



CITY AND COUNTY OF DENVER CLIMATE ACTION PLAN 2015



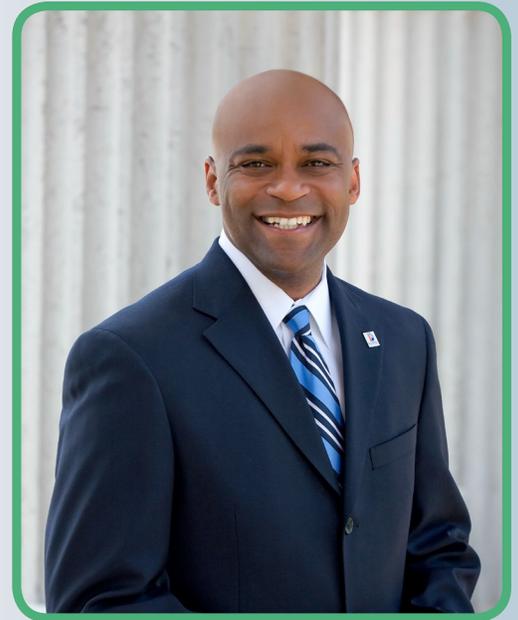
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Dear Neighbors,

When Denver released its original Climate Action Plan in 2007, we became one of the first large cities in the nation to recognize the potential threats and broad-reaching impacts of climate change.

Since then, the city has continued to lead in municipal climate planning. By measuring, tracking and setting goals for the reduction of climate-changing greenhouse gas emissions, we led the way in ensuring that economic investments consider the impact on our climate. Denver was also one of the first cities to sign on to the Mayors' Climate Protection Agreement of the U.S. Conference of Mayors, and recently joined the new, more ambitious Mayors' National Climate Action Agenda. To further ensure Denver's commitment to climate resiliency, Denver released its 2020 Sustainability Goals in 2013 and followed it with a Climate Adaptation Plan in 2014.



Over the past few years, science, awareness and recognition of the effect humans are having on the planet has evolved. From increases in droughts and extreme weather events, to public health concerns and the economic impacts related to infrastructure, the evidence clearly shows communities across the globe are experiencing the consequences of a warming planet.

We have a responsibility to act, and there is no greater urgency to be part of the solution. Climate action is the biggest opportunity of the 21st century to protect public health, grow our economy and secure a bright future for generations to come, and we have the technology to move to cleaner, more sustainable forms of energy.

In this plan, Denver is setting a new long-term goal, in alignment with climate science, to reduce community greenhouse gas emissions 80 percent from its 2005 baseline by 2050. We must commit to being bold and inclusive about how we will meet this goal together. It will take all of us. As a first step, we will launch a robust stakeholder engagement process, beginning in 2016, to advise the city on setting the right strategies, tactics and benchmarks to ensure we make meaningful progress.

Denver's 2015 Climate Action Plan is intended to create a more resilient city by building upon existing efforts to limit the most severe effects of climate change through new strategies to reduce greenhouse gas emissions.

Aligning with Denver's 2020 climate goal, the plan sets a path for a more sustainable future that addresses the top sources of greenhouse emissions comprehensively. By integrating urban planning, energy efficiency, renewable energy measures and improving mobility options, Denver will remain a global leader in meeting the challenges of climate change and deliver a better Denver for future generations.

Respectfully,

A handwritten signature in black ink, appearing to read "Michael B. Hancock". The signature is fluid and cursive, with a long horizontal line extending to the right.

Michael B. Hancock
Mayor

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ACRONYMS AND DEFINITIONS

CACJA	- Clean Air, Clean Jobs Act	LED	- Light-Emitting Diode
CAFE	- Corporate Average Fuel Economy	MNCAA	- Mayors' National Climate Action Agenda
CH₄	- Methane	mpg	- Miles Per Gallon
CO₂	- Carbon Dioxide	MSW	- Municipal Solid Waste
CPD	- Community Planning and Development	mt-CO₂e	- Metric Tons of Carbon Dioxide Equivalent
DEH	- Department of Environmental Health	MW	- Megawatt
DGS	- Denver General Services	NA	- Not Available
DEN	- Denver International Airport	NO_x	- Nitrogen Oxides
DMNS	- Denver Museum of Nature & Science	N₂O	- Nitrous Oxide
DOSP	- Denver Office of Strategic Partnerships	RNAV	- Area Navigation
DPR	- Denver Parks and Recreation	RPS	- Renewable Portfolio Standard
DPW	- Department of Public Works	RTD	- Regional Transportation District
DS	- Development Services	SAC	- Sustainability Advisory Council
DSM	- Demand-Side Management	SCFD	- Scientific and Cultural Facilities District
EMS	- Environmental Management System	SO₂	- Sulfur Dioxide
EPA	- U.S. Environmental Protection Agency	STP	- Strategic Transportation Plan
GHG	- Greenhouse Gas	TBD	- To Be Determined
GWh	- Gigawatt-Hour	TOD	- Transit-Oriented Development
IECC	- International Energy Conservation Code	VMT	- Vehicle Miles Traveled
IPCC	- Intergovernmental Panel on Climate Change		



The Challenge of Rapid Climate Change

Over the past decade, rapid climate change has become the most defining concern of the 21st century. Global emissions of climate-altering greenhouse gases (GHGs) are rising, along with the temperature of the atmosphere and oceans. As a result, communities worldwide are experiencing record temperatures, more frequent and severe drought, severe flooding, and other extreme weather events. Once thought of only as an environmental issue, climate change is now recognized as an issue of tremendous moral, human, economic, and ecological concern.

Globally, cities only take up 2 percent of landmass area, yet are responsible for two-thirds of the world's energy use, with residents producing 70 percent of global carbon emissions.¹ To help address this, local governments are in prime position to create policies and initiatives to minimize climate-altering emissions from the energy, building, and transportation sectors. Such initiatives can also promote economic growth and environmental justice while enhancing the livability of communities through the connection of the natural and built environments.

Denver Responds

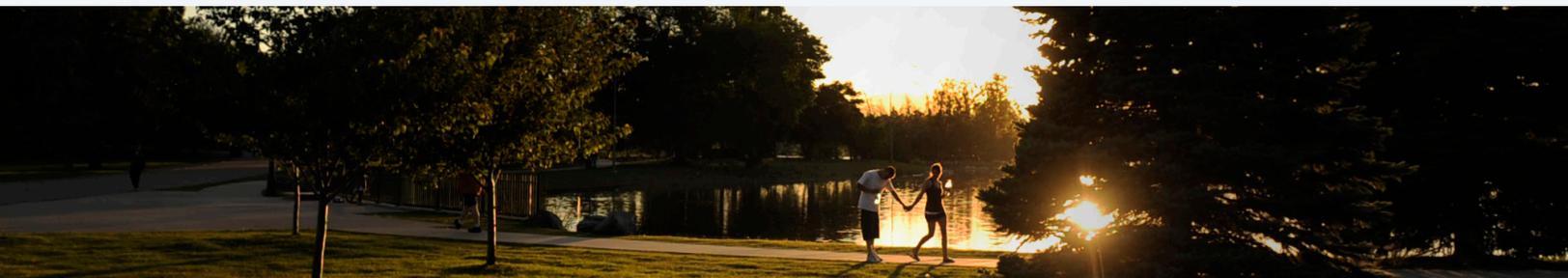
As global concern grows over the role human activity plays in accelerating climate change, opportunity exists to implement changes to minimize the most severe and potentially irreversible impacts on our planet. To help address this critical issue, Denver is releasing an updated Climate Action Plan (CAP) with new strategies to meet our 2020 Climate Goal. Released in 2007, Denver's first CAP set a goal to reduce GHG emissions by 10 percent per capita below 1990 levels (at that time, equivalent to an overall GHG reduction of 3 percent). Denver exceeded this goal in 2010 thanks to innovative regional strategies in the energy sector, with notable reductions in buildings and transportation.

The 2015 CAP integrates the most recent climate science, an updated GHG inventory, GHG reduction strategies to meet the existing 2020 goal and a renewed commitment to necessary reductions by mid-century. Under the leadership of Mayor Michael B. Hancock, in 2013 the City established the Denver 2020 Climate Goal, which calls for an absolute reduction of GHG emissions to 1990 levels by 2020. This would require a 10 percent reduction of GHGs from 2005 levels—an ambitious goal when considering how much growth in population and economic activity will have occurred over that time frame.

“HUMANITY IS CALLED
to take note of the need for
changes in lifestyle and changes
in methods of production and
consumption to combat this
warming. . .”

POPE FRANCIS
2015 Encyclical Letter *Laudato Si'*
of the Holy Father Francis On
Care for Our Common Home

¹ Intergovernmental Panel on Climate Change. 2013. “Summary for Policymakers.” In: *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex, and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, New York, USA.



Climate Mitigation versus Climate Adaptation

While we work to mitigate the impacts of climate change by reducing emissions, we must also prepare for changes to our climate.

Climate mitigation is defined as efforts to reduce or prevent greenhouse gas emissions. Examples of mitigation efforts can include increasing renewable energy use, upgrading and replacing equipment to more energy efficient models, and informing consumer behavior to make sustainable decisions. Policy and infrastructure mitigation efforts range from increasing public transportation and bicycle pathways to enhancing natural carbon sinks (areas that accumulate and store carbon) such as trees.

Climate adaptation is defined as efforts to prepare for and adjust to the current and future impacts of climate change. Examples of climate adaptation include increasing energy efficiency to help offset increases in energy consumption due to extreme weather, ensuring the availability of cooling centers in the face of extreme heat events, and upgrading stormwater infrastructure to better withstand extreme rainfall events.

Climate mitigation and adaptation strategies can be implemented simultaneously. Many strategies that reduce GHG emissions also provide mutual benefits in adapting to a changing climate.

Climate Change Trends

When discussing climate change, it is important to look at long-term climate trends—generally 30 years or more—rather than short-term patterns (i.e., months to years), which reflect natural weather variability. Between 1880 and 2012, the globally averaged combined land and ocean surface temperature increased by 0.85 degrees Celsius (1.53 degrees Fahrenheit). The average surface temperature also increased worldwide from 1901 to 2012. Globally, the atmosphere and oceans have warmed, the amounts of snow and ice have diminished, and sea levels have risen. While warming and cooling have naturally occurred on our planet, the recent warming trend is unprecedented within the last 1,300 years.² The Intergovernmental Panel on Climate Change (IPCC) concludes it is indisputable the global climate is warming.³

²Ibid.

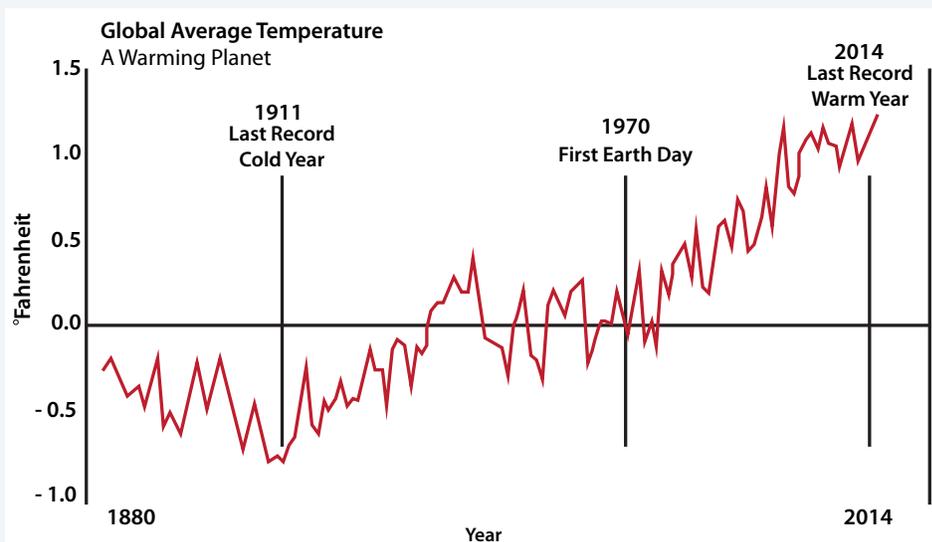
³Ibid.



Carbon dioxide (CO₂) levels are higher now than at any time in at least 800,000 years.⁴ There is scientific consensus that increases in emissions are primarily the result of the burning of fossil fuels (coal, natural gas, gasoline, and diesel), industrial, agriculture, and land-use changes. The IPCC has identified specific effects of rapid global climate change, including increased frequency and duration of warm days and nights, increased frequency of heavy precipitation events, increased intensity and duration of droughts, and global sea-level rise.⁵ Temperatures in Colorado have increased roughly 2 degrees Fahrenheit over 30 years, with the Front Range observing slightly higher trends. Similarly, peak runoff has shifted earlier by 1–4 weeks over the last 30 years. Climate models suggest Colorado's Front Range is expected to experience the following:⁶

- Warming anywhere from 2.5 degrees Fahrenheit to 6.5 degrees Fahrenheit by 2050 relative to the 30-year average temperature.
- By 2050, temperatures in the Front Range are predicted to be similar to temperature regimes currently occurring near the Colorado-Kansas border.
- Typical summer temperatures in 2050 are projected to be as warm as or warmer than the hottest 5 percent of summers that have been observed since 1900.

Global Average Temperature 1880 to 2014



- The January climate of Colorado's Eastern Plains is expected to reflect the climate currently experienced by areas approximately 150 miles further south, which means fewer extreme cold months and more extreme warm months.
- April 1st snowpack is expected to decline in Colorado's mountains as the projected warming increases the fraction of precipitation falling as rain, and also increases moisture loss from the snowpack.
- Peak runoff has already shifted earlier by 1–4 weeks over the last 30 years. By 2050, warming is projected to shift runoff an additional 1–3 weeks earlier and reduce late summer streamflows.
- Droughts are projected to increase in frequency, duration and severity.

DENVER WILL EXPERIENCE INCREASES IN TEMPERATURE, further worsened by urban heat island effect. Denver will also likely experience increases in extreme weather events, reduced snowpack and earlier snowmelt. Changes in snowpack impact the availability of water for irrigation, recreation and consumption. As these changes could have significant impacts on the quality of life in our city, mitigation and adaptation strategies are essential to help avert rapid climate change and become a more climate-resilient city.

For a more thorough listing of climate change impacts and vulnerabilities, please refer to the June 2014 Denver Climate Adaptation Plan, www.denvergov.org/Climate.

⁴ Ibid.

⁵ Ibid.

⁶ The stated impacts are a summary of findings within Denver's Climate Adaptation Plan. City and County of Denver. 2014. "Climate Adaptation Plan." Available at http://www.denvergov.org/Portals/771/documents/Climate/Climate_Adaptation_Final%20with%20letter.pdf.

National and International Progress

Since the 2007 release of Denver’s original CAP, a number of key national and international agreements, plans, and compacts have helped to lower the carbon intensity of electricity, decrease the consumption of energy, and raise overall awareness of climate change.

Increasing Federal Corporate Average Fuel Economy Standards

In 2010, the U.S. Environmental Protection Agency (EPA) and the National Highway Transportation Safety Administration (NHTSA) changed the Corporate Average Fuel Economy (CAFE) standards for the first time in approximately 35 years.

As a result, fuel efficiency for cars and light-duty trucks built between 2012 and 2016 increased. Later mandates were added to improve fuel efficiency on vehicles built between 2015 and 2017, while also including some heavy-duty trucks. Additional efficiency standards, set to take effect in 2017, will increase fuel economy to the equivalent of 54.5 miles per gallon (mpg) for cars and light-duty trucks by Model Year 2025.

As more efficient vehicles replace less efficient vehicles, the carbon intensity of the miles traveled by vehicles will continue to drop. This change is expected to play a key role in mitigating GHG emissions, as transportation emissions are responsible for a significant portion of GHG emissions in Denver. Growth and increased use of single-occupancy vehicles can erode these savings without the implementation of additional transportation-related mitigation efforts.

The President’s Climate Action Plan

In June 2013, President Obama announced the Climate Action Plan—a comprehensive national plan to reduce greenhouse gas emissions and lead international efforts to address global climate change. As a result, a number of important programs and policies have since been launched, including a climate task force, new rules and regulations for GHGs, and a shift in acceptance of anthropogenic causes of climate change. Most importantly, the Plan has prompted the EPA to develop the Clean Power Plan, a pathway for states to reduce carbon emissions from electric generation. Announced in 2015, the Clean Power Plan requires existing power plants to lessen their emissions using a variety of strategies, including increasing the proportion of clean, renewable energy in their generation mix.

Global Climate Commitments

There has been significant support for the United States to join the ranks of countries committed to reducing carbon emissions for both the short and long term. In 2014, the world’s two largest economies — China and the United States — made a historic agreement to cut GHG emissions. China pledged to cap its rapidly growing carbon emissions by 2030, or earlier, while the United States pledged to cut emissions 26 – 28 percent below 2005 levels by 2025. The agreement marks a first for the United States by setting a goal beyond the existing 17 percent target by 2020. While this may or may not have direct impacts at the local level, it represents a shift in widespread acknowledgement that the United States has an obligation to reduce its own emissions and be a leader for global action on climate mitigation.



Crosscutting Themes and Alignment with City Priorities and Goals

Many of the strategies to address climate change provide additional benefits to our economy, public health and social safety net. Strategies listed throughout the plan include an icon to highlight the mutual benefits.

Denver will ensure climate equity and environmental justice is prioritized in climate action planning.



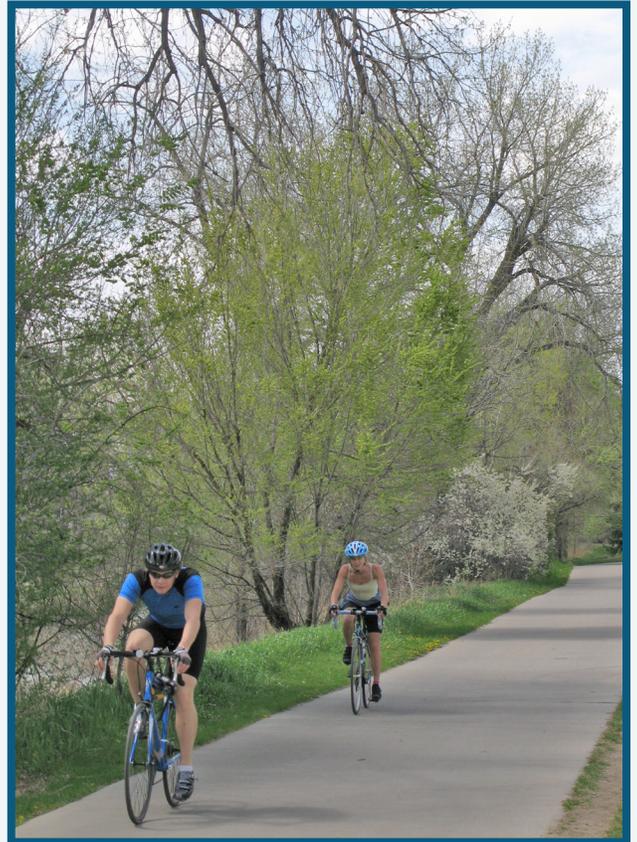
Equity— Climate action needs to be all-inclusive. Denver’s CAP includes many key strategies that not only mitigate GHG emissions, but provide equitable social, economic and health benefits.



Health and Safety— Energy production is a primary source of greenhouse gas emissions. Energy production creates pollutants such as carbon dioxide (CO₂), sulfur dioxide (SO₂), mercury and other air toxics, and surface-level ozone (O₃). By diversifying and increasing the quantity of cleaner, renewable energy sources, Denver can improve public health while ensuring safer and more reliable energy.



Thriving Economy— Many of the key strategies presented in the CAP offer combined opportunities for economic development. Driving greater investment in energy efficiency, renewable energy, and walkable, livable communities will create jobs. Implementing energy conservation measures helps reduce business and residential energy costs which could be re-invested into the local economy.



“TACKLING CLIMATE CHANGE could be the greatest global health opportunity of the 21st century. Many mitigation and adaptation responses to climate change are ‘no-regret’ options, which lead to direct reductions in the burden of ill-health, enhance community resilience, alleviate poverty, and address global inequity.”

The Lancet Commission

www.thelancet.com

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Greenhouse Gas Inventory

Denver evaluates GHG emissions levels and progress made in emissions reduction efforts by conducting annual GHG inventories. The first inventory was conducted in 2005 and measures the three most frequently occurring GHGs — Carbon dioxide (CO₂), methane (CH₄), and nitrogen oxides (NO_x)—attributable to the following:

- Residents and businesses within the City and County of Denver, referred to as “Denver” or “the community.”
- The City and County of Denver government, referred to as “the City.”
- The Denver International Airport (for 2000, 2005, and later) and the Stapleton International Airport (for 1990), both of which are referred to as “Airport” or “Denver’s Airport” or DEN unless otherwise specified.

The methodology used to develop Denver’s GHG inventory has been peer reviewed and published in a scientific journal.⁷

Denver’s GHG inventory accounts for emissions from a variety of sources that can be broken down into two distinct categories:

- **“Core”** or direct emissions are those that typically occur within the boundary of the City and/ or are more directly controlled, representing the greatest opportunity to influence.⁸ They include emissions from building energy use, transportation and fuels, street lights, and waste management.
- **“Upstream”** or indirect emissions occur outside the boundary of the City but are demanded by people and businesses in the City, such as refining of fuel, airline jet fuel, cement production, and food packaging and transport.

GHG emissions are reported as total and per capita emissions in units of metric tons of CO₂ equivalent (mt-CO₂e).⁹

Denver’s Complete GHG Inventory

Scope	Sector	Tracking Metric	2013
Core Emissions	Residential	Natural Gas	834 thousand mt-CO ₂ e
		Electricity from Grid	1,179 thousand mt-CO ₂ e
	Commercial & Industrial	Natural Gas	1,198 thousand mt-CO ₂ e
		Electricity from Grid	3,285 thousand mt-CO ₂ e
	Public	Electricity from Grid	42.2 thousand mt-CO ₂ e
	Surface Transportation	Gallons of Gasoline	1,936 thousand mt-CO ₂ e
		Gallons of Diesel	519 thousand mt-CO ₂ e
Waste	Metric Tons of MSW	139 thousand mt-CO ₂ e	
Upstream Emissions	Airline Travel	Gallons of Jet Fuel	856 thousand mt-CO ₂ e
	Fuel Production	Gallons of Fuel	807 thousand mt-CO ₂ e
	Cement	Metric Tons	295 thousand mt-CO ₂ e
	Food	\$ Spent	1,895 thousand mt-CO ₂ e
Total Emissions			12,985 thousand mt-CO ₂ e
Per Capita Emissions			20 thousand mt-CO ₂ e

Table 1. Denver’s 2013 GHG Inventory

Acronyms: greenhouse gas (GHG); metric tons of carbon dioxide (mt-CO₂e).

⁷ Ramaswami, A. et al. 2008. “A Demand-Centered, Hybrid Life-Cycle Methodology for City-Scale Greenhouse Gas Inventories.” Environmental Science & Technology. 42(17).

⁸ Most GHG methodologies include Scope I & II emissions as core emissions even though the Scope II emissions from electricity, gas, steam, and chilled water may occur outside of the City boundary or are not controlled by the municipality.

⁹ The Clean Air Climate Protection Software developed by ICLEI—Local Governments for Sustainability was used to determine GHG emissions from direct end use of energy in cities in the building and transportation sectors noted above. Lifecycle-based approaches, consistent with World Resource Institute protocols, were used to quantify the GHG impacts of using critical urban materials. The methodology for conducting the inventory is documented within Denver’s Environmental Management System.

Denver's 2013 GHG Emissions By Sector in mt-CO₂e

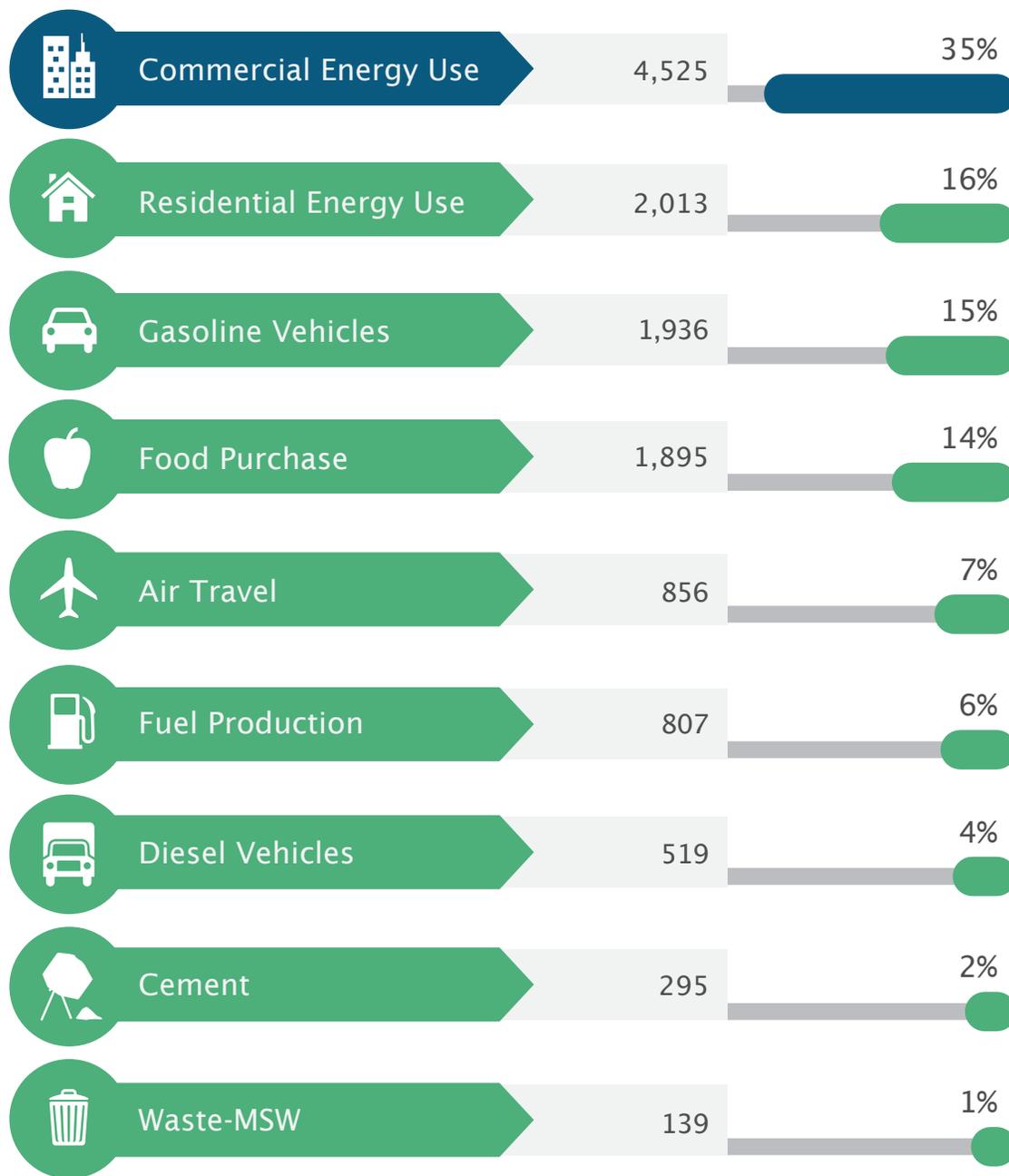


Figure 3. Denver's 2013 GHG inventory, which illustrates relatively large contributions from the building sector. GHG emission equivalent measured in thousands of mt-CO₂e.

Acronyms: greenhouse gas (GHG); metric tons of carbon dioxide equivalent (mt-CO₂e); municipal solid waste (MSW).

Key Findings of the GHG Inventory

Denver’s Community-Wide GHG Emissions Trends: In 2013, Denver’s GHG emissions were below those of 2005, declining from 13.20 million mt-CO₂e in 2005 to 12.985 million mt-CO₂e in 2013. Denver’s emission trends (shown in Figure 4) have followed similar national trends, responding to events such as economic activity, efficiency gains, population, and weather impacts. It is important to note that these reductions have occurred while population and building space have increased significantly during that time.

Comparison of Denver’s 2005–2013 Total GHG Emissions

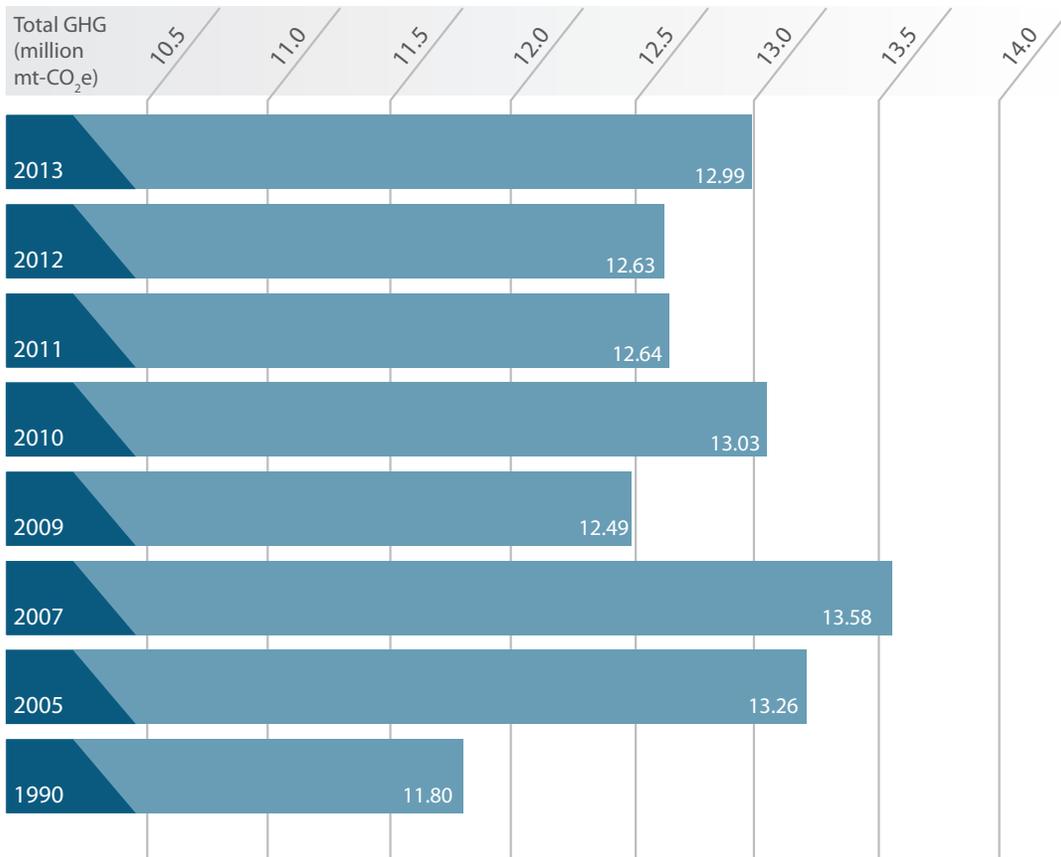


Figure 4. Denver’s total GHG emissions, as measured by inventory process, declined from 13.20 million mt-CO₂e in 2005 to 12.985 million mt-CO₂e in 2013. Note: 1990 emissions were estimated through backcasting based on more limited data than 2005–2013. Denver did not conduct a GHG inventory in 2006 or 2008.

Acronyms: greenhouse gas (GHG); metric tons of carbon dioxide equivalent (mt-CO₂e).

Implications for Reaching Denver’s 2020 Climate Goal: To achieve the 2020 Climate Goal (at or below 1990 emissions levels), Denver will not only have to reduce community emissions by 1.2 million mt-CO₂e (based on 2013 data), but will also have to mitigate the expected increase in emissions from a community that is growing in population and economic activity. Achieving this goal will require significant momentum and implementation of major strategies. Without aggressive action, Denver likely will not meet its 2020 Climate Goal, let alone continue on a downward trajectory. While increased use of less carbon intensive energy sources and the improved 2017 transportation fuel efficiency standards will achieve some gains, much work is still needed to meet the 2020 goal.

Buildings and Energy

As with most major cities, the primary sources of Denver GHG emissions is the building energy sector. Building inefficiency, deferred maintenance, inattention to building performance, and occupants engaging in inefficient behaviors that lead to energy waste, all play key roles in energy emissions.

Locally, emissions related to the built environment have decreased due to cleaner fuels, such as natural gas and renewable energy sources like wind and solar. This reduction is largely attributed to two critical pieces of state legislation: the Clean Air, Clean Jobs Act (CACJA) and the Renewable Portfolio Standard (RPS). However, it is important to note future growth will increase energy demands, which is why effective policies and programs are needed to curb emissions in this sector. Most importantly, the buildings constructed today will be around for decades to come — maximizing the efficiency potential of these buildings will help lessen future energy demands.

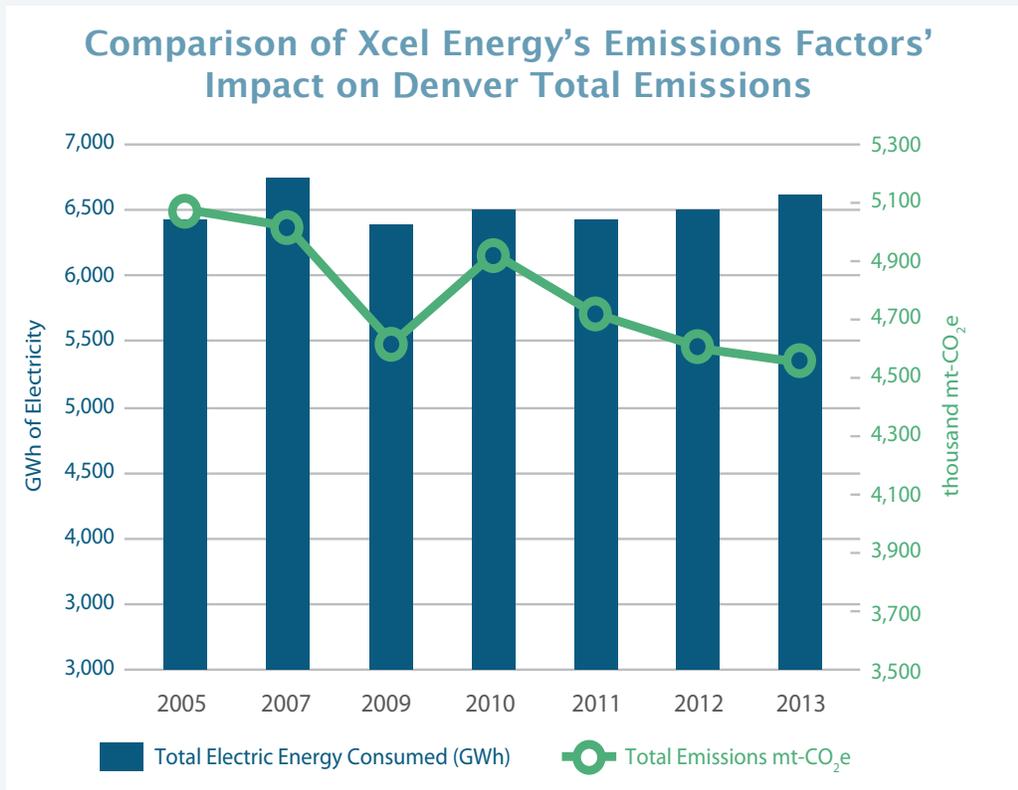


Figure 5. RPS and CACJA impact on emissions factor and resultant overall emissions from the built environment. Denver did not conduct a GHG inventory in 2006 or 2008. **Acronyms:** gigawatt-hour (GWh); metric tons of carbon dioxide equivalent (mt-CO₂e); Clean Air, Clean Jobs Act (CACJA); Renewable Portfolio Standard (RPS).

- **Renewable Portfolio Standard (RPS):** Colorado became the first state to create a RPS by ballot initiative when voters approved Amendment 37 in November 2004. In 2010, additional legislation increased the RPS to 30 percent by 2020 for investor owned utilities and created a requirement that 3 percent of all electric sales must come from renewable distributed generation by 2020. As a result, the emissions factor, or carbon content of electricity, has declined 13.2 percent from 1,748 pounds per megawatt-hour in 2005 to 1,516 pounds per megawatt-hour in 2013.
- **Clean Air, Clean Jobs Act (CACJA):** In late 2010, the Colorado Public Utilities Commission approved an emissions-reduction plan for Xcel Energy under the state's CACJA. The plan calls for Xcel Energy to retire or repower 900 megawatts (MW) of coal-fired electrical generation capacity with cleaner-burning natural gas, renewable energy, or other lower-emitting resources.
- **Community-Based Energy Efficiency Programs:** As a result of the American Recovery and Reinvestment Act of 2009, and through funding for Energy Efficiency Community Block Grants, Denver initiated community programs to reduce energy use in homes and businesses. While federal funding has ceased, these programs, in addition to other community-based energy efficiency initiatives through utility demand-side management (DSM) and nonprofit partners, have led to greater efficiencies in new and existing homes and a greater market for energy efficiency products.

Denver Building Sector Emissions (thousand mt-CO₂e)

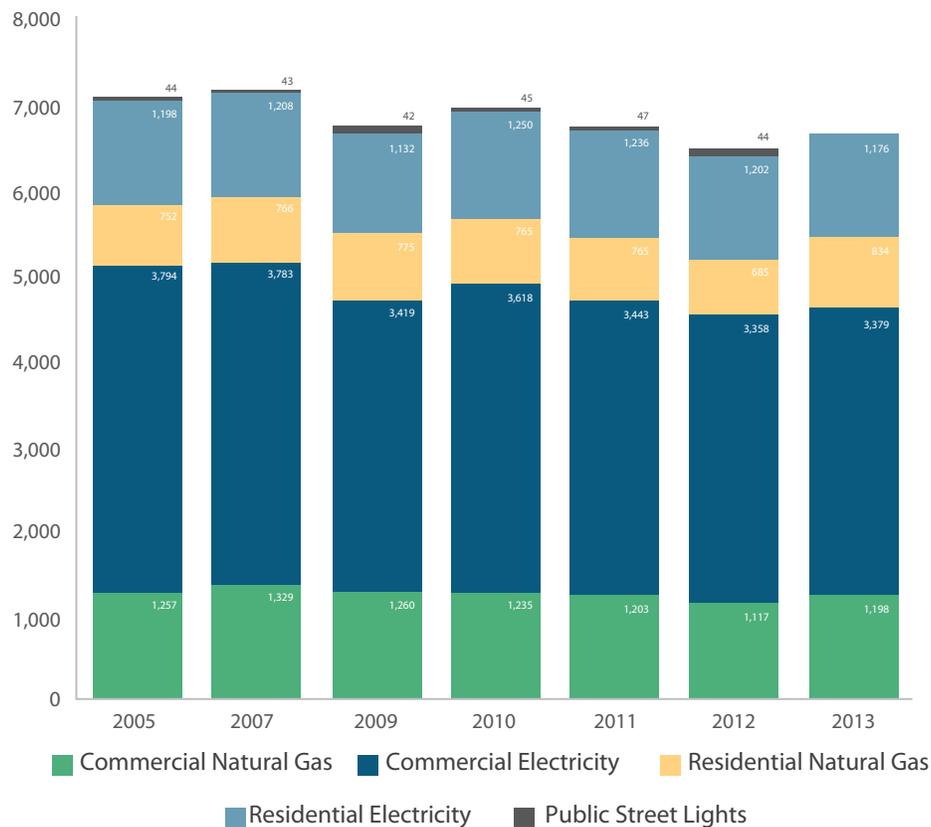


Figure 6. Overall, emissions from the building sector have decreased from 2005, largely as a result of lower emissions per kilowatt-hour consumed. Note: In 2013, Xcel Energy combined public street lights into the commercial sector. Denver did not conduct a GHG inventory in 2006 or 2008.

Acronyms: metric tons of carbon dioxide equivalent (mt-CO₂e).

Land Use and Transportation

Second only to buildings and energy, the land-use and transportation sector emits the next greatest amount of GHGs for Denver. The majority of this sector's GHG emissions result from tailpipe emissions from vehicles, of which a large portion can be attributed to single-occupant motorized vehicle use. Since 2005, GHG emissions resulting from gasoline-powered vehicles, which comprise over half of the emissions in the land-use and transportation sector, have decreased 5.1 percent in Denver. Increases in the fuel efficiency of light-duty vehicles, in large part due to increased CAFE standards, have effectively reduced emissions from transportation. To a lesser degree, but still noteworthy, the Denver Metro Clean Cities Coalition reported that the region experienced an increase in the use of hybrid, plug-in electric, and electric vehicles by nearly 700 percent from 134 vehicles in 2007 to 929 vehicles in 2014. Additionally, improvements and integration of transportation and land-use planning strategies such as transit-oriented development (TOD) reduced the single-occupancy vehicle miles traveled by residents.

Since 2005, **GHG EMISSIONS** resulting from gasoline-powered vehicles, which comprise over half of the emissions in the land-use and transportation sector, **HAVE DECREASED 5.1 percent** in Denver.

Promoting alternative modes of transportation such as biking, walking, and transit use, also helped to reduce overall transportation emissions. Denver and the greater metropolitan region have several programs and strategies that decrease reliance on single-occupant vehicles as a primary mode of transportation, such as FasTracks, bike sharing and bike lanes, ridesharing, and EcoPasses.

Denver Transportation Sector Emissions (thousand mt-CO₂e)

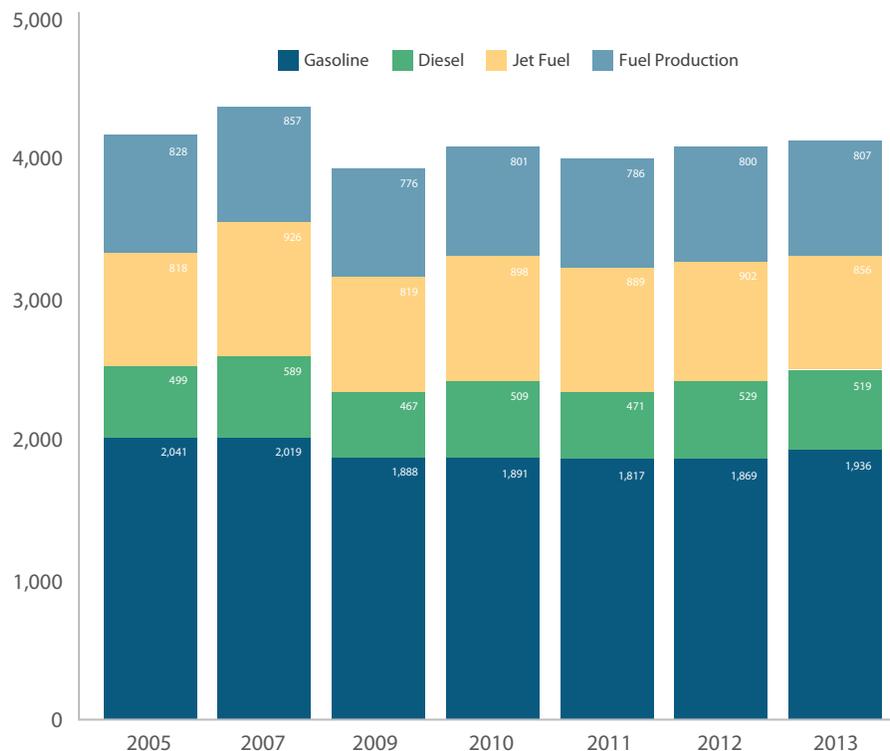


Figure 7. Emissions in the transportation sector can fluctuate due to gasoline prices and other economic conditions. However, general improvements in vehicle fuel efficiency, as well as advances in alternative fuel and electric vehicles, have decreased emissions.

Acronyms: metric tons of carbon dioxide equivalent (mt-CO₂e).

- **Efficient Vehicles:** From 2007 to 2010, national light-duty vehicle fuel efficiency for new vehicles increased from 22.9 mpg to 23.5 mpg. Additional increases in fuel efficiency, set to take effect in 2017, have also contributed to the gradual increase in interim new model vehicle efficiency as car manufacturers prepare their fleets to meet the new standards.
- **Transit-Oriented Development (TOD):** TOD is an important aspect of the Regional Transportation District (RTD) mass transit system throughout the Denver metro area. The expansion of bus, light rail, and commuter rail has allowed for TOD around train and bus stations. National studies have indicated that compact growth can reduce vehicle miles traveled by 20 to 40 percent per capita with GHG emissions reductions averaging 7 to 10 percent by 2050.¹⁰
- **Denver B-Cycle:** In April 2010, Denver launched Denver B-Cycle, a bike-sharing program that allows anyone with a credit card to access bikes for short commutes and errands.
- **Area Navigation at Denver International Airport:** Due to the continued growth of aviation, Area Navigation (RNAV) is a part of the Federal Aviation Administration's NextGen program to manage increased air traffic efficiently. RNAV is a method of navigation that allows more flexibility in takeoffs and landings to reduce jet fuel consumption. RNAV results in a more direct flight pattern and reducing fuel consumption during ascent and descent, when the most fuel is used. It is estimated an average of 200 to 800 pounds of jet fuel is saved per flight, or for a major airline, the savings at Denver International Airport (DEN) could be more than 20,000 mt-CO₂e annually.¹¹

¹⁰ Ewing, et al. 2008. "Growing Cooler: The Evidence on Urban Development and Climate Change." Urban Land Institute.

¹¹ Denver International Airport. June 20, 2014. "Denver's Blue Skies Turn Green with New Departure and Arrival Procedures." Available at http://www.flydenver.com/sites/default/files/downloads/DIAPR_130620e.pdf.

Waste and Consumption

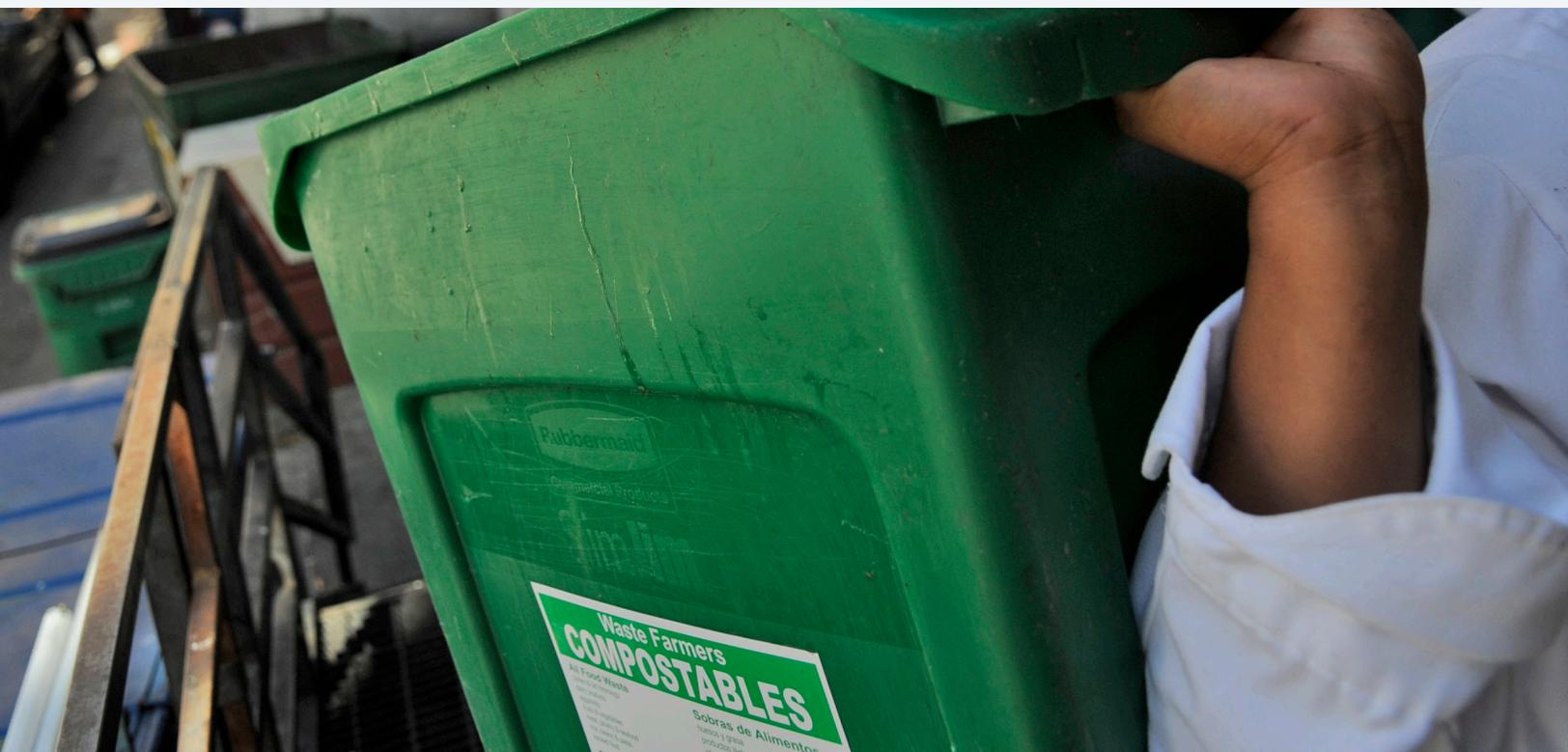
The waste and consumption sector includes municipal solid waste (MSW), as well as the production of key materials used within the City, such as fuel, cement, and food. While GHG emissions from MSW make up just 1 percent of total emissions, these emissions decreased 23.6 percent from 2005 to 2012. MSW emissions are primarily a result of methane emissions from organic waste in the landfill.

In 2008, Denver joined Waste Management and Xcel Energy in opening the Landfill Gas-to-Energy Plant (LGTEP) at the Denver Arapahoe Disposal Site. The LGTEP converts methane to electricity which is incorporated into Xcel Energy's power grid. This greatly reduced MSW emissions from methane at the landfill. In addition, Denver Public Works' (DPW) 2010 Solid Waste Master Plan aims to reduce landfill waste by 30 percent from a 2004 baseline, reducing the associated methane and emissions from transporting the waste. Although full implementation of the plan is ongoing, initial impacts from expanded recycling and composting programs are likely contributors to the reductions.

- **3.2-MW Landfill Gas-to-Energy Plant:** The landfill gas-to-energy plant generates enough energy to power the equivalent of 3,000 homes annually. To put this number in perspective, there were approximately 298,864 housing units in Denver in 2014.¹²
- **Solid Waste Master Plan:** Through the Solid Waste Master Plan, Denver's recycling program has expanded to include Denver Public Schools and many of Denver's parks. In 2008, Denver launched a pilot composting program that has since been expanded to include approximately 9,000 homes.
- **Environmentally-Preferred Purchasing:** Implemented in 2008, Denver's Environmentally-preferred purchasing policy is intended to ensure a more environmentally sound way of sourcing materials. Over the last 5 years, the average annual percentage of environmentally-preferred master purchase orders and one-time bids has increased to an average of 32 percent, with a high in 2010 of 46 percent.¹³

¹² <http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk>

¹³ Denver EMS internal tracking documents.



Urban Natural Resources

Although not a specific metric in the GHG inventory, urban natural resources play an important role in the overall carbon cycle. Urban natural resources typically include trees, vegetation, and green space, which reduce the amount of GHGs in the atmosphere through carbon sequestration. Urban natural resources also contribute to, and improve the livability and quality of life in our city.

Denver has a strong reputation as a tree-friendly city and was recognized by the Arbor Day Foundation in 2013 as one of the top 10 U.S. cities for urban forests. While there is no specific data from the inventory on urban natural resources, the increase in vegetation provides additional and long-lasting carbon sequestration capabilities within the urban landscape, in addition to cooling efficiencies that mitigate more than 175,000 mt-CO₂e.¹⁴

- **Mile High Million Program:** In 2006, Denver adopted a goal of working with other communities in the region to plant a million trees in the metropolitan area by 2025. Through this program, 250,000 trees were planted in the metro area. This offers multiple climate adaptation and mitigation benefits, such as increased shade and cooling, while also engaging the public in natural resource stewardship. With the help of the Mile High Million Program, the City of Denver's urban tree canopy reached 19.7 percent, surpassing the larger metro Denver's urban tree canopy average of 16.4 percent. The program is still in operation, but the goal has changed from a simple count of new plantings to strategic management of the existing canopy of more than two million trees.
- **Green Infrastructure:** DPW and some private developers utilize green infrastructure as a tool to promote efficient and natural stormwater infiltration, while promoting air quality, water quality, and carbon reduction and sequestration. Green roofs, rain gardens, and bioswales are all examples of green infrastructure. Green roofs help filter runoff and requires less concrete conveyances, thereby minimizing the urban heat island effect and lessening the amount of energy required to cool nearby residential and commercial dwellings.

The emissions associated with **FOOD CONSUMPTION** increased by 16 percent between 2005 and 2013, likely as a result of population increases, and associated food purchase increases.

Food and Agriculture

GHG emissions related to food are calculated as a factor of the amount of money spent on food in the Denver area. Because most emissions related to food occur outside the Denver area (agricultural-related emissions, extended distance transportation by petroleum-fueled vehicle emissions, etc.), food is considered an upstream emission. That is, the majority of emissions are not a result of direct activity in the Denver area. The emissions associated with food consumption increased by 16 percent between 2005 and 2013, likely as a result of population increases, and associated food purchase increases.



¹⁴ McPherson, G. et al. 2013. "Metro Denver Urban Forest Assessment." Available at http://www.denvergov.org/Portals/747/documents/forestry/Denver_FinalReport.pdf.

Denver's Climate Goals

Most climate experts agree the next 25 years are critical for realizing deep reductions in GHG emissions to stave off the most severe impacts of climate change. The IPCC states that in order to limit temperature increases to 2 degrees Celsius in this century, GHG emissions must be reduced 40 percent to 70 percent from 2010 levels globally by 2050, and emissions levels need to be near zero by 2100.¹⁵ Recognizing the importance of protecting our climate and our residents, Denver established a goal for reducing GHG emissions by 2020. Specifically, Denver set a goal to reduce its community-wide emissions to 1990 levels, which is 11.8 million mt-CO₂e, despite anticipated growth in our population. For more than a decade, the Department of Environmental Health (DEH) has been the lead agency for identifying, monitoring, and creating programs to reduce GHG emissions that contribute to climate change.

In 2007, Denver released its first CAP, which identified the largest sources of GHG emissions — commercial and home energy use, transportation, and materials production. Since then, DEH has been working collaboratively on programs and initiatives designed to achieve the plan's short- and long-term goals for a healthier City and planet. Through these efforts and those of partners, Denver is on a slow downward trajectory toward the 2020 Climate Goal. However, much work is needed to maintain the strategies that are in place and advance bold new strategies that will put us on a path to meet the 2020 goal and significantly reduce emissions by 2050.

Setting a Long-Term Goal

When Denver signed on to the Mayors' National Climate Action Agenda in early 2015, the City committed to setting an aggressive long-term GHG reduction target for the first time. Leading scientific climate organizations have indicated the necessity for taking bold actions to hold global average temperature rise at 2 degrees Celsius to prevent catastrophic impacts of climate change in the mid-to-late century. Leading cities, states, and nations have set long-term GHG emissions reduction goals of as much as 80 percent by 2050. In alignment with the leading scientific analysis, Denver has set a long-term goal to reduce **GHG emissions 80 percent by 2050**. **Denver will continue to produce and release its annual GHG inventory to report on progress. Denver's CAP is a living document that will continually be updated with new climate science, strategies, policies, and programs.**

“CLIMATE CHANGE threatens our health, economy, environment and our quality of life. We have a responsibility to act and there is no greater urgency than now to be part of the solution.”

- *Denver Mayor*
MICHAEL B. HANCOCK

The Mayors' National Climate Action Agenda

- 1 Calling for binding emission reductions at the U.S. federal level, as well as a global emission reductions agreement.
- 2 Engaging in and supporting activities leading up to and during the 2015 negotiations in Paris to support the Obama Administration and other parties to create a global agreement.
- 3 Establishing and regularly reporting annually or bi-annually a municipal and community-wide GHG inventory (preferably with third-party verification), while supporting standardization of municipal and community-wide inventories and reporting.
- 4 Establishing, or renewing, an existing aggressive GHG emissions reduction target for both the near term (i.e., by 2020 or sooner) and long term (e.g., 80 percent reductions by 2050).
- 5 Developing, or updating, a community climate action plan, which identifies specific strategies for meeting the emissions reduction target, as well as tying mitigation with adaptation measures where possible.
- 6 Exploring how each city can participate—including how to overcome barriers—in an offset project(s) as part of an existing or future protocol established by the Climate Action Reserve via the California (or other) existing system.
- 7 Ensuring climate equity and environmental justice is prioritized in climate action plans.

Figure 9. In line with national and international recommendations, Denver has signed on to the Mayors' National Climate Action Agenda (MNCAA), which recommends setting both medium- and long-term goals. MNCAA was initiated to build on work from the President's Climate Task Force, as well as through a number of other initiatives, including the C40 Cities Climate Leadership Group, the U.S. Conference of Mayors, and the Urban Sustainability Directors Network. This Climate Action Plan will help set the stage for identifying policies and strategies needed to meet Denver's long-term goal.

¹⁵ Intergovernmental Panel on Climate Change. 2014. "Summary for Policymakers." In: Climate Change 2014, Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlomer, C. von Stechow, T. Zwickel, and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, New York, USA.

Taking Action: Denver's Climate Goal

Identifying Climate Action Strategies

In order to focus on the climate action strategies with the most impact by 2020, Denver conducted a thorough analysis of the City's emissions by sector. Those sectors with the highest emissions were given the highest priority.

A collaborative process involving multiple City agencies, the Office of Sustainability, the Sustainability Advisory Council (SAC), and external consultants allowed Denver to identify short-, medium-, and long-term strategies and to estimate potential GHG emissions reductions by strategy.¹⁶ Denver also hosted two community meetings and a meeting for local nonprofits. In particular, the Denver SAC sub-committee for Air, Climate & Energy played an integral part in prioritizing strategies. The sub-committee and SAC identified the building and transportation sectors as priority areas in need of big and bold climate action strategies.

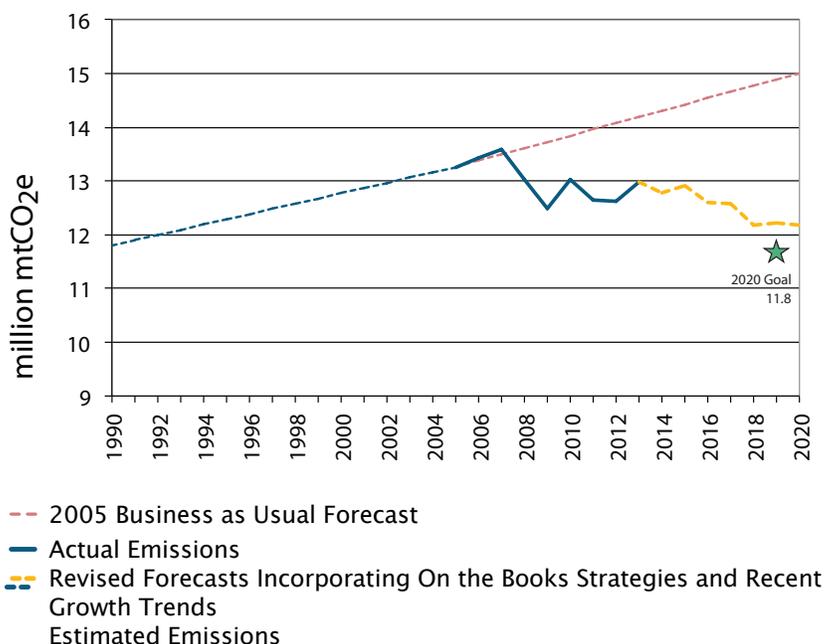
Strategies that will produce significant reductions by 2020 were quantified and prioritized in this plan. Many innovative and high impact strategies were identified that will not deliver significant reductions until after 2020. Those strategies are included in Appendix A and will be further quantified and prioritized as part of the stakeholder engagement process to identify needed strategies to meet Denver's long term goal of an 80 percent reduction by 2050. This process will begin in 2016.

Denver reviewed over 350 strategies, activities, and best practices from more than 30 cities globally. The strategies below are necessary for the city to meet its 2020 Climate Goal. They are prioritized for impact and feasibility prior to 2020.

Denver will pursue the following strategies in order to meet the 2020 Climate Goal of reducing emissions to 11.8 million mt-CO₂e.

¹⁶ The Office of Sustainability Advisory Council is a committee of residents, appointed by the Mayor, who assist the Office in promoting the City's sustainability goals.

GHG Trends 1990–2013 and Forecast to 2020



Since 2009, Denver has conducted annual inventories to closely monitor changes in emissions from year to year. Additional inventories were done in 2005 and 2007. Using the original 2005 inventory and historical data from circa 1990, Denver estimated emissions from 1990 through 2004 as well as a Business as Usual forecast through 2020. Denver is proud of its track record in conducting annual inventories, which allows for long-term trajectory analysis and forecasts. As Denver implements new strategies and analyzes growth, the forecast is adjusted. From the graph to the left, it is evident that Denver has made improvements from 2007, its highest levels. However, as this most recent forecast indicates, Denver could miss its 2020 goal without significant reductions. The strategies that follow are imperative for Denver to meet the 2020 goal.

Comparison of Denver's Emissions and IPCC Long Term Targets

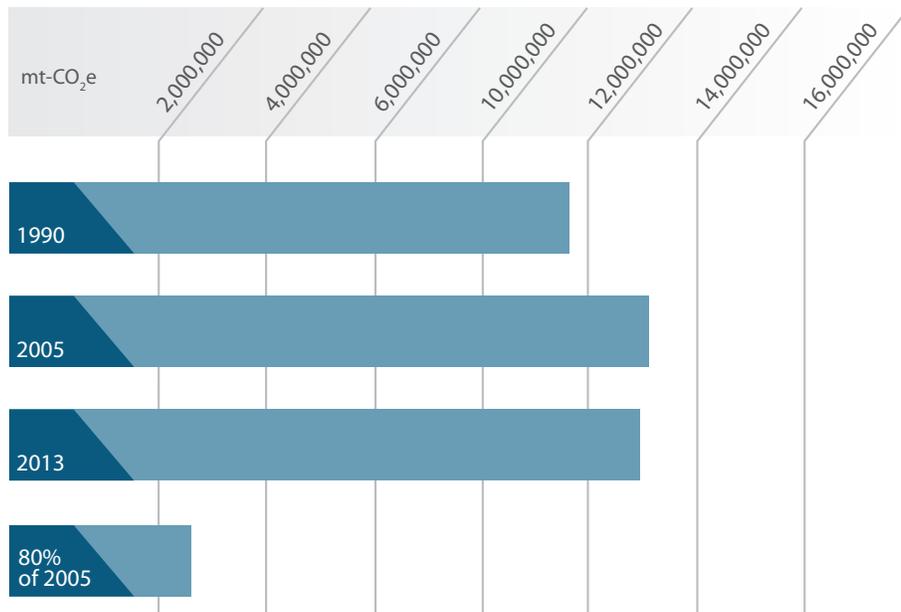


Figure 10. A comparison of baseline emissions (1990 and 2005) and the needed reductions to meet Denver's goal for 2050.

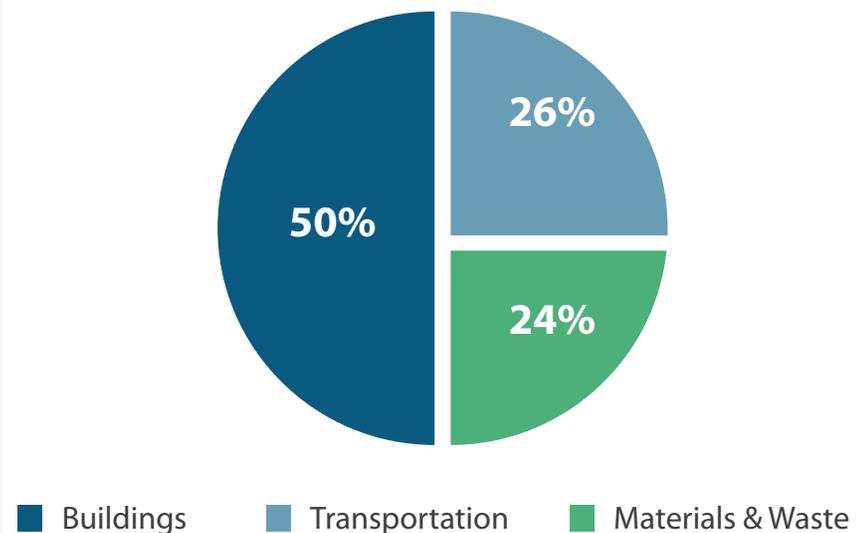
Acronyms: Intergovernmental Panel on Climate Change (IPCC); metric tons of carbon dioxide equivalent (mt-CO₂e).

Priority Strategies

Buildings and Energy

Building energy use is Denver's largest GHG-emitting sector, accounting for nearly 51 percent of total emissions in 2013 (nearing 64 percent of core emissions), or 6.6 million mt-CO₂e. A proportional goal for the buildings and energy sector would require more than 500,000 mt-CO₂e to be reduced in that sector by 2020.¹⁷ However, given the large potential for reductions in both the demand and supply sides of the built environment (detailed below), there is ample room for an aggressive yet achievable goal of 800,000 mt-CO₂e through 2030. Moreover, Denver ranked 10th compared to other leading cities in the 2015 American Council for an Energy-Efficient Economy City Energy Efficiency Scorecard, which shows significant opportunity for improvement within the buildings sector. Specifically, Denver's lack of (1) updated energy efficiency codes and compliance and (2) required building benchmarking, audit, and/or retrofit/recommissioning are areas where Denver missed major points in the Scorecard.¹⁸ Denver can meet its building and energy sector goals by implementing building energy efficiency measures and supply-side reductions through investing in low- or no-carbon fuel sources.

2013 GHG Emissions by Sector



¹⁷ Based on the 2012 GHG Inventory.

¹⁸ Denver is in the process of updating to the 2015 standard – adoption is expected in fall of 2015.

Buildings and Energy (continued)

Overall emission reductions will rely on strategies within the buildings and energy sector that focus on large-scale, long-term solutions to:

- Realize energy savings in existing buildings;
- Set standards for new building construction and major renovations;
- Anticipate growth in commercial property in the City;
- Increase the number of people per square foot that buildings serve; and
- Incorporate more renewable energy sources, such as solar and wind, into our energy mix.

Demand-Side Strategies: Given technological advances in energy efficiency, some estimates point to the potential of a 40 to 60 percent reduction in residential and commercial building energy use based on known technology.¹⁹ Coupled with supply side impacts that are projected to reduce the amount of carbon emitted per kilowatt-hour of energy used, the built environment could easily account for more reductions than just its current percentage of contributions. This is the single most important sector for emissions reductions. Energy efficiency is also the most cost effective energy resource available to Denver.²⁰ Balancing this potential is the fact that a thriving economy typically consists of new development, low vacancy rates in commercial properties, and increasing productivity—all of which can drive up energy demand unless effectively managed. As Denver continues to grow its economy, it is critical to increase efficiency in new and renovated buildings that accommodate growth. In addition, the introduction of medical and recreation marijuana industries, which require significant energy demands, will also create the potential for large growth in the building energy consumption.

Increased energy efficiency can lower the total amount of energy consumed, which in turn would decrease energy demand and result in fewer GHG emissions.

Examples of energy efficiency measures range from benchmarking energy use, to changing occupant behaviors, and upgrading building envelopes and systems. These efforts will be supported through the adoption of the 2015 International Energy Conservation Code.

Supply Side Strategies²¹: Along with increasing energy efficiency, incorporating more renewable energy sources into Denver's energy portfolio will aid in reducing GHG emissions. In addition, Denver has a goal to decrease fossil fuel consumption by at least half of the total consumed for buildings, mobility, and industrial processes by 2020. Using low- or no-carbon emitting energy sources will allow Denver to reduce GHG emissions and reach its 2020 reduction goal, even as population increases, and continue to decrease emissions beyond 2020.



RENEWABLE ELECTRICITY GENERATION from technologies that are commercially available today, in combination with a more flexible electric system, is more than adequate to supply 80 percent of total U.S. electricity generation in 2050 while meeting electricity demand on an hourly basis in every region of the country.

National Renewable Energy Laboratory, Renewable Electricity Futures Study.

¹⁹ American Council for an Energy-Efficient Economy. 2012. "The Long Term Energy Efficiency Potential: What the Evidence Suggests."

²⁰ American Council for an Energy-Efficient Economy. 2014. "The Best Value for America's Energy Dollar: A National Review of the Cost of Utility Energy Efficiency Programs."

²¹ For a more detailed analysis of supply side impacts, reference the upcoming Energy Plan.

Strategies to Meet 2020 Climate Goal

Strategy	Lead Agency	Total Estimated Reduction by 2020 Unless Otherwise Noted	Overall Impact (compared to all strategies)	Sector Impact (compared to sector strategies)	Additional Impacts*
Implement energy-efficient building strategies	DEH, DGS, and some state and federal	300,000–1,500,000 mt-CO ₂ e ²²	High	High	 
Adopt the IECC version 2015 and provide training and resources necessary to ensure code compliance	DS, DEH	40,000 mt-CO ₂ e	Medium	Medium	
Maintain the Renewable Portfolio Standard	DEH, DGS, DPW, and other agencies provide input and analysis to support continued implementation	Both strategies could account for more than 1 million mt-CO ₂ e by 2030 ²³	High	High	 
Maintain Clean Air, Clean Jobs Act			High	High	 
Partner with Xcel Energy to rapidly attain a lower emissions factor for electricity through system efficiencies, additional renewable energy projects, and low- or no-carbon sources	Multiple	200,000–400,000 mt-CO ₂ e	Medium	High	
Improve City building energy efficiency (includes audits, retrocommissioning, and lighting upgrades of municipal buildings)	DGS	100,000–200,000 mt-CO ₂ e ²⁴	Low ²⁵	Medium ²⁶	
Expand community-based energy efficiency programs (both City-led and DSM)	DEH, DOSP	~175,000 mt-CO ₂ e annually ²⁷	Medium–Low	Medium	 
Beyond code programs	CPD, DEH	A 30% reduction in the energy use of new buildings could amount to annual savings of 175,000 mt-CO ₂ e in avoided emissions from new buildings and reduction of emissions in existing building space that is updated ²⁸	Medium	High	

Acronyms: Department of Environmental Health (DEH); Denver General Services (DGS); International Energy Conservation Code (IECC); Development Services (DS); Demand-Side Management (DSM); Department of Public Works (DPW); Denver Office of Strategic Partnerships (DOSP); Community Planning and Development (CPD); metric tons of carbon dioxide equivalent (mt-CO₂e).



Health



Social Equity



Economic

²² Reductions by 2020 would likely fall at the smaller end of this scale with more savings realized through 2030.

²³ Both of these strategies are “on the books” and built into our current projections. Therefore, the estimated reduction cannot be added to the sum of needed reductions to meet the 2020 goal.

²⁴ As part of the Better Buildings Challenge, Denver has committed to reduce the energy use in its portfolio by 20 percent.

²⁵ City building energy use accounts for roughly 2 percent of the total energy used in all commercial buildings in Denver.

²⁶ The City has a long history of leading by example and has provided ample case studies of how incorporating energy efficiency into its buildings helps the bottom line, in addition to saving energy.

²⁷ Based on Xcel Energy’s 2014 Demand-Side Management Plan: Electric and Natural Gas, Public Service Company of Colorado, Docket No. 13A-0773EG, Revised May 2014. Assuming Denver’s participation is 50 percent of territory-wide energy savings. Historically, Denver’s DSM participation is proportionally higher than its consumption compared to the territory. In 2013, Denver’s DSM participation was close to 70 percent of total DSM savings.

²⁸ U.S. Department of Energy. 2011. “Going Beyond Code: A Guide to Creating Effective Green Building Programs for Energy Efficient and Sustainable Communities.” Available at <https://www.energycodes.gov/sites/default/files/documents/GoingBeyondCode.pdf>.

Strategy Descriptions

- **Implement Energy-Efficient Building Strategies:** Denver can achieve widespread adoption of energy efficiency through market-driven incentives, removal of barriers, and policy improvements. These strategies have immediate potential impacts for 2020, and the programs will also have lasting impacts up to and beyond 2050. Denver aims to implement a broad suite of energy-efficient building strategies, such that more buildings pursue the most cost-effective and fundamental energy efficiency work, including benchmarking, retrocommissioning, energy audits, lighting upgrades, and sub-metering of tenants.

Denver can meet the 2020 Climate Goal if 90 percent of commercial and multi-family buildings pursue benchmarking and provide transparency for the resulting benchmarking scores. In addition, the least efficient buildings must take further action to improve their energy efficiency by pursuing strategies such as retrocommissioning, energy audits, lighting upgrades, and sub-metering of tenants. Figure 11 shows how these strategies would help Denver meet its 2020 Climate Goal and decrease energy consumption well into the future.

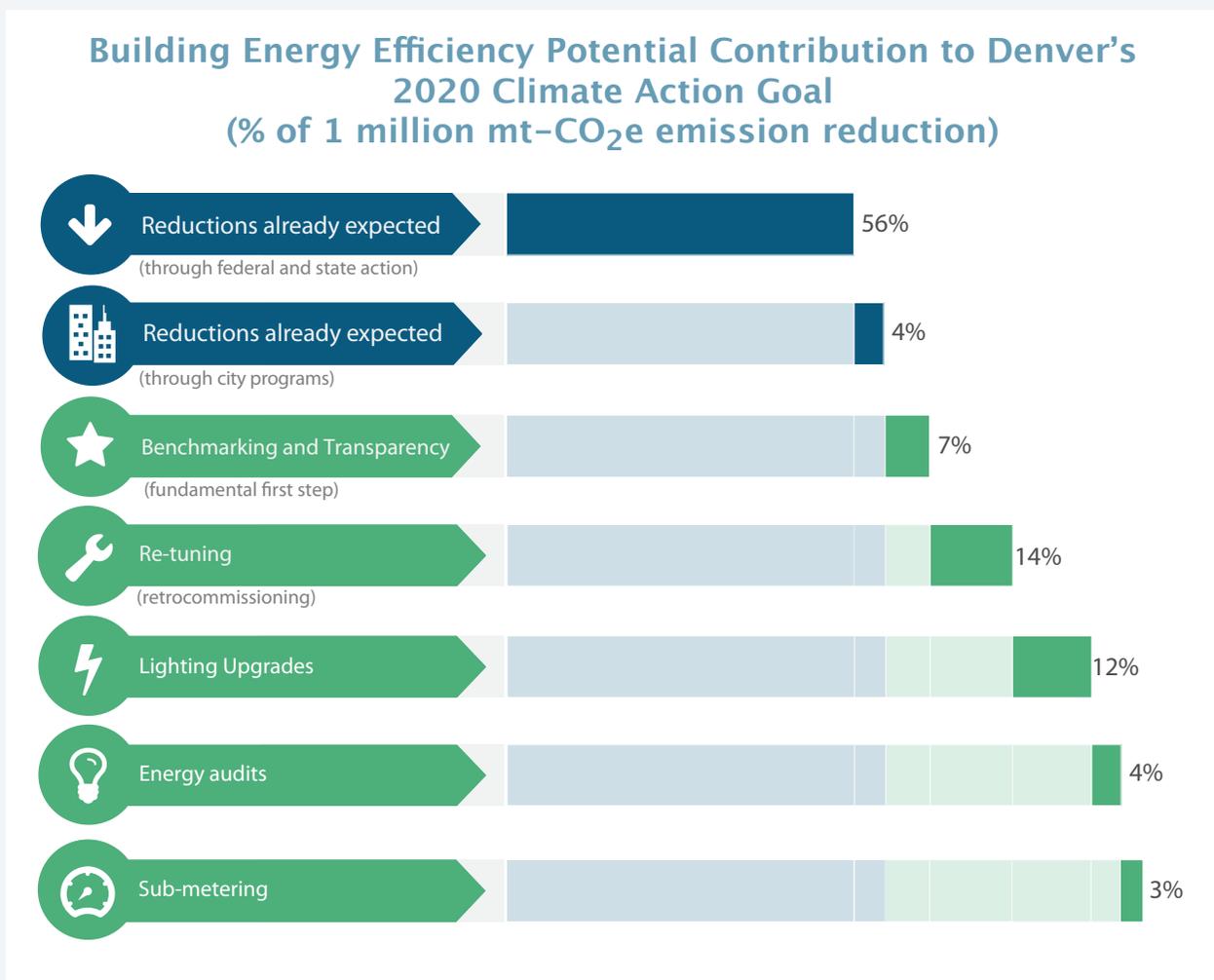


Figure 11. Federal and state actions are projected to mitigate a large percentage of emissions through less carbon-intensive energy and fuels. The remaining percentage must be met with local action that addresses building sector efficiencies—an area where cities typically have a large amount of influence.
Acronyms: metric tons of carbon dioxide equivalent (mt-CO₂e)

Strategy Descriptions

- **Maintain the Renewable Portfolio Standard (RPS):** Colorado became the first U.S. state to create a RPS by ballot initiative when voters approved Amendment 37 in November 2004. Recent efforts in Colorado and other states have been made to roll back RPS; in some states (e.g., Ohio, Indiana, and Florida), these efforts have been successful. In Denver, RPS is the single most impactful emissions-reduction strategy to date.

Requirements for Investor-Owned Utilities

Colorado's RPS requires each investor-owned utility to provide specific percentages of renewable energy and/or recycled energy according to the following schedule:

- 12 percent of its retail electricity sales in Colorado for 2011–2014;
- 20 percent of its retail electricity sales in Colorado for 2015–2019; and
- 30 percent of its retail electricity sales in Colorado for 2020 and each year thereafter.

Denver will participate in the stakeholder process at the state for the development of the Clean Power Plan to ensure renewable standards for Xcel remain aggressive. This process will begin in 2015 and continue until 2018 or beyond. Denver will also continue its engagement in dockets at the Public Utilities Commission to ensure the regulatory process reflects the city's desire for increased renewables.

- **Maintain Clean Air, Clean Jobs Act (CACJA):** In late 2010, the Colorado Public Utilities Commission approved an emissions-reduction plan for Xcel Energy under the state's CACJA. The plan calls for Xcel Energy to accomplish the following by 2017:

- Retire 593 MW of coal-fired power generation;
- Replace retired coal-fired generation with a new, cleaner 569-MW natural gas plant;
- Switch additional units from using coal to natural gas; and
- Reduce emissions from 951 MW of coal-fired generation through modern emissions controls.

Denver will continue to advocate for the transition to cleaner fuels while keeping an eye toward the long-term benefits and potential opportunities offered by carbon-free sources.

- **Improve Municipal Building Energy Efficiency:** The City's 2020 energy goal and Better Buildings Challenge aims to reduce energy use in municipal buildings by 20 percent and double the amount powered by renewable energy. The City has also committed to publicly disclose the energy consumption of its largest buildings as part of the Denver City Energy Project.²⁹ Systematic auditing and a retrofit program that leverages utility rebates and other incentives will identify and partially fund needed energy efficiency improvements. With these strategies, Denver will complete its evaluation and meet the 20 percent municipal reduction target by 2020. However, municipal buildings and operations contribute less than 3 percent of the community-wide emissions. While these efforts will have an impact, they do not have a major impact on overall community emissions unless they can be leveraged to influence private actions.

**COLORADO
BECAME THE
FIRST U.S.
STATE** to create
a RPS by ballot
initiative when
voters approved
Amendment 37 in
November 2004.

²⁹ City and County of Denver. "Denver City Energy Project: Unlocking the Value of Building Efficiency." Available at www.denvergov.org/cep.



- **Expand Community-Based Energy Efficiency Programs:**

- **Certifiably Green Denver:** Certifiably Green Denver provides free, confidential, non-regulatory environmental assistance to Denver's business community. The program helps businesses find opportunities to improve efficiency and profitability while minimizing environmental liability through pollution prevention.
- **Denver Energy Challenge:** The Denver Energy Challenge offers free residential energy advising and energy loans for energy improvements.
- **Energy Efficiency Assistance for Qualified Homes and Nonprofit Energy Efficiency Program:** The Denver Office of Strategic Partnerships (DOSP) offers energy efficiency services to qualified homes and nonprofits. Either as a stand-alone project or in partnership with other state and federal programs, these efforts are focused on providing services at low or no cost to low-income residents and nonprofits.

While individual program impacts may be minor in comparison to sector emissions, collectively and when compounded with utility DSM programs and overall market impacts, these programs are vital in the shift toward a more efficient residential building stock. Denver will remain engaged and supportive of existing community energy efficiency programs and identify continued funding mechanisms for improved impact. In addition, the City will advocate for more robust DSM and renewable programs that address social equity and economic development.

- **Beyond Code Programs:** Examples of beyond code programs that exceed traditional minimum building codes include the International Residential Code; International Building Code; International Mechanical Code; International Energy Conservation Code (IECC); and the standards produced by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers, among others. Beyond code and green building programs regulate or encourage sustainability through siting, site development measures, water and energy conservation and efficiency, materials and resource efficiency, and indoor environmental quality. When Denver finalizes its update of the 2015 IECC, the Office of Sustainability, DEH, and Community Planning and Development (CPD) will explore the creation of a beyond code program.



Land Use and Transportation

Land use and transportation choices are significant contributors to Denver's GHG emissions, making up 32 percent, or approximately 4.3 million mt-CO₂e. A proportional goal for transportation would be roughly a 320,000 mt-CO₂e reduction in this sector.

Both surface transportation emissions—such as those from cars, sports utility vehicles, commercial trucks, and RTD vehicles—and airline emissions from DEN contribute to Denver's total land-use and transportation emissions. Moreover, the transportation sector is highly complex and managed by a combination of local, state, and federal requirements. Denver, as part of the larger RTD and Denver Regional Council of Governments, does not have sole discretion over most of the transportation decisions.

Released by DPW in 2008, [Denver's Strategic Transportation Plan \(STP\)](#) emphasizes the need to "move people rather than cars." In order to do this, the City must provide convenient, comfortable and affordable mobility options that encourage residents to choose modes of transportation with a lower GHG footprint—such as mass transit, carpooling, bicycling, and walking—more frequently. Mode of transportation matters when it comes to GHG emissions. Single-occupancy motorized vehicle travel is the most inefficient mode of transportation, and Denver has set a 2020 mobility goal to reduce single occupancy vehicle commuting travel in Denver to no more than 60 percent of all trips. Land-use planning is also a critical component of reducing single-occupant vehicle travel. Housing developments in urban centers with amenities such as employment, grocery stores, shopping, recreational opportunities, bike paths, and mass transit stations in close proximity will encourage the use of modes of transportation that allow residents to accomplish everyday tasks more efficiently. Coordinated land-use and transportation planning will be necessary to reach our 2020 Climate Goal and continue to decrease GHG emissions in the long term.

Denver's Strategic Transportation Plan emphasizes the need to **"MOVE PEOPLE RATHER THAN CARS."**



Strategies to Meet 2020 Climate Goal

Strategy	Lead Agency	Total Estimated Reduction by 2020 Unless Otherwise Noted	Overall Impact (compared to all strategies)	Sector Impact (compared to sector strategies)	Additional Impacts*
Support multi-modal RTD options	Multiple	66,000 mt-CO ₂ e (based on initial studies prior to FasTracks' P3 implementation)	Medium	High	  
Implement Strategic Transportation Plan and complete streets	DPW	30,000 mt-CO ₂ e–60,000 mt-CO ₂ e depending on synergistic impact of dual programs	Medium	High	
Promote TOD	CPD		Medium	High	
Additional electric vehicle infrastructure	DEH, DPW	40,000 mt-CO ₂ e	Medium	High	
Car sharing	DPW	< 10,000 mt-CO ₂ e	Low	Low	 
Low-carbon fuels	DEH	Dependent on the type of fuel and fuel displaced	Low-Medium	Medium	
Continued support of federal CAFE standards		If maintained, CAFE standards will reduce emissions from vehicles in Denver by 100,000 mt-CO ₂ e–175,000 mt-CO ₂ e	High	High	 
Develop community-wide Eco Pass Program feasibility study		None, but the study could provide more detailed analysis of scenario impacts			
Blueprint Denver	CPD	No specific reductions from Blueprint, yet critical when considering TOD and other transportation and development plans	TBD	High	

 Health
  Social Equity
  Economic

Acronyms: Regional Transportation District (RTD); Department of Public Works (DPW); Transit-Oriented Development (TOD); Community Planning and Development (CPD); Denver Environmental Health (DEH); Corporate Average Fuel Economy (CAFE); To Be Determined (TBD); metric tons of carbon dioxide equivalent (mt-CO₂e).

Strategy Descriptions

- **Support Multi-Modal Regional Transportation District (RTD) Build-Out:** Started in 2004, the RTD FasTracks Program was a multi-billion dollar comprehensive transit expansion plan to build 122 miles of new commuter rail and light rail, 18 miles of bus rapid transit, 21,000 new parking spaces at light rail and bus stations, and enhanced bus service for easy, convenient bus/rail connections across the eight-county district. Continued cooperation and support for similar multi-modal programs will ensure alternatives to single-occupancy vehicle travel are viable and affordable. In addition, CPD has prepared plans for 21 of the 41 stations that leverage the transit investment by calling for more extensive nearby mixed-use development. CPD should implement the land-use plan elements and encourage partnerships and infrastructure investments that achieve the plan's goals.
- **Strategic Transportation Plan (STP) and Complete Streets:** The STP is a multi-modal transportation plan initiated by the DPW, with support from other city agencies and interested stakeholders, to understand and address the current and future transportation needs of the City. The STP addresses “moving people” rather than simply measuring the number of vehicle miles travelled. DPW and partner agencies are updating the STP in 2015–16 and should maximize the potential to decrease single-occupancy commuter trips. The STP also serves as a unique and innovative approach to identifying future system needs and community values, and it provides a method to incorporate them into future transportation decisions and solutions. This update also provides an opportunity to leverage innovative concepts such as the Rocky Mountain Institute’s Mobility Transformation, where the needs of commuters and transporters are met with fewer vehicles. Planning for options that maximize convenient transit options that work in harmony with other City plans, such as transit signal priority, and increasing pedestrian and bike plans, will be a priority.
- **Transit-Oriented Development (TOD):** Successful TOD is attractive, walkable, and sustainable. It allows Denver residents to have fair housing; ample transportation choices; and the ability to live convenient, affordable, and enjoyable lives. The City expects to complete the urban centers and most of the 41 TOD stations by 2018. These urban centers are co-located where 50 percent of Denver’s new housing will be built. Additionally, the City released its TOD Strategic Plan in 2014, which focuses its development around transit stations. Implementation of the TOD plan is critical in meeting both the TOD strategic plan goals and climate goals.

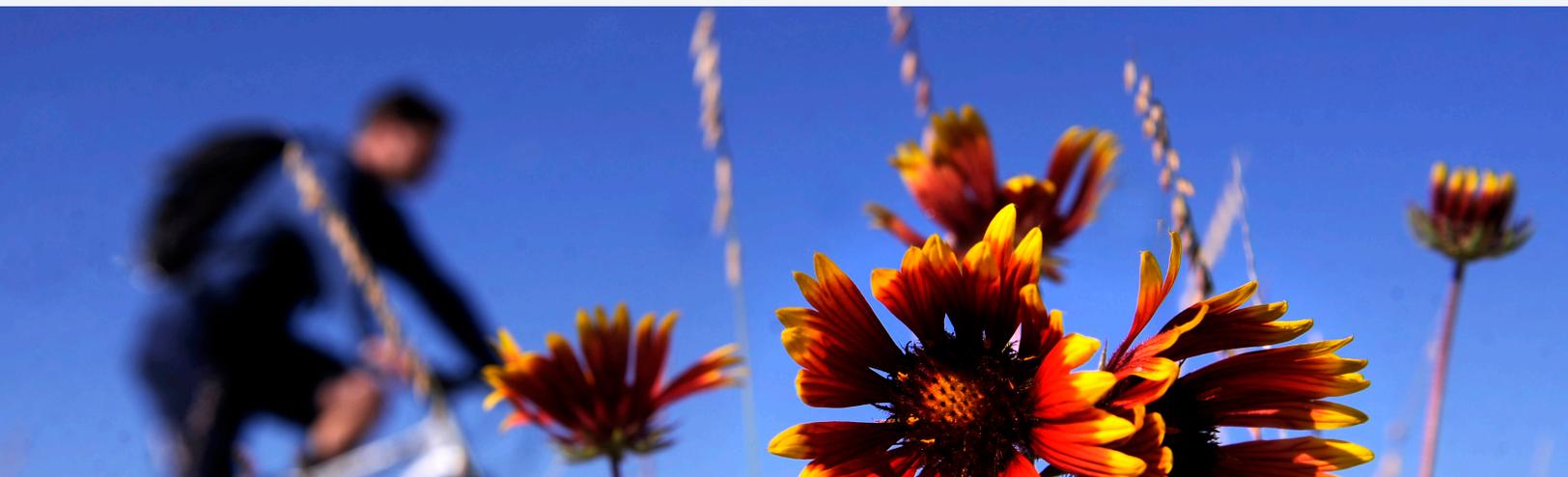


Strategy Descriptions (continued)

- **Electric Vehicle Infrastructure:** Currently, Denver has 12 electric vehicle charging stations located in the downtown urban center and Cherry Creek to attract near-zero emission vehicles to expand low or no carbon commuter options. Continued expansion and availability of electric vehicle infrastructure should be considered in building codes, project developments, and planning efforts. Likewise, appropriate expansion of alternative fuel vehicles, such as hydrogen fuel cell vehicles, should also be considered.
- **Car Sharing:** DPW administers a robust on-street car-sharing permit program to reduce parking demand, decrease vehicle miles traveled, and increase mobility options. With car-sharing becoming more popular, continued and expanded partnerships with car-share companies will help make it a more convenient and affordable option for commuting trips and other necessary trips.
- **Community-Wide EcoPass Feasibility Study:** EcoPass is a bulk-rate, deep-discount transit pass that can be purchased from RTD only through employers, universities, or neighborhoods. The EcoPass program offers deeply discounted passes for a specific group of commuters, making alternative commuting a more affordable, flexible option for commuters that increases ridership. Multiple pilot programs have been conducted in smaller communities in the metro area. Denver should conduct a feasibility study on the costs and benefits of providing EcoPasses at various geographic scales.
- **Blueprint Denver:** Released in 2002, [Blueprint Denver](#) is an integrated land-use and transportation plan that calls for a balanced, multi-modal transportation system. The plan was intended to accommodate future growth by identifying “areas of stability” and “areas of change.” Areas of stability are identified as stable residential neighborhoods where no significant changes in land use are expected in the next 20 years. Maintaining the character of these areas and accommodating for some development are the main goals for areas of stability.

Blueprint Denver’s main focus is on areas of change, where the majority of development is taking place, by integrating multi-modal streets with good pedestrian, biking, public transportation access, as well as automobiles. Blueprint Denver also focuses on mixed-use developments when developing areas of change. Mixed-use developments are urban places where residential, commercial, and retail uses are intertwined around town centers, transit centers, and other urban centers to promote the walkability of an area. Focusing on developing neighborhoods with multi-modal streets and mixed-use development makes walking, biking, and taking public transit more accessible and attractive for residents, further reducing the need for a vehicle.

As Blueprint Denver is updated, continued coordination with City agencies is imperative to ensure development supports efforts to achieve Denver’s 2020 Climate Goal.



Waste and Consumption

To significantly reduce GHG emissions associated with the waste and consumption sector, it is essential to reduce the overall demand for new materials and goods. For example, bolstering markets for waste products to be recycled can create economic opportunity and reduce the need to use a new product, decreasing GHG emissions from the manufacturing, transporting, and disposal of the product. In addition to reducing the reliance on virgin material inputs, increasing diversion rates of waste to the landfill through recycling and composting programs will also reduce GHG emissions generated from MSW at the landfill.

Currently, the waste and consumption sector accounts for 9 percent of Denver's GHG emissions, or about 1.1 million mt-CO₂e. In order to achieve our 2020 Climate Goal, about 90,000 mt-CO₂e needs to be mitigated from the waste and consumption sector annually. In the waste and consumption sector, MSW accounts for 1 percent of emissions, cement production accounts for 2 percent, and fuel production accounts for 6 percent.³⁰ For the purposes of this CAP, the only GHG emissions from MSW included are from the end-of-life methane emissions at the landfill and include residential and an apportioned amount of commercial waste.

Accounting for the Full GHG Impacts of Waste and Consumption: Lifecycle Analysis

The consumption and disposal of goods is linked to all other sectors, whether in the form of energy needed to produce a product, transportation fuels to deliver the product, and eventually the disposal of the generated waste.

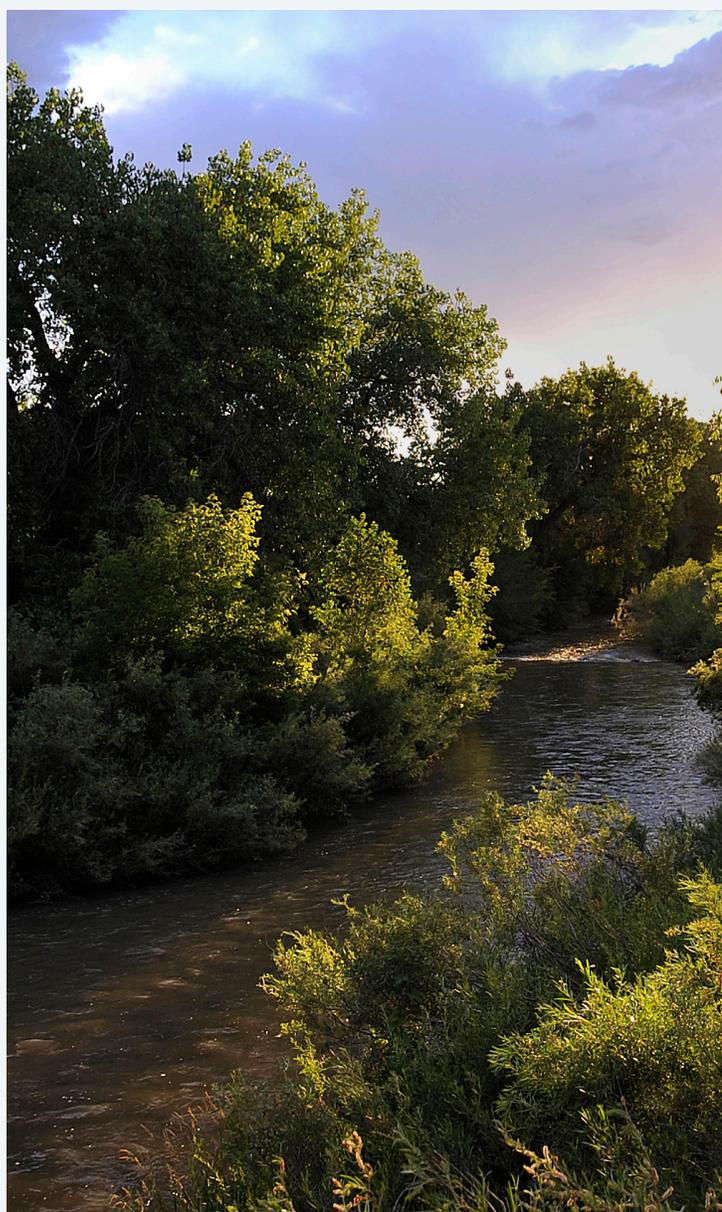
In 2009, the EPA released an alternative approach to measuring GHG emissions in the United States. The new 'materials management' or 'systems-based' approach takes into account the full lifecycle of a good.

The systems-based approach accounts for all of the emissions related to a material—from mining, production, transportation, and consumption all the way to disposal, composting, or recycling. Prior evaluations of the waste from goods only measured the methane emissions from the landfill at the end of a product's life.

When evaluating the impact of consumer goods, keeping recyclables out of the landfill has only a marginal benefit of diversion. The much larger benefit is that the diverted item can be reused or turned into another good, thus reducing the energy and emissions related to the production and transportation of the good. An even greater impact is realized through source reduction, or not even using the material in the first place.

U.S. Environmental Protection Agency. 2009. "Opportunities to Reduce Greenhouse Gas Emissions through Materials and Land Management Practices."

Allaway, D. 2011. "Briefing Paper: Materials Management and Greenhouse Gases."



³⁰ See Greenhouse Gas Inventory section for an explanation of Core and Expanded Emissions.

Strategies to Meet 2020 Climate Goal

Strategy	Lead Agency	Total Estimated Reduction by 2020 Unless Otherwise Noted	Overall Impact (compared to all strategies)	Sector Impact (compared to sector strategies)	Additional Impacts*
Fully implement Solid Waste Master Plan	DPW	22,000 mt-CO ₂ e–198,000 mt-CO ₂ e ³¹	Medium	High	
City environmentally preferred purchasing program	DGS	< 10,000 mt-CO ₂ e; emphasis on City leading by example	Very Low	Low	
SCFD leading by example/education/innovation	Denver Zoo, DMNS	20,000 mt-CO ₂ e	Low	Medium	
DEN 10 percent reduction in landfilled waste goal	DEN	TBD	Low	Medium	



Health



Social Equity



Economic

Acronyms: Denver Public Works (DPW); Denver General Services (DGS); Scientific and Cultural Facilities District (SCFD); Denver Museum of Nature & Science (DMNS); Denver International Airport (DEN); metric tons of carbon dioxide equivalent (mt-CO₂e).

Strategy Descriptions

- **Solid Waste Master Plan:** Denver’s 2010 Master Plan for Managing Solid Waste in the Mile-High City provides a vision for Denver’s future collection, transfer, and disposal of solid waste, recyclables, and organics. The plan also identifies what the Department of Public Works’ Solid Waste Management section needs to achieve Denver’s waste management goal of a 30 percent reduction in landfill tons, using 2004 as the base year (or to reach a 20 percent reduction from a 2012 baseline by 2020).

Components of the Solid Waste Master Plan include:

1. Compost expansion;
2. Standardized refuse collection;
3. Recycling and organics drop-off facilities;
4. Hauler licensing; and
5. Variable rate collection.

While many of the recommendations from Denver’s Solid Waste Master Plan have begun, full implementation of the Solid Waste Master Plan is needed by 2018 in order to maximize impacts prior to 2020.

³¹The amount of carbon reduced will be largely dependent on the composition of the waste reduced. Due to varying emissions factors for the type of material and the manner in which it is eliminated from the waste stream (e.g., composting, recycling, or reductions), there is a range of potential reductions.

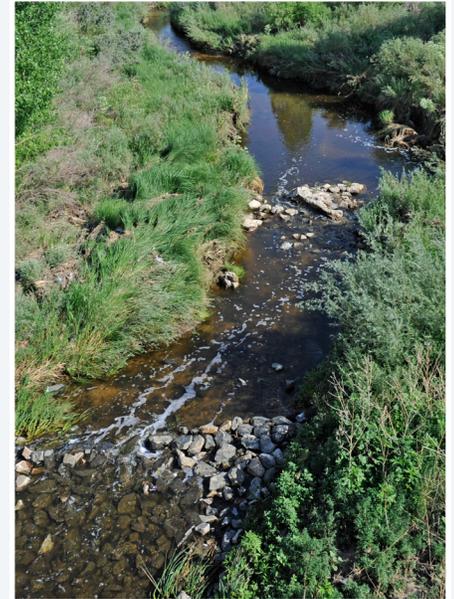
Strategy Descriptions (Continued)

- **City Environmentally Preferred Purchasing Program:** Knowledge of the City's supply chain can inform and determine which supplies are susceptible to disruption or cost increases from inefficient operation or climate change impacts. Moreover, suppliers who have identified and reported their own carbon emissions allow the City to make informed decisions on the complete cost of its purchases. The City should review its supply chain and determine if supply chain management can effectively reduce upstream emissions and disruptions.
- **Scientific and Cultural Facilities District (SCFD) Leading by Example/Education/Innovation:** The Denver Zoo has a goal to become a zero-waste facility by 2025. To help achieve this goal, the Zoo has an extensive recycling program, and a green purchasing policy. The City and SCFD partners should continue to pursue cooperative efforts that provide innovative and educational opportunities for moving toward lower emissions.
- **Denver International Airport (DEN) 10 Percent Reduction in Waste Goal:** DEN is educating business partners on recycling and composting opportunities available at the airport while also adding waste diversion options where they do not currently exist. Food waste composting has been expanded to additional restaurants within the airport. DEN should continue increasing alternative energy use and additional waste diversion strategies to meet the 2020 goal.



Urban Natural Resources

Denver’s urban natural resources include the city’s urban tree canopy, streams that run through the City, and parks and open spaces. Currently, the urban natural resources sector is not directly quantified in the GHG inventory. However, protecting and enhancing these resources can serve as climate mitigation by providing carbon sinks in Denver. Carbon sinks are natural or artificial areas that remove CO₂ from the atmosphere. For example, a larger urban tree canopy can increase the City’s carbon sequestration capacity, mitigating some GHG emissions. According to the 2013 Metro Denver Urban Forest Assessment, Metro Denver’s urban forest mitigates 172,270 tons of CO₂ annually through carbon sequestration and emissions savings from less energy for cooling.³² This represented 1.3 percent of the community’s total emissions. The urban forest currently reduces residential air conditioning demand by 182,000 megawatt-hours.³³ Additionally, incorporating green infrastructure, such as trees and native vegetation, into areas with high impervious surface cover can sequester CO₂ from the atmosphere. This green infrastructure can also mitigate stormwater runoff, improve the water quality in Denver’s streams and water bodies and mitigate the urban heat island effect.



Strategies to Meet 2020 Climate Goal

Strategy	Lead Agency	Total Estimated Reduction by 2020 Unless Otherwise Noted	Overall Impact (compared to all strategies)	Sector Impact (compared to sector strategies)	Additional Impacts*
Tree program/ Composting	DPR	100,000 mt-CO ₂ e–200,000 mt-CO ₂ e ³⁴	Low	Low-Medium	

Health Social Equity Economic

Acronyms: Denver Parks and Recreation (DPR), metric tons of carbon dioxide equivalent (mt-CO₂e).

Strategy Descriptions

- **Tree Program:** Maintain and improve existing tree canopy to retain carbon sequestered in existing trees and provide shading that limits heat islands and resultant excess energy use for cooling.
- **City Compost Cycling:** A City compost cycling program would provide a consistent cycling of compost product provided by Denver’s composting program to large areas of need where additional compostables can be picked up and then delivered to the composting facility. The application of compost to large park areas (e.g., game fields, open space, and general areas) can eliminate the need for most petrochemical-derived fertilizers, increase water infiltration, and create a healthier turf surface. In addition, through coordinated delivery of the compost product, additional compostable materials from the parks (limbs, clippings, soils, sod, etc.) can be picked up for a return trip to the landfill/compost site.

³² McPherson, G. et al. 2013. “Metro Denver Urban Forest Assessment.” Available at http://www.denvergov.org/Portals/747/documents/forestry/Denver_FinalReport.pdf.

³³ Ibid.

³⁴ This number represents carbon sequestered in existing trees in the City of Denver. While Denver does not include land use and land-use change as part of its urban inventory, the loss of the existing canopy would have other impacts, such as increased energy use and decreased walkability.

Tracking Progress

Achieving Denver's Climate Goal

In 2010, Denver became among the first to achieve ISO 14001 Environmental Management System (EMS) certification to evaluate and ensure a continued commitment to reducing GHG emissions. The EMS is a tool used to incorporate environmental considerations into the City's day-to-day operations. With the EMS, climate action strategies are integrated within agencies' existing goals, processes, and plans and analyzed annually. This allows agencies to track implementation and measure the success of the strategies. Through the use of EMS, each agency is held accountable to implement relevant climate action strategies.

Many 2020 or short term strategies are already in the implementation phase as part of City agencies' annual plans. The City will continue to lead by example through its agency actions.

Developing plans to reach Denver's climate goals must be a collaborative process. The stakeholder engagement process that will launch in 2016 will be transparent and action oriented. It will explore all the pathways to meet our goals.



Appendix A

Potential Long-Term Strategies for Consideration

Potential long term strategies are identified below. In total, Denver reviewed over 350 strategies, activities, and best practices from more than 30 cities globally. The selections below represent a distillation of the most robust strategies and best practices relevant to Denver. These, and other strategies, will be analyzed and prioritized for emissions reduction potential, return on investment, and feasibility as part of the stakeholder engagement process. New strategies for analysis may also be added as part of a continuous process of innovation.

Building Strategies

Category	Strategy/Activity	Priority
Building and energy codes	Phase in net-zero energy/carbon-neutral building codes.	High
District energy	Expand the use of district heating and cooling systems and decrease their carbon intensity through combined heat and power and distributed generation.	High
Finance	Develop meter-based financing programs to incentivize long-term efficiency upgrades and/or create incentives for renters.	High
Finance	Encourage and develop innovative financing programs for energy efficiency and onsite renewables (i.e., Property Assessed Clean Energy, revolving loan funds, and bond facilities).	High
Fuel switching	Incentivize switching away from natural gas heating to renewable electricity, geothermal or solar thermal.	High
Grid improvements	Expand high-efficiency transmission lines City-wide to reduce transmission and distribution losses.	High
Renewable energy	Implement shared renewable power purchasing programs.	High
Energy innovation	Support clean energy entrepreneurship and use City facilities for demonstration of new solutions.	Medium
Engagement and incentive programs	Expand advertising and outreach and set targets to increase residential energy efficiency programs in currently underserved communities.	Medium
Engagement and incentive programs	Structure permit fees to incentivize energy efficiency.	Medium
Demand side management	Incentivize use of “smart home” energy management systems.	Medium
Waste heat recapture	Create incentives for waste heat recovery in industrial processes, data centers, and new buildings; investigate waste heat recovery from sewer lines.	Medium

Transportation Strategies

Category	Strategy/Activity	Priority
Efficient and alternative vehicles	Legislate Colorado as a zero-emission state and/or tighten air emission standards.	High
Efficient and alternative vehicles	Incentivize or develop market-based solutions to significantly increase the use of electric vehicles.	High
Efficient and alternative vehicles	Create alternative vehicle incentives (e.g., use of premium or carpool lane) and provide preferred pricing for very-low-emission vehicles.	High
Information and communications technology	Leverage technological advancements to increase ease of use of the full transit system, especially as the mass transit system is improved and supplemented by private sector service (e.g., mobile phone apps and real-time data).	High
Land use	Implement Pedestrian Master Plan and prioritize sidewalk connectivity to transit stops.	High
Land use	Implement Bike Plan.	High
Logistics and traffic management	Decrease emissions from freight and transport through traffic management (including autonomous guidance systems) and alternative fuels for trucks.	High
Mass transit	Enhance local bus stop amenities (shelters and benches)	High
Mass transit	Offer Denver “Last Mile” transit options (e.g., free rides for children and seniors during off-peak hours).	High
Mass transit	Improve regional interconnection (e.g., through advocacy of high-speed rail lines) to reduce emissions from airlines and other high-carbon transport options.	High
Mass transit	Increase bike-carrying capacity on trains and buses.	High
Reduce VMTs	Establish parking regulations and zoning requirements to encourage alternative transportation.	High
Reduce VMTs	Convert more on-street parking to bicycle, pedestrian, and transit lanes.	High
Reduce VMTs	Enhance bicycle infrastructure through cycle tracks and safer riding environments to increase bike trips.	High
Reduce VMTs	Provide safe routes to schools for bicycle and pedestrian students.	High
Efficient and alternative vehicles	Establish local renewable fuel standards and enforce the requirements.	Medium
Efficient and alternative vehicles	Identify alternative fuel sources, such as biofuels from waste streams, and encourage their use and distribution.	Medium
Reduce VMTs	Create pricing and incentive strategies to discourage single-occupancy vehicles, such as congestion pricing, VMT fees, and taxes.	Medium
Reduce VMTs	Decrease per capita car ownership by enhancing rideshare and telecommuting opportunities.	Medium
Reduce VMTs	Expand bike-sharing programs and increase access in more communities.	Medium

Acronyms: vehicle miles traveled (VMT).

Waste and Consumption Strategies

Category	Strategy/Activity	Priority
Lifecycle materials management and extended producer responsibility	Establish producer responsibility and a local take-back program and expand recyclable and compostable products.	High
Recycling and composting	Regulate demolition and construction waste; establish local standards and/or requirements.	High
Lifecycle materials management and extended producer responsibility	Adapt City contracts, procedures, and regulations to incorporate and consider lifecycle emissions from consumption.	High
Lifecycle materials management and extended producer responsibility	Establish a ban on non-recyclable products and requirements for local businesses to reduce waste stream.	Medium
Organic waste management	Expand use of energy from organics, collected waste, and wastewater for use in municipal services (e.g., anaerobic digestion and biogas).	Medium

Urban and Natural Resources Strategies

Category	Strategy/Activity	Priority
Green infrastructure	Use green stormwater infrastructure when designing, building, or upgrading infrastructure.	High
Water conservation	Incentivize rainwater harvesting and conservation practices for residents.	High
Trees and open space	Protect existing tree canopy resources.	High
Trees and open space	Expand open space and green development projects.	Medium

Food Strategies

Category	Strategy/Activity	Priority
Urban farming	Reduce regulatory barriers to urban agriculture and increase acceptable zones for food production.	Medium
Urban farming	Promote development of rooftop gardens (e.g., on large commercial buildings).	Medium



CITY AND COUNTY OF DENVER
CLIMATE ACTION PLAN 2015



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