Reducing Building Greenhouse Gas Emissions through Climate Plan Adoption

by

Anna Salvatorelli

B.S., Kansas State University, 2019

A REPORT

submitted in partial fulfillment of the requirements for the degree

MASTER OF SCIENCE

Department of Architectural Engineering and Construction Science
College of Engineering

KANSAS STATE UNIVERSITY
Manhattan, Kansas

2019

Approved by:

Major Professor
Julia Keen

Copyright

Abstract

In 2017, the U.S. withdrew from the Paris Agreement, an international agreement with a goal to lower greenhouse gas emissions and keep global temperature rise of the current century below 2 degrees Celsius above pre-industrial levels. Stated reasons for the withdrawal was the burdening of American citizens with tax costs, lost jobs, lower wages, industry shutdowns, and diminished economic production. As a reaction, 407 U.S. city mayors signed a statement agreeing to uphold the Agreement's climate goals. Many of these cities have reaffirmed existing climate plans or are creating new climate plans to combat climate change from the expected rise of greenhouse gas levels. A climate plan is a document that guides a city through actions towards reduced greenhouse gas emissions. The plans organize strategies, actions, and resources needed to reach specified climate goals. As commercial buildings can contribute a large percent of energy use and emissions of a city, a climate plan should focus a section of their plan on commercial buildings. The goal of this report is to inform cities on the adoption process of a climate plan through design, development, implementation, enforcement, and reporting as well as present common building strategies. Nine existing city climate plans are summarized with progress towards climate goals presented. The cities are analyzed based on emission reduction progress, plan content, implementation, and specific building strategies. This analysis is intended to provide direction for cities investigating the feasibility of adopting a climate plan.

Table of Contents

List of Figures

List of Tables

Acknowledgements

I would like to thank my parents for encouraging me to pursue my Master's degree and for all of their help over my college career. I would also like to thank my advisor, Dr. Julia Keen, who has been my mentor throughout my undergraduate and graduate years at Kansas State University.

Chapter 1 - Introduction

The Paris Agreement was launched by the United Nations Framework Convention on Climate Change in 2015 (UNFCCC, 2019). The Agreement was developed to combat climate change by fast-tracking actions and investments needed to achieve lower greenhouse gas emissions. The central goal of the Agreement was to keep the global temperature rise of the current century below 2 degrees Celsius (3.6 degrees Fahrenheit) above pre-industrial levels. In 2017, the United States (U.S.) President Donald Trump announced the country would withdraw from the Paris Agreement, stating it as "an agreement that disadvantages the United States to the exclusive benefit of other countries" and "leav[es] American workers […] and taxpayers to absorb the cost in terms of lost jobs, lower wages, shuttered factories, and vastly diminished economic production," (U.S. Office of the President, 2017). Trump stated compliance with the Agreement would cost jobs to manufacturing and production and proclaimed that a cease of national contributions to the Agreement would end financial burdens placed on the country.

As a reaction, the Climate Mayors, a bipartisan peer-to-peer network of U.S. mayors founded in 2014 working together to combat climate change, presented their commitment to uphold the Paris Agreement goals in a formal statement to the U.S. President (Climate Mayors, 2017). The statement was agreed upon and signed by 407 U.S. city mayors who represent 70 million American citizens. The cities agreed to intensify their efforts to meet climate goals set by the Agreement. These political leaders recognize climate change occurring on a localized level and are looking for change in their environmental practices (Koski & Siulagi, 2016). Many of these cities have reaffirmed existing climate plans or are creating new climate plans to combat climate change.

Greenhouse Gas Emissions

Greenhouse gases are gases that trap heat in the Earth's atmosphere (U.S. Environmental Protection Agency, 2018). Certain levels of greenhouse gases are essential to life on Earth. Alterations to these levels from human activity are affecting the Earth's climate. Carbon dioxide (CO_2) is the largest component in greenhouse gases and is found naturally in the atmosphere from the Earth's carbon cycle (U.S. Environmental Protection Agency, 2018). The most influential human activity that emits additional CO_2 into the atmosphere is the burning of fossil fuels. Greenhouse gas emissions are commonly measured in metric tons of CO_2 equivalent ($MTCO_2e$). For brevity, references to emissions in this report refer to greenhouse gas emissions from human activity.

Standards have been created to measure CO_2 emissions generated by a city. The most commonly referenced in U.S. city climate plans are the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (Global Protocol) and the ICLEI-Local Governments for Sustainability U.S. Community Protocol (U.S. Community Protocol). The Global Protocol provides a framework for cities to measure and report city-wide emission levels and develop an inventory which tracks emission amounts by year (Greenhouse Gas Protocol, 2019). The Global Protocol helps cities to establish a base year of emission levels and to monitor their progress with performance tracking. The U.S. Community Protocol is the U.S. national standard and identifies common categories of emissions recommended for measurement: built environment, transportation, solid waste, wastewater and water, agricultural livestock, and life cycle (ICLEI, 2012). This standard is designed to help cities in the same way as the Global Protocol for assistance with measuring and reporting emissions. The U.S. Community Protocol is in use by a majority of U.S. cities and should be adopted by new cities looking to develop a climate plan as

it is the industry standard for local government operations (U.S Environmental Protection Agency, 2016).

The U.S. Community Protocol (2012) built environment emissions accounting method includes measuring emissions from government, residential, commercial, and industrial buildings. The emissions calculated with this protocol are limited to energy use within buildings, refrigerants, fire suppressants, and industrial processes. Energy-related emissions are measured from buildings first by fuel combustion, electricity, or other forms of energy and are then multiplied by emission factors for each source of energy. To estimate a city's refrigerant leakage and fire suppressant emission levels, the general methodology is outlined by the U.S. Environmental Protection Agency. Industrial process emissions are accounted for by obtaining data from inventories that are required to be reported to the U.S. Environmental Protection Agency. For example, to obtain emissions from electricity usage in a city, the city's annual electricity usage would first need to be obtained in either kilowatt-hours or megawatt-hours. This data should be able to be obtained from the electricity utility serving the city. This usage amount would then be multiplied by emission conversion factors found in the Protocol, which will then convert the electricity usage into emissions of CO_2. Similar conversions for each emissions category by the city will need to be done to find the total emissions by a city.

Climate Plans

A climate plan is a long-term document that guides a city through efforts and actions towards a defined climate vision (Office of Energy Efficiency, 2013; Koski & Siulagi, 2016). The climate plan organizes strategies, actions, and resources needed to reach the city's climate goals. A climate plan should outline thoughtful actions based on the priorities of the community

and encompass a broad range of emission reducing opportunities through coordinated planning (Office of Energy Efficiency, 2013). A plan should be structured and carefully organized to provide clear guidance through each action strategy. It needs to be an enduring, long-term plan that establishes how each climate goal is to be achieved over time. The plan should be adaptive so that it remains relevant beyond when the current administration has left office.

In a time when individuals are looking to do their part in reducing their carbon footprint, local government must also step up and do their part. Local governments have the necessary tools available to develop policies, gain financial support, and enforce sustainable emission-reducing actions. Cities wanting to adopt a climate plan as part of its overall effort to create a cleaner environment and increase quality of life for its community need to recognize the financial implications that exist in a plan's creation. The city's ability to demonstrate environmental consciousness, increased sustainability efforts, and promotion of healthy living for its citizens is one way to justify the resource expenditure needed to support a climate plan.

Building Emissions and Energy Use

Commercial and residential buildings account for approximately 40 percent of U.S. energy consumption and 40 percent of U.S. emissions (Vaughan & Turner, 2013). As the square footage of buildings being constructed continues to increase over time, there will be a corresponding increase in emission levels. Currently, urban areas account for 70 percent of global energy use and emissions levels. Continued urbanization will only increase emission values unless cities find a way to reduce them in both new and existing buildings (Deetjen, Conger, Leibowicz, & Webber, 2018). Because of this, climate plans should define the actions that the city will employ to reduce emissions specifically from buildings. The scope of this

report is limited to the discussion of commercial buildings. Residential buildings also provide significant opportunities for reducing emissions, but there is an intentional distinction between the two building sectors in this report. The commercial sector has been selected as the focus because it has the ability to achieve a larger, more rapid impact. The emission reduction results achieved through the corrective actions of a single commercial building owner would likely require the participation of multiple residential home owners to produce an equivalent emission reduction. Therefore, when the term buildings is used in this report, it references only commercial buildings. This focus is easily manageable as city climate plans often incorporate separate residential and commercial building strategies.

This report serves as a reference for cities pursing a reduction of emissions and researching the potential of adopting a climate plan. The focus is on building emissions and energy use as a major climate change contributor. Details of the necessary components to a climate plan and the beginning steps for a city to follow regarding plan development are presented in Chapter 2. Chapter 3 examines building emission reduction strategies commonly included in climate plans. A case study of existing climate plans is included in Chapter 4, followed by an analysis of the progress made by these cities towards their emission goals that reinforces the benefits of a climate plan. Chapter 4 also presents a guide to assist cities in understanding the content components that may be used in developing a new plan. Chapter 5 provides recommendations regarding content that should be included in a climate plan followed by the recommendations and conclusion of this report.

Chapter 2 - Executing a Climate Plan

The execution of a successful climate plan requires a municipality to have a solid foundation and understanding of all that is involved. This includes selection criteria for the correct individuals necessary to lead the effort, the manner to select the content and focus of the plan, and ultimately how to implement and enforce the content. It is important to recognize that there are resources available which can provide cities with helpful information for creating a climate plan such as the U.S. Office of Energy Efficiency and Renewable Energy's "Guide to Community Energy Strategic Planning" (2013). Resources such as this should be utilized by cities that are creating a new plan. This chapter is designed to provide a guide to the climate plan creation process of preplanning, development, and evaluation.

Preplanning

Preplanning is the first phase in designing a climate plan when initial ideas are developed. The first step the city needs to take is to collect input from the community. Once the concept of creating a climate plan has been discussed and community support is established, a team needs to be assembled to oversee plan development. The plan must define the vision of what the city hopes to achieve with its climate plan. The following paragraphs provide more detail into each of these steps.

It is considered a best practice for municipal leaders seeking to develop a climate plan to receive community input in the preplanning process. Gathering this input encourages members of the community to participate and allows them the opportunity to indicate their support or lack thereof of the climate plan. The involvement of a wide range of stakeholders representing both the municipal government and the community, provides valuable insights, yields new ideas, and

assists in prioritizing recommendations for meeting the community's objectives and needs (Office of Energy Efficiency, 2013). Activities such as public forums or online surveys can be used to collect Community input which is helpful in understanding the necessity or public support of a city's proposed climate plan. Community support is critical to the success of any climate plan. If significant resistance to a plan were to occur at the point of community input, it may indicate that the city should rethink their climate plan, regroup, and consider next steps for emission reduction.

After creation of a climate plan has been authorized, the next crucial step is to create a strong leadership team. This team needs to be comprised of people who can maintain focus on the planning process, manage interactions with government offices when necessary, motivate stakeholder to contribute, promote completion of an effective plan, and ensure the plan's implementation over time (Office of Energy Efficiency, 2013). The leadership team is typically selected by the government office or group in charge of initial up-front work for preplanning. The team would then report to a government office, commonly an office of sustainability if it exists within the municipal structure, or form an entity that communicates closely with the city government.

The Office of Energy Efficiency and Renewable Energy's (2013) "Guide to Community Energy Strategic Planning" recommends certain leadership roles be filled to create the team: Champion, Plan Manager, and Leadership Team. The Champion is the executive-level authority behind the plan. This role is typically filled by the city mayor, city councilor, or a prominent government official or staff member. The Champion provides overall leadership for the team and gives credibility to the climate plan from the perspective of the community. The Plan Manager is the lead administrator for the plan process. This person directs logistics, and the

position is often filled by a senior manager with the skills and resources to manage and develop the complete climate plan. This may be a full- or part-time position on top of other municipality duties. Plan Managers are commonly individuals that serve as a public works or energy manager or a sustainability coordinator because of their ability to directly access the Champion. The Leadership Team is the additional group of influential leaders in charge of carrying out the plan process. This team may be composed of heads or representatives from government departments such as sustainability, municipal utility, public works, buildings/construction, planning, transportation, or budget office. The team may also include representatives from the community such as businesses, universities, utilities, or non-profits. The number of team members varies with the needs and size of the city.

The newly created team determines the vision for what the city hopes to achieve with the climate plan and evaluates the current energy profile of the city by completing an emissions assessment. This is an important step because it establishes the baseline of the city's goals and identifies the city's emission values. Guidance for performing an emissions assessment can be found in various emission inventory protocols previously introduced in Chapter 1. To achieve this, the leadership team should engage experts who can develop an energy profile of the city, assess current energy usage and supply, and identify potential future energy sources (Office of Energy Efficiency, 2013). Experts on developing an energy profile and part of a task force can consist of public works department representatives or facility management, analysts to compile data, city budget or finance department employees with knowledge of financial information, and utility company representatives. Once the energy vision is determined, the team then needs to create an organized inventory of energy policies, plans, projects, and programs, to communicate the findings to their stakeholders.

As many of the strategies have a financial impact, determination of the funding mechanism needs to be part of the early planning stages of the climate plan. Determining the funding source for priority items as well as identifying the staging of short- and long-term investments increases the potential of the plan success (Office of Energy Efficiency, 2013). Financial planning must occur early in the climate plan creation process since it likely guides the aggressiveness of the plan. The financing plan establishes how to incorporate the climate plan into other planning and budget efforts by determining how it interacts with other city plans (Office of Energy Efficiency, 2013).

Scott Anders (2018) explains in his post to the Energy Policy Initiatives Center Energy Blog that financial planning needs to be done for expenditure and implementation costs. Expenditure costs include capital expenses, salary and benefits of personal, consultant expenses, and materials and supplies. Implementation cost will need to include both measurement activities and coordination and reporting costs. Measurement activities include developing and enforcing ordinances, developing and implementing programs, and capital projects. Coordination and reporting costs include updates to the emissions inventory, coordination meetings, and costs to monitor and report progress.

Climate plans are not easily comparable when examining the cost of a plan and strategies (Steele, 2018a). Differences between cities such as city history and timing of the climate plan make it very difficult to budget one city based on another's previous results. A benefit cost analysis should be done to determine the cost effectiveness in dollar per $MTCO_2e$ that will result from actions defined in the climate plan (Steele, 2018b). Other metrics of measurement include a benefit-cost ratio, payback period, return on investment, and internal rate of return. These metrics are used to determine the benefits versus costs of a climate plan and the time required for

benefits to equal or pass the cost of strategies. Ultimately, the city will need to view this cost analysis in the preplanning of the climate plan creation process to determine what strategies work best in the city and if their climate plan will impact emission savings over time to justify the expense.

Development Process

The development process of the plan begins after the leadership team has determined the climate vision for the city. The leadership team needs to refine the climate vision by establishing an overall climate goal, and by creating strategies to reach the target emission reductions. Besides defining the strategies, the plan should also identify items such as strategy impacts, the agency in charge of strategies, and a timeline. The more common items typically included in a climate plan are outlined in the following sections of this report. These items are not an all-inclusive list of content nor is every item included in this list required for a successful plan.

Climate Goal

A climate plan is most beneficial when it has a clear goal for which the city can strive. The leadership team is responsible for establishing the plan's climate goal for what the city hopes to achieve after a specified period of time. Typically, climate goals are quantifiable, meaning that they have a numerical value and method to measure progress. There should also be a defined timeline to accomplish the goal.

An example of a common climate plan goal is to reduce emissions from the city by a certain percentage by a specified year. Many cities with climate plans have established a long-term goal to reduce emission levels by 80 percent by the year 2050, in line with the Paris

Agreement. Interim goals should also be developed to help the city remain motivated as well as allow progress over a shorter time to be monitored.

Emission Sectors and Associated Goals

After identifying a goal, divisions of emission sectors should be created. These sectors group the different emissions that should be addressed and then each emission is assigned with an individual strategy. The number of sectors should be determined by how the city wishes to organize and group strategies. The three sectors with the greatest opportunity for impact are 1) commercial buildings, 2) residential buildings and 3) transportation, since these sectors usually contribute the greatest amounts of emissions. Other common sectors that cities often include in their emission analysis include waste and energy. In addition to overall and interim goals, emission sectors should have their own set of smaller goals. These goals are what the city hopes to achieve for each sector. For example, a city plan has a goal for the building sector to reduce emissions from buildings 50 percent by the year 2030.

To achieve emission sector goals, strategies must be identified. Emission sector strategies list the detailed actions the city shall implement. In the example of reducing building emissions by 50 percent, the city may choose to require building benchmarking, require city-operated facilities to have a building certification, or update the current building energy code. The list of strategies is endless, but strategies need to be achievable for the city to have any impact. Chapter 3 further expands upon common building emission reduction strategies.

As the strategies are created, they should be prioritized to allow sector goals to be met. The plan should prioritize strategies that have a larger impact on emission reduction or are able to be implemented quickly. By implementing actions with a higher priority and effectiveness,

the community should see reductions in emission values sooner (Office of Energy Efficiency, 2013). This helps the city leaders gather support for the climate plan as citizens are able to recognize the tangible impact the plan has had on the city and communities.

Strategy Impact

Individual strategies can impact a city in other ways beyond simply reducing emissions to meet the overall goals. Common examples of potential impacts include: emission reduction, economy stimulation, job creation, health benefits, and environmental improvements. These auxiliary impacts become part of the talking points used to encourage the adoption and continuation of effort for a plan.

The economic impact that a strategy has on a city refers to how each strategy benefits the city financially. This impact might also identify whether a strategy is profitable by reducing energy consumption and utility bills for the city. There is the potential that some of the strategies can result in job creation in the green and sustainable market or improve jobs that already exist. An example of a building emission reducing strategy that impact jobs includes expanding demand for the renewable energy market. This may result in the design and application of newer technology on existing buildings such as more photovoltaic panels. This requires the hiring of engineers for the design, contractors for the construction, and increased sale by technology vendors all while reducing emissions. Identifying and communicating this impact illustrates to community members the positive influences emission reducing strategies have toward individuals in addition to the benefits for the city as a whole.

The health benefits of a strategy can also positively affect individuals in the city. Health benefits may be direct, such as promoting walking and bike riding over automotive

transportation, or indirect such as “greening” the city through an increase in the number of trees. Similar to job support, the impacts in the health category benefits individuals with its implementation while also promoting community participation and efforts. Reducing carbon emissions with environmental impact strategies benefits the quality of the natural environment in which the city is located, contributing to the wellbeing of a community.

For effective implementation of the climate plan, strategies should be designated by the leadership team to individual government agencies. Assigning responsibilities to multiple agencies ensures a higher degree of success for the plan as it creates a sense of personal responsibility for the individuals within those agencies to see that their strategies are implemented successfully. A timeline of each strategy is essential for developing the schedule of when each individual action should take place for reaching the climate goal. Documenting the timeframe for each action in the plan contributes to better organization and efficiency while helping to keep the city focused toward their goals.

Implementation and Evaluation

The manner in which a climate plan should be organized should be clearly outlined through an implementation section that addresses how progress will be reported, when the climate plan should be updated, and how often the leadership team will meet. For a plan to be properly implemented, progress needs to be reported periodically, so that decision-makers, stakeholders, and the community are informed on the plan’s effectiveness. Climate plan progress needs to be regularly evaluated and shared with the public to ensure transparency of the plan’s development, implementation and outcomes.

Periodic evaluation of the climate plan allows for adjustments to be made, validates progress towards goals, keeps the public interested, and celebrates plan successes (Office of Energy Efficiency, 2013). Adjustments to the plan can be made, if necessary, when strategies of the climate plan are found to be ineffective at making progress toward the overall goal. Other adjustments may be needed when new data and technologies become available that the city wishes to implement into the plan. Data supporting progress toward the climate goal validates that the efforts and investments made are contributing to reduced emission levels in a measurable and quantifiable manner. The data also provides evidence that the climate plan's longer term goals are realistically obtainable. It is crucial for the public to be continually informed on the plan's progress to keep their interests heightened and to celebrate the plan's successes.

The frequency of progress reporting will vary based on the plan and city, but it is commonly conducted on an annual or biannual basis. Updates to the climate plan should occur on a regular cycle that is clearly defined in the plan. This reporting cycle keeps the plan updated as new strategies and technologies emerge over time. Without regular meetings of the leadership team to review the data and results, the plan may fall out of date and stray farther from achieving its goals.

Chapter 3 - Commercial Building Emission Reduction Strategies

Examining various existing city climate plans currently in effect, it can be seen that commercial buildings typically generate the greatest amount of emissions within a municipality when compared to other emission groups. Because of this, commercial buildings should have a separate emission sector in a city's climate plan. Chapter 3 focuses on examples of commercial building emission reduction strategies that were found within several cities' climate plans. Due to their more significant impact potential, Commercial buildings are often separated from residential for emission reduction consideration, thus this report only focuses on commercial strategies.

Each strategy requires financing, which is necessary to support additional staffing involved with strategy execution, expenses associated with providing incentives, and the cost of strategy implementation. This financing will need to be determined early in the preplanning process of the climate plan, as payback years and dollar per $MTCO_2e$ paybacks should be analyzed to find viable strategies.

To encourage emission-reducing building strategy participation, a city government may offer incentives to building owners to make the implementation of energy efficiency options more affordable. The city may offer rebates and incentives for owners who invest in energy and emission reducing building strategies and should educate owners about these incentives through effective marketing tactics (Deetjen et al., 2018). Incentives may or may not be monetary, depending on the budgeting of the city. The city will need to determine how to finance incentives, whether it be from allocated city budgets, grants, or contracts with utilities. Otherwise, non-monetary incentives will need to be prepared. The following strategies are discussed in this chapter and can be incentivized by the local government: conduct building

benchmarking, retrofit existing buildings, encourage renewable energy, promote energy certifications, and adoption of energy and stretch codes. This is not an all-inclusive list of ways to reduce emissions from buildings, but these are common strategies that have been adopted from climate plans already in effect. Chapter 4 illustrates how these strategies have been applied in specific city climate plans and how these cities have determined financing for strategies and implementation.

Building Benchmarking

A common action for many cities with climate plans is benchmarking. Building benchmarking is the comparison of measured energy performance of a building to that of similar buildings or pre-set benchmarks of modeled simulations (Wang, Yan, & Xiao, 2012). A climate plan that requires benchmarking specifies which buildings need to submit a report. A common example of this would be to require a report from all commercial buildings greater than 50,000 square feet. The leading benchmarking tool available is the ENERGY STAR Portfolio Manager, a free online program through the U.S. Environmental Protection Agency, that allows building owners to compare their properties to similar buildings (Hart, 2015). For benchmarking to be effective, a transparency policy should be adopted that makes energy performances publically available. For example, Minneapolis, Minnesota posts annual reports through their city government website for both private and public buildings in the city (City of Minneapolis, 2018).

By comparing a building's energy use to similar facilities, building owners may identify opportunities for improvements and recognize the benefits of quantifying energy savings (Office of Energy Efficiency, 2019). Though benchmarking, buildings that under-perform are identified, prompting owners to investigate inefficiencies and pursue improvement strategies. Once

changes have been made, any energy savings can be quantified through comparisons to the past performance records for a given building and against the records of other building stock. Cities requiring building energy data to be made available at the time of a building sale, drive the building market to become more competitive as potential buyers are enabled to assess energy usage as an important consideration when evaluating properties. This use of benchmarking strategies in the real estate market gives building owners considering the sale of their property an incentive to reduce energy use of their buildings. The city benefits as well through overall energy reduction and reduced emission levels.

Retrofit Existing Buildings

Existing buildings built under a previous energy code may not be as efficient as new buildings. Because they were built before a city's adoption of a climate plan, any strategies of the plan aimed at new construction of buildings are not be applied to those already in existence. The city may opt to include retrofit programs for existing buildings into their climate plan. Programs targeted at existing building improvements should include strategies designed to bring existing buildings up to a more current energy code.

Existing building programs may also refer to energy saving measures that can be immediately implemented such as energy auditing or retro-commissioning programs. These programs will help buildings identify ways existing equipment and systems can be improved to operate more efficiently (Blumberg, 2018). These reports will also facilitate ways to improve the energy efficiency of an existing building by identifying building system deficiencies that could include actions such as: repairs, cleaning, valve or sensor adjustments, correcting controls and program settings, or changes to operational practices. The city should develop financial

incentives targeted towards existing building owners that encourage them to adopt retrofit programs which allows for greater participation in the climate plan than solely considering programs for new buildings.

Renewable Energy

Cities may adopt programs to expand their renewable energy production and use. Energy that comes from a naturally replenished source such as biomass, hydropower, geothermal, wind, and solar are all examples of renewable energy (U.S. Energy Information Administration, 2018). A climate plan may identify a target of community energy consumption to be a certain percentage of renewable energy by a specified year, such as 50 percent renewable energy by the year 2030 or 100 percent renewable energy by the year 2050. Targets such as this greatly reduce the amount of non-renewable energy used by buildings, thus reducing the total emissions of the city.

Encouraging demand for a net-zero energy construction market through education and incentives is a strategy a city may want to implement in their climate plan. The World Green Building Council (2019) defines a net-zero energy building as one that is highly efficient and is powered completely from on-site and/or off-site renewable energy sources. Net-zero energy buildings consume as much energy as is produced, typically by renewable sources, over the course of a year (Rosenberg, Jonlin, & Nadel, 2017). In some cases, the building may be energy positive and produce more energy than it can consume, and the building is able to sell excess energy back to the electricity grid (Portland, 2015).

Building Energy Certifications

A city climate plan may choose to require new or majorly renovated buildings to obtain a building energy certification. To obtain an energy certification, a building must meet a certain energy performance specified by an authorized institute (Wang, Yan, & Xiao, 2012). These programs typically include an energy rating process or energy labeling scale that quantifies energy use and specifies a minimum performance the building must meet. If the climate plan did not require an official energy certification for new construction, the city may instead provide incentives to building owners who voluntarily elect to earn a certification with rewards such as lower permit fees or an accelerated review process. The climate plan may require city-operated buildings and facilities to earn a specific energy certification.

Some of the more common energy certifications in the U.S. are LEED, ENERGY STAR, Green Globes, Building EQ, and Living Building Challenge. LEED, or Leadership in Energy and Environmental Design, by the U.S. Green Building Council is an internationally recognized green building rating system that works through a points or credit system to provide healthy, highly efficient, and cost-saving buildings (USGBC, 2019). ENERGY STAR rated buildings certified by the U.S. Environmental Protection Agency are widely recognized as being a symbol of energy efficiency and use on average 35 percent less energy than non-rated buildings (ENERGY STAR, 2019). Green Globes is an online green building rating and certification tool administered in the U.S. by the Green Building Initiative and is a self-assessment questionnaire-based platform (Green Globes, 2019). Building EQ by ASHRAE is a quick energy analysis that analyzes a building's energy performance through an online portal that provides a free score (ASHRAE, 2018). Living Building Challenge, by the International Living Future Institute, aims to create buildings that "give more than they take" and requires performance standards be

demonstrated through seven areas: place, water, energy, health and happiness, material, equity, and beauty (International Living Future Institute, 2019).

Building Energy Codes

One way to ensure all newly constructed and renovated buildings in a city are performing better in terms of energy efficiency is to adopt a newer version of building energy codes. Building energy codes define the minimum performance related to energy consumption. Model building energy standards and codes, which are developed and maintained by independent organizations, are developed through the International Code Council (ICC) and ASHRAE with the assistance of the Illuminating Engineering Society and the American National Standards Institute (Cohan, 2016). Both organizations develop codes or standards which are updated every 3 years. ICC developed the International Energy Conservation Code (IECC) to regulate minimum energy conservation requirements for new buildings (International Code Council, 2017). ASHRAE developed Standard 90.1 to serve as the minimum energy efficiency for commercial buildings (ASHRAE, 2016). Standard 90.1 provides minimum energy efficiency requirements for new construction of buildings and their systems, new additions to existing buildings and their systems, and new systems and equipment installed into existing buildings.

Energy codes and standards can be adopted by federal, state, and local governments, but local adoption is most relevant for city climate plans (Cohan, 2016). The Federal Government requires the Department of Energy (DOE) review each newly published model energy code to determine if the code results in an increased energy efficiency. The DOE issues a conclusion of results and declares whether the newest energy code is more stringent than its predecessor and by what degree. By adopting a newer version of the energy code, a jurisdiction can assure that their

newly constructed buildings are meeting a minimum level of energy efficiency greater than that of the previous code.

Financing implications need to be considered when determining the version or level of energy codes to be adopted. A municipality must account for the costs of training code officials and building industry professionals on the new code. Building energy codes and standards are developed with the intent of being cost effective through a return on investment from energy savings realized over the life of the building (Nelson, 2012). Jurisdictions with higher energy costs experience a greater monetary benefit from more rigorous energy codes because increased energy efficiency reduces the cost of building operations. Updated building energy codes advocate for advancements in technology within a jurisdiction as the new codes are written to stay current with the latest developments in building science and technology (Vaughan & Turner, 2013).

Stretch Codes

Stretch codes are a more aggressive, alternate compliance path to a model energy code or standard that results in more energy efficient buildings (New Building Institute, 2019). Buildings under a stretch code are required to be designed to a higher energy efficiency than the base model code or standard. Stretch codes promote advancements in technology and are written to encourage greater energy efficiency than the minimums defined in the IECC or Standard 90.1. Commonly, a version of the IECC or ASHRAE 90.1 is adopted as the foundational document, then additional requirements are defined by the jurisdiction in the adopted stretch code language (U.S. Department of Energy, 2013).

When adopting stretch code content, it may be necessary to have stakeholders' input through advisory group meetings (New Building Institute, 2018). Stakeholders can include code officials, housing agencies, elected officials and their staff, local building owners, engineers, architects, contractors, utilities, and energy efficiency organizations. The stakeholders should review and suggest modifications to the code language based on their knowledge, experience, and perspective.

Leading by Example

City governments should lead by example through the adoption of the strategies created in the climate plan for municipally-owned buildings. If the plan were to call for participation in building strategies, the city would implement those strategies within their own buildings and properties. The advantage of this is to show the community that the government is invested in the new climate plan and is committed to emission reduction. For a climate plan to be effective, the city government needs to implement all strategies of the plan onto their own buildings and properties if they hope for the same implementation to be accepted by members of the community.

Each of the strategies addressed in this chapter should be implemented by the city government on city-owned buildings and properties. A city looking to create a climate plan should also examine examples of plans already in effect to see how other governments are fighting climate change by reducing emission levels in their communities. A building emission reduction strategies may work for one city but not another. It is beneficial to recognize the successful strategies of different climate plans from example cities to determine what should be utilized in a new climate plan. Chapter 4 of this report addresses how climate plans have been

executed in various cities across the United States and provides examples for cities creating new climate plans who are looking to reduce emissions within their city through reduction strategies.

\

Chapter 4 - Case Studies

The prior chapters have addressed development considerations and the content commonly included in climate plans, however, it is also important to examine active climate plans that are proving successful in different municipalities. This is especially helpful to cities who are exploring the options for a new plan. This chapter outlines and compares different city climate plans currently being implemented to provide this perspective. Nine city climate plans were selected for analysis. The criteria used for selection took into consideration their position on the American Council for an Energy-Efficient Economy's (ACEEE) most recent 2017 ranking of U.S. cities on energy efficiency policy and program efforts, city population, age of the city plan, and plan strategies that had quantifiable goals. Every city selected was one of the 407 members of the U.S. Climate Mayors agreement which expressed a commitment to adopt, honor, and uphold the Paris Agreement goals in response to the 2017 U.S. decision to withdrawal from the Paris Agreement (Climate Mayors, 2017).

Each year, ACEEE ranks the largest U.S. cites on energy efficiency policy and program efforts. Many of these larger cities ranked highly due to the climate plans created by these cities which have measurably reduced emission levels. The most recent list from 2017 was reviewed to select greater population cities with climate plans for analysis. Selection was intentionally not limited to the top nine ranked cities to demonstrate that there are cities accomplishing great things besides those that are regularly identified as the most progressive in energy efficiency and emission reduction.

Population differences and age of the plan was additional criteria evaluated for selecting city plans to use as examples for analysis, because it is important to show not only that larger-population cities are utilizing climate plans, but also cities with smaller populations. Cities were

categorized as large that have a population over 500,000 people, medium that have a population between 100,000 and 500,000 people, and small that have a population less than 100,000 people. A variety of city sizes is necessary to demonstrate building emission reducing strategies from small and large cities, which often have different building sizes and types. While a larger city may have high-rises, these types of buildings likely won't be found in many smaller cities. Both older and newer plans were selected for each city size to show it is not too late to for any sized city to create a climate plan, but also to show the progress older plans have achieved over the years.

Cites were also selected based on their climate plans having quantifiable goals. This means that each plan had goals that could be assigned with a numerical value for comparison and monitoring. Every plan selected had an emission reduction percentage that the city wished to reach by a specified year. By analyzing cities with quantifiable goals, the success of the cities' climate plan can be analyzed graphically and compared to one another.

The cities selected are shown on a map of the U.S. in Figure 4.1. Three large cities were selected: Portland, OR; Denver, CO; and Philadelphia, PA (indicated by a green dot). Three medium cities were selected: Cleveland, OH; Minneapolis, MN; and Pittsburgh, PA (indicated by a purple square). Three small cities were selected: Aspen, CO; Blacksburg, VA; and Flagstaff, AZ (indicated by a red triangle). Each of the following sections provide an overview of the city, its climate plan details, and total emission levels within those cities during the baseline year of measurements and the most recent year of data available. These total emission levels are made up of the emission sectors included in the "Emission Sectors Included in Total Emissions", and the protocol used for emission level collection is also provided. Each plan breakdown provides an overview of the climate plan, how the plan addresses commercial

building emissions, and how the city intends to implement the plan moving forward. An analysis of these nine city plans that compares emission reduction progress and climate plan contents located at the end of the chapter.

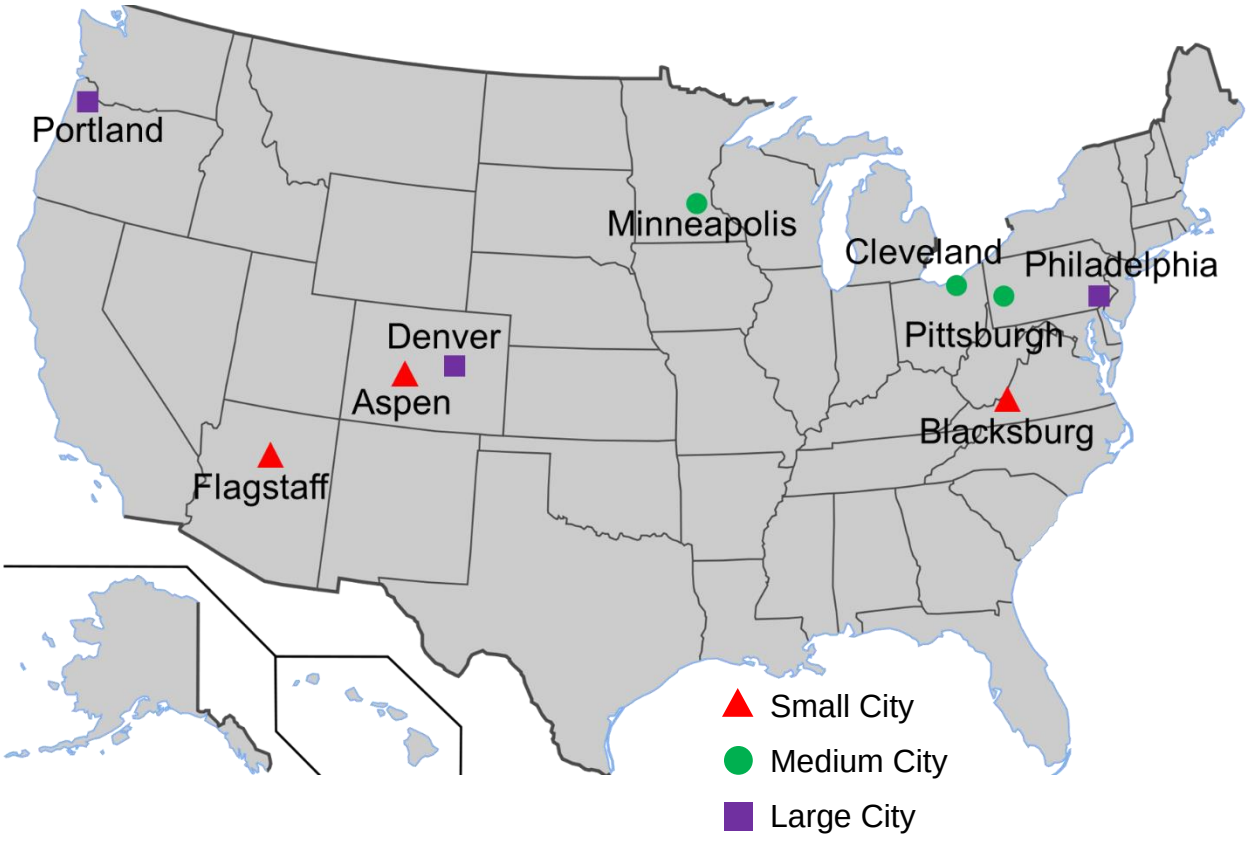


Figure 4.1 U.S. Map Locations of Selected Climate Plan Cities
(Map modified from Wikimedia Commons, 2012)

Portland, Oregon (Large City)

Oregon has a statewide goal to reduce carbon emissions by 10 percent of 1990 levels by the year 2020 and 75 percent by the year 2050 (City of Portland, 2015). Portland, Oregon has already reduced carbon emissions by 14 percent since 1990, even with a population increase of 31 percent over that time period (City of Portland, 2018). The city was ranked number four in the ACEEE's most recent 2017 ranking of the largest U.S. cities on energy efficiency policy and

program efforts (ACEEE, 2017). Portland has a population of roughly 652,000 people, and is the most populated city in Oregon, covering a land area of about 133.5 square miles (World Population Review, 2019a). Portland has a history of working to reduce carbon emissions in the city, beginning with the 1993 Carbon Dioxide Reduction Strategy. In 2001, the Reduction Strategy was followed by the Multnomah County-City of Portland Local Action Plan on Global Warming, and later with the Climate Action Plan in 2009.

Plan Overview

Population: 652,000

Plan Name: Climate Action Plan

Year Created: 2009

Last Updated: 2015

Update Cycle: 5 years

Plan Goal: Reduce carbon emissions by 80 percent from 1990 emission levels by the year 2050, with an interim goal of 40 percent reduction by the year 2030.

1990 Emission Levels (Baseline):

Total: 8,989,460 metric tons of CO_2 equivalent ($MTCO_2e$)

Buildings: 5,512,000 $MTCO_2e$

2013 Emission Levels:

Total: 7,695,000 $MTCO_2e$ (14.4 % reduction from 1990)

Buildings: 4,772,000 $MTCO_2e$ (13% reduction from 1990)

2050 Emission Levels (Goal):

Total: 1,777,000 $MTCO_2e$ (80% reduction from 1990)

A complete list of emission values is provided on Table 4.1 (City of Portland, 2015)

Emission Sectors Comprised in Total Emissions: Buildings, transportation, and waste disposal.

Emission Measurement Process: ICLEI-Local Governments for Sustainability U.S. Community Protocol.

Building Energy Goals: Reduce the energy use of all buildings built before the year 2010 by 25 percent, achieve zero-net carbon emissions in new buildings and homes, and 50 percent of all energy to buildings to come from renewable resources.

Plan URL: https://www.portlandoregon.gov/bps/49989

Climate Plan

The Climate Action Plan was adopted in 2009 in Portland and Multnomah County and is run by Portland's Office of Planning and Sustainability (City of Portland, 2015). The goal of the plan is to reduce carbon emissions 80 percent from 1990 levels by the year 2050 with an interim goal to reduce emissions by 40 percent by the year 2030. The plan has 20 objectives and over a hundred actions the city wishes to complete or have underway by 2020 when the next plan update is to occur, three of which are aimed at building energy use.

Buildings and Energy

The Climate Action Plan has identified buildings to be the largest contributor to carbon emissions in Multnomah County, making up 62 percent of total emissions in 2013 (City of Portland, 2015). The plan identifies two changes that must be made to reduce these emissions:

improve energy efficiency in existing and new buildings and increase the use of renewable energy used. The objectives for emission reduction in buildings by 2030 are to reduce the total emissions of all buildings built before the year 2010 by 25 percent and to achieve zero-net carbon emissions of all new commercial buildings and houses. The city also plans for 50 percent of building energy supply to come from renewable resources with 10 percent of that renewable energy being produced in Multnomah County.

To accomplish these objectives, Portland needs to complete specific actions by the year 2020, when the next plan update will occur. These actions include the implementation of a program that requires building energy performance ratings, reduces the dependency on fossil fuels and coal for electricity, and increases the use of renewable energy (City of Portland, 2015). The city also plans to continue actively participating in revisions to the Oregon building energy code to help incorporate net-zero energy efforts and design practices and help the state develop a market for renewable energy. The building section of the Climate Action Plan can be found in Appendix A.

Implementation and Moving Forward

To achieve the Climate Action Plan objectives, Portland must have the support of government staff and its community for implementation. The goal for plan implementation is for the city's staff to work across departments and bureaus. The actions listed in the climate plan for implementation are to be achieved by the next update in 2020. These actions are fostering community engagement, cross-agency collaboration and training, green energy career training, partnerships, development of climate action metrics, and annual progress reports (City of Portland, 2015).

The government must lead the community by example through implementation of the plan into city operations. As a result of this, Portland's annual energy bill was about $5.7 million less and carbon emissions from city operations were down 17 percent from the 2006-2007 fiscal year (City of Portland, 2015). To further commit to its goals, Portland adopted a renewed set of Sustainable City Government Principles and Environmental Performance Objectives. The city government also passed the Green Building Policy for city-owned facilities that requires new city-owned buildings to register and be certified at a LEED gold level or higher and/or achieve Living Building Challenge status (ACEEE, 2017). It also requires existing city-owned and occupied buildings to achieve LEED silver and G-rated Tenant Improvement Guide certification. Portland is also seeking to provide more opportunities for its lower-income population to participate in energy efficiency and renewable energy programs. The city smartly recognizes that reaching for efficiency and energy goals should benefit lower-income citizens instead of burdening them.

Denver, Colorado (Large City)

Denver, Colorado has a population of approximately 704,600 people (Murray, 2018) and covers about 153 square miles (World Population Review, 2019b). Denver was named ninth on the ACEEE's 2017 ranking of the largest U.S. cities on energy efficiency policy and programs (ACEEE, 2017). In 2007, Denver released its first Climate Action Plan and was one of the first U.S. cities to sign the Mayor's Climate Protection Agreement of the U.S. Conference of Mayors, the Mayor's National Climate Action Agenda, and the Global Covenant of Mayors (City of Denver, 2018). Significant progress has been made in meeting these agreements with the release of the city's Climate Adaption Plan and its 2015 update. The Climate Adaption Plan exists as a

supplement to the Climate Action Plan and offers strategies to adapt to future climate change. The Climate Action Plan, renamed the 80x50 Climate Action Plan, was updated in 2015 and establishes a long term goal to reduce emission levels by 80 percent by the year 2050 using 2005 emission levels as a baseline. Denver's greenhouse gas inventory was updated in 2017 to meet global reporting protocols and detailed analysis.

Plan Overview

Population: 704,600

Plan Name: 80x50 Climate Action Plan

Year Created: 2007

Last Updated: 2018

Update Cycle: none currently in place

Plan Goal: Reduce emission levels by 80 percent by the year 2050 from a baseline of 2005 emissions, with interim goals of 15 percent reduction by 2020, 30 percent by 2025, 45 percent by 2030, 55 percent by 2035, 65 percent by 2040, and 75 percent by 2045.

2005 Emission Levels (Baseline):

Total: 13,200,000 $MTCO_2e$

Buildings: 7,045,000 $MTCO_2e$

2015 Emission Levels:

Total: 12,700,000 $MTCO_2e$ (3.8% reduction from 2005)

Buildings: 6,430,000 $MTCO_2e$ (8.7% reduction from 2005)

2050 Emission Levels (Goal):

Total: 2,640,000 $MTCO_2e$ (80% reduction from 2005)

A complete list of emission values is provided on Table 4.1 (City of Denver, 2019)

Emission Sectors Comprised in Total Emissions: Building energy use, transportation, waste, and material use.

Emission Measurement Process: Global Protocol for Community-Scale Emission Inventories.

Building Energy Goals: Reduce emission levels by 50 percent in commercial buildings from a baseline of 2005 levels by the year 2050 and net-zero energy by new buildings by 2035.

Plan URL: https://www.denvergov.org/content/denvergov/en/environmental-health/environmental-quality/climate.html

Climate Plan

The 80x50 Climate Action Plan stakeholders consist of the Technical Advisory Committee and the Task Force. During the creation process, the Technical Advisory Committee worked to create a list of emission reductions while the Task Force integrated the summary matrix of the Technical Advisory Committee into a larger framework to create a plan to meet the 80x50 climate goals. Denver's 80x50 Climate Action Plan has an overall goal of reducing the city's emissions 80 percent by the year 2050 from its 2005 emission levels (City of Denver, 2018). The 2018 plan lays out interim goals for emission reductions: 15 percent reduction by 2020, 30 percent reduction by 2025, 45 percent reduction by 2030, 55 percent reduction by 2035, 65 percent reduction by 2040, and 75 percent reduction by 2045. The use of multiple interim

goals along with set goals for buildings, transportation, and the city's electricity supply, defines the progression towards the overall 2050 goal.

Buildings and Energy

The overall building goals for Denver are a reduction of emission levels by 50 percent in commercial buildings from a baseline of 2005 levels by the year 2050 and net-zero energy of new buildings by 2035. To achieve this, Denver has planned to adopt the 2018 IECC as part of its plan to decarbonize buildings within the city (City of Denver, 2018). The government also plans to participate in the IECC code update process to influence the adoption of more stringent energy codes. Along with the 2018 IECC, the city plans to develop a stretch code with incentives for new buildings and an energy performance program that would require less efficient existing buildings to make periodic cost-effective and incremental energy improvements. The city anticipates adopting new building energy codes when released while also requiring net-zero new construction by the year 2035. Denver will continue with its Energize Denver program, which focuses on energy efficiency in commercial and multifamily buildings and includes benchmarking requirements. The building section of the Climate Action Plan can be found in Appendix B.

Implementation and Moving Forward

Denver plans to continually reassess the strategies and goals within the plan to stay up-to-date with technological advancements, economic trends, and climate science (City of Denver, 2018). Denver's 80x50 Climate Action Plan does not have a specific section for implementation techniques, but the city has sought community feedback after an extensive stakeholder creation

process. Denver citizens were encouraged to take the 80x50 Climate Goal Survey and attend community presentations over the report. Over 1,700 citizens responded to the survey, with 93 percent of citizens somewhat or strongly agreeing that Denver needs to take aggressive local action to combat climate change. In working towards implementing strategies, the survey discovered that 55 percent of citizens ranked climate impacts as the most important consideration, with the second most important consideration being to account for equality of strategies and solutions.

Philadelphia, Pennsylvania (Large City)

Philadelphia, Pennsylvania is the fifth largest city in the U.S. with a population of about 1,556,00 and covers approximately 134 square miles of land (World Population Review, 2019c). Philadelphia was named twelfth on ACEEE's 2017 ranking of the largest U.S. cites on their energy efficiency policies and programs (ACEEE, 2017). Philadelphia created Greenworks: A Vision for a Sustainable Philadelphia in 2016 to start the city's climate planning (City of Philadelphia, 2017). The city's Office of Sustainability partnered with a consultant to develop a citywide energy model to determine energy usage and carbon emission trajectories. Through this development, the future of Philadelphia's commitment towards its climate goals could be better understood, which led to the development of their climate plan entitled Powering Our Future: A Clean Energy Vision for Philadelphia.

Plan Overview

Population: 1,556,000

Plan Name: Powering Our Future: A Clean Energy Vision for Philadelphia

Year Created: 2017

Last Updated: N/A

Update Cycle: none currently in place

Plan Goal: Reduce emission levels 80 percent by the year 2050 from baseline levels in 2006, with an interim goal of a 28 percent emission reduction from 2006 levels by 2025.

2006 Emission Levels (Baseline):

Total: 22,886,103 $MTCO_2e$

Buildings: 13,996,862 $MTCO_2e$

2012 Emission Levels:

Total: 20,883,359 $MTCO_2e$ (8.8% reduction from 2006)

Buildings: 12,585,450 $MTCO_2e$ (10.1% reduction from 2006)

2050 Emission Levels (Goal):

Total: 4,577,221 $MTCO_2e$ (80% reduction from 2006)

A complete list of emission values is provided on Table 4.1 (City of Philadelphia, 2013)

Emission Sectors Comprised in Total Emissions: Buildings, transportation, streetlights and traffic signals, solid waste, water treatment, wastewater treatment, upstream impacts, and fugitive and process emissions.

Emission Measurement Process: ICLEI-Local Governments for Sustainability U.S. Community Protocol.

Building Energy Goals: Modernizing building energy codes, building code compliance, incentives for high-performance buildings, requirements for existing buildings, and city government leading by example.

Plan URL: https://www.phila.gov/documents/powering-our-future-a-clean-energy-vision-for-philadelphia/

Climate Plan

Powering Our Future, published in 2017, is organized by Philadelphia's Office of Sustainability (City of Philadelphia, 2017). The plan has an overall goal of reducing baseline 2006 emission level amounts by 80 percent by the year 2050, with an interim goal of 28 percent emission reduction by the year 2025. To meet these goals, all levels of government and the community will work within the following five categories: clean electricity supply, citywide solar, energy-efficient homes and businesses, low-carbon thermal energy, and low-carbon economy.

For a clean electricity supply, the power plants within the city's regional grid will need to be generating carbon-free electricity by 2050 (City of Philadelphia, 2017). Citywide solar is the city's goal of installing solar generation on surfaces throughout Philadelphia. The city plans to also reduce the reliance on fossil fuel energy for heating and domestic hot water to buildings to help with the goal of low-carbon thermal energy. Additionally, the city is working with the community and stakeholders to move towards cleaner economic opportunities. The city has published a list of immediate steps that may take to allow Philadelphia to meet their goals of a zero-carbon future in accordance with the 2018 Clean Energy Vision Action Plan.

Buildings and Energy

The Powering Our Future's plan for efficient buildings includes updating building energy codes, increasing building energy code compliance, creating incentives for high-performance

buildings, creating more requirements for existing buildings, and leading by example as a city government (City of Philadelphia, 2017). Philadelphia recently adopted the 2018 IECC for commercial buildings from the previous 2009 code. This is projected to make new buildings as much as 30 percent more efficient (City of Philadelphia, 2017). The city plans to remain current with building energy codes by adopting them every three years as they are being developed. Requirements of energy code compliance extend beyond new buildings to any project that requires a city construction permit. This policy includes renovations, additions, and alterations to existing buildings. With the adoption of up-to-date building energy codes, the city must ensure building code compliance. The city will bring in third-party energy code consultants with greater expertise to assess code compliance. Requirements for energy modeling and disclosure for new construction projects will connect building code compliance to the city's existing building benchmarking plan.

Incentives for high-performing buildings will encourage developers to go beyond the energy code defined minimums. One incentive is permit streamlining which allows for shorter permit issuing when a project meets certain conditions (City of Philadelphia, 2017). The city will also provide a property tax incentive for high-performing new buildings and impose an impact fee on all large new residential, commercial, or renovations projects that don't follow through with obligations during the development process or post construction.

The city has the authority to set requirements for existing buildings, such as the city's existing benchmarking program (City of Philadelphia, 2017). The addition of climate plan-related building requirements, such as expanding the benchmarking program to include smaller buildings, creating building update programs, and requiring energy values be provided at time of sale will serve to reduce carbon emissions from Philadelphia's many existing structures. The

Philadelphia government plans to lead by example through reducing energy consumption and emissions from city-owned and operated facilities. This local government leadership will also be demonstrated through the development of an energy master plan, conducting energy retrofits, and creating a sustainability fund. The building section of Powering Our Future can be found in Appendix C.

Implementation and Moving Forward

Philadelphia received feedback through a public comment period after publishing their climate plan, which led to the creation of the Clean Energy Vision Action Plan. The Clean Energy Vision Action Plan was the community's approval of Powering Our Future that identifies programs and policies that can be started by 2020. The following focus areas have been identified: implementing the municipal energy master plan, growing existing clean energy programs, creating new local programs and policies to advance clean energy, promoting new state legislation to advance clean energy, achieving climate goals beyond the built environment, and advocating for additional planning, education, and advocacy. By fully implementing this Clean Energy Vision Action Plan, the carbon emission reductions can reach nearly 10 percent of baseline 2006 levels by the year 2020. Moving forward, the Office of Sustainability will begin reporting progress of the Vision Action Plan and updating the document to show the progress made towards meeting the city's energy vision.

Cleveland, Ohio (Medium City)

Cleveland, Ohio has a population of about 385,525 and covers roughly 78 square miles, making it the second largest city in Ohio (World Population Review, 2018d). Cleveland ranked

twenty-sixth on ACEEE's 2017 ranking of the largest U.S. cities on energy efficiency policy and program efforts (ACEEE, 2017). In 2009, the city hosted its first Sustainable Cleveland 2019 Summit with a goal to transform the city into a "Green City on a Blue Lake" in ten years. Through this program, the city's Office of Sustainability launched the Climate Action Plan in 2013 to combat emissions.

Plan Overview

Population: 385,525

Plan Name: Cleveland Climate Action Plan

Year Created: 2013

Last Updated: 2018

Update Cycle: 4-5 years

Plan Goal: Reduce emissions by 80 percent below 2010 emission levels by the year 2050, with interim goals of 16 percent reduction by 2020 and 40 percent reduction by 2030.

2010 Emission Levels (Baseline):

Total: 12,843,000 $MTCO_2e$

Buildings: 7,278,000 $MTCO_2e$

2016 Emission Levels:

Total: 12,542,000 $MTCO_2e$ (2% reduction from 2010)

Buildings: 6,098,000 $MTCO_2e$ (16% reduction from 2010)

2050 Emission Levels (Goal):

Total: 2,568,600 $MTCO_2e$ (80% reduction from 2010)

A complete list of emission values is provided on Table 4.1 (City of Cleveland, 2016)

Emission Sectors Comprised in Total Emissions: Energy, transportation, waste, and industrial process.

Emission Measurement Process: Global Protocol for Community-Scale Greenhouse Gas Emission Inventories.

Building Energy Goals: Reduce residential and commercial energy use 50 percent and industrial use by 30 percent by the year 2030, and all large commercial and industrial buildings are tracking and managing energy use by the year 2023.

Plan URL: https://www.sustainablecleveland.org/climate_action

Climate Plan

Cleveland's Climate Action Plan was adopted in 2013 and last updated in 2018. The updated plan was supported by a 90-member Climate Action Advisory Committee and is overseen by the Mayor's Office of Sustainability (City of Cleveland, 2018). The updates build off of the city's previous plan and have an overarching goal to reduce emissions by 80 percent below 2010 emission levels by the year 2050, with interim goals of 16 percent reduction by 2020 and 40 percent reduction by 2030. The focus areas of the plan are energy efficiency and green building, clean energy, sustainable transportation, clean water and vibrant green space, and more local food, less waste. As of 2016, the city saw an overall emission reduction of 2 percent compared to 2010 levels.

Buildings and Energy

Cleveland has two goals for building energy efficiency: to reduce residential and commercial energy use by 50 percent and industrial use by 30 percent by the year 2030, and for all large commercial and industrial buildings to track and manage their energy use by the year 2023 (City of Cleveland, 2018). Three objectives are listed specific to commercial buildings to help achieve these goals. The first is to prioritize energy efficiency in small and mid-size buildings. The second objective is to support community hubs to be more energy efficient and resilient. The last objective is to promote new construction and major renovations that meet high green building standards. For each objective, the plan details the progress made since the last update to the 2013 Climate Action Plan and outlines the actions to be taken until the next update for each objective. The building section of the Climate Action Plan can be found in Appendix D.

Implementation and Moving Forward

Cleveland committed to its efforts in reporting climate action progress by joining the Covenant of Mayors for Climate and Energy, which is an international agreement of cities and local governments with shared visions for promoting action against climate change (City of Cleveland, 2018). The Covenant requires actions plans be made publicly available and defines a common reporting framework. The city also reports its progress through the Carbon Disclosure Project, a non-profit, charity-run global disclosure system designed to help entities manage their environmental impacts. Cleveland was named the 2018 National Winner of the World Wildlife Fund's One Planet City Challenge, which was largely due to the city's climate reporting. Moving forward, the city has identified a need for a dedicated funding stream, specific financing goals and measurable outcomes and buy-in of key leadership across multiple government

sectors. Cleveland also established a prioritization of climate action goals within their civic agenda with a focus on equitable and sustainable economic development. Community-wide support will be needed for plan goals to be realized.

Minneapolis, Minnesota (Medium City)

Minneapolis, Minnesota has a population of roughly 422,300 people and covers about 54 square miles (World Population Review, 2019e). The city was named eleventh on ACEEE's 2017 ranking of the largest U.S. cities on energy efficiency policies and programs (ACEEE, 2017). The city's climate action history dates to 1989 when Minneapolis became one of the first cities in the world to develop a detailed plan to reduce emissions (City of Minneapolis, 2019). In 2012, the city established target emission reduction goals with 2006 as a baseline. In 2013, the Minneapolis Climate Action Plan was adopted.

Plan Overview

Population: 422,300

Plan Name: Minneapolis Climate Action Plan

Year Created: 2013

Last Updated: N/A

Update Cycle: none currently in place

Plan Goal: 15 percent emission reduction from 2006 levels by the year 2015, and 30 percent emission reduction from 2006 levels by 2025.

2006 Emission Levels (Baseline):

Total: 5,173,279 $MTCO_2e$

Buildings: 3,850,396 $MTCO_2e$

2015 Emission Levels (Goal Met):

Total: 4,248,025 $MTCO_2e$ (17.9% reduction from 2006)

Buildings: 3,010,143 $MTCO_2e$ (21.8% reduction from 2006)

2025 Emission Levels (Goal):

Total: 3,621,295 $MTCO_2e$ (30% reduction from 2006)

A complete list of emission values is provided on Table 4.1 (City of Minneapolis, 2019)

Emission Sectors Comprised in Total Emissions: Electricity, natural gas, transportation, solid waste, and wastewater.

Emission Measurement Process: Global Protocol for Community-Scale Greenhouse Gas Emission Inventories.

Building Energy Goals: 20 percent energy efficiency in commercial buildings by 2025, 10 percent of total consumed electricity from local and directly purchased renewables, and 1.5 percent annual reduction in emissions from city facilities.

Plan URL: http://www.minneapolismn.gov/sustainability/climate-action-goals/climate-action-plan

Climate Plan

Minneapolis's Climate Action Plan was developed by a steering committee and technical advisory groups composed of technical experts and community representatives. It was adopted by the city council in 2013 (City of Minneapolis, 2013). The Climate Action Plan is currently supported by the Minneapolis Sustainability Department. The plan focusses on reducing

emissions in three areas: buildings and energy, transportation and land use, and waste and recycling. The emission goals of the plan are to reduce emission levels of the city by 15 percent by 2015 and 30 percent by 2025 from baseline levels from 2006. Minneapolis met its 2015-15 percent reduction goal by reducing emission levels 17.9 percent, 2.9 percent better than the goal (City of Minneapolis, 2019). In 2014, the city passed an 80 percent greenhouse emission reduction goal by the year 2050 not previously stated in the Climate Action Plan.

Buildings and Energy

The Climate Action Plan states three goals for commercial buildings and energy in Minneapolis: achieve 20 percent energy efficiency in commercial buildings from a 2006 baseline by the year 2025, have 10 percent of electricity consumed by the year 2025 be provided by local and directly purchased renewables, and to achieve a 1.5 percent annual reduction in emissions from city facilities (City of Minneapolis, 2013). To achieve this, the city has listed strategies for residential, commercial, and industrial buildings, as well as overall strategies to reduce emissions from buildings.

Minneapolis plans to develop a Green Zone Initiative, which will create zones for environmental and economic development to target new green infrastructure and retrofits (City of Minneapolis, 2013). The city government plans to lead by example in ensuring city facilities and infrastructures are models of energy efficiency and renewable energy technology. Minneapolis will support the state of Minnesota's adoption of the latest IECC and IGCC and plans to adopt the latest IGCC locally. The city will support reduction plans by other government entities and institutions as well as small and minority-owned businesses in hopes of expanding their climate plan.

For commercial buildings, the city will continue to host its annual Kilowatt Crackdown, an energy reduction challenge where building owners track their energy use over the course of two years and compare it to a benchmark of the previous year. The buildings with the greatest energy reduction receive awards. The city plans to begin requiring benchmarking and publication of energy data annually and it will explore incentive options for commercial buildings to investigate the energy saving benefits of transitioning janitorial work to day shift hours. The building section of the Climate Action Plan can be found in Appendix E.

Implementation and Moving Forward

The Climate Action Plan outlines five implementation goals for meeting its emission reduction targets. The first goal is to prioritize high impact, short timeframe, equitable, and cost-effective strategies (City of Minneapolis, 2013). This means the city will make it a priority to complete strategies that will prove most effective, quick, and affordable for emission reduction. The second goal is to seek strategies with multiple benefits. The third goal is to ensure fairness in the benefits of reduction strategies so as not to burden any part of the community. The fourth goal is to monitor progress on an annual basis and review goals and strategies based on progress every three years as a minimum. The last goal is to assess and build resiliency to climate changes and impacts. This goal acknowledges climate change is being felt in the city, and potential impacts as well as appropriate responses should be explored. Since the plan creation, the city has passed the objective of reducing emission levels by 80 percent by the year 2050 to expand upon the Climate Action Plan goal of 30 percent reduction by the year 2025 (City of Minneapolis, 2019).

Pittsburgh, Pennsylvania (Medium City)

Pittsburgh, Pennsylvania is the second largest city in Pennsylvania with a population of about 306,500 people and covers 55.4 square miles (World Population Review, 2019f). Pennsylvania has reached emission levels high enough to rank as the world's twenty-second largest emitter of CO_2, comparable to some of the world's largest nations (City of Pittsburgh, 2018). Moving past Pittsburgh's steel industry, the city has since enacted the first Clean Air Act in the U.S. Pittsburgh was named seventeenth of ACEEE's 2017 ranking of largest U.S. cities on energy efficiency policies and programs (ACEEE, 2017). In 2007, the city signed the U.S. Mayors Climate Protection Agreement that signified the commitment to implementing emission reducing solutions and reducing long-term energy use (City of Pittsburgh, 2018). The city adopted its first Climate Action Plan in 2008, developed by the Green Government Task Force under the Pittsburgh Climate Protection Initiative. This first climate plan outlined strategies for reducing emissions in the city. The plan was updated in 2012 and is in the process of being updated once again. This overview focuses on the current draft of the third version of the climate plan.

Plan Overview

Population: 306,500

Plan Name: City of Pittsburgh Climate Action Plan

Year Created: 2008

Last Updated: 2018 (draft)

Update Cycle: none currently in place

Plan Goal: Reduce emissions by 80 percent compared to 2003 levels by the year 2050, with interim goals of 20 percent reduction by 2023 and 50 percent reduction by 2030.

2003 Emission Levels (Baseline):

Total: 5,300,000 $MTCO_2e$

Buildings: data currently unavailable

2008 Emission Levels:

Total: 6,790,000 $MTCO_2e$ (28.1% increase from 2003)

Buildings: 4,820,900 $MTCO_2e$

2050 Emission Levels (Goal):

Total: 1,060,000 $MTCO_2e$ (80% reduction from 2003)

A complete list of emission values is provided on Table 4.1 (City of Pittsburgh, 2008)

Emission Sectors Comprised in Total Emissions: Residential, commercial, industrial, transportation, and waste.

Emission Measurement Process: ICLEI-Local Governments for Sustainability U.S. Community Protocol.

Building Energy Goals: Reduce energy and water use in existing buildings by 50 percent and achieve carbon neutrality and location efficiency in all new construction by the year 2030.

Plan URL: https://www.nrdc.org/experts/katharine-mccormick/pittsburgh-approves-ambitious-climate-action-plan-update

Climate Plan

Pittsburgh's Climate Action Plan is maintained through the Pittsburgh Climate Protection Initiative, whose job is to ensure the document is implemented (City of Pittsburgh, 2018). The plan was developed in 2008 and has since been updated twice, with the current 2018 version of the plan still being in draft form. The goal of the plan is to reduce emissions by 80 percent compared to 2003 levels by the year 2050, with interim goals of 20 percent reduction by 2023 and 50 percent reduction by 2030. By 2030, the city also has plans for internal operations to use 100 percent renewable energy and have a 100 percent fossil fuel-free transportation fleet. The 2018 action plan is split into six categories: 1) energy generation and distribution, 2) buildings and end use efficiency, 3) transportation and land use, 4) waste and resource reduction, 5) food and agriculture, and 6) urban ecosystems. From 2003 to 2008, the city saw an increase of 28.1 percent total emission levels. According to the 2008 "Pittsburgh Greenhouse Gas Emissions Inventory: A 5-year Benchmark", this increase in emission levels resulted from a multitude of reasons. These reasons include factors such as increased energy usage, expanding transportation data to include all road types, a more accurate natural gas combustion estimate, inclusion of the Bellefield Boiler Plant's coal and natural gas combustion, inclusion of kerosene and fuel oil combustion, and weather differences.

Buildings and Energy

The goals of the Climate Action Plan for reducing emissions from buildings in the city is to reduce energy and water use in existing buildings by 50 percent and achieve carbon neutrality and location efficiency in all new construction by the year 2030 (City of Pittsburgh, 2018). One strategy the city has begun implementing is building benchmarking. This requires all non-

residential buildings 50,000 square feet and larger to report annual water and energy consumption starting in 2018. Building benchmarking improves upon energy developments already seen in the Pittsburgh 2030 District, a Green Building Alliance strategic initiative. The collaborative and nationally recognized community of high performance buildings consists of building owners and managers working together to reduce energy and water consumption. Over 435 commercial buildings in the District have committed to reducing energy and water use by 50 percent compared to 2003 levels by the year 2030.

The city plans to advocate for updated building codes from the state level. Pittsburgh also plans to take action in data collection by aggregating electric consumption data for each of its neighborhoods, as well as natural gas consumption, and potable water use data. Using this data, the city will create a map or matrix of resources for energy efficiency retrofits, create a revolving loan fund for energy and water efficiency retrofits, create a building owner's manual, and expand first time building owner educational classes. The building section of the Climate Action Plan can be found in Appendix F.

Implementation and Moving Forward

To better implement plans for emission reduction, each goal's strategy lists a lead agency or partners. This holds that agency or partner accountable for implementation of the strategy. The draft of version 3 of the plan does not include a clear section on how the city plans to ensure each strategy is otherwise completed, though this may be something yet to be added. The plan does list programs already underway, which demonstrates that the city has been able to implement strategies for emission reductions in the past. Moving forward, Pittsburgh is working to finalize the draft of version 3 of the Climate Action Plan. The city's 2013 10-year benchmark

greenhouse gas inventory for assessing emission reduction progress is under development and the results of that inventory will be used to make adjustments to the new plan.

Aspen, Colorado (Small City)

The city of Aspen, Colorado covers 3.87 square miles and has a population of about 7,100 people (City of Aspen, 2018). Aspen's history of climate change dates to 1989 with the adoption of the Ecological Bill of Rights (City of Aspen, 2017). The Canary Initiative, the original name for the city's Climate Action Department and the city's first greenhouse gas inventory was created and completed in 2004. In 2007, the city developed its first Climate Action Plan and emission reduction goals.

Plan Overview

Population: 7,100

Plan Name: Aspen's Climate Action Plan

Year Created: 2007

Last Updated: 2017

Update Cycle: 3 years

Plan Goal: Reduce emission levels by 80 percent from 2004 levels by the year 2050, with interim goal of 30 percent reduction by 2020.

2004 Emission Levels (Baseline):

Total: 426,017 $MTCO_2e$

Buildings: 252,115 $MTCO_2e$

2014 Emission Levels:

Total: 394,341 $MTCO_2e$ (7.4% reduction from 2004)

Buildings: 223,592 $MTCO_2e$ (11.3% reduction from 2004)

2050 Emission Levels (Goal):

Total: 85,210 $MTCO_2e$ (80% reduction from 2004)

A complete list of emission values is provided on Table 4.1 (City of Aspen, 2014)

Emission Sectors Comprised in Total Emissions: Building energy, transportation, landfill, and wastewater.

Emission Measurement Process: ICLEI-Local Governments for Sustainability U.S. Community Protocol.

Building Energy Goals: Reduce commercial building energy emissions by 80 percent by the year 2050.

Plan URL: https://www.cityofaspen.com/518/Climate-Action-Canary-Initiative

Climate Plan

The 2007 Climate Action Plan created a 10-year goal and has since been updated in 2017 (City of Aspen, 2017). The Climate Action Plan is overseen by the City of Aspen's Climate Action Department. The goal of the plan is to reduce emissions 80 percent by the year 2050 from the city's 2004 baseline emission levels, with an interim goal of reducing emission levels 30 percent by the year 2020. The newly updated Climate Action Plan identifies 46 actions split into six sectors to be completed by the time of the plan's next update in 2020. These actions were developed over four work sessions by a group of over 40 regional experts called the Advisory Committee. The Climate Action Plan has a companion document called the Green House Gas Reduction Toolkit that includes a complete list of strategies that build upon the

Climate Action Plan. The high-impact sectors identified by Aspen for contributing to significant emission levels are the energy supply, residential energy, commercial energy, vehicles and transportation, waste and landfill, and aviation and airport. The total emission reduction achieved between 2004 and 2014 was 7.4 percent. Based on this, the city has concluded that to achieve its 2020 and 2050 goals it must dramatically accelerate the community's reduction rate.

Buildings and Energy

The commercial energy sector is identified by the city as a significant emission producer, contributing to 25 percent of the city's emission levels (City of Aspen, 2017). Commercial energy had a 26 percent emission reduction between 2004 and 2014. If all Toolkit objectives are achieved, commercial energy emission levels are expected to be reduced by 80 percent below 2004 levels by 2050. The following objectives for commercial energy have been identified as needing to be implemented by 2020 for this goal to be achievable: promote energy benchmarking, enhance energy and resource efficiency in new commercial buildings, bring all commercial buildings up to current building codes or retrofit a majority of existing commercial buildings, energy retrofit government buildings, and optimize utility rates.

The city plans to support commercial building benchmarking, which will ensure that potential building buyers have a clearer understanding of the energy used by an individual building. For the city to use energy and resources efficiency in new commercial buildings, it will need to begin providing incentives for new and highly remodeled buildings to exceed code minimums and to also place a limit on emissions from future development (City of Aspen, 2017). Aspen plans to bring all commercial buildings up to the current building code or retrofit a majority of existing commercial buildings by developing a program that enforces this policy.

The city plans to lead by example through energy retrofits of government buildings, offices, and facilities to comply with current building codes. To optimize utility rates, the city will adapt utility rates as necessary to incentivize and balance current and future priorities. Providing rate incentives to building owners will promote energy saving measures will help reduce demand on the existing utility infrastructure. The building section of the Climate Action Plan can be found in Appendix G.

Implementation and Moving Forward

To achieve its goals, the City of Aspen's Climate Action Department needs to put objectives into action through implementation strategies. Aspen plans to implement these strategies through continuing consultation with the Advisory Committee and through seeking advice from research experts so that those in leadership positions can make informed plan decisions (City of Aspen, 2017). The city's Action department will also support entities and organizations currently implementing strategies, assume a leadership role in implementation, and maintain an implementation timeline. Finally, the department will establish outreach efforts, measure its implementation action progress, report emission level trends and goal progress, and keep the community informed on progress results. If Aspen can successfully implement all objectives outlined in its Toolkit by 2050, it should be able to achieve a reduction in emission levels by 71 percent below 2004 levels (City of Aspen, 2017). Although this means the city's goal of 80 percent reduction will not be met, emission levels should be far below the forecasted levels of "business as usual" behavior that would have occurred if the new reduction strategies had not been implemented.

Blacksburg, Virginia (Small City)

Blacksburg, Virginia has a population of approximately 45,000 people and covers almost 20 square miles (Town of Blacksburg, 2019). The city had previously committed to adopting policies to reduce carbon emissions by creating a Comprehensive Plan that encouraged sustainable development practices, altered transportation options, required municipally-owned buildings to pursue LEED Silver certification, and launched the Solarize Blacksburg program which quadrupled the amount of residential solar in less than one year. The Solarize Blacksburg program helped the city to be awarded the U.S. Conference of Mayors Climate Protection Award in 2015. In 2016, the city realized it needed to do more to reduce its carbon footprint and developed its Climate Action Plan.

Plan Overview

Population: 45,000

Plan Name: Climate Action Plan

Year Created: 2016

Last Updated: N/A

Update Cycle: none currently in place

Plan Goal: Reduce emission levels by 80 percent below 1990 levels by the year 2050.

1990 Emission Levels (Baseline):

Total: 382,355 $MTCO_2e$

Buildings: 289,348 $MTCO_2e$

2012 Emission Levels:

Total: 366,427 $MTCO_2e$ (4.2% reduction from 1990)

Buildings: 292,486 $MTCO_2e$ (1.1% increase from 1990)

2050 Emission Levels (Goal):

Total: 76,471 $MTCO_2e$ (80% reduction from 1990)

A complete list of emission values is provided on Table 4.1 (Town of Blacksburg, 2012)

Emission Sectors Comprised in Total Emissions: Residential, commercial, industrial, municipal, and transportation.

Emission Measurement Process: ICLEI-Local Governments for Sustainability U.S. Community Protocol.

Building Energy Goals: Reduce energy waste in the commercial and industrial sectors, increase the use of renewable energy in the business sector, and increase consumer demand for green business practices.

Plan URL: http://www.blacksburg.gov/departments/departments-l-z/sustainability/climate-protection/climate-action-plan-and-supporting-documents

Climate Plan

Blacksburg's Climate Action Plan was developed in 2016 and is overseen by the Climate Action and Community Sustainability Working Group. The plan is divided into six chapters that cover major emission sectors within the community: 1) residential, 2) transportation, 3) commercial/industrial, 4) food, waste and recycling, 5) land use, and 6) renewable energy (Town of Blacksburg, 2016). Each chapter lists goals for that sector, objectives and benefits of meeting those goals, a description of existing conditions, and challenges and opportunities for that sector. The chapters also list individual actions that the community can undertake, short-term strategies

with a 2 to 5-year implementation goal, and long-term strategies with a 5 to 15-year implementation goal. Each section includes how the city plans to lead by example through implementing strategies into municipally-owned facilities. To develop priority strategies, the city examined available information on policies and technologies that would likely reduce emissions. The strategies were prioritized by the Climate Action Plan Working Group, with the criteria of securing community support for each action.

Buildings and Energy

Blacksburg's goals for commercial buildings and energy include reducing energy waste in commercial and industry sectors, increasing the use of renewable energy in business sectors, and increasing consumer demand for green business practices (Town of Blacksburg, 2016). The city climate plan lists ways that individuals can take action to help achieve these goals, including promoting green business practices. Short-term strategies outlined by the city include encouraging industrial facilities to take advantage of energy efficiency programs, analyzing solar capacity on commercial building roof space, creating a local green business certification program, and committing to leading by example with LEED certified government buildings. Long-term strategies include encouraging an energy coalition between businesses to share energy efficient improvements, providing incentives for commercial energy upgrades or LEED certified buildings, and offering free or reduced-cost analysis for commercial buildings to demonstrate return on investment timelines of efficiency upgrades. The building section of the Climate Action Plan can be found in Appendix H.

Implementation and Moving Forward

The city has focused on community efforts to reduce emissions. Each emission sector in the Climate Action Plan identifies individual actions that can be taken by members of the community. These include small actions to be undertaken right away and larger actions that will achieve greater impacts but may require more time or resources to implement. The plan does not specifically list the city's methods for implementation. Moving forward, the plan has been organized into strategies that can be done within a 2 to 5-year or a 5 to 15-year time frame.

Flagstaff, Arizona (Small City)

Flagstaff, Arizona has a population of almost 66,000 people and consists of over 64 square miles (City of Flagstaff, 2018). The city has previously taken steps in reducing its environmental impact. In 2007, the Sustainability Commission was created to address issues of climate and air quality, transportation, energy, solid waste, water, and sustainable building practices (City of Flagstaff, 2018). The City of Flagstaff Resiliency and Preparedness Study was created in 2012 to identify risks resulting from climate change to city operations and services. In 2014, the city started to require all occupied city-owned new construction and major renovations to achieve certification through a recognized sustainability assessment program such as: LEED silver or higher status, Green Globes Three Green Globes rating, or the Living Building Challenge. In 2018, Flagstaff adopted its first Climate Action and Adaption Plan.

Plan Overview

Population: 66,000

Plan Name: Climate Action and Adaption Plan

Year Created: 2018

Last Updated: N/A

Update Cycle: 5 years

Plan Goal: Reduce carbon emissions by 80 percent from 2016 emission levels by the year 2050, with interim goals of 15 percent reduction by 2025 and 30 percent reduction by 2030.

2016 Emission Levels (Baseline):

Total: 787,315 $MTCO_2e$

Buildings: 338,545 $MTCO_2e$

2050 Emission Levels (Goal):

Total: 157,463 $MTCO_2e$ (80% reduction from 2016)

A complete list of emission values is provided on Table 4.1 (City of Flagstaff, 2018)

Emission Sectors Comprised in Total Emissions: Transportation, solid waste, water and water waste, building energy consumption, and process and fugitive emissions.

Emission Measurement Process: ICLEI-Local Governments for Sustainability U.S. Community Protocol.

Building Energy Goals: Consistent schedule for up-to-date energy code adoption, require zero-net energy construction for new residential and commercial buildings by 2040, and 100 percent renewable energy for municipality buildings by 2025 and the community by 2050.

Plan URL: https://www.flagstaff.az.gov/ClimatePlan

Climate Plan

The Flagstaff Climate Action and Adaption Plan was developed in 2018 through a year-long community and stakeholder meeting process, and it is now overseen by the city council (City of Flagstaff, 2018). The process included public open houses, online surveys, meetings with organizations, neighborhood groups, and county representatives, a steering committee, and workshops with technical experts. The plan was designed to achieve the following three goals: 1) reduce emissions compared to 2016 emissions by 80 percent by the year 2050, 2) make neighborhoods, systems, and resources in the city more resilient to climate change impacts, and 3) address climate change to prioritize those most impacted and to ensure cost and benefits of adaption are fairly distributed. The climate plan's interim goals are 15 percent reduction by the year 2025 and 30 percent reduction by 2030. The plan has divided strategies in the following categories: natural environment, water resources, energy, transportation and land use, waste and consumption, public health, services, facilities, and safety, and economic prosperity and recreation.

Buildings and Energy

Roughly half of Flagstaff's emissions comes from building energy consumption (City of Flagstaff, 2018). Through the Climate Action and Adaption Plan, the city will prioritize the following to reduce emissions from the city's buildings: reduce energy consumption, adopt cost-effective efficiency improvements, maximize renewable energy generation and storage capacity, and meet 100 percent of the community's electric energy needs through renewable energy resources. The city has developed three goals with corresponding actions to achieve these. The first goal is to improve energy efficiency in all sectors. The second is to expand renewable

energy generation and use. Cleaner energy generation and use will lower emissions in all aspects of energy use within the city, including the energy use from city buildings. The third goal is to manage energy demand and consumption in residential, commercial, and industrial sectors to reduce emissions. The building section of the Climate Action and Adaption Plan can be found in Appendix I.

Implementation and Moving Forward

The Flagstaff City Council will oversee the Climate Action and Adaption Plan, (City of Flagstaff, 2018). The city council will also be in charge of making policy decisions to support implementation of the plan. The implementation strategy identifies the city departments responsible for different strategies and defines a timeline for when actions need to be taken. It also includes an outreach strategy that outlines how to maintain momentum and support within the community. Using the Community Action Guide, individuals and households are provided with a list of strategies they can employ to combat climate change at their level. The city of Flagstaff will work with the community, local partners, and technical experts to update the Climate Action and Adaption Plan every five years. This is the city's first climate plan, which presented a set of challenges which are typical for nearly every new climate plan. The greatest challenge being to ensure the plan is being properly implemented and that the intermediate goals are being reached.

Climate Plan Analysis and Comparisons

Recognizing that cities considering the development of their own climate plan will likely look at other cities as a basis from which to start their effort, this report compares nine city

climate plans based on their emission reduction progress and climate plan content. The goal of each plan is to reduce emission values, therefore it is valuable to present both their successes or shortfalls toward meeting this goal to provide better perspective when reviewing their strategies and actions as a model for new plans. Climate plan content was also analyzed because it is important to see the similarities between the existing climate plans as well as the differences which is also helpful for cities looking to develop their own plan. Financing for a city considering a climate plan will be the limiting factor on adoption, thus existing plan financing was analyzed. It is important for any city viewing this report to take into consideration the overall success of a another city's plan when selecting one to follow in the development of similar content for their own application and ultimately what financing options are available.

Emission Reduction Progress

The goal defined in each of the selected climate plans is to reduce emission levels from a defined baseline year, which is set by the local jurisdiction to be the earliest year that has the most comprehensive and reliable data collected (Covenant of Mayors, 2010). This baseline year is often the first year that data was collected for an emissions inventory but this is not always the case. The climate plans are designed around how to achieve the city's emission goals including interim goals as well as end goals. The interim goals encourage a continuous effort in reduction rather than simply hoping the end goal is met by the specified year.

The nine cities were analyzed on their individual emission reduction progress. Table 4.1 shows the percent emission reduction from the baseline year by year that each of the analyzed cities recorded emission data. The emission reductions are for total recorded city emission levels. All emission values less than the emission values from the baseline year are identified as

a reduction. It is important to note that not all cities have been recording this information for the same duration of time. In many cases, this is a result of the amount of time that a climate plan has been in place, but some cities such as Blacksburg, have been tracking this data prior to creating their climate plan. Portland, Denver, Cleveland, Minneapolis, and Blacksburg have the longest records of emissions with six or more years since the initial baseline year. Philadelphia and Aspen each have three years of recorded data since the baseline year, while Pittsburgh only has one year of recorded emission levels other than its baseline year. Flagstaff has yet to report any emission levels other than their baseline year.

Table 4.1 Percent Emission Reduction from Baseline Year for Years Emissions were Recorded

Year	Portland	Denver	Philadelphia	Cleveland	Minneapolis	Pittsburgh	Aspen	Blacksburg	Flagstaff
1990	0%							0%	
1991									
1992									
1993									
1994									
1995	-6.3%								
1996									
1997									
1998									
1999									
2000	-14.0%								
2001									
2002									
2003						0%			
2004							0%		
2005	2.9%	0%							
2006			0%		0%			17.7%	
2007		-2.3%			0.0%		-5.9%	11.5%	
2008					1.9%	-28.1%		-1.6%	
2009		5.3%			9.6%			-4.7%	
2010	13.1%	1.5%	5.6%	0%	11.5%			-6.7%	
2011	11.7%	4.5%		-6.2%	7.7%		7.0%	-1.3%	
2012	14.9%	5.3%	8.8%	2.3%	19.2%			4.2%	
2013	14.4%	3.0%		-7.8%	11.5%				
2014		3.0%		-7.8%	7.7%		7.4%		
2015		3.8%		3.1%	17.9%				
2016				2.0%					0%
2017									
2018									
2019									

Climate Plan Adoption Year

Emissions Baseline Year

Climate Plan Adoption and Emissions Baseline Year

In an attempt to provide a clearer picture of the progress being made related to emissions, the percent reductions are compiled based on the size of the city (large, medium, and small population) in Figures 4.2, 4.3, and 4.4. The solid line on the graphs indicate the actual total recorded emission values whereas the dashed lines indicate interim and overall emission reduction goals defined in the associated climate plan. The baseline years are the first point for each city on the graph and are at a zero percent emission reduction value. The baseline year is also the value on which the reductions are based. Eight of the cities with the exception of Minneapolis have an overall goal of 50 percent reduction by the year 2050, which is indicated as the end point on the graphs. The asterisk is placed on the year each city first adopted their climate plan.

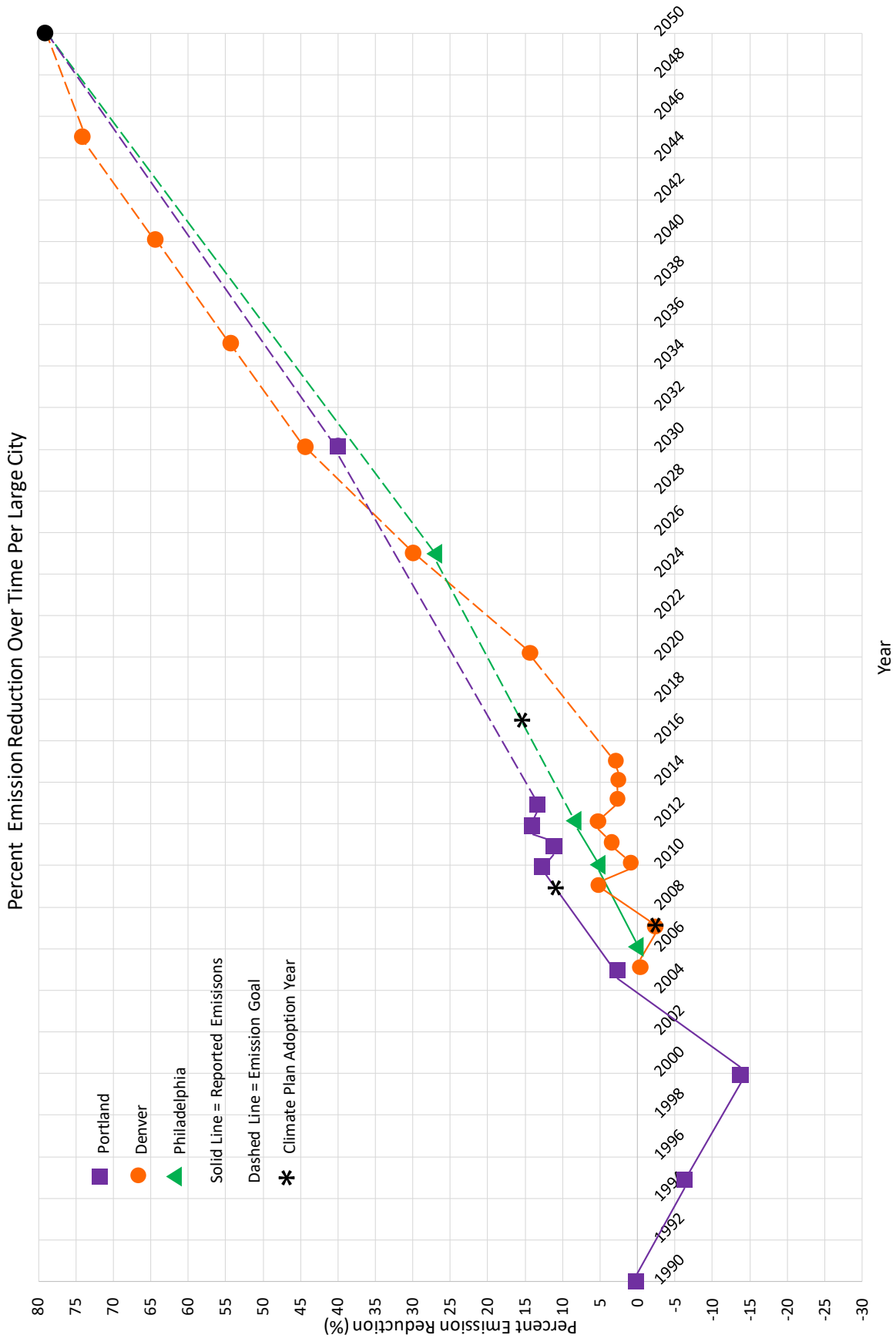


Figure 4.2 Percent Emission Reduction Over Time per Large City

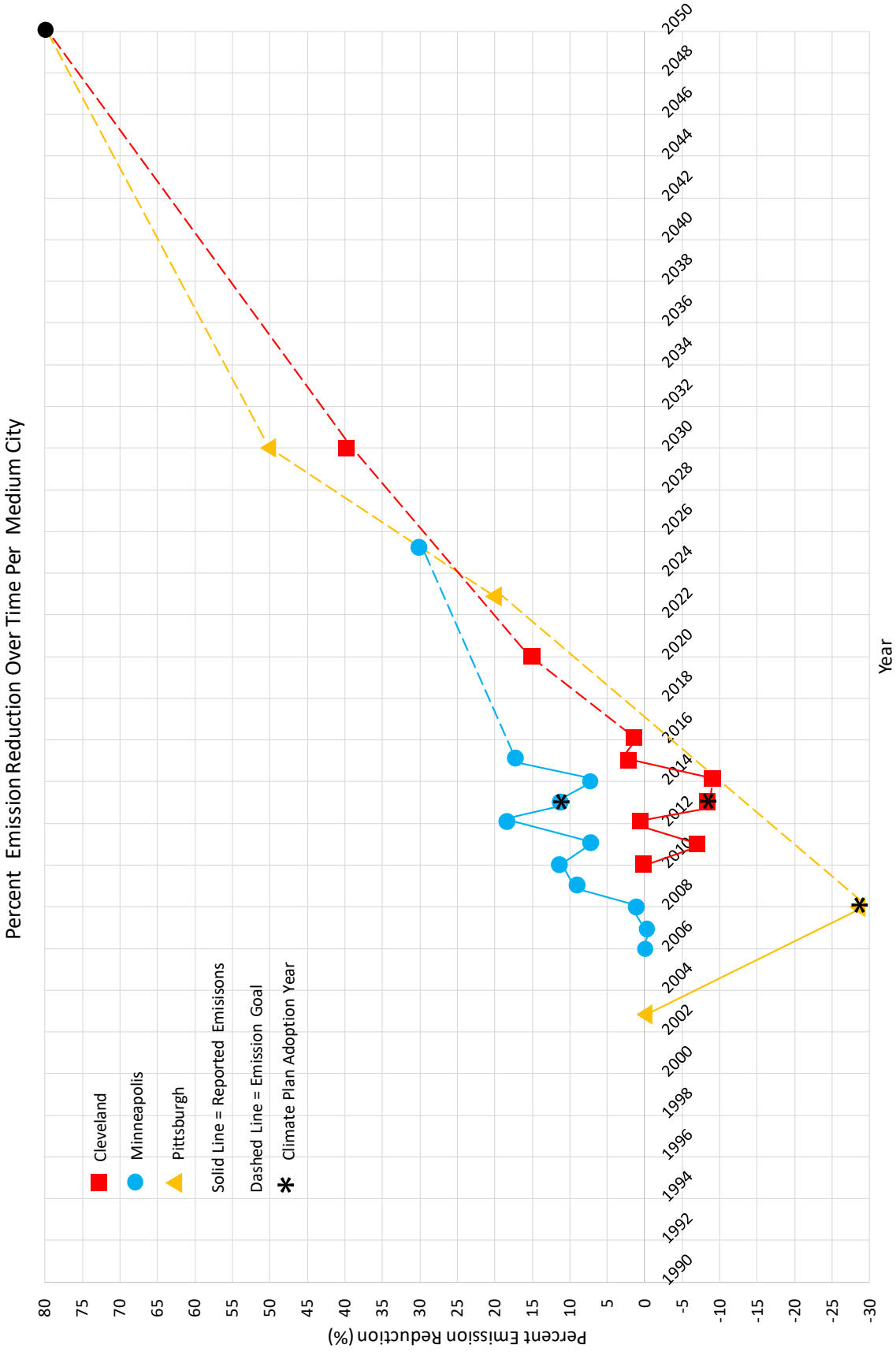


Figure 4.3 Percent Emission Reduction Over Time per Medium City

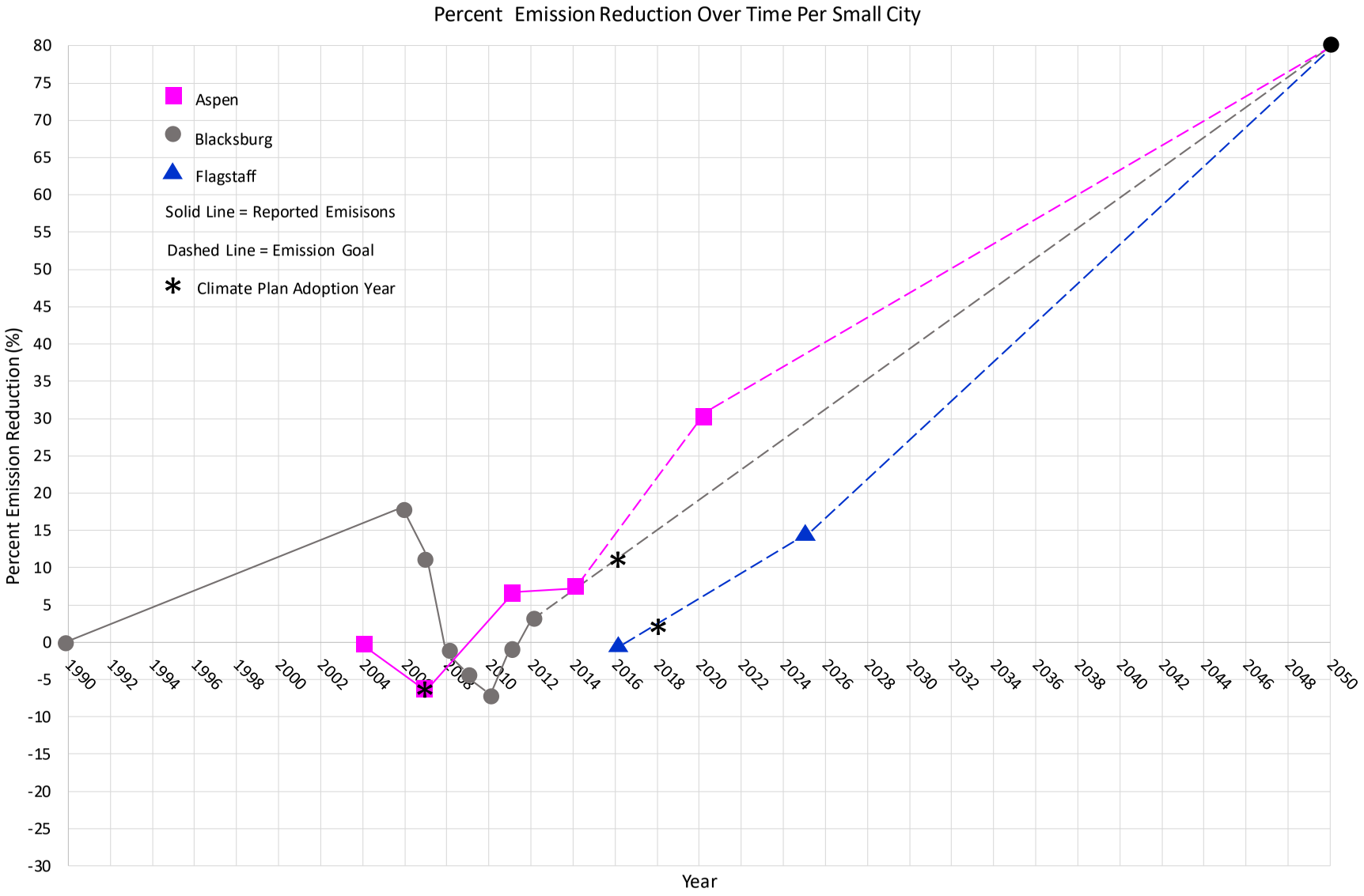


Figure 4.4 Percent Emission Reduction Over Time per Small City

Portland, Cleveland, Minneapolis, Denver, and Aspen all show an increase in percent emission reductions since the adoption of their respective climate plans, as depicted in Figures 4.2, 4.3, and 4.4. Philadelphia and Blacksburg do not have recorded emission values past the year their climate plans were adopted (2016 and 2017 respectively), but as the figures show, both cities have previously made efforts towards emissions reductions and recorded this information. Conclusions cannot be made for Pittsburgh and Flagstaff based on the graphs for progress towards emissions reduction. For Pittsburgh, this is due to only collecting two separate years of emission values. For Flagstaff, only the baseline year of emission values has been reported thus far, therefore no conclusions as to impact can be made because no current emission values exist.

The adoption of a climate plan is shown to be beneficial in the reduction of emissions for a majority of the cities analyzed. A majority (five out of nine) of the cities have seen an increase in emission reduction since the adoption of a climate plan. Portland, Philadelphia, Minneapolis, and Blacksburg recorded reduced emissions before the adoption of a climate plan. Figures 4.2, 4.3, and 4.4 show that the adoption of a climate plan has not been detrimental to the continuation of this trend.

The data presented cannot be considered conclusive but should continue to be monitored as time passes. Limited conclusions can be made based on a plan that has only been in effect a limited number of years. Once a climate plan approaches the years of interim goals and the overall goal, emission reduction values should be reexamined for more conclusive determinations as to the effectiveness of a climate plan.

Climate Plan Content

As introduced in Chapter 2, climate plans commonly focus on similar content areas. These include emission sector goals, goal strategies, implementation, strategy impacts, responsible agencies, timeframe, and progress. To more easily compare the nine selected plans, these primary content areas are presented in Table 4.2. In addition to these content areas, the chart lists the year each plan was adopted and last updated, its update cycle, the agency in charge of the plan, and the number of emission sectors analyzed. The area of strategy impact was broken down further. The additional categories of comparison are whether the city climate plan includes the impact of each strategy in emission reduction, the economy, job support, community health, and the environment.

Table 4.2 Climate Plan Content Comparison

		Portland	Denver	Philadelphia	Cleveland	Minneapolis	Pittsburgh	Aspen	Blacksburg	Flagstaff
Year Adopted		2009	2007	2017	2013	2013	2008	2007	2016	2018
Year Last Updated		2015	2018	N/A	2018	N/A	2018	2018	N/A	N/A
Update Cycle		5 years	N/A	N/A	4-5 years	N/A	N/A	3 years	N/A	5 years
Agency in Charge		Office of Planning and Sustainability	Technical Advisory Committee and Task Force	Office of Sustainability	Office of Sustainability	Sustainability Department	Pittsburgh Climate Protection Initiative	Climate Action Department	Climate Action and Community Sustainability Working Group	City Council
Number of Emission Sectors		8	3	5	5	3	5	6	6	7
Sector Goals		X	X		X	X	X	X	X	X
Goal Strategies		X	X	X		X	X	X	X	X
Implementation Section		X		X	X	X		X		X
Strategy Impact	**Emission Reduction**	X		X				X		
	Economy			X	X			X		X
	Job Support	X		X	X					X
	Health	X		X				X		X
	Environment	X		X	X			X		X
Strategy Assigned to Agency		X		X			X			X
Strategy Timeline		X							X	X
Progress			X	X	X				X	X

Table 4.2 can be used by cities looking to adopt a climate plan to quickly find examples for content they wish to include in their own plan. The table also illustrates common components that climate plans might include, in addition to components a city might identify as important for addressing the priorities of their individual community. It is interesting to note that the inclusion of more components is not limited to larger cities, as well as less components not being limited to smaller cities. It is up to each city to individually determine what is critical to include in their climate plan in order for their goals to realized.

The city climate plans that were analyzed for this report had a range from three to eight emission sectors. Each city plan analyzed had separate goals for each sector, with Philadelphia being the exception. Each city climate plan analyzed also had strategies the city can achieve to reach individual sector goals except for Cleveland. Cleveland, only listed sector goals without including individual strategies to reach them. Although Philadelphia's plan does not have sector goals, the plan does have strategies for each of its emission sectors.

A majority (six of the nine) of the climate plans have a section covering implementation. This section is important because it typically explains how a city ensures that their climate plan will be carried out and realized. Five plans reported on progress the city has made towards emission reductions before the adoption of the climate plan. Of the nine plans, a majority (five of the nine) addressed the impact of individual strategies, more specifically detailing the environmental impact.

As a resource for a city developing a climate plan, Table 4.3 organizes strategies specific to commercial buildings that were contained within the nine analyzed city climate plans. The table indicates which plans have included each of the building strategies. Each of these strategies were discussed in greater depth in Chapter 3. The most common strategies among the

analyzed cities were government incentives, building benchmarking, retrofit of existing buildings, renewable energy, building energy certifications, building energy codes, code stretching, and leading by example. This table should be used to find additional information on how a city has chosen to include and enforce a building strategy into their climate plan. For example, if a city needed more information on how to utilize building benchmarking, they could look at any of the nine analyzed cities with the exception of Blacksburg, which did not include this strategy. If a city needed information on encouraging building energy certifications, they would look at the climate plans of Portland, Denver, and Blacksburg. The complete building strategy sections from the respective climate plans of all nine analyzed cities' can be found in Appendix A through I.

Table 4.3 Building Strategies Included in Climate Plans

	Portland	Denver	Philadelphia	Cleveland	Minneapolis	Pittsburgh	Aspen	Blacksburg	Flagstaff
Government Incentives	X	X	X	X	X		X	X	X
Building Benchmarking	X	X	X	X	X	X	X		X
Retrofit Existing Buildings	X	X	X		X	X	X		X
Renewable Energy	X*	X*	X	X	X*	X	X*	X	X
Building Energy Certifications	X	X						X	
Building Energy Codes	X	X	X		X	X		X	X
Code Stretching	X	X							
Leading by Example	X	X	X		X		X	X	X
Appendix	A	B	C	D	E	F	G	H	I

* City climate plans encouraging net-zero energy buildings

See appendix for complete list of building strategies for each city.

The content of a climate plan does not necessarily lead to its success. A city should be certain their climate plan addresses everything it may need to ensure the plan is properly implemented. Additional detailed content in the climate plan makes the plan more comprehensive, thus leading to a greater chance that actions will be implemented effectively and on time. Greater detail of the strategies and their impacts will be helpful in keeping the city on track towards its goal of emissions reduction.

Financing

The nine cities analyzed were contacted by email and phone for questions concerning how the plan was initially financed, how money allocations were determined, if an anticipated investment return was determined, the sources of funding for strategies, and how incentive programs are funded. Out of the nine cities, four were able to provide information: Portland, Cleveland, Aspen, and Blacksburg.

In an email response from Michele Crim, the Chief Sustainability Officer of Portland, she states "the funding to implement each of those actions is considered by our City Council either through the annual citywide budget process (where various programs or plans might be funded) or on a project by project basis" (Crim, 2019). She also states that investment returns are not calculated because they would be "doing much of what is in [their] climate plan anyhow for other reasons (health, safety, livability)." Sources of funding for the climate plan and incentives "come from a wide array of sources including General Fund, grants, contracts, [and] inter-agency agreements."

A phone interview was done with Erika Meschkat, the Sustainability Manager for Cleveland Major's Office of Sustainability. Meschkat states that for financing of the plan, "these

are community wide plans, so really it's a public-private partnership, so some organizations take on the cost of certain actions while some are financed on their own through allocations" (Meschkat, 2019). The consultant Brendle Group was hired to model out emission reduction potential and what the cost of actions would be, otherwise a payback period analysis was not done. Meschkat states sources of funding take "a variety of capital sources to commit to get these plans going." A new residential construction 15 to 20-year tax abatement for homes built to Cleveland's green building standard is an "example of an incentive on the books, which means less tax revenue or delayed tax revenue and encourages home ownership" which Meschkat states as one of the larger incentives for the Cleveland climate plan.

Ashley Perl, the Climate Action Manager of Aspen, wrote in her email response that monetary allocations for strategies are determined depending on the strategy and "if it's within energy demand or transportation, it would likely come from the City transportation budget or general fund" (Perl, 2019). She explains that the sources for funding comes from a general fund, a utility fund, the Renewable Energy Mitigation Project, and grants. Incentive program funding from Aspen "depends on the subject. Parking fees fund free transportation. Building permit fees fund energy efficiency work."

Carol L. Davis, the Sustainability Manager for Blacksburg, wrote in an email response that "there really isn't a budget for direct implementation of the Town of Blacksburg Climate Action Plan" and that because of this, she has been "focusing [her] efforts on using the Climate Action Plan as a lever to spur policy changes at the local level – mainly around land use and transportation investments" (Davis, 2019). As for staffing cost, she explains that the strategies can be done with current staff so there is not additional funding allocated. Davis states the main incentives the city is offering are non-monetary. Davis is currently pursuing a collaboration with

colleagues in other Virginia communities to push for legislative, policy, and regulatory changes at the state level.

Based on these responses, financing for a climate plan can come from allocations of the city budget, general funds, community organizations, or focused efforts on non-monetary actions. Other methods of financing may exist that were not presented by these cities. Portland and Aspen stated that funding was likely to come from general funds or city budget allocations, and Cleveland and Blacksburg shared that there was a greater focus on community efforts to minimize allocations from the government budget. Based on the four cities that shared financing information, there does not seem to be a correlation in greater city financing of larger city versus smaller city populations.

Chapter 5 - Recommendations and Conclusion

Cities that have established climate plans publically demonstrate that they are environmentally conscious, want to promote healthy living, have sustainability as a priority, and strive to prevent climate change through the reduction of emissions. The increase in urbanization in the U.S. and the increase in global warming greatly affects cities as they are prone to resulting increased heat conditions (Koski & Siulagi, 2016). Through the implementation of sustainable strategies, cities can lower emissions within many different sectors. Commercial buildings make up a large portion of the infrastructure of cities, and climate plans should specifically develop strategies aimed at decreasing building-related emission levels.

This report serves as a guide for cities investigating the need for a climate plan. Plan organization, development, and components are detailed and examples of current climate plans are presented with a focus on commercial building strategies. Nine current plans were analyzed and most exhibited that they are beneficial to a city's emission reduction. More time is required to determine if the specified climate plan goals for these cities are obtainable and if a difference in emission reduction has made a lasting impact on the individual city.

Within the cities analyzed, Portland provides the best example to serve as a guide for cities seeking to develop a climate plan in terms of emission goals and plan content. Portland has a long history with development and implementation of a workable climate plan. The city has recorded emission levels dating back to 1990 and has since achieved emission reductions when compared to their baseline year. Looking at Portland's climate plan content, it can be recognized that a majority of the categories listed in Table 4.2 have been incorporated. The Portland plan is well organized and contains the necessary content needed to ensure that details related to process, implementation, reporting, and evaluation are not overlooked. The plan

covers a wide variety of building strategies aimed at emission reduction, including all of the strategies covered in Table 4.3. Portland should serve as a model guide for cities looking for successful examples to follow for creating their own climate plan.

Other plans analyzed had specific areas worthy of consideration when developing a new climate plan. Philadelphia's climate plan addressed six of the eight common building strategies discussed in Table 4.3 and all of the content items in Table 4.2 except for sector goals and a strategy timeline. Aspen's climate plan did not discuss the impact a strategy has on job support, which agency will be in charge of the strategy, the strategy timeline, but their plan did address every other item on Table 4.2 and five of the eight building strategies from Table 4.3. Flagstaff's climate plan included all the Table 4.2 content items except for strategy emission reduction amounts and it lists six of the eight building strategies of Table 4.3. Considering Denver's plan, listing commercial building-related strategies alone in a plan does not constitute a basis for a well-developed plan. Instead, it is important for the content items from Table 4.2 to also be addressed in order for a plan to be well organized and easier to implement.

If a climate plan had no associated cost, plans would be implemented in a much greater frequency across the country. Instead, a city needs to establish viable financing approaches to make a plan successful, by specifically addressing any fiscal concerns of a city considering climate plan development. Cities will need to determine the financing of the climate plan and strategy implementation, determine if there are any monetary savings over time, and decide where funding will be sourced or if non-monetary objectives will be used. A city must ultimately justify the cost of climate plan adoption against the greater goals of a cleaner environment and improving the quality of life for its citizens.

References

American Council for an Energy-Efficient Economy. (2017). *The city energy efficiency scorecard.* Retrieved January 10, 2019, from https://aceee.org/local-policy/city-scorecard

Anders, S. (2018, April 4). The cost of a CAP part 2: How much is this climate action plan going to cost our city? Message posted to https://epicenergyblog.com/2018/04/04/the-cost-of-a-cap-part-2-how-much-is-this-climate-action-plan-going-to-cost-our-city/

ASHRAE. (2016). *Standard 90.1-2016 (I-P edition)—Energy standard for buildings except low-rise residential buildings (ANSI approved; IESNA co-sponsored).* Georgia: ASHRAE.

ASHRAE. (2018). *Building EQ.* Retrieved February 23, 2019, from https://www.ashrae.org/technical-resources/building-eq

Blank U.S. map with borders. (2012). Retrieved February 1, 2019, from https://commons.wikimedia.org/wiki/File:Blank_US_Map_with_borders.svg

Blumberg, I. (2018). Building codes and energy efficiency: How New York City's building codes succeed and fail in regulating GHG emissions. *Environmental Claims Journal, 30*(3), 201-215.

City of Aspen. (2014). *2014 Aspen community-wide greenhouse gas (GHG) inventory* [PDF file]. Retrieved February 9, 2019, from https://www.cityofaspen.com/564/Greenhouse-Gas-Reductions

City of Aspen. (2017). *Aspen's climate action plan* [PDF file]. Retrieved February 9, 2019, from https://www.cityofaspen.com/518/Climate-Action-Canary-Initiative

City of Aspen. (2018). *Social sustainability* [PDF file]. Retrieved February 9, 2019, from https://www.cityofaspen.com/documentcenter/view/821

City of Cleveland. (2016). *Cleveland climate action plan: City of Cleveland greenhouse gas inventory appendix D* [PDF file]. Retrieved February 9, 2019, from https://www.sustainablecleveland.org/climate_action

City of Cleveland. (2018). *Cleveland climate action plan* [PDF file]. Retrieved February 9, 2019, from https://www.sustainablecleveland.org/climate_action

City of Denver. (2018). *Denver: 80x50 climate action plan* [PDF file]. Retrieved February 9, 2019, from https://www.denvergov.org/content/denvergov/en/environmental-health/environmental-quality/climate.html

City of Denver. (2019). *Climate action plan* [PDF file]. Retrieved February 8, 2019, from https://www.denvergov.org/content/denvergov/en/environmental-health/environmental-quality/climate.html

City of Flagstaff. (2018). *Climate action & adaption plan* [PDF file]. Retrieved February 9, 2019, from https://www.flagstaff.az.gov/ClimatePlan

City of Minneapolis. (2013). *Minneapolis climate action plan* [PDF file]. Retrieved February 9, 2019, from http://www.minneapolismn.gov/sustainability/climate-action-goals/climate-action-plan

City of Minneapolis. (2018). *Energy benchmarking results* [PDF file]. Retrieved February 23, 2019, from http://www.minneapolismn.gov/environment/energy/benchmarking

City of Minneapolis. (2019). *Minneapolis greenhouse gas emissions tracking* [PDF file]. Retrieved February 9, 2019, from http://www.minneapolismn.gov/sustainability/climate-action-goals/ghg-emissions

City of Philadelphia Office of Sustainability. (2013). *Philadelphia greenhouse gas inventory* [PDF file]. Retrieved February 9, 2019, from https://www.phila.gov/documents/2013-municipal-greenhouse-gas-inventory/

City of Philadelphia Office of Sustainability. (2017). *Powering our future: A clean energy vision for Philadelphia* [PDF file]. Retrieved February 9, 2019, from https://www.phila.gov/documents/powering-our-future-a-clean-energy-vision-for-philadelphia/

City of Pittsburgh. (2008). *2008 Pittsburgh greenhouse gas emissions inventory: A five-year benchmark* [PDF file]. Retrieved February 9, 2019, from http://www.pittsburghclimate.org/resources/

City of Pittsburgh. (2018). *City of Pittsburgh climate action plan* [PDF file]. Retrieved February 9, 2019, from https://www.nrdc.org/experts/katharine-mccormick/pittsburgh-approves-ambitious-climate-action-plan-update

City of Portland and Multnomah County. (2015). *Climate action plan* [PDF file]. Retrieved February 9, 2019, from https://www.portlandoregon.gov/bps/49989

Climate Mayors. (2017). *Paris climate agreement.* Retrieved February 16, 2019, from http://climatemayors.org/actions/paris-climate-agreement/

Cohan, D. (2016). *How are building codes adopted?* Retrieved January 1, 2019, from https://www.energy.gov/eere/buildings/articles/how-are-building-codes-adopted

Covenant of Mayors. (2010). *How to develop a sustainable energy action plan (SEAP) - guidebook part 2*. Belgium: European Union.

Crim, M. (2019, March 21). E-mail message to author.

Davis, C.L. (2019, March 21) E-mail message to author.

Deetjen, T., Conger, J., Leibowicz, B., & Webber, M. (2018). Review of climate action plans in 29 major U.S. cities: Comparing current policies to research recommendations. *Sustainable Cities and Society, 41*, 711-727.

ENERGY STAR. (2019). *About ENERGY STAR for commercial buildings.* Retrieved February 23, 2019, from https://www.energystar.gov/about/origins_mission/energy_star_overview/about_energy_star_commercial_buildings

Green Globes. (2019). *About green globes.* Retrieved February 23, 2019, from http://www.greenglobes.com/about.asp

Greenhouse Gas Protocol. (2019). *GHG protocol for cities.* Retrieved February 16, 2019, from https://ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities

Hart, Z. (2015). *The benefits of benchmarking building performance* [PDF file]. Retrieved from https://www.imt.org/resources/the-benefits-of-benchmarking-building-performance/

ICLEI - Local Governments for Sustainability USA. (2012). *U.S. community protocol for accounting and reporting of greenhouse gas emissions* [PDF file]. Retrieved from http://icleiusa.org/ghg-protocols/

International Code Council. (2017). *2018 international energy conservation code*. Illinois: International Code Council.

International Living Future Institute. (2019). *Living building challenge.* Retrieved February 23, 2019, from https://living-future.org/lbc/

Koski, C., & Siulagi, A. (2016). Environmental harm or natural hazard? problem identification and adaption in U.S. municipal climate action plans. *Review of Policy Research, 33*(3), 270-290.

Meschkat, E. (2019, April 9). Phone interview with author.

Murray, J. (2018, March) Denver grew by 100,000 people in just 7 years — but the pace has slowed for the 2nd straight year. *The Denver Post.* Retrieved from https://www.denverpost.com/2018/03/22/denver-population-growth-100000-7-years-pace-slowing/

Nelson, H. T. (2012). Lost opportunities: Modeling commercial building energy code adoption in the united states. *Energy Policy, 49*, 182-191.

New Building Institute. (2018). *Moving energy codes forward: A guide for cities and states* [PDF file]. Retrieved from https://newbuildings.org/resource/moving-energy-codes-forward/

New Building Institute. (2019). *Stretch codes.* Retrieved February 16, 2019, from https://newbuildings.org/code_policy/utility-programs-stretch-codes/stretch-codes/

Office of Energy Efficiency and Renewable Energy. (2013). *Guide to community energy strategic planning.* Retrieved February 5, 2019, from https://www.energy.gov/eere/slsc/guide-community-energy-strategic-planning

Office of Energy Efficiency and Renewable Energy. (2019). *Building energy use benchmarking.* Retrieved February 16, 2019, from https://www.energy.gov/eere/slsc/building-energy-use-benchmarking

Perl, A. (2019, April 3) E-mail message to author.

Rosenberg, M., Jonlin, D., & Nadel, S. (2017). A perspective of energy codes and regulations for the buildings of the future. *Journal of Solar Energy Engineering, 139*

Steele, M. (2018a, April 19). The cost of a CAP part 4: Emissions bang for your buck. Message posted to https://epicenergyblog.com/2018/04/19/the-cost-of-a-cap-part-4-emissions-bang-for-your-buck/

Steele, M. (2018b, April 11). The cost of a CAP part 3: The benefits and costs of CAP measures. Message posted to https://epicenergyblog.com/2018/04/11/the-cost-of-a-cap-part-3-the-benefits-and-costs-of-cap-measures/

Steele, M. (2018c, May 3). The cost of a CAP part 6: Limitations. Message posted to https://epicenergyblog.com/2018/05/03/the-cost-of-a-cap-part-6-limitations/

Town of Blacksburg. (2012). *2006-2012 GHG inventory.* Retrieved February 1, 2019, from http://www.blacksburg.gov/community/community-profile/demographics

Town of Blacksburg. (2016). *Climate action plan* [PDF file]. Retrieved February 1, 2019, from http://www.blacksburg.gov/departments/departments-l-z/sustainability/climate-protection/climate-action-plan-and-supporting-documents

Town of Blacksburg. (2019). *Demographics.* Retrieved February 1, 2019, from http://www.blacksburg.gov/community/community-profile/demographics

U.S. Department of Energy. (2013). *Step 4. select the appropriate code for adoption.* Retrieved February 16, 2019, from https://www.energycodes.gov/resource-center/ACE/adoption/step4

U.S. Energy Information Administration. (2018). *Renewable energy explained.* Retrieved February 16, 2019, from https://www.eia.gov/energyexplained/?page=renewable_home

U.S. Environmental Protection Agency. (2016). *Develop greenhouse gas inventory.* Retrieved February 24, 2019, from https://19january2017snapshot.epa.gov/statelocalclimate/develop-greenhouse-gas-inventory_.html

U.S. Environmental Protection Agency. (2018). *Overview of greenhouse gases.* Retrieved February 16, 2019, from https://www.epa.gov/ghgemissions/overview-greenhouse-gases

U.S. Office of President (Producer). (2017, June 1). *Statement by President Trump on the Paris Climate Accord* [Interview transcript]. Retrieved from https://www.whitehouse.gov/briefings-statements/statement-president-trump-paris-climate-accord/

UNFCCC. (2019). *What is the Paris agreement?* Retrieved February 16, 2019, from https://unfccc.int/process-and-meetings/the-paris-agreement/what-is-the-paris-agreement

USGBC. (2019). *LEED.* Retrieved February 23, 2019, from https://new.usgbc.org/leed

Vaughan, Ellen & Turner, Jim. (2013). The value and impact of building codes. *Environmental and Energy Study Institute,*

Wang, S., Yan, C., & Xiao, F. (2012). Quantitative energy performance assessment methods for existing buildings. *Energy and Buildings, 55*, 873-888.

World Green Building Council. (2019). *What is net-zero?* Retrieved February 16, 2019, from https://www.worldgbc.org/advancing-net-zero/what-net-zero

World Population Review. (2019a). *Portland, Oregon population 2019.* Retrieved January 10, 2019, from http://worldpopulationreview.com/us-cities/portland-population/

World Population Review. (2019b). *Denver, Colorado population 2019.* Retrieved January 10, 2019, from http://worldpopulationreview.com/us-cities/denver-population/

World Population Review. (2019c). *Philadelphia, Pennsylvania population 2019.* Retrieved January 10, 2019, from http://worldpopulationreview.com/us-cities/philadelphia-population/

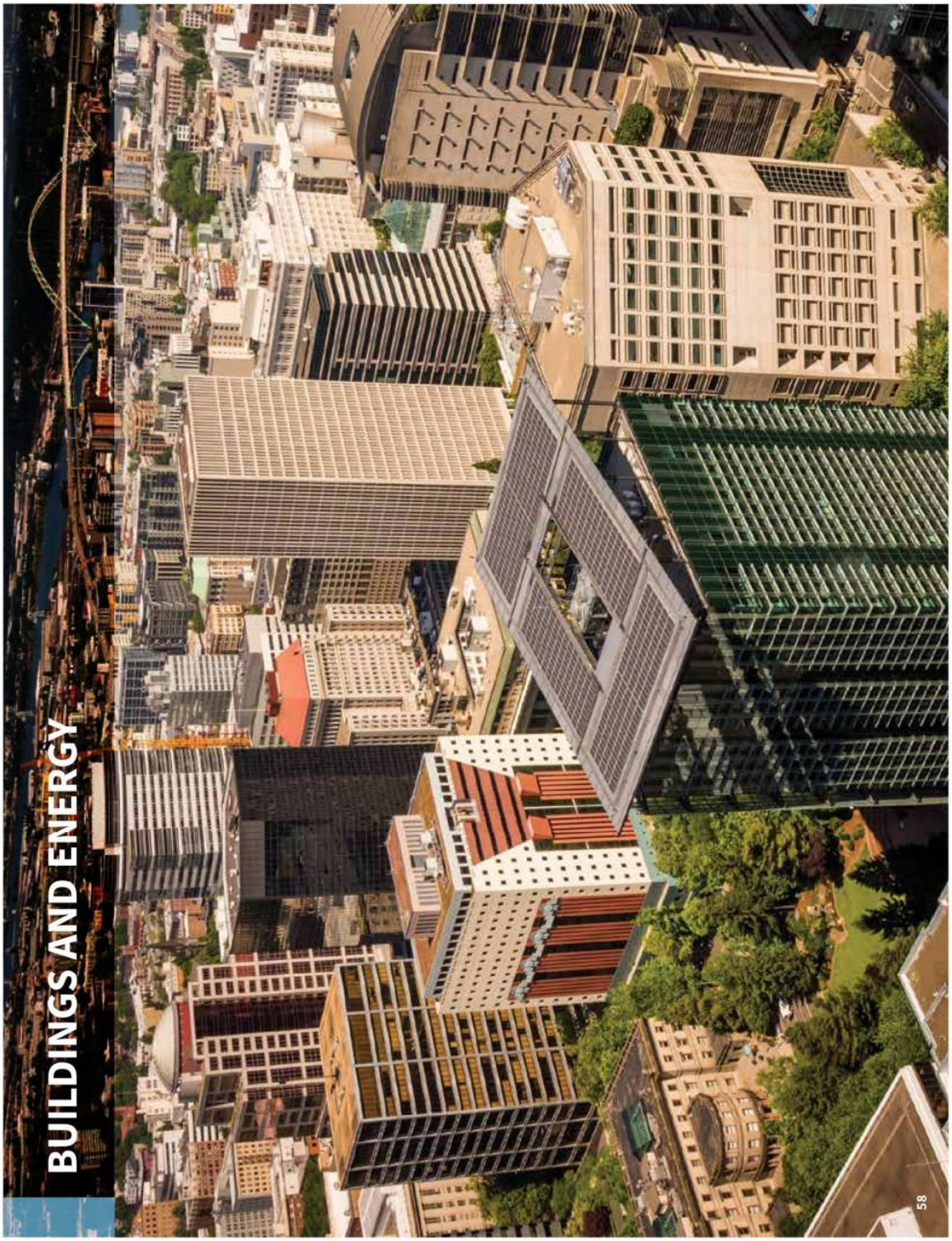
World Population Review. (2019d). *Cleveland, Ohio population 2019.* Retrieved January 10, 2019, from http://worldpopulationreview.com/us-cities/cleveland-population/

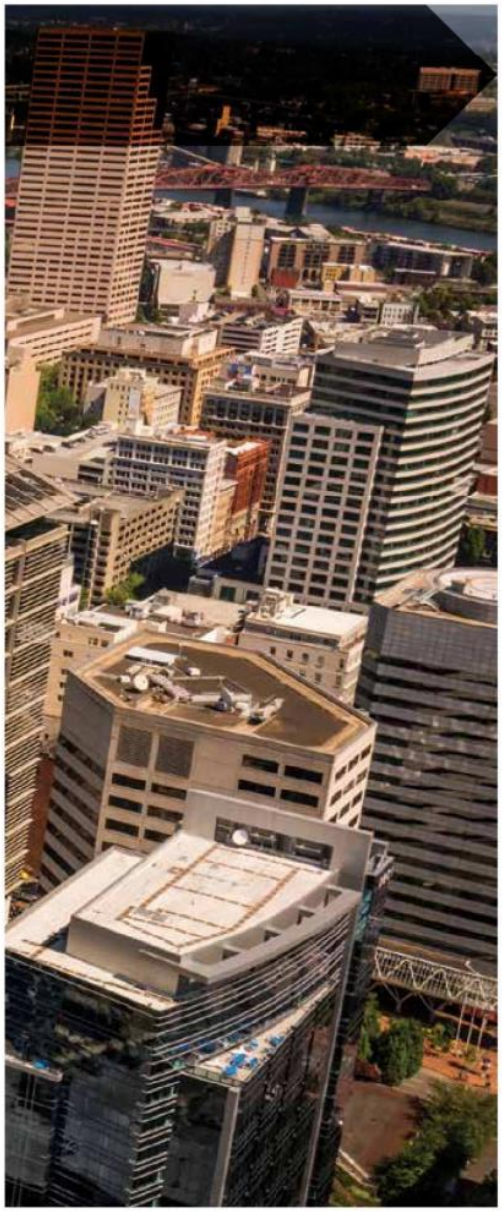
World Population Review. (2019e). *Minneapolis, Minnesota population 2019.* Retrieved January 15, 2019, from http://worldpopulationreview.com/us-cities/minneapolis-population/

World Population Review. (2019f). *Pittsburgh, Pennsylvania population 2019.* Retrieved January 16, 2019, from http://worldpopulationreview.com/us-cities/pittsburgh-population/

Appendix A - Portland Building Climate Plan

Appendix A provides the building goals, strategies, and actions that can be found in Portland's climate plan.


BUILDINGS AND ENERGY
58



Buildings are the single largest contributor to carbon emissions in Multnomah County, accounting for nearly half of all sector-based emissions. Reducing carbon emissions from building energy use requires two changes:

- Improving energy efficiency.
- Reducing the carbon intensity of energy supplies, primarily by increasing renewable sources of electricity such as solar and wind power.

Fossil fuels still dominate the electricity generation mix

Unlike the municipal utilities of Seattle, Tacoma, and Eugene, which get nearly all of their power from zero-carbon sources, Portland's electric utilities rely primarily on coal- and natural-gas fired power plants. Two-thirds of the electricity that serves Multnomah County is generated from coal and natural gas (see Figure 23).

Despite gains in wind and solar generation since 2009, renewable energy accounts for a small percentage of overall electricity generation for Multnomah County. Wind energy is the predominant renewable energy resource locally, as shown in Figure 23. Although more than 2,000 solar energy systems have been installed since 2009, solar still accounts for less than one percent of Multnomah County's electricity generation mix. There is huge potential for renewable energy resources regionally.

Policy choices affect carbon emissions

Portland and Multnomah County work closely with an extensive set of organizations, public agencies and businesses that are advancing energy efficiency and renewable energy. These organizations include Energy Trust of Oregon, Northwest Energy Efficiency Alliance, Oregon Department of Energy, Clean Energy Works, NW Natural, Earth Advantage, Portland General Electric and Pacific Power.

Our power isn't as green as we think it is

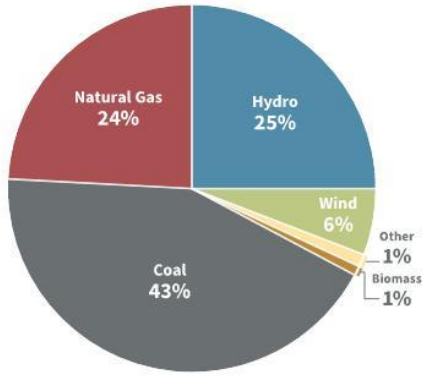


Figure 24. Weighted average of electricity fuel sources for Multnomah County (2010–2012). *Source: Portland Bureau of Planning and Sustainability*

Despite substantial hydropower in the Pacific Northwest, two-thirds of the electricity that serves Multnomah County is generated from coal and natural gas.

Among these partners, the City and County have several unique roles to play. Local governments:

- Set forward-looking vision and call attention to policy priorities and requirements.
- Have extensive relationships and communicate routinely with businesses and residents.
- Can lead by example.

Promising new policies that could advance efforts to reduce energy use in buildings are identified in this plan.

Carbon pricing

When we increase the price of something, we generally use less of it. Putting a price on carbon has been shown to reduce emissions in the places where it has been tried. British Columbia, Canada and the state of California both have some form of carbon pricing.

There are many considerations for carbon pricing, including:

- Which fuels and sectors are included?
- How can regressive impacts for low-income populations be prevented?
- What should the pricing mechanism be (for example, a tax or a cap-and-trade system)?
- What price should be placed on carbon?
- What are the economic impacts on energy-intensive industries and businesses?

A 2014 analysis prepared for the Oregon legislature concluded that a state carbon tax would have very small net economic impacts while reducing carbon emissions (State of Oregon Legislative Revenue Office, 2014). If the state does not move forward with a carbon price, Action 1H calls for the City and County to consider local adoption of a carbon pricing mechanism.

Building performance ratings and transparency

Energy performance ratings are tools that standardize and score how efficiently homes and other buildings use energy. Making a building's rating transparent to prospective buyers and tenants can help the real estate market more accurately value energy efficiency in buildings. Actions 1A and 1B propose energy rating requirements for commercial buildings and homes. Portland is joining 12 cities and two states that have similar building energy performance transparency requirements including Washington, D.C.; Austin; San Francisco; Berkeley; Seattle; New York City; Chicago; Boston; Cambridge; Minneapolis; Philadelphia; California and Washington State. As part of policy development, the City will explore building size thresholds, technical assistance opportunities and reporting options.

ENERGY PERFORMANCE TRACKING AND TRANSPARENCY MAKE ENERGY EFFICIENCY MORE VISIBLE

Tracking energy performance annually helps building owners and operators identify the best opportunities to improve environmental performance, especially for multi-tenant buildings where utility data is not easily accessible. Approximately 100 commercial building owners in Multnomah County currently track their energy performance using Energy Star Portfolio Manager, a free tool provided by the U.S. Environmental Protection Agency (EPA) that scores energy performance between 1 and 100.

EPA's initial analysis of annual energy performance tracking with Portfolio Manager suggests these practices result in average energy savings of seven percent over three years (EPA, 2012). It also helps the City and County connect owners to resources that can help them save energy.

The 2009 *Climate Action Plan* included an action to require energy performance tracking for all commercial and multifamily buildings. To understand the barriers and opportunities related to widespread adoption of energy tracking, the City joined the Building Owners and Managers Association, Northwest Energy Efficiency Alliance, Energy Trust of Oregon, Portland Development Commission, Better Bricks and Clark Public Utilities in a Building Performance Partnership.

ENERGY STAR® PortfolioManager®

Together they recruited buildings to participate in the Kilowatt Crackdown, a free competition that challenged building owners and managers in the Portland region to save energy and reduce operating expenses.

Kilowatt Crackdown provided building owners and tenants assistance in tracking energy use with Energy Star Portfolio Manager, analyzing opportunities for savings and identifying action items to improve building performance. Sixty-four buildings totaling almost 15 million square feet took part in the contest, which recognized participants and winners in May 2014. An initial analysis found that participants reduced natural gas use by an average of 7.5 percent and electricity use by 2.5 percent.

While these efforts are commendable, the voluntary program enrolled only 25 percent of Portland's office space. Because the potential for energy savings in the commercial building sector is much greater, one of the actions in this *Climate Action Plan* requires major office buildings to track energy use and report performance to the City of Portland on an annual basis.

Renewable energy

Programs like Solar Now! and Solarize Portland built demand, reduced costs and provided technical assistance to install solar. At the same time, the City and County's improved permitting, zoning and land-use practices reduce barriers for consumers. However, installations of rooftop solar have declined over the past few years, as Figure 25 shows.

Substantially growing the market for solar by 2019 will require:

- Policy changes to remove barriers to market entry for new participants and allow new business models, such as community solar (see page 69), to emerge.
- Renewed marketing and outreach in collaboration with partners like Energy Trust of Oregon, Solar Oregon and others.
- Continued focus on reducing soft costs, like permitting and inter-connection fees.

Reaching a peak in 2010, rooftop solar installations have declined over the past few years

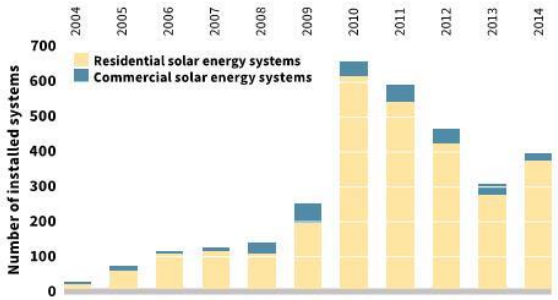


Figure 25. Solar energy systems installed annually (2004–2014). *Source: Energy Trust of Oregon, Oregon Public Utility Commission*

The loss of important incentives for solar has resulted in fewer installations in recent years.

Portland reduced barriers to solar installation

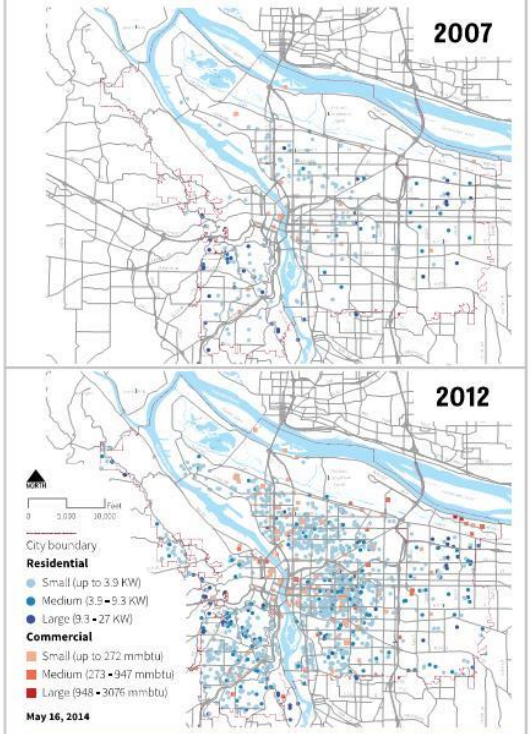


Figure 26. Portland rooftop solar from 2007–2012. *Source: Portland Bureau of Planning and Sustainability*

Comparison of solar installations in 2007 and 2012 illustrates the dramatic increase of rooftop solar in Portland.

Clean energy programs should benefit households vulnerable to cost burdens

Making homes and buildings more efficient and able to produce their own energy on-site are critical actions for reducing carbon emissions. Energy efficiency and renewable energy contribute to:

- Less air pollution.
- Better respiratory health.
- Lower energy costs for households and businesses.
- More dollars reinvested in the local economy.

However, if not carefully designed, energy efficiency and renewable energy programs may fail to serve low-income households.

Energy costs are part of housing costs, which disproportionately burden lower income households. "Housing burden" is often understood to mean households spending 30 percent or more of their income on housing costs.

Currently, people of color are more likely to suffer from housing burden than White households. About 36 percent of White households experience housing burden compared to 54 percent of Black households and 50 percent of Hispanic households (Greater Portland Pulse, 2013, based on American Community Survey data from 2006–2010).

The costs to provide energy for heating, lighting and appliances are strongly influenced by the efficiency of homes and apartments. Many low-income families live in less-efficient buildings with outdated heating systems and appliances.

Data on energy costs borne specifically by low-income households in Multnomah County are not publicly available. However, when looking at the proportion of income spent on home energy costs, low-income households may pay up to three times as much as median-income households.

If investments are made in energy efficiency and renewable energy, the City and County need to ensure that those investments do not have unintended negative consequences for tenants such as higher rental rates.

CULLY WEATHERIZATION 2.0 PROJECT

Living Cully — together with Clean Energy Works, the County, City and other partners — is working to weatherize single-family homes in the Cully neighborhood. This project is advancing the benefits of carbon reduction, energy savings, workforce development and positive health outcomes. Cully Weatherization 2.0 supports neighborhood stabilization efforts by helping to mitigate displacement through addressing critical home repairs and weatherization for low- to moderate-income homeowners.

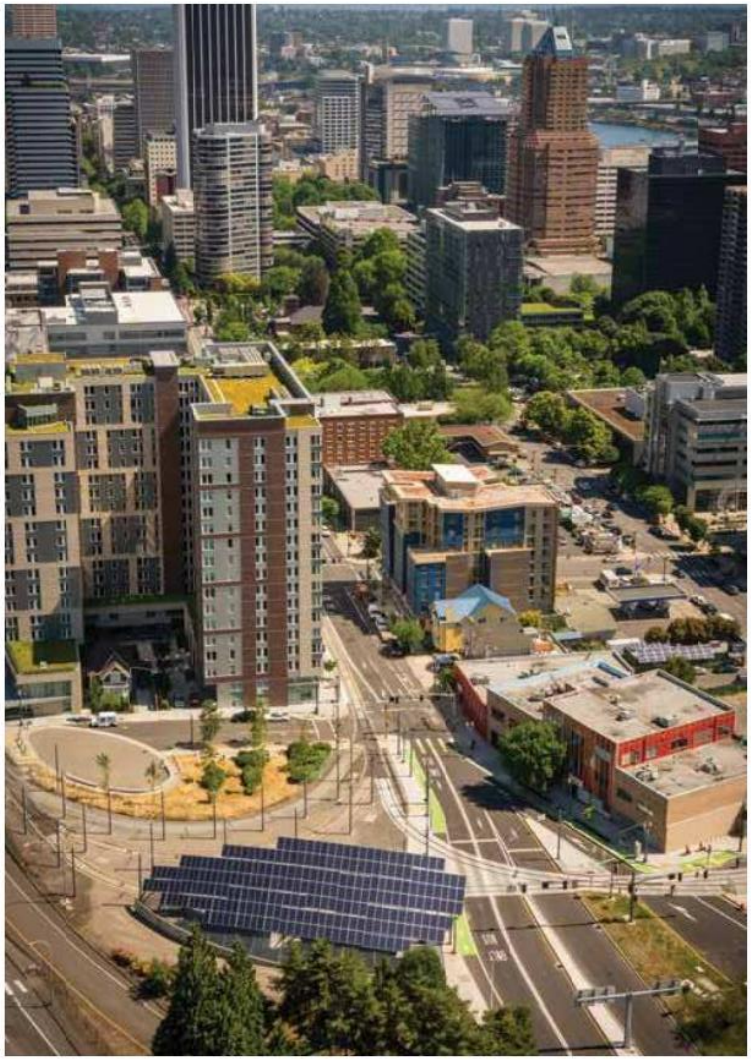
This project has a specific focus on achieving equity goals by working with firms owned by women and people of color and by prioritizing services to homeowners of color. Diverse stakeholders are working collectively to leverage resources and make implementation processes more efficient in order to expand the number of retrofits completed.

Cully Weatherization 2.0 builds off of the success of the Changing the Climate in Cully project (2010), and seeks to:

- **Weatherize 100 homes in the Cully neighborhood, helping to reduce carbon emissions, improve energy efficiency and save homeowners money.**
- **Create economic opportunity, with 50 percent of the project revenues going to companies owned by people of color and women.**
- **Support community wealth building through training and living wages, particularly for people of color and women.**
- **Help mitigate displacement for Cully residents through quality home improvements and weatherization.**
- **Achieve positive health outcomes for families resulting from completed home retrofits and home improvements.**

The project has successfully served low-income homeowners (100 percent), homeowners of color (over 40 percent) and older adults (70 percent), and half of the total revenues have been earned by companies owned by women and people of color (as of April 2015).

Project partners are looking to replicate this service delivery approach in other under-served and under-represented neighborhoods throughout the region.



To ensure that energy efficiency upgrades do not result in increased cost burden to low-income populations and communities of color that are already under financial stress, programs must be designed with this in mind. The impacts on and benefits to these communities will be explicitly addressed in program design and implementation of the *Climate Action Plan*. Approaches include:

- Targeted energy upgrades, or those that focus limited investment dollars on the most cost-effective measures first, that help neutralize the cost burden of energy retrofits for income-qualified buildings or homes.
- Increased incentives for income-qualified households. Energy Trust's Savings Within Reach program is an effective example of this approach.
- Programs like MPower Oregon (www.mpoweroregon.com) that enable owners of affordable multifamily housing properties to access unsecured financing and to share energy savings benefits with tenants, some of whom are among the most vulnerable residents of Multnomah County.
- Green lease mechanisms that enable a fair proportion of costs and benefits to be allocated to both tenants and landlords. The City and County can help educate property owners and managers about emerging financing and leasing tools.

Programs should reach deeper into communities

Opportunities for low-income populations and communities of color to participate in energy efficiency and renewable energy programs must be expanded and enhanced. This not only impacts how energy efficiency and renewable energy programs are designed, but in how they are communicated and marketed. For example, currently, program messages may not ever reach immigrant and refugee communities or communities of color.

Designing equitable and inclusive clean energy programs requires the thoughtful involvement of and coordination with diverse partner agencies and stakeholders. The pursuit of efficiency and renewables in meeting climate objectives should benefit, not burden low-income populations and communities of color. Effective strategies exist to share the employment, environmental and economic benefits of infrastructure investments with all residents of Multnomah County.

BUILDINGS AND ENERGY

2030 OBJECTIVE 1 — Reduce the total energy use of all buildings built before 2010 by 25 percent.

Because buildings last for many decades, more than half of the buildings that will exist in 2050 already exist today. Efforts to reduce emissions from buildings need to address both existing structures and new construction.

From 2008 to 2013, total energy use in residential and commercial buildings decreased by four percent, due both to new programs like Clean Energy Works and the Kilowatt Crackdown and to the Energy Trust's foundational programs.

This progress is encouraging, but existing programs and policies alone are unlikely to achieve the 25 percent reduction. The actions described below will support, enhance and accelerate building energy efficiency programs through partnerships and policy.

ACTIONS TO BE COMPLETED BY 2020		Impact	Lead agency	Timeframe
1A	**Commercial Energy Performance Benchmarking —** Implement energy performance tracking and annual reporting program for commercial buildings and explore options for multifamily buildings. Support improved access to utility data for building owners and managers seeking to improve energy and water performance.	C C C C $ E	**City:** BPS	Near-term
1B	**Residential Energy Performance Ratings —** Require energy performance ratings for all homes so that owners, tenants and prospective buyers can make informed decisions about energy costs and carbon emissions.	C C C C $ E	**City:** BPS	Mid-term
1C	**Energy Partnerships —** Establish long-term partnerships to coordinate equitable access to energy-efficiency resources, incentives, assistance, financing, outreach, education and other tools to residents and businesses. Support neighborhood efforts, including ecodistricts, to improve energy performance of buildings.	C C C C $ E	**City:** BPS **County:** OS	Existing and/or ongoing
1D	**Operations and Maintenance —** Work with partner organizations to promote building retro-commissioning and operation and maintenance practices that improve affordability, comfort, indoor air quality and energy efficiency in all commercial and multifamily buildings.	C C C C $ E	**City:** BPS **County:** OS	Mid-term
1E	**Funding —** Establish a clean energy fund to invest in energy efficiency and renewable energy projects. Develop and expand financing tools such as Clean Energy Works and commercial Property Assessed Clean Energy that are broadly accessible to households and building owners, including rental properties, throughout the community. Remove financial barriers to building retrofits, including limiting property tax increases due to completed energy projects.	C C C C $ E	**City:** BPS, PDC **County:** OS	Near-term

Potential impact C C C C Magnitude of carbon emissions reduction · $ High potential to support jobs and prosperity · E High potential to advance equity · High potential to improve local environmental quality · High potential to improve health

ACTIONS TO BE COMPLETED BY 2020		Impact	Lead agency	Timeframe
1F	**Residential Retrofits —** Partner with Clean Energy Works, Energy Trust of Oregon, utilities and contractors to retrofit 1,000 homes and improve the efficiency of 1,000 multifamily units per year. Establish minimum standards for rental housing.	C C C C $ E	**City:** BPS **County:** OS	Existing and/or ongoing
1G	**Small Commercial —** Support energy efficiency improvements to small commercial buildings, especially in under-served communities. Ensure financial tools such as Commercial Property Assessed Clean Energy can be used by small commercial buildings.	C C C C $ E	**City:** BPS **County:** OS	Mid-term
1H	**Carbon Price —** Support a statewide carbon tax or cap to generate new funding for carbon reduction while alleviating regressive impacts. If the state does not adopt a carbon price, the City will consider local adoption of a carbon pricing mechanism. Prioritize local investments that create jobs and benefit low-income populations and communities of color.	C C C C $ E	**City:** BPS **County:** OH	Existing and/or ongoing
1I	**Weatherization Requirement —** Explore removing the City Charter weatherization prohibition to allow requirements for energy efficiency improvements at the time of sale. Consider benefits and address burdens to low-income populations and communities of color in any future requirements.	C C C C $ E	**City:** BPS	Long-term

CLEAN ENERGY WORKS TRANSFORMS THE MARKET FOR HOME PERFORMANCE

Clean Energy Works (CEW) is a nonprofit organization launched by the City of Portland Bureau of Planning and Sustainability that has helped thousands of Oregonians make their homes more energy efficient. CEW makes energy efficiency upgrade projects easy and manageable, connecting homeowners with financing and high-quality contractors. CEW is also a triple-bottom line organization, and economic development and social equity are important to their mission along with energy savings and carbon reduction.

Clean Energy Works results (as of May 2015):

Upgraded 4,200 homes in Oregon for energy efficiency

Generated $83 Million in economic development

56% of hours were worked by people of color and women

$6.7 million earned by firms owned by women and people of color

Created 470 jobs that pay living wages and benefits

Saving about 4.4 million kilowatt-hours and 1.17 million therms each year or the equivalent of the total energy used by 850 homes per year

Avoiding about 5,000 metric tons of carbon emissions each year

BUILDINGS AND ENERGY

2030 OBJECTIVE 2 — Achieve zero net carbon emissions in all new buildings and homes.

The best time to begin addressing building efficiency is in the initial building design stage. Buildings that have been designed and built with performance as a primary goal are capable of significantly outperforming similar, previously built buildings that have been retrofitted for efficiency. Because total emissions from buildings must be reduced by much more than can be accomplished with retrofits alone, it is critical that buildings built after 2030 generate more energy from clean sources than they consume, resulting in a net emissions reduction.

In the last three years, several homebuilders and developers have pioneered the design of net-zero energy projects in the Portland area, and even more have adopted the Architecture 2030 targets into their projects.

Still, few new building construction projects are seeking this high level of performance. The actions below are intended to move new development toward nearly-zero energy building design and ensure that more efficient standards result in actual energy savings.

ACTIONS TO BE COMPLETED BY 2020		Impact	Lead agency	Timeframe
2A	**Oregon Building Code —** Continue participating actively in the process to revise the Oregon building code to incorporate performance that targets net-zero energy by 2030.	C C C C $ E	**City:** BPS	Existing and/or ongoing
2B	**Minimum Performance —** Establish minimum energy performance targets for new construction and major renovations.	C C C C $ E	**City:** BPS	Mid-term
2C	**Net-Zero Energy Projects —** Build market demand for net-zero energy buildings through incentives, education, demonstration projects, partnerships and recognition.	C C C C $ E	**City:** BPS	Near-term
2D	**System Development Charges —** As part of upcoming renewal of systems development charge methodologies, evaluate options that could promote housing affordability, reduce environmental impacts and fund capital projects that meet climate action objectives.	C C C C $ E	**City:** BPS, PBOT, Water, BES, PP&R, BDS	Long-term

Potential impact — C C C C Magnitude of carbon emissions reduction; $ High potential to support jobs and prosperity; E High potential to advance equity; High potential to improve local environmental quality; High potential to improve health

GETTING TO ZERO

Several initiatives in the building industry support low-to-no energy use by maximizing energy-efficient construction techniques, incorporating on-site renewables and reducing occupants' energy use. These certifications and programs include:

- **Passive buildings —** A design and construction approach used to attain super-insulated, virtually air tight buildings primarily heated by solar gain and minimal equipment. The Passive House Institute US (PHIUS) provides a Passive House certification for projects that meet rigorous and quantifiable levels of efficiency.
- **Net-zero/zero-energy and energy positive buildings —** A net-zero or zero-energy building produces as much energy as it consumes, calculated on a net basis for one year. An energy positive building produces more energy than it consumes, sending excess back into the electricity grid.
- **Living Buildings —** A certification developed by the Cascadia Region Green Building Council, part of the International Living Future Institute. To achieve Living Building status, buildings are required to meet a series of performance requirements, including net-zero energy, waste and water, over a minimum of 12 months of continuous occupancy.
- **Architecture 2030 —** A nonprofit organization working to reduce fossil fuel consumption in the built environment and promote the development of adaptive, resilient projects that can manage the impacts of climate change. It issued The 2030 Challenge to engage the global architecture and development community to construct carbon-neutral and fossil-fuel free buildings by 2030.

The lower the score, the better

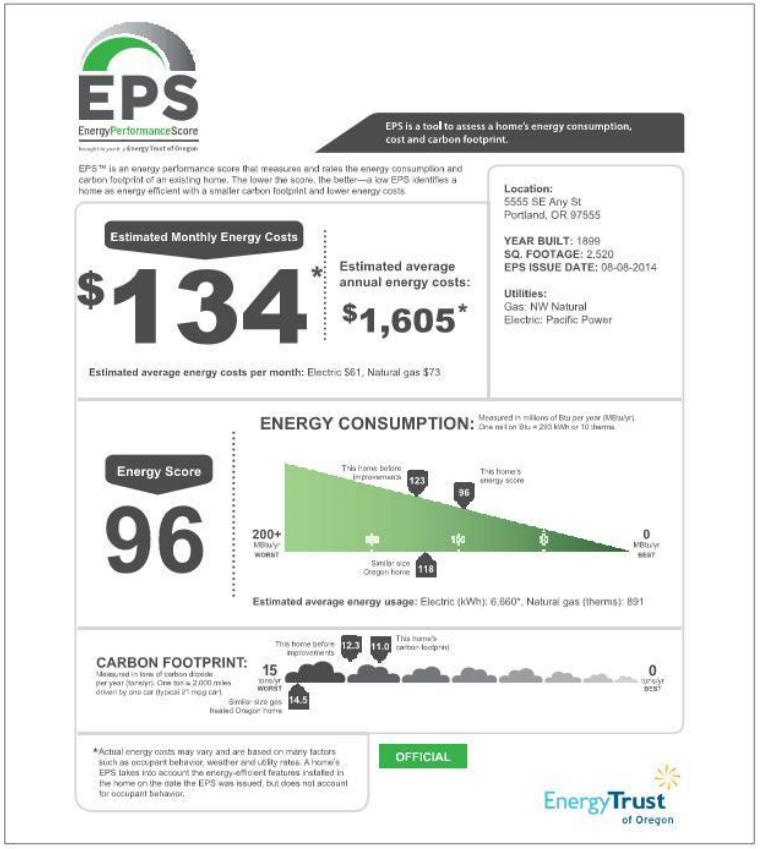


Figure 27. *Energy Performance Score (EPS) highlights energy and carbon use*

This sample residential Energy Performance Score (EPS) is the tool designated by Energy Trust for use in Oregon and considers energy efficiency and renewables.

BUILDINGS AND ENERGY

2030 OBJECTIVE 3

Supply 50 percent of all energy used in buildings from renewable resources, with 10 percent produced within Multnomah County from on-site renewable sources, such as solar.

Oregon law requires that by 2025, 25 percent of all electricity sold by Portland General Electric and Pacific Power in Oregon be generated from new renewable energy sources. Some of these sources will take the form of utility-scale solar and wind farms, often located far from population centers. Neighborhood-scale energy system and distributed generation, like on-site solar, provide an important opportunity for renewable energy generation in an urban setting.

The City and County, along with key partners like US Department of Energy, Energy Trust of Oregon, Oregon Department of Energy and Solar Oregon, have made encouraging strides in transforming the market for solar energy since 2009, adding more than 2,000 systems totaling 10 megawatts of installed capacity.

ACTIONS TO BE COMPLETED BY 2020		Impact	Lead agency	Timeframe
3A	**Electricity Supply —** a) Collaborate with Portland General Electric, Pacific Power, customers and stakeholders to reduce the carbon content in Portland's electricity mix by 3 percent per year. b) Communicate with utilities and the Oregon Public Utility Commission on the critical importance the City and County place on reducing the carbon content of electricity delivered to the City, County and other customers. c) Mitigate potential cost burdens to low-income households principally through efficiency measures that reduce energy use and cost.	C C C C $ E	**City:** BPS **County:** OS	Existing and/or ongoing
3B	**Installed Solar and Solar Access —** Add another 15 megawatts of installed solar photovoltaic capacity. Motivate and assist households and businesses throughout the community to install solar. Revisit City solar access policy and regulations, recognizing changing conditions due to the proliferation of residential rooftop solar energy systems.	C C C C $ E	**City:** BPS **County:** OS	Near-term
3C	**Community Solar —** Support the development of community solar projects that benefit all residents, particularly communities of color and low-income populations.	C C C C $ E	**City:** BPS	Existing and/or ongoing
3D	**Renewable Energy Policy —** Participate in statewide policy discussions to expand the market in Oregon for renewable energy, including solar, wind, geothermal, biogas and biomass, and remove barriers to widespread participation in renewable energy programs like community solar.	C C C C $ E	**City:** BPS **County:** OS	Existing and/or ongoing

Potential impact C C C C Magnitude of carbon emissions reduction | $ High potential to support jobs and prosperity | E High potential to advance equity | High potential to improve local environmental quality | High potential to improve health

ACTIONS TO BE COMPLETED BY 2020		Impact	Lead agency	Timeframe
3E	**Biogas —** Continue to support development of local and regional biogas resources, including anaerobic digestion of food scraps, while minimizing disproportionate impacts on low-income populations and communities of color.	C C C C $ E	**City:** BPS	Existing and/or ongoing
3F	**District Systems —** Continue to support development and expansion of low-carbon district heating and cooling systems.	C C C C $ E	**City:** BPS	Existing and/or ongoing
3G	**Fossil Fuel Exports —** Establish a fossil fuel export policy that considers lifecycle emissions, safety, economics, neighborhood livability and the environment; at the state level, oppose exports of coal and oil through Oregon.	C C C C $ E	**City:** BPS **County:** OS	Near-term

COMMUNITY SOLAR

Community solar represents the next phase of Portland's solar initiatives. Solarize Portland brought rooftop solar to thousands of Portland homeowners, but many more thousands of residents don't have this opportunity. Renters, for example, are typically not able to install solar on their apartment buildings. Other common barriers include shading, roof orientation and financial constraints. Community solar programs recognize these barriers and provide an alternative to on-site solar generation for a broader segment of the population.

In its ideal form, community-shared solar is one larger-scale photovoltaic system that provides power or economic benefits to multiple customers. Unfortunately, current laws and regulations in Oregon do not allow customers to receive a credit on their electric bill or to receive a financial return on investment from shared clean energy systems. These obstacles must be addressed soon.

The City has experimented with and piloted efforts to kickstart community solar in Portland under current market conditions. Most recently, the Bureau of Planning and Sustainability launched Solar Forward, a donation-based campaign that offers community members a way to engage in the development of solar on public buildings like community centers, schools and libraries. Solar Forward brings together solar supporters and available roof space, relying on crowd-sourcing to fund each system. With support from citizens and philanthropic and business communities, Solar Forward raised enough funds to install three solar electric systems: one at Southwest Community Center, one at Oliver P. Lent Elementary School and one at a community center owned by Hacienda Community Development Corporation.

SOLAR FORWARD
Funding Portland's Local Energy Future
TOGETHER

Appendix B - Denver Building Climate Plan

Appendix B provides the building goals, strategies, and actions that can be found in Denver's climate plan.

Decarbonizing buildings

- Adopt the 2018 International Energy Conservation Code (IECC)
- Participate in IECC code update process to influence the adoption of more aggressive energy codes
- Develop an energy performance program, which would require buildings that are less efficient to make periodic cost-effective, incremental energy improvements
- Develop a stretch code and incentives for new buildings
- Continue to increase building code to net-zero energy for new buildings and to be significantly more stringent for existing buildings by 2035
- Target homes in need of efficiency upgrades and pair with additional strategies like electric vehicles, solar, storage, and fuel switching
- Establish a home energy rating for all single-family buildings so that owners, renters and potential buyers can make informed decisions about a home's efficiency and operating costs
- Set minimum energy efficiency standards for rental properties
- Partner with local and national organizations to facilitate group discounts for energy improvements to maximize program uptake and cost savings

The role of efficiency is strategically important to the feasibility and economics of renewable electricity efforts. Efficiency allows for "right-sized" renewable energy additions, both for distributed and utility scale efforts. Efficiency also is an important means to reduce overall costs for energy, through the absolute reduction of energy consumption. Decarbonizing commercial buildings is one of the best ways to achieve our energy efficiency goals and will play a large role in reducing GHG emissions, propelling Denver toward the goal of a 15 percent reduction of total emissions by 2020 and a 45 percent reduction by 2030.

Denver will continue its Energize Denver program that focuses on energy efficiency in commercial and multifamily buildings, including the benchmarking requirement. The program requires buildings exceeding 25,000 square feet to annually benchmark their energy use and make that data publicly available. Future programs will require less-efficient buildings to make periodic cost-effective, incremental energy-efficiency improvements.

Denver will support stronger building codes by adopting the 2018 IECC to ensure that new construction and major renovation projects are highly efficient. The City will also continually improve codes over time by adopting code updates, creating new policies and incentives like stretch codes, and enforcing them; eventually increasing the code to net-zero for all new buildings. Intermediate strategies also include establishing a green lease program, providing incentives for high-performing, LEED and net-zero buildings, and providing training and outreach to drive investments in energy efficiency and behavioral-based energy efficiency.

These efforts are in line with McKinsey & Company's recommendations for emissions reductions associated with the commercial building sector. Denver will raise "building standards for new construction, retrofitting building envelopes, upgrading HVAC and water heating technology, and implementing lighting, appliance, and automation improvements." Since commercial buildings have a lasting presence in communities, ensuring that new buildings and existing buildings achieve high performing building standards is essential to lock in the emissions reductions.

Another important focus of the City is the residential sector. Denver has set a target to decrease energy consumption in single family homes by 10 percent by 2025 and 20 percent by 2035. Denver will provide guidance and develop strategies to drive investments in energy efficiency and behavioral-based changes. Denver will establish minimum energy standards for rental housing and engage property owners to ensure that energy efficiency, renewable energy adoption, and other emissions reduction strategies from fuel switching are implemented cost-effectively for residents. The City will continue to provide resources on existing financing and incentive programs and encourage residents to fully utilize Xcel Energy and Denver programs. The City will explore how sharing a home's energy score during the home buying and selling process can result in energy and utility bill savings. Additionally, the Sustainable Neighborhoods certification program gives residents the opportunity to become active partners in making Denver a vibrant and sustainable community, and can help facilitate deeper engagement and actions related to residential energy efficiency.

Appendix C - Philadelphia Building Climate Plan

Appendix C provides the building goals, strategies, and actions that can be found in Philadelphia's climate plan.

Energy-Efficient Homes and Businesses

WHERE WE'RE GOING

Energy efficiency is the foundation of any strategy to meet Philadelphia's climate goals and move our city toward a more equitable energy future. The Environmental Protection Agency estimates as much as 30 percent of the energy in our buildings is "energy waste" and could be eliminated without reducing occupant comfort. **By 2050 Philadelphia will have eliminated this waste through the actions of local and state government, individuals, and institutions**.

Eliminating energy waste will save money for building owners and tenants and reduce reliance on fossil fuels for both electricity and on-site heating. **By reducing the demand for energy in our buildings, energy efficiency makes meeting Philadelphia's electricity needs with clean electricity generation like solar cheaper and easier.**

Every Philadelphian can save energy in our homes and businesses, and the City and other local institutions have a role to play in helping them to do so.

To achieve our energy vision, we'll need to invest in the efficiency of both our largest buildings, where the greatest carbon savings can be achieved, and in Philadelphia's rowhomes. More efficient homes will save money for Philadelphians, including those facing high energy bills, improve indoor comfort, and create local job opportunities for our residents.

Co-Benefits

EQUITY
Increasing efficiency of rowhomes and apartments is part of a larger strategy to improve housing conditions for all Philadelphia residents.

HEALTH
Efficiency can increase tenant comfort and protect Philadelphians from extreme summer and winter weather.

ENVIRONMENTAL
Reducing energy usage in our homes and buildings is a necessary first step toward reducing Philadelphia's carbon footprint.

ECONOMIC
Energy efficiency improvements lead to energy cost savings for building occupants and create good, local job opportunities.

HOW WE'LL GET THERE

The Office of Sustainability worked with energy experts to model the energy, climate, and health impacts of various energy efficiency policies at the state, local, and individual level. The Energy Efficiency Playbook on the following pages details the results of this modeling, outlines opportunities to improve the efficiency of our homes and businesses, and identifies key players that must be involved to achieve those efficiencies. The City of Philadelphia is committed to measuring progress toward the vision while continuing to update this modeling as new efficiency opportunities emerge.

ECONOMIC OPPORTUNITY FROM ENERGY EFFICIENCY

Cutting energy waste across Philadelphia's 600,000 buildings will take years of effort from a well-trained local workforce, but the good news is that the infrastructure to create that workforce is already in place. Pennsylvania is home to 65,000 energy efficiency jobs, many of them local to Philadelphia thanks to the efforts of local workforce development organizations and trainers like the Energy Coordinating Agency's Knight Training Center.

To meet the workforce needs of an energy-efficient Philadelphia, we'll need to both bring new workers into the building science field and train existing workers (including electricians, HVAC technicians, general contractors, and code inspectors) to identify and implement strategies to cut energy waste and help us move toward a clean energy future.

WHAT YOU CAN DO

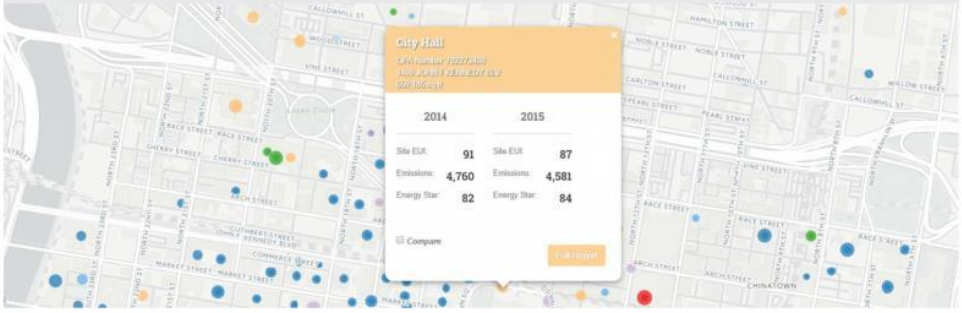
- **Take action at home:** Reducing energy waste as an individual is one of the easiest ways for Philadelphians to act on climate. See Page 39 for ideas on reducing home energy use, and check out Greenworks on the Ground at www.phila.gov/green for more opportunities.
- **Advocate for energy efficiency at work and in other spaces:** Do you know how efficient your school, business, or house of worship is? Most large buildings in Philadelphia disclose energy usage (see below), giving you the power to push for energy efficiency in your existing building or ensure energy is a consideration when choosing a new space to rent.
- **Local, state, and federal advocacy opportunities:** Achieving our energy vision will require action across all levels of government. Let your elected officials know energy efficiency is a priority, and see the Playbook on the following pages for specific advocacy opportunities.

Success Story: Energy Benchmarking

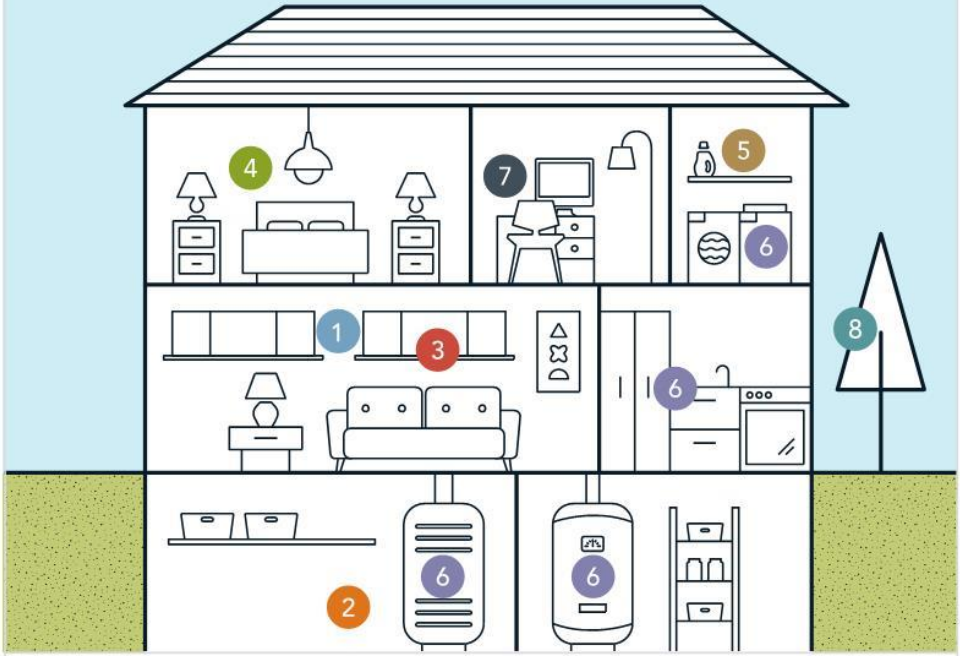
The city's energy benchmarking program helps large building owners and managers in Philadelphia better understand their energy and water use.

In 2017 more than 2,800 buildings reported their energy and water use, representing more than 30 percent of the total citywide square footage. The median Energy Star score (a 1 to 100 scale where 100 is the best energy performer) for these buildings was 63, 13 points above the national average.

OOS shares this data back with building owners via the publicly available building energy data visualization tool (http://visualization.phillybuildingbenchmarking.com) and through custom report cards that highlight their performance relative to peers and provide tips on how to improve. To learn more, visit www.phila.gov/benchmarking.



Reducing Home Energy Use

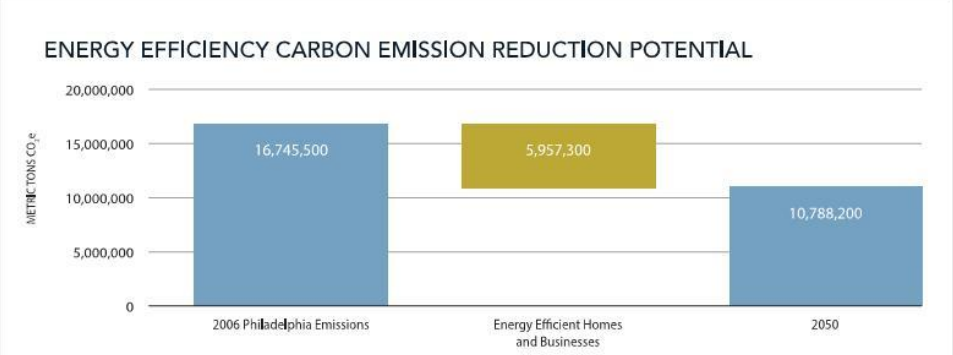


1. Buy a **programmable thermostat** to reduce energy usage when you're away from home.
2. **Clean air filters** and **recharge coolant** to improve the efficiency of air conditioning.
3. Keep your **windows sealed** in the winter.
4. Use high-efficiency **ENERGY STAR-labeled lightbulbs**.
5. Wash your clothes in **cold water** and consider air-drying clothes on racks.
6. Check for **ENERGY STAR** label when replacing appliances and fixtures.
7. User **power management** features to improve efficiency of electronic devices and unplug any devices not in use.
8. Consider **planting trees** to provide shade in the summertime.

Energy Efficiency Playbook

The Office of Sustainability modeled numerous strategies for improving the energy efficiency of buildings citywide. Residents and issue experts recommended many of these strategies as part of the CEV outreach process. Collectively implementing the energy efficiency playbook would result in significant carbon reductions citywide.

The following pages describe modeled energy efficiency strategies in detail. For information on modeling assumptions, see the appendix. Achieving these reductions will require buy-in from multiple stakeholders, who are identified in the Key Players boxes.



This chart indicates the potential carbon emissions reductions from implementing all the modeled strategies for cutting energy waste, assuming a business-as-ususal electricity grid. If Philadelphia achieves our clean electricity supply goals, reductions from energy efficiency will be lower.

KEY PLAYERS

Modernize Building Energy Codes

PA Legislature and Governor's Office: State action required to modernize Pennsylvania's building code (or permit Philadelphia to adopt a more stringent code).

Real Estate Developers, Homebuilders, and Contractors: Must support update and implementation of new building codes.

BY THE NUMBERS

Commercial Energy Codes

CARBON SAVINGS
186,830 $MtCO_2e$

ANNUAL COST SAVINGS
$51,304,207

BY THE NUMBERS

Residential Energy Codes

CARBON SAVINGS
103,290 $MtCO_2e$

ANNUAL COST SAVINGS
$27,140,667

MODERNIZE BUILDING ENERGY CODES

Building energy codes are among the most effective policies to reduce building energy use over time. Even though new buildings typically account for a very small percentage of the building stock, over time they can have very strong impacts on energy use.

Current Pennsylvania law pre-empts the City of Philadelphia from unilaterally adopting codes other than those approved by the state. The potential impact of these strategies highlights the value of advocating for a change to those policies at the state level.

Updating Commercial Energy Codes

Building code standards are set by the International Code Council (ICC) every three years. The Pennsylvania Legislature passed HB409 in 2017, bringing the statewide building code up to the ICC 2015 standard and enabling Philadelphia a one-time opportunity to update to 2018 code standards for commercial construction. 2018 codes were adopted by Philadelphia City Council and signed by Mayor Kenney in June 2018, making Philadelphia one of the first cities in the United States to adopt the 2018 codes.

These codes govern the safety and efficiency of new construction and major renovations. Construction and renovation are the most cost-effective opportunity to do major retrofits to cut energy waste, and the 2018 commercial codes will make new buildings in Philadelphia as much as 30 percent more efficient than under the previous 2009 codes.

To meet the energy code savings numbers modeled as part of the CEV, Philadelphia must implement the 2018 codes and remain current every three years thereafter, as well as work with code officials to ensure future IECC standards continue to prioritize energy savings. OOS and Licenses + Inspections staff voted for efficiency measures as part of the 2018 IECC code update process, and expect to continue to advocate for these measures in future code cycles.

Updating Residential Energy Codes

Modernizing residential codes will also be critical to achieve Philadelphia's climate and energy goals. New home construction and major renovations of existing rowhomes are required to meet the IRC (International Residential Code), and increasing the baseline level of energy efficiency required in these projects can help reduce utility costs while moving us toward Philadelphia's clean energy vision.

KEY PLAYERS

Building Code Compliance

Philadelphia Licenses + Inspections: Agency responsible for code enforcement.

Philadelphia City Council: Approves L+I's code enforcement budget each fiscal year and passes laws for code compliance requirements.

BY THE NUMBERS

Residential Energy Code Enforcement for Renovations and Additions

CARBON SAVINGS
9,290 $MtCO^2e$

ANNUAL COST SAVINGS
$2,440,113

BY THE NUMBERS

Third-Party Energy Code Compliance

CARBON SAVINGS
27,540 $MtCO_2e$

ANNUAL COST SAVINGS
$7,237,511

BUILDING CODE COMPLIANCE

While updating the energy code that Philadelphia builders must follow is currently a state issue, ensuring developers follow through with requirements must happen at the local level. To meet our climate and energy goals we must both modernize the energy code and ensure a high rate of code compliance for new development and renovations of existing buildings.

Residential Energy Code Enforcement for Renovations and Additions

Given current resource constraints, energy codes are most actively enforced in new construction projects. However, any project that requires a City permit could be subject to energy code enforcement, including some residential renovations, additions, and alterations. Because existing-building improvements can account for a large share of total built environment investment in each year, this strategy could significantly extend the energy savings impacts of energy codes.

Analysis by the Harvard Joint Center for Housing Studies indicates there are tens of thousands of projects in the city that may be covered by this strategy, which would require significantly more resources for the Department of Licenses + Inspections (L+I) to implement successfully.

Third-Party Energy Code Compliance

This strategy could allow consultants with energy rating expertise to assess code compliance for certain permitted projects (e.g. blower door testing of new residential construction). The 2018 version of the International Energy Conservation Code (IECC) contain an Energy Rating Index (ERI) compliance path, which enables accredited home energy rating providers to conduct code compliance analyses.

Permitting third-party compliance would engage experts who may be technically better equipped and have better capacity to conduct reviews and inspections than L+I, which is constrained by staff capacity.

Required Energy Modeling and Disclosure for New Construction

This strategy would connect building code compliance with the City's existing energy benchmarking program. Building projects meeting the benchmarking requirement would be required to use a simulation tool to project an energy use index and/or ENERGY STAR score for the building design. After a full year of operation, the buildings' actual benchmarked energy score would be compared to its projected score.

While energy modeling and disclosure itself will not directly lead to energy, carbon, and cost savings, data from that modeling can help assess the impact of other strategies within the CEV and provide information to potential tenants of new construction about the environmental impact of leasing opportunities.

KEY PLAYERS

PACE Financing

Pennsylvania Legislature: Must pass enabling legislation to permit PACE financing.

Philadelphia City Council: Would subsequently pass legislation to create PACE financing program.

BY THE NUMBERS

Commercial PACE

CARBON SAVINGS
6,440 $MtCO_2e$

ANNUAL COST SAVINGS
$1,882,000

PACE FINANCING

The property-assessed clean energy (PACE) model is a mechanism for financing energy efficiency and renewable energy improvements on private property. PACE programs allow local governments to fund the up-front cost of energy improvements on commercial and residential properties, which are paid back over time by the property owners. This allows property owners to engage in energy efficiency and renewable energy projects without taking on the full upfront costs. The property owner pays these funds back over time through property assessments, which are secured by the property itself and paid as an addition to the owners' property tax bills.

The Pennsylvania Legislature passed a bill to enable PACE for commercial properties (excluding any residential property) in Pennsylvania. The City of Philadelphia and Philadelphia Energy Authority are currently evaluating opportunities to implement a commercial PACE program locally. Loan servicing is legally complex and integration with the Revenue Department and other relevant stakeholders will require resources and coordination to ensure the program is successful.

KEY PLAYERS

2030 District

GBU: Non-profit leading the creation of Philadelphia's 2030 District.

Building owners and operators: Volunteering to set energy reduction targets by joining District.

City agencies: Can encourage building owners to join District and provide support for energy savings initiatives.

BY THE NUMBERS

2030 District

CARBON SAVINGS
525,560 $MtCO_2e$

ANNUAL COST SAVINGS
$162,856,453

2030 DISTRICT

2030 Districts are geographically-defined, private-sector led partnerships that commit to reducing energy use 50 percent by 2030 from a 2003 baseline. 2030 goals also address water consumption and transportation carbon emissions. Stakeholders including property owners, managers, and local government work together to leverage financing and shared resources to reach voluntary reduction goals.

Green Building United (GBU) launched the Philadelphia 2030 District in October 2017 with representation from major segments of Philadelphia's building stock in Center City and University City. By joining the District, building owners will have the opportunity to share best practices, access trainings and resources, and work together toward the District's ambitious shared climate goals.

The City of Philadelphia was among the first large real estate owners to join the 2030 District initiative. The City will further support the program by encouraging businesses and institutions to join the District and work with GBU and District participants to help meet goals and address barriers to achieving them.

KEY PLAYERS

Incentives for High-Performing Buildings

Philadelphia City Council: Pass legislation to offer incentives.

Real estate developers: Implement energy-saving measures in new construction and renovation to exceed existing energy code.

City agencies: Support developers in meeting building performance goals and verifying compliance.

BY THE NUMBERS

Permit Streamlining

CARBON SAVINGS
155,660 $MtCO_2e$

ANNUAL COST SAVINGS
$48,798,567

BY THE NUMBERS

Density Bonus

CARBON SAVINGS
559,440 $MtCO_2e$

ANNUAL COST SAVINGS
$158,667,619

BY THE NUMBERS

Property Tax Incentives

CARBON SAVINGS
28,250 $MtCO_2e$

ANNUAL COST SAVINGS
$8,753,754

INCENTIVES FOR HIGH-PERFORMING BUILDINGS

In addition to strengthening the required energy code for new construction, the City of Philadelphia can also incentivize real estate developers to go beyond code through a variety of mechanisms, including some that are already in place but could be further strengthened.

Permit Streamlining

Permit streamlining shortens the time to construction for projects that meet certain conditions. The City of Philadelphia has worked with solar developers to streamline permitting for renewable energy permitting, reducing the soft costs associated with permitting processes that may discourage installation and drive up the cost per kilowatt energy generated. This approach could be extended to new construction or major retrofits that commit to exceeding the required energy code (e.g. by committing to meeting LEED or Passive House requirements or seeking an ENERGY STAR label upon completion).

Several jurisdictions, including the Commonwealth of Massachusetts and cities of Chicago and Seattle have some form of expedited permitting for development that meets sustainability and green building goals. Streamlining opportunities may be combined with other permitting incentives, such as reduced permitting fees, access to technical assistance, and "as-of-right" development. Streamlining can combine several related permits or set time frames for each step to be completed.

Expand Density Bonus Incentive

Density bonuses offer developers an allowance to exceed existing zoning for taller buildings, more units or more floor space if the development provides a public benefit. The City of Philadelphia currently offers a density bonus for meeting LEED requirements and installing green roofs. To take further advantage of this opportunity, bonuses could also be awarded to projects that demonstrate they will exceed the required building energy code or provide other climate or energy benefits.

This strategy would require properties receiving density bonuses to achieve an ENERGY STAR score of 75 or higher or 70 percent reduction below national median for the property type within two years of occupancy (matching ENERGY STAR certification score requirement and 2030 District requirement for new construction and major renovations).

Property Tax Incentives for High-Performing New Buildings

The City of Philadelphia provides a ten-year tax abatement to all new construction and major renovation. Philadelphia City Council has considered various proposals to amend the abatement to meet the City's long-term goals, which should include considerations of Philadelphia's long-term energy and climate goals.

Multiple jurisdictions provide property tax abatements for efficient buildings. For example, Montgomery County, Maryland, provides tax exemptions of varying rates depending on the type of building and level of LEED certification. For this

analysis, OOS evaluated the impact of incentivizing above-code construction for new construction and major renovation.

Providing a property tax incentive for high-performing buildings could be part of a larger strategy to reconsider the tax abatement. Council members and advocates have also proposed using the tax abatement as a tool to promote affordable housing and spur development outside of Center City, both of which could incorporate additional clean energy incentives.

Municipal Impact Fees

To ensure compliance with the planning mechanisms described above, the City of Philadelphia could consider implementing an impact fee on all large new residential, new commercial, or certain renovation projects that do not meet specified requirements or fail to follow through with commitments during the development process. If projects do not meet these targets, the fees are withheld and are used to support public benefit initiatives such as energy efficiency programs.

In spring 2016 Miami Beach, Florida, became one of the first jurisdictions in the United States to implement an impact fee: new development that fails to meet green development standards will be required to pay a five percent fee on the cost of the project, with funding directed to programs to mitigate the impact of climate change on the coastal community.

UTILITY-FUNDED EFFICIENCY OPPORTUNITIES

In 2008, the Commonwealth of Pennsylvania passed Act 129, requiring investor-owned utilities to invest a percentage of their revenue in energy efficiency programming. PECO has since invested hundreds of millions of dollars in its service territory to improve the efficiency of homes and businesses, primarily through the Smart Ideas program. PGW voluntarily launched a similar program, Energysense, which provides a robust portfolio of market rate and low income usage reduction programs for residential, commercial and industrial customers.

Both Smart Ideas and Energysense provide rebates, incentives, and reduced costs for auditing services. The City and non-profit partners like the Energy Coordinating Agency work with the utilities to promote these efforts, which could be bolstered to supplement PECO and PGW's marketing and ensure that Philadelphians are maximizing the opportunity to save money and energy.

The City, key partners, and individuals and businesses should also continue lobbying for the next phase of Act 129 funding. The Pennsylvania Public Utilities Commission (PUC) will design future programs, set cost-effectiveness measurements, and authorize spending.

Both the City and residents can extend their roles advocating for Act 129 and future programs that benefit Philadelphia homes and businesses. Requests could include increased spending and programming designed to reach populations not currently benefitting from energy efficiency. Stakeholders interested in advocating for these changes can testify at public hearings, submit written comments, and participate in PUC working groups.

KEY PLAYERS

Utility-Funded Efficiency Opportunities

PECO and PGW: Manage efficiency programming in Philadelphia.

PUC: Regulatory body authorizing Act 129 investment across Pennsylvania.

City and residents: Can advocate for Act 129 programming benefitting Philadelphians.

BY THE NUMBERS

Act 129 Opportunities

CARBON SAVINGS
573,910 $MtCO_2e$

ANNUAL COST SAVINGS
$186,209,120

EXISTING BUILDING REQUIREMENTS

While the City of Philadelphia cannot currently increase the stringency of the building codes for new and existing buildings, the City does have authority to set other requirements for existing buildings, as was done with the creation of Philadelphia's energy benchmarking requirement. Additional existing building requirements could help building owners identify and implement energy savings opportunities in their homes and businesses.

Expand Energy Benchmarking Program

Energy benchmarking and disclosure policies require owners of large buildings to report their energy usage annually, providing a basis for comparing performance among buildings and driving energy improvements over time. As one of the first cities to mandate energy benchmarking, Philadelphia completed its fifth year of data collection in 2017.

Philadelphia's benchmarking requirement was last amended in 2015, adding residential buildings 50,000 square feet and larger. This threshold is consistent with other jurisdictions, though some cities have required smaller buildings to report their energy usage.

Reducing the benchmarking threshold to 25,000 square feet would increase the number of properties required to report from 2,900 to more than 4,000. Many of these buildings would be smaller apartment buildings, which could provide valuable information both to the City and to potential tenants.

Requiring additional buildings to report would increase the administrative costs of the program to the Office of Sustainability and local utilities providing data. OOS has found that buildings from 50-100,000 square feet are often under-resourced and thus less able to easily comply with the benchmarking requirement. The expectation is that buildings smaller than 50,000 square feet would be similarly challenged by the request without significant support from the City or a partner.

KEY PLAYERS

Existing Building Requirements

Philadelphia City Council: Must pass legislation for additional building requirements.

OOS: Implements existing benchmarking program.

Local utilities: Provides energy data building owners.

Building owners and real estate community: Must support new requirements.

BY THE NUMBERS

Expand Energy Benchmarking Program

CARBON SAVINGS
25,110 $MtCO_2e$

ANNUAL COST SAVINGS
$7,441,115

Building Tune-up Program

Several jurisdictions across the country have introduced requirements that go beyond energy benchmarking to require the implementation of specific measures to improve energy performance. In Seattle, building owners will soon be required to perform building tune-ups (also called retro-commissioning), where a building professional will identify energy- and cost-saving measures that can be implemented immediately.

By optimizing building's controls, systems, and maintenance, tune-ups can save building owners between 5 and 20 percent annually on energy costs, with a typical payback over a period of 6 months to 2.5 years. Tune-ups also provide detailed systems information for owners and operators, increased comfort for building occupants, and opportunities for skilled energy efficiency services jobs.

Unlike the energy benchmarking program, building owners would incur an estimated average cost of $0.20 per square foot for building tune-ups. This may be burdensome to some building owners, particularly if the building is already high performing and has few tune-up opportunities. Like the expansion of the benchmarking program, a tune-up requirement would also require staff time from OOS or another implementing agency to help owners and operators understand the requirement and manage program compliance.

BY THE NUMBERS

Building Tune-Up Program

CARBON SAVINGS
183,380 $MtCO_2e$

ANNUAL COST SAVINGS
$54,640,606

Residential Energy Disclosure at Time of Sale

When you buy a home in Philadelphia, you receive a disclosure from the seller that covers the physical condition of the house. By adding a disclosure for energy performance (either through a rating system or through a direct sharing of recent utility bills), buyers would be better informed about the potential energy costs of their new homes, and sellers could improve the efficiency of a property before listing.

Several jurisdictions, including Chicago, Portland, Austin, Denver, and Berkeley, have adopted residential energy disclosure policies for existing homes. Portland, the latest city to approve residential energy disclosure, will require single-family home owners to obtain a home energy score through a professional and disclose the score at time of listing for sale. Factors to consider for a residential disclosure policy include:

- **Timing of disclosure:** at time of listing, contract period, or at closing.
- **Method of disclosure:** utility data, home energy rating system (HERS), or Home Energy Score.
- **Where disclosure is posted:** Multiple Listing Service listing or inspection.
- **Costs to the buyer, seller, and agent.**
- **Resource availability:** City staff for implementation, home energy professionals, access to utility data.

BY THE NUMBERS

Residential TOS Requirements

CARBON SAVINGS
1,125,830 $MtCO_2e$

ANNUAL COST SAVINGS
$311,223,662

BY THE NUMBERS

Commercial TOS Requirements

CARBON SAVINGS
1,533,550 $MtCO_2e$

ANNUAL COST SAVINGS
$432,233,682

Landlord Disclosure Requirement

Most Philadelphia renters currently have no reliable data on the potential cost and quality of energy in houses and apartments during the leasing process. Renters are often also the most financially insecure households, underscoring the need to provide information on energy costs prior to a lease agreement. A disclosure requirement for landlords would provide much-needed information to the marketplace, similar to Philadelphia's current energy benchmarking program for large commercial and multifamily properties.

A recent report by Rocky Mountain Institute, Better Rentals, Better City, highlighted the opportunity to require landlords to share energy usage with prospective tenants as well as to consider energy upgrade requirements for properties not meeting a certain level of efficiency. These upgrades must be balanced against the risk of displacement and gentrification for current and prospective residents, and the Office of Sustainability is currently working with the C40 Cities Exchange to understand more about the opportunities and challenges of this policy opportunity.

Energy Conservation Requirements at Time of Sale

Meeting the energy conservation code is currently required to receive a certificate of occupancy after construction or major renovation. Given the high percentage of buildings constructed prior to the advent of today's modern energy codes, requiring buildings to meet the energy conservation code or require other conservation measures at the time of sale (TOS) could have a significant impact.

Large commercial buildings frequently change ownership, which means TOS requirements could quickly result in energy savings. Frequent turnover may also make TOS requirements inefficient because they could result in substantial and expensive retrofits as frequently as every three years (the international code update cycle).

Residential properties change hands less frequently, but given the structural challenges in many of our city's rowhomes, time-of-sale energy code requirements may need to be part of a larger strategy to improve Philadelphians' homes.

To reduce the cost of compliance for sellers, Philadelphia could model this requirement after similar ordinances in San Francisco and Berkeley, California which require a list of measures subject to technical and financial feasibility.

KEY PLAYERS

Lead by Example

Energy Office: Implements energy efficiency investments for city-owned buildings.

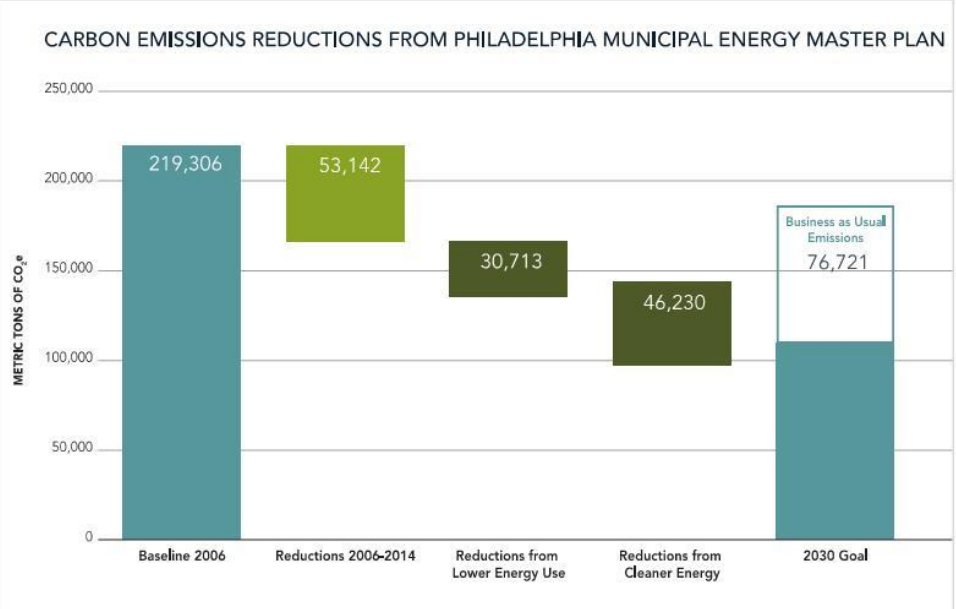
Philadelphia Energy Authority: Provides technical expertise and holds long contracts for guaranteed energy savings projects.

Philadelphia City Council: Allocates capital and operating funding for energy efficiency and approves long-term contracts.

LEAD BY EXAMPLE

Since 2013 the City of Philadelphia's energy consumption has decreased, and the City's carbon footprint has been declining since 2006. The City will deepen this progress and demonstrate leadership in climate action by continuing to reduce energy consumption and carbon emissions from its own buildings through strategies including:

- **Municipal Energy Master Plan:** The Office of Sustainability's Energy Office recently published the city's first energy master plan, which addresses centralized programs and actions that the City can take to reduce carbon emissions and improve efficiency in more than 600 City-owned facilities.
- **Philadelphia Museum of Art energy retrofit:** The City, Philadelphia Energy Authority, and Philadelphia Museum of Art have begun construction on $11.3 million in energy efficiency upgrades to the museum's Main, Perelman and Rodin Museum buildings, among the City's largest energy users. The project will reduce energy usage by more than 20%.
- **Rebuild initiative:** Rebuilding Community Infrastructure (Rebuild) is a $500 million program to upgrade parks, recreation centers, and libraries throughout Philadelphia. The Energy Office is developing energy efficiency guidelines to help reduce municipal energy usage as the City improves these assets for Philadelphia residents.
- **Energy Efficiency and Sustainability Fund:** The Energy Efficiency and Sustainability Fund, which provides operating departments funding through the Energy Office to invest in projects to improve the energy efficiency and sustainability of City-owned facilities.



The Municipal Energy Master Plan sets long-term energy and carbon reduction targets for City-owned buildings and streetlighting.

Appendix D - Cleveland Building Climate Plan

Appendix D provides the building goals, strategies, and actions that can be found in Cleveland's climate plan.

ENERGY EFFICIENCY & GREEN BUILDING

729

non-residential heating, ventilation, and cooling (HVAC) contractors were employed in Cleveland in 2015 with an average wage of

$60,200

These people are instrumental in both energy efficiency retrofits in existing buildings and the construction of new high-performing buildings.

Summary

The business case for energy efficiency and green buildings is strong. They have lower utility and maintenance costs, less risk from energy price volatility, increase property values, improve health and productivity of occupants, create local jobs, and much more. Scaling up green building practices across the city is critical to ensuring every neighborhood and business receives these benefits.

Key Facts

- In 2016, building energy use was the source of 44% of all GHG emissions for the City of Cleveland.
- In 2015, Ohioans spent roughly $3,600 per person annually on energy, according to the Energy Information Administration, which is down from $4,700 per person in 2010 (due to increased production of natural gas and residential pricing lower than the US Average for this resource).
- Workers in green, well-ventilated offices record a 101% increase in cognitive scores (brain function)[4].

Goals

- By 2030, reduce residential and commercial energy use 50% and industrial use by 30%.
- All large commercial and industrial buildings are tracking and managing their energy use by 2023.

Objectives

1. **Make More Homes Affordable, Comfortable, Healthy, and Energy Efficient**
2. **Prioritize Energy Efficiency in Small and Mid-Size Businesses**
3. **Support Community Hubs to be More Efficient and Resilient**
4. **Promote New Construction and Major Renovations that Meet High Green Building Standards**

Cross-Cutting Priorities

Social & Racial Equity

Policies implemented in the 1920s and applied through much of the 1960s made securing a loan to repair or renovate your home or purchase a home in a nicer neighborhood impossible for many black Clevelanders (Zeltner, 2016). One consequence is that many homes in predominantly black neighborhoods have fallen into disrepair. Greening these homes not only makes utility bills more affordable, but also provides a healthier environment for occupants.

Good Jobs, Green Jobs

Industries to watch focus on products and services to improving energy efficiency and building performance, including:

- New construction and remodelers
- Electrical, plumbing and HVAC (heating, ventilation, and cooling) contractors
- Architectural and engineering services
- Lighting equipment manufacturing

In 2017, total employment in these industries in Cleveland was 6,276 and average annual wages were $68,038.

Climate Resilience

As climate change brings more extreme heat to Cleveland, heat-related illnesses will become more prevalent and have a disproportionate impact on poor and elderly populations. More frequent heavy rain events will also have an impact on basement flooding. By making homes, businesses, and community hubs more efficient and resilient to extreme weather, these buildings can provide comfortable and safe places to shelter for those most vulnerable.

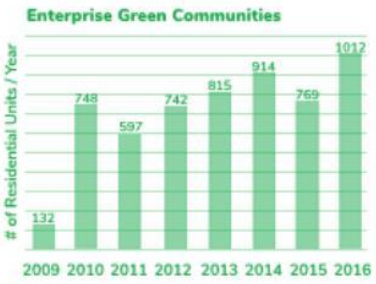
Business Leadership

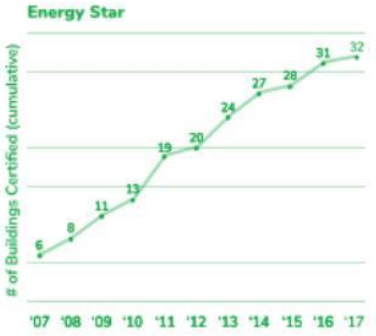
By investing in energy efficiency measures, Cleveland businesses can reduce energy price volatility, decreasing costs, and increase profits. Green buildings not only cost less to operate, but are also proven to improve worker retention and productivity.

Objective 1: Make more homes affordable, comfortable, healthy, and energy efficient

Summary

Cleveland's aging building stock and improving economy create opportunities for improved energy efficiency of existing older homes. This can be done through better insulation and air sealing, more efficient heating and cooling equipment, and efficient appliances and electronics. Key benefits include residents less burdened by utility costs and homes that are healthier and more comfortable.





Progress since 2013

- Cleveland Energy$aver, Cleveland's energy efficiency program, re-launched
- Northeast Ohio Public Energy Council (NOPEC) launched *My Energy My Way*
- The National Healthy Housing Center's ranking for Cleveland is currently 22 out of 45, with a prior rank of 35
- Dominion Energy Ohio and First Energy providing energy efficiency incentives to homeowners
- City of Cleveland and Cuyahoga County launch programs to combat lead poisoning; specific departmental efforts from the City's *Healthy Homes Interdepartmental Initiative* include:

  Cleveland Department of Health *increased lead investigations and enforcement*; Building and Housing *created the Rental Inspection Healthy Homes Initiative*; Community Development *awarded HUD funding to provide grants to eligible families for lead hazard repairs*

Actions

- a Educate owners and tenants of affordable, multifamily housing about cost-savings gained from energy efficient homes through training programs
- b Hold regular workshops with building contractors on green building best practices
- c Expand marketing plan for home weatherization citywide
- d Pursue coordinated one-touch approach to expand low-income housing programs by layering healthy homes, lead, and weatherization programs
- e All local utilities provide energy efficiency incentives and other resources to customers

Objective 2: Prioritize energy efficiency in small and mid-size businesses

Summary

Increasing energy efficiency in commercial and industrial properties can significantly increase savings on energy bills. Efficient buildings cost less to operate, adding directly to bottom-line profits for local businesses.

Progress since 2013

- As of 2017, Cleveland 2030 District signed up 50 building owners (representing 57 million square feet) to reduce energy use, water use, and transportation emissions, all supported by 60+ professional and community partners. These buildings have reduced the energy use per square foot by about 20%.
- Over the last several years COSE (Council of Smaller Enterprises) has conducted more than 1,000 energy audits (and 100 more per year through 2024), saving businesses millions
- Case Western Reserve University (CWRU) has developed an Industrial Assessment Center through the U.S. Department of Energy
- U.S. Green Building Council Ohio, NEO Region, restructured, partnered with Cleveland 2030 District on Annual Green Building Challenge

Actions

a Coordinate and expand green building support to more sectors and neighborhoods

b Explore energy efficiency policy options, including mandatory benchmarking and disclosure programs

c Establish a local Industrial Assessment Center to support students and manufacturers in advancing energy efficiency

d Become a leader in US DOE's Better Buildings Program and Better Plants Program through expanded engagement

Objective 3: Support community hubs to be more efficient and resilient

Summary

Community hubs that implement best practices of energy efficiency and resiliency are integral to a community's ability to respond during extreme weather events. If the grid goes down or Cleveland experiences extreme heat or cold snaps, buildings like rec centers, libraries, schools, community development corporations (CDCs), and places of worship can serve a critical role for residents in need.

Progress since 2013

- Burten, Bell, Carr Development Inc. piloted an effort to make its building resilient in the face of extreme weather.
- A number of places of worship working to install solar on-site.
- 21 LEED certified educational facilities in Cleveland (Cleveland Metropolitan School District, Case Western Reserve University, Cleveland State University, Cleveland Public Library, Cuyahoga Community College), with many others currently in design.

Actions

a Work with neighborhoods to identify and connect community hubs with limited resources to existing programs

b Ensure energy efficiency and resiliency are prioritized in new school construction and retrofits

Objective 4: Promote new construction and major renovations that meet high green building standards

Summary

Modern green building standards not only focus on ensuring an energy efficient building, but also an environment that promotes well-being. Buildings that meet these standards are less expensive to operate and maintain, improve employee retention, and lead to healthier and more productive occupants.

Progress since 2013

- The City of Cleveland's Green Building Standard, which must be met to receive residential property tax abatement, was updated.
- In 2016, Ohio was the only state to receive a perfect score in Global Green's analysis of green building criteria in low-income housing tax credit programs.
- The Cleveland Clinic's Center for Functional Medicine achieved WELL building certification, which places additional emphasis on the connection between building performance and human health.
- Development of statewide green building council (U.S. Green Building Council Ohio, Northeast Ohio Region).

Actions

a. Develop more formal green policy for new commercial buildings that goes beyond code, especially for those projects receiving public money

b. Update Cleveland Green Building Standard to incorporate new codes, support higher performance building, and advance social equity

c. Incentivize continued use of financing tools to promote green building

Appendix E - Minneapolis Building Climate Plan

Appendix E provides the building goals, strategies, and actions that can be found in Minneapolis's climate plan.

Buildings & Energy

Goals

1. **Achieve 15 percent energy efficiency in residential buildings from the growth baseline by 2025.**
2. **Achieve 20 percent energy efficiency in commercial/industrial buildings from the growth baseline by 2025.**
3. **Increase electricity from local and directly purchased renewables to 10 percent of the total consumed by 2025.**
4. **Achieve a 1.5 percent annual reduction in greenhouse gas emissions from City facilities.**

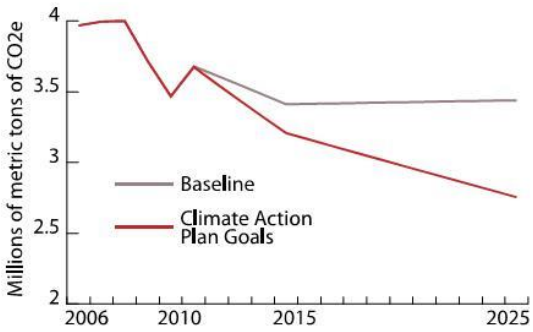


Figure 12. Estimated Emissions Reductions from Buildings and Energy Goals and Strategies

Cross-Cutting Strategies

1. **Develop a Green Zone Initiative.** The Green Zone Initiative will create a city designation for neighborhoods or clusters of neighborhoods that face the cumulative impacts of environmental, social, political and economic vulnerability. A Green Zone is an environmental and economic development tool that targets new green infrastructure and retrofits to an area in a comprehensive manner. Green Zones could correspond with targeted housing and commercial retrofit campaigns, to increase energy efficiency or boost renewable energy installation. Areas with Green Zone designation may better be positioned to access benefits offered by the city as well as state and federal agencies, ranging from targeted pollution reduction to increased funding opportunities.
2. **Launch a public-private energy efficiency campaign to catalyze action in businesses large and small.** Most of the energy in Minneapolis is consumed by businesses, necessitating efforts that businesses and properties can undertake to reduce their energy usage. The aggregated potential energy savings from small businesses can also be significant and should be identified and targeted. Research shows that the most effective energy efficiency programs succeed because they have committed leadership from the top. The City can use its leadership position to bring top City leaders to the table and affirm their commitment to working together to achieve this goal.

3. **Ensure that City facilities and infrastructure, across all neighborhoods, are models of energy-efficiency and renewable energy technology.** The City will investigate opportunities in buildings, street lighting, traffic signals and parking ramps to constantly increase energy efficiency and reduce water use. Those neighborhoods with infrastructure in immediate need should be prioritized. The City-operated water treatment plant is a large energy user, and opportunities for increasing efficiency will be continuously reviewed. Tools like the State's Guaranteed Energy Savings Program could be used to finance retrofits to City buildings. The City will continue to identify opportunities for renewable energy deployment on its facilities to reduce long-term operating costs and demonstrate new technologies.

4. **Continue and expand efforts to promote green jobs that support greenhouse gas emissions reduction goals.** The City of Minneapolis Employment and Training Program will engage in workforce planning, leveraging existing resources and seeking out innovative development opportunities through Step-Up, RENEW Minneapolis and other programming. The potential to develop a City of Lakes Energy Conservation Corps that provides Americorps opportunities with higher education subsidies to low income residents and youth from low-income census tracts will be explored. Future efforts will seek the alignment of educational, internship, and apprenticeship opportunities to produce a certified, well-prepared Minneapolis labor force, directing resources toward conservation and green retrofitting, water conservation, community composting, and green houses.

5. **Support the State's adoption of the latest International Energy Conservation Code (IECC) and International Green Construction Code (IGCC) and adopt the IGCC locally.** The IECC and IGCC will change the building code to require new commercial construction be more water and energy efficient and more durable than under previous versions of the code. If the IGCC is adopted at the state level as an appendix chapter, Minneapolis will need to adopt it locally before it can be in force.

6. **Incentivize energy and water efficiency in private buildings during every interaction with the City.** City departments could promote energy and water efficiency efforts to anyone interacting with the City for regulatory purposes, such as when seeking a permit or participating in design or zoning review. This may be targeted toward certain kinds of buildings that showed high promise for targeted efforts on energy efficiency, such as restaurants.

7. **Require City-financed projects to meet an energy efficiency standard, like Sustainable Buildings 2030 (SB2030).** The State of Minnesota has adopted a requirement that all State bonded projects meet the SB2030 standards. This requires progressively better energy performance from new projects. Similar requirements include Saint Paul's Sustainable Building Policy. Alternatively, or in combination, the City could require projects to complete Xcel Energy's Energy Design Assistance program. In conjunction, the City should review the ratios required for project financing (gap financing to overall project cost) to minimize any disruption to affordable housing construction that may be caused by implementing additional requirements.

8. **Explore opportunities to restructure the mechanical permit fee schedule and other fee schedules to incentivize energy- and water-efficient products and renewable energy.** Mechanical permit fees for products like furnaces are currently based on a percentage of the total value of the work being performed. More energy

efficient products are typically more expensive than less efficient products, in turn increasing the permit fee, which could be a disincentive to contractors and building owners who are considering more efficient equipment. With City staff and stakeholders, explore changes to the permit fee structure (ideally revenue neutral) that would incentivize the installation of more energy- and water-efficient equipment or renewable-supportive building design (e.g., "solar ready" buildings).

9. **Determine the feasibility of establishing conservation-based pricing or structuring of franchise fees and using the franchise agreement to support renewables.** During the update of franchise agreements with Xcel Energy and Centerpoint, Minneapolis should explore options to encourage energy conservation – through utility fee structure or the price passed on to customers. Examples could include structuring fees based on usage per customer or reducing fees if utilities meet energy efficiency goals. Franchise negotiations also provide an opportunity to plan for better integration of distributed solar PV into the grid (e.g., by linking up to the distribution system currently in place in many City rights-of-way).

10. **Evaluate and expand incentives granted for high energy performance.** Density bonuses are currently available to developments in the downtown zoning districts achieving high energy performance and can be used as an amenity for a planned unit development to obtain approvals for alternatives to the zoning regulations. These bonuses could be extended to areas outside of downtown and/or incorporated into other incentive programs. Extend these incentives to buildings that incorporate or are designed to allow for easy installation of significant renewable energy systems and to those in targeted under-invested communities (i.e., a City Green Zone program). Maintaining a diverse mix of housing types and affordability levels is a priority for the city. The displacement of low and moderate income households should be avoided in the implementation of any specific incentive policy.

11. **Develop tools to finance energy efficiency and renewable energy retrofits for commercial and residential buildings that have low barriers to entry and limited risk for local government.** Property-assessed financing, on-bill financing and other financial mechanisms could provide low-interest financing opportunities for homeowners and commercial properties. High interest rates,

the need for perfect credit, and complex program design can all be barriers to widespread adoption of these programs, especially for low-income households. Programs should be designed to maximize participation and provide access to all housing types and income levels. Working through a process led by the State of Minnesota, identify tools that the City or another regional entity can develop to provide more opportunities for energy efficiency and renewable energy financing.

12. **Support the adoption and implementation of emissions reductions plans by other government entities and institutions.** Hennepin County and the University of Minnesota have adopted targets for emissions reduction. Other entities, like health care campuses, may also be taking action on greenhouse gas emissions. Minneapolis should support these and other efforts and collaborate on implementation. The University of Minnesota's goal of achieving net zero emissions by 2050 is particularly ambitious; Minneapolis will support the University's efforts wherever possible.

13. **Support the adoption and implementation of emissions reductions plans by small and minority-owned businesses.** The City of Minneapolis is currently exploring the expansion of the Minnesota Technical Assistance program (MNTAP) to assist small, local businesses assess their energy use and the range of potential retrofits. Expand this program and target outreach to achieve equal representation from minority-owned businesses.

14. **Monitor new technologies and regularly reassess strategies.** There are many new technologies that could hold promise for improving energy efficiency and reducing emissions. Real-time pricing coupled with smarter appliances could reduce costs for electricity consumers and emissions. Advanced energy management technology could reduce wasted energy. These technologies should be implemented wherever feasible.

15. **Identify opportunities to increase conservation efforts within the downtown district heating and cooling system and make the system more efficient using technologies like combined heat and power.** The downtown district heating and cooling system, in total, represents one of the single largest loads in the City. Operated by NRG, the City is a major user, with connected loads including the Convention Center. Because customers on this system do not have access to utility conservation programs, there is an opportunity for the City to help increase the efficiency of the customers on this system. There may also be opportunities to make the district heating itself more efficient. For example, natural gas fired plants could be retrofitted to include combined heat and power generation. Every effort to reduce co-pollutant emissions should be made when considering such opportunities. The City should work with Hennepin County and NRG to determine where these retrofits might make sense.

16. **Identify opportunities to expand the use of district heating systems to new and existing buildings.** The downtown district heating and cooling system provides an efficient alternative to individual building heating and cooling systems.

18

Identify barriers to expansion into existing and new buildings in downtown. Seek opportunities for expanded district heating and cooling, especially using combined heat and power, outside downtown with new or existing systems.

17. **Work with utility providers and the State of Minnesota to conduct a robust energy end-use analysis to inform future energy planning efforts by the City.** Energy end-use analyses can provide insights into the best options for reducing energy consumption by identifying where energy is used inside a home or business (e.g., space and water heating, air conditioning, appliances, electronics). The Energy Information Agency (EIA) maintains this information for the country in general categories, but only has data through 2005. The State of Minnesota last updated an energy end-use analysis in 1988. Work with the state and utilities to determine if data is available and update an analysis for Minneapolis.

Residential Buildings

1. **Help 75 percent of Minneapolis homeowners participate in whole-house efficiency retrofit programs by 2025, ensuring the distribution reflects the current percentage of low and moderate income home ownership in the city.** The City of Minneapolis provided initial support for the Center for Energy and Environment's (CEE) Community Energy Services (CES) program, which has served about 4,800 Minneapolis owner-occupied homeowners, or just over five percent of the target population. The City could continue to help recruit homeowners into the program, and set a goal of 75 percent of homeowners participating in CES or similar whole-house retrofit program. As these programs expand, the City should assess the geographic and household income distribution the program has achieved. The expansion of CES and similar programs should be undertaken equitably across the City. Where possible, programs should be conducted jointly with other "healthy homes" initiatives like lead abatement.

2. **Help 75 percent of Minneapolis renters and rental property owners participate in efficiency retrofit programs by 2025, with a distribution that reflects the current percentage of low and moderate income rental housing in the city.** Programs targeted to residential rental facilities should be expanded. Existing programs like weatherization are available to low- and moderate-income renters, and as programs expand they should reflect the distribution of household incomes in the community. The split financial incentives between renters and rental property owners must be addressed in order to reduce carbon emissions from rental property. The City should use its rental licensing authority, along with targeted incentives, to increase energy efficiency in rental property, while ensuring that the energy savings benefit renters.

3. **Create time-of-sale and time-of-rent energy label disclosure.** New homeowners and potential tenants are a target group to promote energy upgrades, as they can be more receptive to making these investments (particularly when financing is available). Tenants could also use an asset rating label to make comparisons about energy performance and cost between units or buildings. Minneapolis currently requires a home inspection prior to any Minneapolis home being put on the market (the Truth-in-Housing program). The City could green the Truth-in-Housing program by including the collection of data sufficient to generate an energy label as well as other easily accessible data such as lead paint, history of superfund site, etc. In order to be cost-effective, data collection would need to be as limited as possible while providing useful information to the homeowner. The Center

for Energy and Environment has developed an energy label that is particularly relevant for Minneapolis housing stock that is currently being used in the Community Energy Services residential program, and could be expanded for use in the Truth-in-Housing program. A label for multi-family structures does not yet exist.

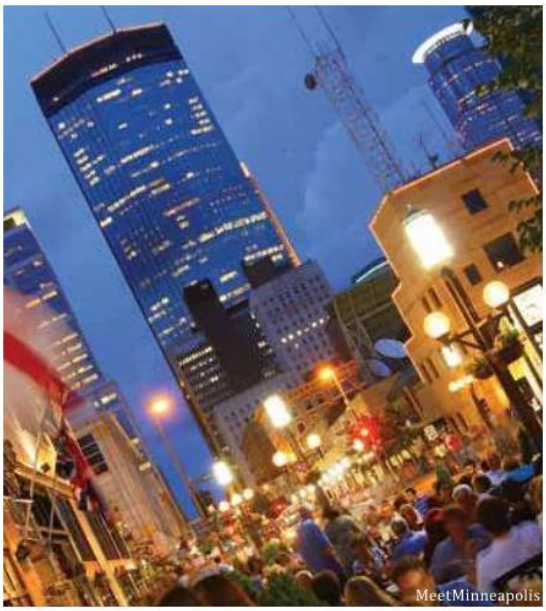
4. **Connect and collaborate with other residential energy efficiency efforts.** This includes:

   - Through city contracts, promoting the development of partnerships with low-income and supportive housing serving organizations to ensure that efficiency and renewable programs, incentives, and practices, meet the specific needs of these populations.
   - Helping to promote and work with on-line energy efficiency efforts that build teams and help to increase energy efficiency awareness and actions, including the Minnesota Energy Challenge, and OPOWER's new Facebook application.
   - Promoting appliance trade-ins through City events.
   - Promoting the use of energy benchmarking in Minneapolis multifamily buildings, as through the Minnesota Energy Scorecards program.

Commercial Buildings

1. **Continue to host an annual Energy Reduction Challenge ("Kilowatt Crackdown") for Commercial Buildings in conjunction with the Building Managers and Owners Association (BOMA) and other partners.** BOMA has developed a program, called the Kilowatt Crackdown, which local chapters can implement. Using the EnergySTAR Portfolio Manager tool, building owners track their energy use over the course of a year or two. This is compared to a benchmark of the previous year, and the buildings with the highest energy reduction receive awards. While the Kilowatt Crackdown is currently composed primarily of large commercial buildings, the City should encourage BOMA to expand participation to include more small and medium-sized buildings in the challenge.

2. **Implement the Building Energy Disclosure policy for medium and large commercial buildings.** The recently adopted commercial building energy disclosure policy that requires benchmarking and publication of data annually will help increase the



impact of energy use information in the marketplace, driving further energy efficiency improvements.

3. **Explore implementation of a commercial asset rating program, such as the Department of Energy's Commercial Building Energy Asset Rating.** Asset ratings provide a tool to evaluate the physical characteristics and as-built energy efficiency of buildings. An asset rating can also identify areas where improvements are needed.

4. **Develop incentives for commercial office buildings to investigate transitioning janitorial work to "Day Shift Cleaning" as a means of reducing energy consumed.** Work with janitors in their building to ensure a worker friendly transition. The City should also investigate the feasibility of implementing Day Shift Cleaning standards for commercial office buildings in Minneapolis.

5. **Develop "green lease" model language that allows building owners and tenants to share the energy savings from building capital improvements.** Tenants and building owners often have a split incentive when it comes to energy efficiency improvements since tenants frequently pay the energy bills. New model language could make more capital improvements likely.

Industrial Buildings

1. **Continue to support a loan program to help businesses including industrial companies to become more energy efficient and expand their businesses.** A relatively small number of Minneapolis industrial customers are responsible for a large proportion of total energy usage in the city. Focusing efforts to increase the energy efficiency of these businesses can have a large impact, while increasing the competitiveness of Minneapolis businesses and support job growth.

Renewable Energy

1. **Support efforts to align utility practices with City and State renewable energy policy.** State and local policies express a clear preference for renewable energy and distributed generation. The City thus supports efforts to reform or eliminate all practices that discourage property owners from adopting on-site renewable energy generation. Efforts could include limiting standby rates, improving interconnection standards, modifying demand charges, expanding net metering benefits to large commercial/industrial businesses, and exploring concepts like feed-in tariffs. The City should continue intergovernmental relations efforts to reduce barriers and encourage development of renewable energy resources.

2. **Implement small to mid-sized business renewable and on-site renewable incentive programs.** Market existing and develop new incentive programs that are targeted to small and mid-sized businesses.

3. **Investigate the feasibility of large-scale renewable energy purchasing for municipal government and/or residents.** The City routinely receives unsolicited requests to invest in bulk purchasing of renewable energy. Establish a proactive review process for these requests and/or explore an RFP process for bulk purchasing.

    - Create policies and programs to promote readiness for renewable energy into all new commercial and residential buildings. A number of cities and states across the nation are creating long-term policy goals and setting in motion building code changes that anticipate the declining cost curve for both solar energy and energy efficiency.

- Develop a "solar-ready" building certification. Existing buildings were not built to accommodate solar energy installations; retrofitting existing buildings adds significant costs to solar energy. Making new buildings "solar-ready" adds virtually no cost to construction costs. The next generation of the city's building infrastructure should accommodate the next generation of energy production. Information on solar-ready building could be distributed during permitting or the design review process (see Cross-Cutting Strategy #4). Solar-readiness could also be incorporated into green building requirements that may be adopted when the City has financial involvement in a project (e.g., affordable housing gap financing, see Cross-Cutting Strategy #5).

4. **Encourage "net-zero" energy buildings.** Net-zero energy buildings maximize synergies between energy efficiency and distributed energy generation. Policies in other states are anticipating building codes that require net-zero standards for residential buildings as soon as 2020. Minneapolis should plan to capture this transformative market trend through support of state efforts and creation of local incentives.

5. **Support new financing and ownership models for developing Minneapolis' solar resource.** Support explicit authorization of third-party solar leasing and ownership and enabling community solar projects, and other delivery/financial mechanisms (e.g., cooperatives, sustainable utilities). Third party ownership and leasing models expand access to on-site renewable energy generation by simplifying the adoption process and enabling the cost-effective bundling of tax incentives, long-term financing, installation, and operation and maintenance into a single transaction. Minneapolis residents who do not own property or whose property has a poor solar resource should be enabled to own part of an off-site solar PV installation, and receive a share of the production credits on their utility bill.

Appendix F - Pittsburgh Building Climate Plan

Appendix F provides the building goals, strategies, and actions that can be found in Pittsburgh's climate plan.

CHAPTER THREE: Buildings

Goal: Reduce energy and water consumption by 50%

Buildings Actions: Data

Description	Lead Agency (Partners)
Get monthly/hourly electricity consumption data by sector for each neighborhood (or zip code)	Duquesne Light
Get monthly natural gas consumption data by sector for each neighborhood (or zip code)	Peoples Natural Gas & Columbia Gas
Get monthly potable water use data by sector for each neighborhood (or zip code)	PWSA & PA American Water
Get annual square footage by use type and neighborhood (or zip code)	Allegheny Office of Property Assessments

Objective #1: Reduce energy and water use in existing buildings by 50% by 2030
Existing Building Actions: Policy

Description	Lead Agency (Partners)
Pass state level enabling legislation for residential energy and water disclosure	City of Pittsburgh, GBA & Philadelphia?
Pass Pittsburgh Commercial Building Energy Benchmarking Ordinance	City of Pittsburgh (Energy Benchmarking Working Group)
Create legal framework for Property Assessed Clean Energy program	City of Pittsburgh & Philadelphia?

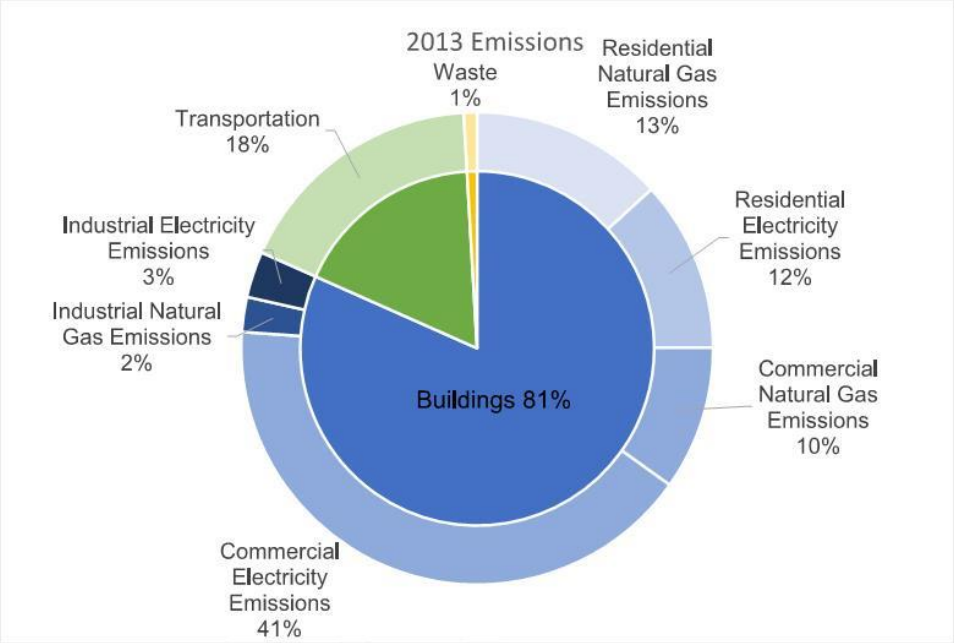
Existing Buildings Actions: Resources

Description	Lead Agency (Partners)
Create a map/matrix of resources for energy efficiency retrofits	CCI/GHHI
Create a revolving loan fund for energy and water efficiency retrofits	ACHD, PWSA, ALCOSAN?
Create a building owner manual and expand first time building owner classes	HACP, CCI, GBA?

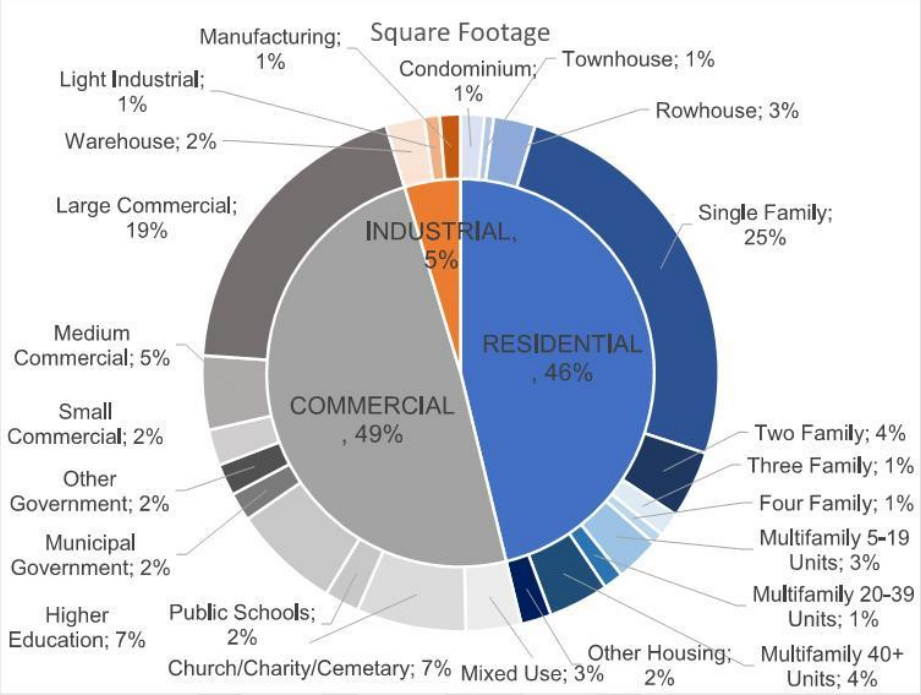
Objective #2: Ensure all new buildings are carbon neutral and location efficient by 2030
New Buildings Actions: Policy

Description	Lead Agency (Partners)
Pass state level enabling legislation for local building code adoption	City of Pittsburgh & Philadelphia?
Adopt Passive House/Climate Smart building energy codes	City of Pittsburgh, GBA
Create a Location Efficiency Overlay and use Transfer of Development Rights to encourage density while protecting open space	City of Pittsburgh, ALT

Based on the 2013 sector based inventory, Pittsburgh's buildings are responsible for 81% of carbon emissions through the consumption of electricity and natural gas.



This large source of CO2 provides many opportunities for deep carbon reductions. Improving energy generation and distribution systems is method to reduce energy related emissions. Improving end use efficiency can also significantly reduce emissions. Energy efficiency improvements are needed in commercial, residential, and industrial buildings and strategies specific to end use type can be deployed.



Energy use intensity measures how much energy a building uses per square foot, which is largely determined by the building use type and age. For example, a manufacturing facility with heavy machinery will use much more energy than a warehouse with only lighting. A newer home should be more efficient than an older home, and thus use less energy per square foot.

It is currently not possible to link energy use back to a specific building or use type, so energy use by sector is divided among the total square footage by sector, which loses some of the nuance. Ideally, in future years it will be possible to link energy use to use type and building size and geographic location to tell a better story of Pittsburgh's energy use.

	2013 Natural Gas MMBtu	2013 Electricity kWh	MMBtu	Square Footage	EUI (kBtu/SF)
Residential Energy Use	11,905,971	890,774,648	14,946,185	200,906,307	74.39
Commercial Energy Use	8,876,464	3,143,404,541	19,604,904	213,664,963	91.76
Industrial Energy Use	2,153,685	240,839,479	2,975,670	20,282,785	146.71

Objective #1: Reduce energy and water use in existing buildings by 50% by 2030

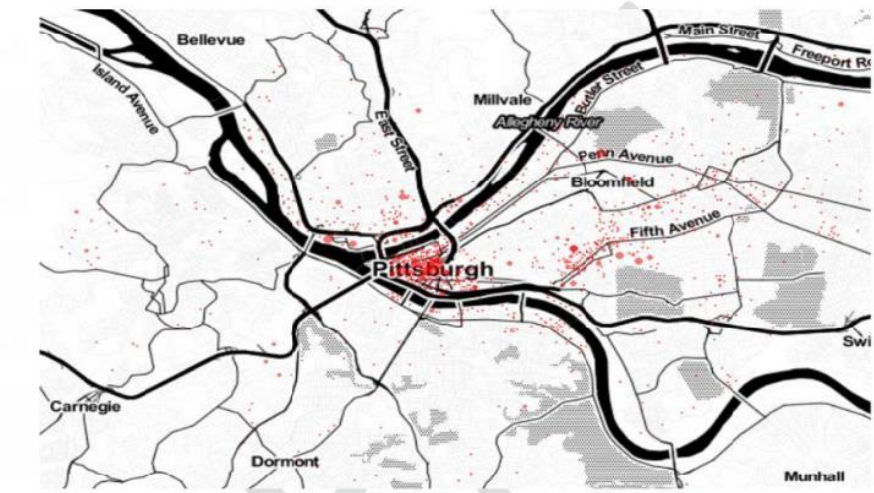
	2013 EUI (kBtu/SF)	2030 EUI (kBtu/SF)
Residential Energy Use	74.39	37.2
Commercial Energy Use	91.76	45.88
Industrial Energy Use	146.71	73.36

	2013	2030
Estimated Water Use (MGD)	70	35
Daily Water Use/Residential Population (gallons/person)	229	115
Daily Water Use/Daytime Population (gallons/person)	153	76
Annual Water Use Intensity (gal/SF)	59	29

Commercial Buildings

Building Benchmarking

In October 2016, the City of Pittsburgh enacted a new Building Benchmarking ordinance. This ordinance requires all nonresidential building 50,000 square feet and greater to report annual water and energy consumption starting in June 2018.



Map of the buildings that are 'covered' by the benchmarking ordinance

As the adage goes, "You can't manage what you can't measure." The first step in making any energy reductions is to get a better understanding of how energy is used. Benchmarking a building will allow the owners and operators as well as possible tenants of the building be able to understand how a building is performing in relation to other buildings of similar size and use type. This information can help inform future decisions and investments. Similar legislation had been implemented in cities across the US with measurable success. In the first year of the legislation, New York City the building benchmarking ordinance resulted in nearly 6% cumulative energy savings. San Francisco saw an 8% energy reduction as a result of similar policy. Pittsburgh hopes to recognize similar savings and begin to carve away at the 51% of emissions that are a result of commercial building operations.

Pittsburgh 2030 District

The building benchmarking ordinance looks to expand upon the energy efficiency improvements already being recognized with in the Pittsburgh 2030 District.

The Pittsburgh 2030 District, a Green Building Alliance strategic initiative, is a collaborative, nationally recognized, local community of high performance buildings in the Downtown, Oakland, and North Shore neighborhoods. It consists of building owners, facility managers, community partners and local resource partners working together to dramatically reduce energy and water consumption, decrease transportation emissions, and improve indoor air quality while increasing competitiveness in the business environment and enhancing returns on investment.

Using performance targets provided by the global Architecture 2030 Challenge, the Pittsburgh 2030 District seeks to demonstrate that high performing buildings are the most profitable buildings in the City.[1] Over 435 commercial buildings in Pittsburgh's 2030 District have committed to reducing energy and water use by 50% below 2003 levels by 2030. The 2030 District also set a goal of reducing transportation emissions by 50% below the 2015 modeled baseline by 2030.

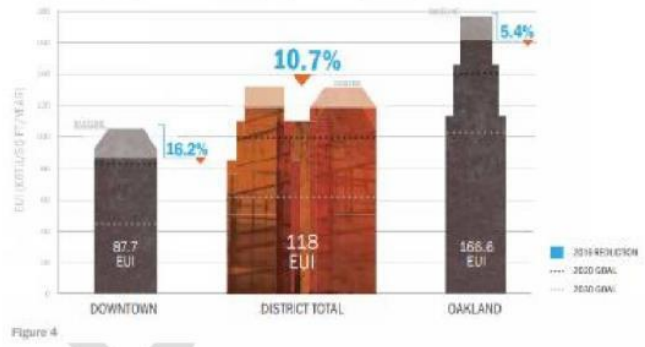


Figure 4

Since 2012, the 2030 District has been able to reduce energy consumption by an average of 10.7% below the baseline. This equates to 2.6 Billion kBTUs, the equivalent of more than 305,000 Tons of CO_2 equivalent, and a savings of $52.3 million dollars.

These collective efforts have established the Pittsburgh 2030 District as an example of a financially viable, sustainable, multi-sector endeavor that maximizes performance and profitability while significantly reducing greenhouse gas emissions. This type of collaborative action will keep Pittsburgh competitive and also represents a major investment in Pittsburgh's future.

Energy Intelligence Network

Through a partnership with Carnegie Mellon University's Center for Building Performance and Diagnostic and the Metro 21 group, the City recently rolled out a building energy use dashboard. This dashboard is part of a larger 'Energy Intelligence Network' (EIN) currently in development.

The Energy Intelligence Network is designed to improve data quality and access in order to better understand and thus reduce the environmental impact of City facilities. Starting in the City County Building, the EIN utilizes a number of monitors to collect and display real time energy consumption data. Real time, granular data about the energy being used by plug loads, lighting, and HVAC systems as well as the total energy being consumed can be used in numerous future projects and decision making processes.

Demand Response

Improved data quality as supplied by initiatives such as the Energy Intelligence Network can improve energy management capabilities. Energy management such as demand response programs can reduce energy costs and emissions and also improve the resiliency of electric grid infrastructure. However, real time data is needed in order to optimize these programs. Demand response allows building operators to reduce or shift energy consumption during periods of peak consumption across the grid. Through a variety of options, individual buildings can impact the demand and supply ratios of electricity in order to help ensure the demand does not exceed the available supply. Additionally, a more level load throughout the day will ensure that the supply is not too great which results in wasted energy.

Currently, if electric companies are unable to manage peak demands for energy, new sources of energy generation must be added to the grid. This often occurs in either 'restarting' coal fired power plants or building new power plants in order to reach the needed output. These plants often are only utilized during peak hours, and there is a negative economic and environmental impact of having to build additional capacity.

Peak load shaving, load shifting and time of use pricing, are a few demand response programs that can help reduce energy costs and prevent grid failures. The highest demand for energy often occurs mid-day in the summer. Commercial buildings are often at their highest occupancy in the middle of the day and this is also when outside temperatures peak. This means more time that air conditioners have to work harder to maintain indoor temperatures and cool the buildings. Several options such as raising air-conditioning temperatures, scheduling energy intensive processes at alternative times or closing an office and allowing employees to work from home can help to reduce energy demand during peak hours.

Demand response programs not only reduce energy consumption, they also save money that would otherwise be spent to build additional capacity.

Building Code Updates

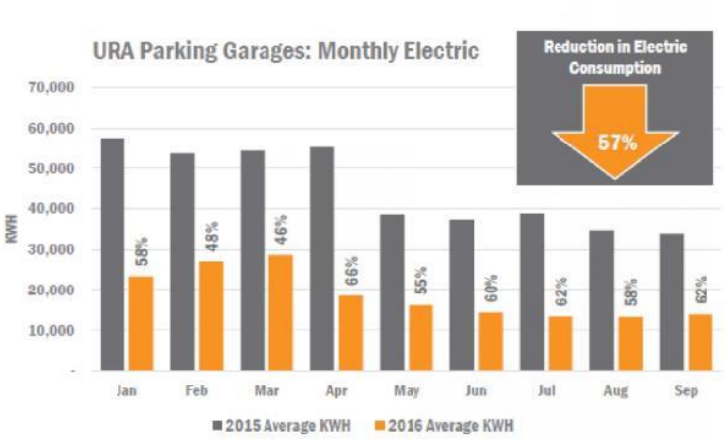
Currently, the state of Pennsylvania follows the 2009 International Building Codes (IBC) even though the International Code Council (ICC) instituted updated codes in 2012 and again in 2015. To date, state level legislation has prevented the adoption of the most up to date building codes. Building Codes are put in place to protect the health and well-being of building occupants and ensure that best practices are used in construction and renovations. As codes are updated new technology, techniques, and best practices are incorporated. Writing of the 2009 building codes began in 2006 meaning that technology developed in the past 10 years are not accounted for in Pennsylvania codes. Up to date building codes not only allow designers and builders to be competitive, but they ensure that public health, safety, and environmental considerations are protected. Keeping in line with the current building codes ensures that buildings reach optimum levels of energy efficiency and reduce related greenhouse gas emissions.

In addition to the higher greenhouse gas emissions contributions, Pennsylvanians are also subjected to higher insurance premiums and higher building operating costs due to the lack of compliance with leading standards and improved efficiency. The content of modern building codes included updated technology and standards that allow buildings to be more energy efficiency, cost-effective, and resilient.

With the help of the City of Philadelphia and local stakeholders, Pittsburgh is advocating for adopting up to date building codes in the state of Pennsylvania.

Green Garage Initiative

The Pittsburgh Green Garage Initiative (GGI) is an example of a simple energy efficiency measure that creates a significant impact on energy use. Dramatic energy savings were realized as part of the GGI when the City changed a few building code lines in order to allow for LED lights to be used in parking garages .The GGI has evolved into a collaboration of the Green Building Alliance, the Pittsburgh Parking Authority, the Sports and Exhibition Authority, and the Urban Redevelopment Authority to improve parking garages' energy efficiency and expand electric vehicle charging infrastructure.. A recent study concluded that 6,000 kW of solar photovoltaics could be installed on Pittsburgh Parking Authority garage roofs and at the Second Avenue parking lot.



As part of the garage initiative and energy grant, URA retrofit five local parking structures with extraordinary results. For the first nine months of post-retrofit operations, the Authority averaged a 57% reduction in electricity use. URA's complete retrofit portfolio to date includes five parking garages with a total of 3,051 parking spaces lit by 1,436 new fixtures. As a result of these remarkable results, the Authority is evaluating its entire parking garage portfolio and planning to leverage savings from its initial projects by reinvesting into other facilities via a new sustainability revolving fund.

Pittsburgh Parking Authority is not far behind, having completed a similar First Avenue Garage lighting and control retrofit in August 2016. This enterprise is expected to have comparable extraordinary electricity reductions of 50% to 60%. PPA is now designing similar retrofits on nine additional garages.

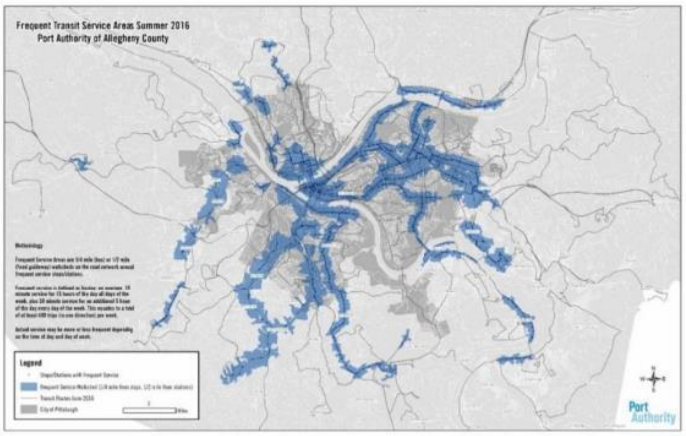
Lighting design were completed on SEA, URA, and PPAP parking garages. Within just one year of completing its resultant retrofits, SEA also experienced a 64% reduction in annual electricity use.

New Construction

Objective #2: Ensure all new buildings are carbon neutral and location efficient by 2030

New Buildings Actions: Policy

Updated building codes will help ensure that all new construction is built to perform at optimum efficiencies. Beyond a building's energy and water use, location has a significant impact on greenhouse gas emissions. If a new building is sited on a green field far away from residential areas and transit, the building decreases carbon sequestration and increases emissions from cars traveling to it. If the building is far from existing infrastructure, there is additional cost and energy loss conveying electricity and natural gas to the site.

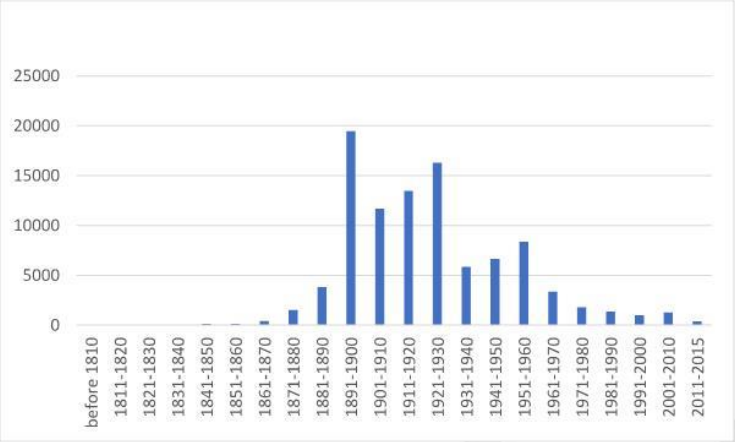


Location Efficiency Map

Pittsburgh defines a location efficiency using overlay map that integrates the walksheds around job centers (1/4 mile), walksheds to frequent service transit (fixed guideways) and protected bikeways to job centers/frequent service transit.

Residential Buildings

With 51% of emissions coming from commercial buildings, it is easy to focus attention solely on commercial energy efficiencies. However, residential efficiency actions also offer opportunities for significant impact. As with commercial buildings, updated building codes will help ensure that energy efficiency is prioritized as new homes are built. However, over seventy percent of existing residential buildings in Pittsburgh were built prior to 1960, many years before energy efficiency standards were integrated into national building codes in the 1970s. While sturdily built, these older homes need renovations to improve efficiency, health and safety.



Residential energy efficiency projects can offer equity benefits in addition to the potential emission reduction benefits. The American Council for an Energy-Efficient Economy (ACEEE) recently ranked Pittsburgh among the top ten cities where energy burdens, the ratio of utility bills to annual household income, were found to be greatest for low-income households. Nationally, the average energy burden for American households is approximately 4%. However, low income households' in Pittsburgh experience an energy burdens upwards of 15%.

In commercial buildings, electricity reduction offers the greatest opportunity for energy savings. In residential buildings, natural gas efficiency generates the maximum impact. Heating-related natural gas usage constitutes up to 56% of all natural gas usage in the City, 38% of all non-transportation energy usage, and up to 25% of the non-transportation related greenhouse gas emissions in the City. The residential sector is of particular interest, as up to 68% of gas usage in that sector is heating-related, amounting to an estimated 17% of energy use for the City (not including transportation sector emissions). Especially with the aging housing stock, which often lacks insulation or other heat saving updates, a significant amount of heat-related energy is 'lost' or wasted.

There have been a number of initiatives targeting residential improvements however, the ReEnergize Pittsburgh Coalition identified key barriers to increasing residential energy efficiency in Pittsburgh including;

1) Lack of homeowner education and awareness around energy efficiency programs and home performance issues
2) Difficulty connecting homeowners with available programs
3) Homeowner misconceptions about the value and ease of energy efficiency project implementation
4) Uncertainty around demand for and ability to sustain a skilled workforce

ReEnergize Pittsburgh Coalition also identified key strategies for improving residential efficiencies that include; improving consumer education resources, monetizing the value of home energy investments, integrating regional organizations and planning efforts, and identifying financing options and opportunities (Solving the Residential Home Energy Efficiency Challenge).

Green and Healthy Homes

In July 2017, Pittsburgh became the 19th United States city to join the Green and Healthy Homes Initiatives (GHHI). The Baltimore based organization utilize 8 key elements to help create healthier, more energy efficient homes. These whole-house strategies address issues from lead-based paint contamination, to poor indoor air quality, to energy efficiency in order to reduce housing costs specifically in low income households. These actions can help alleviate costs due to not only high energy burdens but also the socio-economic costs of related issues such as lead poisoning, asthma, lost labor force productivity, and high residence turn-over rates. In the United States, nearly six million households are exposed to 'unhealthy homes.' Through education, hazard remediation, advocacy, and efficiency services, Green and Healthy Homes is striving to improve the living conditions in those households.

Residential Energy Labeling and Green Listings

The new building benchmarking ordinance mandates transparency in the commercial building sector, however, similar transparency does not always exist at the residential level. The US Department of Energy offers a Home Energy Score program that aims at improving residential energy efficiency. Similar to vehicle fuel efficiency, the Home Energy Score provides useful energy use and efficiency information to homeowners and buyers. The scoring process also provides homeowners with suggested energy efficiency projects or updates for the home (https://betterbuildingssolutioncenter.energy.gov/home-energy-score).

In addition to promoting Home Energy Scoring, allowing for 'green' information to be included in multi-listing databases will also help improve residential energy efficiency.

Green information such as, solar panels, high-efficiency HVAC, insulation levels, or Home Energy Scores, are not currently included in multi-listing databases. However, this information could have a significant impact on appraisal values and accounting for the true value of these items

Home energy scores, green listings, and point of sale energy audits can help improve transparency in the home buying process. Increasing the information available to potential homeowners can allow those individuals make informed decisions and, as with the commercial energy benchmarking ordinance, begin to prioritize energy efficiency in residential reality.

Act 129

Utility-managed energy saving initiatives, such as Act 129 in Pennsylvania, represent a significant portion of available efficiency programs available for homeowners and renters. While these programs have a number of applications and benefits, they are often underutilized. Act 129 is legislation which requires Electric Distribution Companies (EDCs), such as Duquesne Light, to reduce electricity consumption. Improving education and access to Act 129 benefits can help significantly reduce residential energy use in cost-effective way.

Industrial Buildings and Activity

Pittsburgh has made great progress from the time when it was referred to as 'Hell with the lid off.' For much of the 20th century, the improved air quality standards and downturn of the steel industry in Pittsburgh resulted in significant emissions reductions. Whereas most emission previously were a result of the steel production and related industries, industry currently accounts for only 5% of the greenhouse gas emissions in Pittsburgh.

While the 5% emissions calculation accounts for things such as water treatment and sanitation, there is little data about privately-operated industrial activity. Greenhouse gas emission from energy use at industrial sites often only account for a portion of the environmental impact. Onsite activity can have additional air quality and environmental health implications. In order to better account for the true environmental impact of industry in the city, a concise database is needed. Those working in industrial sectors can best identify key areas for improvement as well as identify impediments to action. With improved information, key stakeholders can be brought to the table and further action can be taken.

Appendix G - Aspen Building Climate Plan

Appendix G provides the building goals, strategies, and actions that can be found in Aspen's climate plan.

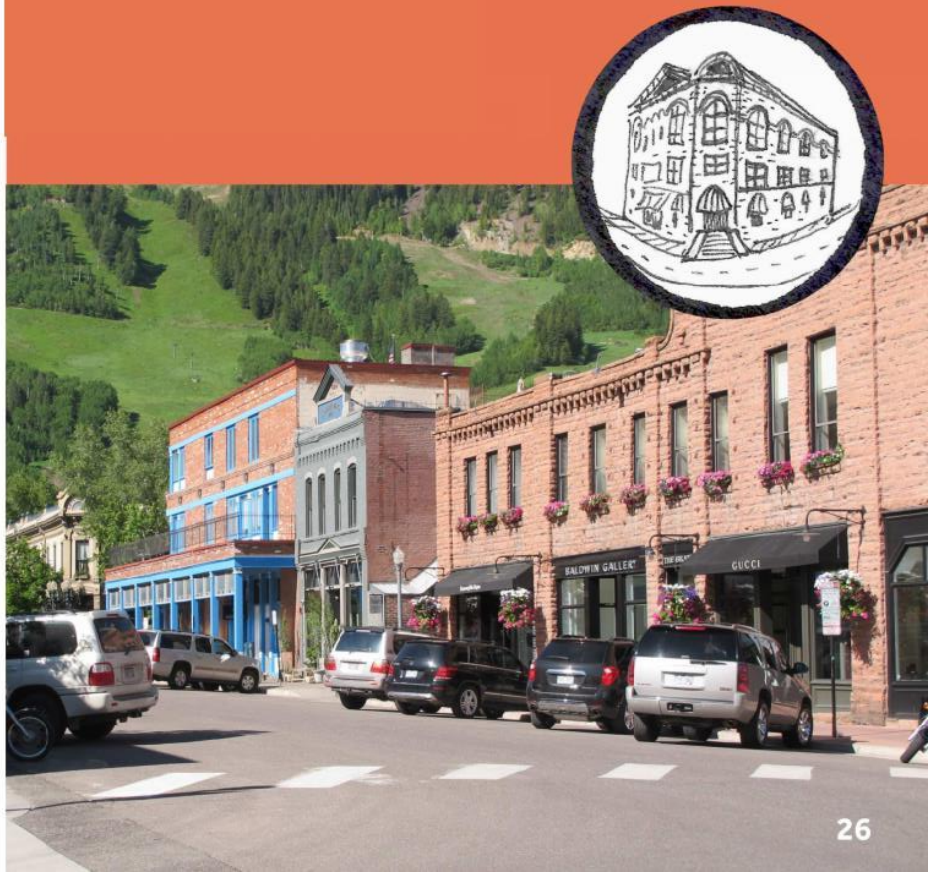
Sector Overview

COMMERCIAL ENERGY

Aspen's commercial building stock is made up of free market and subsidized properties that vary in age, quality, size and occupancy, and include owner-occupied and tenant-occupied businesses in single occupancy, condominiumized, and mixed-use buildings. GHG emissions in the Commercial Energy sector are associated with the use of electricity and natural gas in those spaces, and most are served by both types of utilities.

Roughly 800 commercial electric accounts in the Aspen EIB are served by Holy Cross Energy, while 1,000 are served by Aspen Electric. The 900 commercial natural gas accounts in the EIB are served by Black Hills Energy. These commercial properties have a variety of utility metering configurations, from single common meters to individualized sub-metering.

Opportunities to reduce GHGs include making the supply of energy flowing to commercial properties more renewable and consuming less energy in them. The co-benefits of successfully reducing Commercial Energy sector GHGs include direct financial savings for businesses and enhancing the health, safety, and comfort of the built environment.

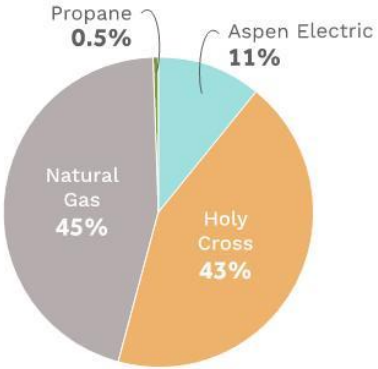


If all objectives in the Toolkit are fully and successfully implemented, Commercial Energy GHGs could be reduced 80% below 2004 levels by 2050.

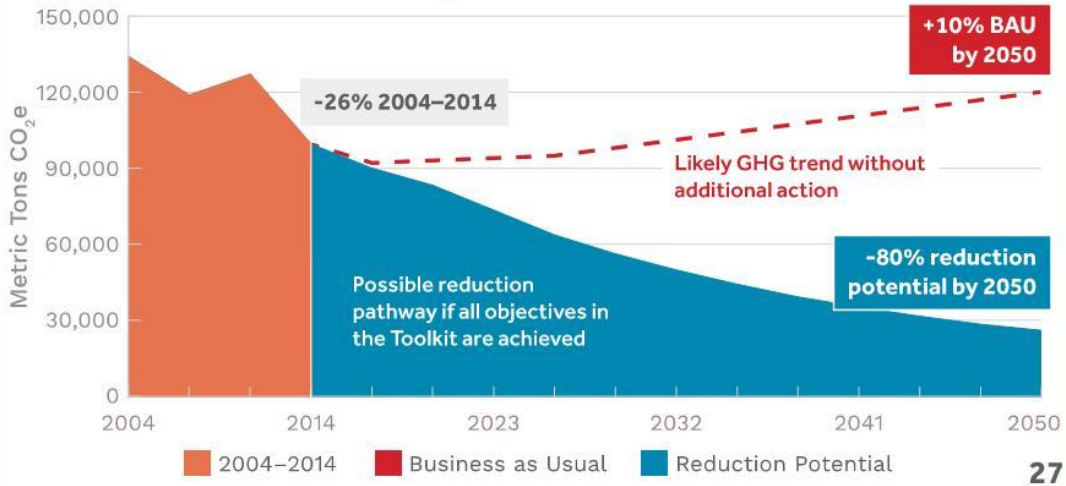
Commercial Energy GHG Trends

Commercial Energy GHGs declined 26% between 2004 and 2014 thanks to increases in renewable electricity generation and active energy efficiency programming. A majority of GHGs come from use of natural gas and from electricity on the Holy Cross Energy grid. Under business as usual, GHGs could decline 31% below 2004 levels by 2020 but then rise 10% above them by 2050. If, however, all objectives in the Toolkit are fully and successfully implemented, Commercial Energy GHGs could be reduced 80% below 2004 levels by 2050.

Sources of Commercial Energy GHGs



Commercial Energy GHG Past and Possible Futures



Commercial Energy: Recommended Actions

During the CAP process, the Advisory Committee initially brainstormed over 38 potential actions for reducing GHG emissions in the Commercial Energy Sector. **The CAP recommendation is to pursue implementation of the following seven actions** over the next three years. These actions align with the criteria described in the 'Understanding the CAP Recommendations' section of this document.

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS
Promote energy benchmarking and reporting in commercial buildings	C C C C	Primary Co-Benefits: $ ❄ + ∞
ACTIONS		
Support commercial energy benchmarking and incremental EE improvements through policy	C C C C	$ ❄ +
Enhance energy and resource efficiency in new commercial developments	C C C C	Primary Co-Benefits: = $ ❄ + ∞
ACTIONS		
Provide incentives for new and remodeled buildings to build above code	C C C C	❄ +
Limit GHG emissions from future development through the use of controlled growth and coordinated land use in and around the Urban Growth Boundary	C C C C	❄ +
Delay the need for air conditioning via building design and management	C C C C	$ ∞

COMMERCIAL ENERGY PARTNERS

Community Development Department

Building Department

Utilities Department

Holy Cross Energy

Aspen Skiing Company

Aspen Chamber Resort Association

Commercial Energy continues on the next page.

C Level of Potential GHG Reduction | = Promotes Equity | $ Fosters Economic Sustainability | ❄ Improves Local Environmental Quality | + Enhances Public Health & Safety | ∞ Builds Resilience

Commercial Energy: Recommended Actions (Continued)

OBJECTIVE	GHG REDUCTION POTENTIAL	CO-BENEFITS
Bring all commercial buildings up to current building codes or retrofit a majority of existing commercial buildings	C C C C	Primary Co-Benefits: $ ❄ + ∞
ACTIONS		
Establish new program to bring existing buildings to meet current energy codes	C C C C	❄ + ∞
Model best practices through energy retrofitting of government buildings and properties	C C C C	Primary Co-Benefits: $ ❄ + ∞
ACTIONS		
Retrofit government buildings, offices and facilities (including affordable housing units and complexes) to comply with current energy code	C C C C	$ ❄ + ∞
Optimize utility rates	C C C C	Primary Co-Benefits: = $ ∞
ACTIONS		
Adapt utility rates as necessary to incentivize and balance current and future priorities (i.e. EVs, fuel switching, time of use, peak shaving, energy efficiency, DSM)	C C C C	= $ ❄ + ∞

COMMERCIAL ENERGY RELATED PLANS

Aspen City Council Top 10 Goals (#8) 2015-2017:

Energy efficiency-related code changes to transform the energy use of buildings within the community

2012 Aspen Area Community Plan:

Require new development and redevelopment to minimize their energy usage and use on-site renewable energies as the site allows.

Existing development should minimize energy usage and use onsite renewable energies as the site allows.

C Level of Potential GHG Reduction | = Promotes Equity | $ Fosters Economic Sustainability | ❄ Improves Local Environmental Quality | + Enhances Public Health & Safety | ∞ Builds Resilience

Appendix H - Blacksburg Building Climate Plan

Appendix H provides the building goals, strategies, and actions that can be found in Blacksburg's climate plan.

COMMERCE AND INDUSTRY

GOALS

REDUCE ENERGY WASTE IN THE COMMERCIAL & INDUSTRIAL SECTORS
INCREASE THE USE OF RENEWABLE ENERGY IN THE BUSINESS SECTOR
INCREASE CONSUMER DEMAND FOR GREEN BUSINESS PRACTICES

CO-BENEFITS

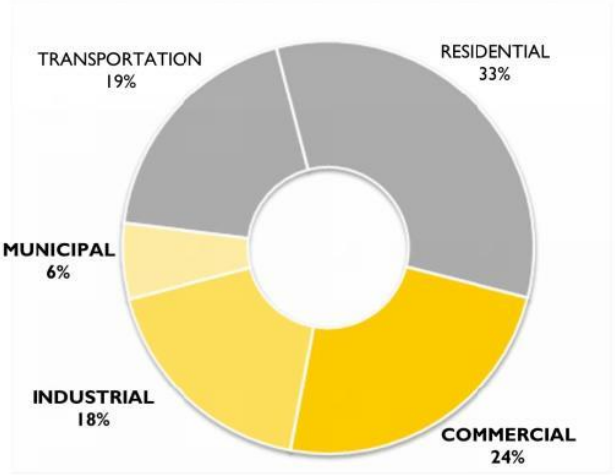
- reduced energy costs for local businesses and industry
- customer appreciation & other reputational benefits
- job creation in the clean energy/energy efficiency field
- improved local air quality

COMMERCE & INDUSTRY

BASELINE CONDITIONS, CHALLENGES & OPPORTUNITIES

Taken together, the commercial and industrial sectors comprise **42%** of the community's greenhouse gas emissions. From a functional standpoint, municipal buildings and operations have many similarities with the commercial sector, and represent an additional **6%** of the community's emissions. Improvements to **building efficiency and lighting upgrades have the greatest potential** to reduce commercial and industrial energy waste and emissions since heating/cooling and lighting drive the majority of the energy consumed by local businesses— 49% and 18% respectively.

COMMERCIAL & INDUSTRIAL SECTORS
Share of Greenhouse Gas Emissions



Blacksburg's residents interact with the community's commercial and industrial sectors in three ways - as consumers, as employees, and in the case of local businesses, as owners. As a result, citizens have more than one avenue to influence the business sector to move toward cleaner energy choices—as business leaders, as advocates within the workplace, and as consumers who make deliberate choices in how to spend their dollars on household goods, entertainment, dining, and recreation. Rewarding businesses who adopt and expand sustainability practices sends a clear message and gives other businesses an incentive to make similar changes.

The Town is already leading by example in this regard, ensuring that municipal buildings serve as models for sustainability through its commitment to pursue at minimum a **LEED Silver** rating for new construction or substantial renovation of municipal buildings, pursuing high-efficiency upgrades on existing buildings, and exploring the potential for on-site renewable energy generation on public properties. Primary strategies for the commercial and industrial sector center on developing small business incentive programs that promote **energy-efficient retrofits** and on-site **renewable energy** systems, and adoption of **green business practices/certifications** that reduce waste, conserve energy, and protect natural resources, all while saving businesses substantial money in the long run.

Meeting Our Commercial & Industrial Energy Goals:

- Reduce greenhouse gas emissions from commercial and industrial buildings by 10% by 2020 and 45% by 2050.
- Increase the amount of commercial energy demand met with on-site renewables tenfold by 2020 and two-hundred sixty fold by 2050.
- By reducing use of disposable goods, increasing recycling, and diverting organics from the landfill, reduce commercial and industrial solid waste by 30% by 2020 and 70% by 2050.

COMMERCE & INDUSTRY

INDIVIDUAL ACTIONS

TAKE ACTION TODAY!	NEXT STEPS....	BIGGER CHANGES
Avoid disposables. Bring your own bags to the grocery, your own travel mug to the coffee shop, and even your own to-go container to the restaurant.	(Politely) ask your favorite restaurant to switch from Styrofoam cups and to-go containers to something recyclable, compostable, or better yet—reusable (for a small fee).	Make a six-month commitment to not use any disposable items and share your progress with friends and family on social media.
If you catch your favorite local businesses doing something green, be sure the tell them you notice and appreciate it!	Nudge. If you see ways that your favorite local businesses could "green" their practices, let them know you would welcome a change.	Vote with your dollars and reward the local businesses that are going the "extra green mile" .
If you work in an office, think about the spaces where "**daylighting**" might be possible—places where natural light is sufficient for a good portion of the day.	Point your employer toward **local resources** that can help Blacksburg businesses improve the energy efficiency of their buildings.	Form a "**green team**" at your workplace and look for other opportunities to save energy and resources across the organization.
If you are a local business owner, investigate the DEQ's Virginia Environmental Excellence Program (**VEEP**), or the **Virginia Green** initiative.	Look into green certifications for your industry sector (such as the **Green Restaurant Association**, or the **U.S. Green Retail Association**)	Pursue and attain state and/or industry green certifications for your place of business. Display these proudly for all your customers and clients to see!

Virginia Green

You have power as an individual and as a consumer, and you can "vote" with your dollars every day when you choose alternatives to energy-intensive products and services. Instead of buying food that has traveled 1,500 miles to the local grocery store, why not pick up some in-season produce at the farmers market? The table above lists actions you can take as an individual consumer, an employee, and a business owner. Simple things you can try today, next steps to start building new habits, and bigger changes you can take on when you're ready to be a champion for greening our local economy.

GOALS

REDUCE ENERGY WASTE IN THE COMMERCIAL & INDUSTRIAL SECTORS
INCREASE THE USE OF RENEWABLE ENERGY IN THE BUSINESS SECTOR
INCREASE CONSUMER DEMAND FOR GREEN BUSINESS PRACTICES

PRIORITY STRATEGIES

COMMERCE & INDUSTRY

Let's Get Started:

Industrial Energy Efficiency Programs: Encourage industrial facilities to take advantage of existing and emerging federal and state programs such as the DOE's Industrial Technology Program, which sponsors energy audits for manufacturing plants.

Education & Outreach for Businesses: Engage local business owners in low and no-cost energy savings measures, including behavioral campaigns for employees (anti-idling policies, water conservation, daylighting initiatives, etc.)

Commercial Solar Potential: Perform a community-wide analysis of commercial properties to determine solar capacity of existing commercial roof space.

Green Business Certification Program: Create a local green business certification program to recognize local businesses that have made energy efficiency improvements and adopted other sustainability actions.

LEED Buildings: Through the Town's LEED building commitment, continue to lead by example for new construction or substantial rehab of commercial-grade buildings.

LEADING BY EXAMPLE: GILLIE'S RESTAURANT

One of Blacksburg's oldest and most-loved restaurants, **Gillie's** offers vegetarian fare right in the heart of downtown. While most restaurants offer Styrofoam or plastic to-go containers, Gillie's has offered **compostable to-go containers** for several years.

GOALS

REDUCE ENERGY WASTE IN THE COMMERCIAL & INDUSTRIAL SECTORS
INCREASE THE USE OF RENEWABLE ENERGY IN THE BUSINESS SECTOR
INCREASE CONSUMER DEMAND FOR GREEN BUSINESS PRACTICES

PRIORITY STRATEGIES

COMMERCE & INDUSTRY

Looking Ahead:

Commercial Energy Coalition: Foster collaborations among area businesses to share information on energy efficiency improvements and pool resources to purchase energy-efficient materials or equipment.

Incentives for Commercial Energy Upgrades: Establish incentives, financing tools, and other resources that would enable local businesses to cost-effectively pursue energy efficiency upgrades in their buildings and operations.

Green Leases: Explore opportunities (such as Green Leases) for renter businesses to partner with commercial property owners on efficiency upgrades or solar PV installations.

Commercial Energy Evaluations: Offer free or reduced-cost analysis of local commercial buildings to demonstrate return on investment timeline and potential cost-saving of efficiency upgrades.

LEED Building Incentives: Establish incentives, financing tools, and other resources that would enable local businesses and industry to cost-effectively pursue LEED certification or some suitable equivalent.

Innovative Financing for Commercial Efficiency: Identify collaborative financing options for large-scale commercial systems, such as privately owned and operated joint ventures.

KEY CONCEPT: GREEN LEASES

Green leases, also known as "**aligned leases**", work by aligning the financial and energy motivations of building owners and tenants so they can work together to save money and conserve energy resources. In a typical commercial lease, the energy costs are either entirely borne by the tenant (property owner has little motivation to invest in efficiency) or entirely borne by the owner (tenant has little motivation to conserve energy day-to-day). The situation is often referred to as a "split incentive" problem. Although green leases are available for residential properties, they work especially well for **commercial rentals**, where tenants may be in one location for years or even decades.

The **Natural Resources Defense Council**, the **Institute for Market Transformation**, and the **Department of Energy** have teamed up to develop a free library of template green leases for all types of commercial settings.

GOALS

REDUCE ENERGY WASTE IN THE COMMERCIAL & INDUSTRIAL SECTORS
INCREASE THE USE OF RENEWABLE ENERGY IN THE BUSINESS SECTOR
INCREASE CONSUMER DEMAND FOR GREEN BUSINESS PRACTICES

COMMERCE & INDUSTRY

LEADING BY EXAMPLE:

SHELTER ALTERNATIVES

For more than 25 years, **Shelter Alternatives** has been a leader in the community and across the state in green business practices, receiving numerous awards along the way, including the most recent, the **2014 Montgomery County Chamber of Commerce's NRV Green Company of the Year**. Shelter (as *it is colloquially known* in Town) was nominated by their Chamber peers for this award, which is given annually to recognize a business that "values and practices sustainability in their office, business operations, and outreach."

Sustainability governs all decisions made in the daily operations of the company. "Product choice, energy management and reduce/reuse/recycling protocols are just some of the ways that we make it a priority" says office manager Gregg Moneyhun. That same philosophy is echoed as part of the company's core values, directing employees to take responsibility for their actions and impacts on the environment.

Top: the staff of Shelter Alternatives posing in front of their Blacksburg office for a 25th anniversary photo in 2013.
Bottom: The 2014 Montgomery County Chamber of Commerce Green Company of the Year Award

Sources and Additional Resources:

Garrison, S., J. Randolph, D. Pitt, C. Davis, and J. Gruss. *Blacksburg Climate Action Plan Technical Report. 2008 - 2013. Commercial Industrial Chapter*

Green Leases. U.S. Department of Energy, 27 Dec. 2007. Web. 08 Mar. 2016.

"LEED for Commercial Buildings." *Leadership in Energy and Environmental Design. U.S. Green Building Council, n.d. Web. 8 Mar. 2016.*

Energy Information Administration (EIA)- Commercial Buildings Energy Consumption Survey (CBECS). N.p., n.d. Web. 08 Mar. 2016.

Daylighting. U.S. Department of Energy, n.d. Web. 08 Mar. 2016.

Virginia Department of Environmental Quality - Virginia Environmental Excellence Program (VEEP) . N.p., n.d. Web. 08 Mar. 2016.

Virginia Green. Virginia DEQ; Virginia Tourism Corporation, Virginia Economic Development Partnership, n.d. Web. 08 Mar. 2016.

EERE-Industrial Technologies Program. U.S. Department of Energy, n.d. Web. 08 Mar. 2016.

Appendix I - Flagstaff Building Climate Plan

Appendix I provides the building goals, strategies, and actions that can be found in Flagstaff's climate plan.

Energy

Energy refers to the ways energy usage impacts and is impacted by climate change. It includes strategies related to community energy consumption and efficiency, clean and renewable energy sourcing, future energy grid resilience, and energy-related land use, transportation, and building standards.

BACKGROUND INFORMATION

Building energy consumption accounts for almost half of Flagstaff's total greenhouse gas emissions. These emissions come from residential, commercial, and industrial buildings consuming electricity and burning natural gas. Emissions forecasts show that without action, emissions from energy will grow 35% by 2030. Climate change will shift building heating and cooling demands. By 2050, Flagstaff will likely see hotter temperatures and longer summers. The growth in cooling needs will increase energy use and costs, which in turn may stress lower-income families.

CURRENT COMMUNITY EFFORTS

- The City of Flagstaff provides home energy efficiency rebates for residents who upgrade equipment or weatherize their homes, and free Home Energy Efficiency 101 workshops for renters and homeowners.
- Several local companies are installing residential and commercial rooftop solar systems throughout Flagstaff.
- Solar installations have been installed at City facilities throughout Flagstaff, including City Hall, Rio de Flag Water Reclamation Plant, and the Aquaplex.

VISION:

In 2030, Flagstaff residents, businesses and organizations have access to affordable renewable energy, new building construction is designed to minimize energy use, and existing buildings have been upgraded to maximize energy efficiency.

GOALS, TARGETS, AND INDICATORS

The City of Flagstaff will prioritize reducing community greenhouse gas emissions associated with energy use by:

(1) Reducing energy consumption
(2) Adopting cost-effective energy efficiency improvements
(3) Maximizing renewable energy generation and storage capacity
(4) Meeting 100% of the community's electric energy needs through renewable energy resources.

GOAL

Reduce energy consumption and associated greenhouse gas emissions from heating, cooling, and powering buildings.

KEY PERFORMANCE INDICATORS	TARGET
Greenhouse gas emissions from heating, cooling and powering buildings	Reduce emissions from 2016 baseline: 15% by 2025 28% by 2030 54% by 2040 80% by 2050

Greenhouse gas emissions from heating, cooling and powering buildings, by building sector	Reduced emissions from 2016 baseline: **Industrial**: 15% by 2025 / 80% by 2050 **Commercial**: 15% by 2025 / 80% by 2050 **Residential**: 15% by 2025 / 80% by 2050
Natural Gas usage, by building sector	Reduced usage from 2016 baseline: **Industrial:** 15% by 2030 / 25% by 2050 **Commercial:** 17% by 2030 / 30% by 2050 **Residential:** 20% by 2030 / 40% by 2050
Proportion of newly constructed residential and commercial buildings that are ENERGY STAR, LEED-certified, and Coconino County Sustainable Building Programs buildings	20% of annual permits by 2025
Proportion of newly constructed residential buildings that are net-zero energy homes	50% by 2025
Flagstaff building code	Adoption of the most efficient, most recent building code
Energy efficiency retrofits of existing rental and owner-occupied residential homes	500 homes by 2025
Participating households in City energy efficiency programming, including workshops	1,000 households by 2025
SMARTregs	Initiation by 2020 50% of rentals participating by 2025

CORRESPONDING STRATEGY

Strategy 1. Improve energy efficiency in all sectors.

Strategy 3. Manage energy demand and consumption in residential, commercial, and industrial sectors, to reduce greenhouse gas emissions.

Goal

Increase renewable energy generation within the community and City municipal organization.

KEY PERFORMANCE INDICATORS	TARGET
Proportion of municipal electricity use from renewables (%)	2017: 5.4% 100% by 2025
Proportion of community electricity use from renewables (%)	18% by 2025 35% by 2030 68% by 2040 100% by 2050

CORRESPONDING STRATEGY
Strategy 2. Expand renewable energy generation and use.

Goal

Pursue a greater array of options for Flagstaff's energy needs in order to reduce greenhouse gas emissions.

KEY PERFORMANCE INDICATORS	TARGET
Renewable energy generation capacity on residential and commercial buildings	*Target to be established once benchmark data is available*

CORRESPONDING STRATEGY
Strategy 2. Expand renewable energy generation and use.

BALANCING ENERGY CONSERVATION AND FLAGSTAFF'S DARK SKY HERITAGE

Dark skies are a part of Flagstaff's identity. They enhance quality of life for Flagstaff residents while supporting wildlife, enhancing tourism, and sustaining economic development in Flagstaff's astronomy industry. As the world's first International Dark Sky City, the Flagstaff community has worked to proactively address problems associated with increased artificial light, air pollution, illuminated signage, and development since 1958.

To preserve its dark sky heritage, Flagstaff must often balance dark skies, energy conservation, and economic development. Streetlights are a good example. The City needs to replace its current low pressure sodium (LPS) lighting, which is dark-sky friendly but has been discontinued. The City and its partners have been working since 2012 to secure light emitting diode (LED) technology for streetlight fixtures that will support dark skies, provide appropriate lighting levels, and be cost-effective. The City and its partners have found that the type of LEDs that best protect dark skies use more energy in some applications than the current LPS fixtures. A thoughtful, collaborative, and rigorous process determined that dark sky preservation is, in this case, a greater priority than energy conservation.

Implementation of this Climate Action and Adaptation Plan may lead to other areas where climate action seems to conflict with community values. It will be important to continue this collaborative, transparent approach with strong public participation and technical rigor so that the City can effectively balancing competing demands.

STRATEGIES AND ACTIONS

STRATEGY 1. Improve energy efficiency in all sectors.

Constructing and upgrading buildings to meet the highest thresholds for green building performance can dramatically reduce long-term energy use and emissions.

Priority Actions

E-1-A	Establish a revolving loan fund to advance energy efficiency upgrades and make $125,000 available annually in loans for building efficiency upgrades.
E-1-B	Develop viable financing options for energy efficiency upgrades to commercial and residential buildings, such as a revolving loan program and new service and product models that enable homeowners to participate in energy efficiency improvements without upfront costs.
E-1-C	Fund and implement a contractor training and rebate program for solar thermal, on-demand water heaters, electric heat-pump space heaters, and conversions from gas to electric appliances, based on analysis demonstrating reductions in greenhouse gas emissions.
E-1-D	Subsidize home energy efficiency retrofits for affordable housing units, and housing that serves low-income and senior populations while maintaining the supply of existing housing.
E-1-E	Adhere to a consistent schedule for adopting the most up-to-date energy codes in alignment with Coconino County, ensure enforcement, and consider where local Flagstaff codes should exceed minimum standards.
E-1-F	Perform a full-scale energy audit and implement recommended energy retrofits for all City of Flagstaff facilities from this full-scale audit and the Airport Sustainability Plan.
E-1-G	Develop and adopt a SmartReg rental licensing policy program requiring minimum efficiency standards for all housing rentals.
E-1-H	Require zero-net-energy construction for all new residential and commercial buildings by 2040.
E-1-I	Work with partners to develop a specific plan for an aggressive building electrification program to decrease reliance on combustion fuels.

Other Actions

E-1-J	Expand homeowner energy efficiency workshops and other energy efficiency outreach and strengthen partnership support for the Coconino County Sustainable Building Program.
E-1-K	Develop an EnergySmart program to offer technical assistance, help schedule contractors for energy efficiency improvements, and offer incentives above and beyond what is offered by the utility.

E-1-L	Develop a policy requiring new affordable housing to be energy-efficient.
E-1-M	During City facility upgrades and new construction, install electric space and water heaters.
E-1-N	Work with APS to develop programs that incentivize residents to electrify water and space heating.
E-1-O	Introduce a policy that rewards builders who go beyond energy efficiency code requirements or obtain 3rd-party certification for green building performance, such as LEED certification, with lower City fees and expedited review.

STRATEGY 2. Expand renewable energy generation and use.

Clean energy generation presents a key opportunity to cut greenhouse gas emissions, enhance resiliency, and promote long-term economic security. Careful consideration should be given to ensure that any energy development is truly reducing greenhouse gas emissions.

Priority Actions

E-2-A	Move forward with City Council target of 100% renewable energy use for the municipality with a plan for achieving that target by 2025.
E-2-B	Move forward with City Council target of 100% renewable energy use for the community with a plan for achieving that target by 2050.
E-2-C	Establish a revolving loan fund to advance renewable energy and make $125,000 available annually in loans for renewable energy development.
E-2-D	Buy and produce local and regional renewable energy, including through partnerships with Arizona tribes.
E-2-E	Introduce local policies that incentivize renewable energy adoption and passive solar. This could include providing funding for expedited building code review for new homes with solar and for solar installations on existing homes as well as reduced City fees for homes with renewable energy.
E-2-F	Establish a locally controlled revolving loan fund or similar mechanism to improve community access to financing for renewable energy development—particularly solar—at commercial and residential sites.
E-2-G	Update City code to require pre-wiring for solar in all new residential and commercial buildings to reduce the cost of post-construction rooftop solar, battery storage, and electric charging system installations.

Other Actions

E-2-H	Improve the co-digestion process at Wildcat Hill Water Reclamation Plant and increase clean energy production.

E-2-I	Investigate renewable heat standards that would require or incentivize a percentage of thermal loads in all new homes to be generated renewably (i.e., solar thermal, heat pumps, biomass boilers).

Related Action

NE-2-C	Support forest product industry innovation and the construction of a biomass-based energy facility, to use the abundant forest products resulting from the thinning and restoration of regional forests.

STRATEGY 3. Manage energy demand and consumption in residential, commercial, and industrial sectors, to reduce greenhouse gas emissions.

Reducing peak energy demand helps energy providers reduce total electricity generation. This serves as an important step in reducing emissions from Flagstaff's energy usage.

Priority Actions

E-3-A	Collaborate with large energy users, such as Northern Arizona University, on reducing energy consumption and adopting new energy-saving technologies.
E-3-B	Provide tools and resources to help households manage their energy use.
E-3-C	Update the building code to clarify steps for the installation of battery storage systems by residents and businesses.

Other Actions

E-3-D	Continue to support community members in taking 'first-step' solutions that can be easily, inexpensively, and rapidly implemented by community members, such as unplugging appliances and installing LEDs indoors.
E-3-E	Develop a comprehensive energy management plan for government facilities and operations.
E-3-F	Form partnerships with businesses, APS, and entities such as Electrify America to increase the use of and piloting of energy storage systems such as batteries, thermal storage, and electric vehicles.
E-3-G	Educate customers about energy price signals such as time-of-use pricing and how to mitigate energy use at high-price times, to both reduce greenhouse gas emissions and save money.
E-3-H	Continue community collaborations to maintain Flagstaff's dark skies, select appropriate outdoor lighting that balances energy efficiency and dark sky goals, and reduce outdoor lighting.

What about electric vehicles?

Switching from gas to electric vehicles provides an opportunity to reduce emissions associated with transportation. Strategies related to electric vehicles are covered in the ***Transportation and Land Use Focus Area*** *on page 100. However, electric vehicles only offer emission savings if the grid electricity comes from renewable sources. By maximizing renewable energy generation, strategies in the Energy sector have the potential to enable green transportation, transforming both energy and transportation emissions.*

What about nuclear?

The burning of fossil fuels produces greenhouse gases. Therefore, this Plan focuses on the production of renewable energy. The Plan does not contemplate nuclear energy, as the supply of nuclear energy is expected to remain a consistent portion of Arizona's energy mix.

STATE-LEVEL OPPORTUNITIES

Preparing for the multifaceted impacts of climate change requires coordination among local governments, state agencies, and federal agencies. Statewide action can enable Arizona residents, agencies, and municipalities to take proactive steps that make communities stronger amidst change.

The City will advocate for the following state-level actions to help achieve our greenhouse gas emissions reduction goals:

Energy:

- State legislative and regulatory changes to allow broader implementation of solar in the community and decrease the proportion of fossil fuels in the energy mix.
- A statewide home performance rating system to require home energy performance scores at the sale of a home.
- Allowing cities to require energy benchmarking, to compare the energy performance of buildings over time and across the City to inform and motivate performance improvement.
- Improvements in and expansion of demand-side management programs and incentives.
- Legislation enabling local governments to establish Commercial Property Assessed Clean Energy (C-PACE) programs.

ACTION ID	DESCRIPTION	ADAPTATION OR MITIGATION	COST	CO-BENEFITS	LEAD ENTITY	CITY OR COMMUNITY	POTENTIAL PARTNERS	TIME-FRAME	LEVER
STRATEGY 4. Maximize passive and active community rainwater infiltration.									
WR-4-A	Increase implementation of low impact development and water programs, including rainwater harvesting, the low impact development ordinance, and the NPDES Section 402 Program.	Both	Medium	Environment	Water Services	City		Long Term	Management
WR-4-B	Maintain the rural floodplain ordinance.	Adaptation	Low	Quality of Life	Community Development	City	Coconino County	Ongoing	Policy
ENERGY									
STRATEGY 1. Improve energy efficiency in all sectors.									
E-1-A	Establish a revolving loan fund to advance energy efficiency upgrades and make $125,000 available annually in loans for building efficiency upgrades.	Mitigation	Medium	Economy	Sustainability Section	City and community	Coconino County	Long Term	Policy
E-1-B	Develop viable financing options for energy efficiency upgrades to commercial and residential buildings, such as a revolving loan program and new service and product models that enable homeowners to participate in energy efficiency improvements without upfront costs.	Mitigation	Low	Equity	Sustainability Section	City and community	Coconino County	Short Term	Policy

ACTION ID	DESCRIPTION	ADAPTATION OR MITIGATION	COST	CO-BENEFITS	LEAD ENTITY	CITY OR COMMUNITY	POTENTIAL PARTNERS	TIME-FRAME	LEVER
E-1-C	Fund and implement a contractor training and rebate program for solar thermal, on-demand water heaters, electric heat-pump space heaters, and conversions from gas to electric appliances, based on analysis demonstrating reductions in greenhouse gas emissions.	Mitigation	Low	Economy	Sustainability Section	City and community	Contractors, business community, APS, Coconino County	Short Term	Education, Policy
E-1-D	Subsidize home energy efficiency retrofits for affordable housing units, and housing that serves low-income and senior populations while maintaining the supply of existing housing.	Both	Mediu m	Equity	Sustainability Section	City and community	Contractors, business community, APS, Coconino County	Long Term	Policy
E-1-E	Adhere to a consistent schedule for adopting the most up-to-date energy codes in alignment with Coconino County, ensure enforcement, and consider where local Flagstaff codes should exceed minimum standards.	Mitigation	Low		Community Development	City	Contractors, development community, APS, Coconino County	Short Term	Policy
E-1-F	Perform a full-scale energy audit and implement recommended energy retrofits for all City of Flagstaff facilities from this full-scale audit and the Airport Sustainability Plan.	Mitigation	Low	City Budget	Sustainability Section	City	APS	Short Term	Infrastructure
E-1-G	Develop and adopt a SmartReg rental licensing policy program requiring minimum efficiency standards for all housing rentals.	Mitigation	Low	Equity	Sustainability Section	City	Property owners and managers, Coconino County	Long Term	Policy
E-1-H	Require zero-net-energy construction for all new residential and commercial buildings by 2040.	Mitigation	Mediu m	Quality of Life	Sustainability Section	City	Development community	Long Term	Policy
E-1-I	Work with partners to develop a specific plan for an aggressive building electrification program to decrease reliance on combustion fuels.	Mitigation	Low		Sustainability Section	City	Development community	Short Term	Policy

ACTION ID	DESCRIPTION	ADAPTATION OR MITIGATION	COST	CO-BENEFITS	LEAD ENTITY	CITY OR COMMUNITY	POTENTIAL PARTNERS	TIME-FRAME	LEVER
STRATEGY 2. Expand renewable energy generation and use.									
E-2-A	Move forward with City Council target of 100% renewable energy use for the municipality with a plan for achieving that target by 2025.	Mitigation	Medium	Resiliency	Sustainability Section	City	APS, tribal nations	Short Term	Policy, infrastructure
E-2-B	Move forward with City Council target of 100% renewable energy use for the community with a plan for achieving that target by 2050.	Mitigation	Medium	Resiliency	Sustainability Section	City and community	APS	Long Term	Policy, infrastructure
E-2-C	Establish a revolving loan fund to advance renewable energy and make $125,000 available annually in loans for renewable energy development.	Mitigation	Low	Economy	Sustainability Section	City	APS	Short Term	Policy
E-2-D	Buy and produce local and regional renewable energy, including through partnerships with Arizona tribes.	Mitigation	Medium	Resiliency	Sustainability Section	City and community	APS, tribal nations	Long Term	Infrastructure
E-2-E	Introduce local policies that incentivize renewable energy adoption and passive solar. This could include providing funding for expedited building code review for new homes with solar and for solar installations on existing homes as well as reduced City fees for homes with renewable energy.	Mitigation	Low	Economy	Community Development and Sustainability Section	City and community	APS	Short Term	Policy
E-2-F	Establish a locally controlled revolving loan fund or similar mechanism to improve community access to financing for renewable energy development—particularly solar—at commercial and residential sites.	Mitigation	Medium	Economy	Sustainability Section	City and community	APS	Long Term	Policy

ACTION ID	DESCRIPTION	ADAPTATION OR MITIGATION	COST	CO-BENEFITS	LEAD ENTITY	CITY OR COMMUNITY	POTENTIAL PARTNERS	TIME-FRAME	LEVER
E-2-G	Update City code to require pre-wiring for solar in all new residential and commercial buildings to reduce the cost of post-construction rooftop solar, battery storage, and electric charging system installations.	Mitigation	Low	Economy	Community Development and Sustainability Section	City		Short Term	Policy

STRATEGY 3. Manage energy demand and consumption in residential, commercial, and industrial sectors, to reduce greenhouse gas emissions.

E-3-A	Collaborate with large energy users, such as Northern Arizona University, on reducing energy consumption and adopting new energy-saving technologies.	Mitigation	Low	Economy	Sustainability Section	Community	NAU, business community	Long Term	Management
E-3-B	Provide tools and resources to help households manage their energy use.	Both	Medium	Economy	Sustainability Section	City and community	APS	Short Term	Education
E-3-C	Update the building code to clarify steps for the installation of battery storage systems by residents and businesses.	Both	Low	Economy	Community Development and Sustainability Section	City	APS	Short Term	Policy

TRANSPORTATION AND LAND USE

STRATEGY 1. Advance land use planning that minimizes the distance people have to travel by car and that increases community resiliency.

TLU-1-A	Support intentional high-density development that increases mixed uses and *residential density*.	Mitigation	Low	Quality of Life	Community Development	Community	Development community	Ongoing	Policy
TLU-1-B	Increase the supply of attainable housing in proximity to employment opportunities, activity centers, and the permanent transit network.	Mitigation	Medium	Equity, Quality of Life	Community Development	City and community	Development community	Long Term	Policy