

City and County of  
**DENVER**

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**80 x 50 Climate Goal:  
Stakeholder Report**

August 2017

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# THE VISION OF THE 80X50 STAKEHOLDERS

- Make Denver a leader in clean and local energy that comes from the sun, wind, or other innovative renewable technologies.
- Transform Denver buildings into high-performing places to live, work, learn and play.
- Inspire community action and ensure environmental justice and equity as Denver transitions to a carbon-free energy system.
- Transform Denver into a community where people walk, bike, take transit, or carpool for most trips in a safe, accessible and affordable transportation network.
- Aggressively transition toward a clean, carbon-free transportation system that improves the health and livability of Denver's communities.
- Become a leader in sustainable, smart transportation through innovative partnerships, policies, programs and technology.



## INTRODUCTION

Climate change is one of the greatest threats facing humanity today. From local impacts such as more hot summer days and severe storms to global impacts like reductions in food supply and sea level rise that would cause geopolitical turmoil, the effects will be felt in Denver and around the world. Future generations will judge us on how well we preserved the habitability of our only home — Earth. Seventy percent of Colorado residents agree that climate change is real and more than half believe that local government officials should do more to both minimize and adapt to its effects.<sup>1</sup>

In late 2015, Mayor Michael B. Hancock renewed Denver's leadership in the effort to prevent the worst effects of climate change by releasing an updated Climate Action Plan. The plan set a long-term greenhouse gas (GHG) reduction goal to reduce emissions 80 percent below 2005 levels by 2050 (80x50) and called for a robust stakeholder engagement process to identify strategies to achieve the goal. This goal builds on 10 years of Denver actively reducing citywide GHG emissions and preparing for climate change. Beginning with the 2007 Climate Action Plan, Denver committed to a GHG reduction goal of 10 percent per capita by 2012, based on 2005 levels. This goal was met, and, as a result, Denver set more aggressive reduction goals through its 2020 Sustainability Goals, Global Covenant of Mayors commitment, Mayor's National Climate Action Agenda and 2015 Climate Action Plan.<sup>2</sup>

Although Denver has made notable progress towards these goals, even more ambitious policies and initiatives will be required to achieve the emission reductions needed to reach 80x50. To that end, Mayor Hancock, tasked Denver's Department of Environmental Health with organizing a stakeholder process to identify the transformational strategies and targets needed to reach the 80x50 goal. Through a robust process, Denver identified individuals with varied expertise, perspectives and backgrounds.

<sup>1</sup> For more information see [Yale Project on Climate Change Communication Report \*Climate Change in the Colorado Mind\*](#)

<sup>2</sup> For more information see [www.denvergov.org/climate](http://www.denvergov.org/climate)





These stakeholders committed to developing an attainable 80x50 plan for Denver by creating a comprehensive list of strategies and targets to meet goal by 2050. In addition, the stakeholders were asked to integrate the strategies and targets into a larger transformative framework made up of six vision statements that set the groundwork and priorities for Denver in the short-, mid- and long-term.<sup>3</sup>

Denver's 80x50 stakeholder process consisted of two key stakeholder groups: the Technical Advisory Committee and the Task Force. Prior to the first stakeholder meeting, Lotus Sustainability and Engineering, LLC prepared a Gap Analysis and survey for the stakeholders to help identify potential areas for discussion.

- The role of the Technical Advisory Committee was to create a broad list of transformative system-based approaches to GHG reductions within the mobile and stationary energy sectors. The group largely drew from academic/non-profit expertise and research institutes related to both sectors. Their outcome was a summary matrix of potential strategies that would achieve the 80x50 GHG reduction goal but not be limited by advanced analysis of economics, feasibility, or other constraints.
- The role of the Task Force was to integrate the summary matrix into a larger transformative framework. The Task Force was tasked with furthering the discussion of the technical, financial, market, regulatory and social factors that impact energy systems into a plan that will meet Denver's target of 80 percent emissions reductions by 2050. Task force members provided insight into opportunities, barriers and "ground truthing" of the Technical Advisory Committee's initial list of strategies. The Task Force also identified preliminary barriers and opportunities of the Technical Advisory Committee's recommendations and categorized strategies into

short-, mid- and long-term. Finally, members ensured that the final list of strategies and targets were equal to or greater than the projected necessary GHG reductions.

- Consultants estimated each strategy's emission reduction potential based on stakeholder input and assumptions. The selected strategies were collectively analyzed for impact and progress towards the 80x50 target/goal. As individual strategies are considered or withdrawn for implementation, a more detailed analysis and additional stakeholder and public input will be needed.
- Stakeholder Report: While this report lists many strategies, targets, and timeframes, it does not imply that there was 100 percent agreement on the prioritization, timeframe for implementation, or feasibility.

As with any stakeholder process, there was a robust discussion and the vision, strategies and analysis presented in this plan will immediately be followed by community outreach conducted by the Department of Environmental Health. The goals of community outreach will be to:

- raise awareness of Denver's climate plans and actions to date
- educate the community on a recommended pathway to 80x50
- provide opportunities for additional input to the strategies
- collect community feedback and input to the stakeholder derived strategies

The vision, strategies and analysis presented in this plan will be followed up by community outreach conducted by the Department of Environmental Health to build community-wide awareness and support for the vision to meet the 80x50 goal.

## Opportunities for Denver

The benefits of climate action for Denver residents are clear and provide significant opportunities to protect public health, encourage economic growth, create and utilize innovative technologies, support environmental justice, and secure a bright and resilient future for all Denver residents for years to come. Denver is already pursuing many successful programs and policies that combat climate change while creating jobs, educating the public and reducing emissions.

As Denver considers how to reduce GHG emissions, its population continues to grow, adding to the complexity of climate change mitigation. Denver's population has doubled since 1960, increased by nearly 25 percent since 2000, and is expected to exceed 700,000 by the end of 2017. The Colorado Department of Local Affairs estimates that Denver's population will continue to grow 1 percent annually until 2050. A growing population uses more energy, travels more and produces more waste. These activities produce more GHG emissions, which in turn degrade air quality, increase urban heat island, contribute to more severe weather events and reduce snowpack.

Denver is not alone in this growth, as cities around the world continue to experience growth and densification. Consequently, it is incumbent upon all cities, including Denver, to reduce their climate impacts to limit the rise in global average temperatures in this century to just 2°C.

From hotter summers to extreme weather events, Denver is already experiencing the impacts of climate change. According to Denver's 2014 Climate Adaptation Plan,

Denver must find ways to prepare, mitigate and plan for the following growing climate impacts:<sup>4</sup>

1. Increased temperatures and urban heat island effects
2. Increased frequency of extreme weather events
3. Reduced snowpack and earlier snowmelt

Per the Rocky Mountain Climate Organization, if worldwide emissions continue to rise at the historical rate, by mid-century Denver will have, in extreme years, 25 days per year of temperatures at or above 100°F, and, by the end of the century, Denver's most extreme year could see 72 days of temperatures at or above 100°F. In comparison with very low global emissions, by mid-century Denver is projected to experience an extreme year of only 10 days of temperatures at or above 100°F and by the end of the century, Denver would have only eight days of temperatures at or above 100°F in extreme years (see Figure 1).<sup>5</sup>

A drastic increase in temperatures would likely double heat-related mortalities by 2050, with low-income, elderly, and children and babies being most at risk.<sup>6</sup> Denver currently ranks third in the nation for the worst heat island effect, with up to a 23°F difference between the city and nearby rural areas.<sup>7</sup> Denver also ranks among the top 10 U.S. metropolitan areas for number of asthma attacks and is the eighth most ozone-polluted city in United States.<sup>8, 9</sup> The resulting adverse effects on the respiratory system are particularly dangerous for children and the elderly.

Higher temperatures may also have a significant impact on water supplies. Denver Water provides residents with water primarily taken from stream flows sourced

<sup>4</sup> For more information, see: [City and County of Denver Climate Adaptation Plan](#)

<sup>5</sup> For more information, see: <http://www.rockymountainclimate.org/extremes/denver.htm>

<sup>6</sup> Source: Climate Central, methodology controlled for elevation and climate of surrounding areas

<sup>7</sup> Source: Climate Central, methodology controlled for elevation and climate of surrounding areas

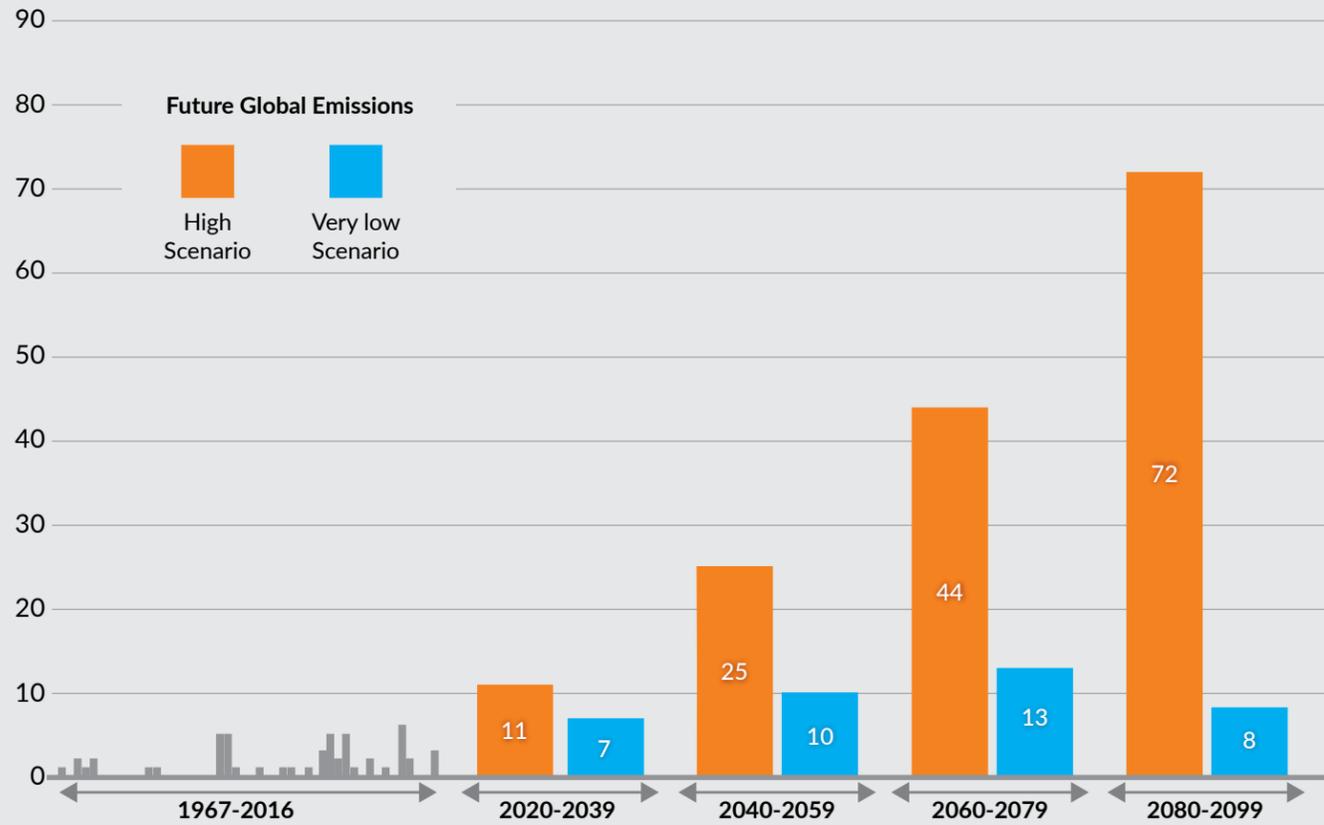
<sup>8</sup> Source: Gasping for Breath report by Clean Air Task Force with CSU researchers

<sup>9</sup> Source: State of the Air 2016 report by American Lung Association

<sup>3</sup> Short-term is defined as present day to 2020, mid-term as 2020-2030 and long-term as 2030 to 2050.



Days 100° or hotter in extreme years  
Projections for the hottest year in each 20-year period



**Figure 1**  
Number of days on average at or above 100 degrees in the hottest individual year in each of the 20-year periods for Denver.

by annual snowmelt. Rising temperatures tend to cause earlier snowmelt in the mountains, which can often lead to diminished water supplies in the summer months when demand is highest. Climate change has already made Colorado more susceptible to extreme weather events such as heat waves, drought, flooding, wildfires, and storms

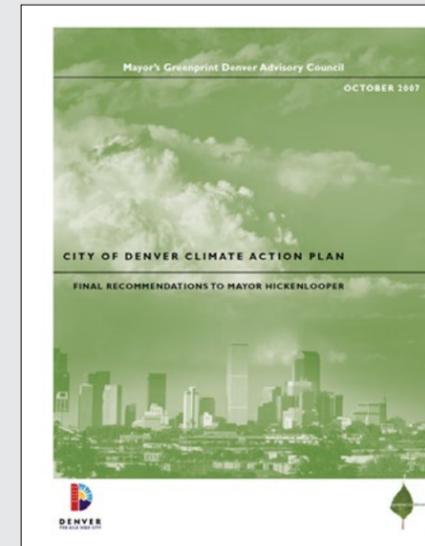
which inflict sizable costs on Denver’s environment, public safety, healthcare and economy.<sup>10</sup> Denver’s 80x50 commitment to puts Denver in a strong position to establish policies, programs, and initiatives that promote economic growth and environmental justice while simultaneously addressing climate change.

<sup>10</sup> For more information, see: [City and County of Denver Climate Adaptation Plan](#)

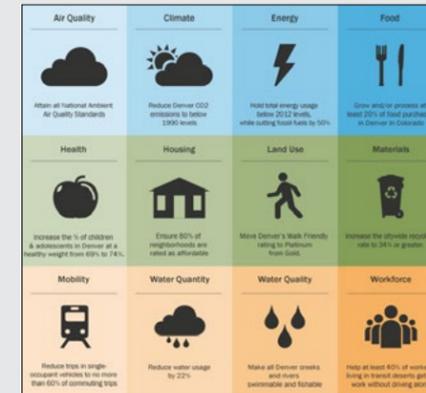
## Building on a Strong Foundation

In 2007, Denver established its first GHG emission reduction goal with the 2007 Climate Action Plan and signed on to the Mayors’ Climate Protection Agreement of the U.S. Conference of Mayors. Since then, Denver has continued to identify aggressive long-term goals with the hopes of drastically reducing Denver’s GHG footprint. These goals are outlined in three plans:

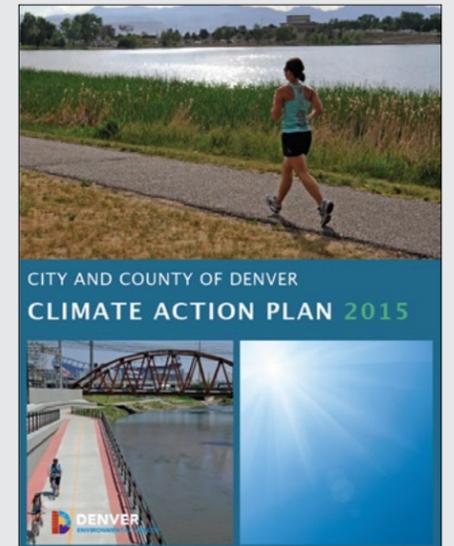
- **The 2007 Climate Action Plan** established a GHG reduction goal of 10 percent per capita for 2012 relative to 2005 values. The plan also laid out numerous other sustainability goals and targets to achieve by 2012.
- **The 2020 Sustainability Goals** plan called for reducing GHG emissions in 2020 to below 1990 levels (11.8 million metric tons of carbon dioxide equivalent (mtCO<sub>2</sub>e)). Consumption reduction targets and improved quality of life metrics were also identified for 12 resource areas including air quality, climate change, energy, food, health, housing, land use, materials, mobility, water quantity and quality, and workforce.
- The revised **2015 Climate Action Plan** updated the 2007 Climate Action Plan and set new GHG reduction goals to reduce emissions by 80 percent below 2005 levels by 2050 (80x50). A reduction of 80 percent requires 10.6 million mtCO<sub>2</sub>e to be reduced with a 2050 value of 2.2 million mtCO<sub>2</sub>e. The 80x50 goal is aligned with the GHG reduction goals of other leading cities nationwide, such as Atlanta, Boston, Minneapolis, New York City, Portland (Oregon) and Salt Lake City.



The 2007 Climate Action Plan



The 2020 Sustainability Goals

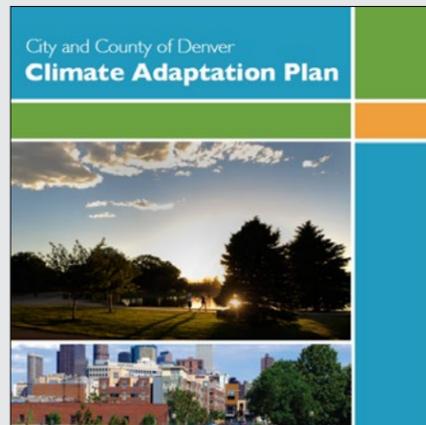


2015 Climate Action Plan

## Building on a Strong Foundation *continued*

This 80x50 plan builds upon existing Denver initiatives and plans and will influence future initiatives and plans, including:

- **Denver's Climate Adaptation Plan:** A plan to prepare Denver for a hotter and more variable climate.
- **Denverright Denver Moves:** A suite of multimodal plans (bicycles, transit, pedestrians and trails) establishing the vision, prioritization, and implementation of reliable, safe and connected transportation options in Denver.
- **Denverright Blueprint Denver:** A plan that sets urban design goals to create a pedestrian- and bike-friendly environment, increase transit service on major corridors, create shared parking in business districts and build more housing in mixed-use areas.
- **Denverright Parks & Recreation Game Plan:** A plan that focuses on providing quality recreational amenities citywide, especially in the neighborhoods that need them most.
- **Denverright Pedestrians & Trails:** A plan to make walking a viable and primary way for people to get around town and access recreational resources comfortably and safely.
- **Energize Denver:** An initiative to reduce the energy consumption in all commercial buildings by 10 percent by 2020 and 20 percent by 2030.



Denver's Climate Adaptation Plan



Denverright



Energize Denver



## MOVING FORWARD

“ Climate change is an issue of global concern that impacts every aspect of our quality of life. We have a responsibility to do everything we can to preserve and protect our children's future, and I believe establishing a long-term goal sets us on the right path. ”

– Mayor Michael B. Hancock

The Stakeholder Report offers a robust set of stakeholder recommended targets and strategies that will aim for an 80 percent reduction in GHG emissions by 2050. Each strategy and target was created and reviewed by a group of stakeholders that generally considered technology limitations, funding constraints, public support, the feasibility of implementation, impacts on environmental justice and other barriers. These recommendations will continue to be evaluated, incorporating changes in technology, economics, regulatory impacts and other considerations. Strategies may be refined over the timeframe of the 80x50 goal.<sup>11</sup>

<sup>11</sup> Note that several of these strategies are from the Mayor's Mobility Group and Energize Denver Plan.





The following lists the stakeholder-recommended 80x50 targets to maintain a vibrant, healthy, and safe Denver for future generations, while improving the quality of life for those who live here today. The statements below represent the discussion of the stakeholders to identify a progression

of targets needed to help measure progress towards the 80x50 goal. The targets will continue to be refined and clarified as associated implementation activities occur. Unless specifically noted, the targets refer to the community of Denver as a whole.

#### By 2020

- Reduce commercial building energy use by 10 percent

#### By 2030

- Reduce commercial building energy use by 20 percent
- 100 percent of Denver's electricity will come from renewable energy
- 9 percent of Denver's commuters will carpool
- 8 percent of Denver's commuters will bike to work
- 9 percent of Denver's commuters will walk to work
- 16 percent of Denver's commuters will use public transit
- 7 percent of Denver's commuters will telecommute
- Power Electric Vehicles with 100 percent renewable energy

#### By 2035

- All new buildings in Denver will be net-zero

#### By 2050

- 70 percent of Denver's households and businesses will participate in smartgrid/smart appliance programs
- 90 percent of Denver's existing buildings will complete energy-efficiency improvements
- 50 percent of Denver's tenants will participate in a green lease program
- 50 percent of heating fuel derived from fossil-fuels (natural gas and propane) will be switched to a low-carbon fuel source and/or electric heat
- 18 percent of Denver's commuters will bike to work
- 15 percent of Denver's commuters will walk to work
- 18 percent of Denver's commuters will use public transit
- 100 percent of public transportation will be carbon free
- 80 percent of light-duty vehicles will be electric
- 100 percent of Denver's light- and heavy-duty vehicles will be electric or fueled by carbon-free fuel
- 100 percent taxis and of transportation network companies' cars will be electric
- 75 percent of freight trucks will be carbon-free

### The stakeholders created six vision statements of what needs to happen for Denver to meet the 80x50 goal:

- Make Denver a leader in clean and local energy that comes from the sun, wind, or other innovative renewable technologies.
- Transform buildings into high-performing places to live, work, learn and play.
- Inspire community action and ensure environmental justice and equity as Denver transitions to a carbon-free energy system.
- Transform Denver into a community where people walk, bike, take transit, or carpool for most trips in a safe, accessible and affordable transportation network.
- Aggressively transition toward a clean, carbon-free transportation system that improves the health and livability of Denver's communities.
- Become a leader in sustainable, smart transportation through innovative partnerships, policies, programs and technology.



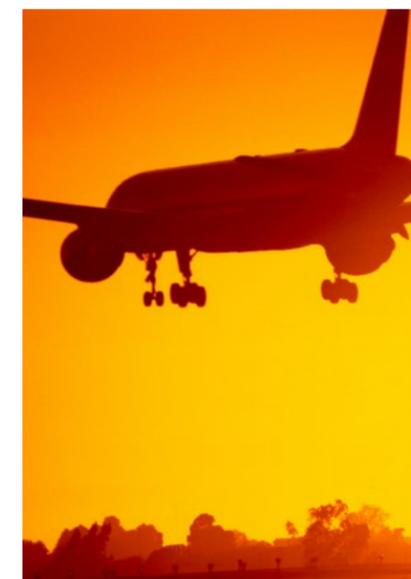
## DENVER'S GREENHOUSE GAS INVENTORIES

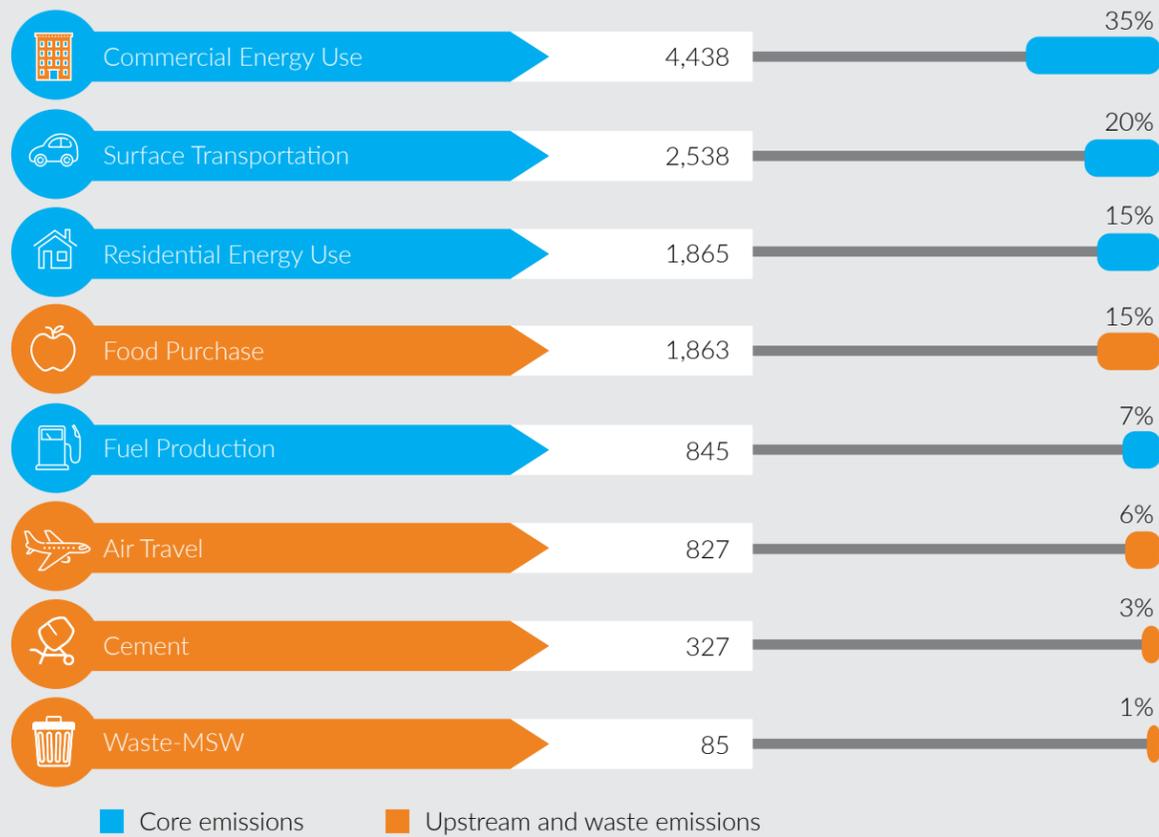
Since 2005, Denver has performed nine GHG emission inventories. Eight inventories were completed using a city-scale demand-centered hybrid life-cycle methodology that included key urban consumption-based activities such as cement use, water treatment, food purchases, and transportation fuels, and incorporates spatial allocations of ground and airline transport. The ninth, and most recent, GHG inventory is using the Global Protocol for Community-Scale (GPC) GHG Emission Inventories methodology and will also include consumption-based activities.<sup>12</sup> Denver's inventory focuses on the three most frequently occurring GHG's – carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), and nitrogen oxide (N<sub>2</sub>O). The sources can be broken down into two distinct categories:

- “Core” or direct emissions are those that typically occur within a city's boundary and/or are more directly controlled by the city, representing the greatest opportunity to influence reductions. They include emissions from building energy use, transportation and fuels, street lights and waste management.
- “Upstream” or indirect emissions occur outside the city's boundary 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.

The stakeholder report looks at strategies designed to reduce core emissions from residential, commercial and industrial building energy use; vehicular surface travel; and fuel production (excluding jet fuel). This study does not include waste, which makes up less than 0.7 percent of Denver's overall projected emissions in 2015. Throughout the remainder of this report, waste will not be included as part of the “core” emissions. Denver's “core” GHG emissions make up approximately 76 percent of Denver's total GHG footprint (see Figure 2).

<sup>12</sup> Note that Denver is in the process of finalizing its ninth GHG inventory.





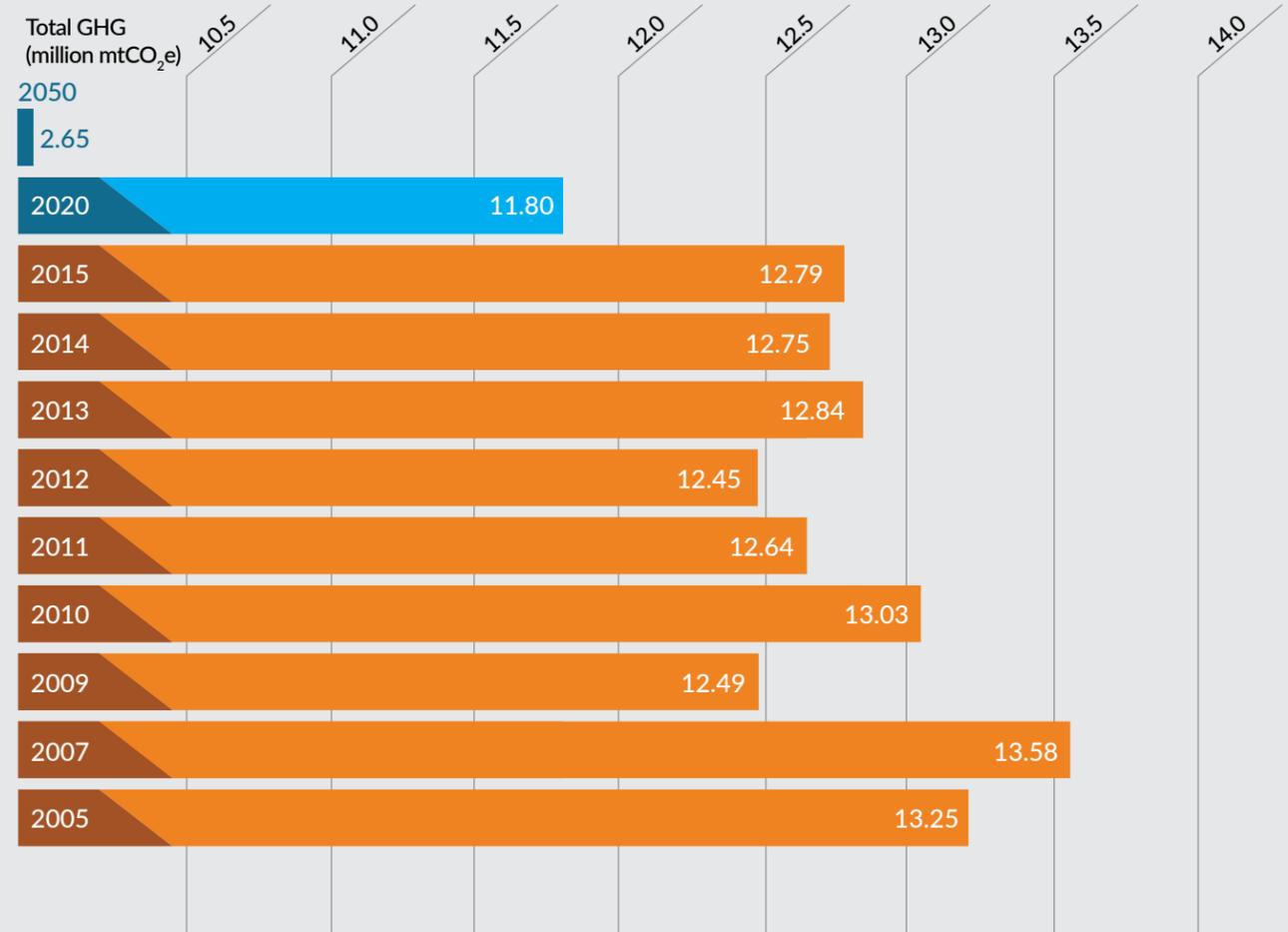
**Figure 2**

Denver's 2015 GHG emissions in thousand mtCO<sub>2</sub>e (numbers may not add up to 100 percent due to rounding)

The Stakeholder Report does not include strategies to reduce GHG emissions from key urban materials, food, waste, and air travel (including jet fuel production), which make up 24 percent of Denver's total GHG footprint. Without reducing GHG emissions in these sectors, in addition to stationary and mobile emissions Denver is very unlikely to reach its goals; however, Denver has decided to focus its

attention on the sectors where its policies and programs are most likely to have the greatest influence, which will ultimately indirectly reduce emissions associated with upstream emissions.

A review of past GHG inventories shows that Denver's GHG emissions have followed a downward trend since the



**Figure 3**

Comparison of Denver overall GHG emission 2005–2015 and 2020 and 2050 goals

2005 baseline year, even while individual years may show a slight increase. An overall reduction of 3.5 percent was achieved in 2015 compared to the 2005 baseline year. “Core” emissions were reduced by 7 percent.

Data may be extrapolated to 2050 to better evaluate the effort that will be required for Denver to achieve its 80x50 goal of reducing emissions to 2.2 million mtCO<sub>2</sub>e by 2050 for core emissions and 2.65 million mtCO<sub>2</sub>e for overall

emissions. Comparisons of estimated business-as-usual scenarios against reductions that should result from existing initiatives and plans were created to understand how close Denver might be in achieving the 80x50 goal. If Denver had continued along its business-as-usual trajectory prior to 2005, emissions from core sectors would have been expected to reach nearly 15.2 million mtCO<sub>2</sub>e by 2050, nearly eight times more than the 80x50 target value in 2050 of 2.65 million mtCO<sub>2</sub>e (see Figure 4).

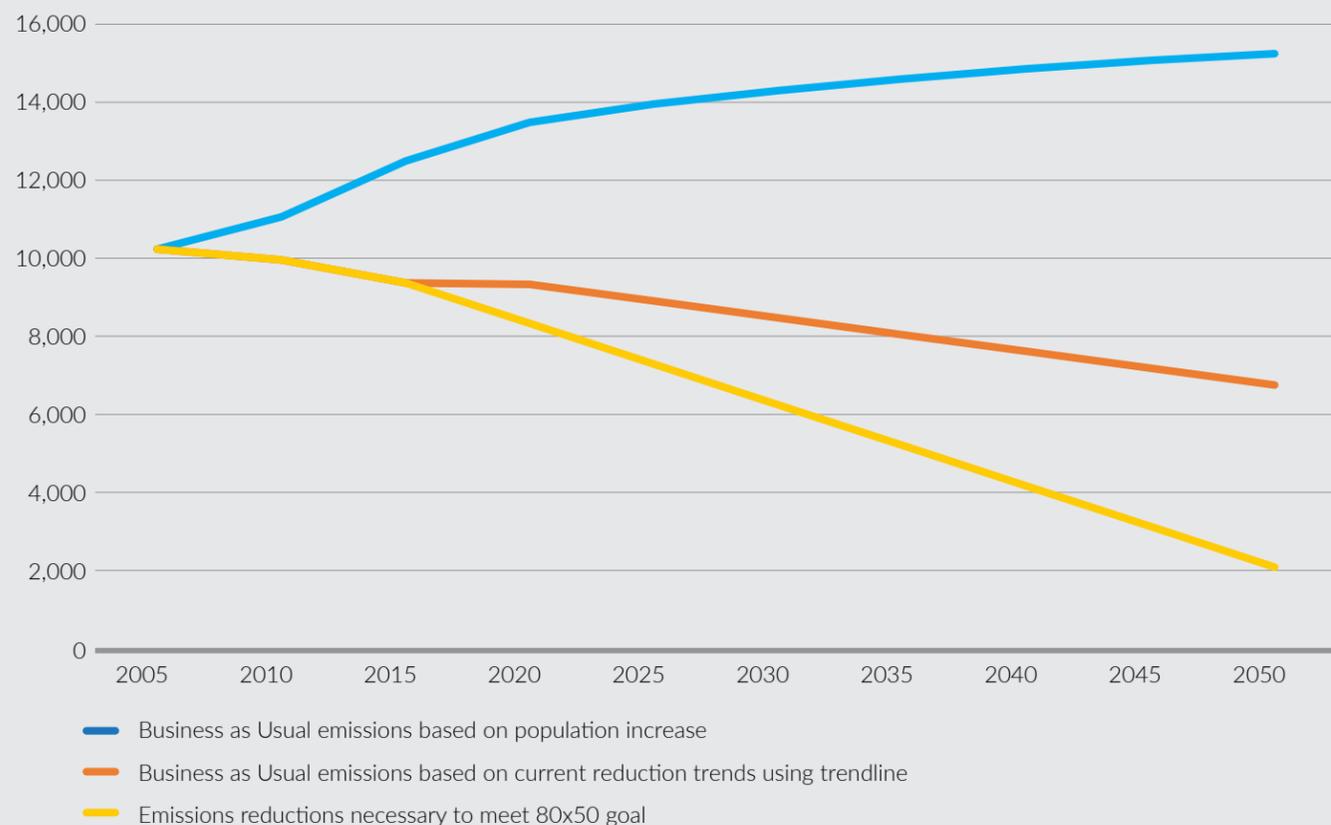


Figure 4

GHG trends and forecast

With the implementation of various energy reduction strategies, decreased electricity emission factors and improvements in vehicle mileage efficiency, Denver has seen regular reductions in GHG emissions from key sectors. If the same rate of decrease were to continue, emissions from core sectors would equal approximately 6.75 million mtCO<sub>2</sub>e by 2050, three times greater than what is required by the 80x50 goal.

Reaching the 80x50 target of 2 million mtCO<sub>2</sub>e for core emissions will require an average annual reduction in emissions of 216,060 mtCO<sub>2</sub>e. Neither of the business-as-usual scenarios will put Denver on the pathway to reach to its 80x50 goal; major reductions in energy consumption

and fossil fuel based travel and a cleaner electric grid are required to get the level of GHG emission reductions needed. Denver is faced with ongoing population growth and entrenched consumer habits, that make it more difficult to significantly reduce GHG emissions. Even after successful implementation of the 2007 Climate Action Plan and achievement of the 2020 Sustainability Goals, reaching Denver's 80x50 goal will require implementation of new, innovative and aggressive GHG reduction strategies. The stakeholder process and resulting recommendations detailed in this report will help guide and prioritize which strategies to pursue in order to achieve 80x50.



## GHG EMISSION REDUCTION PATHWAY

Through a lengthy and deliberate process, Denver identified individuals with varied expertise and a commitment to innovation and to developing an achievable 80x50 plan for Denver by creating a comprehensive list of strategies and targets. While some strategies and targets in this plan build on past and current work being completed by Denver, the stakeholders also listed many new priorities that they believe should be the focus for Denver in the short-, mid- and long-term. As such, all strategies and targets listed in this plan can be attributed to the stakeholders.<sup>13</sup>

While there was general consensus between stakeholders on each target and strategy, there were several items that individual stakeholders questioned or about which the stakeholders had differing opinions. Many strategies will require partnerships and favorable regulatory environments. Most, if not all strategies, will require updates and adjustments as Denver moves towards the 80x50 goal. Moving forward, Denver will continue to develop in-depth action plans, with additional input as appropriate, for the energy and mobile sector to ensure that both sectors are on a path to achieve an 80 percent reduction in GHG emissions by 2050.

To reach a goal of 80x50, Denver will need to reduce emissions from electricity production by 3.6 million mtCO<sub>2</sub>e, 2.9 million mtCO<sub>2</sub>e from energy use in the building sector, 2.4 million mtCO<sub>2</sub>e from its transportation sector, and 0.4 million mtCO<sub>2</sub>e through carbon sequestration. Note that these numbers are based on current estimates and will likely change over time due to new policies and regulations (local, state and federal), technological advances, population and economy changes, and other factors.

In 2005, only 4 percent of Denver's power came from renewable energy, with the remainder generated by coal (66 percent) and natural gas (30 percent). By 2016, as a result of Xcel Energy's rapid acquisition of renewable resources, Denver's grid had changed significantly, with 29 percent of electricity coming from renewable energy sources and the remainder being generated by coal (46 percent) and natural gas (26 percent). As a result, Xcel Energy's emission factor for electricity was reduced by 30 percent between 2005 and 2015.

<sup>13</sup> Present day to 2020, mid-2020 to 2030, and 2030 to 2050.





Accordingly, the majority of Denver's emission reductions achieved to date are the result of more renewable energy on the grid.

Xcel Energy, Denver's only utility, expects this trend to continue due to the cost effectiveness of renewable resources, the geographic advantages for renewables in Colorado, and a desire to provide customers with renewable choices. Moreover, Xcel Energy has set emission reduction goals for 45 percent by 2021 and 60 percent by 2030 (based on 2005 baseline).

Through the alignment and analysis of stakeholder recommended strategies, it became clear that Denver's grid must be powered by 100 percent renewable energy in the near- to mid-term to set the stage for drastic GHG reductions. The significance of this target is shown in Figure 5 where the majority of GHG reduction comes from the 100 percent renewable energy goal. Achieving a renewable grid will offset GHG emissions from anything that is electrified thereafter, which will help offset the potential

impact of population growth leading up to 2050, and provide a carbon-neutral energy source for other sectors, including transportation and heating. Without a renewable grid, the benefit of electrifying other sectors can never be fully realized.

The next largest reductions need to come from energy efficiency and fuel switching. Denver can ensure that upgrades to infrastructure and buildings can be made with low-carbon, low-cost technologies that can help benefit generations to come. In this Stakeholder Report, the stakeholders have set noteworthy energy-efficiency goals including switching to net-zero building codes for new buildings by 2035, and by 2050 ensuring that 90 percent of all buildings will complete energy efficiency improvements. In 2015, natural gas consumption in buildings made up 19 percent of core emissions. As the grid continues to become cleaner, Denver will start to convert 50 percent of all commercial buildings and 50 percent of all residential buildings from natural gas heating to electric heating. This will significantly reduce natural gas emissions, by providing electric heat from a no- to low-carbon source.



Since 2005, surface transportation emissions have remained relatively constant. With the increase in cleaner vehicles, denser urban planning, and shifts toward low-carbon transportation options, Denver expects to see a significant reduction in transportation emissions in personal, public and commercial vehicles. In 2050, driving should make up 34 percent of total mode share; transit, biking, walking and

telecommuting follow at 18 percent, 18 percent, 15 percent, and 15 percent, respectively.

Lastly, Denver recognizes carbon sequestration from urban and regional natural resources as a valuable and essential part of reducing GHG emissions and is included as a reduction strategy.

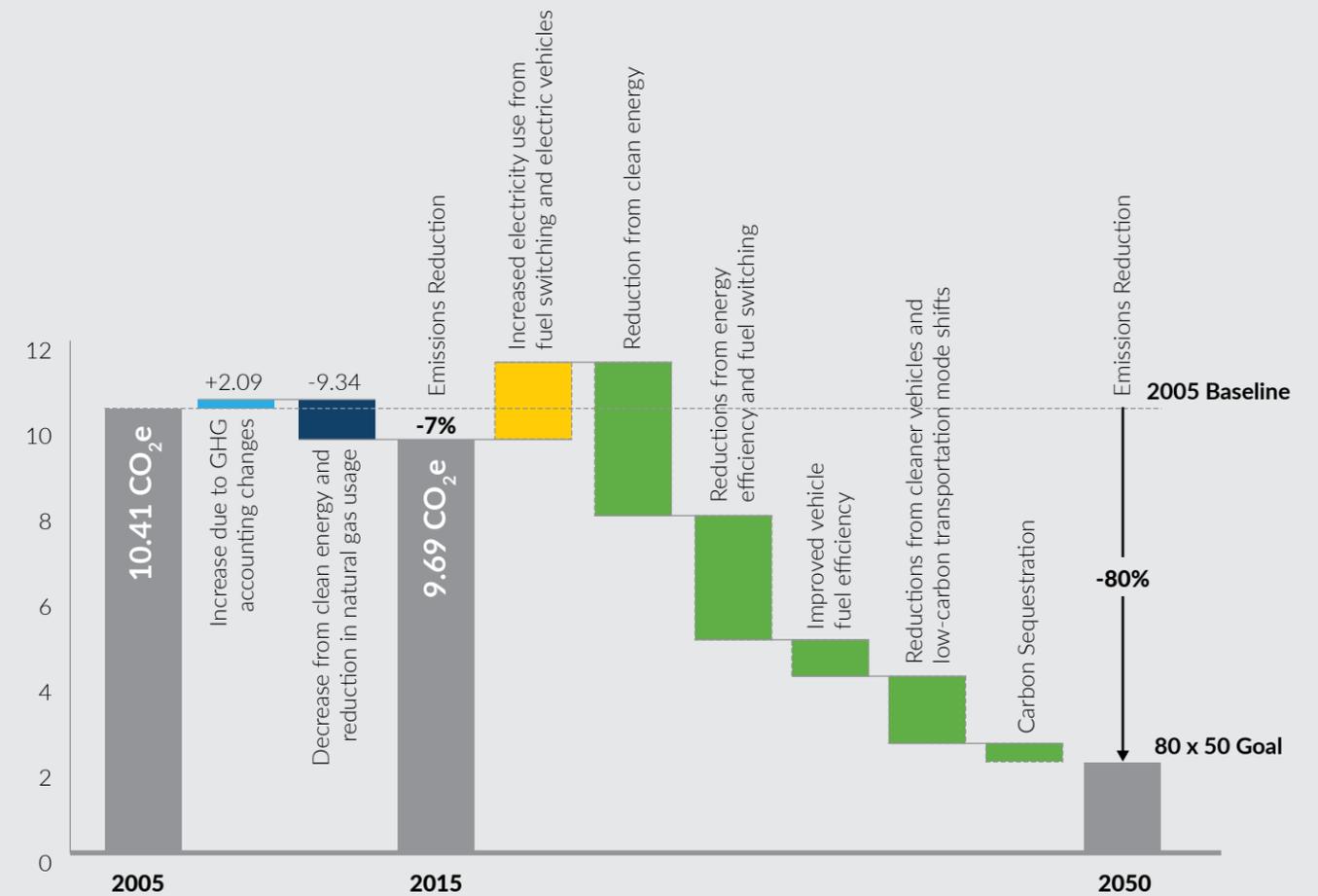
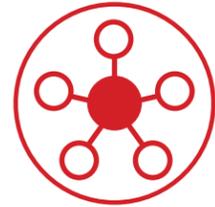


Figure 5

Pathway of reductions in Denver's core GHG emissions to 80x50



## ORGANIZATION OF THIS PLAN

This 80x50 Plan is split into two sections: **Stationary** and **Mobile**. The Stationary section is focused on building energy consumption and energy sources, while the Mobile section focuses on ground transportation. There are a total of seven chapters that focus on high-level topics:

1. Renewable Energy and Electric Grid Improvements
2. Energy Efficiency and Fuel Switching
3. Carbon Sequestration
4. Biking, Walking and Telecommuting
5. Public Transportation, Vanpool and Carpool
6. Electric Vehicles and Electric Grid Integration
7. Freight

Each section and chapter includes several elements that helped inform the stakeholders or were developed by the stakeholders:

- **Introduction:** An overview of the chapter and topic area
- **Vision Statements:** A roadmap and framework for Denver to accomplish ambitious and achievable targets and strategies
- **Targets:** Measurable and time-bound results that will indicate whether Denver has reached its 80x50 goal
- **Strategies:** Initiatives that need to be taken to achieve the overarching GHG reduction goal, as well as targets and vision statements; strategies are broken out into short-term (prior to 2020), mid-term (2020-2030) and long-term (after 2030).



## STATIONARY SECTOR

### VISION for the Stationary Sector

- **Vision Statement:** Make Denver a leader in clean and local energy that comes from the sun, wind, or other innovative renewable technologies.
- **Vision Statement:** Transform Denver buildings into high-performing places to live, work, learn and play.
- **Vision Statement:** Inspire community action and ensure environmental justice and equity as we transition to a carbon-free energy system.



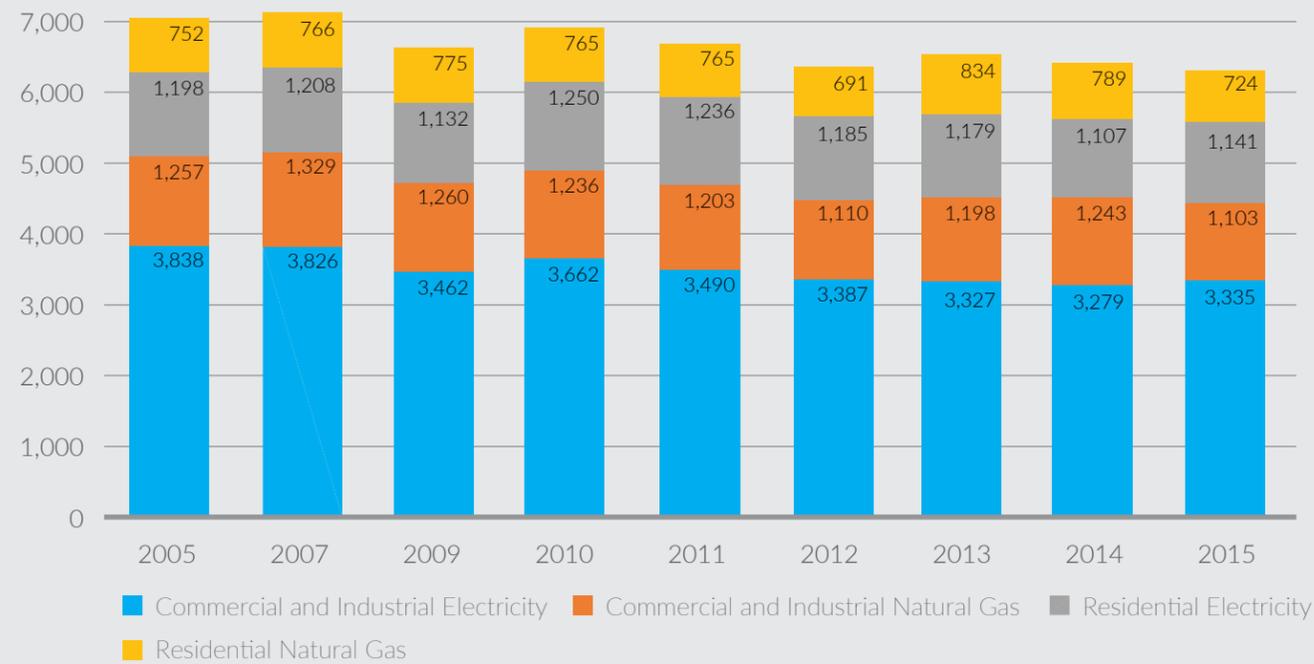


Figure 6

Denver building GHG emissions (thousand MtCO<sub>2</sub>e)

### The Stationary Sector Today

As of 2015, buildings (residential, commercial and industrial) produced 49 percent of Denver's total GHG emissions and 65 percent of its core GHG emissions. Commercial & industrial energy demand accounted for 70 percent of the stationary GHG emissions and residential energy demand made up the remaining 30 percent. Natural gas consumption accounted for approximately 29 percent of total stationary GHG emissions, and electricity consumption accounted for the remaining 71 percent (see Figure 6).

While Denver and Xcel Energy have deployed many tools to reduce electricity consumption, increasing construction,

square footage, and population have led to a 12 percent increase in residential electricity use and a 2 percent increase in commercial electricity use between 2005 and 2015.

However, as shown in Figure 7, due to Xcel Energy's increase in renewable energy (and therefore a reduction in electricity emission factors), emissions from electricity have reduced even as consumption has increased.

Natural gas usage has decreased by 2 percent in the residential sector and by 11 percent in the commercial sector between 2005 and 2015. As a result, total emissions from natural gas have decreased (see Figure 8).

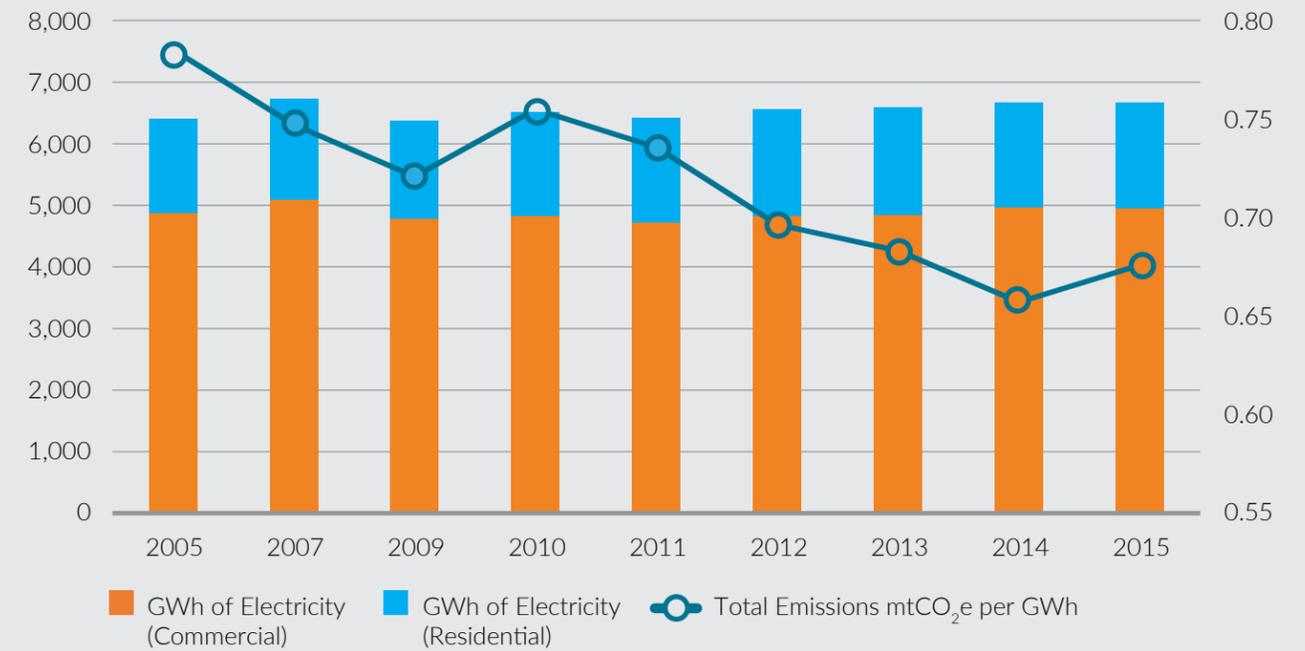


Figure 7

Comparison of Xcel Energy's emissions factors impact on Denver's total emissions

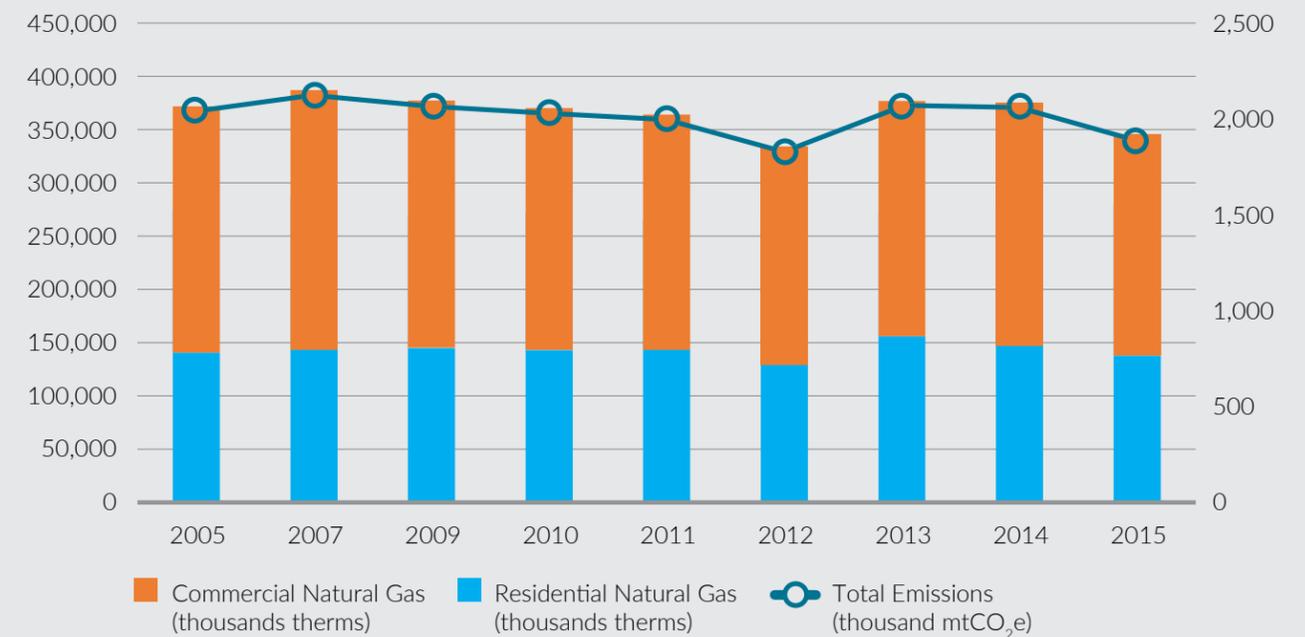


Figure 8

Comparison of Xcel Energy's emissions factors impact on Denver's total emissions



## Renewable Energy and Electric Grid Strategies

In 2004, Colorado passed the first voter-led Renewable Portfolio Standard in the nation, requiring electricity providers to obtain a minimum percentage of their power from renewable energy sources. Since then the Colorado Legislature has increased the amount of renewable energy required by Colorado utilities three times. Most notably, in 2010, investor-owned utilities (including Xcel Energy) were given a new requirement to generate 30 percent of their electricity from renewable energy sources by 2020. Alongside this legislation, the Colorado Legislature passed the Colorado Clean Air, Clean Jobs Act, which provided a roadmap to reduce emissions from older coal-fired power plants. Through these pieces of legislation, and as a result of market forces, there has been a significant reduction in the costs of renewable energy. Moreover, as communities have emphasized a desire for clean energy, Xcel Energy has responded by increasing the percentage of renewable energy on the electric grid substantially, with projections to exceed the Renewable Portfolio Standard requirement. Colorado has become a leader in renewable energy, with increasing investments in wind, solar, biomass, geothermal, small hydroelectric and other renewable energy resources.

As of 2016, renewable energy made up approximately 29 percent of the resource mix for Denver's electricity production, which has resulted in a 30 percent emission factor reduction and 34 percent overall emission reduction since 2005. By 2021, Xcel Energy estimates that renewables will make up 41 percent of its resource mix, resulting in a 45 percent overall emission reduction from 2005 (see Figure 9 and Figure 10).<sup>14</sup> Even so, without a large and quick uptake of renewable energy on the grid, Denver will not be able to maintain its 2020 or reach its 2050 GHG reduction goal.

To meet these aggressive renewable energy goals, Xcel Energy will need a grid that is interactive, flexible, affordable,

intelligent and efficient. As a national leader in renewables and grid optimization, Xcel is well positioned to meet these needs. In addition, the grid must meet new challenges

posed by climate change (i.e. extreme weather), national security (i.e. cyber threats) and new services (i.e. electric vehicles).

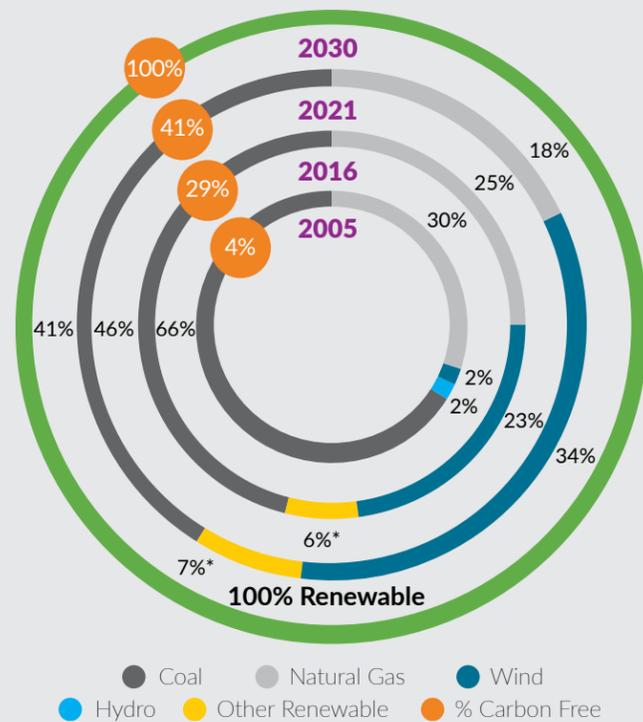


Figure 9

Denver's changing energy mix (2005, 2016, 2021 [Xcel projection], and 2030 80x50 target)

Source: Xcel Energy's Energy and Carbon Emissions Reporting 2016 Summary and 80x50 2030 target.

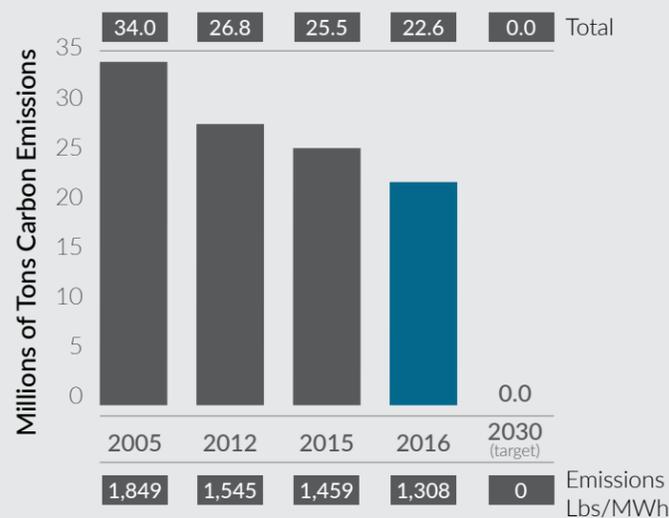


Figure 10

Denver's changing electric emission factor

Source: Xcel Energy's Energy and Carbon Emissions Reporting 2016 Summary and 80x50 2030 target.

<sup>14</sup> For more information see: Xcel Energy's Energy and Carbon Emissions Reporting 2016 Summary

## Targets



By 2030, Denver will be powered by **100%** renewable energy.



By 2050, 70 percent of households and businesses will participate in smartgrid/smart appliances programs.

## Strategies

Rapidly increase the amount of renewable energy on the grid

### SHORT-TERM STRATEGIES

- Advocate at Public Utilities Commissions for continued large-scale renewable energy investments

### MID-TERM STRATEGIES

- Require solar on all new construction where feasible and beneficial

### LONG-TERM STRATEGIES

- Advocate for Xcel Energy's fleet modernization and transition initiatives at Public Utilities Commission and legislature
- Explore pros and cons to increases to the renewable portfolio standard and advocate as appropriate
- Provide education on how to lease rooftops to provide aggregated community solar gardens

### Modernize the grid

#### SHORT-TERM STRATEGIES

- Accelerate smart grid through advocacy and/or programs

- Provide a program and/or advocate for flexible grid investments to enable larger solar photovoltaics

### MID-TERM STRATEGIES

- Adopt Distributed Voltage Optimization program from Xcel Energy
- Continue to work with Xcel Energy to allow isolated districts and microgrids
- Rapidly increase energy storage through advocacy as well as projects and programs supported by the City

Help fund renewable energy while disincentivizing fossil fuels

### MID-TERM STRATEGIES

- Advocate for ongoing solar renewable energy credits for distributed generation projects
- Create a property-tax exemption for commercial solar projects
- Explore and understand the impacts of federal cap and trade policies, and advocate where appropriate
- Create a City policy or ordinance for a carbon tax to fund efficiency (all sectors) and renewables
- Support the creation of a statewide carbon reduction goal



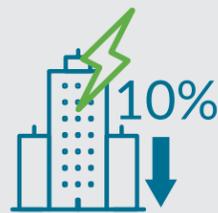
## Energy Efficiency and Fuel Switching

As of 2017, the American Council for an Energy-Efficient Economy ranked Denver ninth in the nation on its City Energy Efficiency Scorecard. Although Denver has a strong suite of programs that address energy efficiency, the City could employ many more policies, regulations, and programs to reduce energy use in new and existing buildings. Energy-efficient buildings provide long-term benefits to the Denver community including lower energy

bills, local green jobs, and healthier, more comfortable spaces to live, work, learn and play.

If Denver is going to reach its 80x50 goal, Denver must start to move away from fossil fuels, particularly for heating. This undertaking can provide a challenging business case due to the lower costs of natural gas and propane for heating compared to electricity. However, sourcing energy for heat from renewable electricity (directly or via heat pumps) and leveraging solar processes heat can greatly lower GHG emissions, stabilize prices and further reduce Denver's reliance on volatile fossil fuels.

### Targets



By 2020, Denver will reduce commercial building energy use by 10 percent.



By 2030, Denver will reduce commercial building energy use by 20 percent.



By 2035, all new buildings in Denver will be net-zero.



By 2050, 90 percent of existing buildings will complete energy efficiency improvements.



By 2050, 50 percent of tenants will participate in a green lease program.



By 2050, switch 50 percent of fuel usage in commercial and residential properties from natural gas/propane to low-carbon fuel and/or electric heat.



## Strategies

Support Energize Denver ordinances

### SHORT-TERM STRATEGIES

- Support the *Energize Denver: Energy Benchmarking and Transparency* ordinance which requires owners of buildings exceeding 25,000 square feet in size to annually benchmark their energy use
- Create the *Energize Denver: Perform and Improve* ordinance which would require buildings that are less energy efficient to make periodic cost-effective, incremental energy efficiency improvements. In the Energize Denver Task Force proposal, building owners would have the option to pick between improving building efficiency 15 percent any way they want, retrocommissioning the building, or undertaking an energy audit and implementing all items identified with less than a 2.5-year payback

Update and enforce energy codes

### SHORT-TERM STRATEGIES

- Continually improve codes (ideally on a three-year basis) by creating new policies or ordinances
- Enforce energy codes

### MID-TERM STRATEGIES

- Continue to increase building code to net-zero for new buildings and to be significantly more stringent for existing buildings by 2035, through policy or ordinance

Incentivize high-performance buildings

### SHORT-TERM STRATEGIES

- Create green lease programs that incentivize tenants to demand efficiency that benefits both landlords and tenants

- Support the statewide energy-efficiency resource standard

### MID-TERM STRATEGIES

- Offer expedited permitting for Leadership in Energy and Environmental Design (LEED) and net-zero buildings through program and/or policy
- Provide performance-based incentives for buildings

### LONG-TERM STRATEGIES

- Provide permit-fee reimbursement for LEED and net-zero Energy Buildings
- Provide density bonuses for LEED/Living Building/net-zero buildings
- Reduce distributed energy soft cost through streamlined permitting and process
- Create a city-sponsored green bank

Educate Denver residents and businesses about energy efficiency

### LONG-TERM STRATEGIES

- Provide training and outreach to drive investments in energy efficiency and behavioral-based energy efficiency
- Provide education on existing financing and incentive programs and encourage residents to fully utilize Xcel Energy and Denver programs
- Create outreach campaign to highlight green goals and sustainability initiatives

Fuel switching

### MID-TERM STRATEGIES

- Switch to low-carbon fuel and/or electric heat once grid power is cleaner than gas



## Carbon Sequestration

Research indicates that carbon sequestration—the process of capturing and storing atmospheric CO<sub>2</sub> — can contribute to reducing a city’s carbon emissions. By utilizing Denver’s urban natural resources and vast mountain park system of soils, trees, vegetation and green space, Denver could reduce substantial amounts of GHG’s from the atmosphere while improving the quality of life in the city.

### Strategies

Utilize carbon sequestration to reduce GHG emissions

#### MID-TERM STRATEGIES

- Measure and use tree planting as a sequestration method

#### LONG-TERM STRATEGIES

- Subsidize and encourage carbon sinks in existing and new buildings
- Support research and development of negative emission technologies
- Utilize regenerative agriculture, forestry, and grazing in Denver-owned land and/or surrounding communities

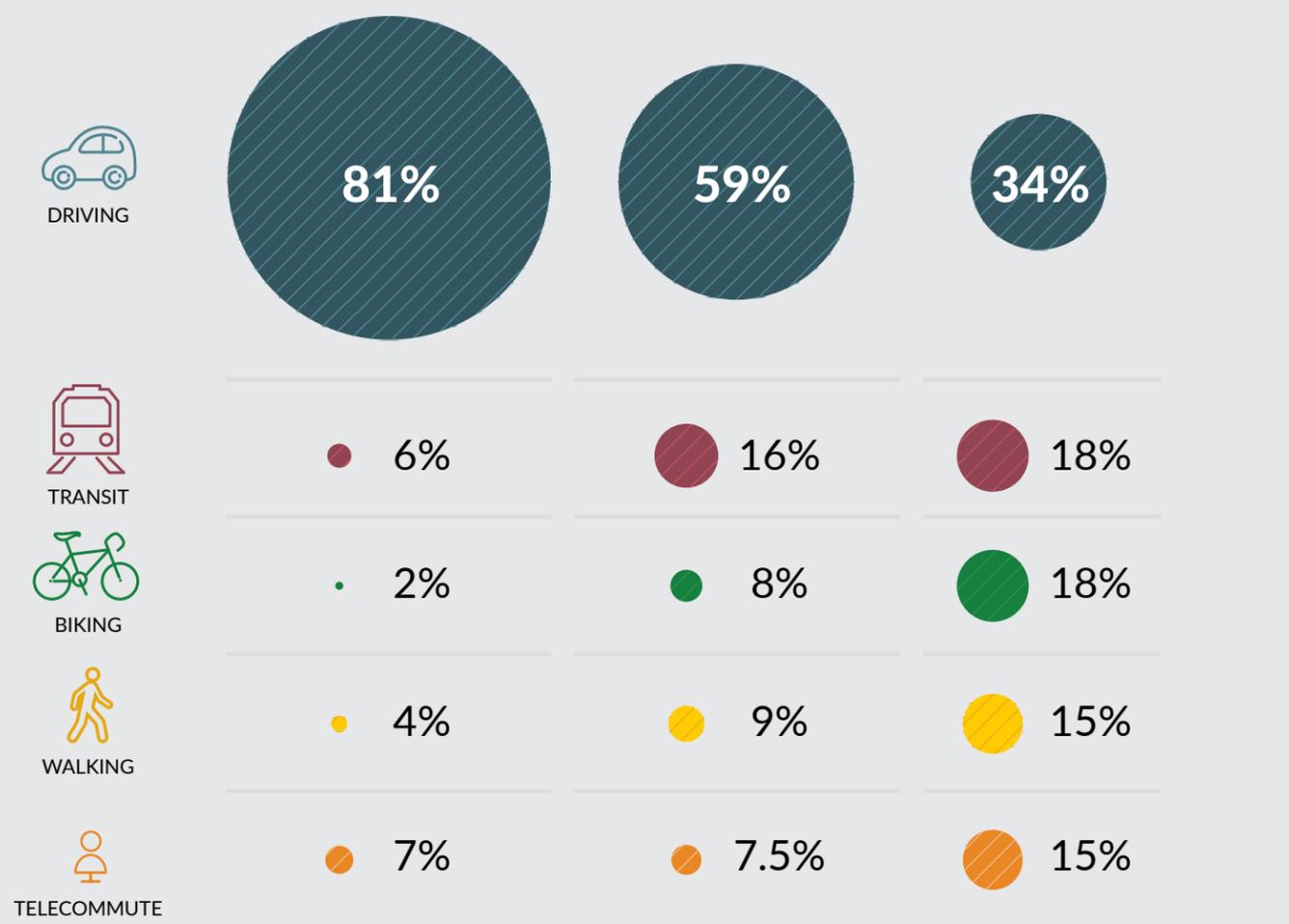


## MOBILE SECTOR

### VISION for the Mobile Sector

- **Vision Statement:** Transform Denver into a community where people walk, bike, take transit, or carpool for most trips in a safe, accessible and affordable transportation network.
- **Vision Statement:** Aggressively transition toward a clean, carbon-free transportation system that improves the health and livability of Denver's communities.
- **Vision Statement:** Become a leader in sustainable, smart transportation through innovative partnerships, policies, programs and technology.





**Figure 11**

2015 Denver Mode Share

**Figure 12**

2030 Denver Target Mode Share

**Figure 13**

2050 Denver Target Mode Share

### The Mobile Sector Today

Denverright, a community-driven planning process, creates a vision of how Denver wants to evolve in land use, mobility, parks and recreational resources over the next 20 years. Through this planning process and as defined in the Strategic Transportation Plan, Denver emphasizes the need to "move more people, not just vehicles." To do this, the City must provide convenient, comfortable, safe 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.

Behind the stationary sector, the mobile sector (herein defined as transportation) emits the next greatest amount of GHG emissions for Denver. In 2015, transportation accounted for 27 percent of all emissions (7 percent of which comes from producing fuel for vehicles). Between 2005 and 2015, ground transportation emissions (including fuel production) increased by 0.5 percent.

Transportation has proven an especially significant challenge for Denver due to the City's exponential growth. Compounding this growth is the fact that each workday, Denver's population temporarily balloons by 200,000 commuters — the clear majority driving single-occupant vehicles powered by gasoline. The challenge is to accommodate this growth, while enacting policies and programs that will mitigate the environmental impact from the transportation sector.

Denver staff and the 80x50 stakeholder group have set aggressive targets and strategies to account for population growth while drastically decreasing GHG emissions and improving air quality. Currently, 81 percent of Denver's population commutes to work by driving mostly gasoline-powered vehicles (see Figure 11). However, in the future, significantly more area residents will travel to work and school by taking transit, walking, or biking (see Figure 12 and Figure 13).<sup>15</sup> Of the vehicles that remain on the road, there will be a significant shift away from gasoline and diesel to lower-carbon transportation fuels, like electricity.

### Targets



By 2030, 8 percent of commuters will bike to work.



By 2030, 9 percent of commuters will walk to work.



By 2030, 7.5 percent of commuters will telecommute.



By 2050, 18 percent of commuters will bike to work.



By 2050, 15 percent of commuters will walk to work.

<sup>15</sup> Note that the 2030 mode share targets are from the Mayor's Mobility Working Group.



## Strategies

Expand infrastructure

### SHORT-TERM STRATEGIES

- Expand safe biking and walking infrastructure through direct action by the City and/or policy/ordinance creation

### LONG-TERM STRATEGIES

- Fully build out Denver Moves Bicycle plan

Provide funding support

### SHORT-TERM STRATEGIES

- Establish an annual fund in the City's budget for bike and pedestrian infrastructure



### MID-TERM STRATEGIES

- Provide incentives to employers who support telecommuting as an option for their workforce

### LONG-TERM STRATEGIES

- Fund installation of a B-cycle station at all major transit facilities

Celebrate successes

### SHORT-TERM STRATEGIES

- Create outreach campaign to highlight green goals and sustainability initiatives



## Public Transit and Carpool Strategies

Transit service and programmatic improvements in Denver are important in providing reliable, safe, and affordable transit service and increasing transit use. Supporting these improvements includes: a build out of the Regional Transportation District (RTD)'s FasTracks system; development and implementation of the city's first transit vision (Denver Moves: Transit); creation of transit fares and pass programs that meet the needs of the most vulnerable community members; and development of new and

emerging technologies to improve reliability and increase the ease of use of the transit system.

According to the Downtown Denver Partnership, only 4.8 percent of downtown Denver employees use carpooling or vanpooling as an option to get to work. With such a small percentage of the workforce using this option, there is a significant potential to grow the ridesharing community and reduce GHG emissions by eliminating single-occupancy vehicle trips. In return, Denver has set a 2020 Sustainability Goal to reduce single-occupancy commuting travel in Denver to no more than 60 percent of all trips.

## Targets

16%



By 2030, 16 percent of commuters will use public transit.

18%



By 2050, 18 percent of commuters will use public transit.

100%



By 2050, 100 percent of public transportation will be carbon free.



## Strategies

Expand high-quality, equitable transit options across the city

### SHORT-TERM STRATEGIES

- Focus on linking transit—especially first and last mile— through advocacy and/or program

### MID-TERM STRATEGIES

- Create bus rapid transit on existing streets and advocate for and/or create a financing mechanism to support longer range options

### LONG-TERM STRATEGIES

- Continue to expand transit/adjust routes through advocacy and education
- Locate services closer to major transportation centers by creating new policies and ordinances and/or direct action by city
- Redesign network to attract potential riders

Help fund public transit and disincentivize single-occupancy vehicle trips

### SHORT-TERM STRATEGIES

- Advocate and/or create a financing mechanism to partially or fully subsidize EcoPass
- Work with RTD to offer free transit days
- Explore innovative vanpool/carpool strategies for use by commuters

### LONG-TERM STRATEGIES

- Increase parking fees downtown
- Add a tax to local gasoline sales and/or initiate a carbon tax to help fund transit
- Convert more roads to high-occupancy toll (HOT) lanes
- Use dynamic ridesharing on high-occupancy toll (HOT) lanes
- Restrict car traffic on certain days through mandates



## Electric Vehicle Strategies

By 2050, 80 percent of all light-duty vehicles will be electric and 100 percent of transportation network vehicles (i.e. Taxis, Uber, Lyft, etc.) and public transit will be fueled by renewable electricity. This translates to more than 800,000 light-duty electric vehicles on the road in 2050. To meet

this crucial goal, Denver must quickly increase access to electric vehicle charging infrastructure, electrify its own fleet, encourage the usage of electric vehicles through incentives and benefits, partner with stakeholders to electrify those fleets, and prepare the grid for the huge increase in electric demand.

## Targets



By 2030, all electric vehicles will be powered by 100 percent renewable electricity.



By 2050, 80 percent of light-duty vehicles will be electric.



By 2050, 100 percent of City and County of Denver's light- and heavy-duty vehicles will be electric or fueled by other carbon free fuel.



By 2050, 100 percent of taxis and transportation network vehicles will be electric.



## Strategies

Incentivize electric vehicles

### SHORT-TERM STRATEGIES

- Continue or increase electric-vehicle tax incentives through advocacy or direct action by city

### MID-TERM STRATEGIES

- Create a cash-for-clunkers program to trade in combustion engine vehicles for electric vehicles

### LONG-TERM STRATEGIES

- Increase power purchase partnerships with multiple car dealerships to aid cost of public adoption of electric vehicles

Make sure everyone benefits from electric vehicles

### MID-TERM STRATEGIES

- Create electric vehicle lease/ownership programs for lower income residents
- Ensure electric ridesharing or transit service is available in low-income neighborhoods

### LONG-TERM STRATEGIES

- Provide charging stations at all RTD Light Rail stops

Educate the public on the many benefits of electric vehicles

### SHORT-TERM STRATEGIES

- Create electric vehicle education and public outreach campaigns
- Support electric vehicle workplace charging programs

Create pro-electric vehicle policies and regulations

### SHORT-TERM STRATEGIES

- Increase car-sharing electrification through policy/ ordinance and/or program
- Create building codes to require charging facilities at multi-family units and workplaces
- Provide electric-vehicle charging infrastructure in all city and county buildings

### MID-TERM STRATEGIES

- Advocate for a regional low-carbon fuel standard or adopt California Clean Car Standards
- Create regulations requiring autonomous vehicles to be shared and electrified

### LONG-TERM STRATEGIES

- Forbid non-electric vehicles in the city's core, with an exception for those owned by Denver residents
- Provide priority parking for electric vehicles and restricted parking for non-electric vehicles at all public facilities



## Freight Strategies

Denver's freight infrastructure is critical for day-to-day operations and connects Denver residents and businesses to commodities such as food and construction materials. In addition, I-70, which runs through Denver, is the main east-west throughway for long-haul trucks. Reducing emission from freight is essential to reducing emission within the city and region, while reducing particulate matter and ozone, which can affect Denver residents' health.

## Strategies

Plan for the future

### SHORT-TERM STRATEGIES

- Support anti-idling and idling reduction technologies and campaigns at truck stops and big filling stations

### MID-TERM STRATEGIES

- Create a freight plan

Promote carbon-free fuels and alternative fueling infrastructure

### MID-TERM STRATEGIES

- Electrify medium-duty delivery trucks and rail yards
- Support the creation of an alternative fuel corridor for freight
- Pair smaller, alternative transportation options with traditional freight operations to complete shorter-range trips within urban settings

### LONG-TERM STRATEGIES

- Promote development of renewable diesel and renewable natural gas

## Targets



By 2050, 75 percent of freight trucks will use carbon-free fuel.



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