



BOULDER'S CLIMATE COMMITMENT

Rising to the climate challenge, powering a vibrant future.



MAY 2017

City of Boulder, Colorado

Dear neighbors,

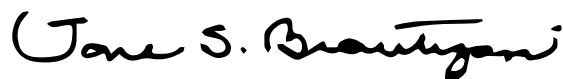
Boulder has long understood the importance of local climate action. Boulder's residents and businesses were among the first in the country to implement programs like the Climate Action Plan Tax (CAP Tax) and a host of other energy efficiency and conservation programs. Some of these, including EnergySmart, SmartRegs and the Building Performance Ordinance, are being replicated elsewhere as they begin to achieve the full benefits of their implementation locally. Others, like a local carbon offset fund and changing our energy supply from fossil fuels to renewable sources through the possible creation of a local electric utility, are still taking shape.

Over our years of work, however, the reality has become increasingly clear: climate change is happening, human activity is the cause and the scale of the challenge is even greater than we originally understood. Scientists now tell us that we need to reduce greenhouse gas emissions by at least 80 percent by 2050 to stop the trend of warming – and slow the impacts already underway. Successfully addressing this challenge will require bold, broad measures. This document outlines the areas of action that we, in your local government plan, to focus on in the years ahead. We believe that city leadership in these key areas is critical to success. But we can't do it alone. Community-wide participation, innovation and action are essential to fully address this challenge.

With so many other challenges and demands on your time, why should this be a priority for you? Well, as is often the case, challenges also present opportunities. For those in our community drawn to Boulder's entrepreneurial spirit, creating new approaches to renewable energy generation, storage and management—and being able to test those approaches here in Boulder—are leading to unprecedented business and local job opportunities. For those concerned about how we'll withstand the impacts of climate change, these innovations also enable us and to build resilience in our critical infrastructure, as well as support vulnerable populations that are disproportionately stressed during emergencies. And for the average household, being able to use less energy, generate it yourself and intelligently plan for home system upgrades can add up to significant cost savings. Rather than sending over \$300 million each year out of our community to pay for fossil fuels we simply burn up, we can reinvest those dollars in energy systems that could last a lifetime or more.

This is a critical time for our environment and our community—but it is also an exciting time. Once again, our community is positioned to be a leader. We are eager to hear your thoughts about our planned focus areas and your ideas for how each of us can play a role in achieving our goals. We're up to the challenge. We hope you are, too.

Sincerely,
Suzanne Jones, Mayor
Jane Brautigam, City Manager



Boulder's Climate Commitment

Our Challenge

The combustion of fossil fuels is warming earth's atmosphere and changing our climate. The current trajectory, if left unchecked, will lead to a human-induced warming of 7 degrees Fahrenheit (4 degrees Celsius), or higher. Such an increase in global temperatures will be catastrophic. To change this course, we must achieve dramatic near-term reductions in greenhouse gas emissions by rapidly transitioning from fossil fuels to renewable energy. Stabilizing the climate will also require using resources more efficiently and removing carbon from the atmosphere by restoring and enhancing ecosystems.

Our Opportunity

Transformation of our energy system is essential if we are going to stop burning fossil fuels. This transition presents an unparalleled opportunity. Technology, innovation and collective social change have the potential to create a world in which the fuel to power our lives is clean, abundant, free and accessible to all. We need to redirect our energy system investments, making them more decentralized and resilient in the process. More efficient use of energy and other resources can also support greater community abundance and shared equity. Enhancing ecosystems to remove carbon from the atmosphere also improves local air and water quality, leading to better public health.

Our Commitment

Boulder will rapidly transition to a clean energy economy and lifestyle through innovative strategies, products and services that dramatically reduce greenhouse gas emissions, enhance our community's resilience and support a vital and equitable economy.

Our Goal

We will power our city with 100 percent renewable electricity by 2030 and reduce Boulder's greenhouse gas emissions by at least 80 percent below 2005 levels by 2050.

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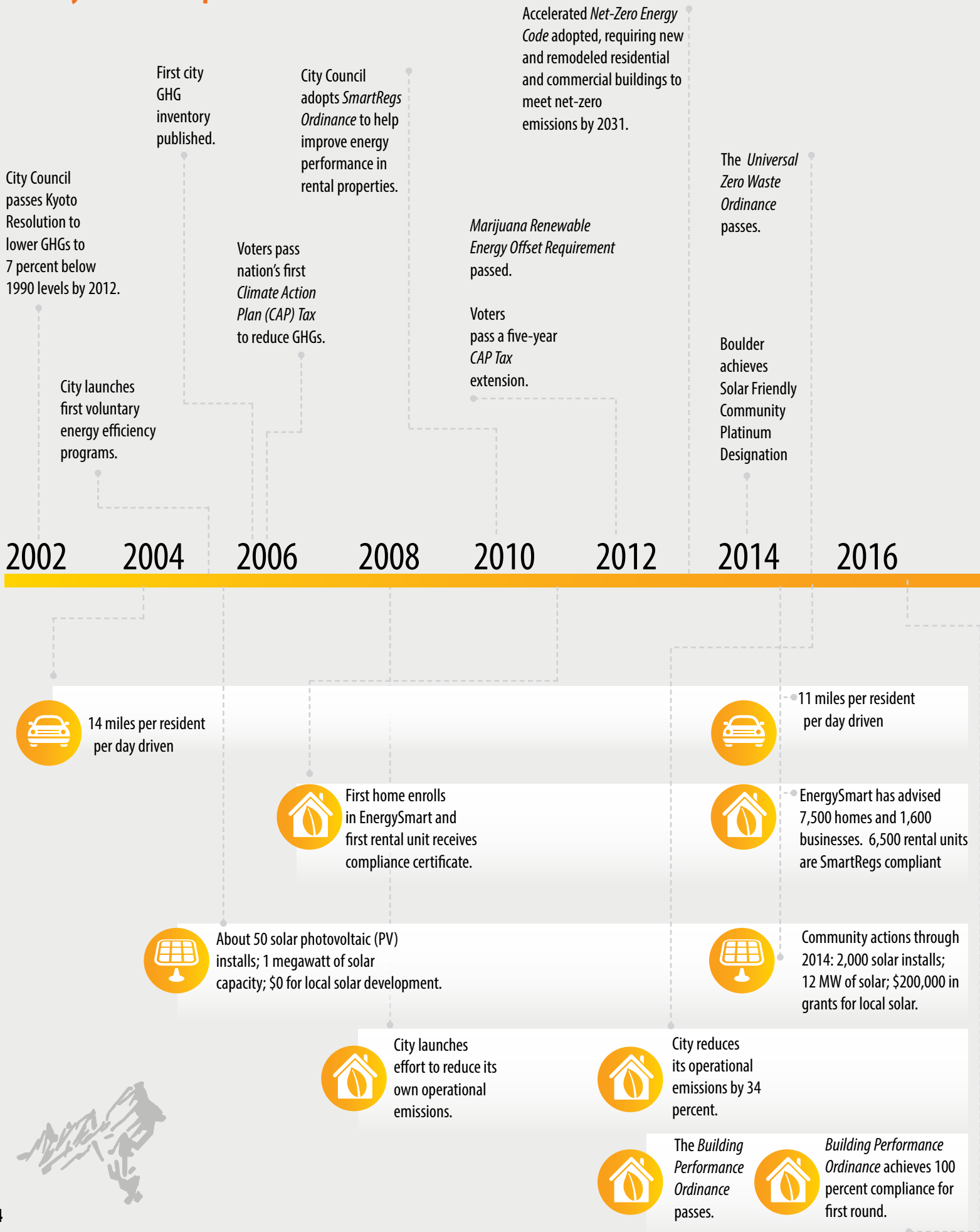
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History and Accomplishments To Date



Vision Into Action

Vision

Boulder is a world leader in the development and implementation of renewable energy and emissions reductions programs that create local economic opportunities, enhance community well-being and build resilience. Through these efforts, Boulder inspires and enables other communities to participate in reducing carbon emissions and stabilizing the climate.

Goal

Boulder will reduce its greenhouse gas emissions by 80 percent or more below 2005 levels by 2050.¹

Action Areas

Energy—Reduce fossil fuel demand from buildings and transportation; rapidly transition to an energy system and economy that is powered 100 percent or more by renewable clean electricity with 50 percent or more of that produced locally.²

Resources—Reduce the emissions impacts caused by the use of goods and services by maximizing the productivity of all resources used and making purchasing decisions that support responsible resource use.

Ecosystems—Enhance the ability of urban, wildland and agricultural ecosystems to capture and stabilize atmospheric carbon and provide critical buffering against climatic extremes.

Community Climate Action—Support the inspiration and innovation of those who live, work, study and visit Boulder to create a low-carbon economy and lifestyle that improves the health, shared prosperity and long-term security of the community.

Emissions and Energy Goals³

	TARGET AREA	2020	2030	2050
COMMUNITY	Emissions Reduction	15%	50%	80%
CITY ORGANIZATION	Emissions Reduction	50%	80%	+90%
RENEWABLE ENERGY	Percent of electricity supply that is renewable	40%	100%	100%

¹The City of Boulder uses the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC) for greenhouse gas accounting.

²The current methodologies for calculating community-wide greenhouse gas emissions account primarily for energy-related sources. Recognizing the important role that both resource use and ecosystem management play in emissions reduction, the city is working on incorporating methods for quantifying the impacts of actions in these areas.

³Community emissions are measured against a 2005 baseline. City organization emissions are measured against a 2008 baseline.

2015 Boulder Community Greenhouse Gas Inventory

Greenhouse gases (GHGs) absorb radiation from the sun and trap heat in Earth's atmosphere. The more GHGs there are, the more heat is trapped in our atmosphere, leading to global warming and climate change. GHGs measured here include carbon dioxide, methane and nitrous oxide and are measured in metric tones (MT) of carbon dioxide equivalent (CO₂e).

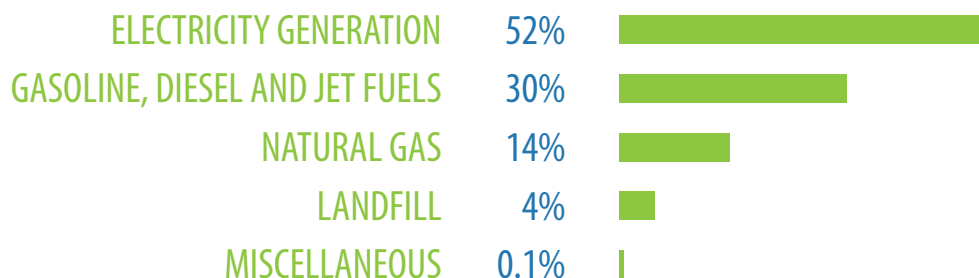
More than 70 percent of global carbon emissions come from cities like Boulder. Hundreds of these cities are measuring GHG emissions to track progress and identify new opportunities to lessen negative climate impacts. Boulder and several other cities across the globe have committed to reducing emissions 80 percent or more by 2050.

WHERE WE ARE
2015
1,848,741 MT

OUR GOAL IS AN
80%
REDUCTION
BELOW 2005 LEVELS

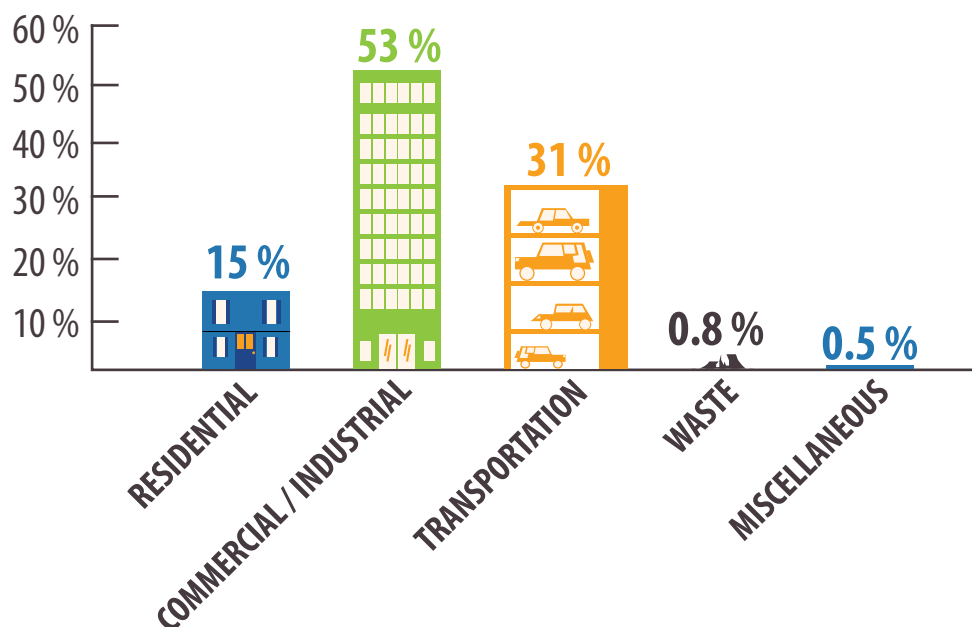
WHERE WE
WANT TO BE
2050
390,000 MT

EMISSIONS BY SOURCE



***96% of Boulder's emissions
come from burning fossil fuels.***

EMISSIONS BY SECTOR



The Climate Change Challenge

Our understanding of the causes, dynamics and consequences of human-induced climate change continues to evolve; however, we know this for certain: climate change is not a hypothetical possibility. It is a current reality that could become significantly more difficult to address if we delay taking critical actions.

The accumulated impacts of over a century of rapidly escalating GHG emissions have already caused changes in the climate, with noticeable and significant impact. Globally, temperatures are setting seasonal and annual records. According to NOAA, July 2016 was the fifteenth month in a row to break a monthly heat record and is the warmest month ever recorded.¹

An associated consequence of higher temperatures is an increase in the amount of moisture in the atmosphere. This combination adds both energy and precipitation potential to every weather event. Many climate scientists now believe these factors are contributing to the growing intensity of many extreme weather events. Increased global temperatures are also speeding up polar ice melt, raising sea levels, causing greater levels of ocean acidity and accelerating species loss.

Locally, average annual temperatures are already over 1 degree Celsius (2 degrees Fahrenheit) warmer. While this may not sound like much, it is having significant impacts: heightening the risk of high intensity wildfires and increasing the number of “high heat” days we experience. The number of days each summer over 95 degrees Fahrenheit have already nearly doubled in the last 15 year—from an average of five each summer to over eight now. If significant emissions reductions are not achieved, this number will rise dramatically. In 15 years, over 20 days could be hotter than 95 degrees. By 2050, these temperatures could exist for nearly half of the summer.² As temperatures continue to increase, our natural landscape will change and many species currently native to the area will no longer find suitable conditions.

The causes and consequences of a changing climate are well documented and there is growing global consensus that significant action is needed now. But even as that consensus grows, so, too, does worldwide investment in the exploration, extraction and combustion of fossil fuels. These investments perpetuate our dependence on an energy system and lifestyles that are having increasingly devastating consequences.

Climate Change on the Front Range

In a recent analysis of past and future climate conditions along the northern Front Range, University of Colorado Boulder’s Western Water Assessment team constructed a temperature history and projections. This analysis shows a clear warming trend since 1950, with temperatures already nearly 2 degrees F above average. This is, in part, responsible for fire seasons that are now nearly five weeks longer than the 1970s and average flowering dates for plants that are one to two weeks earlier than 20 to 30 years ago. By 2050, temperatures are projected to rise by a minimum of 2 degrees with a possible increase as high as 6 degrees. At 2 degrees, Boulder’s climate would resemble Pueblo, Colorado. At 6 degrees, the closest comparison would be Albuquerque, New Mexico.



Already nearly 2 degrees F above average.



Flowering dates are one to two weeks earlier.



Fire seasons nearly five weeks longer.



Projected to be 2 to 6 degrees warmer by 2050.

What does this look like for Boulder? ◀.....

+2°

Fahrenheit



PUEBLO, CO

+6°

Fahrenheit



ALBUQUERQUE, NM

¹ <http://www.noaa.gov/news/july-was-hottest-month-on-record-for-globe>

² <http://planthardiness.ars.usda.gov>

We Need to Change the System, Not Just the Light Bulbs

Boulder launched its first formal climate action efforts in 2002. Since that time, the city has been at the forefront of innovation in working to reduce climate impacts: adopting the country's first tax dedicated to addressing climate change, developing a national model for delivering energy efficiency services, enacting the country's most stringent energy code for new buildings and much more.

During the past dozen years, we've made progress and learned lessons. In recent years, we have integrated climate action strategies within relevant planning efforts, such as the Transportation Master Plan and the Boulder Valley Comprehensive Plan, and developed better tools for analyzing and tracking progress. We are working on an array of policies, programs and projects to reduce emissions and realize other important community outcomes. We know that long-term success will require better feedback loops, honest assessment, persistence and collective action.

Perhaps most important, it has become clear that while energy efficiency and related investments are essential to long-term impact, we need to fundamentally transform our energy system—not just in electricity, but also natural gas and transportation fuels.

DID YOU KNOW?

Currently, Boulderites spend over \$300 million a year on energy (electricity, natural gas, and gasoline combined). Nearly all of this money leaves the community, and most of it goes to buy fuel that is then burned.

It is this realization—grounded in extensive analysis, affirmed through engagement with numerous experts and reflected in industry and technology trends—that led the city to explore municipalization of its electric utility in recent years. Guided by the principles of “Decarbonize, Democratize, and Decentralize” and by our vision for the “Utility of the Future” (described in detail at BoulderEnergyFuture.com), Boulder's municipalization effort is a key step toward energy system transformation. If this effort is not successful, the city will redirect its efforts to partner with the current electric utility and/or explore other options.

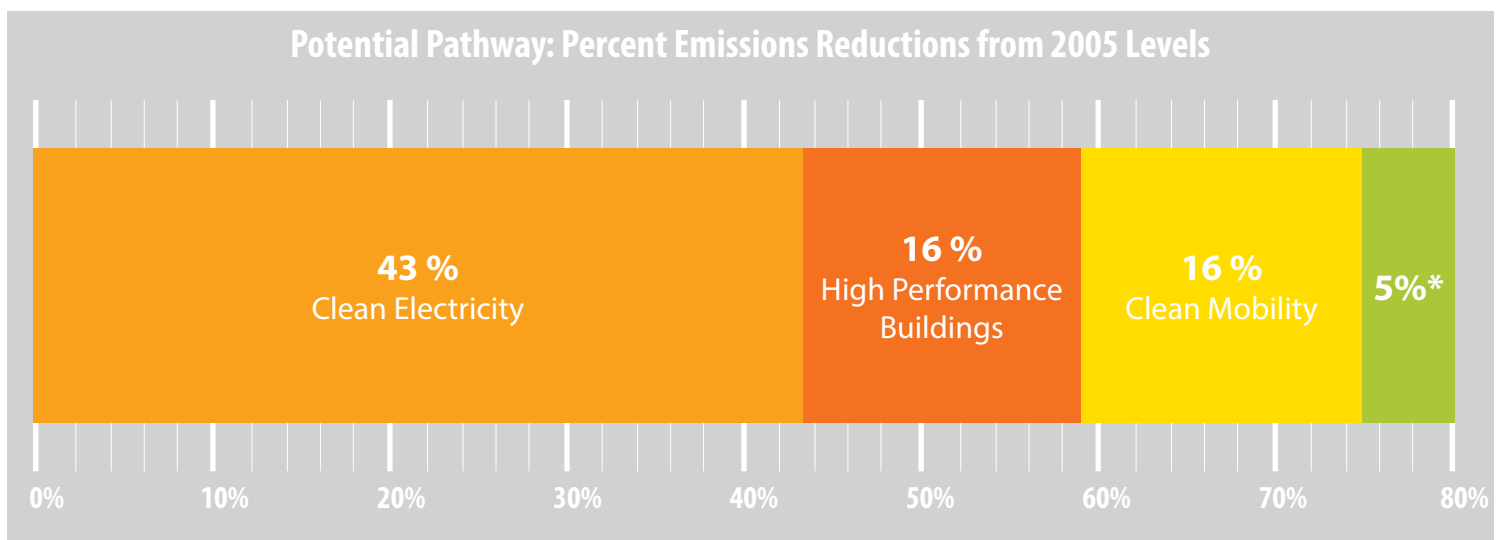
As described in this document and demonstrated in the municipalization analyses, not only is transformation of our energy system essential to our long-term health and sustainability, it is a better economic proposition as well. The International Energy Agency estimates

that emission reduction activities represent a \$10 trillion global marketplace. Boulder's research infrastructure, start-up culture, and venture capital resources provide the building blocks for a climate solutions engine that can support local action as well as an export economy for this emerging marketplace.

The economic benefits of climate action also translate into health cost savings due to reduced pollution levels. In an assessment of transportation emissions alone, Fort Collins projected that deep emission reductions could save local residents over \$17 million in health care costs between now and 2030. An analysis conducted by The Solutions Project for a Colorado-wide clean energy system estimated annual health savings of more than \$7.4 billion.

Pathway to Climate Commitment Goal

This chart shows a potential pathway to achieve the city's 2050 goal of reducing GHG emissions by 80 percent. By modeling and projecting savings for all current and future planned programs, we can achieve a total emissions reduction of 75 percent. The remaining 5 percent will need to come from a combination of future technology or program innovations that will occur between now and 2050 and emissions savings from efforts in waste and aviation that we currently don't have enough information to accurately model or predict. The subsequent Energy section of this document will provide more information on how these reductions are achieved.



* Future technology or program innovations that will occur between now and 2050

Organizing for Action

Recognizing the need for a comprehensive strategy, Boulder's Climate Commitment is divided into three areas: Energy, Resources and Ecosystems. Of these, energy is the primary near-term focus due to the critical importance of reducing fossil fuel combustion. Simultaneously, the city and community continue to explore ways to address the impact that resource use has on emissions, and how ecosystem management can enhance the emission-minimizing services provided by natural systems. In recognition that community action is integral to success, a fourth section, "Community Climate Action," provides details about how the city will support these efforts.

Energy—Nationally, close to 90 percent of GHG emissions are generated by energy-related activities. Locally, over 96 percent of the emissions tracked through Boulder's 2015 inventory were from burning fossil fuels. The three areas of action within Energy are High Performance Buildings, Clean Mobility and Clean Electricity Sources.

Resources—Boulder is also responsible for emissions related to the production, distribution and disposal of resources in the goods and services we consume. This includes the acquisition of raw materials and the energy used to transform those materials into useful products and services. The majority of these products and services are produced outside Boulder and are not included in Boulder's GHG emissions inventory, though they are part of our carbon footprint¹. The three areas of action within Resources are Waste, Water and Food.

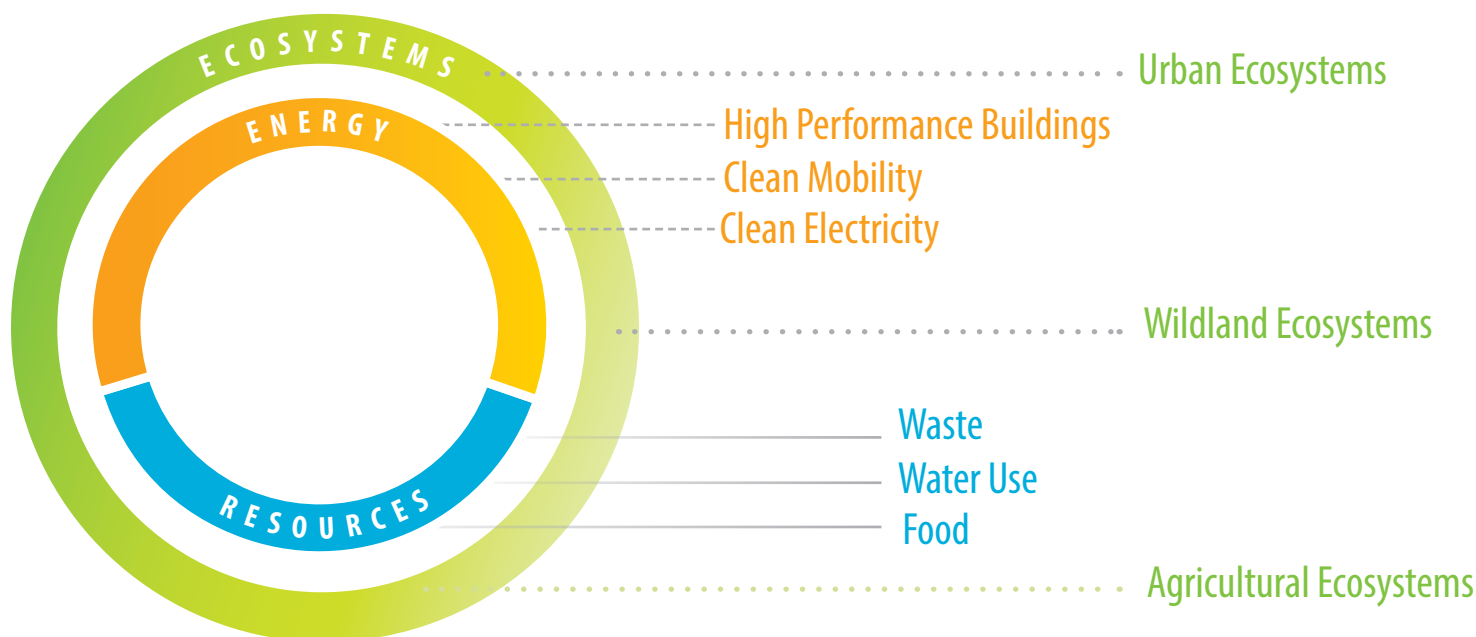
Ecosystems—The unseen regulators of GHG emissions are the different natural ecosystems that can reduce emissions and even remove or "sequester" CO₂ out of the atmosphere. Trees, for example, capture atmospheric carbon while also providing temperature buffering and moisture retention. The three areas of action within Ecosystems are Urban, Wildland and Agricultural. Currently, ecosystem services are not included in the protocols for Boulder's GHG inventory.



Act Locally, Impact Globally

In 2014 Boulder was invited to join 20 other vanguard cities committed to deep carbon reductions. The Carbon Neutral Cities Alliance—representing a diversity of cities such as London, New York, Copenhagen, Yokohama, and San Francisco—is a learning and innovation network that seeks to develop and test new approaches to accelerated climate action. The Alliance also helps ensure a stronger voice for cities in global climate discussions, and recognizes that urban centers are the innovation labs where the world's climate solutions will be pioneered. Boulder is also active in climate and sustainability work with International Council for Local Environmental Initiatives (ICLEI), National League of Cities, the Compact of Mayors and other venues.

The Climate Emissions System



¹The city adopted the ICLEI Global Communities Inventory method for assessing community-wide GHG emissions. This community protocol is primarily energy related. Methods for evaluating emissions impacts of resource use and ecosystem management are in development and will be incorporated as they become available.



ENERGY

S E C T I O N I

Reduce fossil fuel demand from buildings and transportation; rapidly transition to an energy system and economy that is powered 100 percent or more by renewable clean electricity with 50 percent or more of that produced locally.

HIGH PERFORMANCE BUILDINGS
CLEAN MOBILITY
CLEAN ELECTRICITY SOURCES



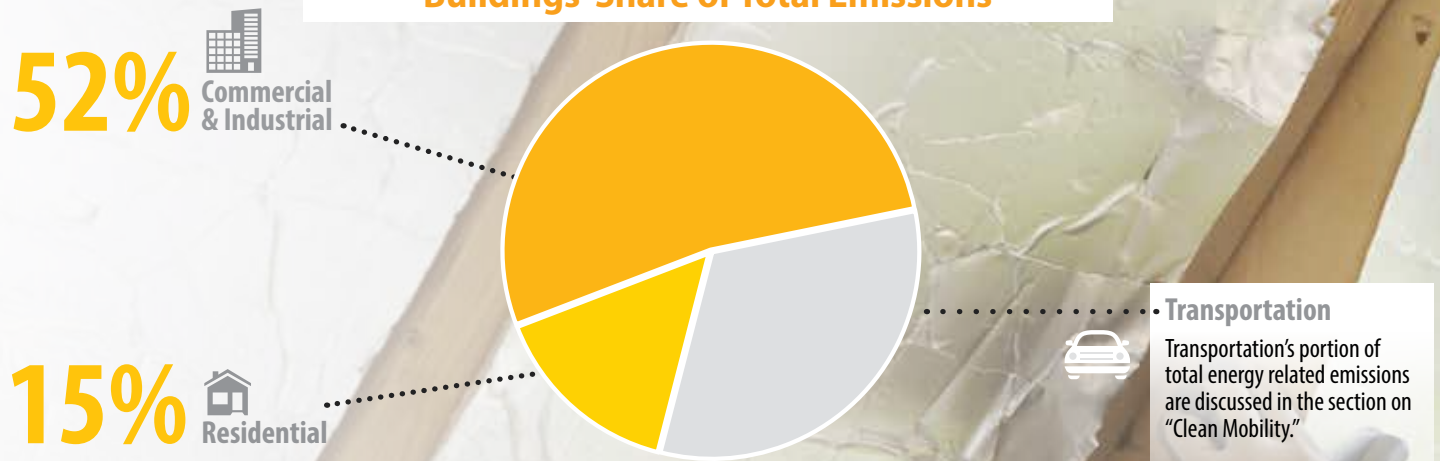
HIGH PERFORMANCE BUILDINGS

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. The majority of natural gas use will be replaced by renewably generated electricity except in situations or processes for which viable options are not yet available.

Boulder's Buildings Today

Boulder has approximately 44,000 residential dwelling units and 3,700 commercial and industrial buildings. Together the energy used to maintain these buildings and the activities taking place within them use over two-thirds of the total energy consumption in the community. Currently over 90 percent of this energy comes from the burning of fossil fuels. As a consequence, buildings and the energy uses within them contribute approximately 67 percent of the city's overall energy-related greenhouse gas emissions¹. These emissions can be further divided into two major building use sectors: residential and commercial/industrial.

Buildings' Share of Total Emissions



Targets for Progress Indicators

Buildings ²	Metric	2015	2020	2030	2050
Residential Per Capita Emissions	MT CO ₂ e/ person	2.56	2.25	1.5	0.5
Reduction in Total Building Emissions ³	% below 2005 levels	2%	25%	30%	75%
Reduction in Residential Electricity ⁴	% below 2005 levels	1%	1%	3%	-2%
Reduction in Residential Natural Gas	% below 2005 levels	1%	15%	40%	85%
Reduction in Commercial and Industrial Electricity ⁵	% below 2005 levels	-16%	-20%	-6%	6%
Reduction in Commercial and Industrial Natural Gas ⁶	% below 2005 levels	5%	6%	15%	35%
Commercial Energy Use Intensity (Average) ⁷	kBtu/sq ft/yr	108	100	85	60

¹ These percentages are estimates derived from a combination of Xcel community energy reports and other publicly available data.

² The building energy and emissions values are total amounts, not per capita or per economic output. Both population and economic output have increased since 2005.

³ Modeled with the current electric utility's grid mix projections out to 2050 to separate savings from "High Performance Buildings" from "Clean Electricity."

⁴ Increase in electricity use is expected due to increased electric vehicle adoption and the transition from natural gas to electricity (which occurs primarily in later years).

⁵ From 2005 to 2015, there has been a significant increase in electricity in the Commercial and Industrial sector. This is at least partially due to the addition of a number of high energy intensity buildings, such as marijuana grow facilities and data centers. Increase in electricity use is expected due to increased electric vehicle adoption and the transition from natural gas to electricity (which occurs primarily in later years).

⁶ Natural gas variation is likely due to industrial processes that vary greatly from year to year. Further, natural gas savings will not be fully realized until 2030 when the Building Performance Ordinance requirements are implemented.

⁷ Applies only to buildings covered by the city's Building Performance Ordinance.

**HIGH
PERFORMANCE
BUILDINGS WILL
CONTRIBUTE A**

16%

**REDUCTION
IN OVERALL
EMISSIONS
BY 2050**

DID YOU KNOW?

Improvements to city buildings have already reduced the city building emissions by over 40 percent and save the city almost \$700,000 each year since 2010.





HIGH PERFORMANCE BUILDINGS

2017 to 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, and 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 three 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

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

Voluntary Education, Services and Incentives for Building Owners

- Continue to provide information, incentives and support for deep efficiency retrofits through energy advising and rebate programs like EnergySmart and Partners for a Clean Environment (PACE).
- Support the use of newly developed clean energy financing mechanisms such as the Boulder County property-assessed clean energy financing 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.
- Implement the requirement for all marijuana facilities to offset 100 percent of their electricity use with renewable energy or approved offsets.
- Continue implementation of building energy efficiency upgrades on city facilities, including piloting net zero energy retrofits.

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

Replace all building systems that rely on fossil fuels, particularly heating and cooling systems and water heating. In other words, switch from natural gas equipment to electric equipment, such as air, water or ground-source heat pumps.

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.



Redesign

Redesign building codes and community infrastructure to create “net zero” or “net positive” buildings and neighborhoods. Integrate systems at the district scale and incorporate local generation of clean energy.

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 buildings achieving net zero energy by 2031.

Piloting New Programs and Services

- Create a local energy impact offset fund to support local projects and innovations in carbon reduction. Initial investments in this fund will come from the current requirement for all marijuana grow facilities.
- Launch the next round of community innovation investments through the Boulder Energy Challenge.

City Buildings Lead The Way!

In 2010 the City of Boulder hired an energy performance contractor to conduct a comprehensive energy assessment and develop an emissions reduction strategy. Based on this assessment, the city invested over \$11 million in energy efficiency measures and the installation of renewable energy. Through these efforts, the city improved energy performance 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 facility emissions by over 40 percent—over 8,000 metric tons of greenhouse gases—and saves 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 percent or more by 2030.



Solar array installed on the East Boulder Community Center (5660 Sioux Drive)



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 320,000 metric tons by 2050, a 16 percent reduction from estimated 2005 baseline year emissions. The remainder of emissions reductions must be achieved through changes to our transportation system (as described in the “Clean Mobility” section) and through changes to our electricity sources (as discussed in the “Clean Electricity Sources” section).

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).

Energy Efficiency Ordinances



47,000 mt

Natural Gas Switching



115,000 mt

Voluntary Efficiency Investments



52,000 mt

Net Zero Codes



106,000 mt

320,000 mt

**16% 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. Much of the information necessary to monitor this progress will depend on the willing participation and engagement of the community's energy providers, particularly those of electricity and natural gas. These efforts will also depend on the investments and actions of other leading community institutions.

Building Partnerships

Boulder is fortunate to have many progressive organizations working hard to meet our community's climate goals.

The University of Colorado plans to continue its long-term commitment to investing in clean energy improvements. The Board of Regents has approved \$50 million in spending authority to be awarded through Energy Performance Contracting. Energy efficiency upgrades have been proposed in seven facilities, with projected annual energy savings of over \$1.3 million and an estimated annual reduction of emissions of 11,400 metric tons.

Boulder County has been the lead partner in administration of both the EnergySmart 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, triple the national average.

Boulder Valley School District completed its Sustainable Energy Plan in 2013, calling for a 20 percent reduction in overall energy use by 2019, with a long term goal of being net zero energy by 2050. As part of its recently passed bond measure, it has targeted many of its facilities for significant upgrades including eight buildings with deep retrofits (less than 50 percent energy use reduction) and many more that will receive renovations and mechanical system retrocommissioning. The bond also includes constructing four new zero net energy capable buildings (buildings that have the ability to produce as much energy as they consume).

Boulder's 14 **federal labs** have also been leaders in implementing federal building efficiency standards. As a major presence in Boulder, the federal labs' efforts will substantially contribute to Boulder's reduction in GHG emissions.





By 2050, people and goods will travel around Boulder generating little or no GHG emissions. This will include walking and biking as well as shared transportation like transit, car share, and van pools. The personal and work vehicles that remain will use clean energy sources such as renewably produced electricity and alternative fuels such as hydrogen or fuel cells.

How We Move Today

Boulder has over 63,000 vehicles registered to residents. Tens of thousands of additional vehicles enter and depart from Boulder every day carrying employees, students, goods and visitors. While Boulder has one of the highest per capita percentages of hybrid and Electric Vehicle (EV) ownership, we also have one of the highest per capita proportions of SUVs, bringing Boulder's average fuel efficiency to 21.4 MPG, a little higher than the state average. Together, this ground transportation accounts for 24 percent of the city's recorded emissions. An additional eight percent is added for Boulder's share of the regional air travel out of Denver International Airport.

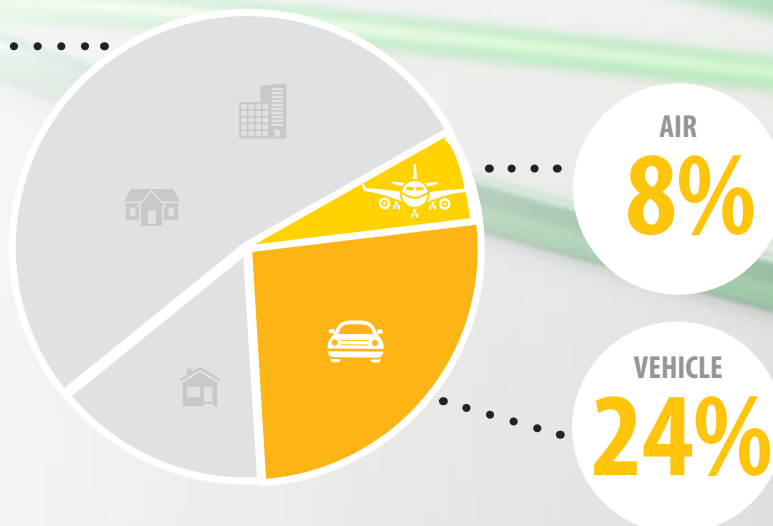
Targets & Time frame

	METRIC	2015	2020	2035 ¹	2050 ²
Vehicle Miles Traveled (VMT)	Millions of Miles	2.65	2.32	1.95	1.59
Walk/Bike/Transit Rideshare	% of trips	64%	69%	80%	92%
Vehicle Energy Efficiency	MPGe	22	40	61	88
% Complete Neighborhoods	% of Census Blocks	26%	N/A	80%	N/A
Electric and alternative Fuel Vehicles	% Light-Duty Fleet	1%	15%	45%	75%

Transportation Share of Total Emissions

Buildings

The proportion of total emissions from buildings and their related energy sources are discussed in the section on "High Performance Buildings."



¹Transportation Master Plan (TMP) Adopted Objectives set long-term goals using a 2035 timeframe.

²Projected levels based on simple linear extrapolation of TMP objectives out to 2050. Continued reductions between 2035-2050 will require additional investment, innovations and community land use changes beyond those in the TMP. Targets will continue to be refined over time.

A Boulder Success Story: Holding the Line on Vehicle Miles Traveled (VMT)

In 1996, Boulder's Transportation Master Plan (TMP) established a goal of holding VMT steady to 1994 levels. Now 20 years later, while most other communities on the Front Range have seen vehicle miles traveled increase by 113 percent, Boulder has been able to minimize its VMT growth, despite growth in population and employment.

To help meet the new 2050 GHG reduction goals, the 2014 TMP Update established a goal to reduce vehicle miles traveled by 20 percent by 2035. Together, the VMT reduction programs and strategies outlined in the TMP are projected to achieve close to a quarter of the transportation emissions reduction goal by 2050.

The Many Benefits of a Low Carbon Transportation System

A low carbon transportation system has many community benefits in addition to helping reduce climate change. Boulder's 20-year success in managing vehicles miles traveled has avoided an estimated 1.9 million additional daily vehicle miles of travel around the Boulder Valley.

This has kept a significant amount of pollutants out of the air, even as VMT and related emissions have nearly doubled in the Denver metro region. The city has also enhanced pedestrian, bike and transit systems providing transportation options to all members of the community, saving transportation costs and supporting forms of mobility that improve our health. The city's support of Regional Transportation District's EcoPass program has had significant impact on travel behavior. GHG emissions as residents with EcoPasses emit 45 percent less transportation related GHGs than residents without access to the annual unlimited use transit pass. The city also continues to integrate more diverse and connected neighborhoods. This, combined with the city's goal to make all areas accessible by walking and biking, minimizes the miles we have to travel by vehicle and the distance we have to travel when we do use our cars.

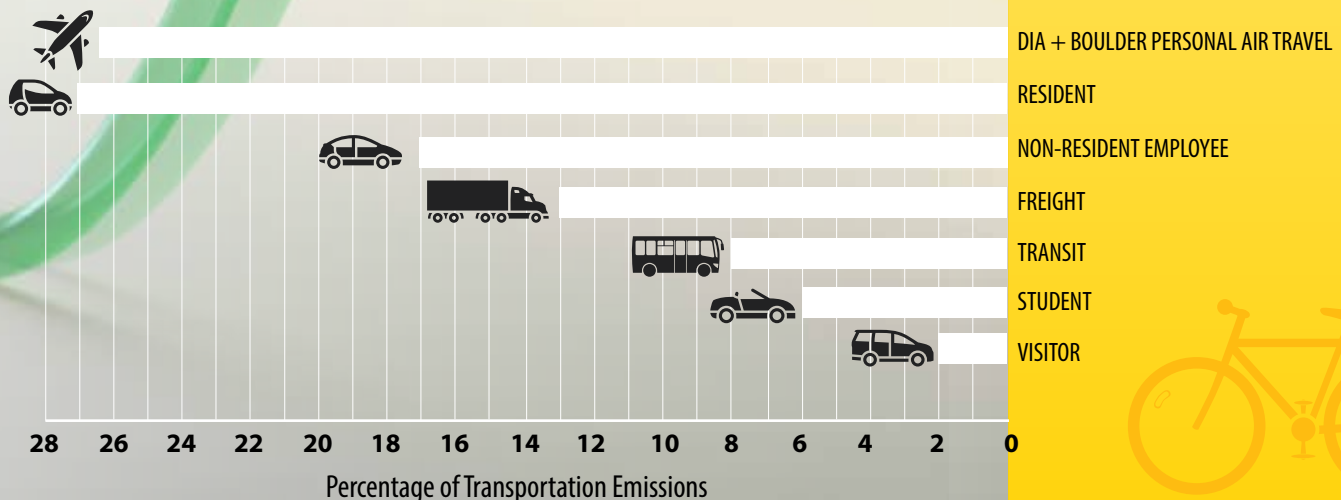
**CLEAN MOBILITY
WILL
CONTRIBUTE A**

**16%
REDUCTION
IN OVERALL
EMISSIONS
BY 2050**

DID YOU KNOW?

Approximately 70,000 Boulder residents and employees have access to an EcoPass; RTD's discounted unlimited ride annual transit pass.

2012 Transportation Emissions By Travel Type





CLEAN MOBILITY

2017 to 2020 City Action Priorities

Similar to the actions described for the building and related energy use sectors, there are three broad areas of action within which the city has initiated programs.

R E D U C E

Create multiple mobility options

- Expand access to transit including implementation of a community-wide EcoPass and expansion of Bus Rapid Transit routes.
- Expand ride share programs by adding additional incentives and support for expanded carpool/vanpool.
- Enhance bike and pedestrian travel options through creating protected bike lanes on key travel corridors and improved pedestrian efficiency through mobile route mapping.

Use digital technology to maximize our transportation efficiency

- Pilot and promote telework and other no-travel work options.
- Create enhanced mobility tools through development of new mobile applications for trip planning.

Create incentives to explore new mobility options

- Use parking management to encourage other travel options by creating financial incentives that reward commuters who don't require daytime parking.

R E P L A C E

Support the adoption of electric vehicles and other non-fossil fuel mobility options for personal vehicles

- Collaboratively expand regional electric vehicle (EV) charging infrastructure.
- Implement electrification of city vehicle fleet.
- Co-organize Workplace Charging Challenge with other leading employers.
- Develop employee EV commuting pilot project.

Catalyze the development of non-fossil fuel transit systems

- Promote electrification/clean fuel options for the Regional Transportation District (RTD) transit fleet.
- Pilot clean energy transit on select local routes, especially the city's "HOP" route.

R E D E S I G N

Develop parking management systems that stimulate adoption of high efficiency mobility options

- Encourage parking management systems using the city's "SUMP" (Shared, Unbundled, Managed, & Paid) principles.
- Create parking districts with enhanced mobility options e.g. car share, bike share, transit hubs.

Integrate mobility enhancements in land use planning

- Continue complete streets planning to provide safe and convenient travel options.
- Integrate mixed use development close to neighborhoods to provide walkable destinations for daily needs (15 minute neighborhoods).

Piloting new programs and services

- Launch the next round of community innovation investments through the Boulder Energy Challenge.

Movers and Shakers

Creating a clean mobility system requires a collective effort. Boulder is fortunate to have many leaders and partners working together to achieve transformative change.



UCAR



Boulder Valley
School District



The University of Colorado (CU) has an extensive program to significantly reduce the use of single occupancy vehicles and provide viable options in transit, biking and walking. The university provides transit EcoPasses to all 30,000 of its students through student fees along with over 13,000 bike parking spaces (more than cars!). It has a vanpool service for employees and is actively planning for the development of an EV charging infrastructure for both staff and students.

Boulder County has invested in low-emissions transportation alternatives throughout the county and was a lead sponsor, along with the city and CU, in a countywide electric vehicle adoption assessment. That assessment explored electric vehicle charging infrastructure needs as well as how building codes, transportation programs and employee commuting incentives could promote EV ownership. The county is currently helping to coordinate the Boulder County Electric Vehicle Workplace Charging Challenge to encourage other employers to actively support EV adoption by the over 50,000 daily in-commuters to Boulder and Boulder County.

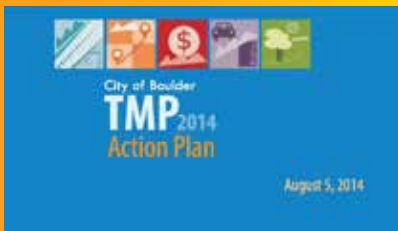
Boulder Valley School District (BVSD) has initiated a wide range of programs to reduce emissions from its bus and administrative fleet, including initiatives to increase walking, biking, transit and carpooling as well as efforts to lower emissions through hybrid buses, alternative fuels and efficient routing schedules. Through an internally developed "Trip Tracker," over 2,000 participating students in 17 schools cut an estimated 75,000 car trips in a single school year. The district is also exploring the expansion of its current EV fleet and charging infrastructure to provide more opportunities for both students and staff to use EVs.

University Corporation for Climate Research (UCAR) and its other federal lab partners in the Boulder area provide van pool and ride sharing support for employees, and free bicycle check outs, complementary bike share membership and EcoPasses for all employees. Recently, the labs secured funding to install an EV charging network for employees and has been an active partner with the city, county, CU and BVSD in developing a community-wide EV adoption plan.

Making it Happen: The Path to 2050

The combined efforts of local transportation strategies and federal fleet efficiency standard improvements can have a significant impact in reducing the emissions generated by the transportation sector.

Transportation Master Plan Actions



73,000 mt

Federal Efficiency Standards



120,000 mt

Electric Vehicles and Other Innovations



112,000 mt

Total Projected Emissions Reduction = **305,000 mt or 16%**



CLEAN ELECTRICITY SOURCES

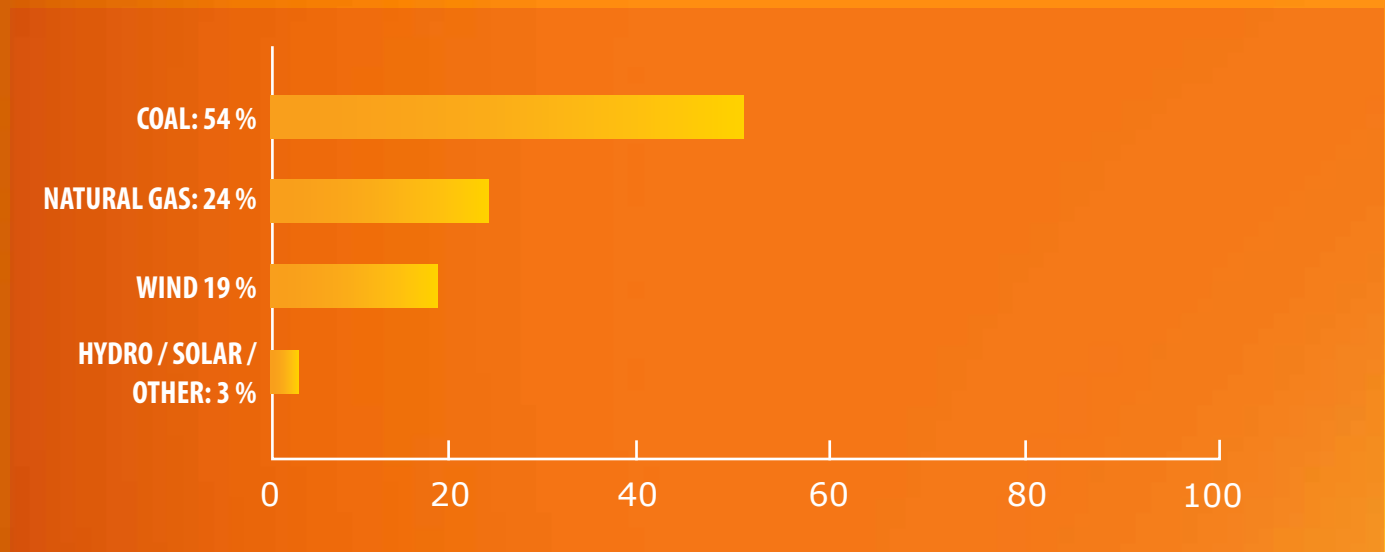
By 2050, Boulder will be powered by 100 percent clean electricity.

The majority of residents and businesses will have the opportunity to participate in the production of this clean electricity, and in doing so, share in the prosperity, well-being and resilience of our entire community.

The Current Energy System

Boulder's electricity generation mix is determined by the electric utility. According to Xcel Energy's 2015 Corporate Responsibility Report, fossil fuels make up approximately 78 percent of Boulder's electricity generation— 54 percent generated by burning coal and 24 percent generated by burning natural gas. Twenty-two percent of Boulder's electricity generation mix is renewables.

2015 Electricity Generation Sources



Targets for Progress Indicators

GOAL	METRIC	TARGETS ¹			
		2015	2020	2030	2050
% of Grid Electricity that is Renewable	% Renewable Electricity	22%	40%	100%	100%
Total Local Renewable Electricity	Megawatts Installed	30	50	100	175

¹ All targets are measured using 2005 as the base year.

ENERGY CLEAN ELECTRICITY

CLEAN
ELECTRICITY
SOURCES WILL
CONTRIBUTE A
43%
REDUCTION
IN EMISSIONS
BY 2050

DID YOU KNOW?

In 2007 there were fewer than 100 solar systems in Boulder. By 2015, nearly 2,500 systems were approved, representing over 17 MW of solar capacity— enough energy for approximately 3,000 of Boulder's 44,000 homes!





CLEAN ELECTRICITY SOURCES

Clean Renewable Electricity—How Much Do We Need?

There is growing agreement that the most viable path to deep emission reductions in the next 13 years is the conversion of 80 percent or more of all energy use—in buildings, transportation and business processes—to electricity generated from clean, renewable energy sources.

Using the extensive analyses conducted for establishing a community-owned electric utility, the city has been able to estimate total energy use across all sectors of the community. Using standard energy conversions, it's then possible to estimate the amount of clean, renewable electricity needed to replace current fossil fuel combustion, as summarized below:

ENERGY TYPE	TOTAL NEEDED
 Electricity	200 to 250 Megawatts (current usage)
 Natural Gas (converted to electricity)	35 to 50 Megawatts
 Petroleum (converted to electricity)	50 to 80 Megawatts
TOTAL ELECTRICITY NEEDED	approx. 285 to 380MW

These estimates are based on 2015 energy consumption. With the substantial efficiency measures implemented across the building and transportation sectors, the total electricity requirement could be reduced by 20 to 30 percent by 2050.

Building a Rooftop Solar Tool

With more than 300 days of sunshine per year, Boulder is the perfect place to take advantage of solar. In fact, since 2007, Boulder has seen the installation of approximately 17 MW of solar in the city, helping to avoid over 69,000 metric tons of GHG emissions (equivalent to taking 14,500 cars off the road). To assist residents, businesses and property owners in understanding their unique rooftop potential, the City of Boulder has created a Rooftop Solar Tool to:

- Determine how much electricity can be produced from a solar photovoltaic (PV) system and what system layout may work best on every rooftop within city limits
- Estimate system cost and payback time based on local energy costs and financial incentives
- Help residents or community members better visualize how use of renewable energy impacts the environment



Solar potential of city building at 11th and Spruce

Discover your rooftop solar potential at BoulderSolarTool.com

Is There Enough Clean Energy to Meet Boulder's Needs?

Boulder, like most communities, has substantial clean, renewable energy resources. With currently available technology, Boulder can rapidly transition to energy that is abundant, environmentally sustainable, and economically viable. Boulder's goals for clean energy include a mix of localized generation such as solar, combined heat and power, and other technologies, as well as larger scale grid-based renewables. These changes will be implemented through an integrated strategy that balances customer benefits, resilience and affordability. While issues of storage and load balancing must be addressed to deal with intermittency, there are significant local renewable resources that can be tapped:



Solar—The city recently completed the first stage of a community-wide solar assessment of the generation capacity of just rooftop area. This assessment indicates the potential for over 500 megawatts of rooftop generation capacity. Substantial additional capacity is possible in parking lots and other non-building spaces.



Wind—According to the American Wind Energy Association, as of March 2017, Colorado ranked tenth for installed wind power capacity with 3,026 MW. Colorado generated 13.8 percent of its power from 1,530 wind turbines in 2013. A recent Department of Energy (DOE) Study determined that Colorado has the potential to install 387,220 MW of additional wind power generation—more than 160 times current production!



Hydro—Significant pressure develops as water flows downhill from the city's mountain reservoirs to delivery systems in Boulder. Instead of mechanically reducing the excess pressure, the city converts it into energy by causing the flowing water to spin turbines that spin electrical generators to produce electricity. No fossil fuels are consumed and nothing is emitted in the energy conversion process.

Boulder's Energy Future: Guiding Principles

There are multiple potential paths to achieving a clean energy future. The choices made in how this new energy system is created—and who gets to make those choices—will significantly affect who benefits from this transition and who will pay its costs. Boulder's exploration and development of its clean energy future have been guided by principles that have been developed and refined through community conversations and council direction over the past several years. These principles include:

- 1 **Ensure affordable, clean, reliable and secure energy**—The first priority is ensuring community access to energy that is affordable, clean, reliable and secure. This includes investments in system enhancements that enable energy services to withstand local and regional disruptions—both community wide and at individual household, business and institutional levels
- 2 **Prioritize a rapid transition from fossil fuels**—Rapidly retiring fossil fuels reduces GHG emissions. It also insulates the community from fossil fuel price and supply volatility while protecting and restoring local environmental health.
- 3 **Invest in our local economy**—Fostering rapid development of local renewable energy resources enables the community to keep a growing share of its energy expenditures local, thereby sustaining the local economy, supporting existing businesses, creating new jobs and expanding business opportunities.
- 4 **Design a marketplace for innovation**—Central to achieving these principles is the creation of a marketplace that fosters innovation and the development of new energy products and services, responding to local needs, and then exporting solutions to regional, national and international markets.
- 5 **Just Transition**—Integrate social equity considerations in all major energy transition initiatives to improve the economic, social and political opportunities for all segments of the Boulder community.



CLEAN ELECTRICITY SOURCES

Clean Electricity Source Change: Making the Transition

Making a transition to renewable energy future will require the rapid transition to 100 percent renewable electricity as the foundation of this change. This will include:



Reduce

Reduce the need for additional generation through continued improvements in energy efficiency and productivity.

Expansion of Energy Services

- Encourage community-based innovative approaches to local renewable electricity development through the Boulder Energy Challenge competitive grants program.
- Provide expanded demand side management services through implementation of the municipal utility.

Expansion of On-site Solar

- Continue to work with Boulder County and other public institutions to launch group solar acquisition programs designed to lower the costs of ownership through collective purchase agreements. This expansion in residential and commercial on-site solar will help reduce the overall demand for electricity and the scale of renewable energy assets or purchases necessary to achieve emissions reductions.



Replace

Replace all coal and natural gas electricity generation with renewable energy systems such as solar and wind.

Municipalization

- Assume operational authority and begin operations of an electric utility by early 2023. Explore opportunities to create financing mechanisms that support both energy efficiency and renewable generation development. These mechanisms could include on-bill financing and on-site generation incentives.

Local Generation Analysis

- Conduct a second stage analysis of additional on-site generation opportunities, including combined heat and power, heating/cooling district analysis and energy storage infrastructure development.



Redesign

Redesign the existing electricity delivery system to make it more reliable, more secure and more supportive of a diverse mix of electricity sources.

Nanogrid and Microgrid Development

- Work with both institutional and private sector partners to pilot projects integrating local energy system designs with alternative electricity distribution systems (direct current circuitry) to reduce energy use and costs and increase energy resilience.

Energy Resilience Capacity Building

- Map critical community infrastructure and operations and identify opportunities to develop and deploy energy system upgrades that enable these sites to sustain operations during periods of power grid disruption. Create additional "safe haven" sites to ensure access to basic services for the entire community during periods of power system failure.

Piloting new programs and services

- Launch the next round of community innovation investments through the Boulder Energy Challenge.

The Path to 2050

In 2013, the city analyzed clean energy options as part of the analysis for establishing a municipal utility. This analysis indicated that the city could immediately source more than 60 percent of community electricity needs from renewable energy sources at the same cost as existing coal and natural gas generated electricity.¹ Given the challenges in reducing emissions in sectors like air travel and heavy transport, achieving the full 80 percent emissions reduction by 2050 will require that our electricity come from 100 percent renewable sources by 2050. In achieving this goal, a core consideration will be to prioritize the development of locally based renewable energy sources, in keeping with our community's energy future guiding principles.

Transition to 100% clean electricity will account for a 43% overall reduction in greenhouse gas emissions—*more than half of our total reduction goal.*

¹ See Boulder City Council Memo July 23, 2013; <https://documents.bouldercolorado.gov/weblink8/0/doc/121330/Electronic.aspx>



CLEAN ELECTRICITY SOURCES

Powerful Partnerships

The University of Colorado (CU) is focusing on three initiatives to upgrade campus infrastructure while reducing energy consumption. Its new athletic facility was built to be net zero greenhouse gas emissions including a nearly one megawatt array of solar on its roof. CU is also making substantial upgrades to its existing cogeneration system as an alternative energy source, and expanding its renewable energy resources for campus operations. There is currently over 2.1 MW of total solar capacity installed on CU facilities.

Boulder County has been a national leader in the support and development of renewable energy systems. In 2013, the county became the first in Xcel's Colorado service territory to host a community solar garden. This 500kW array is enough to support approximately 100 residences, with a second 500kW array recently added to this site. The city and county have also sponsored several rounds of pooled solar purchase contracts that have significantly lowered solar acquisition and installation costs for Boulder County employees and residents.

Boulder Valley School District (BVSD) has taken substantial steps to integrate renewable energy into its buildings and teaching programs. Between 2008 and 2014, the District installed close to two megawatts of solar on 28 schools. These systems are providing 15 to 30 percent of these schools' energy needs and eight percent of the district's overall energy needs. Many of the schools have associated websites showing live data from the solar panels and real time energy consumption. These schools also received and are using materials provided by the National Energy Education Development Project and Solar City, to incorporate lessons about renewable energy and efficiency into curriculum. The district has also installed a wind turbine in the Nederland middle/senior school and two geothermal systems, one of which provides over 90 percent of the Casey School's heating and cooling needs.

Boulder Housing Partners (BHP) has been a leader in the integration of renewable energy into its affordable housing projects. BHP's groundbreaking Red Oaks development features 140kW of rooftop solar throughout the development and a 10kW system on the shared community center. BHP is currently working with the City of Boulder to explore integrating solar, battery backup storage and microgrid networks in its new developments to achieve both zero net emissions and the capacity to provide energy "safe havens" for residents and surrounding neighborhoods during periods of grid power disruption.



RESOURCES

S E C T I O N I I

Reduce the emissions impacts caused by the use of goods and services, maximizing the productivity of all resources used and leveraging purchasing decisions to support responsible resource use.

WASTE
WATER USE
FOOD



WASTE

By 2050, Boulder will be a place where residents, business owners, employees and visitors have all the tools they need to generate zero waste.

The community will minimize hazardous and solid waste through conscious consumption choices and reuse opportunities, and will be able to recycle, compost or reuse any waste materials that are produced.

Targets for Progress Indicators

	2015	2020	2030	2050
Pounds of Waste/Person/Day ¹	8.36	4.50	3.50	2.50
Landfill emissions (% of Boulder GHGs)	1%	1.5%	1%	.5%
Diverted from Landfill (%):	38.8%	60%	90%	90%
Total Recycled (Tons):	26,838	25,319	26,009	18,729
Total Composted (Tons):	30,578	28,551	39,014	28,093
Total Diverted (Tons):	57,416	53,870	65,023	46,822
% of Total Diverted That Is Recycled	47%	50%	40%	40%
% of Total Diverted That Is Composted	53%	50%	60%	60%

The Waste-Climate Connection

At the present time, the widely accepted and used community protocol for GHG inventories do not include emissions associated with the use of resources other than landfill waste-related emissions. For Boulder, this represented approximately 2 percent of the community's recorded emissions inventory in 2012.

However, the resources we use and the waste that is generated from this consumption of products and food are responsible for a significantly larger share of emissions, many of which impact areas outside of Boulder's boundaries. According to the U.S. Environmental Protection Agency, approximately 42 percent of U.S. greenhouse gas emissions are associated with the energy used to produce, process, transport, and dispose of the resources we use. This includes the extraction or harvest of materials and food, production and transport of goods, provision of services, reuse of materials, recycling, composting and disposal.²

¹ Reduced overall waste per person will also result in reductions of recycled and composted materials.

² <http://www.epa.gov/climatechange/climate-change-waste/#statistic>



Energy and Resource Emissions



RESOURCES WASTE

**BOULDER WILL
DIVERT
90%
OF ITS WASTE
STREAM FROM
THE LANDFILL
BY 2030.**

DID YOU KNOW?

In 2015, Boulder residents and businesses recycled and composted more than 57,000 tons of waste that would otherwise have gone to the landfill.





WASTE

2017 to 2020 Action Plan Priorities

As part of Boulder's recently adopted Zero Waste Strategy, a new set of strategies is being deployed to both track and manage a larger set of factors that can help reduce the community's waste related emissions impacts. These include:



R E D U C E

Recycle (Reducing Trash)

2017:

- Deliver expanded multifamily housing assistance program to increase recycling and composting.
- Implement the Universal Zero Waste Ordinance, requiring all property owners to provide recycling and compost collection services and requiring businesses to use these services.
- Expand business assistance and advising.
- Negotiate with local partners to provide cost-effective and convenient composting operations for all area organics haulers.
- Support state legislative efforts to encourage recycling and reuse.

Next one to three years:

- Expand the reach of multifamily residential assistance program.
- Expand community-wide educational efforts on available services, incentives, and facilities as well as proper recycling/composting/source reduction methods.
- Support improvements to the Boulder County Recycling Center to facilitate processing of additional materials.



R E U S E

Source Reduction: Replacing Disposables with Reusable Materials

2017:

- Expand community-wide educational efforts on reuse and source reduction opportunities.

Next two to three years:

- Revamp the Disposable Bag Fee ordinance to further reduce bag use.
- Explore consumption-based accounting method to track and measure GHG emissions from products and packaging produced outside of Boulder but consumed locally.
- Include GHG emission reductions from recycling and composting in climate accounting (using WARM model), based on avoided manufacturing emissions; track by total and per person.
- Reduce food waste and improve opportunities to repurpose leftover food to people, animals or energy.



R E D E S I G N

Changes in Community Wide Infrastructure or System Strategies

2017:

- Support product stewardship and other legislative efforts at a state and federal levels to reduce the creation of waste.

Next one-three years:

- Support shifts in business practices that result in more sustainable purchasing, separating recyclable and compostable materials, and avoiding waste.
- Perform a programming exercise to further investigate/analyze future uses of 6400 Arapahoe site to support zero waste goal, including the expansion of CHaRM and ReSource.
- Collaborate with Boulder County and other partners on developing a regional construction and demolition recycling facility.



Tracking the Emissions Benefits of Recycling and Composting

The emission reduction benefits of recycling and composting are currently unrecognized in most conventional emissions inventory systems. To quantify these benefits and improve the tracking and management of this information, the city's Zero Waste team is building greenhouse gas (GHG) accounting capabilities into a new waste hauler reporting tool, Re-Trac Connect, based on the EPA's Waste Reduction Model (WARM). This information will both improve the visibility of these benefits and enable the city and community to continue to improve its programs to maximize these benefits.



Reuse Reduces Emissions: Boulder ReSource

Repurposing used building materials reduces GHG emissions by avoiding the energy used to extract and manufacture new materials. Raising the national recycling rate for construction and demolition (C&D) materials from 30 percent to 80 percent would save 91 million MTCO₂e per year. Locally, ReSource reclaimed more than 3.3 million pounds of building materials in 2014 while creating jobs, conserving natural resources and reducing pollution. The ReSource Tool Library also helps reduce per capita GHG emissions by promoting shared ownership of products. The library rents to more than 800 electrical, plumbing, landscaping and general construction tools.

Zero Waste Partners

Eco-Cycle operates the Center for Hard-to-Recycle materials (CHaRM), keeping tons of large appliances and other difficult to recycle materials out of the landfill. It also organizes the community and volunteers in support of zero waste initiatives, including a network of block leaders throughout the community.

Western Disposal partners with the city to provide yard and wood waste drop-off centers. It is also an active collaborator with the city on pilot projects and innovation solutions, such as the launch of bear resistant trash cans and compost carts.

Boulder County owns and manages regional facilities, including Boulder County Recycling Center, the primary sorting and distribution for the community's recycling materials. It also operates the Hazardous Materials Management Facility, which diverts thousands of pounds and gallons of otherwise toxic materials out of our landfills. The county also jointly supports (with the City of Boulder) the Partners for a Clean Environment (PACE) service, providing zero waste services to Boulder businesses.

The **Center for ReSource Conservation** operates ReSource, which sells reclaimed building materials and runs a community tool lending library. In 2014, ReSource reclaimed more than 3.3 million pounds of building materials.

University of Colorado is an important waste management partner with city by providing outreach to the student community through its student staffed "green teams." These teams provide face-to-face information and education to thousands of students each year, discussing both energy efficiency and waste reduction.





WATER USE

In 2050, water will be managed as a critical resource. Water is an irreplaceable and indispensable resource so it's important to find a balance between supply and demand. Climate change impacts, individual water use and demographic and land use changes all have variable effects that will likely lead to increased total water use in the near future. The community will need to work together to be efficient with water use and be flexible to changing conditions.

Targets for Progress Indicators¹

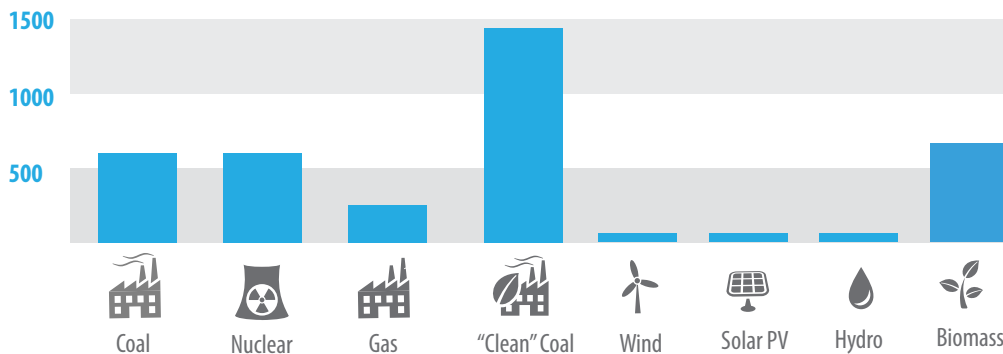
	METRIC	2000	2015	2050
Total Water Use	acre feet	24,433	18,335	19,478
Water Use Per Capita	gallons per capita day	197	143	128
Total Electricity Generation-Hydro	megawatt hours (MW)	39,068	37,656	52,600

The Climate-Water Connection—The Power of Water

The water-energy-climate nexus is well established. It takes energy to heat, treat and pump water and it takes water to produce energy. Since energy sources, especially those dependent on fossil fuels, result in GHGs, renewable energy sources like solar and wind energy not only reduce climate impacts but also use significantly less water to generate energy. Hydroelectricity, for example, requires little to no water consumption, creates a clean energy source and offsets carbon emissions.

In Boulder, the city's collective hydropower facilities across all water resources produce 52 million kilowatt hours of electricity each year, enough energy to power 4,932 homes and offset over 26,000 metric tons of carbon. It should be noted that precipitation, system demand and water supply are significant factors in the city's ability to maximize hydropower. For example, decreased water use or water storage can reduce hydroelectric production.

Gallons of Water Used per Megawatt Hour of Energy Production²



FILLING UP: WATER USED FOR GAS

It takes 5 gallons of water to make 1 gallon of gasoline which means every full tank of gas uses about 60 gallons of water.³



¹ Values are derived from the 2016 Water Efficiency Plan and hydroelectric production extrapolations which are dependent on climate change, government standards, etc.

² Modified graph from Western Resource Advocates, "Protecting the Lifeline of the West"; 2010.

³ Comprehensive Evaluation of Impacts from Potential, Future Automotive Fuel Replacements; Kreider and Curtiss; University of Colorado; 2007.

2017 to 2020 Action Plan Priorities

In 2000, the city's Water Conservation Future Study (WCFS) set a goal to reduce total city water use (using a 1994 to 1996 baseline) by 10 percent at buildout, which was defined as the year 2020. Although the city met and exceeded this goal in 2011, the city's update to the WCFS, titled the 2016 Water Efficiency Plan, summarized climate change, population growth and other factors can be expected to increase the city's future water use. This report recommended to maintain the current water conservation goals to suppress increased water usage and prevent backsliding in water use efficiencies achieved to date while adapting to changing conditions. Every seven years, in conjunction with state reporting requirements, the city will evaluate whether or not new water conservation goals are needed.

Specific water management strategies that support emissions reductions include:

- Expand water conservation programs that focus on outdoor irrigation, which may also support better identification of water-related carbon sequestering opportunities such as using soil amendments, native grasses and proper tree watering.
- Promote measures that reduce the energy needed to heat, treat and transport water, including continued evaluation of new hydroelectric and photovoltaic opportunities.
- Evaluate opportunities for real-time water and energy metering that may help customers better understand and reduce their water and energy consumption.

Partnerships

Boulder Valley School District (BVSD) has worked with the city to promote wise water use in schools—both indoors and outdoors. For example, the city works with BVSD to install refillable water bottle stations in schools to better promote drinking tap water, reducing waste from plastic water bottles and recognizing that bottled water consumes 2000 times more energy than tap water.

Boulder Housing Partners (BHP) has worked with the city to install new low-flow toilets, water efficiency sprinkler heads and other water-saving features. The city and BHP are also working on a submetering pilot to help find system leaks. At one property BHP was able to identify a leak that wasted 8,640 gallons per day; that's 6 gallons per minute!

EPA WaterSense initiatives, like Fix-a-Leak-Week, are supported by the city and helped win the city a 2013 WaterSense Excellence Award.

The **Center for ReSource Conservation (CRC)** offers multiple city supported programs from low-cost xeriscape gardens to low-flow toilet installs. The CRC also promotes energy efficiency in BVSD schools through the "Renew Our Schools" challenge.

Boulder County's EnergySmart Program, run jointly with the city, helps support wise water and energy use by coordinating low-flow shower head retrofits. Partners for A Clean Environment provides free water conservation and energy assessments to businesses.

CLEAN ENERGY AND WISE WATER USE

DID YOU KNOW?

Every year the city's hydroelectric power production offsets the equivalent GHG emissions created by a passenger vehicle driving 85,372,981 miles.





FOOD

By 2050, Boulder residents will have the information

and food choices to actively support the stabilization of the climate and stewardship of healthy ecosystems through the food they eat.

The Food-Climate Connection

The foods that sustain humans have a variety of impacts on the climate—both those we eat directly and those raised to feed animals raised for their meat (cows, chickens, sheep etc.) According to research by the Environmental Protection Agency¹, agriculture accounts for nine percent of the greenhouse gas emissions in the United States. Livestock and manure management account for the greatest amount of emissions within agriculture, at 33 percent and 12 percent respectively. While these resource impacts are often felt far from Boulder, food choices we make here contribute to these impacts. These impacts also vary considerably depending on a variety of factors including:

- how low on the food chain it is—foods derived from plants generate fewer emissions per calorie than those from animals;
- how much water is used to produce the food;
- how much energy is required to cultivate, tend, harvest and process that food; and
- how far the food has to travel before it gets to the table.

Deciding to consume and produce food locally can lessen the impacts on the climate, increase sequestration and improve awareness about where our food comes from. In an effort to foster and grow these benefits of local food choices, a broad collaboration of groups including the city, Boulder County, the Boulder Valley School District, Transition Colorado, the University of Colorado and others have formed a local initiative called “Making Local Food Work.” Among their efforts was the recent launch of a local/regional food awareness campaign branded as “The Shed: Boulder County Foodshed.” A key part of this initiative is the development of marketing materials and support for local food producers who are pioneering new approaches to sustainable, climate-friendly food production, distribution and preparation.

Measuring Success

Tracking the connection between food, especially local food, and climate, is still a new and emerging field of interest. Over the next three to five years, the city and its community partners will be evaluating a number of approaches to begin understanding and monitoring these connections. These initiatives may include:

- Assessing the total water utilized in producing local foods.
- Tracking the “carbon miles” from farm to table for local foods.
- Tracking the number of acres certified in organic production or other sustainable production monitoring systems.

Local Food Achievements

- From 2004 to 2014, Boulder County Farmers’ Market sales increased by 98 percent.
- The “Harvest Bucks” program was implemented in 2014, which increased Supplemental Nutrition Assistance Program purchases at the Boulder County Farmers’ Market from \$12,500 in 2013 to \$23,455 in 2014.
- As of 2015, Boulder County is known to have more than 12 community gardens.



¹ <http://epa.gov/climatechange/ghgemissions/sources/agriculture.html>



Livestock, Land Use and Soil Sequestration

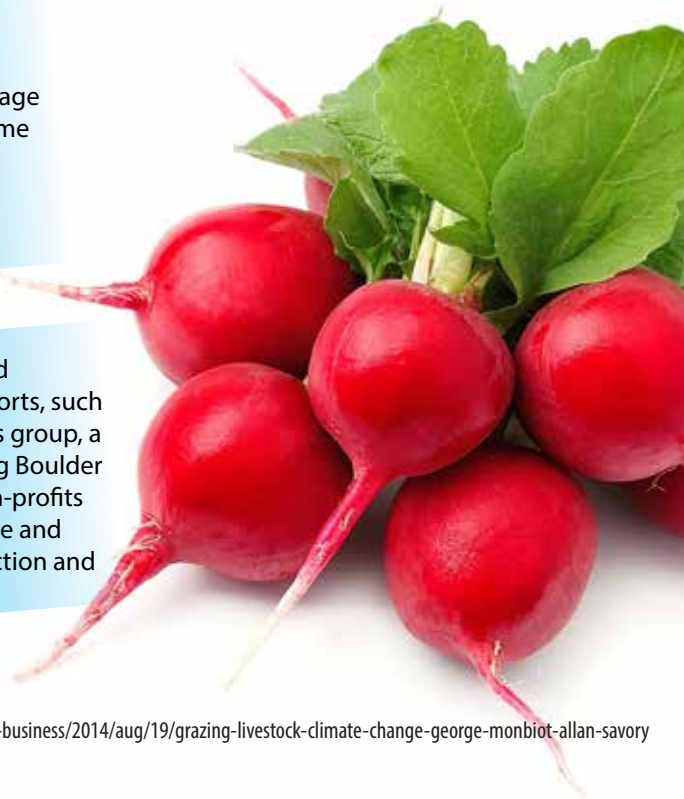
The already frequently debated topic of eating meat has recently added climate impacts to its list of disputed issues. In Boulder and Boulder County, a significant amount of the agricultural land is not well suited to the production of vegetables and grain crops. Consequently, much of the 15,000 acres of agricultural land owned by the city—nearly 80 percent—is used as grazing land for livestock. Emerging research indicates that both perspectives are right: many conventional livestock management practices contribute significant amounts of carbon emissions, in large part due to impacts to the soil. In contrast, a growing movement of ranchers and range managers have begun using livestock rotation and management techniques that mimic natural processes of wild grazers. These techniques have been shown to actually improve the health of the soil and foster enhanced sequestration of carbon out of the atmosphere.² To be successful, these progressive land managers need positive support from a marketplace of food buyers that ask for—and in some cases are willing to pay a premium for—the meat products that come from these operations. Many of Boulder County’s farmers that direct the market use practices such as these that sequester greenhouse gases or reduce their emissions (see Agricultural Ecosystems section on page 44).

2017 to 2020 Action Plan Strategies in Development: Climate-Friendly Food

The Boulder Valley Comprehensive Plan outlines broad goals and objectives for local food and agriculture, including support for local food production, sustainable agricultural practices, urban gardening and access to locally produced foods. In 2015, a cross-departmental staff team was formed to begin exploring additional actions the city could take in support of these objectives. Specific strategies being explored or under development include:

Encouraging sales of residentially-produced vegetables, fruits and cottage foods (when people become producers they develop a greater understanding of the impacts of what they consume).

Continued leadership and investment in regional efforts, such as the Making Local Foods group, a collaborative effort among Boulder County governments, non-profits and businesses to promote and support local food production and consumption.



**SUPPORT
LOCAL FOOD,
DECREASE
CLIMATE
IMPACTS**

DID YOU KNOW?

From 2004 to 2014,
Boulder County
Farmers’ Market sales
increased by 98 percent.



² <http://www.theguardian.com/sustainable-business/2014/aug/19/grazing-livestock-climate-change-george-monbiot-allan-savory>



ECOSYSTEMS

S E C T I O N I I I

Enhance the ability of urban, wildland and agricultural ecosystems to capture and stabilize atmospheric carbon and provide critical buffering against climatic extremes.

URBAN ECOSYSTEMS
WILDLAND ECOSYSTEMS
AGRICULTURAL ECOSYSTEMS



URBAN ECOSYSTEMS

In 2050, Boulder's urban landscape will be fully planted with trees and vegetation selected to moderate climate extremes, reduce energy and water usage, improve water quality and enhance the beauty and livability of Boulder's urban environment.

Targets for Progress Indicators

	2015	2020	2030	2050
Urban Tree Canopy (% canopy cover)	16%	11.5%	15%	20%
Number of Trees Planted Annually	1,500	2,500	3,400	3,400

The Climate-Urban Ecosystem Connection: The Power of Trees

Research indicates that healthy trees can mitigate a range of environmental impacts, including stormwater runoff, poor air quality and temperature extremes. Trees also provide significant energy use reductions associated with both cooling and heating. The density and placement of trees in an urban environment is typically measured by the percentage of area covered by the trees during full foliage—the urban tree canopy (UTC). Cities with higher UTCs are typically able to reduce temperature extremes—often referred to as the “urban heat island” effect. These reductions can be significant.

The City of Boulder's urban forest and ecosystems are an integral part of its living infrastructure. The city has over 650,000 trees, approximately seven trees per capita. However, given the significant open space in the community, this results in a canopy cover of less than 25 percent. The city has also recently been impacted by a combination of factors that have dramatically impacted the city's trees. Extreme weather events including huge temperature swings, floods, late snowstorms and the loss of over 25 percent of the canopy due to the Emerald Ash Borer (see below), all contribute to a loss of canopy closure that the city must recover from over the next decades. Returning to current levels of canopy cover will require enormous action—both public and private. The current levels of tree planting—approximately 1,500 per year—will need to more than double to restore and increase urban tree cover. This will take unprecedented levels of collaboration between public land managers, private landowners and planners working on how we will respond and adapt to a climate change



Trees, Energy and Emissions

According to the Environmental Protection Agency, a mature tree can reduce peak summer temperatures between 2°F to 9°F! Trees properly placed around buildings can reduce air conditioning needs by 30 percent and can save 20 to 50 percent in energy used for heating by reducing wind exposure. This reduction in energy usage, particularly during high energy use periods such as hot summer days, translates directly into reducing carbon emissions where the energy being reduced would otherwise have been produced by a fossil fuel source (coal and natural gas).



Emerald Ash Borer

Boulder has the unwelcome distinction to be the first western community to experience an infestation of the Emerald Ash Borer. This small green beetle has swept through the Midwest causing complete mortality in untreated ash tree species. As much as one-fifth of Boulder's urban forests are comprised of ash including many spectacular trees on Boulder's iconic Pearl Street Mall. While climate change is not the cause of this outbreak, the increased plant stress it causes already appears to be accelerating the pace of the spread of the infestation. This loss of up to 20 percent of the urban tree canopy over the next five to 10 years will have a significant impact on the many environmental, aesthetic and economic benefits provided by the urban canopy. It also provides an opportunity to replace the ash with diverse species that are well suited to the hotter conditions expected as a result of climate change. Species selection and planting locations can also address other objectives, such as coordination with optimizing rooftop solar capture capacity.

¹Unoccupied planting spaces' refers to locations suitable for planting trees along roads and public areas that are currently unoccupied.

Trees In Jeopardy: Climate Change and Exotic Pests

Climate change is beginning to exacerbate the stresses urban trees are already facing, including temperature extremes, drought stress, infestation and disease, adding to the urgency to create effective protection and restoration strategies. Effects of climate change include:

- Hotter summers are stressing young trees and increasing external watering needs.
- Milder winters enable a proliferation of pests and increase susceptibility to premature budburst and subsequent freeze damage to new growth.
- Extreme temperature fluctuations can stress or kill trees. During 2014, a November temperature drop from 64° to -11° in 48 hours created substantial local damage and dieback.
- Increased water stress will also make trees more susceptible to a wide range of insects and disease that attack low vigor trees. Boulder is currently experiencing a number of these threats, most notably the likely eradication of Green Ash due to the Emerald Ash Borer.

2017 to 2020 Action Plan Priorities

The City of Boulder's Urban Forestry workgroup manages all city trees in parks and street rights of way in Boulder. Under the guidance of the 2014 Parks and Recreation Master Plan, staff is now preparing to develop the city's first Urban Forest Strategic Plan. Key action items anticipated as part of its workplan over the next three years include:

- Review and revise parking lot shading guidelines and enforcement of increased canopy cover.
- Conduct a comprehensive urban forest inventory.
- Monitor the urban forest using both on-the-ground and remote sensing technologies to document how it is responding to climate change and establish ongoing monitoring protocol.
- Increase the diversity of urban tree species to improve overall urban forest resilience.
- Review and improve strategies for responding to pest and disease invasions.
- Review and refine park and natural space plans to minimize damage from the impacts of increased use and warmer conditions.
- Explore the establishment of a partner non-profit urban forest foundation to leverage additional financial and community support for the urban forest.

**BY 2050,
THE BOULDER
COMMUNITY
WILL PLANT**

3,400

**TREES PER
YEAR.**

DID YOU KNOW?

A mature tree can
reduce peak summer
temperatures between
2°F to 9°F!





In 2050, the city will continue to be surrounded by vibrant, diverse natural ecosystems.

The city and a broad consortium of partners are engaged in stewardship and restoration activities that enhance the resilience of these systems, enabling them to continue to thrive and provide the wide range of climate buffering services the community enjoys.

The Climate-Wildland Ecosystem Connection

Wildland ecosystems—from forests and grasslands to alpine and desert—are integral parts of the climate system. Each ecosystem has a unique interaction with the climate depending on its geography, moisture profiles, seasonal characteristics and a host of other factors. In Boulder, the extensive wildland buffers that surround and weave through Boulder's landscape have important roles in moderating local climate conditions, sequestering and holding carbon (especially forests) and maintaining the complex network of species that support a vast array of biological functions—each essential to a stable environment. A changing climate will alter this balance, with potentially dramatic impacts on biodiversity and ecosystem services, as well as the ecological processes that link the two.

Summary of Current Conditions

Over the last 50 years, Boulder has experienced a steady increase in temperature and precipitation. Looking forward, all climate models predict that temperatures will continue to rise; predictions for precipitation are less certain. The ecological effects of climate change in Boulder are understudied, but we may anticipate increased fire and flood frequency, declines of snow pack, increased drought, altered seasonal water flows, upslope shifts in the distribution of plants and animals, earlier arrival of migratory birds, advanced blooming time of plants, increased spread of invasive species and even the local extinction of some species.

2017 to 2020 Action Plan Priorities

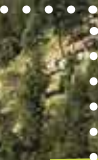
Protecting and sustaining wildland ecosystems is essential to address the city's emission reduction objectives and its climate adaptation and resilience strategy. In many ways, these strategies are closely integrated. To maintain the climate stabilizing services provided by wildland ecosystems, the city will need to manage their adaptation to the changing climatic conditions already underway, particularly species conservation. To this end, it will be necessary to convene a multidisciplinary team that includes hydrologists, conservation planners, geographers and biologists. Ongoing strategies should include:

- Incorporating climate change into all levels of planning. In particular, invest in scenario planning, focusing on novel future conditions so that recommendations for land management reflect the best available and most current science and potential range of impacts.
- Manage landscapes to support ecosystem transitions.
- Identify multiple biological indicators of climate change sensitivity and response; specifically, identify high risk assets for monitoring or intervention.
- Develop downscaled future climate layers and use them to predict the return interval of extreme events.

RESILIENT ECOSYSTEMS SUPPORTING THE CLIMATE

DID YOU KNOW?

Boulder's Open Space and Mountain Parks department manages over 45,000 acres of land. This land is home to thousands of species, unique geologic features and 151 miles of trails.



Progress Indicators

Understanding wildland ecosystems' role as part of the city's climate strategy is a new area of focus. Over the next several years, staff from across the organization will be working together to identify suitable metrics and targets that integrate with existing wildland management efforts. Possible success measures being considered include:

- Reducing the impact of large rainfall events.
- Preventing large, stand-replacing wildfires.
- Establishing a credible first iteration of local climate projections for 2050 and 2070.
- Modeling the response of vegetation and biodiversity to climate change.
- Modeling the carbon balance of the dominant ecosystems and agroecosystems on open space lands.
- Monitoring plant and animal phenology.
- Identifying and monitoring the stability of high-risk species.
- Educating the community on the possibility of novel ecosystems and species shifts.





In 2050, agricultural operations on city lands will be recognized for maximizing the fertility and climate stabilizing capacity of the soil and associated ecosystems.

The city's agricultural lands will continue to provide local foods and support the critical ecological services these agricultural lands provide.

The Climate-Agricultural Ecosystem Connection

The inclusion of agricultural land management in the city's emissions and climate action strategy is a new area of consideration and development. While agricultural-based emissions are not currently captured under the emissions protocol used by Boulder and most cities, the importance of agriculture as both an emissions source and a possible emissions reduction strategy is a rapidly emerging field of study. According to the US EPA, agriculture is responsible for approximately nine percent of all greenhouse gas emissions nationally¹. The sources of these emissions include livestock, soil and crop management and the equipment and operations associated with agricultural operations.

Emissions from agriculture have been increasing since 1990 and are projected to continue to increase if current management practices and food preferences are maintained. However, agricultural practices can also be used to reduce carbon emissions and sequester carbon out of the atmosphere. A hopeful new movement, referred to as "Carbon Farming," shows encouraging progress in developing land management practices that can sequester carbon in soils and contribute to climate stabilization, while maintaining or enhancing agricultural production and land health.

The City of Boulder through its Open Space and Mountain Parks department (OSMP) currently leases almost 15,000 acres of agricultural lands, 80 percent of which is used for livestock grazing. Close to 500 acres are currently leased to farms focusing on locally-marketed food products, including beef, lamb, honey and fresh produce. OSMP has a variety of initiatives designed to maintain and improve land health, including support for farmers utilizing organic and other sustainable farming practices, such as rotational grazing systems, reduced tillage, and other soil stabilization and conservation practices.



2017 to 2020 Action Plan Priorities

- 1 Continue the development of Best Management Practices for Soil Sequestration—Soil sequestration of carbon is a new science and best management practices for our local climate and soils are still being developed. The city is working on developing soil organic matter sampling procedures to set standards for acceptable conditions and work towards increasing soil organic matter and soil health on city-owned agricultural lands.
- 2 Implement soil protection actions—Work with agricultural lessees and university researchers to adopt soil conservation systems such as reduced tillage, cover cropping and longer crop rotations.
- 3 Identify suitable sites to run pilot projects for soil sequestration of carbon—Explore collaboration opportunities between the city and Boulder County, as well as private farms which are already using many soil carbon sequestration methods, to provide opportunities for testing various soil sequestration strategies.
- 4 Explore Opportunities to Incentivize “Carbon Farming”—Identify and assess opportunities to incentivize sequestration management through both local carbon offset funding or the development of external carbon market incentives such as the Carbon Trade Exchange³.
- 5 Initiate a public information campaign to encourage Soil Sequestration of Carbon by homeowners, farmers, and on public lands. Carbon can be sequestered in lawns, mulched flower beds, vegetable gardens, farm fields, rangelands and forest lands. Partnerships with public or private entities can amplify the campaign’s effectiveness.

Carbon Farming: Agriculture as a Carbon Sequestration Technology

A growing movement of agriculturalists, soil scientists, permaculturists and others interested in land stewardship have been engaged in both formal and informal research on the potential for using agriculture to stabilize the climate. The Marin Carbon Project has begun publishing findings from a range of on-farm pilot projects intended to use agricultural practices to sequester carbon. In one study, University of California Berkeley researchers found that a single application of 1 ton/hectare of composted green waste increased carbon sequestration by an average 25 to 70 percent while also increasing forage production by as much as 50 percent.² Given the growing recognition that stabilizing the climate will require both reducing emissions and finding ways to recapture much of the carbon now released, approaches to augmenting sequestration are critical. Careful research and testing is necessary before widespread use of these techniques is implemented. This research should be directed towards highly modified landscapes only, such as tilled agricultural fields and previous industrial sites.

¹ <http://www.epa.gov/climatechange/ghgemissions/sources/agriculture.html>

² <http://www.marincarbonproject.org/science/land-management-carbon-sequestration>

³ <http://ctxglobal.com/>

SUPPORTING AGRICULTURE, SEQUESTERING CARBON

DID YOU KNOW?

One ton of composted green waste per hectare increases the carbon sequestration capacity of annual grasslands by up to 70% while increasing forage up to 50%.²



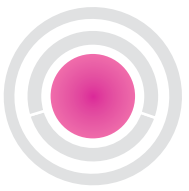


COMMUNITY CLIMATE ACTION

S E C T I O N I V

Supporting the inspiration and innovation of those who live, work, study and visit Boulder to create a low-carbon economy and lifestyle that improves the health, shared prosperity and long-term security of the community.

**COMMUNITY PERSPECTIVE
COMMUNITY LEADER PROFILES
JUST TRANSITION
NEXT STEPS**



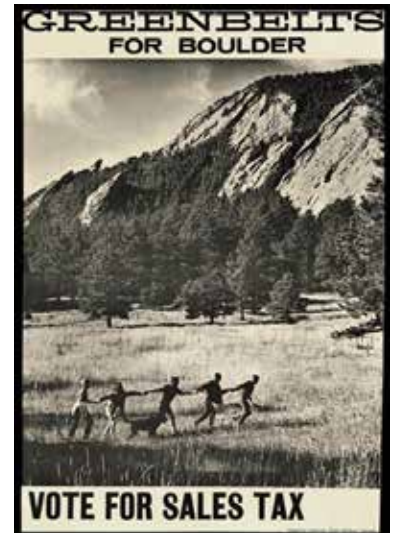
COMMUNITY PERSPECTIVE

The people of the Boulder Valley have cared deeply about this place for centuries.

Boulder's residents have shown themselves to be leaders in protecting this beautiful but fragile landscape and the clean air and water that sustain it.

Boulder demonstrated its commitment to the environment in the 1960s, when it voted to support taxes for the purchase of open space. Over 45,000 acres now surround the community, providing healthy landscapes for today and for future generations. In 2006, Boulder took additional action, becoming the first community in the country to tax itself to support programs and initiatives to reduce the harmful carbon emissions that drive climate change.

Building on this legacy, Boulder now has the capacity to have a significant impact on climate action, both locally and around the world. Boulder is home to over 3,000 climate researchers, hundreds of active and innovative local community members and dozens of the leading-edge businesses developing clean energy and other sustainable resource use products and services. Certainly, Boulder can show how climate action creates community health, shared prosperity and security.



The Community's Perspective: Climate Change and Climate Action

Recognizing that climate action means community action, the city spent nearly two years conducting extensive outreach and dialogue within the community. This included:

- 655** Survey responses
- 29** Community presentations by city staff
- 15** 90-minute facilitated community dialogues
- 4** 90-minute focus groups



One of 15 community dialogue groups.

The community engagement mechanisms revealed that strong alignment across the community exists on climate change, priority solutions and preferred actions. Key findings include:

STRONG COMMUNITY ALIGNMENT

DID YOU KNOW?

94 percent of Boulder residents and workers surveyed believe that climate change is happening.



There is a clear understanding that climate change is occurring.

94 percent of Boulder residents and workers surveyed believe that climate change is happening.

Concern for well-being is a primary motivator.

Boulder residents and workers consistently cited concern for the well-being of themselves, others and future generations as the primary value motivating action on climate change.

Preferred action steps are clear.

Those who participated demonstrated strong agreement that the top solutions needed in the community are:

- Increased renewable energy;
- More public transportation, biking and walking options (that equitably benefit both the Latino and low-income populations) and;
- New land use policies that reduce in-commuting and promote low-GHG transportation.

Action is already happening.

Nearly 91 percent of Boulder residents and workers surveyed are already taking climate action; focus groups revealed that community groups are taking action, too.

Measuring Success

A key objective of the community discussions was to identify what the community would see as important indicators of climate action progress. Residents were asked to prioritize progress indicators for both the community and for the city government. These priorities showed both consistency and important points of distinction:

COMMUNITY	CITY
Install more renewable energy in homes and businesses	Adopt renewable energy options
Reduce energy use through behavior change	Create policies incenting efficiency
Use low emissions transport	Change land use to promote low emissions transportation

Climate Action and Community Benefit

An important insight that has emerged over the past 10 years of Boulder's climate efforts is the recognition that climate change is not a problem to be solved separately. Instead, it is an indicator that other fundamental human systems—energy systems, ecosystem management systems and resource use systems—are no longer sustainable, given both human populations and demand. Consequently, effective climate action means updating some of these human systems in ways that can diminish their impacts and reduce carbon emissions, while simultaneously increasing the capability of natural systems to reabsorb harmful carbon emissions. The good news is that the actions that help reduce climate impacts can also bring significant local benefits including supporting energy security and ownership, expanding access to affordable living and clean, accessible mobility, capitalizing on economic opportunity and improving environmental health and biodiversity. Many Boulder residents, businesses and organizations are already leading the way.



Houses demonstrating vibrant low-carbon lifestyles

Brett and Elizabeth Astor's efficient home



Through a project initially funded by the city's Boulder Energy Challenge, Brett and Elizabeth Astor received support to identify ways they could make their household more compatible with their desire to live a low-carbon lifestyle. With assistance from EnergySmart and a local energy company, Elizabeth

and Brett were able to implement energy efficiency measures, a new solar system and integrate a used electric LEAF in ways that actually reduced their overall monthly energy expenditures. According to Brett Astor: "I get jazzed about eliminating waste and not making a mess of our environment. I just needed to know it wasn't dumb financially, that I wasn't kidding myself. The LEAF is fun to drive, it is inexpensive and it is so cool to plug it in and know the solar is powering it! The house is much more comfortable with the added insulation and whole house fan."



Businesses in the lead

Reynolds solar installation on commercial property

For over four decades John Reynolds and his father, Bill, have worked in the Boulder real estate business. While considering upgrades to his existing commercial properties, John explored various features that would appeal to the growing number of companies relocating to Boulder that highly value sustainability. This led John to evaluate the financial viability of installing rooftop solar, in addition to integrating several other healthy building design principals, during a major remodel of one of his Boulder properties. John installed 50 kW of solar on this building and is pleased with the results. "I wanted the focus of this project to be on well-building, and in addition to day-lighting, art, and stairs worth taking, it seemed that we could also produce some of our own electricity. I am proud that we were able to accomplish these goals and offset some of our energy demands with a solar electric system."



Faith communities lead by example

Unitarian Universalist Congregation

The Unitarian Universalist Church of Boulder (UUCB) is committed to taking action on environmental issues and is inspired by its principles of “the inherent worth and dignity of every person,” and “respect for the interdependent web of all existence of which we are a part.” The church formed a Climate Action Team in 2010. Key accomplishments to date include: partnership with the Citizen’s Climate Lobby to advocate for a revenue-neutral carbon tax, congregational resolution to divest from fossil fuel and extensive work on public transportation. The church also installed solar panels that enable the UUCB to produce more electricity than it uses. This followed extensive energy efficiency upgrades including increased roof insulation and ongoing installation of energy efficient windows and doors. Additional and ongoing work includes: forums, study groups, and films for the congregation and wider community on climate topics; recycling; home energy improvements; carpooling and alternate transportation; local food, water and soil conservation.



Youth innovation and leadership

Monarch High School Climate Commitment Competition winners implement climate innovations

Students participated in the BoCo Youth Climate Challenge, a solutions oriented competition for middle and high school students to imagine creative local solutions for climate change. The winning team from Monarch High School (Mariah Wagner, Simone Fohrman, Erika Shapiro and Alexis Weismann) proposed the development of an online platform to increase visibility of local businesses that use clean energy. Although not a winner in the competition, a second team from Monarch High School proposed a project to increase bicycle commuting for students at their school. The team, led by student Rita Trick, worked with mentors Alana Wilson, board member of Community Cycles, and the Boulder Valley School District transportation planner Landon Hilliard. As a result of this student-initiated project, the school district is now working on the development of a bike lane and sidewalk along Campus Drive for students commuting to Monarch from Superior.





Ensuring a Just Transition to a More Sustainable World

As Boulder creates the strategies to achieve these changes, it is also critical that the community think carefully about **how** these changes are made to ensure they are accessible and beneficial to everyone. The concept of making a just and equitable transition to a low-carbon future surfaced as part of the Climate Commitment outreach process. Out of this effort, a new organization was formed, the Just Transition Collaborative (JTC). The JTC includes individuals and organizations committed to helping the city develop both strategies and ways of monitoring the effectiveness of those strategies. This has taken shape as a set of principles and objectives outlined in a “Just Transition Goals and Action Plan” summarized below.

Just Transition Goals and the Climate Action Plan

The transition to a low-carbon future will affect every member of our community. There are, however, multiple pathways, each with different costs and benefits. Some of these pathways could significantly improve the well-being, security and shared prosperity of the community. Others could result in significant unintended impacts, particularly to the most vulnerable segments of the community. As an outcome of the community dialogue and feedback around the community’s climate action commitments and strategy, the following set of equity and just transition goals and objectives were developed to guide the city’s efforts around climate and clean energy transition.

Goal 1: Build Community Capabilities and Leadership

Strengthen community capabilities and leadership, advance diversity in policy input, and collect stories from diverse voices—including underrepresented groups—to guide and to inspire public engagement in a just transition.

- Recognize leadership in low-carbon lifestyles in all segments of the community.
- Diversify community grants and program support to insure participation and benefit across all community segments.
- Ensure all parts of the community, especially lower income and minority communities, are included in climate and energy policy development.

Goal 2: Promote Equity in Energy and Resource Costs and Ownership

Manage disproportionate impacts of energy and resource costs associated with decarbonizing energy sources on lower income or vulnerable parts of the community; ensure that related programs, ownership of assets and resources benefit and prioritize those that are impacted the most.

- Utility rate affordability and relief
- Access to renewable energy
- Access to energy efficiency and conservation
- Access to vehicle efficiency and public transportation

Goal 3: Generate Socially Just Economic and Employment Opportunities

Work with public and private sector partners to increase the capacity of ethnic and lower income populations with professional skills to work in renewable energy and green businesses.

- Living wage green jobs
- Entrepreneurial opportunities for all



COMMUNITY
JUST TRANSITION

**ECOLOGICAL
ECONOMIC
EQUITABLE**

DID YOU KNOW?

The full text of the city's Just Transition goals and objectives can be found at the city's climate action page:
BoulderClimate.com





NEXT STEPS

The city has received significant feedback, guidance and leadership of the community.

2017 to 2020 Action Focus Areas

2017: ENERGY	2018: ECOSYSTEMS
The city will continue working with the wide variety of community and business groups it contacted during the outreach and engagement phase to take the next steps in coordinating community-wide action in rapidly transitioning to a renewable energy-based economy. This will include enhanced support for solar and electric vehicle adoption, seminars on key issues such as energy security and low-carbon product and service business opportunities and work on public-private sector partnerships to significantly expand renewable energy development in the community.	As the community's energy strategy goes into full-scale implementation, city staff will coordinate a broad community outreach and dialogue similar to the one conducted around energy and climate to identify key issues, opportunities and priorities around ecosystems and climate change. These efforts will coordinate with the development of the Open Space and Mountain Parks master planning process, the Parks and Recreation Urban Forest Management Strategy, and other city, county and community ecosystem stewardship efforts.
	

Building Platforms for Collaboration

A critical tool in the support of community leadership and dissemination of practical and effective low-carbon living strategies is the development of new types of information and communication platforms. Working closely with both the University of Colorado Boulder and the community's robust digital innovation sector, the city will be developing a new set of both digital and face-to-face tools and technologies. These systems will be designed to help accelerate the development and adoption of clean energy, sustainable ecosystem stewardship and efficient resource use alternatives that improve both individual and community health, economic vitality and long-term resilience and security. These systems will be designed to: share stories, information and resources; provide action guides with tools and resources; and foster collaboration with other communities and businesses.

Supporting Community Leadership

The success of climate action depends on the relevance of those actions to the day-to-day concerns and considerations of individuals, households and businesses. Boulder has an abundance of leaders in every sector of the community who are actively demonstrating that a low carbon lifestyle is both possible and prosperous. Over the next three to five years, the city will work closely with other organizations and institutions to both identify and support these early leaders and work with them to document and replicate what they have learned that can benefit others. This includes leaders in neighborhood/community organizing, business, community/social groups and academic and research sectors. A special focus will include work with leaders in the lower income and minority segments of the community, many of which are already living lifestyles with much lower per-capita carbon impacts.

Building on this, the city has committed resources to the following next steps in support of communitywide climate action and leadership development.

2019: RESOURCE USE INNOVATION	2020: PROGRESS REVIEW AND STRATEGY UPDATE
The third major focus area within the Climate Commitment—resource use—will be a primary focus of community outreach and engagement during 2019. This will include the significant efforts already initiated around the city's Zero Waste Master Plan as well as activity taking place in water conservation, local foods, sustainable procurement practices and other strategies for reducing the carbon impacts of the resources, products and services we use.	Together with the Boulder community, City Council will determine where we're headed next.
	

Tracking Progress: Learning, Adapting, Thriving

An essential function of the new information and communication systems being developed will be their usefulness in helping track progress, learn from actions taking place, and adapt as circumstances and opportunities change. Major milestones in evaluating our progress include:

2018 Progress Review

Community-wide GHG inventories will be conducted every year with major reviews by staff, citizen advisory boards and city council to occur every two years. The next major review will take place in 2018.

2020 Progress Indicators Review and Five-Year Strategy Update

The next major progress milestone will be the review of the 2020 milestone progress indicators established in this document. This review will provide both the council and community with an indication of overall progress as well as an opportunity to evaluate the efficacy of existing programs and initiatives. It is anticipated that a new set of five-year progress indicators will be established during this review.



REFERENCES AND RESOURCES

Boulder Climate Commitment References and Resources

I. INTRODUCTION

- p. 5 ... <http://www.climatecentral.org/news/12-months-warmest-on-record-19010>*
- p. 5 ... USDA - <http://planthardiness.ars.usda.gov>*
- p. 6 ... Trenberth, Kevin E. "Framing the way to relate climate extremes to climate change." *Climatic change* 115 (2012): 283-290.
<http://link.springer.com/article/10.1007%2Fs10584-012-0441-5>*
- p. 7 ... Transportation Master Plan - <https://bouldercolorado.gov/transportation/tmp>
- p. 7 ... Boulder Valley Comprehensive Plan - <https://bouldercolorado.gov/planning/boulder-valley-comprehensive-plan>
- p. 7 ... Fort Collins Climate Action Plan--<http://www.fcgov.com/common/pdfs/spotlight-pdf.php?id=1092>*
- p. 7 ... The Solutions Project--<http://thesolutionsproject.org/>*
- p. 8 ... 'Nationally, close to 90% of GHG emissions are generated by energy related activities. See World Resources Institute-
<http://www.wri.org/resources/charts-graphs/us-greenhouse-gas-emissions-flow-chart>*
- p. 8 ... Carbon Neutral Cities Alliance - <http://usdn.org/public/Carbon-Neutral-Cities.html>**
- p. 8 ... International Council for Local Environmental Initiatives (ICLEI) - <http://usdn.org/public/Carbon-Neutral-Cities.html>**
- p. 8 ... 2012 Boulder GHG Emissions inventory <http://www.boulderclimate.com>

II. ENERGY

- p. 2 ... Summary of analysis on ability to achieve an 80% emissions reduction goal by 2050--<https://documents.bouldercolorado.gov/WebLink8/0/doc/129619/Electronic.aspx>
- p. 7 ... City of Boulder Emissions Reduction Projection Tool & User Guide
- p. 7 ... Transportation Master Plan - <https://bouldercolorado.gov/transportation/tmp>
- p. 13 ... Preliminary Assessment of the ground-source heating & cooling capacity in Boulder—"Resources" section of www.boulderclimate.com
- p. 14 ... Building Performance Ordinance - <https://bouldercolorado.gov/pages/boulder-building-performance>
- p. 21 ... 2012 Boulder GHG Emissions inventory <http://www.boulderclimate.com/>
- p. 17 ... Electric Vehicle Policy Options Analysis ("Resources" section of <http://www.boulderclimate.com/>)
- p. 17 ... Transportation Fuel and Technology Decarbonization Study ("Resources" section of <http://www.boulderclimate.com/>)
- p. 17 ... Transportation Emissions Analysis ("Resources" section of <http://www.boulderclimate.com/>)
- p. 18 ... Transit System GHG Emissions Analysis ("Resources" section of <http://www.boulderclimate.com/>)
- p. 18 ... Electric Vehicle Adoption Assessment ("Resources" section of <http://www.boulderclimate.com/>)
- p. 18 ... 2013 Vehicle Assessment ("Resources" section of <http://www.boulderclimate.com/>)
- p. 23 ... Boulder Solar Tool—<http://www.mapdwell/boulder/en>
- p. 25 ... Analysis of renewable energy portfolio potentials under municipal utility 7/23/13—<https://documents.bouldercolorado.gov/WebLink8/0/doc/121330/Electronic.aspx>
- p. 25 ... Projections of emissions through 2050 under two utility scenarios: existing utility and municipal utility—"Resources" section of www.boulderclimate.com

III. RESOURCES

- p. 29 ... EPA - <http://www.epa.gov/climatechange/climate-change-waste/#static>*
- p. 31 ... Boulder Zero Waste Strategic Plan 2/2015--https://www-static.bouldercolorado.gov/docs/DRAFT_ZWSP_final-1-201502121650.pdf
- p. 33 ... Water Utilities Master Plan - <https://bouldercolorado.gov/water/water-utility-master-plan>
- p. 33 ... 2000 Water Conservation Futures Study(WCFS) - <https://www-static.bouldercolorado.gov/docs/conservation-study-2000-1-201304231052.pdf>
- p. 33 ... Kreider, Jan F., and Peter S. Curtiss. "Comprehensive evaluation of impacts from potential, future automotive fuel replacements." ASME 2007 Energy Sustainability* Conference. American Society of Mechanical Engineers, 2007. <http://proceedings.asmedigitalcollection.asme.org/proceeding.aspx?articleid=1603098>*
- p. 35, 44 ... EPA - <http://epa.gov/climatechange/ghgemissions/sources/agriculture.html>*
- p. 36 ... <http://www.theguardian.com/sustainable-business/2014/aug/19/grazing-livestock-climate-change-george-monbiot-allan-savory>*

IV. ECOSYSTEMS

- p. 40 ... City of Boulder Urban Forestry Program--<https://bouldercolorado.gov/parks-rec/urban-forestry>*
- p. 41 ... City Grassland Management Plan--https://www-static.bouldercolorado.gov/docs/Grassland_Plan_Ag_Excerpts-1-201407071533.pdf*
- p. 44 ... Carbon Trade Exchange - <http://ctxglobal.com/>
- p. 44 ... Marin Carbon Project - <http://www.marincarbonproject.org/science/land-management-carbon-sequestration>

* External Resource

** Organization

Long-term success will require better
feedback loops, honest assessment,
persistence and collective action.



Boulder's Climate Commitment

Our understanding of the causes, dynamics and consequences of human-induced climate change continues to evolve; however, **we know this for certain**: climate change is not a hypothetical possibility. It is a current reality that could become significantly more difficult to address if we delay taking critical actions.

Our Commitment

Boulder will rapidly transition to a clean energy economy and lifestyle through innovative strategies, products and services that dramatically reduce greenhouse gas emissions, enhance our community's resilience and support a vital and equitable economy.

Our Goal

We will power our city with 100 percent renewable electricity by 2030 and reduce Boulder's greenhouse gas emissions by at least 80 percent below 2005 levels by 2050.

