C I T Y O F B O U L D E R
PLANNING BOARD
AGENDA ITEM

MEETING DATE: July 13th, 2015

Discussion of Upcoming Study Session with City Council re: Boulder's Climate Commitment

PRESENTERS:

David Driskell, Executive Director of Community Planning and Sustainability
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I. Purpose

There will be a study session with City Council on July 30th to discuss the draft Climate Commitment goal, near-term targets and strategy document. The purpose of this check-in with Planning Board is to discuss and obtain the board's feedback on the building-related portion of the strategy document and associated greenhouse gas emissions (GHG) reduction goal and targets as well as the associated implementation strategies.

Also provided with this memo, in **Attachment A**, is the recently completed staff report on the 2012 Community GHG Inventory. This information forms a basis for an ongoing assessment of community emissions reduction achievements. **Attachment B** provides a table showing the more detailed metrics and targets proposed for tracking progress towards the city's GHG reduction goal. **Attachment C** provides an overview of the communications strategy designed to launch community outreach and engagement around refinement and adoption of the Climate Commitment strategy.

II. Questions for the Planning Board

1. Does the board support the proposed emissions reduction goal of 80 percent below 2005 levels by the year 2050; the overall framing and strategies associated with Boulder's Climate Commitment; and specifically the proposed targets and actions related to emission reductions through "high performance buildings"?
2. Are there key emissions reduction actions not represented in the city's current programs and strategies that should also be considered?
3. How can the city most effectively engage the community in the refinement and implementation of the proposed Climate Commitment?

III. Updates

Two prior City Council Study Sessions have been held to discuss the development of Boulder's post-Kyoto[1] climate action goal. The July 29, 2013 Study Session presented analysis of a range of potential emissions reduction goals ranging from an 80 percent emissions reduction by 2030 to a 100 percent emissions reduction by 2050. Council provided staff direction at this meeting to conduct further analysis on the viability of implementing an 80 percent emissions reduction below 1990 levels by 2050. At the November 12, 2014 Study Session, staff presented council with a detailed assessment of the emissions reduction potentials of existing and anticipated city programs to determine the likelihood that these programs could achieve this 80 percent emissions reduction goal. This analysis indicated that a combination of full implementation of all existing and anticipated building and transportation emissions-reduction programs, coupled with an electric utility providing 100 percent clean electricity, could meet or achieve this emissions goal. Staff also recommended changing the baseline year to 2005 to better align the city's reporting with both the State of Colorado and a growing number of cities in the US and internationally. Subsequent to these study sessions, staff has continued to refine the city's emissions analysis and projection tools as described below.

GHG Inventory

In early 2015, staff completed a new community GHG emissions inventory using a more comprehensive inventory protocol (ICLEI US Community Inventory Protocol) and an enhanced inventory system developed to align the city's methodology with national and international standards. Given the ongoing challenges in acquiring energy use data from Xcel, the city relied on energy data acquired through legal discovery. The most recent year for which the city could compile all of the necessary energy use information was 2012. A full review of the inventory process and results are included as **Attachment A** to this memo. The summary results of the inventory have also been compiled as an infographic intended to make the findings more comprehensible and useful to the community. Key findings of the inventory are summarized in the sidebar. As part of the inventory analysis, staff is recommending adopting a 2005 emissions baseline year (previously 1990). This will create better alignment between the GHG inventories of the city organization and the larger community, and uses the same baseline year as the state of Colorado and a growing group of both US and international cities.

2012 Community GHG Inventory Key Findings

- Overall emissions declined slightly (↓~1%) between 2005-2012
- During the same period, overall employment increased (↑2.7%) and economic activity grew (↑23%)
- Emission reductions were more significant in several sectors, including residential (↓4% per household), ground transportation (↓8%) and waste (↓8%)
- Emissions increased in the commercial and industrial (C&I) sectors, up by 13% in electricity and 27% in natural gas.

C&I emissions growth was likely the result of both significant increases in business activity and the addition of medical marijuana grow facilities, new data centers, and other added industrial processes.

Emissions Reduction Potential of Alternative Energy Source Change Scenarios

Previous and current analyses have all underscored the necessity of substantially shifting Boulder's electricity generation sources in order to achieve deep reductions in GHG emissions. Even with significant investments in improved energy efficiency and widespread adoption of technologies such as rooftop solar, the community's

[1] In 2002 Boulder's City Council adopted the Kyoto Protocol goal of reducing greenhouse gases by 7 percent below 1990 levels by 2012.

[2] Transportation energy systems change was analyzed by the Southwest Energy Efficiency Project as part of analysis

emissions will remain high as long as coal and natural gas remain a substantial part of the fuel mix used to generate Boulder's electricity.

To inform the current effort toward defining a viable "path to 2050" for achieving a reduction of 80% or more in Boulder's GHG emissions, staff has analyzed alternative fuel mix scenarios for Boulder's electricity supply to test the potential emission reduction impacts of changes to energy source when combined with efforts related to energy efficiency and other "demand side" initiatives. The three scenarios analyzed and the results are described below.

1 **Business As Usual**
Continuation of current fuel-switching trends and DSM investments, maintaining current utility target of 30% renewables portfolio and extending natural gas fuel switching reductions to 2050. This analysis relies on Xcel's published Electric Resource Plan (ERP) that projects its portfolio out to 2037. Staff then extended the emissions reduction trend projected through 2037 out to 2050. It uses Xcel's stated intention to set its renewables generation portfolio based on the current mandate of 30% renewables as outlined by the Colorado's mandated Renewable Portfolio Standard (RPS). The majority of emissions reductions achieved beyond 2020 are related to the retirement of coal plants and their replacement with natural gas-fired power plants.

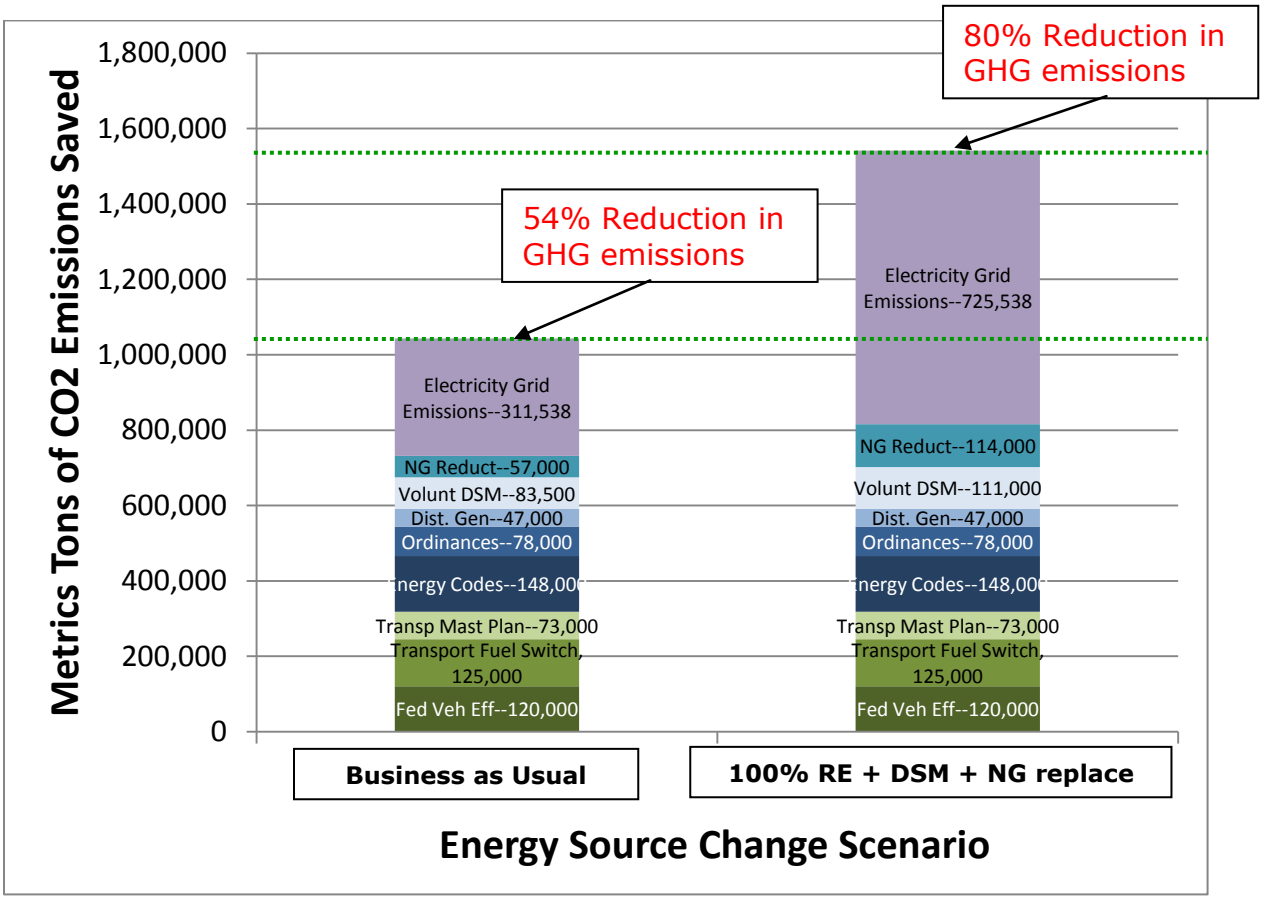
2 **80% Renewables + DSM + NG replacement**
Achieving an 80% renewable electricity (RE) portfolio by 2050, with more aggressive demand side management (DSM) and natural gas replacement(NG replacement). This analysis assumed a utility model that prioritizes higher levels of investment in renewable energy, utilizing wind, solar and hydro to generate electricity, with only 20% of generation relying on fossil fuels (natural gas). It also projects higher levels of investment in Demand Side Management (DSM) programs, represented by additional energy efficiency and distributed generation incentives, and resulting emission reduction impacts. Additionally, it assumes additional programmatic efforts to support replacement of natural gas-based heating and process uses in residential, commercial and industrial applications. The renewable electricity analysis draws on modeling completed for Boulder's exploration of creating a municipal electric utility which demonstrated that a significant shift towards renewables is possible within existing energy markets.

3 **100% RE + DSM + NG replacement**
Achieving a complete switch from fossil fuel generation to renewable electricity(RE) generation by 2050, with more aggressive demand side management (DSM) and natural gas replacement(NG replacement). This scenario assumed the augmented level of energy services, demand side management programs, and natural gas replacement modeled in scenario 2 (80% renewable), and additional assumed changes in technology and investment such that the remaining 20% of energy is also provided by renewable sources. As shown in Figure 1, *this configuration is the only one that enables Boulder to achieve a full 80% reduction in all GHG emissions by 2050.*

<u>Emissions Reduction Potential of Existing Policies and Programs</u>
In November 2014, staff presented a preliminary assessment of the projected emissions reduction potential of the city's existing building and transportation-related policies and programs. Since then, assumptions and

analyses have been refined and updated, including incorporation of the potential emission reductions that could be achieved through implementation of the proposed new commercial and industrial energy efficiency ordinance, now referred to as the Boulder Building Performance Ordinance. This analysis was combined with utility scenarios #1 (Business as Usual) and #3 (100% RE-DSM-NG replace) to project the total emissions reduction potential of each. The results of this analysis are illustrated in Figure 1.

Figure 1 – 2050 Emissions Reduction Potential for Current Policies and Programs in Combination with Two Energy Source Change Scenarios



Glossary of Abbreviations

Electricity Grid Emissions—Reductions in emissions due to adding renewable energy generation sources
NG Reduct—Natural gas reduction programs assume some combination of fuel switching and efficiency. Additional reductions could be realized if alternative renewable fuels are developed.
Volunt DSM—Voluntary demand side management programs coordinated by the city—Energy Smart or similar, with enhanced program capabilities under municipal utility and actions taken by other institutions e.g. CU, BVSD, Boulder County, federal labs
Dist Gen—Promotion of on-site distributed generation
Ordinances—SmartRegs rental energy efficiency ordinance and the Boulder Energy Ordinance for commercial and industrial properties
Energy Codes—Both residential and commercial Net-Zero Energy Ordinances
Trans Mast Plan—Transportation Master Plan efficiency related programs
Transport Fuel Switch—Electric Vehicle adoption and similar clean transport fuel programs
Fed Veh Efficiency—Federal vehicle efficiency standards (CAFE standards)

The projected reduction potential for each city policy/program area was determined through a modeling tool developed by the Brendle Group, combined with additional reduction projections from the ongoing improvement of energy systems and technology in natural gas uses and transportation[2]. The 2050 projected reductions, summarized in Table 1, are based on a 2005 baseline year. The highlighted areas are the major emissions reduction differences between the two utility configurations.

Table 1: Projected Emission Reductions from Current Policies/Programs under Two Utility Scenarios by 2050

Programs	Metric Tons Saved	
	Business as Usual	100% RE-DSM-NG replace
Energy Codes	148,000	148,000
Ordinances	78,000	78,000
Distributed Generation	47,000	47,000
Transportation Master Plan	73,000	73,000
Transportation Fuel Switching	125,000	125,000
Federal Vehicle Efficiency	120,000	120,000
Voluntary DSM	83,500	111,000
Natural Gas Reduct Programs	57,000	114,000
Electricity Grid Emissions	311,538	725,538
Total Emissions Saved	1,043,038	1,541,538
% Reduction from 2005 Levels by 2050	**54%**	**79%**

The Value of Conservation and Efficiency

The projected emission-reduction contributions of building-related efficiency measures vary significantly depending on the characteristics of the electricity provided by an electric utility. In scenarios such as "Business as Usual," the continued use of both coal and natural gas for a significant portion of generation capacity results in relatively "dirty" electricity, meaning that it has higher carbon per kilowatt (called the "carbon intensity factor"). Consequently, every kilowatt hour saved creates a relatively high number of pounds of carbon emissions reduced. As a result, without Demand Side Management efforts, the emission reductions for the "Business as Usual" scenario would likely be closer to 30 percent rather than 54 percent.

Conversely, as electricity sources become "cleaner" (more renewable energy that generates low-or-no carbon per kilowatt), the emissions reduction "value" of each kilowatt is reduced. In this case (as in the 100% Renewables scenario), while conservation and efficiency do not have a direct emission reduction benefit (because all of the power is essentially emission-free), they continue to be a worthwhile investment because they reduce the amount of renewable energy generation needed. Under current and projected pricing for development of renewable generation in comparison to the cost of efficiency and conservation, money spent

[2] Transportation energy systems change was analyzed by the Southwest Energy Efficiency Project as part of analysis conducted for the 2014 Transportation Master Plan. Natural gas reductions were based on a projected reduction in NG use of 30% below 2005 Business as Usual usage rates. This is significantly lower than the overall goal of reducing NG by 80% below 2005 by 2050 but was sufficient to support achievement of the 80% overall emissions reduction goal.

to reduce energy demand (through high performance buildings and more efficient appliances, for example) will continue to be more cost effective than having to invest in additional solar or wind generation to power wasteful buildings and processes.

IV. Factors Shaping Boulder's Next Stage Climate Commitment

The next generation of Boulder's climate action represents an evolving strategy based on the extensive efforts and investments made by the city and the larger community over the past decades. A brief summary of these efforts illustrates how Boulder's strategy has evolved and how past experiences are informing the strategy now in development.

Climate Action Gets Underway (~2002 to 2009)

A focus on incentive-driven behavior change and the country's first local carbon tax. While Boulder has been active in energy and environmental issues for many decades (dating back to the 1970s), the focus on climate change was formally launched in 2002 with passage of Resolution 906, adopting the Kyoto Protocol goal of a 7 percent reduction in greenhouse gas emissions by 2012. Similar to early climate action initiatives in most places, Boulder's initial climate action strategies focused on behavior change initiatives, focusing primarily on individuals and households. A number of different educational and technical assistance initiatives were launched during this period. Importantly, in 2006 the community recognized the need for a dedicated source of funding to support these efforts and passed one of the first local carbon taxes, establishing a surcharge on both residential and commercial/industrial electricity use. These funds were directed primarily towards providing incentives to encourage changes in energy use through behavior change (turning down thermostats, driving less) and efficiency investments (e.g., lighting retrofits and insulation).

Climate Action Matures (~2010 to 2015)

Analysis leads to program redesign, regulatory standards, integration, and a focus on energy source change. In 2009, analysis of progress in the city's climate action efforts led staff and community members to recognize that the substantial work taking place was not achieving the hoped for emission reductions. In response, several community working groups were formed to evaluate existing efforts and recommend changes, and council acted to increase the carbon tax to the maximum level previously approved by voters. As a result, several important new initiatives were launched, including:

- **"Two Techs and a Truck"—the quick-install and energy advisor model for efficiency services.** Based on ideas generated by a community working group, the city piloted a new approach to the design and delivery of its energy efficiency services, focusing on "quick install" actions that could be done in conjunction with energy audits (to act on "the low hanging fruit" right then and there) coupled with an "energy advisor" who could walk property owners through the audit process, help them understand results, connect them with financing and rebates, and even help select a pre-qualified contractor to do the work. Following the model's refinement, the program launched countywide as "EnergySmart" thanks to a federal grant (as part of the American Reinvestment and Recovery Act). The result has been a substantial increase in the reach and penetration of energy efficiency investments in Boulder. With the purchase of private sector partner Populus by CLEAResults in 2014, the energy advisor model pioneered in Boulder is now being used by utilities and agencies nationwide to deliver efficiency services.
- **Leading Edge Energy Codes and the "Path to Net Zero."** In 2013/14 the city adopted new energy

codes for commercial construction and renovation that are among the most stringent in the country, and will soon be working on the next update to the city's Green Points program for residential construction. The planning board and council also expressed support for a proposed "path to net zero" that will guide continued code-related work, with the aim of achieving "net zero" energy in all new construction by 2030.

- **Innovative Efficiency Requirements.** Recognizing that incentives and services alone would not catalyze investment in situations where one party (the property owner) must make the investment and another party (the renter or tenant) realizes the benefit of lower utility bills, the city engaged a working group to develop baseline energy efficiency requirements for rental housing as a first-step toward addressing such "split incentive" situations. The result--"SmartRegs"--established efficiency requirements for all rental housing, with implementation linked to the city's existing Rental Housing Licensing Program. The combination of SmartRegs and new EnergySmart services has resulted in thousands of additional units implementing efficiency improvements. In 2014/15 a key focus has been on developing a rating and reporting requirement for commercial and industrial properties. The proposed Boulder Building Performance Ordinance, developed with significant input from another community working group--will be considered for adoption in the second half of 2015.
- **Energy Source Change and Municipalization**. Analysis in 2009 and 2010 made it clear that even the most aggressive energy efficiency efforts that could be conceived would not come close to achieving the community's emission reduction goals as long as coal and natural gas were the predominant fuels used to generate Boulder's electricity. As a result, Boulder voters decided to create a "utility occupation tax" in order to allow the city's existing franchise with Xcel Energy to expire and to provide time for exploring alternatives that could achieve Boulder's energy future goals. Subsequently, following more analysis and discussion, voters also approved a tax to pay for the exploration of municipalization as a path to achieving deep emission reductions and other goals, and authorized city council to create a municipal utility if certain conditions could be met. Recent analyses have confirmed that significant shifts toward a renewable energy supply are not only possible, but also economical. The effort to create a locally owned utility has been the most significant city work effort related to climate and energy, and--if successful--could realize the most significant GHG reductions through energy source shift, the impacts of which are described earlier in this memo.
- **Solar Friendly Community.** The city has continued to encourage and facilitate solar installations in the city, including large ground-mount solar gardens like the 1 MW installation at the wastewater treatment plant and rooftop installations at many city facilities, as well as the solar grants program and work to ensure that regulations are supportive of solar installations. Combined, these efforts recently earned the city a "platinum" rating as a Solar Friendly Community from the Colorado Solar Energy Industries Association.
- **Energy Innovation Partnerships.** To stimulate market transformation and catalyze private and nonprofit sector innovation, the city has partnered to launch two pilot initiatives: Boulder's Energy Challenge, which provided $300,000 in seed money to six winning teams that had developed innovative ideas for achieving deep carbon reductions; and the Community Power Partnership, in collaboration with the Pecan Street Research Institute from Austin, to install and test 'behind the meter' circuit-level energy data readers in a sampling of Boulder homes and businesses. Evaluation of both pilot initiatives is now underway and next steps are being planned.
- **Transportation-related Emission Reductions.** A key focus of recent years has been to integrate

emission reduction planning in relevant city master plans and other efforts. In 2014, this happened for mobile emissions through the integration of climate analyses and actions in the update of the city's Transportation Master Plan, incorporating a variety of strategies and new pilots aimed at reducing vehicle use and associated emissions.

- **City Leadership.** The city initiated a major energy efficiency initiative for city facilities that achieved a more than 20 percent reduction in both energy use and overall GHG emissions. The project has also resulted in significant financial savings, demonstrating the economic benefits of efficiency measures capable of creating significant emissions reduction.
- **Carbon Tax Extended**. In 2012, city voters expressed their support for the city's climate work, and the clear priority of ongoing climate action, by re-approving the city's carbon tax with 82 percent support.

Climate Action Seeks System Transformation (2015 and beyond)

Emerging focus on whole system thinking and transformative action, embracing goal of comprehensive energy system decarbonization. As outlined above, significant community effort has created a foundation of community technical assistance, responsible energy use standards, and a pathway to local renewable electricity. Together these efforts have the potential to significantly reduce emissions while creating substantive economic and social benefits. However, achieving a goal of 80 percent GHG reduction or more requires transformation of our energy systems in fundamental ways--not just in electricity, but also in thermal systems (natural gas) and transportation. Four major action areas will be integral to this energy transition:

1. **Maximize productivity and energy efficiency.** As conversion of the community's energy system to clean electricity proceeds (see #2, below), the most cost-effective way to minimize the need for new electricity generation (and thereby associated system expansion costs) is to maximize efficiency and system productivity. The substantial platform of energy efficiency services the city and county have jointly developed, and the enhanced demand side management services that could be offered by a new generation utility model, provide the foundation for development and delivery of these enhanced productivity and efficiency services.
2. **Rapidly transition to 100 percent clean electricity.** Electricity represents the one energy form that can currently be produced at large scale through renewable/non-fossil-fuel based systems. The rapid reduction in costs for both wind and solar--and rapidly improving technology and competitiveness for associated energy storage--have now made these sources cost competitive with conventional fossil fuel sources in a growing number of markets. Given the challenges of transitioning some existing forms of energy use away from fossil energy sources (air travel, heavy transport, some industrial uses), the transition to clean electricity is one of the areas that needs to achieve at or near 100 percent renewable energy adoption.[3]
3. **Retire natural gas systems (80 percent or greater) through equipment conversion.** Deep emissions reduction will require a rapid phase-out of existing equipment and systems that rely on natural gas, such as boilers, furnaces, water heaters, chillers and other natural gas process uses. This is a new area of focus for both technical and policy solutions. Boulder is taking a leading role in beginning to assess options in this area (see below).
4. **Replace petroleum-based transportation fuel with electric and other clean fuel options (80 percent or greater).** Transportation represents a total of 30 percent of Boulder's emissions, with more than 20 percent of this related to ground transportation. Of these ground transportation emissions, the majority

[3] Numerous technical assessments have been conducted documenting the technical feasibility of achieving this level of renewable resource-based energy production, such as that outlined at http://thesolutionsproject.org/.

are generated by light duty personal vehicles. The rapidly expanding electric vehicle marketplace already offers a growing range of options that are capable of replacing shorter range travel (less than 40 miles round trip), which represents more than 80 percent of the miles travelled in this vehicle class. Again, electricity is currently the most promising energy source commercial viable for large-scale petroleum systems replacement in the light duty vehicle fleet, however technology in the transportation sector is rapidly evolving as the need and demand for clean energy alternatives expands.

This transition will need to take place at all levels of the community—households, businesses and institutions. Essential to this transition is the proactive anticipation of the natural replacement cycles of a significant portion of these energy assets—heating and cooling systems, and vehicles—in ways that leverage these already anticipated investments to build a new clean energy system. An important emerging role for the public sector will be the development of financial programs and standards that can support and enable this infrastructure transition. Boulder County's recent step to become the first Colorado county to implement the renewed, state-enabled Property Assessed Clean Energy financing (PACE) for commercial properties is an example of this kind of public sector financing mechanism. On-bill financing, in which efficiency and system replacement costs are financed and billed on the utility bill, is another increasingly popular mechanism to support private investment. There are also an increasing number of other public-private financing mechanisms designed to leverage private sector investment.

V. Boulder's Climate Commitment, 2015 to 2020

The Climate Commitment strategy document provides a high level overview of Boulder's path to deep emission reductions, based on the goal of 80 percent or more reduction in GHG emissions by 2050—a goal based on what climate science currently indicates is needed *at a minimum* in order to avoid catastrophic changes to the Earth's climate. The Climate Commitment outlines not only what is necessary and possible, but also makes the case that fundamental transformation of our energy systems is a significant economic opportunity as well.

Consistent with the direction established in recent years, the Climate Commitment provides the overarching vision, direction and targets for Boulder's climate action efforts, emphasizing that emission reduction is not something that will be achieved by government alone: it is a community-wide, multi-sector effort, in which local government has an important role to play, along with regional, state and national bodies.

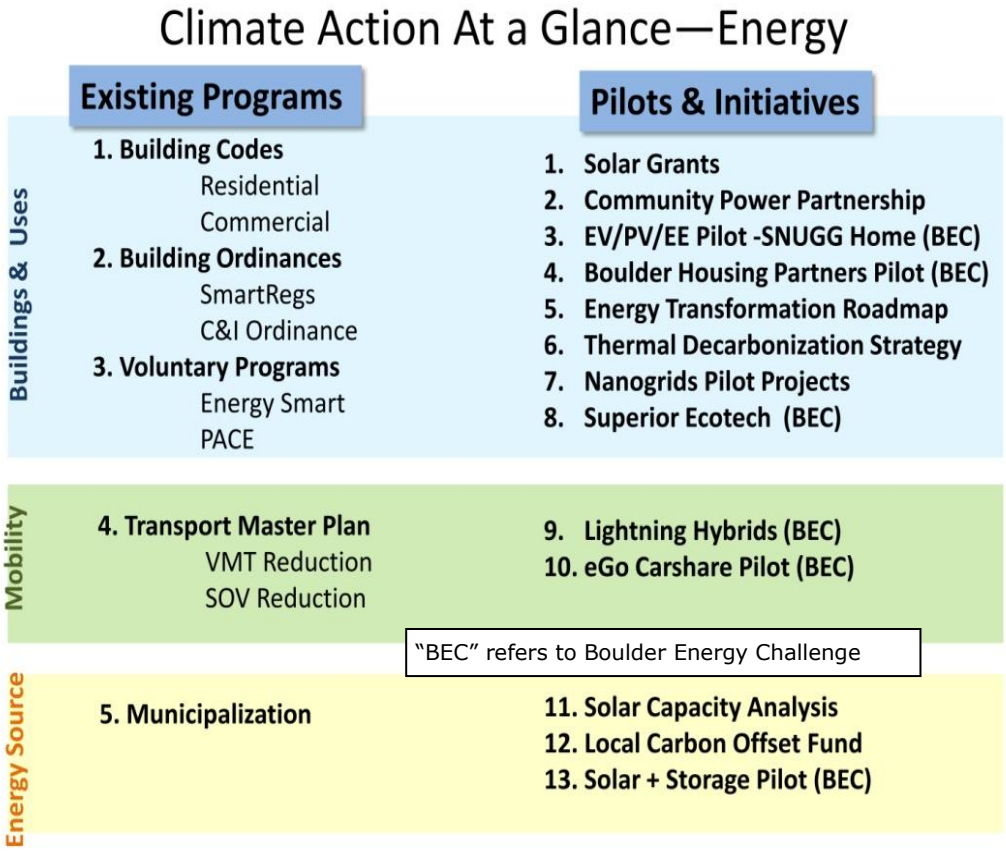
The document outlines a path to 2050, but focuses more specifically on actions needed in the next five years in order to make progress toward that long term goal. As outlined below, Boulder's five year climate action plan builds on the foundation of experience and programs established in prior stages of work and integrates additional pilot projects and initiatives to achieve deep emission reductions.

<u>Implementation of Existing Programs</u>

As summarized in the chart below, there are five major city program areas focusing primarily on energy-related emission reductions. These existing initiatives were the basis for the projected emissions reductions described in the Updates section above. The city's waste related emission reductions represent a sixth program area that is discussed in the Responsible Resource Use section of the Climate Commitment Strategy Document.

Together, the five energy-related program areas represent a major investment of organizational resources across multiple city divisions and programs. A number of these programs are either recently implemented (e.g., SmartRegs, and the latest building energy codes), represent significant new investments (transportation), or are still in final development and have not yet reached implementation stage (e.g., Boulder Building Performance Ordinance, and municipalization).

Full and effective implementation of this existing portfolio of emissions impacting programs will draw significantly on existing organizational resources and will likely require additional staffing as programs mature. In addition to these five major program areas, the city has initiated 13 related pilot projects or initiatives that are designed to explore and develop further emissions reduction opportunities. Together, these five program areas and 13 pilots and initiatives (including their next steps) constitute the primary areas of action and resource investment by the city over the 2015 to 2020 timeframe. A number of these initiatives are profiled below to illustrate emerging opportunity areas for additional climate action.



New Initiatives and Pilot Projects

Several new initiatives are described below to illustrate the type of work planned for the 2015-2020 time period, in addition to the emission-reduction work already in place.

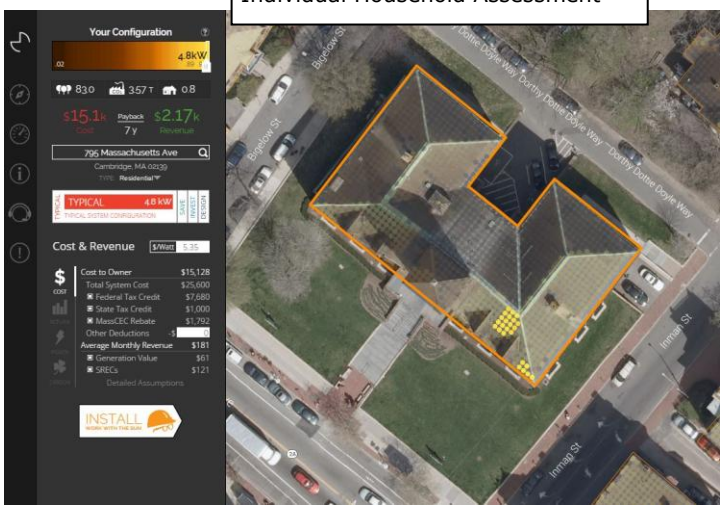
Solar Capacity Assessment – As part of the planning for implementation of a municipal utility, a local energy generation analysis has been initiated with a first stage focus on evaluation of local solar potential. In a collaborative assessment conducted with the National Renewable Energy Labs, the city integrated recently acquired high quality satellite imagery with NREL's solar capacity assessment capabilities to evaluate the solar energy potential for every roof surface in the city of Boulder. This analysis included consideration of orientation to the sun, elevation, shading and minimum solar area suitable for a viable solar installation.

Based on this preliminary analysis, National Renewable Energy Lab (NREL) has projected a total potential solar generation capacity of over 600 MW of electricity during peak production. Given a variety of factors this total capacity is sometimes discounted by as much as 80% to account for factors like shading or imperfect aspect. However, this still indicates that Boulder has the capacity to produce a significant amount of energy locally, particularly as a strategy to reduce energy demand at a building level. This capacity will be significantly enhanced as new storage technologies enables more of this energy to be captured and stored for later use. A second phase of this analysis will conduct a more in-depth assessment of the technical and financial feasibility of high potential solar sites to identify the constraints and opportunities for stimulating implementation of high value solar sites.

Mapdwell Community Solar Map—A second solar capacity mapping project has also been initiated to provide all Boulder building owners with an initial solar capacity assessment. To conduct this project, the city has contracted with MIT spin-off Mapdwell to utilize its proprietary solar capacity assessment tools capable of generating site specific solar capacity information—including an initial financial viability assessment—for every building in Boulder. The images below show samples of a city-wide analysis (left) and how this information is made available at an individual building level. The community-accessible portal is scheduled to become available in late August of this year (2015).

Cambridge Solar Capacity Map

Individual Household Assessment



Whole Energy System Transition Analysis and Planning – Recognizing the need to achieve decarbonization of energy across all sectors (power, thermal and transportation), the city has leveraged its participation in several national and international collaborations to secure grant funding to evaluate renewable energy transition options from a "whole system" perspective, including the gradual replacement of both natural gas (for heating) and petroleum (for mobility). On July 22 and 23, the city will use grant funds received from the Urban Sustainability Directors Network to bring staff from five other leading US cities—Boston, Minneapolis, Seattle, Portland and San Francisco to work together on the development of a set of tools cities can use to take a more active and influential role in creating low carbon energy systems. This gathering will also include technical specialists and leaders in energy policy including a member of the German Parliament who has been an active participant in helping develop and guide Germany's world standard setting

"energiewende" clean energy transition plan. This event will include a public presentation and discussion at e Town hall Wednesday July 22 2015.

In two closely related projects, the city was recently awarded grants through the Carbon Neutral Cities Alliance[4] to lead teams of cities working on energy decarbonization projects. The first project will identify pathways to achieve whole energy system transition in different types of neighborhoods or districts within cities (e.g., residential, mixed use, commercial/industrial). The second project will identify specific renewable energy replacement strategies for natural gas-based heating systems in both residential and commercial/light industrial settings. Both of these projects are expected to be complete by mid-2016.

Energy Resilience Capacity Building – In early 2015, the city convened a public private partnership with several leading energy firms and the Colorado Clean Energy Cluster to pursue DOE funding as part of the Resilient Electricity Delivery Infrastructure (REDI) grant program. This project will support design and implementation of renewable energy systems that improve the ability of critical facilities to maintain operations during power disruptions. The lead project for this initiative is the installation of renewable energy back-up power systems at the city's Boulder Reservoir water treatment facility. Two additional projects are also being planned, one with Boulder Community Hospital and another with Boulder Housing Partners, to implement similar systems at their facilities. These projects are being designed to integrate new energy savings features that will create significant financial savings in addition to improving the ability to withstand energy disruptions. These projects will also provide valuable initial experience in support of a larger community-wide critical energy infrastructure resilience assessment being evaluated with technical assistance providers made available through the 100 Resilient Cities initiative.

VI. A Comprehensive Climate Commitment Framework

The preceding sections provide an overview of the energy-related initiatives that have been the primary focus of Boulder's climate action efforts to date, consistent with action strategies modeled in the most recent Intergovernmental Panel on Climate Change (IPCC) reports and numerous supporting assessments. However, these reports and a growing body of research and analysis are now pointing to two other broad areas that play a significant role in either the total production of emissions for which a community is responsible, or the ability of natural systems to stabilize community emission impacts. These two areas represent important focus areas as part of a comprehensive long-term community climate stabilization commitment.

[4] The Carbon Neutral Cities Alliance is a consortium of 17 of the world's leading cities who have all made commitments to deep emissions reduction. Boulder was invited to be a founding member of the CNCA in 2014.

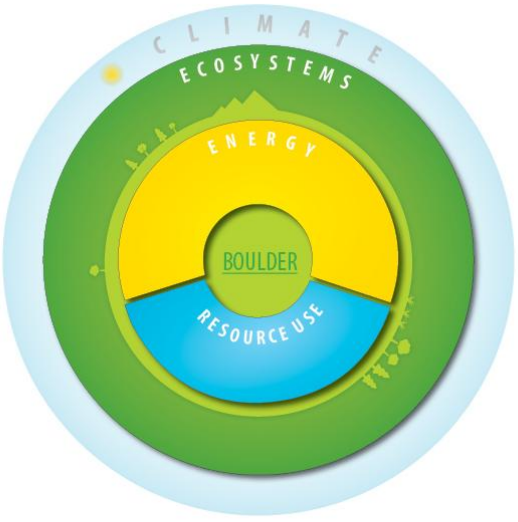
Resource Use – Currently the majority of internationally recognized community emission inventories measure only the emissions associated with energy use within defined boundaries. However a community's full emissions impacts include its use and consumption of resources—from food, water and material goods, to the energy intensive streaming of digital media and the management of waste. Currently there is no standardized method for quantifying the impact of these resource based emissions beyond the landfill emissions allocated to organic waste streams--currently about 2% of Boulder's overall emissions inventory. These additional emission sources are being increasingly recognized as integral considerations for a community's overall emissions impacts and long-term sustainability. As appropriate methodologies for accounting for consumption-related emissions are developed and agreed to, it will be necessary to consider how they should be considered and incorporated in Boulder's ongoing climate work.

Ecosystems – While the majority of attention and climate action to date has been focused on emissions generation, the eventual stabilization of the climate will also depend on effective management of ecosystems. Ecosystems have two significant roles related to emissions. First, without effective management, large scale catastrophic events like wildfires can result in enormous carbon releases and degrade future capacities of ecosystems to maintain healthy carbon cycles. Second, there is a growing body of research indicating the potential to accelerate the capacity of natural systems to recapture (sequester) the excess amounts of carbon responsible for climate destabilization.

In recognition of these factors, the attached Climate Commitment Strategy document organizes and describes its next stage climate actions as three related broad goals: Clean Energy Future, Responsible Resource Use and Restorative Ecosystems. These are portrayed graphically in a way intended to both illustrate the relationships between these factors and simplify the often confusing complexity of the many factors implicated in climate change. Additional explanation of this approach is provided in the Climate Commitment Strategy Document.

<u>Clean Energy Future</u>

This focus area encompasses the majority of efforts Boulder has identified as its primary climate action efforts. It is also the basis of the city's proposed 80 percent emissions reduction goal. In the attached Climate Commitment Strategy document, these actions are discussed in three sectors of activity: high performance buildings; clean mobility; and clean energy sources. Given the central importance of energy as a driving factor in climate change, energy related action areas will continue to be the primary focus of the city's climate action efforts as describe in the prior sections.



<u>Responsible Resource Use</u>

In recognition of the importance of raising awareness about the connection between resource use and emissions, the city is focusing its resource related climate action efforts on three major resource use areas. These include:

Water—Boulder's long-standing water conservation efforts continue to explore the connection between water use, energy use and associated emissions.

Waste—The city's Zero Waste Master plan has both direct and indirect influences on the city's climate impacts. The city's current GHG inventory indicates that approximately 2% of city emissions are directly attributable to methane releases caused by community organic waste streams. More extensive diversion of both organic and recyclable materials could also further reduce indirect emissions for the city's waste stream.

Food—The growing interest and initiative around local foods and agriculture could also have emission consequences. The management of local agricultural lands in ways that either enhance or degrade ecosystem services such as sequestration is one example. A second potential effect is the displacement of energy and water intensive agricultural products by more low emission local products. It should be noted that this is an area in which only limited quantitative research has been completed.

Restorative Ecosystems

In addition to energy and resource use, ecosystems play a significant role in both maintaining and stabilizing climatic systems. Three areas of local ecosystem action are described in more detail in the Climate Commitment document:

Urban Ecosystems – The primary focus of this area is the management of urban landscapes in ways that mitigate climatic extremes (heat and cold) to reduce energy needs and their associated emissions. Boulder' urban forest plays a critical role in this process. These landscapes currently face a number of significant disruptive influences that could significantly impact their ability to provide these services including increased temperature extremes, water stress, and invasive species impacts e.g., Emerald Ash Borer.

Natural Ecosystems – The city's extensive open space system plays a significant role in maintaining stable ecosystem functions that provide substantial local ecosystem services (cooling, moisture retention, stormwater management) that could have serious negative energy and emissions impacts if damaged through wildfires, drought or other chronic stresses or disruptive events.

Agro-ecosystems – A growing body of information and research suggest that deliberate strategies to enhance the sequestration capacities of managed lands could achieve measurable carbon capture and holding benefits. This is an area of emerging consideration, particularly in the context of agricultural and other highly managed landscapes, such as parks.

Additional detail on both the Responsible Resource Use and Restorative Ecosystem focus areas will be included as part of the Climate Commitment Strategy document that will be completed by mid-July.

VII. Measuring Progress

The proposed 80 percent emissions reduction by 2050 goal is intended to provide the overall direction and long-term vision that guides all aspects of the city's operations and collaborations with the larger community. To measure interim progress towards achieving this goal, relevant divisions within the city have established shorter term metrics and targets that can be "rolled up" into cumulative emissions reduction objectives. These programmatic metrics and targets are summarized in **Attachment B**.

VIII. Community Engagement

Achieving an 80 percent emissions reduction by 2050 will require coordinated and sustained action across all sectors of the Boulder community. Mobilizing and coordinating this action will require extensive collaboration that leverages Boulder's innate creativity and innovation to develop a clean energy economy and lifestyle that grows economic vitality, social opportunity and environmental quality for the entire community.

The development of the attached Climate Commitment Strategy Document and the ratification of the emissions reduction goal are a starting point for the next steps in creating a community-wide discussion and development of an implementation strategy that honors a long-term commitment to maintaining a livable climate and acknowledges the more immediate and tangible concerns and considerations of daily community life. **Attachment C** provides an overview of the proposed Climate Commitment Communications Plan that will kick-off this next stage of community dialogue and collaborative implementation plan development. This engagement phase is intended to take place from August through the end of 2015 and culminate in Council's final approval of a Climate Commitment implementation strategy.

Attachment A: 2012 GHG Inventory Report

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.[5] 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)[6] 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.

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

6 Two separate sectors that have been aggregated into one due to limited data availability.

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.[7] 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

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

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.

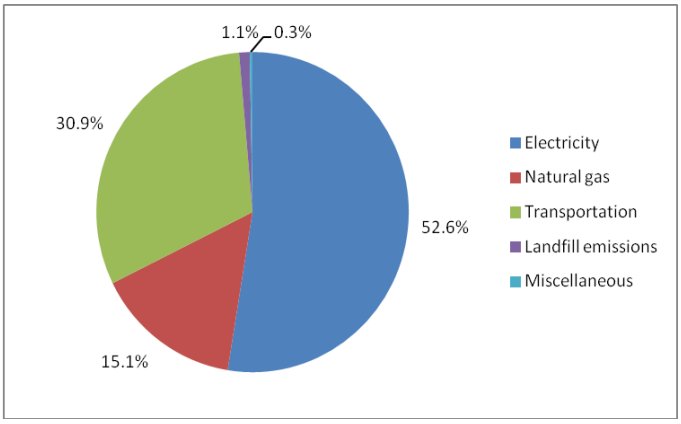
It is also important to note that with the change in methodology and the adoption of the new ICLEI protocol, the city has taken the opportunity to update some of its existing assumptions and conversion factors. For example, the city previously calculated CO_2 using the Environmental Protection Agency (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.

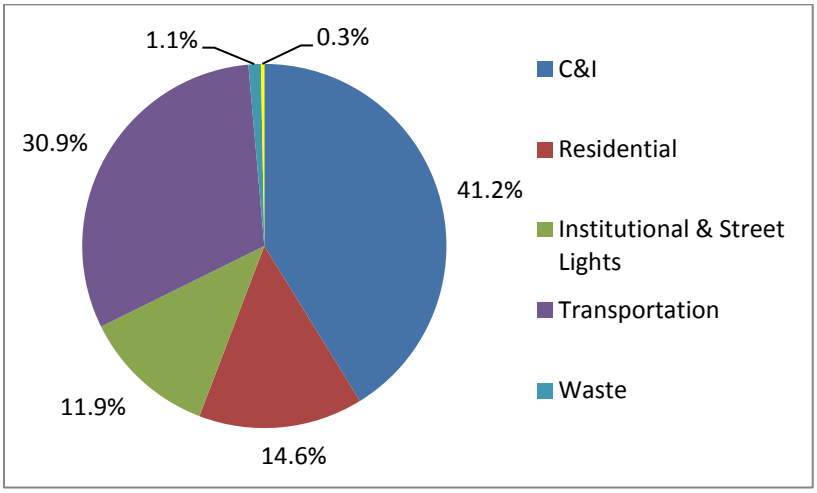
Chart 1. Emissions by Source



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.

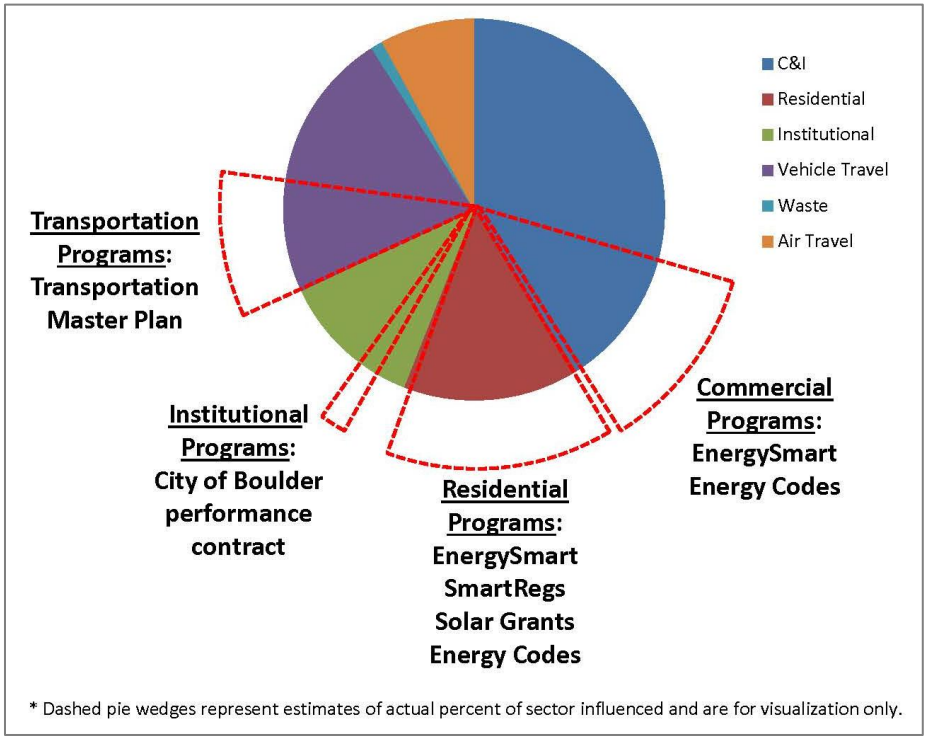
Chart 2. Emissions by Sector



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.

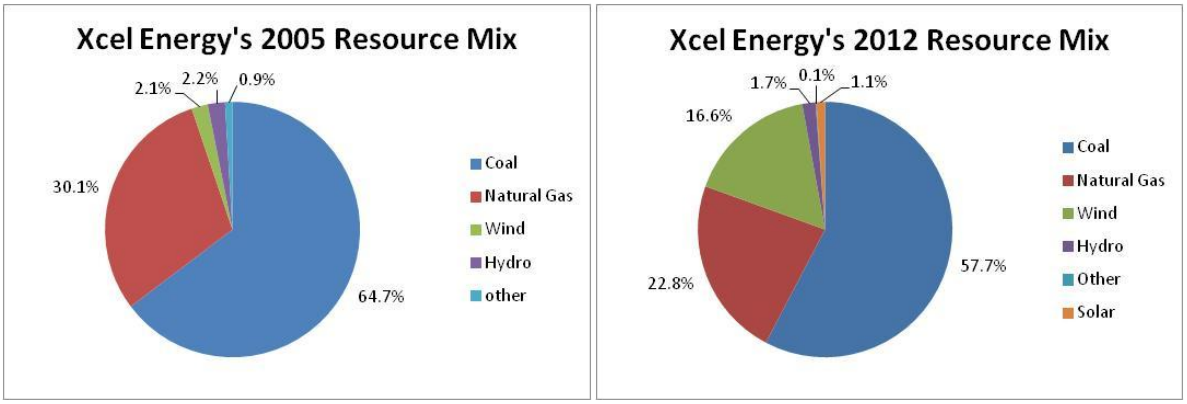
Air Travel

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[8]

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

[8] 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/

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[9]. 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

[9] 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.

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.[10]

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

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

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.

Attachment B: Summary Table of Emission Reduction Metrics and Targets[11]

		TARGETS BY DECADE		
	2015	2020	2030	2050
Overall CO2 Emissions				
Total CO2-MtCO2e--annual		1,327,313	1,005,540	361,994
Per capita MtCO2e--annual		11	8	3
Clean Energy Future				
Buildings & Related Uses				
Residential--kwh/HH/year		5,000		1,600
Residential Electricity Savings		10%		70%
Residential--therm/HH/year		38,000		28,000
Residential NG savings		5%		25%
Commercial EUI		70		65
Commercial Electricity Savings		-7.5%		30%
Commercial & Industrial NG Savings		7%		20%
Transportation/Mobility				
Total VMT--Anuual	883,000,000	846,000,000	757,000,000	579,000,000
VMT Per person				
Residents--miles per day	11	10	8	4
Non-residents--miles per day	14	14	12	9
Transit Mode Share				
Residents--% using transit	5%	6%	9%	14%
Non-residents--% using transit	9%	10%	11%	14%
Bike Mode Share				
Residents--% biking	19%	22%	27%	38%
Non-residents--% biking	1%	1.50%	2%	3%
Ped Mode Share-Residents--% walking	20%	21%	24%	29%
SOV Mode Share				
Residents--% driving alone	36%	32%	24%	8%
Non-residents--% driving alone	80%	75%	65%	45%
Neighborhood Accessibility--Residents	26%	40%	67%	100%
Light Duty Vehicle MPG equipvalent	23mpg	36 mpg	50 mpg	74 mpg
% electric & alternative vehicle ownership	1%	15%	30%	75%
# of electric vehicles		2,000	10,000	30,000
# of other zero carbon fuel vehicles (e.g. hydrogen)		250	2,000	5,000
# of business with workplace charging		25	200	500
# of chargers/employees		1/1,000	1/500	1/50
# of public and workplace charging stations		50	500	2,500
Energy Source Change				
MW Clean Electricity		75	150	300
% Clean Energy		30%	50%	80%
MW Local Energy		30	60	150
% Local Energy		12%	22%	50%
Energy Cost/unit (all forms)				
Natural Gas replaced/reduced		5%	25%	80%
Petroleum replaced/reduced		5%	25%	80%
Community Infrastructure				
% undergrounded utilities	60%	70%	80%	90%
% of critical services facilities with islanding capability		75%	85%	95%
# of community solar gardens		5	15	30

[11] 2050 targets for a variety of programs including Transportation were created by extrapolating trends from 2035 to 2050. Continued reductions between 2035 to 2050 will require additional investment. Targets will continue to be refined over time.

Attachment C: Climate Commitment Communications Plan

August through December 2015

Objective: To build momentum around, and a better understanding of, Boulder's next-generation climate goals and the strategies necessary to achieve them.

Goals:

1. To help target audiences understand the need for more aggressive and impactful climate action
2. To communicate the goal that City Council chooses to adopt, whether it is an 80 percent reduction in emissions by 2050; a fossil-fuel future; or some hybrid
3. To describe the three focus areas of the city's proposed Climate Commitment and facilitate community feedback on this approach. The three areas are:
    a. Creating a Clean Energy Future
    b. Using Resources Wisely
    c. Encouraging Restorative Ecosystems
4. To explain how existing initiatives, including municipalization, energy efficiency standards and programs; and innovative pilots and partnerships fit into this framework
5. To identify what the city can do, what community partners can do and what individuals can do to help reach Boulder's goals

Target Audiences:

- Residents, including students/youth
- Business and property owners
- Institutional and non-profit partners
- Environmental allies and other communities working on similar goals
- Legislators and regulators
- Potential investors and grantors

Key Messages:

- Boulder has long been a leader in confronting climate change, and meaningful action is more important than ever. Our community and others are already experiencing the negative effects of climate change and it is important that we focus both on minimizing these and adapting to them (or building resilience to them).
- The strategies the city and partners adopt to confront this challenge are good for the environment, and they have many other benefits for Boulder, including an improved quality of life; energy independence and enhanced reliability of service; economic vitality; and a continued commitment to innovation. These benefits may, in fact, be better motivators for encouraging communitywide action.
- The three focus areas stem from our greenhouse gas inventories and our knowledge, acquired through the actions we have taken in Boulder since voters created the carbon tax in 2006, about the areas where the biggest impacts are possible and where we, as a community, can have the most local control.
- The first – Creating a Clean Energy Future, which includes, but is not limited to municipalization – is the area in which the most city resources have been devoted in recent years. This is because energy (both in terms of how we power our homes, businesses and other buildings and how we get around town) is the single largest source of Boulder's emissions.

- The city has valuable programs in the two other focus areas – Using Resources Wisely and Encouraging Restorative Ecosystems – and plans to continue these both because they play a part in climate action and because they are consistent with other important community priorities and values.
- The climate commitment is a long-term initiative, and the second and third focus areas, in particular, are ripe for development of policies and programs that would tackle the emerging areas of consumption and carbon sequestration.
- There are steps the city can – and is taking – to address climate change, but we have the greatest opportunity of being successful through partnerships and regional, national and international coalitions. In addition to this, individual action remains a high priority. Each one of us has a role to play.

Challenges:

- City Council has not yet adopted a Climate Commitment goal.
- The city has many different projects going on simultaneously, leading to community and organizational confusion about the city's overall approach and how the different pieces fit together
- Much of the focus has been on the highly politicized topic of municipalization. This has stolen the community's focus and threatens to undermine what had been community consensus around the importance of taking action.
- The city wants to support existing initiatives, which have led to meaningful success, but additional, significant and potentially costly work is required to effect real change.
- There are insufficient resources (both monetary and in staff capacity) to take on additional initiatives or efforts. It is anticipated that these staff teams will be seeking additional resources as part of the 2016 budget process, but these requests will have to be weighed against other city needs and priorities.

Opportunities:

- City Council's and Boulder's demonstrated commitment to this issue
- Recent events, like flooding, that have raised the community's interest in preparedness and resilience in the face of natural disasters
- More knowledge and data than we've ever had before about our energy use, supply and potential for improvements
- A recently adopted Transportation Master Plan that includes greenhouse gas emission reduction and infrastructure transformation as key goals
- Recent efforts to solidify and create new partnerships, coalitions and alliances within the city, in the county/region, across the country and internationally
- Success in pursuing grants to provide additional funding, especially for pilot and innovative programs
- Strong programs in the areas of resource conservation and restorative ecosystems upon which to build in the future

Strategies:

- Use this communication plan and the Climate Commitment framework as a way to unify messaging and communication efforts around <u>all</u> work being done by the city in this area (To be clear, communication subplans will continue to exist and be updated for focus areas that fall within this broader context, such as Energy Future, the C&I Energy Efficiency Ordinance, Boulder Energy

Challenge, Transportation Master Plan, etc. but their objectives/messaging/tone of messaging must roll up to those articulated by this effort)

- Shift tone of messaging away from gloom and doom/guilt-inducing moral imperative/avoiding peril to one that is both fact-based and positive, emphasizing the opportunity to leave a strong legacy for the next generation and co-benefits to our current way of living and economic security

- Leverage our existing relationship (and limited purchase order funds) with Vermilion for two phases of work

  - First phase from now until December 2015 – Creating clear and integrated informational materials, starting with a Climate Commitment executive summary report for the July 2015 Study Session and followed by a web framework that provides the overall presence and launching place for information on all efforts related to climate action
  - (Not built out in this plan, but just so you can see the bigger picture) Second phase – anticipated for 2016 – Building on the groundwork that has already been laid in creating a brand for an action-oriented campaign, i.e. Boulder Up that encourage individuals to support both collective action, including that taken by the city and institutions, and individual responsibility

- Maximize audience reach in a cost-effective way by utilizing existing communications platforms, including social media (specifically the city Facebook account and the City of Boulder LEAD Twitter account), Channel 8 programming, the Energy Future e-newsletter and LEAD e-newsletters (as appropriate), Inspire Boulder and strong media relationships to share information and seek feedback on the city's Climate Commitment direction

- Tap into existing and new partnerships (and the expertise and reach of individuals within these partnership organizations) for the purposes of cross-promoting consistent messages and meaningful climate action.

Tactics, in proposed chronological order (includes proposed timing and who's responsible for what):

- Build internal consensus around the three focus areas, messaging framework, key story components, overall tone and integration into GHG inventory work (Now until end of May 2015 – David, Brett, Jonathan, Susan and David – no budget needed)

- Develop visually compelling "Executive Summary" document that spells out the three focus areas, shows targets and where we are starting from and explains what roles the city, partners and individuals have; document will provide outline for content as it lives on web (Deadline July 17, 2015 for release as part of July 28, 2015 study session - David as lead writer; Brett as content generator; Sarah as editor and coordinator; and Vermilion as editor and designers - $10,000)

- Production and release of climate commitment motivational video that explains the need to act and outlines the three proposed focus areas; thinking of involving children and if they are willing, Boulder Dinner Theater directors who work with kids (Deadline July 28, 2015 – Sarah as coordinator; Brett as content generator; outside videography firm – not to exceed $4,000)

- Hiring of outreach fellow/intern (By July 1, 2015 – Brett as coordinator and manager - $5,000 contribution from CAP comm. budget; remainder of pay comes from elsewhere in CAP)

- Create or resurrect email listserv for people interested in receiving climate news or re-purpose/broaden EF email listserv (By July 22, 2015- Sarah, Colette and Lisa – minimal funding needed if we create new list; no funding needed if we add info to EF list)

- Coordination of media information for likely news articles both advance and coverage of July 28, 2015 study session (Week before and of July 28 study session – Sarah as lead coordinator; David and Brett as subject-matter expert spokespeople – no budget needed)

- Requests for inclusion in partner newsletters and communication platforms (post-study session through Oct. 15, 2015 - Sarah to forward content; Brett to make requests based on his relationships – no budget needed)

- Minimum of one business presentation and three community/neighborhood meetings to present video, proposed framework and solicit feedback (post-study session through Oct. 15, 2015 – Brett and outreach fellow with Sarah and Colette providing support in the way of inviting people to participate – room rental and refreshment costs anticipated to be about $1,000)

- Online feedback mechanism, such as a survey on Inspire Boulder and social media (post-study session through Oct. 15, 2015 – Sarah and Colette as coordinators; Brett and outreach fellow as content generators – no budget needed)

- Development of web landing page and framework for building out of additional pages (by Dec. 1, 2015 – Sarah as project coordinator; Colette and Lisa as web content coordinators; Brett, David and Jonathan as content generators; Vermilion as designers - $27,100)

- Channel 8 coverage of issue and milestones; social media blasts associated with feedback opportunities; e-newsletter articles (ongoing and as needed – Sarah, Colette and Lisa as coordinators; Brett and David as content generators and subject matter spokespeople – no budget needed)

Attachment D: High Profile Buildings-Climate Commitment

HIGH PERFORMANCE BUILDINGS

By 2050, all buildings in Boulder will be high performance, with air-tight and insulated building envelopes that reduce the need for heating and cooling; highly efficient equipment, lighting and appliances; on-site renewable energy generation and storage where possible; and smart, automated energy management systems that ensure building comfort, efficiency and livability.

Boulder's Building Today:

Boulder has approximately 43,000 residential dwelling units and 3,700 commercial and industrial buildings. Together the energy used to maintain these buildings and the activities taking place with them use over 2/3 of the total energy consumption in the community. Currently over 90% of this energy comes from the burning of fossil fuels. As a consequence, buildings and the energy uses within them contribute over 2/3 of the city's overall energy-related greenhouse gas emissions. These emissions can be further divided into three major building use sectors: residential, commercial/industrial, and institutional (city organization, Boulder County, Boulder Valley School District, University of Colorado).).

Targets & Timeframe:

Energy Efficiency	2020	2050
Residential Electricity Savings	10%	70%
Residential Natural Gas Savings	5%	40%
Commercial/Industrial Electricity Savings	(7.5%)	20%
Commercial/Industrial Natural Gas Savings	7%	30%
Commercial Energy Intensity (kbtu/sqft)	70	65

[1] Residential electricity savings includes the projected increase in installed roof-top solar. This on-site generation and use also results in reduced energy purchased from the grid and is therefore a "savings" of energy not needed from a utility energy system.

[2] Includes the City, CU, BVSD, and Boulder County. Data from the federal labs is still being researched but could add several percent age points to the institutional category that would be subtracted from the Commercial & Industrial sector.

26%

TARGET REDUCTION IN EMISSIONS BY 2050

DID YOU KNOW?

Enhancements to city buildings have already reduced the city's overall emissisons by 22% and save the city almost $700,000 each year.

HIGH PERFORMANCE BUILDINGS

City Buildings Lead The Way!

The 2010 the city of Boulder hired McKinstry and Associates to conduct a comprehensive energy assessment and develop an emissions reduction strategy development. Based on this assessment, the city invested over $11,000,000 in both energy efficiency measures and the installation of renewable energy. Through these efforts, the city improved energy efficiency in 43 buildings, changed out over 10,000 light fixtures, and installed new building controls and other mechanical systems.

These measures reduced the city's overall emissions by over 22%--over 8,000 metric tons of greenhouse gases. These investments have saved the city almost $700,000 per year in energy costs. The city is now exploring a next stage of opportunities in energy efficiency and renewable energy generation to achieve the goal of reducing emissions 80% or more by 2050.

How to Make Buildings Better

Achieving high performance buildings throughout Boulder will require significant investment. But the good news is: over the next 30 years, significant investment will happen regardless, as property owners and businesses replace outdated systems, new buildings are built, and old buildings are remodeled. It's not so much that we need to make new investments; it's that we need to make different investments. And while sometimes those investments may cost more up front, they will invariably save money over time, as less energy is needed to achieve the same outcomes. The three key areas of action to make this happen are outlined below.

Reduce

Reduce the energy needed to operate buildings and power the activities within them through deep energy efficiency retrofits, "net zero" building codes, and improvements in the energy performance of appliances and other equipment.

Replace

Replace all building systems that rely on fossil fuels, particularly heating and cooling systems and water heating. In other words, switch from natural gas systems to either electric (assuming a shift to a clean electricity supply) or other clean, renewable energy systems (e.g., groundsource heating and cooling).

Redesign

Redesign building codes and community systems to create "net zero" or "net positive" buildings and neighborhoods, integrating systems at the district scale and incorporating local generation of clean energy.

The community has installed enough solar panels to power over 2,000 homes.

Whole Energy Systems Change—For Your Home!

As part of its effort to support community-generated innovation in emissions reduction, the City of Boulder sponsored the Boulder Energy Challenge in 2014. Among the projects selected for funding is an exciting initiative developed by a local company—SNUGG Home—to create innovative financing strategies that can support local households in securing a complete clean energy system makeover…at about the same cost as maintaining an existing fossil-fuel dependent system. This exciting initiative is already helping Boulder households map out a strategy to deep emissions reduction—often 80% or more—while making their homes more comfortable, lowering energy costs, and creating the energy needed to drive around on solar power!

BOULDER ENERGY CHALLENGE

2015-2020 City Action Priorities

Improving the energy performance of buildings has been a key area of focus in Boulder over the past decade, particularly in the residential sector, but increasingly in the commercial and industrial sectors as well. But there is a long way to go.

While shifting Boulder's energy source to clean and renewable "fuels" like sun and wind will make a significant contribution to deep emission reductions, achieving much higher levels of energy efficiency is critical to a cost-effective energy transition. This will require changes not only in how buildings are built (and renovated), but also in the choices each of us makes when purchasing new appliances and equipment, or when managing our daily energy use at home and work. Over the next five years, aggressive action is needed to set us on the path to our community's climate commitment. To support community action, the city plans to prioritize the following:

REDUCE

Voluntary Education, Services and Incentives for Building Owners

- Continue to provide information, incentives and support for deep efficiency retrofits through energy advising programs like EnergySmart and Partners for a Clean Environment.
- Support the use of newly developed clean energy financing mechanisms such as the Boulder County property-assessed clean energy program.

Building Efficiency Standards and Requirements

- Implement the Building Performance Ordinance that requires the largest commercial and industrial buildings to track and report energy use – and eventually to implement specific energy efficiency actions.
- Achieve 100 percent compliance in residential efficiency requirements for rental housing by 2019 (SmartRegs).
- Explore the potential for time-of-sale energy efficiency requirements for owner-occupied housing.

Piloting New Programs and Services

- Implement programs such as the community power partnership (piloted in 2014) that provide households and businesses with enhanced information about their energy usage and access to customized efficiency and energy management services.
- Pilot integrated approaches to energy efficiency, solar energy installation and electric vehicle acquisition to create deep emission reduction pathways for Boulder households such as those being tested in two Boulder Energy Challenge funded projects (SNUGG Home pilot project, Solar +Storage pilot project).

Energy Efficiency and Demand Side Management as Priorities of Municipal Utility

- Ensure that investments in aggressive energy efficiency measures are a core part of the resource planning, services plan and business model for a new municipal electric utility.

REPLACE

Infrastructure Assessment & Transition Planning

- Assist building owners in identifying clean energy alternatives to existing systems dependent on natural gas and create a retirement and replacement plan consistent with the normal replacement cycles of these systems.
- Use city facilities and other leading edge businesses and institutions to develop and test new clean energy systems and develop the technical and financial information needed to support broader scale adoption.

Roof-top Solar

- Provide residences and businesses with solar capacity information for every building in the city through the current Mapdwell solar capacity analysis to encourage and facilitate more widespread installation of rooftop solar.

REDESIGN

Clean Energy Future Design for New Buildings

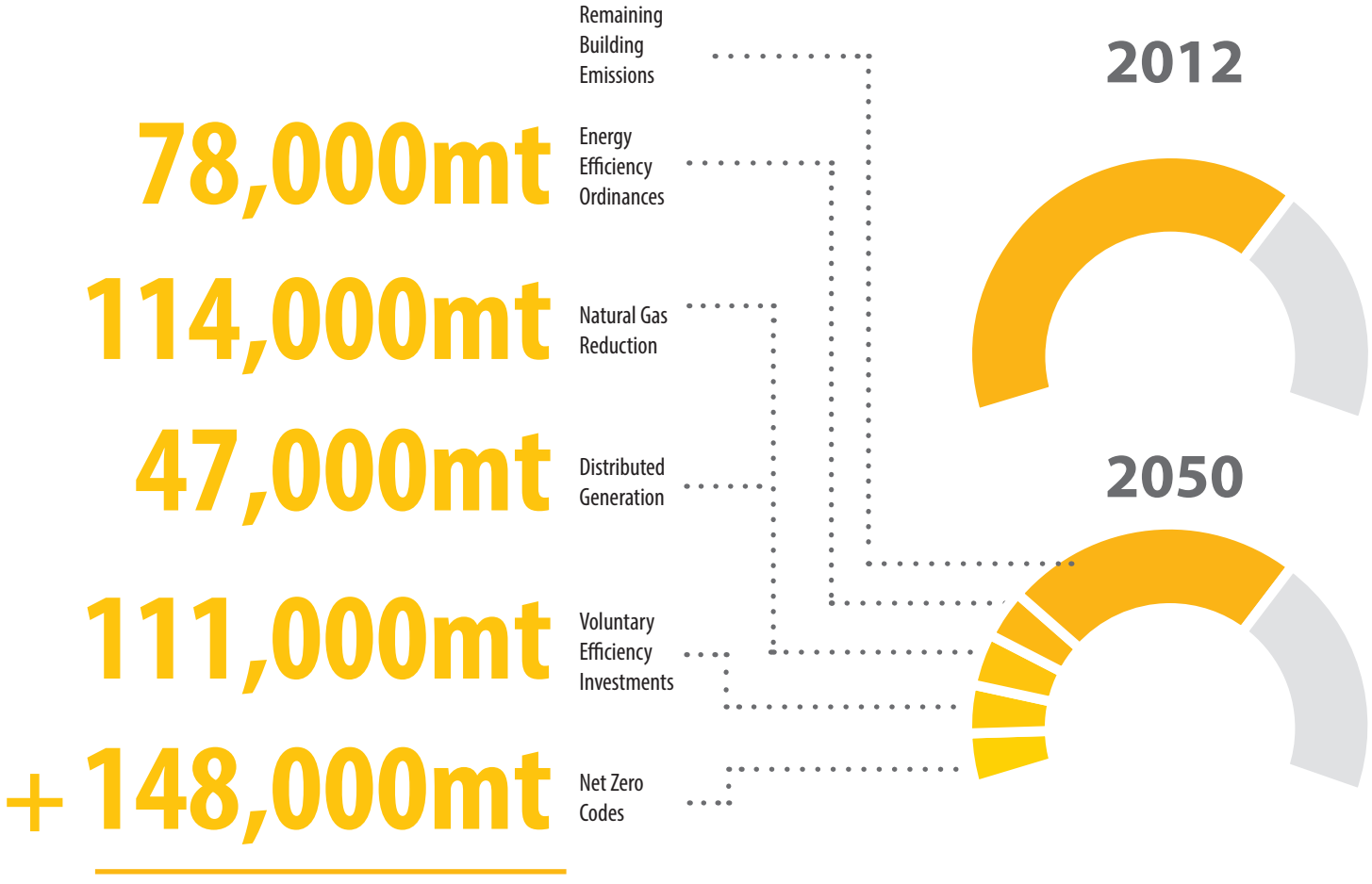
- Manage and refine implementation of the Net Zero Building code compliance pathway with the goal of all new commercial and industrial buildings over 20,000 sq. ft. achieving net zero emissions by 2031.

HIGH PERFORMANCE BUILDINGS

Making it Happen: The Path to 2050

The figure below summarizes projected emission reductions that can be achieved through investments in high performance buildings, based on current information and assumptions. Taken as a whole, these efforts would result in a reduction of 500,000 metric tons by 2050, a 26 percent reduction from estimated 2012 emissions.

The ability to hit these long-term targets requires a utility partner committed to deep efficiency, with capabilities for on-bill financing of efficiency investments, net metering, and rate structures that are consistent with an overall goal of reducing energy use, rather than selling more electricity. The chart also shows the expected impact of energy efficiency in city buildings and other institutions, like CU, federal labs and local schools, which are not subject to city codes and requirements.



498,000mt **26%** Total Projected Emission Reductions

Measuring Success

The city has developed an extensive set of performance measures to evaluate our community's progress towards achieving high performance building objectives. The full set of metrics and targets for building performance and the city's other energy related initiatives can be found in Attachment A of this document. Much of the information necessary to monitor this progress will depend on the willing participation and engagement of the community's energy providers, particularly electricity and natural gas. These efforts will also depend on the investments and actions of other leading community institutions.

Powerful Partnerships

Boulder is fortunate to have many progressive organizations also working hard to meet our climate goals.

The University of Colorado plans to continue its long-term commitment to investing in clean energy improvements. It's new indoor athletic facility will be built to be net zero greenhouse gas emissions including a nearly 1megawatt array of solar on its roof. The University has also initiated a comprehensive energy efficiency upgrade program with McKinstry and associates similar to efforts that helped the city reduce its greenhouse gas emissions by more than 20%.

Boulder County has been the lead partner in administration of both the Energy Smart residential energy efficiency program and the Partners for a Clean Environment (PACE) commercial and industrial energy efficiency program. More than 7,000 households and 3,000 businesses have been served through these programs since 2010, stimulating over $12 million in private investment in energy efficiency on less than $3 million in public incentives. Seventy-five percent of homeowners in contact with the program implement some form of efficiency, 3 times the national average.

Boulder Valley School District completed its Sustainable Energy Plan in 2013 calling for a 20% reduction in overall energy use by 2050. It has also set ambitious building energy efficiency goals, including a target of reducing its building energy use intensity (EUI) by nearly 50% over the same period. As part of its recently passed bond measure, it has targeted many of its facilities for significant upgrades including 8 buildings with deep retrofits (>50% energy use reduction) and many more that will receive renovations and mechanical system retrocommissioning.

Boulder's 14 **federal labs** have also been leaders in implementing President Obama's recently issued executive order to improve federal building efficiency standards mandate a 40% improvement in building energy efficiency over the next five years. As a major presence in Boulder, the federal labs efforts will substantially enhance the community's efforts to reduce GHG emissions.

UCAR

Boulder Valley School District

Boulder County