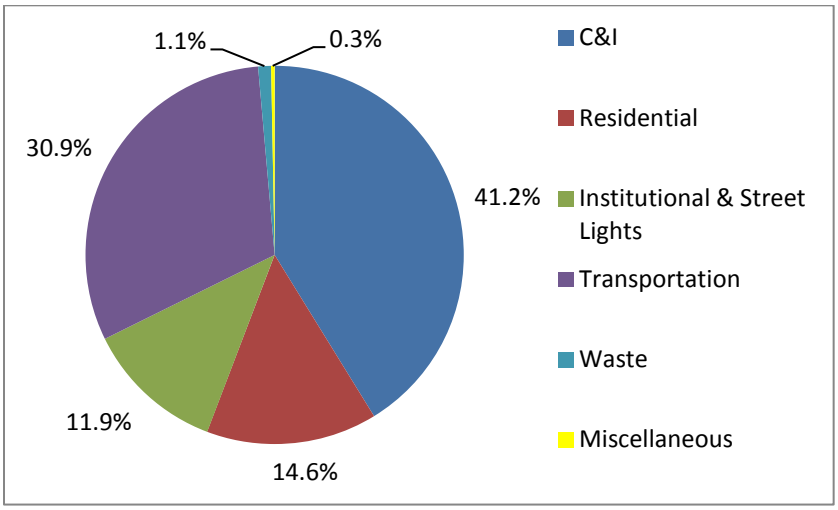
Chart 1. Emissions by Source



As shown in **Chart 1,** electricity and natural gas account for nearly 68 percent of all emissions, while transportation accounts for an additional 31 percent, bringing the total for these three sources to nearly 99 percent of Boulder's total emissions. Electricity and natural gas are the energy sources most commonly used to power and heat or cool buildings, while transportation includes gasoline and diesel used in vehicles and jet fuels used in air travel by Boulder residents at the Boulder Municipal Airport and Denver International Airport.

Another way to visualize the results of the 2012 inventory is to look at emissions broken out by sector. In **Chart 2,** electricity and natural gas are divided by residential, C&I and institutional uses. This represents the same roughly 68 percent of emissions attributed to buildings in Chart 1, with energy use in C&I buildings accounting for the largest portion of the inventory at 41.2 percent. It is worth noting that nearly 12 percent of community emissions come from institutional buildings, which include city and county operations within city limits (including street lighting and signals), the Boulder Valley School District and the University of Colorado, Boulder. The federal labs are represented in the C&I sector, rather than institutional, as breakout data was unavailable.

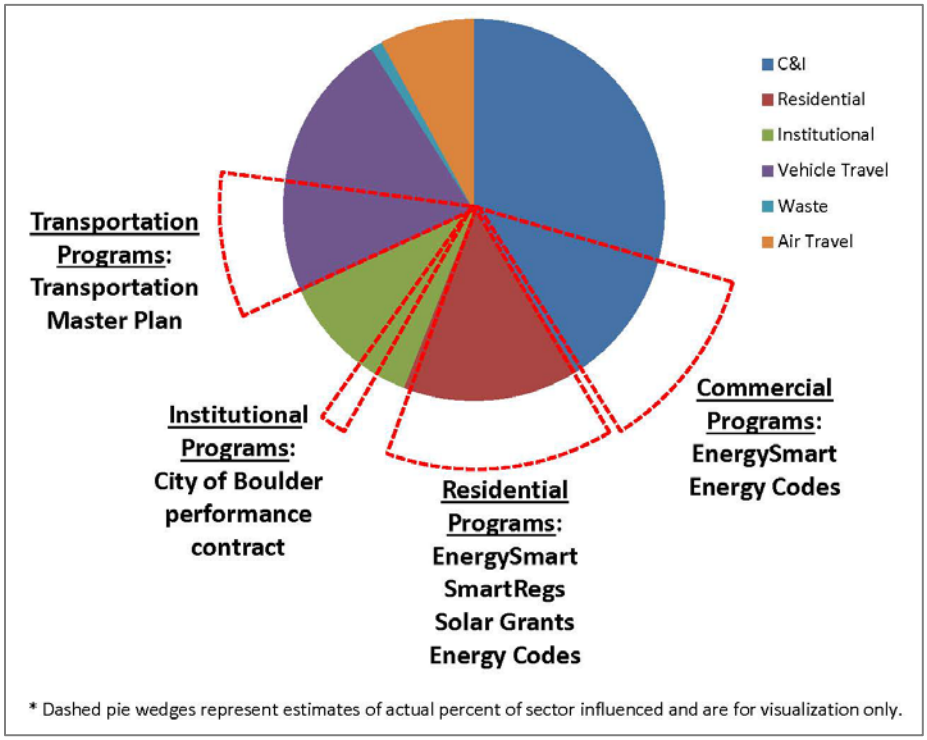
Chart 2. Emissions by Sector



In order to understand community emissions trends over time, the city recreated an estimate of the 2005 baseline using the new SWCA tool and ICLEI protocol and omitted data sources in 2012 for which data was not available in 2005. Every effort was made to create as accurate a comparison as possible; however, the data is imperfect. The inventory shows that emissions have remained fairly constant at a 0.5 percent increase from 2005 to 2012, despite significant growth in population, jobs and economic activity, which will be discussed further below.

Two areas targeted by the city's climate programs between 2005 and 2012 show some measure of success. These include a reduction in emissions associated with waste, which can be attributed to zero waste initiatives such as curbside compost and recycling programs, commercial incentives and rebates, and special events policies; per capita residential energy use, targeted by EnergySmart; and reduced vehicle miles traveled through prescribed efforts from the Transportation Master Plan. Because this inventory is for the 2012 calendar year, the impact of program activities since January 2013 is not reflected. As shown in **Chart 3**, city climate programs through 2012 impacted some but not all emissions inventory sectors. SmartRegs and the EnergySmart program have since facilitated upgrades in thousands of additional residential units. In 2016, new policies and programs for commercial and industrial buildings are expected to go into effect that will facilitate reductions in that sector while improving the quality of Boulder's building stock.

Chart 3. Emissions Sectors Influenced by Current City Programming



FACTORS INFLUENCING EMISSIONS

Quality of data dictates the quality of any emissions report. As previously stated, accurate energy data has become harder to attain without the aid of a franchise agreement with Boulder's utility provider, Xcel Energy, and due to the adoption of stricter customer data privacy rules by the PUC in 2012.

Additionally, the change in methodology with the introduction of the new ICLEI protocol affects emissions inputs and calculations as well as the ability to compare this inventory to past inventories. To this effect, the most significant addition to this inventory is the source category of air travel, which had not previously been accounted for. Finally, changes in emissions factors, determined by the energy resource mix (coal, natural gas, wind, solar, hydropower, etc.) of the local electricity provider, have significant impacts on the outcome of an inventory.

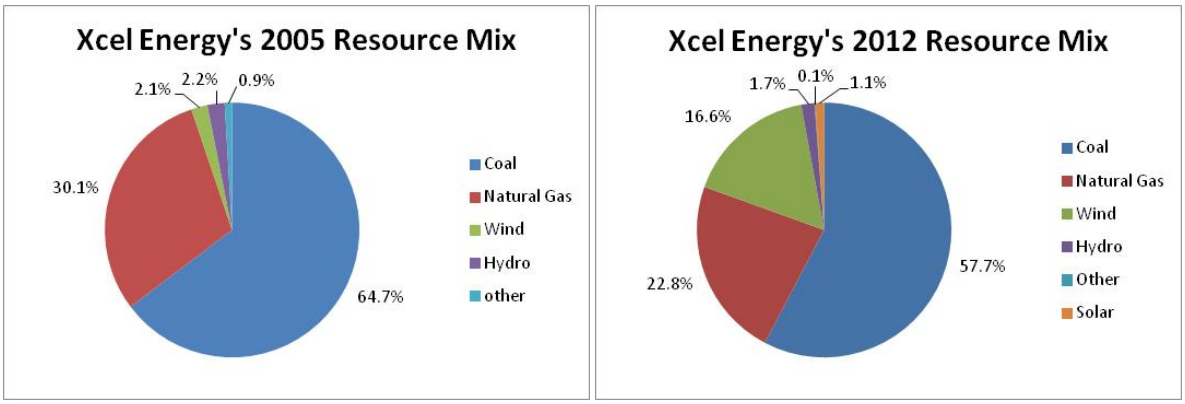
Air Travel

Air travel is an additional source category in the inventory under the new ICLEI protocol. The proxy measure for air travel of Boulder residents is the percent of total Denver International Airport travel represented by the population of Boulder as a percent of the greater metro-Denver area. This methodology does not provide an accurate accounting; however, absent better data, it provides a standard by which to account for this sector of emissions until better data becomes available. Based on the current methodology, air travel accounts for roughly one third of emissions produced by the transportation sector, or 8 percent of Boulder's total 2012 community inventory. This finding underscores the significance of air travel—a carbon-intensive activity—in terms of its contribution to Boulder's total emissions and climate impact. Total air travel has increased considerably since 2005, making this addition to the inventory quite substantive. To illustrate this point, the 2005 and 2012 inventories were compared with air travel removed as an emissions source. The result was a comparison calculation that showed Boulder's emissions had *decreased* by 3.4 percent rather than increased by 0.5 percent.

Emissions Factor for Xcel Energy's Electricity Mix

The Boulder community receives its electricity and natural gas from Xcel Energy. The types of energy Xcel incorporates into its electricity resource mix influence the carbon intensity of Boulder's electricity, and therefore the greenhouse gas emissions related to energy use in buildings. A comparison of Xcel's Colorado-wide electricity resource mix in 2005 and 2012 is illustrated in **Chart 4.**

Chart 4. Comparison of Xcel Energy's Colorado-wide Electricity Resource Mix 2005 to 2012



With the increase in renewable energy resources mandated by the Colorado Renewable Portfolio Standard, Xcel's emissions factor related to electricity generation has decreased from 1849 pounds (lbs.) CO_2e in 2005 to 1561 lbs. CO_2e in 2012. This underscores the great potential of renewable energy to reduce greenhouse gases. The decrease in Xcel's carbon factor impacts Boulder's net emissions; carbon

intensity went down even while overall electricity use increased. Energy consumption—for both power and thermal uses—is the other side of this emissions analysis.

ENERGY ANALYSIS

Because total emissions are dependent upon the emissions factor of grid electricity, it is important to analyze and compare actual energy use as a metric in order to evaluate Boulder's climate progress.

Table 2. Total Energy Use Comparisons—2005 to 2012

	Units	*2005*	*2012*	*% Change*
Residential Electric	kWh	244,648,421	247,876,097	1.3%
Residential Natural Gas	dTh	1,870,490	1,869,965	0.0%
C&I Electric (excluding CU)	kWh	870,465,652	979,845,533	13%
C&I Natural Gas (excluding CU)	dTh	2,208,664	2,796,898	27%
CU Boulder Electric	kWh	75,778,347	143,680,272	90%
CU Boulder Natural Gas	dTh	1,324,306	900,173	-32%
Grid Loss	kWh	63,474,566	66,375,852	5%
Total Electric	kWh	1,254,366,986	1,437,777,754	15%
Total Nat Gas	dTh	5,403,460	5,567,036	3%
Total Electric (without CU)	kWh	1,178,588,639	1,294,097,482	10%
Total Nat Gas (without CU)	dTh	4,079,154	4,666,863	14%

To help understand the impact of a significant change in the University of Colorado, Boulder (CU Boulder) plant operation, the table above separates out the energy use of the campus (see following section for more information). Excluding CU Boulder, total electricity and natural gas consumption for the Boulder community from 2005 to 2012 has increased 10 percent and 14 percent, respectively. To explore this data further, the table below summarizes various metrics for energy use "effectiveness"—energy use per household, per employee and per floor area.

Table 3. Energy Use Effectiveness Comparisons—2005 to 2012

	Units	*2005*	*2012*	*% Change*
Residential Electricity per Household	kWh/HH	6,263	6,035	-4%
Residential Natural Gas per Household	dTh/HH	47.9	45.5	-5%
C&I Energy Use Intensity*	kBtu/sf	161	188	16%
C&I Electricity per employee*	kWh/FTE	8,997	9,858	10%
C&I Natural Gas per employee*	dTh/FTE	23	28	23%

** Excludes CU Boulder*

The data in the above table indicate the following key findings:

- From 2005 to 2012, Boulder reduced residential energy use per household (per capita reductions are similar). This reflects, in part, the impact of climate programs on waste reduction and residential energy efficiency (zero waste programs and facilities, EnergySmart residential and SmartRegs).
- In the C&I sector, total energy use intensity (energy per square foot of floor area) and energy use per employee has increased. While more recent efficiency program investments have targeted commercial and industrial energy uses, and achieved an estimated 8,500 $mtCO_2e$ in savings, there is clear growth in this sector in the comparison of 2005 and 2012 inventory data.
- Despite a warmer winter (see following section), natural gas use in the C&I sector has increased even more than electricity. This indicates that the increase can likely be attributed to process loads in the industrial sector, which are not weather dependent. It is important to note that no existing city program addresses energy use in the industrial sector; however, a proposed C&I energy efficiency rating and reporting ordinance that would begin to address energy use in this sector may take effect as soon as 2016.

To fully understand what this data means, it is important to consider all of the factors that influence energy use and how they have changed from 2005 to 2012. Specifically with regard to C&I energy use, the economic recovery and expansion of economic activity could explain the increase in energy use intensity. This factor and additional factors are discussed in the following section.

FACTORS INFLUENCING ENERGY USE

The city and larger community have implemented a wide range of strategic and integrated efforts intended to address climate change by reducing energy use in residential and commercial buildings. As illustrated by the inventory, these efforts have had a positive overall impact. Distinct from these efforts, a range of other factors can significantly influence community energy use and emissions. This section provides an overview of some of the key factors that need to be considered and monitored as part of assessing both the overall trends in energy use over time and the impact of city programs.

Data Limitations

Due to the absence of franchise reports after 2010, which would have provided standardized reporting to the city, and stricter data privacy rules instituted in Colorado in 2012, the city used alternative sources to collect the source data for this inventory. These sources were not in the same format as previous reports received from Xcel when the city was still under a franchise agreement. As a result, there may be differences in the data that could influence Boulder's reported energy usage for both electricity and natural gas from year to year. The data sources used in the 2012 inventory differ from those used in 2010 and will differ from data used in the next inventory. Although the city has tried to correlate numerous sources to confirm data accuracy, the challenges in securing this data from Xcel could continue to create uncertainties in the inventory unless the PUC requires utilities to use an

aggregation standard that does not compromise the quality of data in community energy reports provided to local governments. An open docket on this issue was being deliberated by the PUC at the time this report was written.

Weather

The intensity of both summer and winter weather can significantly impact the amount of energy a community uses to maintain comfort and livability in its buildings. Warmer summers lead to an increase in the use of air conditioning, water use (and associated pumping), and other heat mitigation actions. This typically results in an increase in electricity usage. Given the majority of heating systems in Boulder utilize natural gas, colder winters lead to an increase in natural gas usage.

One metric for tracking these weather variables is known as degree days. Warmer temperatures in the summer lead to more cooling degree days (CDD) and more cold weather in the winter leads to more heating degree days (HDD). **Table 4** shows the difference between cooling degree days and heating degree days between 2005 and 2012 in the 80302 zip code of Boulder.

Table 4. Annual Total Heating and Cooling Degree Day Comparison—2005 to 2012[iv]

2005		2012		Comparison Percentage	
HDD	CDD	HDD	CDD	HDD	CDD
5,227	745	4,664	1,126	-11%	51%

These results suggest that 2012 had a slightly warmer winter—and subsequent slight reduction in the need for natural gas for heating. This could partially explain the reduction of natural gas use per household (-5 percent) in the residential sector. As mentioned earlier, despite a warmer winter, natural gas use per employee in the C&I sector increased by 23 percent. This increase can likely be attributed to additional process loads in the industrial sector, which are not weather dependent.

Conversely, the significant increase in cooling degree days in 2012 suggests a hotter summer, which might have led to more electricity usage for cooling activities. This makes the 4 percent reduction in electricity use per household even more impressive, and could partially explain the increase in electricity use per employee in the C&I sector.

Population Growth and Economic Trends

The period between 2005 and 2012 encompasses the significant economic recession experienced by the U.S., and to a somewhat lesser extent, Boulder. By 2012, significant economic recovery had taken place and there was measurable growth in jobs and revenue compared to the 2005 baseline year – this must be considered when looking at the total energy usage.

Table 5. Economic Activity Comparisons—2005 to 2012

	2005	2012	% Change
Retail Sales	$1,750,987,683	$2,279,823,724	23.2%
Population	98,526	101,169	2.6%
Employment	96,755	99,400	2.7%

Not captured in this economic activity data is the development of new, highly energy-intensive facilities in Boulder, such as medical marijuana (MMJ) grow and processing facilities and International Business Machine's (IBM) large data center[v]. While MMJ was legalized in Boulder in 2000, there were only a few small grow operations until the announcement that the federal government would not interfere in states where MMJ was legal (2010). The city began licensing medical marijuana facilities in 2010 and saw a marked increase in operations, with 43 facilities licensed in 2012. Because data centers and MMJ grow and processing facilities are between 20 and 100 times more energy intensive than office buildings, the city can reasonably postulate that the addition of new MMJ facilities and the addition of new industrial activities such as the large IBM data center are partially responsible for the significant increase in C&I electricity use since 2005.

University of Colorado (CU) Boulder's Cogeneration Plant

Cogeneration, also known as combined heat and power, is the simultaneous production of electricity and heat from a single fuel source, such as natural gas. CU Boulder had been running a natural gas driven cogeneration system that produced electricity from a turbine, and recovered and reused free waste heat from the process. In 2004, CU Boulder began to phase out the operation of its cogeneration facility due to the increased cost of natural gas (the majority of the "phasing out" occurred between 2005 and 2012). Taking the cogeneration system offline resulted in a corresponding drop in natural gas consumption, a significant increase in the amount of grid electricity CU consumed and a marked increase in CU Boulder's overall emissions, which significantly impacted the 2012 GHG inventory and may impact the next inventory, as well.

Since shutting down its ageing cogeneration system, CU Boulder has been designing and building a new $91 million campus utility system that should be fully operational by the end of 2015. This new campus utility system includes:

- A new heating and cooling plant
- Renovation of the existing 103-year-old campus utility system, including expansion of cogeneration capabilities
- Interconnection of the two plants with new and upgraded distribution

While CU Boulder and the city expect that this new system, in addition to a number of other efforts at CU, will reduce total emissions for the campus, these reductions will not be evident for several inventories.

Technology and Usage Change

Another emerging factor affecting energy usage, particularly the electricity sector, is the rapid proliferation of electronic devices that are adding additional plug loads. Despite the documented increase in residential plug load, including energy use from plasma televisions and the charging of more and more mobile devices, 2012 still saw a reduction in electricity use per household.

In commercial buildings, plug loads are one of the fastest growing drivers of energy consumption and typically account for 30 to35 percent of the total electricity used in a given office building. Data from the Energy Information Administration's Annual Energy Outlook shows that plug load electricity use increased almost 20 percent from 2005 to 2012.[vi]

Beyond plug load growth, there has been a trend in recent years to make more efficient use of space in commercial office buildings. New companies are adopting open office floor plans, which result in higher energy use intensities, but lower energy use per employee. Likewise, the typical workday has lengthened over time and commercial buildings are operating for more hours than ever before.

Though important anecdotal trends, the direct impacts of technology and plug load growth on energy use cannot be measured. Still, understanding these factors and trends helps the city design future programs that better address today's lifestyle.

Local Solar Growth

Local, or rooftop, solar electricity reduces the amount of electricity consumed and accounted for in the GHG inventory. Because the energy is consumed behind the main electric meter, local solar functions like reduced demand or energy efficiency in terms of accounting for electricity consumption. Boulder made important progress between 2005 and 2012 with regard to growth in local solar adding nearly 10 MW of permitted solar to the grid. Over three megawatts (MW) has been installed since 2012, and the city has plans to ramp up efforts to support the installation of more local solar on both residential and commercial buildings by providing residents better access to solar potential information.

Table 6. Rooftop Solar Permits – 2005 to 2012

	Solar Permits
2005	< 1.180 MW (prior to 2007)
2012	11.79 MW (through 2012)

CONCLUSIONS AND NEXT STEPS

The 2012 greenhouse gas inventory represents a new beginning in Boulder's inventory reporting, as Boulder increases accountability for its greenhouse gas emissions, adopts a new national reporting standard, takes ownership for additional emissions sources, and establishes new tools for measuring and projecting the impact of current and future community climate efforts.

As this is the first inventory performed according to the ICLEI U.S. Community Protocol using a more localized carbon factor and new data sources, it essentially represents a new baseline. This new baseline, however, will provide increased accountability for the emissions generated in Boulder and will enable the community to compare results to other communities in the U.S. and share best practices. Given better data availability and access, the inventory performed for 2015 will be a more accurate assessment of the overall trends in community emissions. The ability to conduct a 2015 inventory will be dependent upon the outcome of the PUC negotiation for a standardized Community Energy Report. In any inventory year, factors such as heating and cooling degree days, economic trends, and significant local developments (such as the CU Boulder cogeneration system and IBM data center) impact annual emissions, requiring careful attention to and consideration of these factors in mapping overall emission trajectories to measure progress and inform next steps in policy and action.

A number of factors make it difficult to do a direct comparison between the 2012 inventory and past inventories. These include the difficulty to obtain standardized energy usage data from Xcel, restrictions imposed by data privacy rules and methodological changes in calculations and categories of information included with the introduction of a new protocol. Be that as it may, some general trends can be identified: although emissions appear to be holding constant, community energy use as a whole has increased. The energy results of 2012 compared to 2005 show reduced per capita residential energy use despite growing plug loads and a significantly warmer summer. This finding points to the success of residential energy efficiency programs such EnergySmart and SmartRegs, as well as zero waste and transportation efforts to reduce emissions. The majority of Boulder's increased energy use comes from the boost in energy use in the C&I sector. While the city has devoted significant resources to Commercial EnergySmart, this program does not target the highly energy intensive industrial businesses and manufacturers. To address the growth in electricity and natural gas use in the C&I sector, the city is proposing new requirements for rating and reporting for all C&I buildings greater than 20,000 square feet (sq ft.) These requirements will be brought to council in the form of an ordinance in Q3 of 2015. Still, there are limitations to how much the city can truly affect energy use in the industrial sector, which is responsible for the majority of the city's jobs and revenue. While many of the large industrial businesses have improved their energy productivity (the amount of energy related to their economic

output), total energy use continues to rise with growth in business. The city will continue to strive to strike a balance between robust business activity and reducing GHG emissions.

Given the abstract nature of greenhouse gas emissions and the complex nuances of emissions data analysis, the city recognizes an inherent challenge in communicating the findings of the 2012 greenhouse gas inventory to the public in a way that is comprehensive, intelligible and engaging. To address this challenge, city staff has worked with a local design firm to develop an infographic that relies on visual components to convey the high-level takeaways from the this inventory. In addition to reporting the findings of the 2012 greenhouse gas inventory, the city intends to use this infographic to supplement climate education and engagement and to help the public connect existing and planned climate action efforts to the larger context of Boulder's climate footprint.

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[i] Previous city inventories were calculated using the Greenhouse Gas Protocol Initiative's GHG Protocol Corporate Standard.

[ii] Two separate sectors that have been aggregated into one due to limited data availability.

[iii] "Status of Ratification of the Convention". United Nations Framework Convention on Climate Change. Retrieved 2015-04-25.

[iv] HDD and CDD calculated as deviations from a 65 degree balance point with a chosen geographic location of 80302 zip code. "A negative percentage means the Comparison Year was more mild than the Base Year. A positive percentage means the Comparison Year was more severe than the Base Year. Annual Total comparison percentages include all heating and cooling degree days." http://www.weatherdatadepot.com/

[v] While IBM's new data center was constructed to be extremely energy efficient, data centers are energy intensive by nature and this still represents a large new electric load.

[vi] http://www.eia.gov/oiaf/archive.html