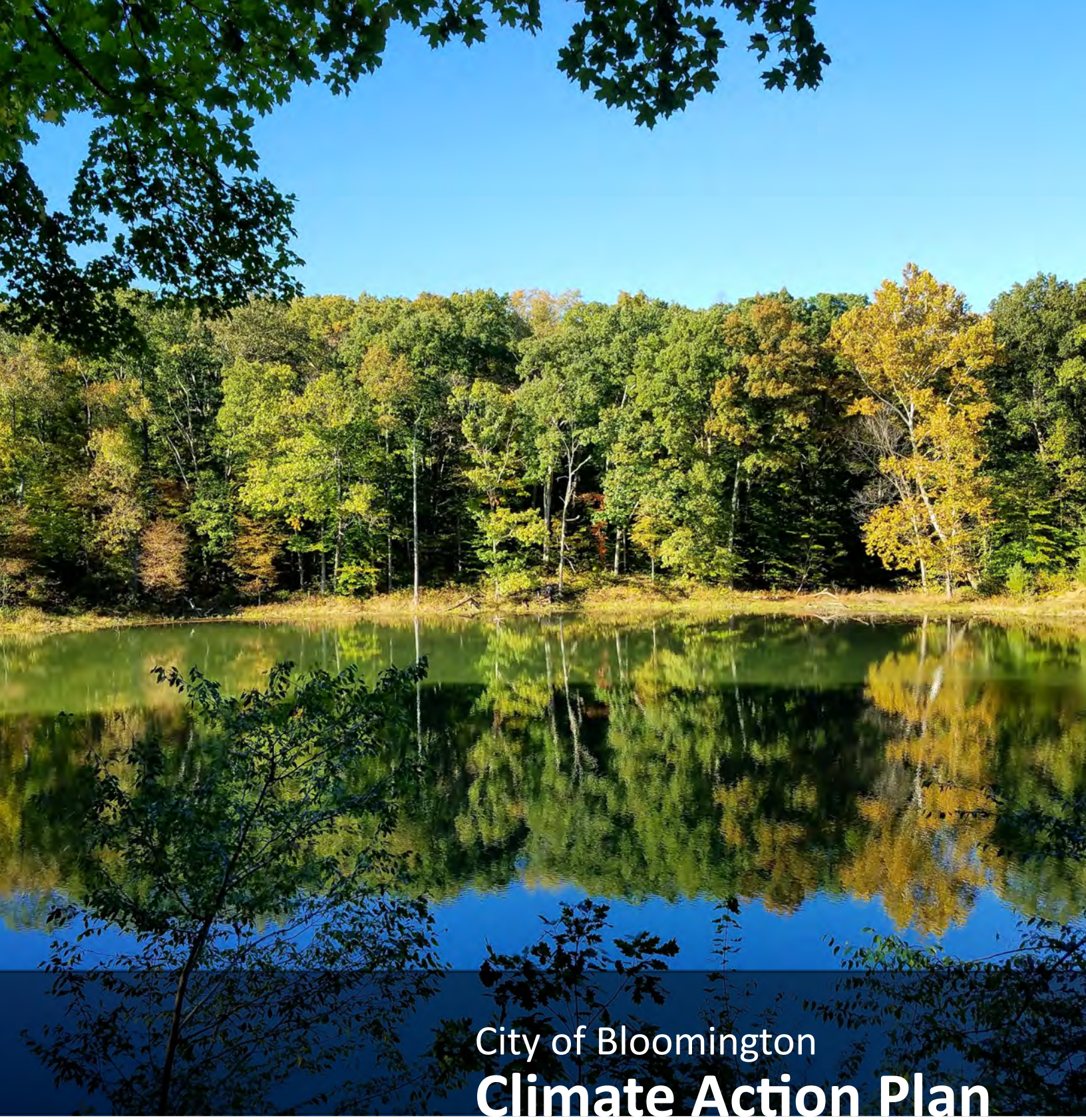

City of Bloomington

Climate Action Plan

March 2021

CITY OF BLOOMINGTON

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By the 2050s Bloomington Will Likely See an Increase in…

Average Annual Temperature:	Days Above 95°F:	Air Conditioning Demand:	Average Rainfall:	Heavy Precipitation Events:	Growing Season:
+5°F	+49 days	+28%	+8%	+15%	+26 days

Executive Summary

The City of Bloomington has a long-standing commitment to sustainability. City programs and community efforts focused on energy conservation, waste reduction, solar development, and the growth of the local food market have established Bloomington as a regional sustainability leader. Building on decades of environmental progress, the 2018 Sustainability Action Plan (SAP) represented the first formal sustainability planning effort for the City of Bloomington. The SAP serves as the City's strategic guide to preserve natural resources, maintain Bloomington's culture, build a diverse and thriving economy, and ensure a healthy and equitable standard of living for all residents.

Bloomington's Sustainability Action Plan established clear goals and priority actions to lower the environmental impact of City operations, reduce community greenhouse gas emissions, improve ecosystem health, support the local food economy, and reduce energy, water, and waste generation. The actions identified by the SAP are helping Bloomington mitigate emissions and prepare for the impacts of climate change, while enriching quality of life for residents. In recognition of the City's efforts to improve environmental performance in city operations, the Indiana Department Environmental Management awarded the Greening the Government Award to the City of Bloomington in 2019. For more on Sustainability Action Plan and to learn about implementation progress please visit: https://bloomington.in.gov/sustainability

One fundamental objective of the Sustainability Action Plan is to prepare Bloomington for the impacts of climate change and minimize greenhouse gas emissions. The City of Bloomington demonstrated its commitment to meeting greenhouse gas (GHG) reduction goals set by the 2015 Paris Climate Agreement as a signatory to both the Mayors National Climate Action Agenda and the "We Are Still In" letter. Building on the City's initial 2006 commitment to the U.S. Mayors Climate Protection Agreement, the City of Bloomington has continued to demonstrate its leadership on climate by joining the Global Covenant of Mayors in 2019.
To mobilize climate action, the City of Bloomington has also developed emissions profiles for the community and local government operations to help build a roadmap towards emissions reduction. This Climate Action Plan continues Bloomington's efforts towards climate action by establishing a detailed comprehensive plan of specific goals, strategies, and actions that will be necessary to reduce community greenhouse gas emissions and build climate resilience.

Our Challenge

Combustion of fossil fuels is warming earth's atmosphere and changing our climate, disrupting the delicate balance of our ecosystems. Climate change is already affecting Bloomington by straining city infrastructure, adversely affecting human health, and causing disruptions to the local economy. It is important to address these climate impacts now, as climate change will become much more severe in the coming decades, contributing to additional strain on vulnerable populations, social systems, and overall community resilience.

Our Opportunity

Local action by cities is key to addressing climate change because many emissions are produced and can be reducing at a community level with immediate positive impacts on community quality of life. Climate change represents an opportunity for Bloomington to take this action and lower its carbon footprint through more efficient infrastructure and sustainable development. Transformation of Indiana's energy infrastructure will be essential to meet climate goals due to the current utilization of carbon intensive fuel sources for electricity generation. This transition towards renewable and low carbon fuel sources represents a chance for Bloomington to reduce the community's carbon footprint. Directing the community's energy investments towards renewable sources will create a more diversified and resilient energy system, while also fostering local job creation. The promise of innovation, technological, and social change that climate action can bring represents the possibility of improved environmental, economic, and equity outcomes across the community.

Our Climate Action Vision

Bloomington's vision is to be climate resilient, leading in the social and economic transitions necessary to reduce citywide greenhouse gas emissions in accordance with the Paris Climate Agreement, while protecting Bloomington's natural ecosystems, most vulnerable populations, and economic vitality against the increasing impacts of climate change.

Executive Summary

GHG Emission Reduction Goal in Global Context

To validate the appropriateness of the City's Climate Action Plan emissions reduction goal, the recommendations of the International Panel on Climate Change (IPCC) were considered. The IPCC is the United Nation Environment Programme (UNEP) body that assesses the science related to climate change and provides support to countries globally in climate action policy making. The scientific consensus of the most recent IPCC recommendations is that it is necessary to reduce global GHG emissions at a pace that will limit global warming to 1.5°C. The Paris Agreement affirms this recommendation by aiming to limit global warming to 1.5°C to 2°C above pre-industrial levels, considered to be the threshold for dangerous climate impacts.

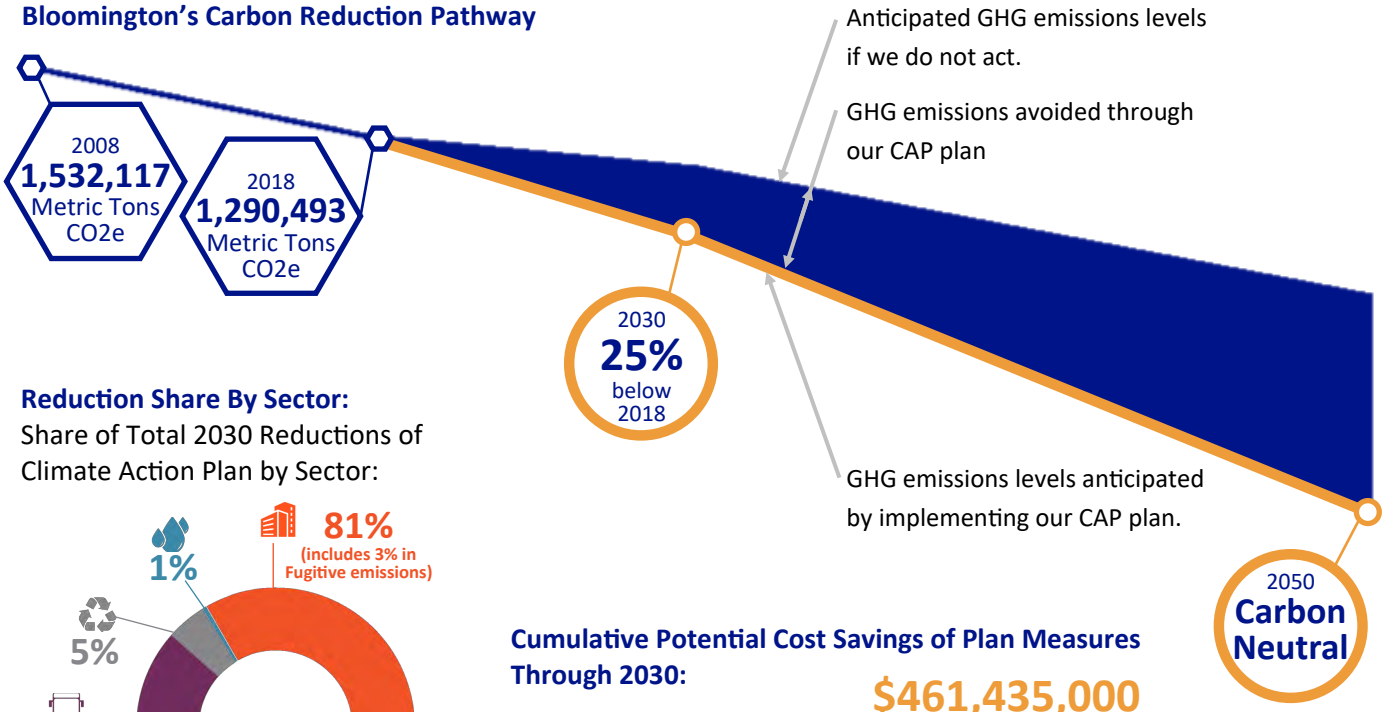
The UNEP Emissions Gap Report published in November 2019 asserts that by 2030, global emissions will need to be 25% lower than 2018 emissions levels to put the world on the least-cost pathway to limiting global warming to below 2°C, the level required to meet Paris Agreement goals. To limit global warming further to 1.5°C, the same report finds emissions would need to be 55% lower than 2018 emissions levels by 2030. By 2050, IPCC guidance indicates it will be necessary to achieve 80% to 100% emission reductions (carbon neutral) by 2050 to remain within the 1.5°C-2°C global warming range. These global recommendations were accounted for in the formulation of appropriate carbon reduction goals for Bloomington.

Our Carbon Reduction Goal

The Bloomington Climate Action Plan (CAP) seeks to re-affirm the City of Bloomington's commitment to meeting the goals of the Paris Climate Agreement. To accomplish this carbon reduction target, the CAP goal must align with the IPCC suggested carbon emission reduction goals of a 25%-55% reduction in emissions by 2030 and an 80% or greater reduction in emissions by 2050. To reduce community-wide GHG emissions in line with the Paris Climate Agreement with intermediate reduction goals based on the latest IPCC scientific recommendations as follows:

To reduce Bloomington community greenhouse gas emissions 25% below 2018 emissions levels by 2030 and achieve carbon neutrality by 2050 .

Bloomington's Carbon Reduction Pathway



Reduction Share By Sector:

Share of Total 2030 Reductions of Climate Action Plan by Sector:

Cumulative Potential Cost Savings of Plan Measures Through 2030:

$461,435,000

Implementing many of the measures in this plan, such as reduction of energy consumption can save money for the community.
(see Appendix for more)

Executive Summary

Climate Action Plan as Living Plan

The Bloomington Climate Action Plan is intended as a "living plan" rather than a static document. This means that the implementation phase of this plan should be characterized by intermittent measurement of progress and plan adjustments. Plan adjustments may include increasing implementation speed for scope areas which illustrate success, modifying goals for strategies which may fall short of desired outcomes, and identifying additional opportunities for action.

As a "living plan," the 2030 emission reduction goal should be seen as a guiding constant to achieving emissions reductions. However, recognition should be given that the initial implementation actions may not yet fully achieve plan goals. Intermittent plan progress measurements and adjustments will be necessary to identify additional actions that may be necessary to reach the CAP goal, as well as any adjustments to implementation targets that may be needed to meet the greenhouse gas reduction goal by 2030.

Our Climate Action Goals

Section 02 Transportation and Land Use

Goal TL 1 Decrease vehicle miles traveled (VMT) by 8% of 2018 values.

Goal TL 2 Support and encourage electric vehicle adoption, achieve 30% of vehicles sold and 15% of VMT community-wide by 2030.

Section 03 Energy And Built Environment

Goal EB 1 Increase distributed renewable energy to 250,000 MWH of total generation annually by 2030.

Goal EB 2 Increase energy efficiency citywide 16% for electricity and 12% for natural gas of 2018 values.

Goal EB 3 Support decarbonization of the local electricity grid.

Goal EB 4 Promote "fuel switching" to reduce on-site fossil fuel use in the building sector by 3% of 2018.

Goal EB 5 Increase financing options for energy efficiency and renewable energy projects citywide.

Section 04 Waste Management

Goal WM 1 Increase landfill solid waste diversion by 30% of 2018 values (26,500 tons of waste reduction).

Goal WM 2 Educate, motivate, and empower the public to achieve waste reduction and diversion.

Section 05 Water and Wastewater

Goal W 1 Decrease potable water consumption by 3% of 2018 values.

Goal W 2 Maintain source and drinking water quality through climate related challenges.

Goal W 3 Reduce energy use associated with treating and transporting water and wastewater by 10% of 2018 values.

Goal W 4 Mitigate flood hazards and impacts.

Section 06 Local Food and Agriculture

Goal FA 1 Increase food and nutrition security citywide.

Goal FA 2 Increase local agricultural resilience to climate shocks.

Goal FA 3 Increase and stabilize local food market.

Section 07 Health and Safety

Goal HS 1 Educate, engage, and empower the public for climate health and safety.

Goal HS 2 Prepare Bloomington for climate risks and impacts.

Goal HS 3 Respond to climate risks and impacts.

Section 08 Greenspace and Ecosystem

Goal G 1 Increase quantity and quality of greenspace within the community.

Goal G 2 Increase quantity and quality of climate adaptive native habitats.

Goal G 3 Increase citywide tree canopy coverage by 3% of 2018 values.

Goal G 4 Reduce stormwater and micro heat island impacts.

Section 09 Climate Economy

Goal CE 1 Build marketplace climate resilience.

Goal CE 2 Attract, create, and support businesses that are committed to sustainability and climate goals.

Goal CE 3 Develop new mechanisms for financing City climate action plan implementation.

Section 01
Introduction

Click here to return to TOC

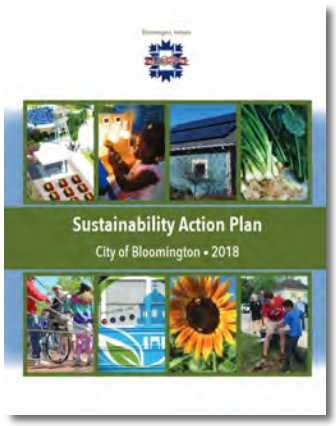
Introduction

The City of Bloomington addresses sustainability through careful attention to environmental, economic, and social equity issues. Sustainability and livability are guiding principles and are considered to be foundational to quality, long-lasting economic and community development.

In 2019, as part of Bloomington's commitment to the Global Covenant of Mayors, the City of Bloomington began developing a Climate Risk and Vulnerability Assessment and Climate Action Plan. To assess local risks, hazards and vulnerabilities to climate change, the Climate Vulnerability Assessment evaluated Bloomington's forecasted exposure, sensitivity, and adaptive capacity to changing climate conditions and serves as a crucial reference document to prioritize climate action and mitigation actions. The Climate Vulnerability Assessment was presented to the Bloomington City Council in 2020 to detail how climate change is affecting Bloomington now, identify current and future climate vulnerabilities, and forecast how climate vulnerabilities will change in coming decades. This Climate Action Plan has built on past emissions inventories, planning efforts, and climate assessments to develop science based targets to implement climate mitigation and adaptation commitments.

Support of Bloomington Plans

This Climate Action Plan leverages, supports, and expands on the City's other recent planning efforts. The strategies and actions included in this report relate closely to the foundational work already completed by the City, including the 2018 Sustainability Action Plan, as well as the 2018 Bloomington Comprehensive Plan.



Climate Action as a Journey

The Climate Action Plan represents a robust vision of the future with a comprehensive scope of action befitting the magnitude of the collective climate challenge ahead. This Climate Action Plan establishes a long-term climate resilience vision and mitigation goal for the community through 2050. The plan itself, its strategies, and detailed actions, are intended as a 10 year plan. It is anticipated that this plan would be updated by 2030 to outline the next phase of action towards achieving the long-term community-wide goals.

The Bloomington Climate Action Plan should be seen as a living document. Action progress and effectiveness should be reviewed at regular intervals through the plan's implementation and adjustments should be made to expand or modify the scope of individual actions and to augment the plan with new actions as appropriate to respond to ever-changing market and community conditions.

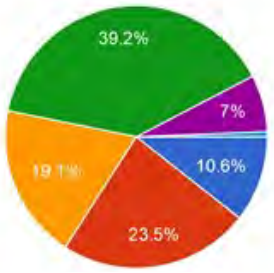
Introduction

The process

The Climate Action Plan was developed in consultation with a 27 person planning team of community members, economic development representatives, Monroe County and City of Bloomington staff. The planning team was organized into sub-teams aligned with each of the sectors included in this plan (see Plan Framework). The plan's strategic framework, goals, strategies, and actions were developed and refined through a number of planning workshops held between June and October 2020.

Community Survey

The City of Bloomington issued a community survey about climate change to collect input from members of the community. The online survey was an important early step in climate action planning process in identifying issues of concern to the community, as well as areas of support for climate action. The survey was instrumental in identifying initial sustainability and climate adaptation needs, opportunities, priorities, and issues for the City of Bloomington at the start of the planning process. The community responses collected by survey informed the development of the strategies and detailed actions included in this plan. The community climate survey was designed as an online questionnaire survey with self-selected engagement. The survey was made available online on a dedicated webpage and was available from March 2020 through June 2020 and was completed by 472 community members representing a broad demographic of the community .



Survey Respondent Ages

- 25 or younger
- 26 – 39
- 40 – 54
- 55 - 74
- 75 and over
- 55 - 75

How Concerned Are You About Climate Change?

- **11.6%** Not at all concerned
- **6.1%** Slightly concerned
- **8.0%** Moderately concerned
- **21.5%** Very concerned
- **52.8%** Extremely concerned

Community Engagement

At the beginning of 2020, the City of Bloomington began the climate action planning process. To engage community members, an engagement plan was developed with consultant assistance to ensure that the recommendations of the plan had received feedback from a range of constituents and community members.

Initially, the engagement plan included community gatherings to discuss the development of the Climate Action Plan. Due to emergent realities of COVID-19 and community stay-at-home orders, the engagement was conducted entirely through virtual sessions. These virtual sessions were hosted by community groups and leaders who were interested in providing their perspective on Bloomington's climate goals. The co-hosts of these virtual sessions included staff and constituents of the Banneker Community Center, Bloomington Housing Authority, Bloomington Community and Family Resource Department, and Indiana University students.

Three virtual sessions were held in June-August 2020 to inform the development of the climate planning strategies. The feedback provided was utilized to develop of the draft Climate Action Plan. After the draft was released for public feedback, three more listening sessions were held from October 2020- January 2021, in addition to presentations to the Bloomington Commission on Sustainability, the Bloomington Environmental Commission, the Bloomington City Council Climate Action Committee, and written comments received by City of Bloomington staff, planning team members, and the public. Input received from public engagement has been considered and integrated into the final Climate Action Plan .

Introduction

Why Create a Climate Action Plan

The creation and dedicated implementation of a Climate Action Plan (CAP) is an organized way for a city to contribute to solving the global climate crisis while helping its resident and business communities create improved resilience to the current and future impacts and risks of climate change. Climate action can also create investment in innovation, jobs and actions that save households and businesses money.

What is a Climate Action Plan (CAP)

The development and dedicated implementation of a Climate Action Plan (CAP) provides a dedicated roadmap for a city to reduce greenhouse gas emissions and build resilience to climate impacts. Implementation of CAP strategies helps contribute to solving the global climate crisis and improves resilience to climate change risks and impacts. By taking specific steps to reduce emissions and build resilience, climate action can also foster investments in innovation and job growth, while saving households and businesses money.

What is Climate Change Mitigation?

Climate change mitigation addresses the root causes of climate change by taking action to reduce or prevent greenhouse gas (GHG) emission generation. Mitigation can include utilizing new technologies such as renewable energy, improving the energy efficiency of existing technologies, or changing management practices or consumer behavior.

What is Climate Change Adaptation?

Some climate change impacts are now inevitable due to the current atmospheric concentrations of greenhouse gases. Adaptation actions seek to lower the risks posed by these impacts by anticipating and responding effectively to the threats that climate change poses. Both mitigation and adaptation actions are necessary to perform, because even if global emissions are dramatically decreased, society will need to adapt to the climate impacts already set in motion.

The Role of Cities in Climate Action

Cities play an important role in addressing climate change because urban areas representing the majority of the population generate the majority of the emissions accelerating climate change. Even though each individual city's impact on global greenhouse emissions is relatively small, the role of leadership to motivate change in each community can be extremely significant. According to a survey by the US Conference of Mayors, more than half of member cities (53%) had committed to reducing greenhouse gas emissions, a necessary first step to addressing climate change.

Introduction

Using This Plan

This Climate Action Plan includes an implementation framework designed to achieve community-wide goals for greenhouse gas reduction and climate adaptation and resilience. The plan is structured around the eight community-wide sectors that are central to achieving greenhouse gas reduction and climate resilience.

Each of these sectors has a dedicated chapter that includes background information on that sector, as well as the current status of Bloomington's efforts. In the beginning of each chapter, equity considerations are identified that should be addressed during implementation.

Every sector has over-arching strategies that were identified as necessary to accomplish 2030 climate goals, as well as detailed actions for implementation. Actions in each sector are focused on climate mitigation, climate adaptation, or both mitigation and adaptation (see Climate Action Plan Framework).

Strategies: specific statements of intent that expand on the sustainability vision and GHG reduction goals to guide decisions about future public policy, community investment, and actions.

Actions: detailed activities that should be completed to carry out the vision and strategies identified in the plan.

Co-Benefits

Climate action strategies may offer additional benefits to Bloomington residents and businesses beyond emissions reduction. These co-benefits are highlighted by icons in each section. Each icon is labelled with the respective co-benefit type.

Co-Benefits

Introduction

Climate Action Plan Framework
Each of the sectors of this CAP have strategic focus on Climate Mitigation, Climate Adaptation, or both:

Climate Mitigation: addresses the root causes of climate change through the reduction or prevention of greenhouse gas (GHG) emissions. Sectors with this as a significant focus are shown to the right with this symbol:

Climate Adaptation: seeks to lower the risks posed by the impacts of climate change which are now inevitable or likely. Sectors with this as a significant focus are shown to the right with this symbol:

Emissions from on-road vehicle traffic occurring in the community. Strategies in this sector area include reductions in vehicle miles traveled as well as shifts to public transit and alternative modes of transportation like biking and walking.

Emissions associated with all electricity and natural gas consumption within the city. Strategies in this sector area include improved energy efficiency and resilience.

Community health impacts and resilience in the face of current climate impacts and projected risks. Strategies in this sector focus on community resilience to extreme heat and weather, vector-borne and water-borne disease, and air quality impacts of climate change.

Economic development, jobs, and business creation potential represented by the actions and goals of all sectors in this Climate Action Plan. Strategies in this sector include workforce development, economic development and new business financing, and resilience of businesses in the community.

Introduction

All solid waste generated by residents and businesses within the community and their associated emissions. Strategies in this sector focus on diversion of food, consumer, and construction waste, as well as reduction of landfill gas generation and beneficial use of unavoidable landfill gas emissions.

All potable water distributed to Bloomington residents and businesses, wastewater collection and treatment, stormwater collection, flood mitigation, and surface water health. Strategies in this sector focus on water conservation, wastewater reduction and beneficial use of wastewater emissions, flood mitigation, and stormwater infiltration.

Commercial and non-commercial food cultivation and distribution, food and nutrition insecurity, and food waste. Strategies in this sector area include reduction of food waste, food system and distribution resilience, strengthening of local food production capacity, and equitable access to healthy food.

Environmental, climate resilience and benefits of urban tree canopy, ground cover, community greenspace and parks, and ecosystems that rely on these natural elements. Strategies in this sector include resilience/expansion of urban tree canopy coverage, improvement of beneficial use of lawn areas, and mitigation of

Climate Action Benefits

- Job creation and economic development
- Improved air quality and public health
- Cost savings for residents and businesses
- Improved energy resilience
- Improved water quality and ecosystems
- Improved community resilience

Introduction

Bloomington's Vulnerability to Climate Risks:

Climate change is a global phenomenon that creates local impacts. It presents one of the most profound challenges of our time. A broad international consensus exists among atmospheric scientists that the Earth's climate system is being destabilized due to elevated levels of greenhouse gas emissions in the atmosphere.

Two changes to Indiana's climate are occurring already: shorter winters with fewer cold extremes, and more heavy and extreme precipitation events. Increases in the global surface temperature and changes in precipitation levels and patterns are expected to continue and intensify for decades. In turn, these changes in climate have subsequent impacts on the economy and health of local communities.

The following highlights the vulnerabilities to climate risks facing Bloomington, excerpted from the 2020 Bloomington Climate Vulnerability Assessment:

Heat Stress
(High)

Warmer temperatures and more extreme heat may lead to higher risk of heat-related illness.

Air Quality
(High)

Increased heat may result in more days of poor air quality and exposure to allergens, impacting respiratory illnesses.

Vector-Borne Disease
(Medium)

Longer growing seasons and higher temperatures may increase vector-borne diseases like West Nile Virus and Lyme disease.

Mental Health
(Medium)

Exposure to increased climate impacts and disasters may lead to increased anxiety and other mental health ramifications.

Housing
(High)

Warmer temperatures will increase demand for air conditioning and weatherization needs. Energy costs may be difficult for vulnerable populations to meet. Heavier rains coupled with higher risk of surface drought conditions may cause more local flooding, particularly "flash flooding" which could cause damage to housing and reduce mobility for portions of the community.

Stormwater Management
(High)

Heavier rains coupled with higher risk of surface drought conditions may significantly increase demand on stormwater management. The city's stormwater infrastructure may not be capable of handling the amount of runoff during more frequent heavy down pours, requiring resources to make needed upgrades.

Trees, Greenspace, and Agriculture
(High)

Increased temperatures and changes to precipitation will stress trees, greenspace, and agriculture. Conditions may be more favorable for disease, pests, and invasive species. Trees and crop species which formerly thrived in the area's climate may be less suited for future climate conditions.

Surface Water Quality
(Low)

Increases to heavy rain events and flooding/flash flooding risk may negatively impact water quality in the city's lakes, streams, and rivers. Increased pollutants and contamination potential, combined with increased annual water temperatures could increase risk to algal and bacterial growth, harming habitats and limiting recreation.

Introduction

Estimated Economic Risk of Climate Change to Bloomington by 2100

Incidents of severe weather in the United States, such as significant flooding in the Midwest, are tangible examples of the types of projected climate trends that will have significant economic impacts. Future economic and social impacts of climate change include impacts to agriculture, energy costs, labor impacts, death rates, and crime impacts among others. "Estimating Economic Damage from Climate Change in the United States," a study from the University of California Berkeley, was a comprehensive effort at quantifying the economic impacts for every county within the United States.

The study collected national data documenting the responses in six economic sectors to short-term weather fluctuations. These data sets were integrated with probabilistic distributions from a set of global climate models and used to estimate future costs during the remainder of this century across a range of scenarios. In terms of overall effects on gross domestic product, the authors predicted negative impacts in the southern United States and positive impacts in some parts of the Pacific Northwest and New England.

The sectors assessed, and the findings for annual economic impact as a percentage of GDP for Monroe County and the City of Bloomington are:

Agriculture	Energy	Productivity	Property Crime	Violent Crime
-35.6%	+11.7%	-5%	+.97%	+3.5%

$150,518,657
Annual Cost Impact (in 2020 dollars)*

* Figure does not include increased healthcare costs due to increased illness and disease, nor increased property damage due to increased extreme weather events.

Estimated Social Cost of Carbon

"Social Cost of Carbon" is an effort to properly account for the damages caused by greenhouse gas emissions and the resulting climate change impacts. By including the social cost of carbon in planning efforts, agencies and business can properly evaluate policies and decisions that affect greenhouse gas emissions. The "Social Cost of Carbon" is measure of the share of climate change economic harm and impacts from emitting one ton of carbon dioxide into the atmosphere. For Bloomington it can be calculated as follows:

Estimated Economic Risk of Climate Change:		Current Annual GHG Emissions:		Current Estimated Localized Social Cost of Carbon:
$150,518,657 Annual Cost Impact	÷	**1,290,216** Metric Tons	=	**$116** Per Ton

Cumulative Economic Savings Potential of Implementing the Climate Action Plan Through 2030

Transportation Savings Potential:		Energy Efficiency and Renewable Energy Savings Potential:		Waste Reduction Savings:		Social Cost of Avoided Carbon:
$101,936,000	+	$146,533,000	+	$79,175,000	+	$133,791,000

Cumulative Community-Wide Savings Potential:
= **$461,435,000***

* Value does not include economic potential of job creation and new business potential represented in the Climate Action Plan actions. (see Appendix for more)

Introduction

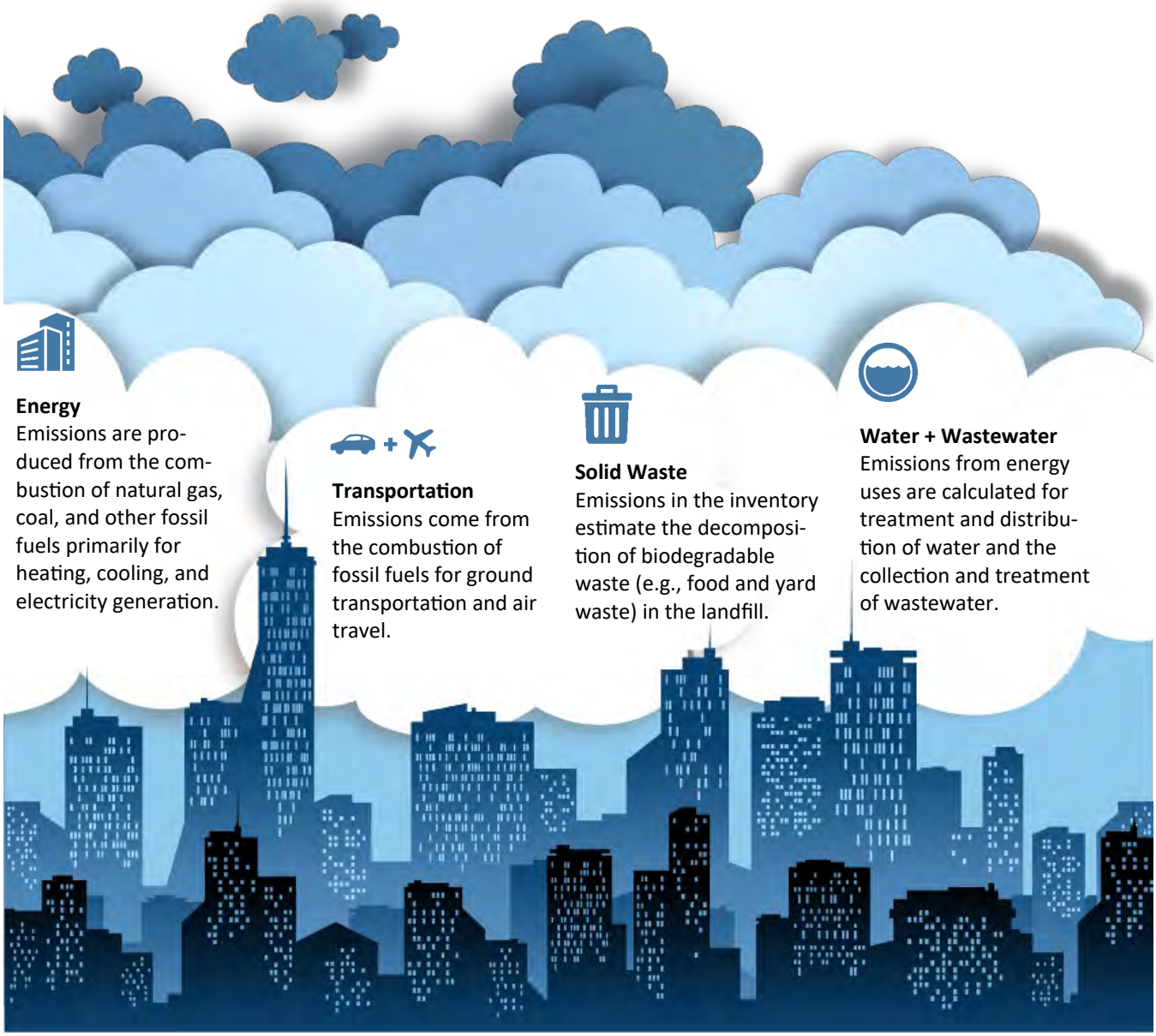
What Are GHG's?

Greenhouse gases (GHG) absorb radiation and trap heat in the Earth's atmosphere. These gases are the basis of the greenhouse effect, a process that warms the Earth's surface. The more GHGs there are, the more heat that is trapped in our atmosphere and the more climate change accelerates. The most common greenhouse gases include carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O).

GHG emissions reduction pathways are different high impact ways to approach driving down emissions. The pathways towards high impact GHG emissions reduction include:

Greenhouse Gas Sectors

Where do citywide GHGs come from?



Introduction

Higher Impact GHG Emissions Reduction Pathways

GHG emissions reduction pathways are themes which represent higher impact greenhouse gas reduction potentials. The pathways towards high impact GHG emissions reduction include:

Reduction

A focus on reducing consumption of fossil fuels is an important strategy across all sectors. This includes reducing the direct combustion of fossil fuels, as well as reducing of the consumption of services, products, and materials that require fossil fuel energy in their creation, use, or disposal.

Fuel Switching

Converting energy sources from fossil fuel based to low and no-carbon renewable energy sources is paramount to the reduction of our greenhouse gas emissions. A major focus in this pathway is the decarbonization of the electric grid by generating electricity from renewable energy sources rather than fossil fuel sources. This pathway also includes the creation of on-site renewable energy sources and equipment conversion from fossil fuel combustion based to renewable fuel and electricity based power .

These pathways weave across citywide GHG emissions sectors and can be found throughout this Climate Action Plan. Below are how these pathways are applied in the major GHG emissions sectors in Bloomington:

Transportation and Land Use

- **Reduction**: Reductions in this sector focus on decreasing vehicle use to reduce the total amount of transportation related fuel use. Actions to achieve vehicle fuel use reduction include the use of more fuel efficient vehicles, increasing shared and public transit options and use, increasing walking/biking mobility, and decreasing demand for transportation through increased land use density and approaches like increased work-from-home employment options.

- **Fuel Switching**: In this sector, fuel switching includes a focus on converting vehicle stock from traditional internal combustion engines to electric vehicles, plug-in hybrid vehicles, or vehicles using low-carbon renewable fuels such as hydrogen or biodiesel derived from non-fossil fuel sources.

Energy and Built Environment

- **Reduction**: Reductions in this sector focus on decreasing electricity, natural gas, and heating fuel consumption by improving energy efficiency. Actions to improve energy efficiency include conducting energy audits and upgrades for homes and businesses, establishing energy benchmarking programs to help owners and renters better understand potential energy efficiency improvements, and promoting high performance building construction design and technology.

- **Fuel Switching**: In this sector, fuel switching focuses on increasing on-site renewable energy installations, supporting actions by electric utilities to procure electricity from renewable energy sources, electrifying heating and cooking systems, and switching natural gas consumption to renewable natural gas.

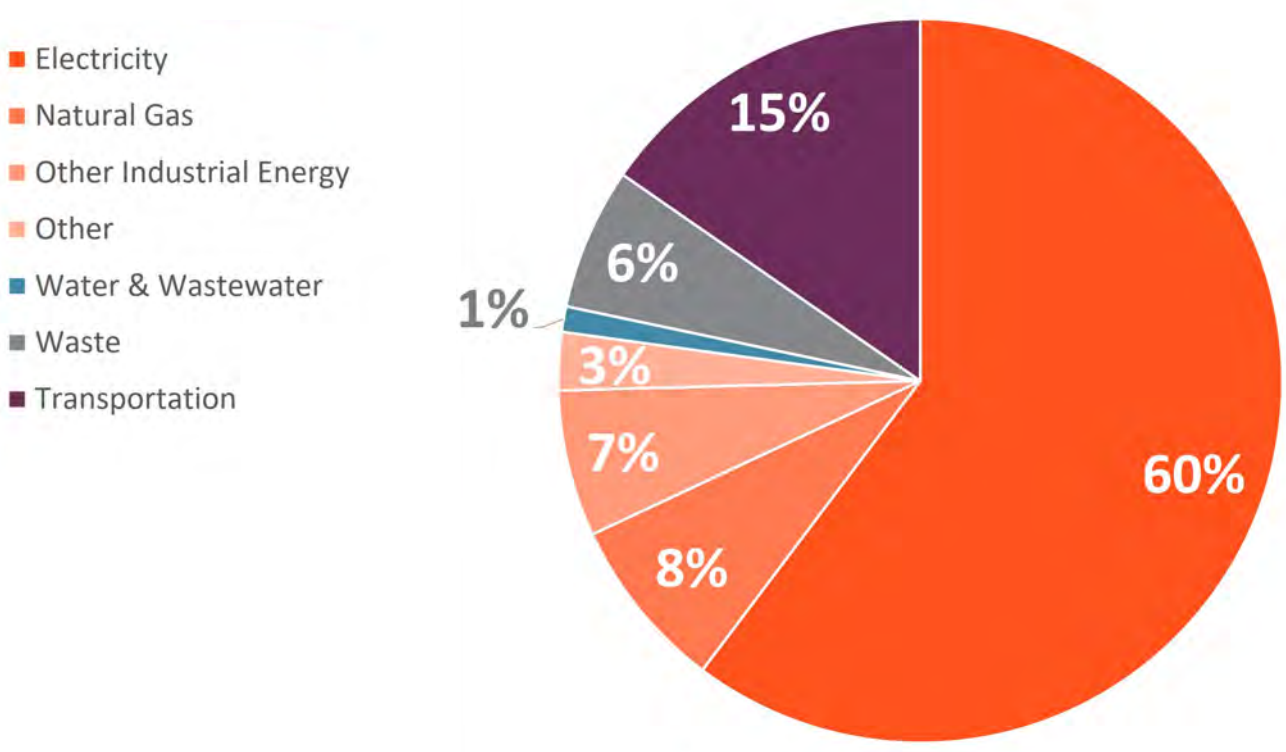
Introduction

Citywide GHG Emission History 2008-2018

Bloomington emitted nearly 1.3 million metric tons of carbon dioxide equivalent (MT CO2e) in 2018. Energy use in residential, commercial, and industrial buildings was the largest source of greenhouse gas (GHG) emissions in Bloomington in 2018, accounting for 68% of emissions. The majority of Bloomington's 2018 GHG emissions are associated with electricity use—a value that has fallen in recent years as the electricity supply has decarbonized and efficiency has improved. Natural gas is the other source of significant energy use in buildings. The next largest source of 2018 GHG emissions was transportation at 15% of the total, which is primarily from the fuel use of personal and commercial vehicles. Indiana University's combined heat and power (CHP) plant also emitted 7% of GHG emissions in 2018, while Solid waste accounted for 6% of GHG emissions. The electricity use to supply and treat water, along with the nitrous oxide production associated with wastewater treatment resulted in 1% of emissions. Electricity lost as it is transmitted and distributed from power plants to end use accounted for 2% of 2018 emissions and methane fugitive emissions associated with natural gas consumption accounted for 0.3% of emissions.

In 2020, the City of Bloomington standardized reporting of Bloomington's historical emissions to utilize current emissions reporting protocols. More up to date data was integrated, resulting in minor adjustments to 2018 emissions values. For more information about Bloomington emissions values- see 2018 GHG Inventory**.**

Citywide GHG Emission 2018



(Source: City of Bloomington 2018 GHG Inventory as Updated in 2020)

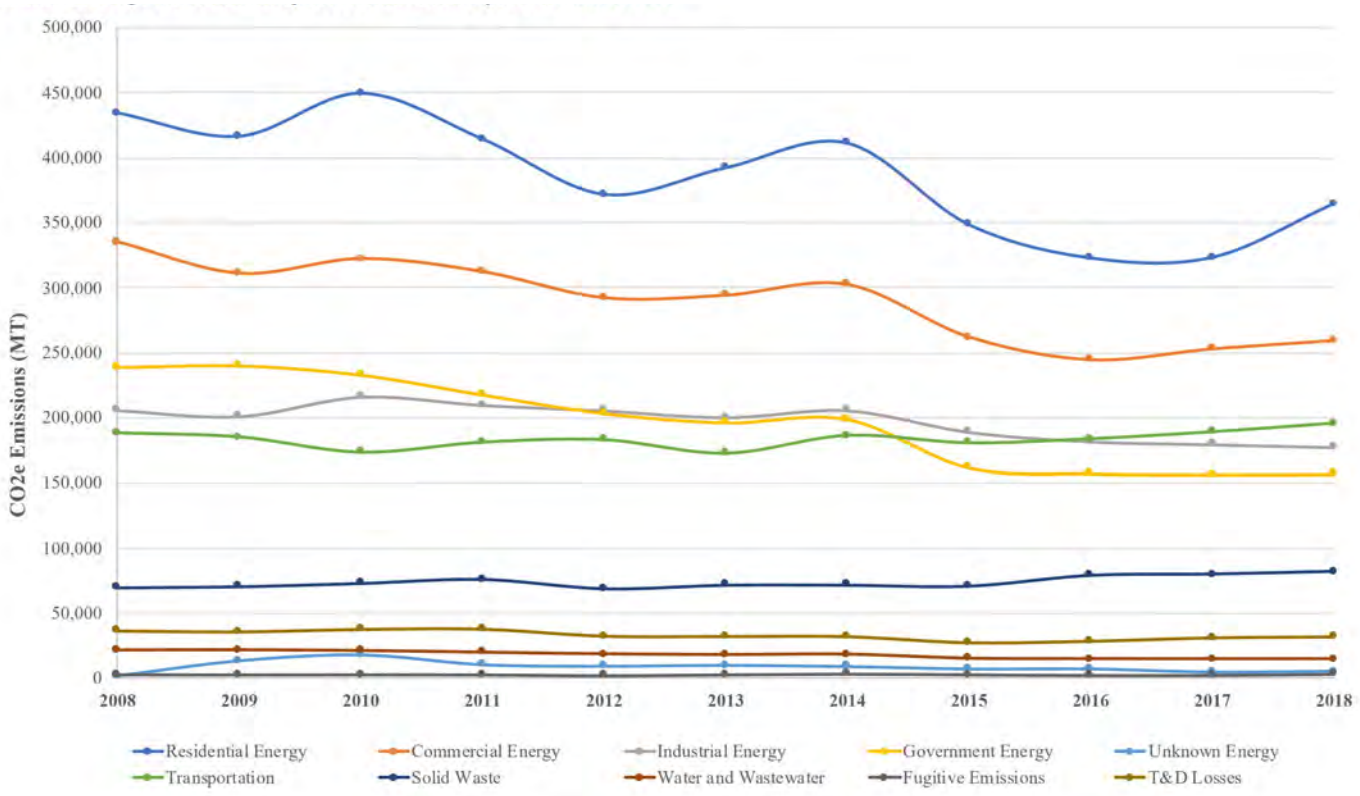
Introduction

This historical look at Bloomington's GHG emissions from 2008-2018 shows that emissions associated with energy use can vary from year-to-year, often due to weather variability, but overall energy emissions declined over that decade. Electricity use fell a modest 2% across all sectors, but the sources of electricity became 24% less carbon intensive over that period. Natural gas use grew 8%, however, partially offsetting building emissions savings. This chart shows the general trends behind the Residential, Commercial, Industrial, Government, Unknown, Fugitive, and T&D Losses. Bloomington's transportation emissions grew from 2008-2018 as vehicle miles traveled grew 8% over that decade. Vehicle fuel economy in the U.S. improved slightly over that period, but not enough to offset the increased travel in Bloomington, so transportation emissions grew 4%. However, considering population growth, transportation emissions fell 7% per capita.

The emissions associated with solid waste treatment grew 17%-- an equivalent to a 5% increase per capita when accounting for population growth. The emissions from water and wastewater fell 31% as those systems used less electricity and the electricity utilized became less carbon intensive. In total, Bloomington's GHG emissions fell 16% from 2008 to 2018 a change overwhelmingly driven by the reduced carbon intensity of Bloomington's electricity sources.

In total, Bloomington's GHG emissions fell 16% from 2008 to 2018 a change overwhelmingly driven by the reduced emissions of Bloomington's electricity sources.

Citywide GHG Emissions History 2008-2018 by Sector



(Graphic source: City of Bloomington 2008-2018 GHG Backcast)

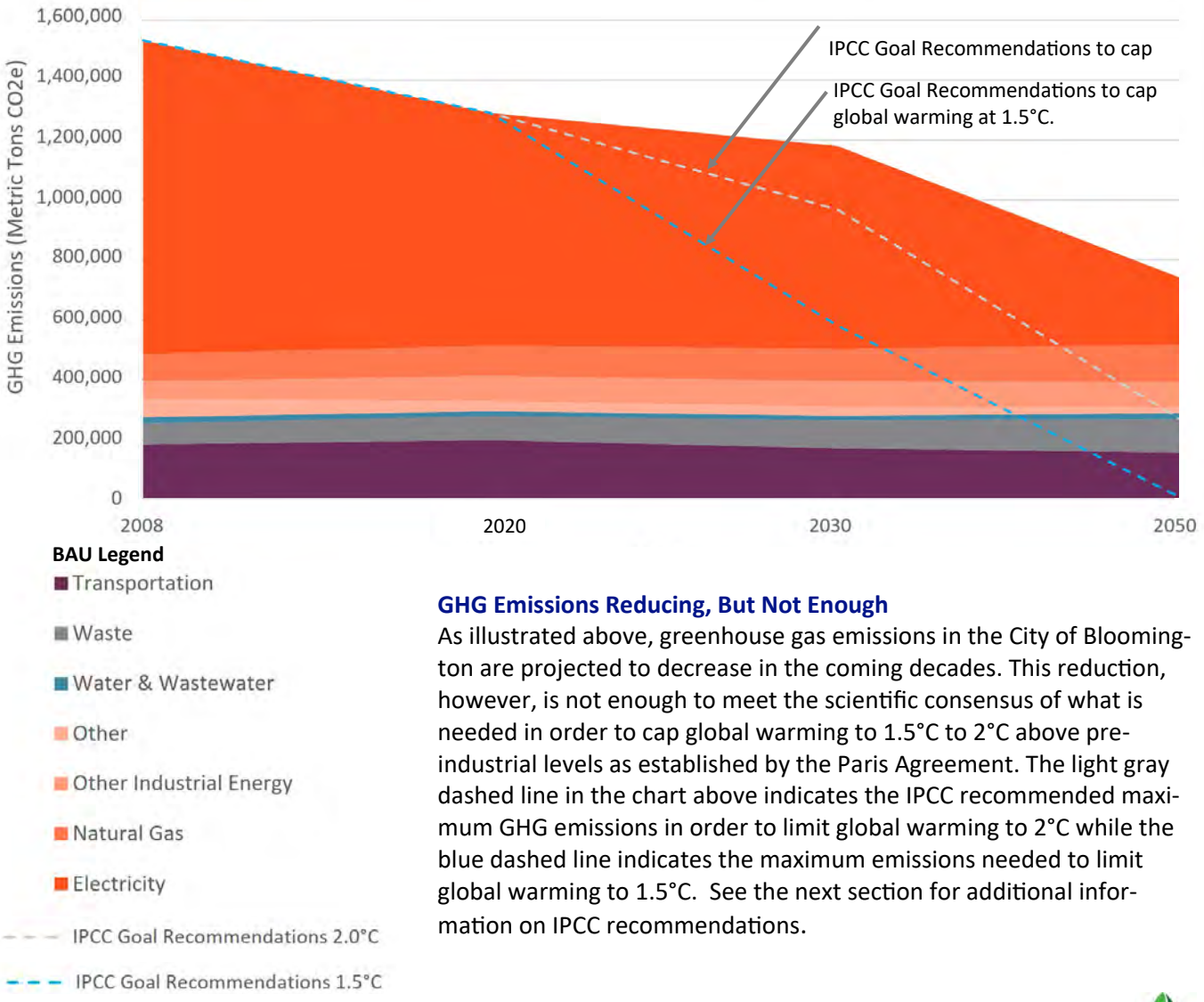
Introduction

Citywide GHG Emissions Forecast

A GHG emissions forecast supports GHG reduction planning efforts by anticipating what emissions may be like if action is not taken. Emissions are typically forecasted under a business-as-usual (BAU) scenario. The Intergovernmental Panel on Climate Change (IPCC) defines a "business-as-usual" baseline case as the level of emissions that would result if future development trends follow those of the past and no changes in policies take place. The City of Bloomington GHG forecasts included here were based on population and employment growth estimates determined by 10 and 20 year historic growth rates. In addition to these data, the BAU draws from information from the US Environmental Protection Agency, US Department of Transportation, and US Energy Information Agency. The full assumptions used for the Business-as-Usual GHG Emissions Forecast model are outlined in detail in the appendix of this plan.

The BAU projections illustrate a reduction of 9% in city-wide emissions from 2018 levels by 2030 and a 43% reduction by 2050. These reductions are a result of a number of factors (please see appendix). The largest projected change in Bloomington's future emissions is the decarbonization of the electricity grid; Duke Energy has pledged net zero emissions by 2050. The forecast also accounts for hotter summers and warmer winters in Bloomington that will change energy demand and transportation trends of vehicle efficiency and electrification. Consequently, the total electricity consumption is projected to increase through 2030 and beyond even while overall electrical emissions decrease.

Citywide GHG Emissions Forecast



GHG Emissions Reducing, But Not Enough

As illustrated above, greenhouse gas emissions in the City of Bloomington are projected to decrease in the coming decades. This reduction, however, is not enough to meet the scientific consensus of what is needed in order to cap global warming to 1.5°C to 2°C above pre-industrial levels as established by the Paris Agreement. The light gray dashed line in the chart above indicates the IPCC recommended maximum GHG emissions in order to limit global warming to 2°C while the blue dashed line indicates the maximum emissions needed to limit global warming to 1.5°C. See the next section for additional information on IPCC recommendations.

Introduction

Our Carbon Reduction Goal

This plan has established GHG emissions reductions goals which re-affirm the City's commitment to the Paris Climate Agreement. To do so, the plan must align itself within the IPCC suggested carbon emission reduction goals of 25% to 55% reduction by 2030 and 80% or greater reductions by 2050. The plan's city-wide emission reduction goals based on this latest IPCC scientific recommendations is as follows:

> **To reduce Bloomington community greenhouse gas emissions 25% below 2018 emissions levels by 2030 and achieve carbon neutrality by 2050 .**

This community-wide goal is reflected in goals established for individual sectors which seek to both support the City's Climate Action Plan in creating a climate resilient community and to reduce city-wide GHG emissions in line with the above goal. Sector goals related to GHG emissions reductions are designed to balance reduction across all sectors and achieve the overall emissions goals set forth for the community. The goals seek to strike a balance between achievability while also reaching for improvement beyond business-as-usual.

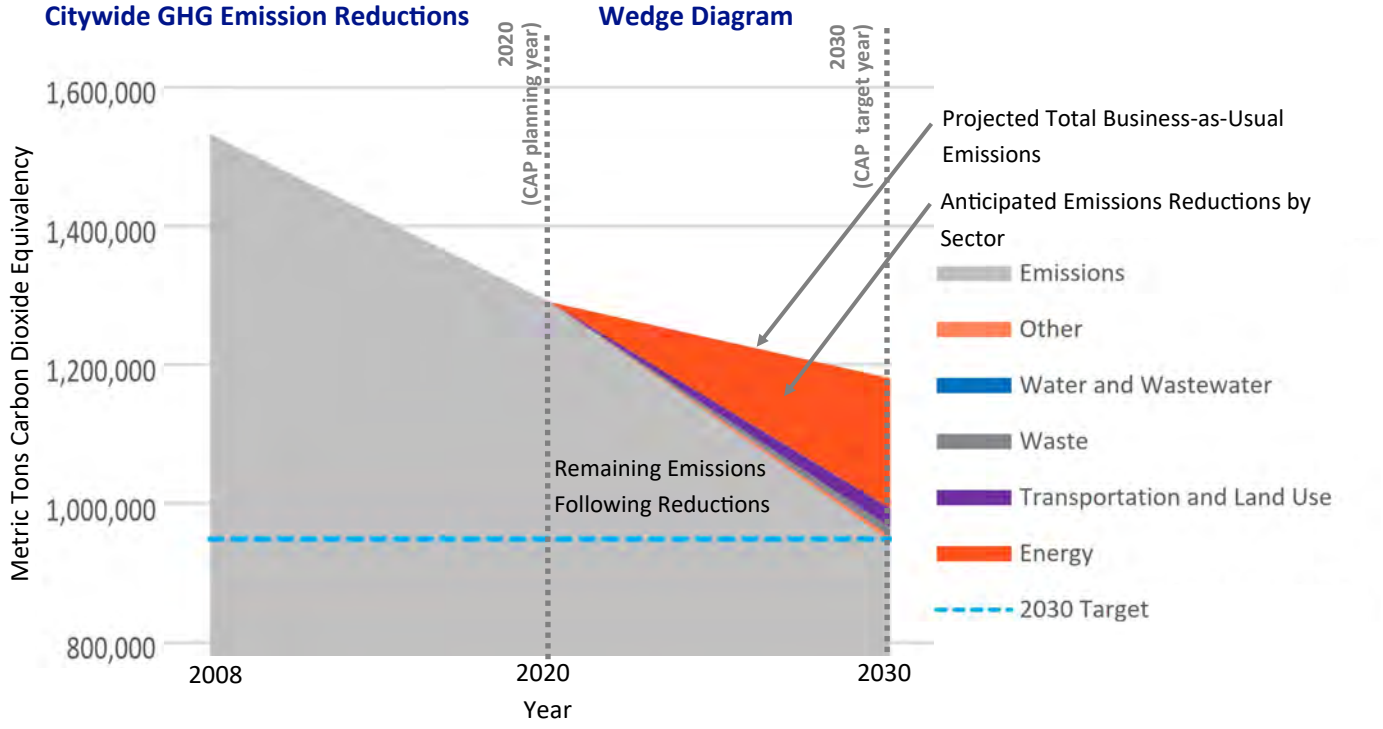
Estimated Citywide GHG Reductions Included in This Plan

Through successful implementation of this climate action plan, annual GHG emissions are projected to be 321,856 metric tons below 2018 citywide levels. The potential cumulative GHG emissions reductions over the 10 year implementation period are estimated at over 1,162,719 metric tons - an elimination of over 22.8 billion cubic feet of manmade greenhouse gas atmosphere resulting from this climate action plan.

The total projected GHG emissions reductions estimated for the initial implementation actions of this plan are projected to be sufficient to achieve a total reduction in annual emissions of 25% below 2018 baseline emissions by 2030. As outlined on the previous page, the implementation phase of the plan should be characterized by intermittent measurement of progress and plan adjustments based on results in order to achieve the ultimate 2030 reduction goals.

Citywide GHG Emission Reductions Wedge Diagram

The diagram below shows the estimated emission reductions from the Business-as-Usual projections, by emission sector, of the Climate Action Plan actions and targets.




NO SMOKING

Section 02

Transportation and Land Use

Click here to return to TOC

Transportation and Land Use

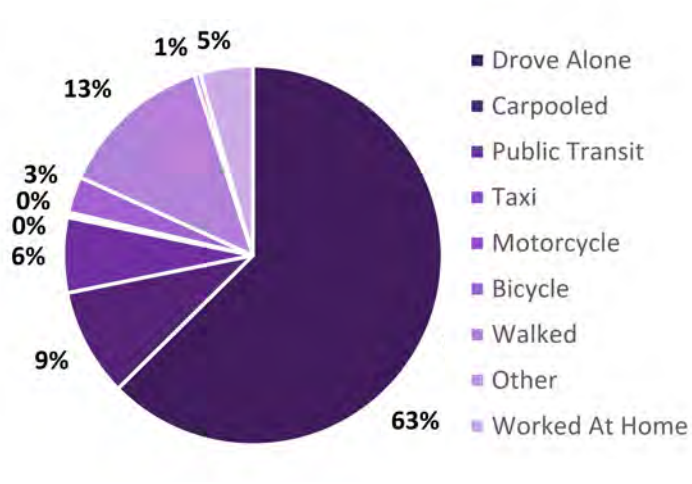
Why Transportation and Land Use Is Important

The design of a city can limit or expand the mobility choices and opportunities available to its residents. Where and how we live, our mobility options to and from the places in our community we visit daily, and the related global impact of those decisions are all influenced by how our community is designed. The transportation systems we have access to and choose to use—including private and public vehicles, trains, and planes - can have significant impacts on the environment.

In Bloomington, the transportation sector accounts for 15.4% of citywide greenhouse gas emissions (2018 GHG Inventory). As shown in the commuter transportation pie chart to the right, the majority (63) of Bloomington residents drive to work alone. The remaining walk (13%), carpool (9%), use public transit (6%), telework (5%), or bicycle (3%).

Of the Bloomington workforce, the average commute-to-work time is 16.1 minutes compared to the State of Indiana average of 23 minutes while only 1.08% have "super commutes" in excess of 90 minutes compared to 1.82% for the State of Indiana. 91.1% of Bloomington households (26,626 households) live within ½ mile of transit routes and 24.1% (7,031 households) live near rush-hour high frequency transit routes.

Commuter Transportation in Bloomington



Continuing to improve the equity and sustainability of Bloomington's land use and transportation systems requires a focus on developing systems and networks that allow for greater choice in where residents live and work, as well as how they commute. Implementation of Complete Streets and a connected system of transit, bike and pedestrian infrastructure along with emphasis on neighborhood design that supports density and walkability. These strategies are lower cost solutions that will save households money while helping Bloomington reach its goal to reduce city-wide GHG emissions by 25% below 2018 levels by 2030.

Climate Change Considerations

Climate Impacts

This sector impacts climate change through the combustion of fossil fuels (gasoline, diesel, propane) for on-road cars and trucks and off-road vehicles and equipment.

Climate Hazards

Hazards to transportation and land use include increased damage to roads and transportation infrastructure due to increased freeze and thaw cycles, flooding, and extreme weather and temperatures.

Transportation and Land Use

Equity Considerations

- Increased opportunities for public transit and active transportation can help address health disparities for many at-risk populations.
- Affordable and reliable options for mobility for people with special transportation needs can significantly improve transportation equity. Populations with special transportation needs include older adults, youth, persons with disabilities, and persons with reduced incomes.
- Some neighborhoods in Bloomington have fewer housing and transportation options than others. This can limit people's choices in where they live and how they get to work or other activities. Households that rely on public transit service or who rent their home will be limited in where they can find housing that meets both needs.

Sector Goals

Sector goals are established to both support the City's Climate Action Plan in creating a climate resilient community and to reduce city-wide GHG emissions 25% below 2018 levels by 2030.

Sector goals related to GHG emissions reductions are designed to balance reduction across all sectors and achieve the overall emissions goals set forth for the community. The goals seek to strike a balance between achievability while also reaching for improvement beyond business-as-usual.

As indicated in the introduction, the Climate Action Plan is intended to be a 10 year plan to be updated at the completion of that time. Consequently, the goals and strategies outlined in this section are intended to be achieved by 2030 unless otherwise noted.

Implementation of actions are anticipated to be initiated over 3 phases: phase 1 within 1-3 years, phase 2 within 2-5 years, and phase 3 within 4-8 years of CAP approval.

Goal TL 1

Decrease on-road vehicle miles traveled (VMT) by 8% of 2018 values.

Goal TL 2

Support and encourage electric vehicle (EV) adoption, achieve 30% of vehicles sold and 15% of VMT community-wide by 2030.

Mode Shift Targets Supporting Sector Goals

	Bloomington Transit Use	Single Occupancy Vehicle Use	Carpool + Shared Mobility	Walk + Bike	Electric Vehicles
	+	-	+	+	+
Today	6.5 Million Passenger Miles	61.4%	10.5%	16.8%	0.8% (Statewide)
2030 Targets	**7.3** Million Passenger Miles	**54%**	**14%**	**18%**	**15%**

Goal TL 1 Decrease on-road vehicle miles traveled (VMT) by 8% of 2018 values.

Strategy TL 1-A:

Reduce single occupancy automobile use by 8% of 2018 values.

The local transportation system is planned, funded, built, and maintained by a combination of local, state, and federal organizations, including the Bloomington-Monroe County Metropolitan Planning Organization (BMCMPO). The BMCMPO is a partnership of local governments and transportation service providers to execute federally funded transportation priorities outlined in the 2045 Metropolitan Transportation Plan. MPO members include the City of Bloomington, Monroe County, the Town of Ellettsville, Indiana University, and the Bloomington Public Transportation Corporation (Bloomington Transit), and Area 10 Agency on Aging. Additionally transportation projects are also funded, planned, and executed by City of Bloomington.

How We'll Measure Progress:

Reported “drive alone” commuter transportation data (US Census),
Annual VMT data reported (INDOT)

Co-Benefits of Strategy:

Reduced Costs

Improved Air Quality

Reduced Traffic Congestion

Reduced GHG Emissions

	Actions	Implementation Phase
TL1-A-1	Update the City's Transportation Plan and Metropolitan Transportation Plan to incorporate reductions in carbon emissions and vehicle miles traveled, improved bicycle, pedestrian and transit service standards, and a policy requiring project evaluation to include criteria on climate, equity, economic benefit, health, safety, and cost effectiveness.	1
TL1-A-2	Establish a City of Bloomington employee Parking Cash Out benefit program to promote alternative commute options. Invite other public agencies and private sector employees to establish similar benefit programs. (https://www.bestworkplaces.org/pdf/ParkingCashout_07.pdf https://www.boston.gov/transportation/parking-cash-out)	1
TL1-A-3	Conduct a road pricing strategy study to explore options appropriate for the City of Bloomington that accurately capture the cost of driving and auto-centric infrastructure on city roads. Include a study on parking fees, demand-based fees, fee discounts for carpools and EV's and fuel efficiency charge options. Study should include national and international case studies and identify pilot projects for implementation.	2
TL1-A-4	Identify locations and partners to facilitate parking buyback programs for municipal and other employers in the city. (https://www.bestworkplaces.org/pdf/ParkingCashout_07.pdf https://www.boston.gov/transportation/parking-cash-out)	2
TL1-A-5	Determine appropriate locations for car-free pedestrian zones in high-density areas. Establish implementation based on Kirkwood pilot project observations and recommendations. Evaluate feasibility of limiting vehicles on certain days of the week and implementing congestion parking pricing, where appropriate.	2
TL1-A-6	Identify locations and partners to facilitate bike/walk commute, carpooling, EV ride share, and telecommuting options for municipal and other employers in the city.	3

Strategy TL 1-B:

Increase bicycle/pedestrian commuting from 17% to 18% by creating infrastructure to better encourage alternatives to vehicles.

How We'll Measure Progress:
Reported bike/walk commuter transportation data—US Census, Annual VMT data reported

The 237 miles of roadway within City limits is maintained by the City of Bloomington Public Works Street Division, with additional miles maintained by the Indiana Department of Transportation, Indiana University and the Monroe County Highway Department. For multimodal transportation, the the City of Bloomington Parks and Recreation Department manages over 15 miles of recreational and multi-use paths. The City Trails and Trees bond passed by City Council in 2018 is adding over seven miles of new trails to the transportation system, including the 7 line, RCA/ Powerline and a hiking loop at Griffy Lake. Additionally, several multi-use trails were constructed in 2020 in accordance with the BMCMPO's Complete Streets Policy which states that newly constructed roadways must be able to accommodate all types of roadway users. This strategy's goals for increased bicycle and walking utilization takes into account the city's current participation rates in commuters walking and biking is significantly higher than the national average of 3%.

Co-Benefits of Strategy:

Reduced Costs

Improved Air Quality

Improved Public Health

Reduced GHG Emissions

	Actions	Implementation Phase
TL1-B-1	Increase funding adequate to maintain and improve the existing transportation system and to invest in transportation capital projects and programs that reduce carbon emissions and improve equity.	1
TL1-B-2	Implement the Multimodal Projects recommendations included in the 2019 City of Bloomington Transportation Plan and BMCMPO's Transportation Improvement Program.	1
TL1-B-3	Enhance bike and pedestrian travel options through creating protected bike lanes on key travel corridors and improved pedestrian efficiency through mobile route mapping. Conduct a study to identify and prioritize routes and establish an implementation plan and schedule.	2
TL1-B-4	Promote usage of the Sustainability Development Incentive: density bonuses or expedited review for development projects that have mixed-used zoning (residential, retail and office uses).	2
TL1-B-5	Provide additional earmarked funding and/or prioritization to projects with clear safety and VMT reduction goals. Accelerate 2019 City of Bloomington Transportation Plan, priority bicycle network (5-7 year), pedestrian network, balancing work load, and funding.	2
TL1-B-6	Encourage development of projects within mixed use districts that promote a combination of neighborhood-scale residential, commercial, and institutional uses with pedestrian-oriented design and multi-modal transportation options. Developments should maximize equity considerations and minimize community wide VMT by creating a more walkable, bikeable, and transit friendly community.	2
TL1-B-7	Conduct a Pavement Conversion study to identify underutilized paved areas and identify incentivization and implementation plan to convert identified areas to sustainable green space, and/or pedestrian and biking paths and support space.	3

Transportation and Land Use

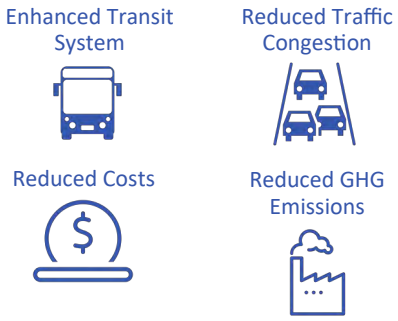
Strategy TL 1-C:

Increase transit utilization by 10% over 2018 passenger miles by 2030 through infrastructure and frequency investments.

How We'll Measure Progress:
Reported public transit commuter data—US Census, Annual VMT data reported

Bloomington Transit is the main local transit service in the City and operates 14 routes with a fleet of 49 buses (Transportation Plan, 2019). The Bloomington Transit Route Optimization Study indicated that increasing frequency, adding weekend service, and expanding service to the west side, to employment centers, housing complexes, and to Ivy Tech are top priorities for transit users. While existing services adequately meet rider's needs, some riders expressed dissatisfaction with service provision, especially that the transit schedules did not align with or satisfy travel needs. Given the current street network, improvements to bicycle, pedestrian, bus, and other supported modes of non-automobile travel along the major N-S and E-W corridors through the center of Bloomington were identified in the Transportation Plan as high-priority for investment.

Co-Benefits of Strategy:



	Actions	Implementation Phase
TL1-C-1	Implement recommendations of the Bloomington Route Optimization Study.	1
TL1-C-2	Collaborate with Bloomington Transit and/or other providers to establish a Guaranteed Ride Home program. Guaranteed Ride Home is a free reimbursement program for registered commuters. Its purpose is to minimize the chance of being "stuck at work" due to limited transit schedules, like express routes that only travel in one direction at certain times during the day.	1
TL1-C-3	Identify and implement micro-transit options as appropriate to improve access to and accessibility of transit system for portions of the community not yet well served, particularly serving vulnerable populations.	1
TL1-C-4	Collaborate with Bloomington businesses to promote and expand on the Guaranteed Ride Home program, and expand participation in the Employer Sponsored Pass program for workplaces to purchase bus passes for employees, students, etc.	2
TL1-C-5	Improve efficiency, convenience, and reliability of bus service and infrastructure (dedicated lanes). Increase bus frequency, establish dedicated bus routes, and create high-frequency rapid transit in corridors to improve "time equity / parity" of the route transit time with what it would be to drive a car. Prioritization to be given on routes serving the city's many employment centers and areas with higher shares of vulnerable populations.	2
TL1-C-6	Prioritize transit-oriented development, as defined by the Bloomington Unified Development Ordinance, along existing and planned transit stops and along primary transit corridors.	3

Transportation and Land Use

Strategy TL 1-D:

Increase shared mobility (carpooling) utilization by 3% of work commute trips.

How We'll Measure Progress:

Reported public transit commuter data—US Census, Annual VMT data reported

Shared mobility can broadly be as transportation services and resources that are shared among users, either concurrently or one after another. This broader definition includes micro mobility (bike sharing, scooter sharing); automobile-based modes (carsharing, rides on demand, and micro transit); and commute-based modes or ridesharing (carpooling and vanpooling). According to the US Census, workers commuting via carpooling has remained consistently near the 9% level since 2013. Increased carpooling for individuals requiring similar commute routes directly reduces annual VMT and GHG emissions.

Co-Benefits of Strategy:

Improved Quality of Life

Improved Social Connectivity

Reduced Costs

Reduced GHG Emissions

	Actions	Implementation Phase
TL1-D-1	Outline clear policies for electric bikes, skateboards and scooters on city bike lanes, paths and trails. Establish a communication campaign to effectively reach users.	1
TL1-D-2	Establish a subsidy / incentive for EV car sharing services with the goal of increasing car share coverage, particularly among vulnerable populations and those without current vehicle access. Qualifying programs must use plug in EV's or other law and no-carbon vehicle alternatives only.	1
TL1-D-3	Establish a communication campaign to effectively reach users to promote electric bicycle, skateboard, and scooter policies and promote use.	2
TL1-D-4	Establish a minimum of 2 EV car sharing locations in the City by 2023.	2

Strategy TL 1-E:

Encourage density and increase housing options and affordability with the goal of increasing gross density by 3% of 2018 values.

Residential density in the City of Bloomington ranges from 700 people per square mile to over 19,300, with an average of approximately 3,600 people per square mile. When well-planned, increased density means shorter commutes, better "walkability" between home and a range of destinations, reinforced public transit corridor utilization, increased housing near jobs and community resources, and overall increased quality of life for residents.

How We'll Measure Progress:
Reported population per square mile of developed land

Co-Benefits of Strategy:

Reduced Traffic Congestion

Reduced GHG Emissions

	Actions	Implementation Phase
TL1-E-1	Encourage development of accessory dwelling units ("ADU") to create additional legal ADUs compatible with residential neighborhoods. This will add additional housing options for the City's workforce, seniors, families with changing needs, and others for whom ADUs present an affordable housing option.	1
TL1-E-2	Reevaluate minimum parking requirements in the Unified Development Ordinance as listed in Table 04-9: Minimum Vehicle Parking Requirements. Require parking for all modes of travel in project design, as appropriate.	1
TL1-E-3	Continue assessment and review of Unified Development Ordinance for identification of zoning modifications to encourage appropriate increased density, increased community "walkability," and decreased reliance on automobile use.	1
TL1-E-4	Conduct a Development Study to identify and prioritize available sites for redevelopment and in-fill development to advance City's walkability, bikeability, and transit utilization. Study should include a review of under utilized surface parking infrastructure capable of being redeveloped.	2
TL1-E-5	Issue competitive redevelopment Request for Proposals based on findings and recommendations of Development Study to encouraging high quality mixed use redevelopment on redevelopment, infill properties and existing surface parking lots within downtown district. RFP's should focus on equity, affordability, livability, and compliance/ support of Climate Action Plan goals.	2
TL1-E-6	Implement form-based code along transportation corridors with goal of improved pedestrian experience (frequent access points, greenspace).	2
TL1-E-7	Establish an ordinance to require developers and landlords to "unbundle" parking from rent structures. Policy should focus on maintaining transit and transportation equity. Resource: https://dot.ca.gov/-/media/dot-media/programs/research-innovation-system-information/documents/preliminary-investigations/final-pricing-parking-management-to-reduce-vehicles-miles-traveled-pi-a11y.pdf	2
TL1-E-8	Improve the city's average Walkscore from 43 to 60 by 2030. Collaborate with WalkScore for data analysis and identification of high-impact actions to increase score. (https://www.walkscore.com/professional/research.php)	3

Transportation and Land Use

Strategy TL 1-F:

Build Complete Streets; goal 10% increase in Complete Street coverage by 2030.

How We'll Measure Progress:
Reported Complete Street status

Complete Streets are streets designed and operated to enable safe use and support mobility for all users of all ages and abilities and all modes of travel including pedestrians, bicyclists, scooter riders, public transportation riders, and drivers of other motorized vehicles. Complete Street strategies address a wide range of elements, such as sidewalks, bicycle lanes, bus lanes, public transportation stops, crossing opportunities, median islands, accessible pedestrian signals, curb extensions, modified vehicle travel lanes, streetscape, and landscape treatments.

Co-Benefits of Strategy:

	Actions	Implementation Phase
TL1-F-1	Review, modify, and adopt a revised BMCMPO Complete Streets Policy to add criteria and review procedures for City funded projects. Include in the review and modification an assessment of national best practices in support of achieving the goals of the Climate Action Plan. Resource: 2018 MPO Complete Streets Policy	1
TL1-F-2	Conduct a Sidewalk and Bike Path Quality Assessment and Master Plan to identify needs to accelerate bike paths, building sidewalks, crosswalks, and other walking infrastructure, particularly in high-need areas and areas serving vulnerable populations. Create an implementation plan establishing annual increases in the total miles of sidewalks, on-road bicycle lanes and multi-use paths. Resources: 2020 City Council Sidewalk Reports, 2018 City Sidewalk, Curbs, and Accessible Curb Ramps Condition Report	1
TL1-F-3	Establish a method for projecting the lifecycle carbon emissions of land use and transportation investments associated with the City's Transportation Plan and Transportation Improvement Program including consideration of embodied energy, operations and maintenance (see City of Eau Claire WI Land Use Carbon Calculator).	2
TL1-F-4	Adopt project review criteria for City transportation projects that align with and complement the MPO Complete Streets policy and prioritize low carbon modes of transportation, including, but not limited to pedestrians, bicyclists, and public transit infrastructure.	2
TL1-F-5	Align City's Transportation Plan and Transportation Improvement Program regional mode share targets with carbon reduction targets and encourage the development of mode share goals specific to the varying community needs and transit infrastructure around the region.	2
TL1-F-6	Explore establishing a tiered bike infrastructure improvement approach which include adding trees and green stormwater infrastructure whenever possible/ prioritized.	3

Strategy TL 1-G:

Increase pedestrian access and safety.

How We'll Measure Progress:

Reported walking and biking commuter data, reported pedestrian and bike accidents

Walking is a basic and common mode of transport in all societies around the world. Virtually every trip begins and ends with walking. Beyond the environmental and GHG emission reduction benefits, increased walking has well established health benefits such as increasing physical activity that may lead to reduced cardiovascular and obesity-related diseases. According to the World Health Organization "Pedestrian safety measures improve walking environments and contribute to urban renewal, local economic growth, social cohesion, improved air quality and reduction in the harmful effects of traffic noise."

Co-Benefits of Strategy:

Safer Streets

Improved Mobility

	Actions	Implementation Phase
TL1-G-1	Implement improvement recommendations of the 2019 Transit Stop Safety and Accessibility Assessment.	1
TL1-G-2	Create and implement a 5 year transportation funding plan that matches the MPO Metropolitan Transportation Plan and 2019 Transportation Plan.	1
TL1-G-3	Establish an implementation plan for the redesign of roads to be safer for people including road width reductions on all four-lane city streets as well as on multi-lane one-way streets, installing curb extensions, and refuge medians.	2
TL1-G-4	Develop a Safe Routes To Schools Implementation Plan (SRTS) for all schools within the City. Plan implementation should focus on infrastructure and policy changes as well as education and encouragement.	2
TL1-G-5	Prioritize transportation funding for Vision Zero engineering improvement projects paired with VMT reduction strategies to create safe streets for people walking, biking and riding transit.	2

Strategy TL 1-H:

Reduce commercial/industrial vehicle use by 8% of 2018 values

How We'll Measure Progress:
Reported commercial and industrial VMT

Commercial and Industrial vehicle use makes up an estimated 10% of city-wide VMT according to the City of Bloomington 2018 Greenhouse Gas Inventory. Utilization of low-carbon goods movement alternatives and fleet utilization optimization can support the reduction of commercial vehicle miles traveled and increase commercial/industrial profitability.

Co-Benefits of Strategy:

Improved Air Quality

Reduced GHG Emissions

	Actions	Implementation Phase
TL1-H-1	Establish an Electric Vehicle Suitability and Fleet Optimization Study utilizing fleet monitoring technology to assess fleets for alternative fuel suitability as well as identify fleet optimization management options for reduced VMT. (https://www.geotab.com/fleet-management-solutions/evsa/) Include City's fleet in program efforts. Goal: Achieve 6 fleet assessments annually.	1
TL1-H-2	Collaborate with the Bloomington Chamber of Commerce, Downtown Bloomington, community businesses, and Indiana University to conduct a study identifying the advantages/disadvantages, and lessons learned by businesses in the community related to use of video/remote meetings in lieu of business travel for meetings and events. Based on findings of the study, establish, distribute, and promote a "best practices" guide outlining the opportunities for operational savings and reduced vehicle use and encouraging effective, long-term increased remote meeting technologies. Establish a freight committee as part of an existing MPO committee as noted in the Metropolitan Transportation Plan.	2
TL1-H-3	Collaborate with partners including Indiana Railroad, Monroe County, and Bloomington Chamber of Commerce, and Indiana University to assess railroad infrastructure and Bloomington business community transportation needs, identify rail freight system and service improvements to increase utilization and encourage rail system owners to make improvements.	2
TL1-H-4	Establish a freight committee as part of an existing MPO committee as noted in the Metropolitan Transportation Plan.	2

Strategy TL 1-I:

Reduce citywide off-road and lawn equipment annual emissions to below 35,000 metric tons. (equipment includes gas and diesel powered construction equipment, recreational equipment, and lawn equipment)

Emissions from off-road equipment like construction and lawn equipment comprise a significant portion of fossil fuel consumption in Bloomington. Reduction of fossil fuel off-road equipment use is associated with improved emissions as well as improved air quality, particularly for the users of the equipment. https://www.edmunds.com/car-reviews/features/emissions-test-car-vs-truck-vs-leaf-blower.html

How We'll Measure Progress:

City electric off-road equipment adoption rate, policy adoption status

Co-Benefits of Strategy:

Improved Air Quality

Reduced GHG Emissions

	Actions	Implementation Phase
TL1-I-1	Introduce a policy to replace City off-road and lawn equipment with electric and low-carbon fuel alternative options at the time of replacement with traditional internal combustion engine (ICE) as optional requiring proof of need. Establish emissions standards, testing and biofuel preference for any combustion vehicles remaining in the equipment fleet. Encourage County, School District, and Indiana University to develop and implement their own policies.	1
TL1-I-2	Develop an incentive program to convert fuel-burning lawn equipment such as gas-powered lawn mowers and blowers to electric. Coordinate with Duke Energy for support and identification of additional rebate programs to promote electric yard equipment.	2
TL1-I-3	Establish a gas powered lawn equipment phase-out ordinance transitioning to lawn equipment powered by electricity or alternative clean fuels and decreased noise pollution levels.	2
TL1-I-4	Develop an incentive program to convert fuel-burning lawn equipment such as gas-powered lawn mowers and blowers to electric. Coordinate with Duke Energy for support and identification of additional rebate programs to promote electric yard equipment.	2

Goal TL 2 Support and encourage electric vehicle adoption, achieve 30% of vehicles sold and 15% of VMT community-wide by 2030.

Strategy TL 2-A:

Transition City fleet to electric vehicle and alternative fuels (hybrid/ hybrid electric, plug in hybrid electric).

Adoption of electric and other alternative no-fossil-fuel vehicles is a core requirement of reducing GHG emissions associated with City operations. Beyond reduced emissions, electrification of municipal fleets have a number of benefits, including improved air quality, decreased fuel costs, decreased maintenance requirements, and even improved driver safety.

How We'll Measure Progress:

Reported number of electric vehicles within fleet

Co-Benefits of Strategy:

Reduced Costs

Reduced Pollution

Improved Air Quality

Reduced GHG Emissions

	Actions	Implementation Phase
TL2-A-1	Introduce a policy to replace City fleet vehicles and buses with electric and hybrid options at the time of replacement, and require emissions standards, testing and biofuel preference for any combustion vehicles remaining in the fleet.	1
TL2-A-2	Conduct a municipal fleet inventory and EV Implementation plan. Effort to identify opportunities for electrifying, right-sizing, and improving overall efficiency of vehicles to meet CAP Goals. Include implementation recommendations to incorporate EV's through right-timing purchases with a planned vehicle-replacement schedule.	2

Strategy TL 2-B:

Support and encourage electric vehicle and alternative fuel (hybrid/ hybrid electric, plug in hybrid electric) vehicle adoption citywide.

How We'll Measure Progress:
Registered EV vehicles citywide

Electric vehicles (EVs) are a critical component of meeting Bloomington's long-range emission reduction goals, in fact, meeting those goals will not be possible without a transition to alternative fuel vehicles. While no greenhouse gas emissions directly come from the "tailpipes" of EV, short-term transition to EVs in Bloomington will have limited overall emissions decrease due to the relatively high emissions factor associated with Bloomington area electrical generation which is still significantly produced from fossil fuels. However, the GHG reduction benefits of EVs will continue to rapidly increase in the Bloomington area as electric grid goals are achieved. Additionally, other co-benefits of EV transition such as lowered vehicle operation costs and improved local air quality will be leveraged even in early transitions.

Co-Benefits of Strategy:

	Actions	Implementation Phase
TL2-B-1	Coordinate with Monroe County and State of Indiana to establish an annual auto registration reporting process to monitor the adoption rate of electric vehicles in the City.	1
TL2-B-2	Create an Electric Vehicle (EV) Action Plan to guide access to chargers on City property and citywide, explore alternative technologies like smart cable technology and streetlight/EV charger integration, address barriers to charging for garage-free homes and rental properties, increase use of EVs in car sharing programs, assess options to lower EV and EV charger implementation costs, and recommend EV charging station requirement amendments to the Unified Development Ordinance to support EV plan. Coordinate with ERI or Purdue to establish tracking of EV registration within the community.	1
TL2-B-3	Support electric car charging station infrastructure in new commercial and multifamily housing during the initial construction phase by providing information on appropriate conduit and electrical panel considerations as a part of permit application process. Collaborate with electric utility to develop and provide information on utility, local, State, and Federal incentives supporting EV infrastructure.	1
TL2-B-4	Incentivize the purchase of electric vehicles through rebates on vehicles and/or residential chargers. Work with utility company on this program. Explore expansion of current Duke program: https://www.duke-energy.com/energy-education/energy-savings-and-efficiency/electric-vehicles/ev-initiatives	2
TL2-B-5	Incentivize electric vehicle sales by providing low/no cost charging at city owned parking lots and working with employers to provide workplace charging and multi-family property owners to provide rental housing charging.	2
TL2-B-6	Explore incentive opportunities to advance installation of EV infrastructure at workplace and multi-family locations.	2

Transportation and Land Use

Planned Transportation and Land Use GHG Emission Reductions

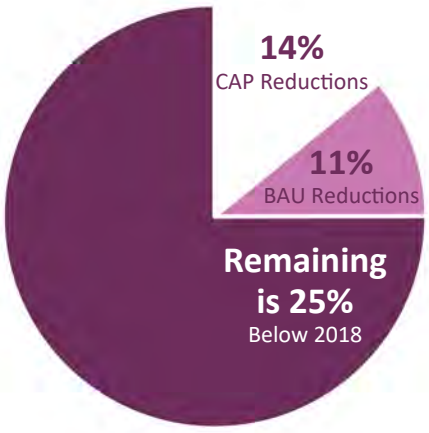
Planned Sector Emission Reductions Through 2030

The strategies and actions included in this section of the Climate Action Plan are projected to reduce the city's annual GHG emissions by 28,037 metric tons (MT) by 2030 - a 14% reduction over 2018 levels. Changes in business-as-usual impacts are anticipated to reduce an additional 21,437 metric tons for a total community wide transportation sector reduction of 25% over 2018 levels.

This is equivalent to eliminating **970 million** cubic feet of man-made greenhouse gas atmosphere annually by 2030.

Sector Emissions Reduction below 2018 Achieved by 2030

The total change to sector emissions include CAP Plan reductions as well as BAU emission changes as follows:



Individual Strategy Annual Emission Reductions by 2030

Below are the CAP Plan reductions by strategy for this sector:

Strategy	Annual GHG Reductions by 2030
Strategy TL 1-A: Reduce single occupancy automobile use by 8% of 2018 values.	**4,666 MT**
Strategy TL 1-B: Increase bicycle/pedestrian commuting from 17% to 18% by creating infrastructure to better encourage alternatives to vehicles.	**149 MT**
Strategy TL 1-C: Increase transit passenger mile utilization from 6.7 million to 7.3 million through infrastructure and frequency investments.	**151 MT**
Strategy TL 1-D: Increase shared mobility (carpooling) utilization from 9% to 12% of commuters.	**372 MT**
Strategy TL 1-E: Encourage density and increase housing options and affordability; target: increase gross density by 3% of 2018 values.	**170 MT**
Strategy TL 1-F: Build Complete Streets; target 10% increase in complete street coverage by 2030.	(included)
Strategy TL 1-G: Increase pedestrian access and safety.	(included)
Strategy TL 1-H: Reduce commercial/industrial vehicle use by 8% of 2018 values.	**1,439 MT**
Strategy TL 1-I: Reduce citywide off-road and lawn equipment annual emissions to below 35,000 metric tons. (equipment includes gas and diesel powered construction equipment, recreational equipment, and lawn equipment)	**15,202 MT***
Strategy TL 2-A: Transition City fleet to electric vehicle and alternative fuels (hybrid/ hybrid electric, plug in hybrid electric).	**133 MT**
Strategy TL 2-B: Support and encourage electric vehicle and alternative fuel (hybrid/ hybrid electric, plug in hybrid electric) vehicle adoption citywide.	**5,756 MT**

* Transportation and Land Use Reduction totals under Planned Sector Emission Reductions Through 2030 exclude emissions and savings from offroad transportation. Offroad transportation emissions were modeled at 50,202 MTCO2e in the 2018 inventory, but further study is needed to verify these emissions for Bloomington. The offroad transportation climate strategy aims to reduce these to 35,000 MTCOe2 or less by 2030.

Transportation and Land Use

Estimated Cumulative Economic Savings

Implementing many of the measures in this plan, such as reduction of single-occupancy auto use, can save money for the community. The estimated community savings of the goals for this section include:

Goal TL1 Decrease VMT by 8%:		Goal TL2 Increase EV utilization to 15% of VMT		Estimated Cumulative Savings Potential*
$81,512,30	+	**$20,424,533**	=	**$101,936,832**
$958 per capita		**$661** per household		**$1,198** per capita

* Savings for Goal TL1 are based on multiplying the estimated vehicle miles saved by AAA calculated auto use cost per mile and 2020 Bloomington Transit pass costs. Savings for Goal TL2 are calculated based on multiplying the estimated vehicle miles switching from gas/diesel fuel vehicle by the sum of the AAA calculated gas/diesel auto use cost per mile subtracting the EPA estimated EV auto use cost per mile. See Appendix for Cumulative Potential Cost Savings Assumptions and data sources.

What You Can Do

- Merge 2 or more errands into a single driving trip.
- Join a carpool or use ridesharing to get to work, a group activity or event.
- Walk to work, an appointment, a group activity or event.
- Ride a bike, electric bike or scooter to work, an appointment, a group activity or event.
- Take public transit to work, an appointment, a group activity or event. Plan your trip here: https://bloomingtontransit.com/maps-and-schedules/
- With a family member or friend, take public transit to a group activity or event.
- Buy or tune up a used bike.
- Sell or donate a bike (in good condition) you aren't using.
- Buy or lease a hybrid or electric vehicle, or a gas-powered one that averages more than 35 mpg.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Section 03

Energy and Built Environment

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Energy and Built Environment

Why Energy and Built Environment Is Important

Building construction and operations can have extensive direct and indirect impacts on the environment, society, and economy. Buildings use significant resources (energy, water, raw materials, etc.), generate waste (occupant, construction, and demolition), emit potentially harmful atmospheric emissions, fundamentally change the function of land, and the ability of that land to absorb and manage water.

Building energy use is a major contributor to greenhouse gas (GHG) emissions. The Building Energy sector includes all residential, commercial, and industrial buildings. Greenhouse gas emissions from this sector come from **direct emissions** – from fossil fuels burned *on-site* for heating or cooking needs – as well as **indirect emissions** – from fossil fuels burned *off-site* in order to supply that building with electricity. Building design plays a large role in determining the future efficiency and comfort of facilities. Increasing energy efficiency can help reduce GHG emissions and result in significant cost savings for both homes and businesses. The Bloomington community can also achieve environmental, social, and economic benefits through enhancements to the built environment.

The Energy and Built Environment (including IU Power Plant) is 77% of citywide GHG emissions for the City of Bloomington. Within this sector, the share of residential consumption is 38%, commercial and government buildings is 44%, and industrial share is 18%.

The current fuel mix used to generate electricity by the electricity utility serving the community, Duke Energy, is heavily coal based with over 61% derived from coal, 37% from natural gas, and less than 1% combined for hydro, wind, and solar. According to Duke Energy's 2018 Integrated Resource Plan, the projected energy mix of their portfolio is anticipated to decrease reliance on coal, with a significant increase in natural gas and some increase in solar and wind through 2037. This planned shift in energy portfolio will help contribute to Bloomington's GHG reduction goals, however, will not be enough to meet the reductions needed.

Advancing significant GHG emission reductions in the Energy and Built Environment sector will require a focus on reduced coal and fossil fuel use in the generation of electricity and building heating systems. The success of Duke Energy in reducing the use of fossil fuel use for the generation of grid electricity, increased implementation of distributed (on-site) renewable energy citywide, and improved energy efficiency will be key in Bloomington reaching its goal to reduce city-wide GHG emissions 25% below 2018 levels by 2030.

Climate Change Considerations

Climate Impacts

This sector impacts climate change through the combustion of fossil fuels (coal, natural gas, heating oil, propane) to generate electricity and heat/cool our buildings.

Climate

Hazards to Energy and Built Environment include damage to buildings and energy grid infrastructure from extreme weather and flooding, increased power outages, and increased energy demand and cost expenditure due to rising temperatures and weather variability.

Energy and Built Environment

Equity Considerations

- Families that live in properties that are not energy efficient are also those that can least afford high-cost utility bills. These households may lack the ability to pay for energy efficiency improvements or access renewable energy options.
- Renters of both single family homes as well as multi-family housing usually do not have the ability to implement energy efficiency measures to the buildings they live in to gain the benefits of energy efficiency. Energy efficiency retrofits are typically in the hands of the landlord while the costs associated with the resulting energy use are usually paid by the occupant.
- Families with fewer resources must dedicate a disproportionately larger share of their income towards energy costs, which exacerbates other vulnerabilities including exposure to heatwaves and other climate vulnerabilities. These same families are sometimes forced to forego basic access to service altogether - an estimated 70 households in Bloomington go without heating fuel of any type (US Census heating fuel utilization data).

Sector Goals

Sector goals are established to both support the City's Climate Action Plan in creating a climate resilient community and to reduce city-wide GHG emissions 25% below 2018 levels by 2030.

Sector goals related to GHG emissions reductions are designed to balance reduction across all sectors and achieve the overall emissions goals set forth for the community. The goals seek to strike a balance between achievability while also reaching -for improvement beyond business-as-usual.

As indicated in the introduction, the Climate Action Plan is intended to be a 10 year plan to be updated at the completion of that time. Consequently, the goals and strategies outlined in this section are intended to be achieved by 2030 unless otherwise noted.

Implementation of actions are anticipated to be initiated over 3 phases: phase 1 within 1-3 years, phase 2 within 2-5 years, and phase 3 within 4-8 years of CAP approval.

Goal EB 1
Increase distributed renewable energy to 250,000 MWH of total generation annually by 2030.

Goal EB 2
Increase energy efficiency citywide 16% for electricity and 12% for natural gas of 2018 values.

Goal EB 3
Support decarbonization of the local electricity grid.

Goal EB 4
Promote "fuel switching" to reduce on-site fossil fuel use in the building sector by 3% of 2018 values.

Goal EB 5
Increase financing options for Energy Efficiency and Renewable Energy projects citywide.

Energy Mix Targets Supporting Sector Goals

	Citywide Renewable Energy	Citywide Electricity Consumption	On-Site Fossil Fuel Consumption	Cleaner Electric Grid
	+	-	-	-
Today	0.5%	1,461 GHW*	18.8 MTherms*	0.53 mTons/MWH**
2030 Targets	10%	1,430 GWH	18.4 MTherms	0.35 mTons/MWH**

*Under BAU, energy use is anticipated to increase

**mTons/MWH = Metric Tons of greenhouse gas emissions per megawatt hour of electricity generation.

Goal EB 1 Increase distributed renewable energy to 250,000 MWH of total generation annually by 2030.

Strategy EB 1-A:

Increase solar on City facilities 20% by 2030.

The City of Bloomington is a leader in on-site solar installations in the region with solar installed on 32 of the City's facilities and sites. City solar arrays generated 3 GWH of electricity in 2019, or approximately 70% of City building electricity consumption in 2018 (excluding water and wastewater processing). Identifying additional solar installation potential, including ground mounted arrays, "carport" arrays, and remaining cost effective rooftop array locations can increase the City's renewable energy portfolio. An increase of 20% on-site solar generation would result in 80% carbon-free City facility electric consumption.

How We'll Measure Progress:

Total on-site renewable energy installed, renewable energy credits (REC) purchased

Co-Benefits of Strategy:

Reduced Costs

Jobs / Economic Development

Improved Energy Resilience

Reduced GHG Emissions

	Actions	Implementation Phase
EB1-A-1	Conduct a detailed "Renewable Energy Master Plan" for all primary city facilities which have not yet already achieved renewable energy meeting 100% annual energy demand. Plan to incorporate strategies to address electricity storage, energy resilience, emergency operations, explore virtual net metering with Duke Energy, and provide an implementation plan to achieve on-site renewable energy goal and outline options to achieve 100% renewable energy for all city facilities (on-site and off site options).	1
EB1-A-2	Establish a policy which requires all new construction and significant renovation projects for City facilities to be constructed to meet "Solar Ready" requirements and to include a solar feasibility assessment and project option for inclusion of on-site solar, include "Return on Investment" assessment, and incorporate solar where return is favorable. See City's Solar Reay Guidelines: https://palebluedot.llc/bloomington-solar-ready-guide	1
EB1-A-3	Study City facilities and potential partner entities to identify low-carbon district heating and cooling systems and Solar+Storage microgrid project options and select, by 2024, a project to implement as a pilot project.	2

Strategy EB 1-B:

Support and accelerate installation of on-site solar PV to 250,000 MWH of total generation citywide annually by 2030.

As of 2019, over 538 solar PV's have been installed in Monroe County for a total of 6.04 megawatts (MW) in nameplate generating capacity, the majority of which are within the City of Bloomington. Based on Monroe County permit data 2020, Residential arrays are 44%, government facility arrays are 39%, commercial, non-profit, and industrial arrays total 11.6%, and utility solar installations are 5.4% of the total existing installed capacity. Fewer than 1.5% of households and 1.75% of commercial/industrial establishments have on-site solar installed indicating significant opportunity for increasing on-site solar installations citywide.

How We'll Measure Progress:

Total citywide on-site renewable energy installed

Co-Benefits of Strategy:

Reduced Costs

Jobs / Economic Development

Improved Energy Resilience

Reduced GHG Emissions

	Actions	Implementation Phase
EB1-B-1	Identify the "Solar Top 50" commercial/industrial properties within the city and produce detailed solar feasibility assessments for each site. Assessments to include potential solar generation and economic performance and return on investment estimates, information on financing and ownership models, and next step resources. Provide solar assessment reports to properties, free of charge, and conduct an informational workshop to assist building owners and businesses in understanding the assessments and next step potential. "Solar Top 50" assessment effort could be repeated annually, particularly through 2025.	1
EB1-B-2	Sponsor a community-wide "Solarize" program for commercial and Industrial group purchase of Solar PV. Include an invitation to participate to all building sites included in the "Solar Top 50" feasibility effort. Explore use of city staff, resources, or financing mechanisms to support the required reach of annual solarize programs to achieve long-range goals. (goal, installed capacity equal to 1.1% of commercial/industrial sector electrical consumption annually) https://www.nrel.gov/docs/fy12osti/54738.pdf	1
EB1-B-3	Continue to sponsor a community-wide "Solarize" program for residential group purchase of Solar PV. Explore use of city staff, resources, or financing mechanisms to support the required reach of annual solarize programs to achieve long-range goals. (goal, 200 homes installed annually with 20% of arrays serving households at or below 100% AMI) https://www.nrel.gov/docs/fy12osti/54738.pdf	1
EB1-B-4	Partner on a county-wide solar strategy to expand solar, especially to low and moderate income households with a goal of 60 low income homes installed annually. Explore the establishment of financing mechanisms such as revolving loans, grants, or use of LIHEAP funding to support affordability and equitable renewable energy adoption.	1
EB1-B-5	Determine the true value and potential of customer-owned photovoltaics to the infrastructure, economics and renewable goals of the City. Analysis should include time of generation, capacity credit, distribution circuit support, customer characteristics, technical and market potential, resilience, etc. (Value of Solar study). Study results can be shared with community businesses and Bloomington Economic Development Corporation for information to advance solar awareness.	2
EB1-B-6	Motivate and assist businesses throughout the community to install solar. Provide information on solar incentives, tools, and financing to businesses throughout the City.	2
EB1-B-7	Establish a Solar Ready Ordinance to require all new residential and commercial buildings to be solar ready. See City's Solar Reay Guidelines: https://palebluedot.llc/bloomington-solar-ready-guide	2
EB1-B-8	Promote, provide and distribute the City's Solar Ready Guide document to local home shows or remodeler showcase events, designers, homebuilder associations, and realtors (https://palebluedot.llc/bloomington-solar-ready-guide). Include the City's Solar Ready Guideline documents on the City's Design Guidelines webpage (https://bloomington.in.gov/utilities/review/design/manual)	2

Strategy EB 1-C:

Improve energy policy

According to the Department of Energy, complex or poorly-defined local government processes can add up to $2,500 to the cost of solar PV installations. Completing SolSmart designation can help municipalities simplify and making approval processes more efficient which, in turn, reduces costs for solar developers, installers, and City operations. In addition, policies which protect the ability of one property to continue to receive sunlight across property lines without obstruction from another's property are critical to ensure long-term viability of solar resources for property owners.

How We'll Measure Progress:

Total on-site renewable energy installed, renewable energy credits (REC) purchased

Co-Benefits of Strategy:

Reduced Costs

Reduced GHG Emissions

Improved Energy Resilience

Improved Community Equity

	Actions	Implementation Phase
EB1-C-1	Streamline and offer expedited permitting for renewable energy installations.	1
EB1-C-2	Complete the SolSmart process to streamline permitting for renewable energy installations and assist in reducing solar project "soft costs" related to City solar processes. Achieve a Sol smart Gold rating by 2025	2
EB1-C-3	Establish Solar Access Ordinance and policies which recognize changing conditions due to the proliferation of residential rooftop solar energy systems.	2

Goal EB 2 Increase energy efficiency citywide 16% for electricity and 12% for natural gas of 2018 values.

Strategy EB 2-A:

Increase total City owned building electrical energy efficiency 16% for electricity and 12% for natural gas of 2018 values.

The City of Bloomington is a leader in on-site solar installations in the region with solar installed on 32 of the City's facilities and sites. City solar arrays generated 3 GWH of electricity in 2019, or approximately 70% of City building electricity consumption in 2018 (excluding water and wastewater processing). Identifying additional solar installation potential, including ground mounted arrays, "carport" arrays, and remaining cost effective rooftop array locations can increase the City's renewable energy portfolio. An increase of 20% on-site solar generation would result in 80% carbon-free City facility electric consumption.

How We'll Measure Progress:

Annual City operated facility electricity and natural gas consumption reported

Co-Benefits of Strategy:

Reduced Costs

Jobs / Economic Development

Improved Building Quality and Comfort

Reduced GHG Emissions

	Actions	Implementation Phase
EB2-A-1	Update the City's Green Building Program policy to include clear energy reduction requirements to be measured annually during the building's operation (such as "achieving and maintaining a minimum ENERGY STAR rating of 75, and built to meet or exceed IGCC code"). Consider increasing the minimum LEED design standard to Gold. Invite County, School District, and other public agencies located within the City to participate in City's Green Building Program standards. Resource: City of Bloomington Green Building Ordinance (2009)	1

	Actions	Implementation Phase
EB2-A-2	Establish a policy to require all primary City facilities to benchmark and disclose annual energy consumption. Invite County, School District, and other public agencies located within the City to participate in City's facilities benchmarking and disclosure effort.	1
EB2-A-3	Conduct a Building Energy Audit on all primary City owned facilities without energy audits conducted within last 5 years. Fully implement recommendations of these and previous audits. Prioritization should be given to the City's largest energy consuming sites.	1
EB2-A-4	Establish a City policy requiring the review of all large capital expenditures against the GHG emission reduction and climate adaptation goals of the CAP. Capital projects to be reviewed against their projected contributions in reduced GHG emissions, energy use, and vehicle-miles-traveled as well as the project's projected social cost of carbon savings and climate resilience. Explore development of project calculator tools to evaluate capital project proposals against City's CAP Goals (see City of Eau Claire WI land use calculators).	1
EB2-A-5	Continue conversion of City streetlights and signals to LED. Complete 100% conversion by 2026.	2
EB2-A-6	Conduct an Occupancy and Plug Load Energy Efficiency Study of primary city owned facilities to identify plug load control strategies and establish a "Plug Load and Occupancy Energy Efficiency Guide" outlining operational practices to advance the City's energy efficiency goals for City facilities. Provide training to all existing city employees and provide on-going training to all new city hires. https://sftool.gov/learn/about/426/plug-loads	2

Strategy EB 2-B:

Support and accelerate energy efficiency citywide.

Compared to State of Indiana averages, electric consumption in Bloomington is 142% of the residential average (per household) and 87% of the commercial and industrial average (per job) while natural gas consumption is 76% of the residential average and 8% of the commercial and industrial average. According to the US Energy Information Administration, homes built after 2000 used 15% - 40% less energy than homes built before 1990. Nearly 60% of all homes in Bloomington were built prior to 1990. The deviation from State averages, combined with a large share of older homes in the community, indicate that significant energy savings are likely possible in all sectors, making energy efficiency an important strategy for reducing building and energy emissions.

How We'll Measure Progress:

Annual citywide electricity and natural gas consumption reported

Co-Benefits of Strategy:

Reduced Costs

Jobs / Economic Development

Improved Building Quality and Comfort

Reduced GHG Emissions

	Actions	Implementation Phase
EB2-B-1	Adopt, implement, and promote a Commercial Building Energy Benchmarking and Disclosure ordinance for all public buildings and all commercial buildings 30,000 square feet and larger. https://www.energystar.gov/buildings/program-administrators/state-and-local-governments/see-federal-state-and-local-benchmarking-policies	1
EB2-B-2	Work with utilities to incentivize and promote replacement of inefficient building heating and cooling equipment before end-of-life, and facilitate the bulk purchasing of efficient equipment. Goal: achieve 250 households replacing equipment annually.	1

	Actions	Implementation Phase
EB2-B-3	Establish an Energy Efficiency Upgrade cost sharing incentive program providing a 25% matching grant for qualified buildings and applicants. Coordinate grant with utility offered rebates. Goal: utilization by 60 businesses annually. Example program: http://www.minneapolismn.gov/environment/greencostshare http://www.minneapolismn.gov/www/groups/public/@health/documents/webcontent/wcmsp-221550.pdf	1
EB2-B-4	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. Goal: 60 businesses commissioned annually.	1
EB2-B-5	Collaborate with utilities, community partners, and rental property owners to promote and provide comprehensive audits followed by energy efficiency upgrades benefiting multifamily residents, with a particular focus on low-income communities. Goal: Achieve 220 audits and upgrades annually.	1
EB2-B-6	Develop a "Green Roof" pilot project to exhibit heat island mitigation strategies and measure potential for effectiveness. Identify city building with low solar PV prioritization/feasibility for inclusion as cool roof pilot location. Alternatively, pilot program could be advertised for submission by City of Bloomington residents, businesses and neighborhoods for potential sites to be considered for pilot project selection. Preference should be given to sites serving low income or at risk communities with high heat island impact potential. https://www.epa.gov/heatislands/using-green-roofs-reduce-heat-islands	2
EB2-B-7	Develop specific energy efficiency programs for hard-to-reach segments of multi-family and commercial properties (e.g., commercial rental, restaurants, large scale manufacturing, offices, affordable multifamily housing). Explore partnerships to include a job training component focused on providing training to low income community members in the program. Potential partners may include Monroe County and Bloomington Work One Center.	2
EB2-B-8	Enable institutions within each sector to learn about successful efficiency work through pilots, workshops, and case studies.	2
EB2-B-9	Improve training, certification, and education opportunities for energy auditors and professionals involved in the disposal and use of refrigerants.	2
EB2-B-10	With a focus on low income households and renters, engage residents on low cost ways to save energy and money, such as installing programmable thermostats. Pair educational content with access to incentives and resources.	2
EB2-B-11	Use a focused outreach program to contact local businesses to encourage participation in energy efficiency programs. Explore the development of an "Energy Reduction Top 50" energy efficiency assessment and recommendation program similar to the "Solar Top 50".	2
EB2-B-12	Develop a "Cool Roof" pilot project to exhibit heat island mitigation strategies and measure potential for effectiveness. Identify city building with low solar PV prioritization/feasibility for inclusion as cool roof pilot location. Alternatively, pilot program could be advertised for submission by City of Bloomington residents, businesses and neighborhoods for potential sites to be considered for pilot project selection. Preference should be given to sites serving low income or at risk communities with high heat island impact potential. https://www.energy.gov/energysaver/design/energy-efficient-home-design/cool-roofs	2

	Actions	Implementation Phase
EB2-B-13	Adopt, implement, and promote a Residential Energy Benchmarking and Disclosure or "Truth In Sale" ordinance for homes listed for sale. Examples include: http://www2.minneapolismn.gov/ccs/ccs_tish https://austinenergy.com/ae/energy-efficiency/ecad-ordinance/ecad-for-residential-customers	3
EB2-B-14	Host a “data jam” session in support of benchmarking ordinances where building managers can enter energy with technical assistance providers present.	3
EB2-B-15	Develop a "Cool Pavement" pilot project to exhibit heat island mitigation strategies and measure potential for effectiveness. Identify city road or parking pavement location with high micro heat island potential for pilot project location. Alternatively, pilot program could be advertised for submission by City of Bloomington residents, businesses and neighborhoods for potential sites to be considered for pilot project selection. Preference should be given to sites serving low income or at risk communities with high heat island impact potential.	3

Strategy EB 2-C:

Increase net zero energy residential building stock to 1% of homes Citywide by 2030.

Net zero buildings are buildings with high energy efficiency that produce as much on-site renewable energy as they consume in a year. Net zero buildings tend to be high performance buildings that provide a higher level of occupant comfort and building health. According to a 2019 study by the Rocky Mountain Institute, net zero homes in the Indiana region average a return on investment of 12 years or less - after which they deliver "free" energy to their owners. As a part of this Climate Action Plan, a Net Zero Energy Guide and Solar Ready guide have been developed to assist Bloomington homeowners and commercial building owners in exploring and achieving a Net Zero building. (https://palebluedot.llc/bloomington-net-zero-energy-guide) (http://palebluedot.llc/bloomington-solar-ready-guide)

How We'll Measure Progress:

Reported certified net zero homes

Co-Benefits of Strategy:

	Actions	Implementation Phase
EB2-C-1	Promote, provide and distribute the City's Net Zero Energy Building Guide document to local home shows or remodeler showcase events, designers, homebuilder associations, and realtors. (https://palebluedot.llc/bloomington-net-zero-energy-guide) Include the City's Net Zero Energy Building Guide and Solar Ready Guideline documents on the City's Design Guidelines webpage. (https://bloomington.in.gov/utilities/review/design/manual)	1
EB2-C-2	Provide training on solar ready and net-zero strategies as found in the City's Net Zero Energy Building Guide and Solar Ready Guidelines to area homeowners, multi-family building owners, local builders association, and real estate agents. Goal: 1% market coverage (300 households) attending training annually. (https://palebluedot.llc/bloomington-net-zero-energy-guide) (http://palebluedot.llc/bloomington-solar-ready-guide)	1
EB2-C-3	Utilize incentives, vacant City land, and current programs for pilots of net-zero buildings across different sectors. Explore option of issuing a competitive RFP for effective and innovative Net Zero pilot projects. Focus on "Net zero building in every neighborhood" to establish visibility of strategies within the community.	2

Goal EB 3 Support decarbonization of the local electricity grid.

Strategy EB 3-A:

Support Duke Energy's grid emissions goal of 50% below 2005 levels by 2030.

The electric utility serving Bloomington, Duke Energy, has established a goal of reducing the GHG emissions associated with their electricity 50% by 2030 and to achieve net zero by 2050. Implementation of this goal by Duke Energy is critical in achieving the overall GHG emission reduction goals represented in this Climate Action Plan - should Duke Energy not accomplish this grid emission goal it could mean additional GHG emissions of 520,000 metric tons or more annually. https://news.duke-energy.com/releases/duke-energy-aims-to-achieve-net-zero-carbon-emissions-by-2050.

How We'll Measure Progress:

Reported annual electric grid GHG Emissions Factors

Co-Benefits of Strategy:

Improved Air Quality

Reduced GHG Emissions

	Actions	Implementation Phase
EB3-A-1	Collaborate with Duke Energy for the development of a pilot/demonstration community solar program achieving a total of 7,000 MWH in subscribed annual community solar energy by 2030. Identify underutilized sites such as landfill, brownfield, superfund sites, or detention pond sites (for floating solar) and identify most advantageous site to develop and install pilot solar garden. Collaboratively develop and issue an RFP for community solar developers to advance community solar options and subscriptions within City. RFP shall focus on projects that benefit all residents, particularly communities of color and low-income populations. Include community solar option benefiting small businesses. (Goal: 500 households and 200 businesses subscribed to community solar by 2030) (example projects at superfund sites: https://www.epa.gov/superfund-redevelopment-initiative/alternative-energy-superfund-sites)	1
EB3-A-2	Collaborate with Duke Energy to develop a pilot / demonstration solar lease program for photovoltaic on buildings connected via net metering open to Duke and third party vendors.	2

Energy and Built Environment

Strategy EB 3-B:

Advocate for stronger State policy.

Surrounding states have shown that policies such as the allowance of Property Assisted Clean Energy (PACE) programs, and improved solar policies such as allowance of Power Purchase Agreements, Solar Lease agreements, virtual net metering, aggregated net metering, and community solar laws can help "level the playing field" for improved energy efficiency and renewable energy. Collaborations with other communities and non-profit groups to help educate and guide State leaders towards making improved policy decisions can play a critical role in meeting Bloomington's goals.

How We'll Measure Progress:

Status of State energy efficiency and renewable energy policies

Co-Benefits of Strategy:

Reduced GHG Emissions

Jobs / Economic Development

Improved Community Equity

Improved Quality of Life

	Actions	Implementation Phase
EB3-B-1	Collaborate with other communities, industry, and state agencies to support the State establishing the enabling legislation for Commercial Property Assessed Clean Energy (C-PACE) and Residential Property Assisted Clean Energy (R-PACE) financing.	1
EB3-B-2	Collaborate with other communities, industry, and state agencies to support the State in establishing policies and laws to expand the market for renewable energy, make it easier for large multi-family, commercial, and industrial customers to benefit from renewable energy (e.g. feed-in tariff, Power Purchase Agreements, Solar Lease agreements, roof space rental, community solar, virtual net metering, aggregated net metering, etc.) Include information on current State of Indiana related regulations and cost and payback information.	1
EB3-B-3	Collaborate with other communities, industry, and state agencies to support the State advancing increased energy efficiency building code requirements, establishing minimum energy performance requirements, net zero considerations and/or the establishment legislation enabling cities to establish "stretch codes" within their jurisdiction.	3

Goal EB 4 Promote "fuel switching" to reduce on-site fossil fuel use in the building sector by 3% of 2018 values.

Strategy EB 4-A:

Support and accelerate electrification of on-site fossil fuel combustion systems citywide by 2% of 2018 consumption levels (natural gas, propane, fuel oil, etc).

The reduction and elimination of on-site fossil fuel combustion community-wide is a critical long-term pathway towards GHG emission reductions. As the Bloomington area electric grid becomes cleaner (see goal EB3), the benefits of electrification will become more and more meaningful. According to US Census data, over 50% of Bloomington homes use electric heat, while technologies like conduction cook tops illustrate the effectiveness and improved safety of electricity in lieu of natural gas.

How We'll Measure Progress:

Reported Natural Gas consumption citywide, US Census data on homes using electric fuel for heating.

Co-Benefits of Strategy:

Improved Air Quality

Reduced GHG Emissions

	Actions	Implementation Phase
EB4-A-1	Conduct an "Electrification Assessment and Action Plan" to outline actions and priorities for electrification of all City facilities to move towards zero on-site fossil fuel combustion. Work with regional energy partnerships to implement Plan for all City facilities. Include new and existing buildings, explore strategies to address electricity storage, and create a case study to highlight and share challenges, solutions, and lessons learned to share with the broader community.	1
EB4-A-2	Explore the establishment of polices or ordinances supporting all electric buildings, such as an all electric requirement for buildings receiving PUD or Conditional Use Permit approvals, an all electric reach code such as Menlo Park, or a natural gas ban such as Berkeley.	3
EB4-A-3	Deploy an incentive program for electrification. Work with Duke Energy or other regional partnerships to create financial incentives to electrify new and existing buildings. For example, rebates for panel upgrades, electric appliances, electric water heaters, Air Source Heat Pumps, and Ground Source Heat Pumps can encourage the transition to electric energy use in homes and businesses. Goal: Goal 3% residential market conversion (90 households annually) and 3% commercial/industrial market conversion (an estimated 15 commercial businesses, 3 industrial businesses annually) by 2030. Collaborate with program partners to quantify potential cost savings of electrification and provide ROI information to potential program participants.	3

Strategy EB 4-B:

Support and accelerate low/no carbon alternatives to on-site fossil fuel combustion by 1% of 2018 consumption levels (natural gas, propane, fuel oil, etc).

Renewable Natural Gas, RNG, is natural gas derived from organic waste material found in daily life such as food waste, garden and lawn clippings, and animal and plant-based material. RNG is considered a carbon-neutral fuel because it comes from organic sources that once absorbed carbon dioxide from the atmosphere during photosynthesis. RNG has even greater benefits when it's produced from organic waste that would otherwise decay and create methane emissions. In addition, RNG utilization provides a beneficial pathway for waste streams. Although combustion of biofuels and RNG does emit CO2 they are considered low or no-carbon fuels. Burning fossil fuels releases carbon that has been locked up in the ground for millions of years, while burning biomass emits carbon that is part of the biogenic carbon cycle. In other words, fossil fuel use increases the total amount of carbon in the biosphere-atmosphere system while bioenergy systems operates within this system; biomass combustion simply returns to the atmosphere the carbon that was absorbed as the plants grew.

How We'll Measure Progress:

Status of State energy efficiency and renewable energy policies

Co-Benefits of Strategy:

Reduced GHG Emissions

Jobs / Economic Development

Improved Energy Resilience

	Actions	Implementation Phase
EB4-B-1	Work with Vectren to establish an option for Renewable Natural Gas sourced from regional sources for residential and commercial customers. Program to include tracking for citywide natural gas reporting for GHG inventories. Achieve 5% use by 2030 (150 households and 30 businesses per year).	1
EB4-B-2	As recommended by the City of Bloomington Waste To Energy Taskforce, the City should further investigate the potential of an aerobic digester wastewater-to-energy installation at the Dillman Road Wastewater Treatment Plant. Utilization of biogas as renewable natural gas source for city facilities, large corporate offtaker, or community residents should be included in study. (https://bloomington.in.gov/departments/office-of-the-mayor/projects/waste-energy-task-force).	1
EB4-B-3	Study the potential of capturing beneficial use of landfilled solid waste stream through waste-to-energy strategies including zero emission plasma gasification, methane capture, and anaerobic digestion.	1

Goal EB 5 Increase financing options for Energy Efficiency and Renewable Energy projects citywide.

Strategy EB 5-A:

Promote Equity in Energy and Resource Costs and Ownership.

How We'll Measure Progress:

Reported Natural Gas consumption citywide, US Census data on homes using electric fuel for heating

Co-Benefits of Strategy:

Jobs / Economic Development

Reduced GHG Emissions

Improved Community Resilience

Improved Community Equity

Low income communities are among the most vulnerable to the impacts of climate change, the most likely to struggle with housing cost burdens, and the most likely to struggle with energy insecurity - low-income families are adversely impacted by rising utility costs with the poorest families spending between 7.2% and 10% of their incomes on electricity, while the average household pays less than half of that amount, or only 3.5% of their income on electricity. Low income households are also nearly 3 times more likely to rent rather than own their home (https://www.zillow.com/research/homeownership-by-income-9419/), meaning they have much less control over the energy efficiency of their home.

In recent studies, American Council for an Energy-Efficient Economy (ACEEE) found that 97 percent of the excess energy burdens within renter households could be eliminated by bringing their homes up to median efficiency standards while a 2015 study by the U.S. Department of Energy found that the value of energy upgrades is 2.2 times their cost. The less energy efficient a building is, the higher that value to cost ratio becomes. Supporting pathways to create equity in energy alleviates energy burdens for those that need relief the most as well as expands the market for energy efficiency and renewable energy investments.

	Actions	Implementation Phase
EB5-A-1	Develop partnerships with low-income and supportive housing serving organizations, the County, and the Bloomington Housing Authority to ensure that efficiency and renewable programs, incentives, and practices, meet the specific needs of these populations.	1
EB5-A-2	Collaborate with Duke Energy and Vectren to increase energy efficiency funding options for families including low-interest financing, on-bill financing, Pay As You Save, and other programs as determined to be most effective.	1
EB5-A-3	Establish a Recover Forward energy fund to invest in energy efficiency and renewable energy projects with a focus on supporting improved equity in Renewable Energy and Energy Efficiency in the community.	1
EB5-A-4	Collaborate with partners such as Citizens Action Coalition to establish and regularly host utility bill clinics similar to those offered by Minnesota Citizens Utility Board (http://cubminnesota.org/) to help residents understand their bills, discuss energy savings options, and hear about rebate/incentive availability and clean energy options.	1
EB5-A-5	Create a coordinated "one-stop" program approach to expand low-income housing programs by layering healthy homes, lead abatement, bill clinic, weatherization, and renewable energy programs.	2
EB5-A-6	Establish a Community Cost Share Fund for tax advantaged donations applied towards energy efficiency improvements and renewable energy projects for renters. Example program: https://www.como.gov/trust/share-the-light/	2

	Actions	Implementation Phase
EB5-A-7	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 and that are broadly accessible to households and building owners, including rental properties, throughout the community. Potential tools may include Guaranteed Energy Savings program, Carbon Market funding, Mortgage-Backed Energy Efficiency and Renewable Energy Financing, and Municipal Energy Efficiency and Renewable Energy Revolving Loan, and Municipal rebates. Combine offerings with Duke Energy and Vectren incentive programs. Explore establishing a tiered incentive program with increasing incentivization for projects achieving 5%, 10%, 15%, and higher improved, measured energy efficiency over code requirements as well as an incentive add for low income beneficiaries. http://newbuildings.org/sites/default/files/EnergyEfficiencyFinancing_ModelsStrategies201110.pdf	2
EB5-A-8	Explore partnering City's investment and financing concepts with Indiana University to establish collaborative financing mechanisms, program, or implementation strategy to advance equitable energy efficiency and renewable energy in the community.	2
EB5-A-9	Evaluate the potential for a municipal or regional carbon tax or fee with dividends provided to lower income individuals. Funds to be used to support and promote energy efficiency and no/low carbon energy transitions for low income and vulnerable individuals.	3
EB5-A-10	Establish a Renewable Energy TIFF Policy, requiring on-site renewable energy for all projects receiving TIF financing. Policy could also include the establishment of a Renewable Energy TIF District specifically identifying TIF financing potential for properties receiving redevelopment which include on-site renewable energy.	3

Energy and Built Environment

Planned Energy and Built Environment GHG Emission Reductions

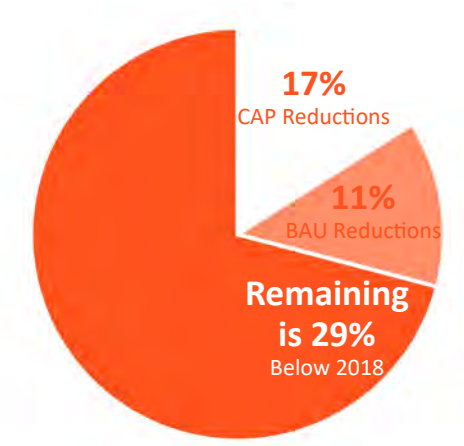
Planned Sector Emission Reductions Through 2030

The strategies and actions included in this section of the Climate Action Plan are projected to reduce the city's annual GHG emissions by 171,373 metric tons (MT) by 2030 - a 17% reduction over 2018 levels. Changes in business-as-usual impacts are anticipated to reduce an additional 131,458 metric tons for a total community wide building and energy sector reduction of 29% over 2018 levels.

This is equivalent to eliminating **5.87 billion** cubic feet of man-made greenhouse gas atmosphere annually by 2030.

Sector Emissions Reduction below 2018 Achieved by 2030

The total change to sector emissions include CAP Plan reductions as well as BAU emission changes as follows:



Individual Strategy Annual Emission Reductions by 2030

Below are the CAP Plan reductions by strategy for this sector:

Strategy	Annual GHG Reductions by 2030
Strategy EB 1-A: Increase solar on City facilities 20% by 2030.	**319 MT**
Strategy EB 1-B: Support and accelerate installation of on-site solar PV citywide.	**70,240 MT**
Strategy EB 1-C: Improve energy policy.	N/A
Strategy EB 2-A: Increase total City owned building electrical energy efficiency 16% for electricity and 12% for natural gas of 2018 values.	**322 MT**
Strategy EB 2-B: Support and accelerate energy efficiency citywide.	**90,082 MT**
Strategy EB 2-C: Increase net zero energy residential building stock to 1% of homes citywide by 2030.	**3,711 MT**
Strategy EB 3-A: Support Duke Energy's grid emissions goal of 50% below 2005 levels by 2030.	(included)
Strategy EB 3-B: Advocate for stronger state policy.	N/A
Strategy EB 4-A: Support and accelerate electrification of on-site fossil fuel combustion systems citywide.	**(594) MT***
Strategy EB 4-B: Support and accelerate low/no carbon alternatives to on-site fossil fuel combustion.	**1,001 MT**
Goal EB 5 Increase financing options for Energy Efficiency and Renewable Energy projects citywide.	N/A
Strategy EB 5-A: Promote Equity in Energy and Resource Costs and Ownership.	N/A

* Due to current high emission factors for grid provided electricity, early stage electrification efforts may increase total emissions slightly, however, as emission factors associated with grid electricity decrease electrification will result in net emissions decreases.

Energy and Built Environment

Estimated Cumulative Economic Savings

Implementing many of the measures in this plan, such as increased energy efficiency and renewable energy, can save money for the community. The estimated community savings of the goals for this section include:

Residential Energy Efficiency and Renewable Energy Savings:		Commercial/Industrial Energy Efficiency and Renewable Energy Savings:		Estimated Cumulative Savings Potential*
$74,954,273	+	$73,070,358	=	$148,024,631
$2,447 per household		$1,441 per job		$1,740 per capita

* Savings for residential and commercial/industrial energy efficiency are based on current average energy rates applied to projected energy reductions. Savings for residential and commercial/industrial renewable energy are based on an estimated 15 year ROI on solar installations with an average solar array design life of 30 years. See Appendix for Cumulative Potential Cost Savings Assumptions and data sources.

What You Can Do

- Unplug 2 or more electricity "vampires" in your home or apartment. https://www.duke-energy.com/Energy-Education/Energy-Savings-And-Efficiency/Energy-Vampires
- Convert 3 or more lights or lamps to LED bulbs.
- Set your thermostat 2 or more degrees higher during cooling season, lower during heating season.
- Turn down your water heater to 120°.
- Replace an older home thermostat with a “smart,” programmable model.
- Replace a major appliance (e.g., refrigerator, air conditioner, furnace) with a newer, energy-efficient model.
- Replace a gas range or clothes dryer with an electric model.
- Schedule a home energy audit with a licensed contractor or Duke Energy. https://www.duke-energy.com/home/products/home-energy-house-call
- Learn about adding solar panels to your home. Attend a free Solar Indiana Renewable Energy Network information session, or schedule a solar suitability assessment of your home by a licensed contractor. https://bloomington.in.gov/sustainability/solarize
- If you don’t own your home but support clean, renewable energy, sign up for Duke Energy’s GoGreen Energy Program. https://www.duke-energy.com/home/products/renewable-energy/gogreen-energy
- Install — or have a licensed contractor install — more insulation in your home.
- Install energy-efficient windows and doors, working with a licensed contractor.
- Install solar panels at your home, working with a licensed contractor. If possible, participate in Bloomington's residential solar group purchasing program.

Photo: Andrew Williams, Indiana Daily Student

Section 04
Waste Management

Click here to return to TOC

Waste Management

Why Waste Management Is Important

In Bloomington, solid waste contributed 6.3% of citywide greenhouse gas emissions in 2018. Municipal solid waste sector has great potential to avoid emissions thanks to waste reduction and waste recovery. Landfills are the third largest anthropogenic (man-made) source of methane, accounting for approximately 11% of the estimated total global methane emissions.

Habitat destruction, global warming, and resource depletion are some of the effects of our materials consumption. Recycling - converting discarded materials into new materials or putting them to beneficial use - is an important approach in mitigating these impacts and reducing the pollution caused by wasting. Recycling reduces the need for raw materials so that natural resources, and the environments in which they exist, can be preserved. Recycling creates manufacturing jobs, extends the value of materials, and conserves natural resources while reducing the need for landfill space.

Food discards and residuals that decompose in landfills release methane, a greenhouse gas that is at least 28 times more potent than carbon dioxide. This makes food waste a significant contributor to solid waste greenhouse gas emissions. On the other end of the food supply chain, food production accounts for 26% of global emissions. In the United States, approximately 30% of the food produced is wasted - meaning nearly 8% of US emissions come from the production and distribution of discarded food.

There are four distinct collectors of mixed waste in Bloomington and Monroe County: Monroe County Solid Waste Management District (MCSWMD) drop-off centers, City residential collection, haulers contracted by Indiana University (IU), and other private collection. These waste management providers manage the waste system by collecting waste generated by businesses, industry, multi-family residences, and households. City of Bloomington Sanitation Department collects waste and recycling from single family homes, all other customers must drop off at the District or contract with a private hauler.

According to the MCSWMD 2018 Mixed Waste Processing Feasibility Study, waste collection by hauler breaks down as 4% collected by the City, 6% associated with IU, 2% by the District, and 88% by private haulers. The report indicates that total county-wide mixed waste is over 118,000 tons and the City's 2018 GHG inventory reports the Bloomington city-wide mixed waste total as 88,196 tons.

Climate Change Considerations

Climate Impacts

This sector impacts climate change through combustion of fossil fuels in the collection and processing of materials, as well as the generation of methane from anaerobic decomposition of organic materials in landfills.

Climate

Hazards to the waste management system include damage to infrastructure from extreme weather and flooding.

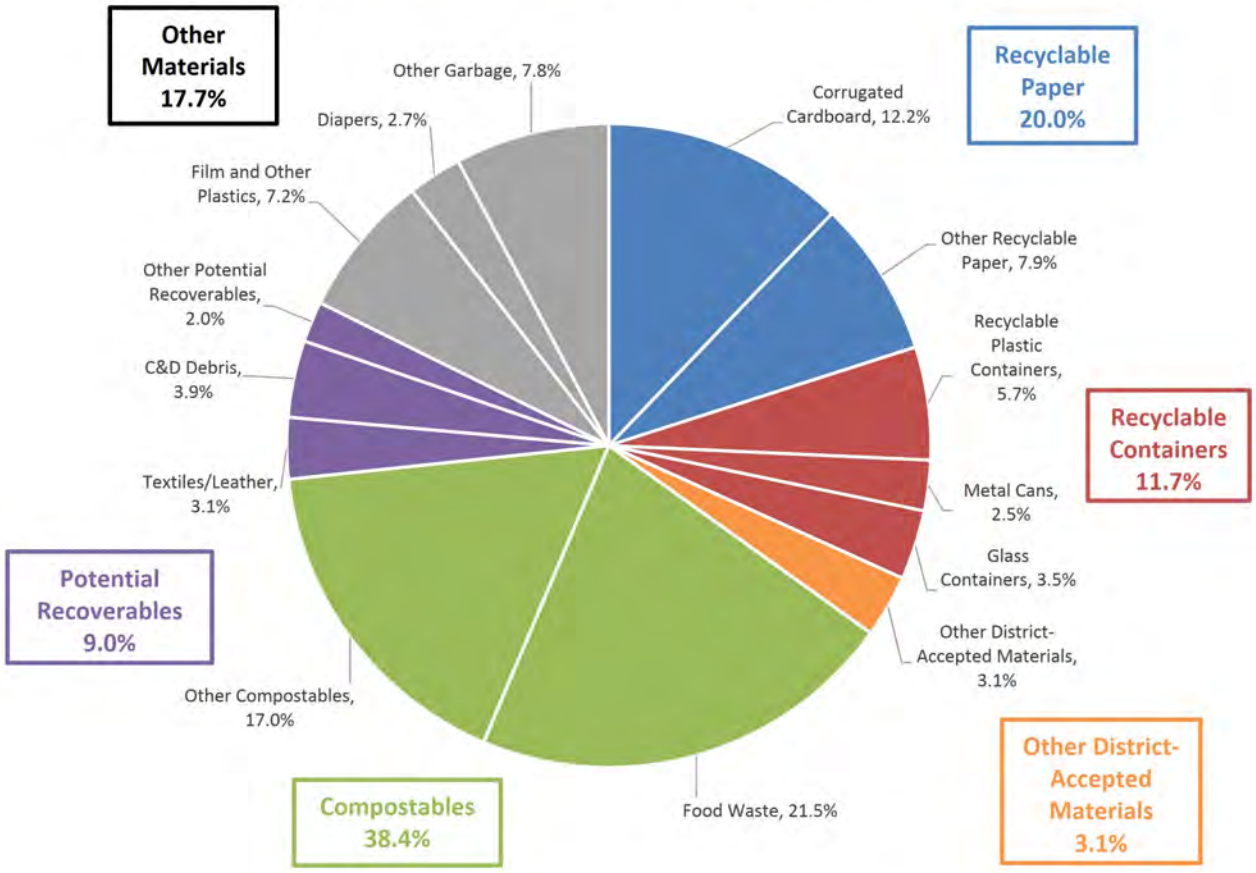
Opportunities

As indicated in the Waste Diversion Potential diagram above, a significant portion of Bloomington's waste stream has the potential for being put to beneficial use while avoiding GHG emissions.

Bloomington 2018 Solid Waste Characteristics

The 2018 MCSWMD study included mixed waste characteristics studies by hauler type. For purposes of projecting the uncaptured potential within the Bloomington waste stream, we have chosen to use the waste characteristics for private haulers from that report as they comprise 88% of the waste stream and consequently the majority of the potential. Based on that data, shown on the chart below, 38.4% of Bloomington waste (city-wide private haulers) is compostable organics, 31.7% are recyclable materials, and 9% are potentially recoverable/reusable. Taken together, this indicates the waste stream has up to 79.1% which can be diverted to beneficial use. As stated in the study "Private haulers are by far the largest untapped source of recyclable materials in the County."

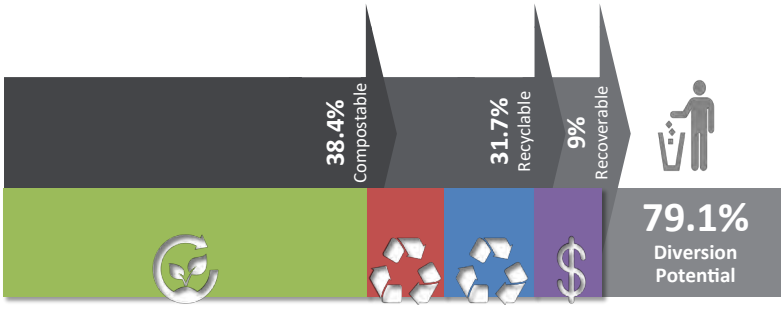
Mixed Solid Waste Composition Profile (Monroe County Private Hauler)



Source: MCSWMD 2018 Mixed Waste Processing Feasibility Study

Waste Diversion Potential

The waste diversion potential indicated in the 2018 MCSWMD study is illustrated to the right. Of the total mixed solid waste being landfilled today, there is a potential of up to 38.4% organics which could be diverted or beneficially used, 31.7% potentially recyclable material, and 9% potentially recoverable material. Successfully diverting these resources would reduce solid waste being landfilled by up to 79.1%.



Waste Management

Equity Considerations

- Accessibility to recycling and composting programs may not be equally and readily available to all community residents and may also be impacted by other participation-related barriers, including awareness of programs, user fees, accessibility based on housing type, and language barriers.
- Populations that are situated very close to the landfill or composting facility may experience nuisance issues like bad odors and potential health issues unless mitigation actions are implemented.

Sector Goals

Sector goals are established to both support the City's Climate Action Plan in creating a climate resilient community and to reduce city-wide GHG emissions 25% below 2018 levels by 2030.

Sector goals related to GHG emissions reductions are designed to balance reduction across all sectors and achieve the overall emissions goals set forth for the community. The goals seek to strike a balance between achievability while also reaching -for improvement beyond business-as-usual.

As indicated in the introduction, the Climate Action Plan is intended to be a 10 year plan to be updated at the completion of that time. Consequently, the goals and strategies outlined in this section are intended to be achieved by 2030 unless otherwise noted.

Implementation of actions are anticipated to be initiated over 3 phases: phase 1 within 1-3 years, phase 2 within 2-5 years, and phase 3 within 4-8 years of CAP approval.

Goal WM 1

Increase landfill solid waste diversion by 30% of 2018 values (26,500 tons of waste reduction).

Goal WM 2

Educate, motivate, and empower the public to achieve waste reduction and diversion.

City-Wide Solid Waste Targets Supporting Sector Goals

	Organics Diversion	Recyclables Diversion	Recoverable Material Diversion
Today (% of total waste)	38.4%	31.7%	9%
2030 Targets (% of total waste)	23%	21%	6%

Goal WM 1 Increase landfill solid waste diversion by 30% of 2018 values (26,500 tons of waste reduction).

Strategy WM 1-A:

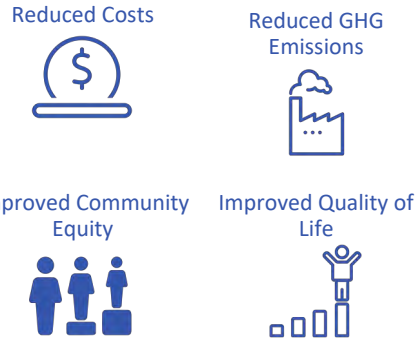
Increase organics diversion by 40% of 2018 values (from 33,900 tons - 38.4% of community mixed waste based on private hauler data - to 20,300).

All landscape organics collected at IU are composted at the IU nursery while food organics collected at IU and City of Bloomington Parks and Recreation are hauled to Green Earth by JB Disposal Services. Yard waste generated by City Parks and Recreation, as well as organics collected from private residences and commercial customers is hauled by the private composting company, Earthkeepers, to Fable Farms. Compost drop off services are offered District owned facilities for those with an Earthkeepers subscription. According to the 2018 Mixed Waste Processing Feasibility Study, most compostable waste is not being diverted from the landfill with the current system. Significant generators of food waste from non-residential sources in Bloomington include restaurants, grocery stores, food manufacturers, nursing homes, schools, and hospitals. Restaurants and grocery stores alone account for 93 percent of food waste from non-residential sources and represents a significant opportunity for improvement.

How We'll Measure Progress:

Reported organics processed at landfill, Waste mix reported by characteristics study

Co-Benefits of Strategy:



	Actions	Implementation Phase
WM1-A-1	Create a pilot "Food Scraps Bag" pilot program to test food scraps composting collection across restaurant, commercial and residential customer base where food scrap bags are separated at landfill without separate compost bins and collection vehicles. https://cutt.ly/tfBf5Dj	1
WM1-A-2	Establish a “Towards Zero Waste Certification” program to provide education to food retailers and restaurants on strategies to reduce waste and to promote businesses successfully achieving certification levels. Goal: 20 additional businesses enrolled annually. Resources or models for establishing a program include: https://carbonfreedining.org/ https://true.gbci.org/ https://www.crra.com/certification	1
WM1-A-3	Coordinate with local food banks to support edible food donation through coordination with the food bank and donations from City and community partner events. Explore expansion of effort by identifying food retailer and restaurant partners for increased participation and support.	1
WM1-A-4	Partner with Monroe County Waste District to promote drop-off of compostable material.	2
WM1-A-5	Increase voluntary participation in commercial food scrap collection by identifying businesses that face barriers to participation and providing direct outreach and assistance.	2
WM1-A-6	Establish an At-Home and Community Garden Composting program supporting the expansion of food waste diversion through at-home composting. Provide backyard composting workshops, tips, and resources. (https://www.bouldercounty.org/environment/composting/)	2
WM1-A-7	Based on results of the Food Scraps Bag pilot project, establish a policy or ordinance expanding or requiring in-trash food scrap composting based on results of pilot project. https://cutt.ly/tfBf5Dj	2

	Actions	Implementation Phase
WM1-A-8	Close the loop on organics recycling; initiate a Compost Soil Amendment pilot project for use of compost as a soil amendment for public and private construction projects.	2
WM1-A-9	Based on Compost Soil Amendment pilot project results create a policy encouraging or an ordinance requiring use of compost soil amendments for all projects meeting appropriate threshold as supported by the pilot project.	3

Strategy WM 1-B:

Increase recyclables diversion by 35% of 2018 values (from 28,000 tons - 31.7% of community mixed waste based on private hauler data - to 18,200).

The District manages five drop-off recycling centers throughout the County for use by its residents, as well as a pay as you throw and hazardous waste recycling program. Private haulers, such as Republic, also provide recycling services and collect comingled recyclables from for delivery to a material recovery facility in Indianapolis to be sorted, baled, shredded or granulated for purchase from brokers or end-user purchasers. If materials are not loose, clean, dry, or appropriately sorted, that decreases the feasibility of the items being recycled. Recyclable containers (plastic, metal, and glass) and recyclable paper items make up 31.7% of communitywide waste stream indicating a significant opportunity for increased diversion of materials being landfilled and an opportunity for increased beneficial use.

How We'll Measure Progress:

Reported recyclable material processed at landfill, waste mix reported by characteristics study

Co-Benefits of Strategy:

Jobs / Economic Development

Reduced GHG Emissions

	Actions	Implementation Phase
WM1-B-1	Ensure that recycling in schools, City buildings, public housing, and public spaces is fully implemented. Conduct a study to determine which facilities do not currently have recycling or could have recycling diversion significantly improved. Coordinate with those facilities to improve recycling participation.	1
WM1-B-2	Conduct outreach to determine what assistance may be needed to increase recycling, organics collection, and composting.	1
WM1-B-3	Incorporate criteria regarding recycled content and extended producer responsibility into procurement guidelines for City purchasing.	3

Strategy WM 1-C:

Increase diversion of potential recoverables by 33% of 2018 values (from 8,000 tons - 9% of community mixed waste based on private hauler data - to 5,280).

Potentially recoverable materials are materials that have the potential to be recovered or recycled, but are not currently collected for recycling at the District's collection centers or in the City's single stream recycling program. Some of these materials, such as textiles/leather and construction and demolition debris, would require source separation and/or additional processing to recover, rather than recovery through mixed waste processing. Outreach and partnering with waste sources (businesses, households, etc.) to support the identification of recoverable materials and explore re-use and recycling pathways represent an opportunity to increase diversion of these materials.

How We'll Measure Progress:

Reported potential recoverable material processed at landfill, Waste mix reported by characteristics study

Co-Benefits of Strategy:

Reduced Costs

Reduced GHG Emissions

Jobs / Economic Development

Reduced Pollution

	Actions	Implementation Phase
WM1-C-1	Develop and fund a waste audit and diversion assistance program for businesses. Program to support businesses in establishing tracking and reporting waste streams, identify reduction, diversion, beneficial use opportunities, identification of potential financing sources, and connect businesses with energy audit and other resources in support of full CAP goals. Goal: 60 business waste audits completed annually with businesses engaged in measuring and diverting waste. Example programs: https://www.mnchamber.com/your-opportunity/waste-wise https://www.portland.gov/sustainabilityatwork	1
WM1-C-2	Conduct a Beneficial Use Study to identify greatest beneficial use opportunities present in current City solid waste streams. Study to estimate potential return on investment and identify job and economic development potential associated with opportunities. Research/identify pilot project opportunities to explore capture of benefit.	1
WM1-C-3	Conduct a Phase 2 Waste-to-Energy Analysis to build on and proceed with further analysis of the waste-to-energy potential at wastewater treatment facilities as outlined in the recommendations of the 2020 Phase 1 Waste-to-Energy Analysis. Phase 2 analysis should identify pilot project(s) and an implementation schedule.	2
WM1-C-4	Establish a policy requiring the use of recycled asphalt, used roofing shingles, or other materials, particularly construction and demolition debris, in new streets.	2
WM1-C-5	Explore partnership with clothing reuse non-profits and businesses and a textile specialized recycling company to create a Clothing Reuse and Recycling pilot project to explore the potential of zero waste textiles within the City. Example clothing reuse entities: https://www.goodwillindy.org/ https://sisterscloset.org/ Example recycling partners: http://atrscorp.com/ https://www.terracycle.com	2
WM1-C-6	Establish a policy or ordinance expanding or requiring textile reuse and recycling based on outcomes of the Clothing Reuse and Recycling pilot project. Example clothing reuse entities: https://www.goodwillindy.org/ https://sisterscloset.org/ Example recycling partners: http://atrscorp.com/ https://www.terracycle.com	3
WM1-C-7	Explore options to support, influence and increase the preservation, reuse, repurposing and retrofit of existing structures to reduce demolition waste, preserve the embodied energy and materials, while avoiding the energy usage related to demolition.	3

	Actions	Implementation Phase
WM1-C-8	Continue to support collaborative consumption community projects, such as neighborhood compost projects, tool libraries, and repair cafes through mini-grant programs.	3
WM1-C-9	Provide event support for Fix It Fair at the Library and create a resource list for reuse.	3
WM1-C-10	Research best practices for recycling hydrofluorocarbons (potent GHG used in refrigeration and air conditioning) and identify Hydrofluorocarbon Pilot Project to implement.	3
WM1-C-11	Based on best practice research and the Hydrofluorocarbon Pilot Project, recommend city policy or ordinance modifications.	3

Strategy WM 1-D:

Support waste reduction through policy and operational refinements.

According to a 2011 study ("Policy versus Practice in Municipal Solid Waste Diversion" Canadian Journal of Urban Research), municipalities typically do not pursue policies supporting aggressive landfill diversion and increased beneficial use of waste streams until their landfill capacities reach crisis levels. Establishing visionary policies and operational refinements to advance meaningful landfill diversion and beneficial use of waste streams, therefore, represents a significant environmental opportunity for Bloomington, as well as an opportunity to avoid long-term landfill capacity crisis and to model for other communities the benefit of visionary policy establishment in lieu of waste management by crisis management more frequently experienced by other communities.

How We'll Measure Progress:

Status of Zero Waste policy, PAYT trash rate establishment, Universal Waste Ordinance, and other policies supporting significant waste diversion

Co-Benefits of Strategy:

Improved Community Equity

Improved Quality of Life

	Actions	Implementation Phase
WM1-D-1	Establish a Zero Waste policy for City operations that outlines increasing incremental annual waste reduction goals charting a path to Zero Waste. Policy to require that outside users of City facilities also follow Zero Waste policy and will modify the event permit application to require the inclusion of recycling and composting at events.	1
WM1-D-2	Study current best practices and most effective progressive Pay-As-You-Throw (PAYT) residential trash rates and implement a restructuring of City solid waste solid waste collection rates to promote solid waste diversion.	2
WM1-D-3	Explore the creation of a Universal Zero Waste Ordinance, requiring all property owners to provide recycling and compost collection services and requiring businesses to use these services. Example policy: https://bouldercolorado.gov/zero-waste/universal-zero-waste-ordinance	2
WM1-D-4	Increase recycling surcharge on landfill fees to develop more recycling programs.	2
WM1-D-5	Conduct an optimization study to increase the efficiency of City solid waste collections and transfer routes and implement findings.	3

Strategy WM 1-E:

Expanded recycling and organics options for multi-family residents.

According to the US Census, 49% of Bloomington's residents live in multi-family buildings with 3 or more units. This very significant portion of the city's population represents an under-tapped waste diversion resource. If all multi-family households were able to participate in a recycling program, it would significantly reduce the city's waste stream. Apartment recycling can also have real, tangible benefits for landlords, property managers and the tenant community including: reduced costs for trash pick-up, potential for additional revenue through sale of recoverable material, provide an amenity for residents and help landlords attract tenants.

How We'll Measure Progress:

Reported potential recoverable material processed at landfill, Waste mix reported by characteristics study

Co-Benefits of Strategy:

Improved Community Equity

Improved Quality of Life

Jobs / Economic Development

	Actions	Implementation Phase
WM1-E-1	Based on results of outreach action WM1-B-2, identify financial and other barriers to recycling and composting in multi-family buildings (e.g., different priorities between property management company and tenants, lack of knowledge of costs).	1
WM1-E-2	Based on results of outreach action WM1-B-2, and action WM1-E-1, explore creation of additional collection drop off sites.	1
WM1-E-3	Make a brochure that can be used by landlords to give info to their residents to assure developers and apartment owners help residents know about park locations, bike/walk/transit info, sustainability goals and resources, trash and recycling opportunities, renewable energy options, incentives, etc. Brochure can be distributed as a part of the Rental Licensing program in addition to other avenues. Brochure should link to the most up-to-date information maintained on the https://bloomington.in.gov/ website	1
WM1-E-4	Developing a fiscal impact statement of expanding the organics and recycling program ordinance. Impact statement should compare implementation options such as offering multi-family residents opt-in pick up services, or an incremental implementation starting with smaller apartment complexes and gradually expanding to larger complexes.	2

Goal WM 2 Educate, motivate, and empower the public to achieve waste reduction and diversion.

Strategy WM 2-A:

Create, implement, and promote public awareness and education campaigns.

How We'll Measure Progress:
Status of communication, marketing, and education campaigns

Landfill alternatives have many benefits including GHG emissions reductions, utilization of beneficial materials, and potential for economic development. If community residents and businesses do not properly utilize these diversion programs or limit their consumption of disposable goods, the programs developed will make far less of an impact than they are capable of. A focus on a robust, clear, and consistent message to support education, awareness, and utilization of resources available can support achieving better success.

Co-Benefits of Strategy:

Reduced Costs

Improved Quality of Life

	Actions	Implementation Phase
WM2-A-1	Create a comprehensive communication campaign to provide standardized information and communications on waste reduction, recycling, and organics collection options to reach the residential sector. Example campaigns: City of Portland Be Cart Smart, City of Fayetteville Solid Waste Diversion and Recycling Education Plan: https://palebluedot.llc/bloomington-cap-policies	1
WM2-A-2	Collaborate with partners such as Bloomington Chamber of Commerce, Downtown Bloomington, community businesses, and Indiana University to create a recycling marketing campaign and branding and provide reduce/recycle marketing and signage at storefronts, in parking lots, at point-of-sale, on websites, in local papers, on TV, etc. Campaign to standardize information and communication on solid waste, recycling, and organics options.	2
WM2-A-3	Coordinate with the Monroe County Community Schools to establish paths towards Zero Waste program. Program to include zero waste curricula and family content as well as zero waste strategies for school facilities. (https://www.ecocycle.org/files/Zero%20Waste%20A%20Realistic%20Approach%20Sustainability%20Program%20for%20Schools.pdf) (http://www.zerowastechallenge.org/curriculum.html)	3

Planned Waste Management GHG Emission Reductions

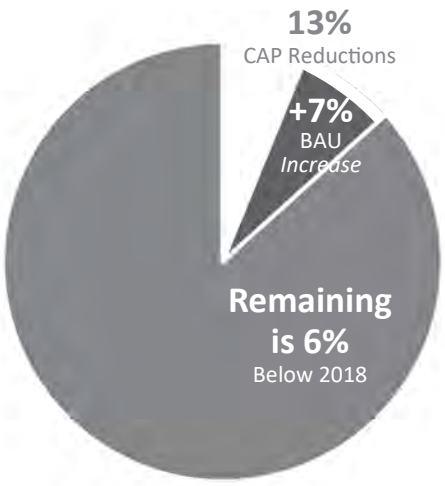
Planned Sector Emission Reductions Through 2030

The strategies and actions included in this section of the Climate Action Plan are projected to reduce the city's annual GHG emissions by 11,000 metric tons (MT) by 2030 - a 13% reduction over 2018 levels. Changes in business-as-usual impacts, however, are anticipated to *increase* emissions in this sector by 5,800 metric tons based on projected population increases. If population projections hold true, the resulting total community wide waste management sector reduction will be 6% over 2018 levels.

This is equivalent to eliminating **99 million** cubic feet of man-made greenhouse gas atmosphere annually by 2030.

Sector Emissions Reduction below 2018 Achieved by 2030

The total change to sector emissions include CAP Plan reductions as well as BAU emission changes as follows:



Individual Strategy Annual Emission Reductions by 2030

Below are the CAP Plan reductions by strategy for this sector:

Strategy	Annual GHG Reductions by 2030
Strategy WM 1-A: Increase organics diversion by 40% of 2018 values (from 33,900 tons - 38.4% of community mixed waste based on private hauler data - to 20,300).	**7,300 MT**
Strategy WM 1-B: Increase recyclables diversion by 35% of 2018 values (from 28,000 tons - 31.7% of community mixed waste based on private hauler data - to 18,200).	**3,580 MT**
Strategy WM 1-C: Increase diversion of potential recoverables by 33% of 2018 values (from 8,000 tons - 9% of community mixed waste based on private hauler data - to 5,280).	**120 MT**
Strategy WM 1-D: Support waste reduction through policy and operational refinements.	(included)
Strategy WM 1-E: Expanded recycling and organics options for multi-family residents.	(included)
Strategy WM 2-A: Create, implement, and promote public awareness and education campaigns.	N/A

Estimated Cumulative Economic Savings

Implementing many of the measures in this plan, such as reduction of food waste, material waste, and overall consumption, can save money for the community. The estimated community savings of the goals for this section include:

Organics/Food Waste Diversion Savings:		Commercial/Industrial Waste Reduction Savings:		Estimated Cumulative Savings Potential
$77,608,211 $2,511 per household	+	$1,567,500 $33 per job	=	$79,175,711 $930 per capita

*Savings for organics/food waste diversion are based on multiplying the estimated pounds of food waste reduced by an estimated value per pound based on "A Roadmap to Reduce US Food Waste" by ReFED. Savings for commercial waste reduction are calculated based on multiplying the estimated number of participating organizations by the average savings per company reported by the MN WasteWise program (a similar initiative). See Appendix for Cumulative Potential Cost Savings Assumptions and data sources.

What You Can Do

- How much of your waste can you divert to recycling? Challenge yourself and your household to increase your recycling. Make sure to rinse and dry your recyclables; dirty materials contaminate the process and have to be landfilled.
- Carry groceries and other purchases in reusable bags.
- Give up single-use plastics by switching to sturdy, reusable items like metal/hard plastic water bottles, cutlery, & to-go containers.
- Give unused clothes and household items (in good condition) to a local nonprofit, neighbor or friend.
- Shop local second-hand and vintage stores.
- Create a composting bin and routine.
- Attend Bloomington's "Fix It Fair." Bring an item to be fixed or buy at least one repaired item.
- Challenge yourself and your household to eliminate your food waste. Minimize your food waste by first eating what you already have in your fridge. Meal planning and making grocery lists can also reduce your food waste. https://www.epa.gov/recycle/reducing-wasted-food-home
- Never throw hazardous household waste, like batteries and paint, in the trash. Take these to the Monroe County Solid Waste District recycling center. https://bloomington.in.gov/utilities/pretreatment/residential/household-hazardous-waste

Section 05
Water and Wastewater

Click here to return to TOC

Water and Wastewater

Why Water and Wastewater is Important

Water is at the core of climate change and sustainable development. Quality water is vitally important for socio-economic development, maintaining healthy ecosystems, and for human survival. Water is central to the production and preservation of a wide range of services benefiting people. How we process water is also integrally linked to how emissions intensive that water treatment is. Water related energy use totals 13% of US electricity consumption and has a carbon footprint of at least 290 million metric tons. Meanwhile, wastewater treatment is responsible for 3% of global GHG emissions.

Water is also at the heart of adaptation to climate change. In our the Midwest, climate change will increase the likelihood of drought combined with additional heavy rain events, flooding, and flash flooding. On average across the Wabash River Basin, precipitation is projected to be 3% higher in the 2020s under a high-emissions scenario compared to the 1971-2000 average (FutureWater Indiana). Climate change will also/result in increased stress on our water systems, increase water pollution potential, and place more risk on maintaining safe water resources. Water is an irreplaceable, critically important resource fundamental to the well-being of our communities. Water can only be considered renewable with high quality best water management practices in place.

According to the "*Hoosiers' Health in a Changing Climate: A Report from the Indiana Climate Change Impacts Assessment* ":

> the increased frequency and severity of precipitation, as well as the timing in the spring and winter, considerably increase the risk of flooding, especially in low-lying areas throughout the state. These flood events may be responsible for fatal and non-fatal injuries and waterborne disease. Heavy storms can cause storm drains and sewage pipes to overflow and residential stormwater management systems (e.g., sump pumps) to fail. Contact with stormwater/wastewater has been correlated with increased rates of gastrointestinal illnesses. Dampness in homes, schools and other buildings caused by flooding can increase mold growth and lead to higher rates of asthma and allergies.

According to FloodFactor, 7% of all properties are at risk for flooding. This is approximately 1,500 properties out of 21,330 assessed. By 2050 the number will increase to 1,543 properties due to climate change impacts. (https://floodfactor.com/city/bloomington-indiana/1805860_fsid)

The City of Bloomington Utilities Department (CBU) provides water to all Bloomington residents and businesses and sells water wholesale to nine rural water cooperatives. CBU provides over 2.8 billion gallons of water to 25,299 water customers directly plus most of the remainder of Monroe County through wholesale customers and also serves 22,574 sewer customers and provide stormwater management services for the entire city of Bloomington. In 2018, the water and wastewater sector contributed 1.14% of citywide GHG emissions with water distribution responsible for 5,847 metric tons and wastewater treatment accounting for 8,904 metric tons.

Climate Change Considerations

Climate

This sector impacts climate change through fossil fuel use to generate the electricity required to process and distribute water.

Climate Hazards

Hazards to the water and wastewater system include damage to infrastructure from extreme weather and flooding. Citywide hazards include increased flooding and flash flooding potential.

Water and Wastewater

Equity Considerations

- Low-income neighborhoods frequently suffer more damage from flooding, according to studies by the National Academies of Sciences, Engineering and Medicine (*Framing the Challenge of Urban Flooding in the United States*, 2019). The frequency and magnitude of heavy rain events is expected to increase as a result of a changing climate, making the future flooding impacts for at-risk neighborhoods potentially more acute.
- Disadvantaged communities within cities often have denser populations, more impervious surfaces, and less open/green spaces. These areas can also be prone to flooding and sewer overflows. Stormwater management through the creation of open, green spaces serve to revitalize and promote health within these disadvantaged communities.

Sector Goals

Sector goals are established to both support the City's Climate Action Plan in creating a climate resilient community and to reduce city-wide GHG emissions 25% below 2018 levels by 2030.

Sector goals related to GHG emissions reductions are designed to balance reduction across all sectors and achieve the overall emissions goals set forth for the community. The goals seek to strike a balance between achievability while also reaching for improvement beyond business-as-usual.

As indicated in the introduction, the Climate Action Plan is intended to be a 10 year plan to be updated at the completion of that time. Consequently, the goals and strategies outlined in this section are intended to be achieved by 2030 unless otherwise noted.

Implementation of actions are anticipated to be initiated over 3 phases: phase 1 within 1-3 years, phase 2 within 2-5 years, and phase 3 within 4-8 years of CAP approval.

Goal W 1
Decrease potable water consumption by 3% of 2018 values.

Goal W 2
Maintain source and drinking water quality through climate related challenges.

Goal W 3
Reduce energy use associated with treating and transporting water and wastewater by 10% of 2018 values.

Goal W 4
Mitigate flood hazards and impacts.

Water and Wastewater Targets Supporting Sector Goals

	Potable Water Consumption	Water + Wastewater Process Energy
Today	92 Gallons/day per capita	282 kWh/year per capita
2030 Targets	88 Gallons/day per capita	250 kWh/year per capita

Goal W 1 Decrease potable water consumption by 3% of 2018 values.

Strategy W 1-A:

Promote increased water conservation citywide.

How We'll Measure Progress:
Reported citywide water consumption

Average per residential capita daily water consumption within the city was 96.2 gallons in 2016. The population of Bloomington and the surrounding area is anticipated to increase while water supplies are finite meaning wee have an obligation to use our limited resources responsibly. Prudent water use practices will help ensure that future generations have access to clean and abundant water sources, despite growing populations and the lack of new supplies. Reducing per capita water consumption by 3% will conserve over 38 million gallons annually in the residential sector alone.

Co-Benefits of Strategy:

Reduced Costs

Improved Community Resilience

	Actions	Implementation Phase
W1-A-1	Facilitate reduction of water use by top 20 customers through an opt-in program. Offer free technical resources to large institutions and businesses to identify specific opportunities for employees or customers to conserve water and incorporate water efficiency into internal operations.	1
W1-A-2	Accelerate the installation of low-flow water fixtures in residential homes and expand the program to commercial businesses. Goal: achieve 100 households and 10 businesses upgraded annually.	1
W1-A-3	Develop a technical assistance and incentive program to encourage water conservation behavior and upgrades, such as use of drip irrigation and low-flow toilets.	2
W1-A-4	Implement a policy to require installation of rainwater collection systems and WaterSense water efficient fixtures and appliances at all City facility projects and all projects receiving $50,000 or more in City tax abatement, financing or funding. Provide information and technical assistance to projects as needed.	2
W1-A-5	Expand water conservation programs that focus on outdoor irrigation, which may also support better identification of water-related carbon sequestering opportunities such as using soil amendments, native grasses and proper tree watering.	3
W1-A-6	Expand water conservation outreach and incentive programs for residents and businesses.	3

Strategy W 1-B:

Maintain and update city plans and standards in support water conservation goals.

Reducing water consumption within City of Bloomington facilities supports citywide water conservation goals, provides opportunities to exhibit water conservation techniques, and will create operational cost savings for the City.

How We'll Measure Progress:
Reported citywide water consumption

Co-Benefits of Strategy:

Protected / Enhanced Ecosystems

Improved Community Resilience

	Actions	Implementation Phase
W1-B-1	Evaluate the potential to update the City's Green Building Ordinance to include installation of rainwater collection systems at City facilities for graywater uses, and investigate opportunities for graywater reuse at existing and new City facilities and properties. Implement graywater systems identified capable of reducing energy/water demand in other areas (i.e. watering urban tree canopy to reduce heat island effect and air conditioning needs).	1
W1-B-2	Continue to plant more native and drought-resistant vegetation.	2
W1-B-3	Encourage developers to utilize the Sustainable Development Incentive and provide low impact development stormwater management by installing permanent infiltration or collection features (e.g., swale, culvert outfall, rainwater cistern) that can retain 100 percent of the runoff.	2

Goal W 2 Maintain source and drinking water quality through climate related challenges.

Strategy W 2-A:

Improve water quality protections and awareness.

Bloomington has a surface water source for drinking water, Lake Monroe. The Monroe Water Treatment Plant filters and cleans the water for public distribution. The MWTP is operated by the City of Bloomington Utilities Department. The Water Treatment Plant is a conventional settling/filtration facility and has several stages of disinfection before the water is sent out into the distribution system. According to the 2020 Annual Drinking Water Quality report, Bloomington water is within required levels of all 12 water contaminate measures, 5 of which are at or below "ideal" levels. https://cutt.ly/zggXnII

How We'll Measure Progress:
Water quality as reported through annual drinking water quality reports

Co-Benefits of Strategy:

Improved Quality of Life

Improved Community Resilience

	Actions	Implementation Phase
W2-A-1	Strengthen riparian/stream/wetland protection in local ordinances and regulations where feasible.	1
W2-A-2	Develop educational materials covering the link between water resources and climate change.	2
W2-A-3	Increase stream buffer requirements to provide additional flood water storage and minimize property damage due to erosion and flooding.	3

Goal W 3 Reduce energy use associated with treating and transporting water and wastewater by 10% of 2018 values.

Strategy W 3-A:

Reduce energy use associated with treating and transporting water and wastewater by 10% of 2018 values.

According to the 2018 GHG Inventory, processing and distributing water within the city of Bloomington consumed 10,984,760 kWh annually. Meanwhile, wastewater collection and treatment consumed 13,450,909 kWh. Reducing energy use associated with water and wastewater treatment by 10% will save over 2.4 million kWh annually.

How We'll Measure Progress:

Reported energy consumption by City water and wastewater systems

Co-Benefits of Strategy:

Improved Energy Resilience

Reduced GHG Emissions

	Actions	Implementation Phase
W3-A-1	Promote measures that reduce the energy needed to heat, treat and transport water, including continued evaluation of new hydroelectric and photovoltaic opportunities.	1
W3-A-2	Identify and support opportunities for residents and businesses - particularly those with significant hot water loads such as laundromats and hospitals - to electrify water heaters or install solar thermal technology.	2

Strategy W 3-B:

Capture and use of wastewater energy potential.

As recommended by the City of Bloomington Waste To Energy Taskforce, the City should further investigate the potential of an anaerobic digestion wastewater-to-energy installation at the Dillman Road Wastewater Treatment Plant. As outlined in the Taskforce's findings, an anaerobic digestion site could produce approximately 325 kW of electricity, which is about 36% of the plant's average electrical consumption.

How We'll Measure Progress:

Status of study

Co-Benefits of Strategy:

Reduced Costs

Reduced GHG Emissions

	Actions	Implementation Phase
W3-B-1	Research into biogas opportunities at the City's wastewater treatment plant and explore opportunities for renewable natural gas development capacity.	1
W3-B-2	Following completion of study for retaining City wastewater treatment plant produced Renewable Natural Gas (RNG) and kWh for City heating and electrical needs implement recommendations of study.	2

Goal W 4 Mitigate flood hazards and impacts.

Strategy W 4-A:

Update design standards and plans for flood mitigation.

How We'll Measure Progress:
Status of flood mitigation standard plan integration

According to "Hoosiers' Health in a Changing Climate: A Report from the Indiana Climate Change Impacts Assessment," Indiana will see an annual precipitation increase of 6-8% by 2050 with an increase in the likelihood of heavy downpours. Meanwhile, changes in precipitation patterns are projected to increase Indiana's drought potential severity index by 5% - meaning heavier rainfalls will likely be falling on harder ground more susceptible to increased water runoff and flash flooding. Maintaining community plans and design standards based on projected climate impacts will be key in minimizing flood hazard threats.

Co-Benefits of Strategy:

Improved Community Resilience

	Actions	Implementation Phase
W4-A-1	Review and update public infrastructure design standards and the City's Stormwater Management Plan to meet climate change projections for Bloomington.	1
W4-A-2	Perform a flood risk assessment using historical data and future precipitation forecasts to identify areas and critical infrastructure vulnerable to flooding.	1
W4-A-3	Continue to restore and maintain creeks to accommodate increased rain events. Review standards and ensure they include projected precipitation levels due to climate change. Creek restoration can reduce the likelihood and magnitude of flooding and support healthy habitat.	2
W4-A-4	Determine stormwater volume requirements meeting anticipated future storm levels and identify stormwater management systems and infrastructure not capable of meeting projected needs. Prioritize upgrades required and implement. Integrate upgrades into already scheduled maintenance programs and budgets.	2
W4-A-5	Expand inclusion of green infrastructure in City's Stormwater Management Plan. Identify specific types of green infrastructure to implement including: parking lots, alleys, parks, vacant lots, parkways, and grading near sidewalks. In addition, identify property owned by other public entities that have a high potential for improved ecological management to improve stormwater management functions.	2
W4-A-6	Modify water utility bills to provide education to residents on what actions they can take to reduce their risk to extreme precipitation events and flash flooding. Develop an information HUB with tools and resources. (e.g. https://www.cnt.org/tools/my-rainready-home-assessment-tool)	2
W4-A-7	Build more permeable parking lots and driveways and use more recycled materials with concrete.	3

Water and Wastewater

Strategy W 4-B:

Increase green infrastructure capacities citywide.

How We'll Measure Progress:

Reported number, coverage, and capacity of green infrastructure installations

Green infrastructure strategies can build soil quality and improve the permeability (or absorbency) of the soil. The more permeable the surface, the less stormwater runoff there will be, reducing flood risks. Porous natural landscapes, such as meadows and forests, can soak up as much as 90 percent of the rain or snowmelt. By reducing stormwater runoff and protecting floodplains, green infrastructure can help manage both localized and riverine floods.

Co-Benefits of Strategy:

Improved Community Resilience

Protected / Enhanced Ecosystems

	Actions	Implementation Phase
W4-B-1	Promote native landscaping to help restore and conserve natural habitats and avoid turf grass.	1
W4-B-2	Encourage use of rain gardens at public agency sites as well as commercial and residential sites.	1
W4-B-3	Add stormwater absorption features, such as bioswales, rain gardens, and pervious pavement systems to City-owned space.	1
W4-B-4	Prioritize restoration types and areas to increase and improve stream and wetland protection and restoration; develop funding strategy.	2
W4-B-5	Leverage resources to support neighborhood green infrastructure grants and ongoing maintenance.	2
W4-B-6	Incentivize and prioritize the development of “green infrastructure” such as parks, wetlands, riparian and wildlife corridors, natural drainage-ways, and low-impact development. Research green infrastructure implementation and long-term viability in local environment.	2
W4-B-7	Increase the number of public and private use of raingarden and other infiltration projects.	3

Water and Wastewater

Planned Water and Wastewater GHG Emission Reductions

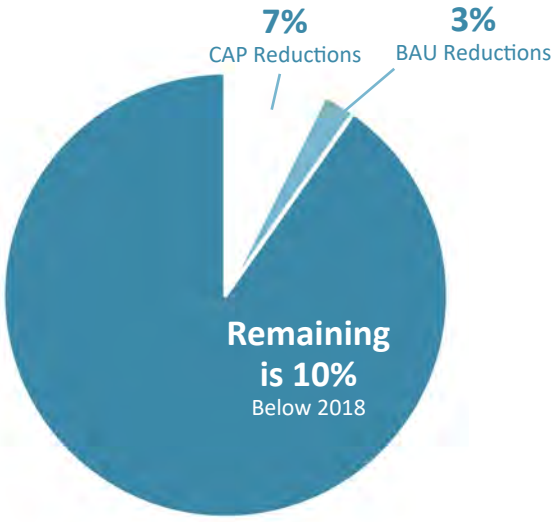
Planned Sector Emission Reductions Through 2030

The strategies and actions included in this section of the Climate Action Plan are projected to reduce the city's annual GHG emissions by 1,100 metric tons (MT) by 2030 - a 7% reduction over 2018 levels. Changes in business-as-usual impacts are anticipated to reduce an additional 350 metric tons for a total community wide water and wastewater sector reduction of 10% over 2018 levels.

This is equivalent to eliminating **3.2 million** cubic feet of man-made greenhouse gas atmosphere annually by 2030.

Sector Emissions Reduction below 2018 Achieved by 2030

The total change to sector emissions include CAP Plan reductions as well as BAU emission changes as follows:



Individual Strategy Annual Emission Reductions by 2030

Below are the CAP Plan reductions by strategy for this sector:

Strategy	Annual GHG Reductions by 2030
Strategy W 1-A: Promote increased water conservation citywide.	**300 MT**
Strategy W 1-B: Maintain and update city plans and standards in support water conservation goals.	N/A
Strategy W 2-A: Improve water quality protections and awareness.	N/A
Strategy W 3-A: Reduce energy use associated with treating and transporting water and wastewater by 10% of 2018 values.	**800 MT**
Strategy W 4-A: Update design standards and plans for flood mitigation.	N/A
Strategy W 4-B: Increase green infrastructure capacities citywide.	N/A

What You Can Do

- Turn off the faucet while brushing your teeth.
- If you have dishwasher, use it. Research shows we use more water washing dishes by hand than running a full or nearly full dishwasher.
- If you have a lawn and garden irrigation system, or use hoses and sprinklers, water thoroughly less often, and do so in the early morning or evening. Alternatively, install a Smart Irrigation Meter to Prevent watering grass that doesn't need it.
- Collect rainwater and use it for indoor and outdoor plants.
- Install — or have a licensed plumber install — water-saving aerators on showerheads and faucets throughout your home.
- Install — or have a licensed plumber install — a water-saving low-flow toilet.
- Reduce or eliminate use of fertilizers and pesticides on lawns to protect surface water quality and ecosystem health.
- Convert lawn areas to native, drought resistant landscaping that does not require watering.

Section 06

Local Food and Agriculture

Click here to return to TOC

Local Food and Agriculture

Why Local Food and Agriculture Are Important

Climate change directly impacts the food system. For people experiencing nutrition insecurity, climate change is a threat multiplier which exacerbates existing food access and affordability issues. Extreme weather events, extreme temperature variations, changes in precipitation, changing soil temperatures and other climate impacts will affect crop yields. Climate impacts can also introduce interruptions in the current food processing and distribution system. Disruptions that occur in the food system are likely to cause food availability or pricing fluctuations

A significant number of individuals in Bloomington are experiencing food insecurity. The Bloomington Food Policy Council identified the following neighborhoods as at risk for food insecurity Crestmont, Reverend Butler, Walnut Woods, Maple Heights, and Broadview. Food insecurity continues to grow in the face of economic challenges with thousands of meals served every week from direct service providers in 2020.

On the map to the left, highlighted sections represent low-income census tracts at least 500 people or 33 % of residents are more than 1 mile (green sections) or 1/2 mile (orange) from the nearest supermarket (defined as a store containing all the major food departments necessary to provide full nutrition to a household) .

Indiana is one of the most powerful agricultural states in the nation, ranked #10 in total production. However, more than 90% of the food consumed and processed in Indiana is imported from other states. Studies conducted by the Indiana State Department of Agriculture (ISDA) and the Indiana State Department of Health (ISDH) over the past eight years have outlined several reasons for this:

- a lack of agricultural diversity and midscale farms producing specialty crops in Indiana
- weak farm to buyer network connections
- lack of local or state policies that support purchasing of local food with public money
- few processing centers for value added food businesses

Though there are now multiple farmer's markets serving the Bloomington area, there are limited retail and institutional purchasing outlets as part of the local food system.

Strengthening the local food market can address the challenges that climate change poses to the broader food system, while simultaneously supporting small businesses and the local economy. Studies have indicated that nearly 32 jobs are created for every $1 million in revenue generated by producers involved in a local food market, compared to only 10.5 jobs for those involved in wholesale channels exclusively. Healthy local food systems can also play a critical role in addressing food access vulnerability and food insecurity within neighborhoods of higher vulnerability. A robust local food system establishes additional supply chains and resilience to distribution disruptions, increasing overall community resilience.

Climate Change Considerations

Climate Hazards

Hazards to the local food and agriculture system include reduced crop quality and yield, vulnerability to pests and soil moisture as well as fluctuation in availability, food price volatility and change.

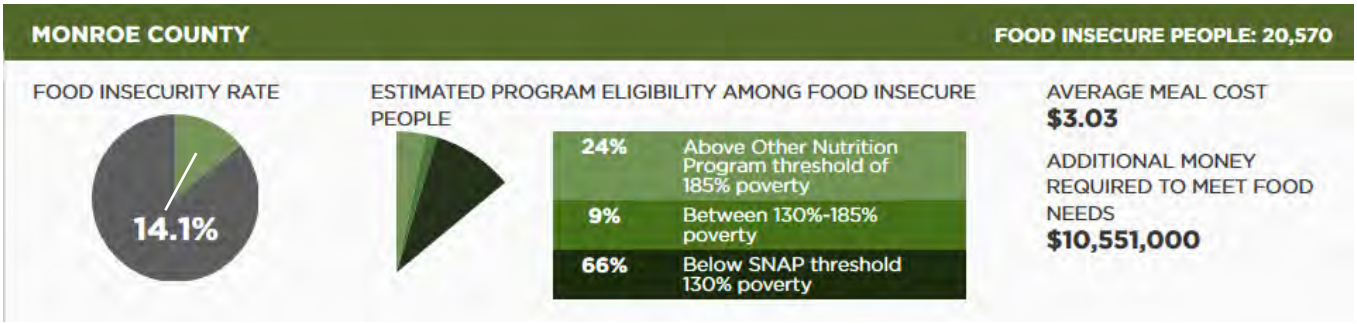
Opportunities

Increased capacity of local food and agriculture systems and improved farm-to-table approaches can reduce community food insecurity while creating local jobs and improved community resilience.

Local Food and Agriculture

Equity Considerations

- People in low-income neighborhoods may have limited access to full-service supermarkets or grocery stores - areas known as a "food deserts." Over 14% of Monroe County households are food insecure – over 30% of those with incomes above assistance program thresholds.
- Studies have also shown that communities with fewer resources often have more outlets that promote unhealthy foods and little access to affordable nutritious food, a condition known as a "nutrition desert."



(Graphic source: Feeding America)

Sector Goals

Sector goals are established to both support the City's Climate Action Plan in creating a climate resilient community and to reduce city-wide GHG emissions 25% below 2018 levels by 2030.

Sector goals related to GHG emissions reductions are designed to balance reduction across all sectors and achieve the overall emissions goals set forth for the community. The goals seek to strike a balance between achievability while also reaching -for improvement beyond business-as-usual.

As indicated in the introduction, the Climate Action Plan is intended to be a 10 year plan to be updated at the completion of that time. Consequently, the goals and strategies outlined in this section are intended to be achieved by 2030 unless otherwise noted.

Implementation of actions are anticipated to be initiated over 3 phases: phase 1 within 1-3 years, phase 2 within 2-5 years, and phase 3 within 4-8 years of CAP approval.

Goal FA 1
Increase food and nutrition security citywide.

Goal FA 2
Increase local agricultural resilience to climate shocks.

Goal FA 3
Increase and stabilize local food market.

Goal FA 1 Increase food and nutrition security citywide.

Strategy FA 1-A:

Address financial food insecurity.

How We'll Measure Progress:
Food insecurity reported in City and County

75% of food insecure individuals in Monroe County are low income. The majority of these individuals (88%) are "very low income" (below 135% of poverty level), indicating a clear relationship between financial insecurity and nutrition insecurity in the community.

Co-Benefits of Strategy:

Improved Community Equity

Improved Community Resilience

	Actions	Implementation Phase
FA1-A-1	Explore potential of collaborating with low cost produce providers to establish local food markets serving low income, vulnerable, and food insecure communities while addressing retail and commercial food waste.	1
FA1-A-2	Continue to provide enrollment assistance for participation in the Supplemental Nutrition Assistance Program (SNAP), the Special Supplemental Nutrition Program for Women, Infants and Children (WIC) Program and other food assistance programs, as well as supporting local initiatives addressing financial food insecurity.	2
FA1-A-3	Work regionally to support and facilitate food donation programs. Food donation programs reduce the amount of healthy, safe food that goes to waste and redirects it to those in need.	2

Strategy FA 1-B:

Improve food access.

How We'll Measure Progress:
Food insecurity reported in City and County

Individuals living with food insecurity are particularly vulnerable to impacts and risks of climate change. As indicated in the USDA Food Map, many sections of Bloomington have significant portions of the population who are economically stressed as well as having limited access to transportation and living 1/2 mile or further from a grocery store. Increasing food access will decrease food insecurity improve community resilience and adaptative capacity to climate impacts.

Co-Benefits of Strategy:

Improved Community Equity

Improved Community Resilience

	Actions	Implementation Phase
FA1-B-1	Conduct a detailed Food Security Assessment to determine food insecurity conditions within the City, areas with limited access to full service grocery stores and markets (particularly within areas of higher vulnerable populations), identify areas within the City for improvement, and establish detailed strategies to increase food security within City.	1
FA1-B-2	Support senior programs that involve both food and community such as volunteering or donating to local charities.	1

	Actions	Implementation Phase
FA1-B-3	Collaborate with convenience stores and food pantries to incentivize the purchase and distribution of affordable, fresh foods.	1
FA1-B-3	Develop an emergency food plan that includes a food needs assessment, scenarios for provisioning necessary food supplies during a range of anticipated emergencies, and a distribution and public communication plan that takes into account those most at risk for food insecurity. Work with local retailers, producers, and warehouses to implement food provisioning scenarios.	2
FA1-B-4	Improve the availability of culturally appropriate food accessible to the City's populations of color, religiously diverse, and limited English speakers. Explore opportunities to expand local development of these goods through engagement with local food producers and promote information on locations and price ranges of uncommon culturally important produce and food products.	2

Goal FA 2 Increase local agricultural resilience to climate shocks.

Strategy FA 2-A:

Provide information and promote climate responsive agriculture practices.

How We'll Measure Progress:
Reported percentage of local food growers adopting climate adaptive strategies

According to research completed for "Estimating economic damage from climate change in the United States," a 2017 study completed by Solomon Hsiang and others from the University of California at Berkeley, agricultural yields are projected to decline with the increase of Global Mean Surface Temperature in addition to impacts related to precipitation changes. Although increased CO2 levels are anticipated to offset a portion of these yield loses, the impact for much of the United States will be a net negative. By 2100 the projected impact to the Monroe County economy is -35.6%. See the Bloomington Climate Risk and Vulnerability Assessment.

Co-Benefits of Strategy:

Protected / Enhanced Ecosystems

Improved Community Resilience

	Actions	Implementation Phase
FA2-A-1	Collaborate with the Monroe County School Corporation, Monroe County, Indiana University, Monroe County Farmer's Association, Indiana Grown, and local organic farmers associations to encourage adoption of strategies to increase soil health and increased carbon sequestration for Croplands and Grazing Lands. Tools: http://www.comet-farm.com/ GHG and Carbon Sequestration Ranking Tool: https://cutt.ly/Vf04djN	1
FA2-A-2	Develop and deliver educational materials for producers that will assist them in understanding the differences between normal weather fluctuations and long term climate change, as well as provide information on the agricultural crops, varieties, and methods most suitable for our area.	2

Local Food and Agriculture

Strategy FA 2-B:

Support climate resilient agriculture through City plans and programs.

How We'll Measure Progress:
Status of City plan and program development

Addressing agricultural resilience through community level planning provides opportunities to improve overall community resilience to climate change impacts and to guide long-term local food infrastructure to support communities in greatest need.

Co-Benefits of Strategy:

Reduced Costs

Improved Community Resilience

	Actions	Implementation Phase
FA2-B-1	Collaborate with Monroe County to develop a comprehensive farmland conservation plan that prioritizes food production while taking into consideration other Bloomington greenspace and climate adaptation priorities. The plan could also include specific maps or areas prioritized for farmland conservation or identify those areas most at risk from development or climate change impacts. Program should focus on exploring increased local food-to-table, local food utilization, and local development of cultural food products in support of Bloomington area underserved communities.	1
FA2-B-2	Work with Bloomington Water Utility and community partners to determine the feasibility of offering rebates or other incentives to farmers for irrigation water management equipment, water storage, reclaimed water, and conservation tillage equipment that saves potable water.	2

Goal FA 3 Increase and stabilize local food market.

Strategy FA 3-A:

Increase local food supply.

How We'll Measure Progress:

Status of Food Coordinator staff position; Status of urban agriculture ordinances

Strengthening local food sources can address both climate change relationships with food and also supports small business local economy. As outlined in the study *The Food System as an Economic Driver: Strategies and Applications for Michigan,* nearly 32 jobs may be created for every $1 million in revenue generated by produce farms involved in a local food market, compared to only 10.5 jobs for those involved in wholesale channels exclusively. Healthy local food systems can also play a critical role in addressing food access vulnerability and food insecurity within neighborhoods of higher vulnerability.

Co-Benefits of Strategy:

Protected / Enhanced Ecosystems

Improved Community Resilience

	Actions	Implementation Phase
FA3-A-1	Fund a Local Food Coordinator position with an annual budget for activities and initiatives to focus on a values-based supply chain for buyers in the City. Working with City officials, this coordinating professional will define the climate values (i.e., local, soil health, animal welfare, fair wages, nutritionally dense, etc.) and define the foodshed or geographic area of food production that the City can influence through policy.	1
FA3-A-2	Revise zoning ordinances to remove barriers to urban agriculture: yard and rooftop food production, edible landscaping and foraging. Examine and pursue other policy levers to increase food production within the City. Utilize available and appropriate Parks and Recreation lands for urban farming and food production.	1
FA3-A-3	Assess, develop, and adopt financial incentives through CDFI and CDBG programs to recruit and support the startup of small and mid-sized food processors in the City.	1
FA3-A-4	Collaborate with Monroe and other nearby County (non-City of Bloomington) officials, residents, and communities to bolster (1) the region's food supply, (2) aggregation and processing abilities, and (3) distribution capacity for both urban and rural residents alike. Work through existing partnerships or develop a new collaborative that brings key stakeholders from the Indiana Uplands as well as Jackson, Bartholomew, Johnson, Morgan, and Putnam counties into conversation for broader regional planning on a resilient food system for the future.	2
FA3-A-5	Support existing school and community gardens and provide opportunities to expand community growing spaces with a focus on youth, immigrant, and low-income residents.	2
FA3-A-6	Support efforts to identify and increase utilization of shared food system assets such as shared food storage space, community commercial kitchens, group purchasing of growing equipment such as backyard greenhouses or hoop houses, and public-private partnerships.	2
FA3-A-7	Equitably promote educational opportunities for residents to gain skills in organic gardening, fruit production, food preservation and cooking and affordable, healthy eating.	2
FA3-A-8	Develop entrepreneurial program for middle and high school parents to grow food and sell in marketplace.	3

Local Food and Agriculture

Strategy FA 3-B:

Strengthen demand for local foods.

How We'll Measure Progress:
Status of Local Food Procurement policies

Increased demand for locally produced food ensures the economic resilience of local producers, leverages the local job creation potential of local food systems, and supports improved nutrition for consumers while improving community resilience.

Co-Benefits of Strategy:

Improved Quality of Life

Improved Community Equity

	Actions	Implementation Phase
FA3-B-1	Pass city policy to procure locally grown and organic foods for events and other organized food catering at city-managed facilities. Coordinate with School District, Indiana University, County, and local hospitals to establish similar locally sourced foods procurement policies. Explore development of group purchasing and logistics agreements to increase efficiency of local farm-to-agency process. https://goodfoodpurchasing.org/	1
FA3-B-2	Establish a policy to allow city facilities to be used as Community Supported Agriculture drop off sites and promote their use among local food producers and consumers.	2
FA3-B-3	Promote and expand public education campaigns to encourage purchasing and procuring locally grown and organic food at the individual and institutional level.	2
FA3-B-4	Expand Farmers Markets (particularly year-round market opportunities), local food hubs and marketing of locally produced and organic foods. Efforts to focus on increased community equity and food security among at-risk populations.	3

Local Food and Agriculture

What You Can Do

- Rent a plot at your local community gardens and grow your own.
- Eat a plant-rich diet. Animal products are extremely GHG-intensive to produce compared to plants. Eating less meat and dairy will reduce emissions associated with food consumption. Eating regionally-grown food that is suitable for the Indiana climate will also make a difference through reduced transportation-related emissions. A great place to start is with “Meatless Mondays” or one meat-free meal a day.
  https://ourworldindata.org/food-choice-vs-eating-local
- Buy food directly from a local grower on an ongoing basis.
- Plant fruit or nut bearing trees or shrubs that are well suited for our hardiness zone on your property.
- Support restaurants and grocery stores that use and sell locally-grown food.
- Buy food that is in season, minimizing the distance food must travel.
- Support your local farmers markets.
- Buy ethically grown and harvested food, like fair-trade coffee and chocolate.


Canon

Section 07

Health and Safety

Click here to return to TOC

Health and Safety

Why Health and Safety Are Important

There is a strong relationship between human health and environmental health. From the air we breathe to the water we drink, life here on Earth depends on the environment around us. This link between the environment and human health is a critical consideration of the impacts of climate change. As outlined in the City's Climate Risk and Vulnerability Assessment, changes in climate, such as higher average temperatures and increased storm frequency and intensity, can intensify public health stressors. These climate change impacts endanger public health and safety by affecting the air we breathe, the weather we experience, our food and water sources, and our interactions with the built and natural environments. As the climate continues to change, the risks to human health continue to grow.

The health of our environment affects our public health, and agencies should promote it as such. There is a direct relationship between climate action and community health because the health of our environment affects public health.

Vulnerable Populations

Climate change impacts the health of all community members, however, people within our communities are differently exposed to hazards and some are disproportionately affected by the risks of climate change. According to the National Climate Assessment, greater health risks related to climate impacts can be experienced by some in our communities including: children, older adults, low-income individuals, and some people of color. Some in these groups are disproportionately affected by extreme heat and weather events, and many have increased health and social vulnerability which decreases their access to resources that can help them avoid the risks of climate change.

According to the National Climate Assessment (https://nca2018.globalchange.gov/chapter/14/):

> Additional populations with increased health and social vulnerability typically have less access to information, resources, institutions, and other factors to prepare for and avoid the health risks of climate change. Some of these communities include poor people in high-income regions, minority groups, women, pregnant women, those experiencing discrimination, children under five, persons with physical and mental illness, persons with physical and cognitive disabilities, the homeless, those living alone, Indigenous people, people displaced because of weather and climate, the socially isolated, poorly planned communities, the disenfranchised, those with less access to healthcare, the uninsured and underinsured, those living in inadequate housing, and those with limited financial resources to rebound from disasters.

Climate Change Considerations

Climate Hazards

Climate stressors include increases in the frequency and intensity of poor air quality days, extreme high temperature events, heavy rainfalls, extended pollen seasons, changed distribution of disease carrying pests.

Opportunities

Strategies which improve community connectedness, mobility, community resilience through healthy lifestyles frequently coincide with climate mitigation measures such as improved pedestrian safety and low income home weatherization.

Health and Safety

Equity Considerations

- Some populations, including aging adults, children, persons with disabilities, economically stressed, non-English speakers, homeless persons, and workers employed in climate exposed jobs are particularly vulnerable to extreme weather, natural disasters, and the health, supply chain, and economic impacts of climate change. Many of these individuals also have limited access to the information, services, and resources needed to ensure resilience in the face of these impacts.
- Areas within the city with increased flood risk, air quality impacts, compromised tree canopy coverage, and older housing stock with insufficient air conditioning are vulnerable environments within our cities with heightened exposure to climate change risks and compromised capacity to adapt.
- Vulnerable populations are disproportionately represented within the vulnerable environments of our cities and frequently lack resources to improve the adaptive capacity of their surroundings.

Sector Goals

Sector goals are established to both support the City's Climate Action Plan in creating a climate resilient community and to reduce city-wide GHG emissions 25% below 2018 levels by 2030.

Sector goals related to GHG emissions reductions are designed to balance reduction across all sectors and achieve the overall emissions goals set forth for the community. The goals seek to strike a balance between achievability while also reaching -for improvement beyond business-as-usual.

As indicated in the introduction, the Climate Action Plan is intended to be a 10 year plan to be updated at the completion of that time. Consequently, the goals and strategies outlined in this section are intended to be achieved by 2030 unless otherwise noted.

Implementation of actions are anticipated to be initiated over 3 phases: phase 1 within 1-3 years, phase 2 within 2-5 years, and phase 3 within 4-8 years of CAP approval.

Goal HS 1
Educate, engage, and empower the public for climate health and safety.

Goal HS 2
Prepare Bloomington for climate risks and impacts.

Goal HS 3
Respond to climate risks and impacts.

Climate Risk Sensitivity

A "Climate Risk" is when the effects of climate change have the potential for negative consequences and outcomes for human health, systems, or communities. The most common way of evaluating the level of risk associated with climate impacts is to consider how sensitive a community is to an impact and how likely that impact is to occur. An approach for anticipating the sensitivity of a community to potential climate change impacts is to quantify and map the potentially vulnerable populations within the community.

Vulnerable Population Climate Impact Sensitivity

The Bloomington Climate Risk and Vulnerability Assessment report quantified the potentially vulnerable populations within Bloomington and identified the risks each population may have heightened sensitivities to (i.e. outdoor workers having a higher sensitivity to extreme heat and weather events). This enables an estimation of the total instances of potential vulnerability to each climate risk. It should be noted that it is possible for individuals to be members of more than one vulnerable population. For example, an individual may be both an adult over age 65 as well as an individual living below 200% of poverty level. Consequently, the “total instances of vulnerability” for each climate risk does not necessarily represent the numbers of vulnerable individuals. The number, however, does provide a representation of the proportion of total climate vulnerabilities within the population and enables an indication of comparative population sensitivity to each climate risk.

	Extreme Heat	Flooding	Air Quality	Vectorborne Disease	Food Insecurity	Water Quality Impacts	Waterborne Disease	Power Failure
children	3,945		3,945	3,945			3,945	3,945
seniors	9,597	9,597	9,597	9,597	9,597			9,597
disabled	9,726	9,726	9,726		9,726			9,726
Low Income Individuals	13,032	13,032	13,032	13,032	13,032	13,032	13,032	13,032
Low Income Families	6,256	6,256	6,256	6,256	6,256	6,256	6,256	6,256
People of Color	17,738	17,738	17,738	17,738	17,738		17,738	17,738
Limited English	5,284	5,284	5,284	5,284	5,284		5,284	5,284
At Risk Workers	5,548	5,548	5,548	5,548			5,548	
No Car	3,577	3,577	3,577			3,577	3,577	
Total by category	**74,704**	**70,759**	**74,704**	**61,401**	**61,634**	**22,866**	**55,381**	**65,579**
Percentage of Vuln pop	105%	99%	105%	86%	87%	32%	78%	92%
Rank by Vuln	**2**	**3**	**1**	6	**5**	11	7	**4**
Percentage of Total Pop	76%	72%	76%	62%	63%	23%	56%	67%

As indicated above, the highest number of potential vulnerable population instances in the community are low income individuals and families, people of color, individuals with disabilities, and seniors. The climate risks which the community may be particularly sensitive to are extreme heat and weather, air quality, flooding, power/infrastructure failure, and food insecurity. See the Bloomington Climate Risk and Vulnerability Assessment for more information.

Since 1998, extreme weather has cost Monroe County an average of: **$727,000** **Annually**

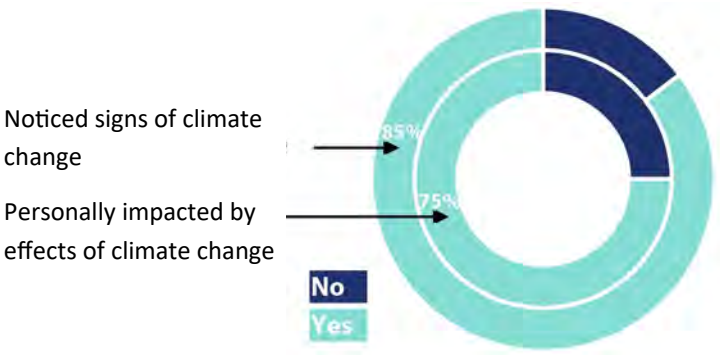
Source: NOAA National Centers for Environmental Information

Health and Safety

Climate Impacts Already Felt

Climate change impacts are already being felt within the community. Over 75% of the 472 individuals responding to the City of Bloomington's 2020 Climate Action Plan Community Input Survey reported being personally impacted by the effects of climate change. The most noted personal impacts observed were:

- Increased air conditioning use,
- Increased contact with ticks and mosquitos,
- Longer allergy season,
- Tree loss due to storm, flooding or drought
- Flooding/flood damage.



Bloomington Climate Risk

The chart below reviews the expected climate impacts, likelihood of occurrence, impact level (Vulnerable Population Climate Impact Sensitivity), potential timeframe of impact, and resulting overall potential risk level for climate risks to the population. Each of these impacts are already experienced. The timeframes represent estimations of when the likelihood of occurrence and/or the overall level of impact may be significantly increased. The timeframes should be understood to be approximate and include "short-term" (current to 20 years), "medium-term" (mid-century) and "long-term" (late century).

Health Impacts	Likelihood of Occurrence	Impact Level (Population Vulnerability)	Timeframe	Risk (Likelihood x Impact)
Extreme Heat	Likely	High	Medium-term	Very High
Flooding	Possible	High	Short-term	High
Drought	Likely	Moderate	Medium-term	Moderate
Air Quality	Likely	High	Medium-term	High
Vector-Borne Diseases	Likely	Moderate	Long-term	Moderate
Nutrition Insecurity	Possible	High	Medium-term	High
Water Quanity/Quality	Likely	Low	Long-term	Moderate
Water Borne Disease	Unlikely	Moderate	Medium-term	Low

Prioritizing Climate Health and Safety Risks

Based on the above review the City's adaptive efforts may be most effective by prioritizing strategies which address the climate risks of Air Quality, Extreme Heat, Flooding, Power/Infrastructure Failure, Energy Costs, Food Insecurity, and Property Crime. Particular attention should be paid to strategies which are most effective. for those in Economic Stress, People of Color, Individuals with Disabilities, and Seniors over 65. See the Bloomington Climate Risk and Vulnerability Assessment for more information

Goal HS 1 Educate, engage, and empower the public for climate health and safety.

Strategy HS 1-A:

Improve training to address risks exacerbated by climate change.

How We'll Measure Progress:
Status of integration of climate change impact projections into training

Hazard and risk identification supporting public safety, emergency management, and social services professional training has largely been based on historical occurrence. However, research indicates that climate change is affecting future patterns of natural hazards. These changes must be anticipated and integrated into how disaster mitigation, preparedness strategies, and training is developed.

Co-Benefits of Strategy:

Improved Public Health

Improved Community Resilience

	Actions	Implementation Phase
HS1-A-1	Ensure public safety staff are properly trained to recognize and respond to physical and behavioral signs of heat-related illness.	1
HS1-A-2	Strengthen emergency management capacity to prepare for and respond to the impacts of climate change. The City should prioritize capacity improvements such as training and equipment to address risks exacerbated by climate change - see the City of Bloomington Climate Risk and Vulnerability Assessment 2020. Emergency management should be equipped to address the possibility of multiple emergencies at the same time, such as the combination of extreme heat and power outage.	1
HS1-A-3	Provide guidance through resource material to social service providers so they are aware of best practices in treating client needs during an extreme heat event.	2
HS1-A-4	Give city and county elected officials and staff tools (e.g. webinar trainings on emergency preparedness, facilitation guides, and other materials in multiple languages) to have dialogues about emergency preparedness within neighborhoods and to create local resilience strategies such as an Adopt-A-Neighbor campaign or hosting an OEM CERT-like training session in their community.	3

Strategy HS 1-B:

Establish and expand public health communication campaigns.

How We'll Measure Progress:
Status of communication campaign development and implementation

Successfully addressing climate change as a public health threat requires prevention strategies which can help influence people's behavior to help prevent and reduce the burden of climate change on human and other populations.

Co-Benefits of Strategy:

Improved Community Equity

Improved Social Connectivity

	Actions	Implementation Phase
HS1-B-1	Develop a climate change public health communication campaign to reach those without access to internet or technology, limited English speakers, and individuals in hard to reach vulnerable populations.	1

	Actions	Implementation Phase
HS1-B-2	Increase public education and outreach about the basics of climate change and how it will affect the community. Consider inclusion of explanation of exponential rates of change if global tipping points are met.	1
HS1-B-3	Expand visibility of the City Air Quality Index including particulate matter and pollen counts so that the public is aware of bad air quality days. Include strategies for coping with poor air quality days	2
HS1-B-4	Collaborate with County Health, school district, Indiana University, and local hospitals to establish a public communications campaign to build awareness of vector borne disease risks, avoidance, and actions. Campaign should be focused particularly on those most vulnerable to exposure.	3

Goal HS 2 Prepare Bloomington for climate risks and impacts.

Strategy HS 2-A:

Strengthen community response capacity and support networks.

The Vulnerable Population Risk Sensitivity Chart (see Bloomington Climate Risk and Vulnerability Assessment) illustrates the instances of vulnerability to each of these projected climate impacts by census tract. Significant portions of the population have a likely elevated sensitivity to the anticipated extreme heat and weather, flooding, and air quality impacts projected. Vulnerability to climate impacts can be lessoned through the improved social connectivity and support that can be provided through strengthened community networks focused on vulnerable community members.

How We'll Measure Progress:

Status of community network coverage for vulnerable populations; Implementation of monitoring program

Co-Benefits of Strategy:

Improved Community Equity

Improved Social Connectivity

	Actions	Implementation Phase
HS2-A-1	Enhance community networks and connections for those who require special attention, such as the elderly, homebound, disabled, isolated, or those likely to be in need of financial assistance during or after extreme weather events (heat, cold and heavy precipitation).	1
HS2-A-2	Strengthen emergency management capacity to prepare for and respond to the impacts of climate change. The City should prioritize capacity improvements such as training and equipment to address risks exacerbated by climate change. Emergency management should be equipped to address the possibility of multiple emergencies at the same time.	2
HS2-A-3	Explore potential of developing an indoor air quality monitoring program. Program could include deploying a series of air quality monitoring stations at appropriately located public facilities, schools, senior living homes, group homes, and public housing facilities.	3

Strategy HS 2-B:

Improve equity of climate adaptation measures.

How We'll Measure Progress:
Status of integration of climate change vulnerability into community plans, programs, and decisions

Integration of climate change impacts and a recognition of the populations and neighborhoods most vulnerable to them into community plans, project approval processes, and program development is a critical requirement to effectively reducing climate change impacts for the portions of the community most likely to be affected.

Co-Benefits of Strategy:

Improved Community Equity

Improved Community Resilience

	Actions	Implementation Phase
HS2-B-1	Utilize current science, best practices and updated maps of flooding and flash flooding potential, micro heat island vulnerability, and populations most vulnerable to flooding and heat impacts to help inform decisions and priorities about projects, project approvals, and programs that help to cool the urban environment.	1
HS2-B-2	Ensure equitable implementation of grid resilience actions by partnering with high-risk neighborhoods and non-governmental organizations to develop resilience hubs—community facilities that offer power and other services during times of need. Establish criteria to screen and select locations for community microgrids to support grid and community resilience.	2
HS2-B-3	Seek to reduce vulnerability to mold and other flood related impacts by providing mold awareness and mitigation assistance for residents within flood and flash flood prone sectors and for vulnerable populations and within multi-family housing. Assistance may include establishing mold inspections for rental properties and/or residences in flood or flash flood prone areas of the city.	2
HS2-B-4	Collaborate with County to establish/expand support of climate and extreme weather safe working conditions, extreme heat and heat stress education and general worker safety for individuals and jobs vulnerable to high heat.	3

Goal HS 3 Respond to climate risks and impacts.

Strategy HS 3-A:

Assist the city's heat, flooding, and storm vulnerable population in preparing for and mitigating climate change impacts.

How We'll Measure Progress:
Shade tree, flood assistance, and weatherization assistance data

By 2050, Monroe County can expect: 50 days of over 95 degrees (historical: 2 days) an average hottest day of the year of 107 degrees (historical: 97 degrees), an average coldest day of the year of 1 degree (historical: -5 degrees), an increase in spring rainfall of 16 percent above historical averages. The Vulnerable Population Risk Sensitivity Chart (see Bloomington Climate Risk and Vulnerability Assessment) illustrates the instances of vulnerability to each of these projected climate impacts by census tract. Significant portions of the population have a likely elevated sensitivity to the anticipated extreme heat and weather, flooding, and air quality impacts projected.

Co-Benefits of Strategy:

Improved Community Equity

Improved Community Resilience

	Actions	Implementation Phase
HS3-A-1	Seek to reduce exposure to extreme heat and improve stormwater damage by promoting, distributing, or providing installation assistance of shade trees focused on community areas identified as having high heat island impact based on City's Citywide Ground Cover and Heat Island Assessment (see Greenspace section, strategy G 3-A) and/or flash flood prone. Assistance should prioritize vulnerable populations.	1
HS3-A-2	Offer on-site and on-line flood assessments and readiness improvements to residents within flood and flash flood prone areas. (e.g. https://www.cnt.org/tools/my-rainready-home-assessment-tool)	1
HS3-A-3	Create a flood risk education campaign including development of an online education hub with information, tools and resources.	1
HS3-A-4	Integrate climate change impact awareness into outreach and systems supporting and interacting with homeless community members. Implement protocols for enhanced support and augmentation of shelters and food shelves during extreme weather events.	2
HS3-A-5	Seek to reduce exposure to extreme heat through distribution of energy-efficient, air conditioning in vulnerable populations with a prioritization in areas of high micro heat island impacts as identified in City's Citywide Ground Cover and Heat Island Assessment. (see Greenspace section, strategy G 3-A)	2
HS3-A-6	Improve the energy efficiency of homes, apartments and commercial buildings to keep interiors cool, improving the comfort and safety of occupants and reducing the need for summer air conditioning. Encourage the planting of trees and vegetation on the south and west sides of homes and buildings to reduce summer heat gain (mid-cost). Job creation opportunity.	2
HS3-A-7	Collaborate with community partners to provide flood insurance education to home owners, particularly new home buyers and at-risk home owners. Education should include when insurance is recommended, purposes for flood insurance, and what is typically covered and not covered by insurance.	2

Strategy HS 3-B:

Establish a climate impacts mutual aid program.

How We'll Measure Progress:

Status of mutual aid agreements addressing potential climate impacts

Projected climate change impacts for Bloomington include the potential for increased frequency and intensity of extreme weather events and increased flood hazard. Establishing mutual aid programs to address the specific response requirements these climate hazards represent (such as downed tree removal, storm debris removal, and flood response) can ensure a higher level of preparedness for extreme weather events and their aftermath.

Co-Benefits of Strategy:

Improved Community Equity

Improved Community Resilience

	Actions	Implementation Phase
HS3-B-1	Coordinate with County, State, Indiana University, surrounding communities, non profit agencies, and utilities to establish a Mutual Aid and Response program. Program to focus on range of current and projected risks and hazards including flooding, extreme weather, storms, power outage, and emergency debris management.	1

	Actions	Implementation Phase
HS3-B-2	Organize a transportation-assistance program for individuals without access to vehicles. Explore partners such as Area 10 on Aging, Bloomington Transit, and local hospitals.	2
HS3-B-3	Educate the public about the health risks of higher temperatures, develop strategies to check on individuals at greatest risk, and make options for cooling widely accessible.	2

Strategy HS 3-C:

Establish and update plans to address climate risks and impacts.

Maintaining community plans and design standards based on projected climate risks and impacts will be key in minimizing hazard threats to community health and safety.

How We'll Measure Progress:

Status of integration of climate change impact projections into community plans

Co-Benefits of Strategy:

Improved Social Connectivity

Improved Community Resilience

	Actions	Implementation Phase
HS3-C-1	Coordinate with County, Indiana University, Red Cross, and utilities to develop a debris management plan to support response to severe storm events and flooding. Explore potential of integrating HAND neighborhood clean up grants into plan.	1
HS3-C-2	In alignment with the American Public Health Association Policy Number: 201711, City will engage County and State environmental offices and health departments and with the EPA regional office in assessing and remediating environmental justice concerns in Bloomington. Concerns to be assessed to include exposures to smog and toxic air pollutants and the disproportionate number of asthma cases among people of color. Assessment to prioritize review of exposures near public housing and schools in the vicinity of freeways, industrial facilities, and power plants. Impacts of land-use planning and infrastructure decisions on air pollution exposure to be reexamined.	2
HS3-C-3	Collaborate with County to ensure Emergency Management Plans include current and projected climate change risks and hazards and prioritize and prepare for responses in the event of climate hazards and extreme weather events. See City of Bloomington Climate Risk and Vulnerability Assessment 2020.	2
HS3-C-4	In collaboration with County, develop a comprehensive heat response plan that incorporates most current climate change impact projections and combines individual strategies into an integrated approach. Coordinate with County to Include Response Plan on County's Public Health Preparedness webpage (https://www.co.monroe.in.us/topic/index.php?topicid=154&structureid=12).	2

What You Can Do

- Put together an emergency preparedness kit for your household by visiting Ready.Gov.
- Get involved with the Monroe County Community Emergency Response Team (CERT). Join your neighbors and receive training to prepare for potential disasters.
- Stay informed. Sign up for Monroe County Citizen Alert Notification, a free program from Monroe County that sends community alerts to your phone and email when you register online. https://cutt.ly/xgg3cBR
- Prepare your home for the extremes. Understand the risk of extreme weather, extreme temperatures, flooding or wildfire to your home, and take action to safeguard your home.
- Keep yourself and your family current with physicals, vaccinations and prescribed medications and therapies.
- Plan and rehearse a fire evacuation plan with everyone who lives in your home or apartment.
- Have breathing-protection masks available for you and your family for when air quality alerts are declared.
- Take first-aid and CPR certification training.
- Notice a person who lives alone. Offer to check on them periodically, especially during extreme weather or a natural disaster.
- Notice a person who sometimes lacks transportation to their doctor, shopping or other services. Offer to drive them.
- Notice a person or family who lacks air conditioning in their home or apartment. Offer to have them visit or stay with you during extreme heat events.

Section 08

Greenspace and Ecosystem Health

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Greenspace and Ecosystem Health

Why Greenspace and Ecosystem Health Are Important

Human activities coupled with natural variations in the carbon cycle, have resulted in a significant increase in the concentration of carbon dioxide (CO_2) and other "greenhouse gases" in the atmosphere, thus causing measurable global warming. Controlling atmospheric CO_2 requires deliberate action that combines reducing emissions and increasing storage, while planning for adaptation to the changes that result. Part of this Climate Action Plan addresses ways that greenspace protection and enhancement is one of Bloomington's most important avenues for lowering our environmental footprint.

Greenspace, plays a central role in supporting community health, improving air, soil, and water quality, reducing energy use in buildings, and supporting climate-change mitigation. An urban greenspace includes any permeable vegetated surface, public or private, set apart for recreational, aesthetic, or ecosystem services in an otherwise urban environment. It is space set aside for providing life-essential benefits people and other living things obtain from properly-functioning ecosystems. The key benefits and services greenspaces provide include:

- Carbon sequestration: Within a greenspace carbon sequestration is sometimes referred to as biological or terrestrial sequestration. Plants convert carbon dioxide into biomass (leaves, stems, etc.) through photosynthesis and with a greater amount of greenspace, the more CO_2 will be removed from the atmosphere.

- Stormwater infiltration and flood mitigation: Greenspace helps protect from flash flooding by absorbing water through roots and slowing down rainwater run off. Native plants have deep roots that can also mitigate erosion and can filter the water through phytofiltration.

- Reduce the urban heart island effect: The more vegetated greenspace in Bloomington, the better the cooling effects. High levels of impervious surfaces (a surface that does not allow water to infiltrate such as pavement and buildings) results in an increased urban heat island effect, which elevates the temperature of the near-surface air, buildings, and pavement higher than the surrounding areas. Ideally, a greenspace would contain the vertical architecture, or levels of a natural forest (canopy, understory, and shrub, herbaceous, and ground layers). Bloomington's Urban Tree Canopy Assessment Summary Report suggests the community needs and has space for additional canopy cover.

- Purify and humidify the air: Plants purify the air when the plants absorb light, carbon dioxide, and water to manufacture sugar. That chemical process, known as photosynthesis, creates fresh oxygen, which in turn purifies for humans and other animals.

- Support pollinators: Animal species that pollinate plants, termed pollinators, carry pollen, either accidentally or intentionally, from the male part of a flower to the female part of the same or another flower. This pollen transfer must occur for the plant to be fertilized and produce seeds, fruits, or young plants. These pollinators are needed to pollinate 90% of flowering plants and one third of our food crops and they also contribute to the intricate web that supports the biological diversity in natural ecosystems.

- Enhance soil biology: Soil is a vital living ecosystem teaming with microorganisms (bacteria, protozoa, fungi) and macroorganisms (worms, beetles, bees) that work symbiotically to break down carbon-rich organic matter and release nutrient-rich waste into the soil (carbon, phosphorus, nitrogen). In fact, it is estimated that soil is home to about one third of all Earth's living organisms! Additionally, just as importantly, soil can absorb and hold rainwater and filter potential pollutants, and the biomass (organic matter) within the soil can sequester CO_2.

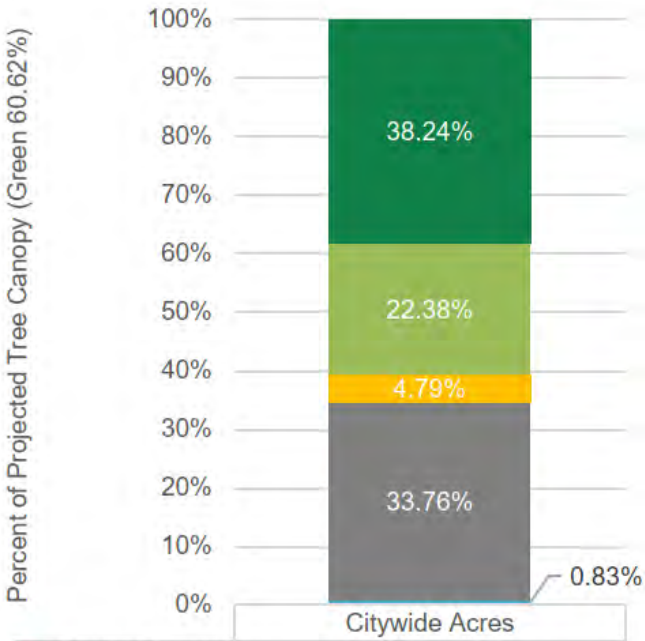
Greenspace and Ecosystem Health

Human health -In addition to the countless ecosystem services greenspace provides, it is also good for humans. Actions as ordinary as going outside, looking out a window, or simply looking at one tree can increase our mood and reduce stress. In fact, recently, our understanding of the human value of greenspace has been expanded to include mental and physical health benefits, such that some doctors have even started prescribing parks as a remedy to patients' health issues.

Bloomington's Tree Canopy

The City's average existing Tree Canopy coverage of 38% is above the national average, however, there are likely portions of the City which could benefit from increased tree canopy. According to the 2019 Bloomington Urban Tree Canopy Assessment Report

> The City of Bloomington's existing tree canopy is 38%; the possible tree canopy is 27%; and the preferred plantable area (possible tree canopy area that takes into consideration the current or future planned land use) is 22%, making the maximum tree canopy attainable under current development conditions at 62% (Figure 10). Reaching the projected tree canopy potential of 62% will require the City of Bloomington to preserve all existing tree canopy while expanding the urban forest in designated preferred plantable areas.



	Citywide Acres
Existing Canopy	5,735.22
Preferred Plantable	3,357.45
Other Pervious Surfaces	718.57
Impervious Surfaces	5,063.85
Open Water	124.83

Figure 10. Projected tree canopy potential within the City of Bloomington, IN (2018)
Source: 2019 Bloomington Urban Tree Canopy Assessment Report

Climate Change Considerations

Climate Hazards

Projected climate change impacts may cause forests and urban trees to experience increased mortality and reduced productivity, more prevalent invasive species and disease all resulting in forest and tree loss, reduction in crop yield. Loss of greenspace, in turn, reduces carbon capture potential of green infrastructure.

Opportunities

Many strategies within the Greenspace sector can advance community resilience and quality of life. Increased tree canopy, decreased impervious surfaces, and increased utilization of native grasses and plantings can reduce heat island experiences, energy consumption, stormwater runoff, and flood impacts.

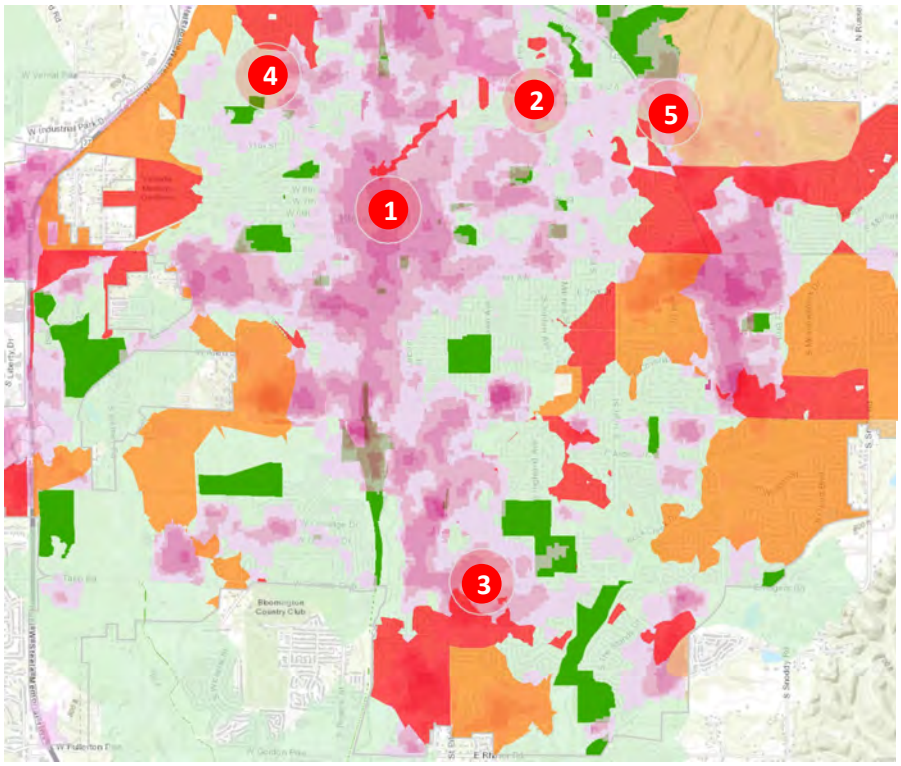
Greenspace and Ecosystem Health

Equity Considerations

- Lower income neighborhoods and neighborhoods with higher proportions of people of color regularly have lower tree canopy coverage, and the environmental, economic, and quality of life benefits trees support than more affluent neighborhoods.
- "Heat islands" and "micro heat islands" are built up areas that are hotter than other nearby areas. This is caused by lack of adequate greenspace and healthy tree canopy coverage combined with too many hard surfaces like roads, parking lots, and hard building surfaces. Frequently neighborhoods with higher vulnerable populations have the highest heat island impacts.

The map to the right from the Trust for Public Land's ParkScore tool shows current and recommended park space throughout Bloomington represented by the red circles (numbers representing priority). The green portions of the map illustrate existing parks with public access while areas with very high need for parks are shown in dark orange and areas with high or moderate need for parks are shown in tan.

Pink sections of the map indicate areas with calculated heat island or micro heat island impacts (darker colors represent higher heat island impacts). The numbered red circles indicate locations ideal for new parks which would serve populations without public park access within a 10 minute walk that are also in an area with higher urban heat island impacts.



Sector Goals

Sector goals are established to both support the City's Climate Action Plan in creating a climate resilient community and to reduce city-wide GHG emissions 25% below 2018 levels by 2030.

Sector goals related to GHG emissions reductions are designed to balance reduction across all sectors and achieve the overall emissions goals set forth for the community. The goals seek to strike a balance between achievability while also reaching for improvement beyond business-as-usual.

As indicated in the introduction, the Climate Action Plan is intended to be a 10 year plan to be updated at the completion of that time. Consequently, the goals and strategies outlined in this section are intended to be achieved by 2030 unless otherwise noted.

Implementation of actions are anticipated to be initiated over 3 phases: phase 1 within 1-3 years, phase 2 within 2-5 years, and phase 3 within 4-8 years of CAP approval.

Goal G 1
Increase quantity and quality of greenspace within the community.

Goal G 2
Increase quantity and quality of climate adaptive native habitats.

Goal G 3
Increase citywide tree canopy coverage by 3% of 2018 values.

Goal G 4
Reduce stormwater and micro heat island impacts.

Goal G 1 Increase quantity and quality of greenspace within the community.

Strategy G 1-A:

Establish city greenspace plans integrating findings and goals of Climate Action Plan.

Create community plans that integrate climate change impacts with recognition of the populations and neighborhoods most vulnerable to them. Use these plans to guide greenspace preservation and development, and ground cover conversion efforts, to capture the beneficial climate adaptation and mitigation potential of community-wide greenspace.

How We'll Measure Progress:

Status of integration of climate action plan findings and goals into community greenspace plans

Co-Benefits of Strategy:

Protected / Enhanced Ecosystems

Improved Community Equity

	Actions	Implementation Phase
G1-A-1	Complete a Land Conversion Opportunity Study. Analyze public and private property for unused turf and impervious areas, and create a Ground Cover Conversion Implementation plan by census tract to convert identified areas to native grasslands, wetlands, shrub, and forested areas. Identify incentive opportunities and establish an outreach campaign.	1
G1-A-2	Conduct a greenspace and preservation equity assessment to evaluate greenspace citywide and determine potential needs for expansion, purchase and preservation of greenspace based on quantified equity, environmental, economic benefits, and Return on Investment based on life cycle costs of greenspace property ownership. Coordinate assessment with findings of the Citywide Ground Cover and Heat Island Assessment and Urban Forest Management Plan.	2
G1-A-3	Develop an incentive and assistance program to support the conversion unused turn and impervious areas in the city to sustainable green space as outlined in the City's Land Conversion Opportunity Study.	2

Strategy G 1-B:

Improve the connectivity and functionality of greenspaces within the city.

Integration of climate change impacts and a recognition of the populations and neighborhoods most vulnerable to them into community plans which guide greenspace preservation and development and ground cover conversion efforts to capture the beneficial climate adaptation and mitigation potential of community wide greenspace is a critical requirement to effectively reducing climate change impacts.

How We'll Measure Progress:

Status of pollinator and wildlife "corridors;" percentage of residents within a 10 minute walk of park; implementation of climate best practices at City parks

Co-Benefits of Strategy:

Protected / Enhanced Ecosystems

Improved Quality of Life

	Actions	Implementation Phase
G1-B-1	Enhance the connectivity of greenbelt and habitat corridors across the community, including identification and improvement of "pollinator corridors" and "wildlife corridors." See Bloomington Environmental Commission documentation on pollinator and wildlife corridors.	1
G1-B-2	Expand and connect green spaces so they are welcoming and within 10 minute walking distance of all residents, especially in underserved communities where there is a high level of impervious surfaces.	2
G1-B-3	Improve the ecological functionality of and resiliency of parks and open space through green infrastructure, best practices for stormwater management, and increased plant diversity and pollinator-friendly habitat. https://www.cnt.org/publications/green-values-strategy-guide-linking-green-infrastructure-benefits-to-community	3

Goal G 2 Increase quantity and quality of climate adaptive native habitats.

Strategy G 2-A:

Create and expand native habitat policies and infrastructure.

Aligning City policies guiding use and maintenance of public facilities, parks, and rights of way with the goals of the climate action has immediate positive impacts advancing citywide goals, and serves as examples and case studies to illustrate effective approaches for residents and businesses throughout the community.

How We'll Measure Progress:
Status of policy development

Co-Benefits of Strategy:

Protected / Enhanced Ecosystems

Improved Community Resilience

	Actions	Implementation Phase
G2-A-1	Create a policy requiring the use of native plants in landscaping at City-owned properties unless a data-driven case can be made that such use is not appropriate.	1
G2-A-3	Establish and effectively manage native-habitat corridors along trails (Parks) and utility easement areas to restore and maintain landscape connectivity.	2
G2-A-4	Support seed banks to address shifts in habitats, microclimates, bioclimatic envelopes.	3

Strategy G 2-B:

Increase the use of native species and pollinator restoration areas.

Native plant and tree species tend to be more drought resistant, increase development of soil organic material and health, help reduce air pollution, and support biodiversity and pollinator health.

How We'll Measure Progress:
Percentage of native species and pollinator friendly ground cover citywide

Co-Benefits of Strategy:

Protected / Enhanced Ecosystems

Improved Community Resilience

	Actions	Implementation Phase
G2-B-1	Install roadside climate-adaptive native vegetation that creates effective barriers to prevent drifting of air pollutants to adjacent schools, residences, and parks. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6060415/	1
G2-B-2	Increase use and promotion of "no mow areas" with plantings of appropriate heights to ensure safety and visibility along roads and parking lots.	2
G2-B-3	Promote “landscaping for absorption” practices for water prone residential and commercial landscapes. Strategies include native moisture tolerant perennial plantings and shrubs.	3

Goal G 3 Increase citywide tree canopy coverage by 3% of 2018 values.

Strategy G 3-A:

Establish city plans and policies in support of tree canopy and ground cover goals.

Increased tree canopy coverage improves soil health, pollution absorption, air quality, and stormwater uptake, and decreases stormwater runoff and micro heat island impacts. Conversion of impervious surfaces to greenspaces using native species, pervious paver systems, and "green roofs" can significantly reduce extreme heat experiences for vulnerable populations. Establishing policies and plans in support of tree canopy goals and outlining planting targets to achieve the goals is an effective path towards achieving the climate action plan greenspace goals.

How We'll Measure Progress:

Status of policy and plan development and implementation

Co-Benefits of Strategy:

Protected / Enhanced Ecosystems

Improved Community Resilience

Improved Community Equity

Improved Quality of Life

	Actions	Implementation Phase
G3-A-1	Conduct a Citywide Ground Cover and Heat Island Assessment. Assessment should include tree canopy, light-colored impervious surface, dark-colored impervious surface, grassland, and water coverage by census tract. Study should include heat island impact study to identify areas of high heat island contribution and impact. Findings of tree coverage, benefits, heat island impacts, and opportunities should be overlapped with vulnerable population mapping from the City's Climate Vulnerability Assessment. See https://palebluedot.llc/tree-canopy-assessments	1
G3-A-2	Develop an Urban Forest Management Plan to establish objectives and best management practices for the Municipality’s urban forest and to identify appropriate canopy cover goals and establish an implementation plan to meet ground cover and tree canopy goals by neighborhood/census tract based on the Citywide Ground Cover and Heat Island Assessment and develop species diversity goals for the City. Recommended species should prioritize drought and flood resistant varieties and varieties likely to be resistive to changing climate and USDA Hardiness zones for City (see appendix 2 of City of Bloomington Climate Risk and Vulnerability Assessment). Species recommendation list to be distributed to and promote among residents, businesses, and contractors within the City.	2

	Actions	Implementation Phase
G3-A-3	Continue to prioritize tree planting and maintenance on public property.	3
G3-A-4	Enhance street scape plantings and tree canopies, especially in areas of high traffic volumes.	3

Strategy G 3-B:

Support and empower community partners, businesses and residents in meeting tree canopy goals.

Aligning the landscaping and greenspace maintenance actions of property owners and businesses citywide is critical to achieving citywide greenspace goals, particularly in sections of the city with high shares of vulnerable populations.

How We'll Measure Progress:

Establishment and utilization of incentives; citywide ground cover characteristics and tree canopy coverage

Co-Benefits of Strategy:

Protected / Enhanced Ecosystems

Improved Community Resilience

Improved Community Equity

Improved Quality of Life

	Actions	Implementation Phase
G3-B-1	Create additional incentives for tree planting, particularly in prioritized areas within the City as established by the Citywide Ground Cover and Heat Island Assessment.	1
G3-B-2	Develop educational and informational resources providing information on beneficial and climate adaptive tree species, "carbon gardening" strategies for ornamental gardens, and produce gardens, tree profile rebuilding, elimination of synthetic fertilizer and pesticide use, high mow deck settings, use of biochar amendments, polyculture lawn mixture and other beneficial greenspace practices included in this CAP.	2
G3-B-3	Create a communication campaign and educational content to increase opportunities for residents to learn about and take care of trees.	2
G3-B-4	Plant shade trees to limit the need for indoor cooling and reduce temperatures at parks, playgrounds, and other outdoor spaces. Collaborate with School District to include school properties.	3

Goal G 4 Reduce stormwater and micro heat island impacts.

Strategy G 4-A:

Reduce impervious surfaces.

Reduction of impervious surfaces, particularly in sections of the community with high existing impervious surface ground cover share, can significantly reduce stormwater runoff and micro heat island impacts. Consistently implementing green streets, green streets, or living streets, or complete street policies will advance replacement of impervious surface with greenspace and pervious surfaces. (Note, “green street” is a stormwater management approach that incorporates vegetation, soil, and engineered systems to slow, filter, and cleanse stormwater runoff from impervious surfaces; “complete street” is a design approach that requires streets to be designed to support safe, convenient and comfortable travel and access for users of all ages and abilities regardless of their mode of transportation; “living street” combines the concepts of complete streets and green streets while putting additional focus on quality of life aspects for City residents)

How We'll Measure Progress:

Status of policy development and implementation

Co-Benefits of Strategy:

Safer Streets

Improved Community Resilience

Improved Community Equity

Improved Quality of Life

	Actions	Implementation Phase
G4-A-1	Create a "Living Streets" policy (Living Streets combines the concepts of complete streets and green streets, and also puts additional focus on quality of life aspects for City residents) to guide current and future street construction, reconstruction, and maintenance projects within the City.	1
G4-A-2	Use green infrastructure such as bioswales, permeable pavement, other pervious surfaces to reduce flood risk and minimize sediment entry into creeks from trails and roads.	2

Greenspace and Ecosystem Health

Strategy G 4-B:

Increase water uptake capacity of greenspace.

How We'll Measure Progress:
Status of policy development and implementation; greenspace and tree coverage

Increasing soil capacities for water uptake, particularly in sections of the city with high flood and flash flood risks, increases the capacity for stormwater management in place and reduces the risks or severity of flooding impacts. Use of best practices like biochar soil amendments and soil profile rebuilding at building and road construction sites can improve the capacity of greenspace.

Co-Benefits of Strategy:

	Actions	Implementation Phase
G4-B-1	Implement a policy requiring a biochar (a carbon-rich product resulting from the pyrolysis of organic residues) soil amendment for all City building and earth working construction sites. Encourage biochar soil amendment use for private sector construction and earth working construction sites. Biochar improves soil carbon sequestration and builds carbon content of topsoil, and improves water retention and permeability characteristics.	1
G4-B-2	Implement a policy to require soil profile rebuilding at new tree installations at all City building project sites or compacted soil conditions to reduce erosion and runoff contaminated with fertilizers, increase soil carbon stores and support long-term soil building. Encourage soil profile rebuilding for private sector building project sites or compacted soil conditions. (https://www.urbanforestry.frec.vt.edu/SRES/)	1
G4-B-3	Explore revegetation, tree preservation planting and maintenance, depaving and porous pavement, and green infrastructure like bioswales ecoroofs and site development performance standards in support of the City's Citywide Ground Cover and Heat Island Assessment, Land Conversion Opportunity Study, and Urban Forest Management Plan.	2
G4-B-4	Keep natural resource areas, especially urban streams, cooler by increasing the width of vegetated areas along streams and wetlands and maintaining tree canopy.	2
G4-B-5	Transition maintenance of all city owned properties to Carbon Gardening practices including elimination of synthetic fertilizer and pesticide use, high mow deck settings, use of biochar amendments, and polyculture lawn mixture.	2

What You Can Do

- Plant a rain garden with native plantings to absorb storm water and replenish our aquifers.
- Plant trees in your yard to provide shade and cooling in summer heat. Select trees suited for the changing climate of Bloomington. (see: https://forestadaptation.org/learn/resource-finder/indiana-climate-change-projections-heat-hardiness-zones-and-tree-species)
- Replace your lawn and landscape with drought-resistant, native or well-adapted, non-invasive plants.
- Make your backyard a Certified Wildlife Habitat with the National Wildlife Federation. www.nwf.org/garden-for-wildlife/certify
- Remove pavement and increase permeable surfaces. De-pave areas wherever possible to encourage stormwater infiltration onsite.
- Install bioswales/rain gardens or rainwater diversion systems to reduce impact on the stormwater system.
- Install a Green Roof (living roof) to reduce your energy consumption. Decrease heat island impacts, and reduce stormwater runoff.

Section 09

Climate Economy

Click here to return to TOC

Climate Economy

Why Climate Economy Is Important

Climate change impacts are increasingly affecting the economy. Left unabated, the impacts of man-made climate change through the end of this century will cost the United States billions of dollars. According to a 2019 EPA study, the discrepancy in climate change related economic impact society faces under a "business-as-usual" scenario and meeting the reduction goal established in the Paris Agreement may account for as much as $224 billion difference in climate related economic impact annually by 2090. According to a 2019 World Bank report on carbon pricing trends, a carbon price range of $40-$80 per ton is necessary by 2020 to reach the goals set by the 2015 Paris Agreement, while other studies have placed the full cost of carbon at $200-$400 per ton. The calculations outlined in Section 1 of this plan estimate a conservative localized cost for carbon at over $116 per ton.

The economy is also directly affected by actions taken to combat climate change, as well. Many that are adverse to taking action on climate cite damage to the economy as a reason for inaction. Evidence continues to build that action can be taken on climate that strengthens economic growth, while also reducing emissions. That has occurred in Bloomington. While the city's GDP has *increased* 59%, Bloomington has experienced community GHG emissions *decrease* by 18%.

Between 2018 and 2028, there are projected to be 8,936 new jobs annually in Monroe County, 8,455 projected to be replacement openings (Job Postings by County, IN Department of Workforce Development). Though higher-wage sectors of life sciences, technology and healthcare have potential as growing sectors, according to the Bureau of Labor Statistics, 89% of the jobs in the Bloomington metropolitan area are in the following areas of employment: manufacturing; trade, transportation, and utilities; professional and business services; education and health services; leisure and hospitality; and government.

"Climate Economy" refers to an economy that is both resilient to the projected impacts of climate change, as well as supportive of reducing community-wide emissions in line with the goals of the Climate Action Plan. Many of the climate actions included in this plan can reduce Bloomington's contributions to global emissions, deal with the risks posed by climate change, while achieving economic growth and opportunity. Transformative change is needed now in how we build our cities, produce and use energy, transport people and goods, and manage our landscapes. The changes that climate change will require also represent opportunities to improve quality of life, improve health outcomes, and provide opportunities for workforce development, new job creation, and economic development.

Climate Change Considerations

Climate Hazards

In many sectors, climate change will impact water and energy consumption and costs. Extreme weather and increasing variability in temperatures and precipitation may stress transportation systems and fleets. Increasing extreme weather hazards may threaten supply material and product supply chains.

Opportunities

Climate mitigation strategies like transformation of Bloomington's energy system, improvements to the energy efficiency of the city's building stock, enhancement of transportation alternatives, and the implementation of goals like tree canopy increases and reduction to impervious surfaces represent opportunities for the development of new businesses and job creation.

Climate Economy

Equity Considerations

- Low income individuals in our communities are especially prone to the impacts of climate change and bear a greatly disproportionate share of the costs—including vulnerability to job instability that can be brought about by extreme weather events and other climate change impacts.
- Income inequality is rising in the US, with September 2019 levels being the highest in 50 years. High inequality leads to lower life spans, increased instances of mental health issues, and increased obesity rates among other social impacts. Because the impacts and the costs of climate change are disproportionately felt by vulnerable populations and low-income individuals, climate change impacts will exacerbate income inequality in our communities.

Sector Goals

Sector goals are established to both support the City's Climate Action Plan in creating a climate resilient community and to reduce city-wide GHG emissions 25% below 2018 levels by 2030.

Sector goals related to GHG emissions reductions are designed to balance reduction across all sectors and achieve the overall emissions goals set forth for the community. The goals seek to strike a balance between achievability while also reaching -for improvement beyond business-as-usual.

As indicated in the introduction, the Climate Action Plan is intended to be a 10 year plan to be updated at the completion of that time. Consequently, the goals and strategies outlined in this section are intended to be achieved by 2030 unless otherwise noted.

Implementation of actions are anticipated to be initiated over 3 phases: phase 1 within 1-3 years, phase 2 within 2-5 years, and phase 3 within 4-8 years of CAP approval.

Goal CE 1
Build marketplace climate resilience.

Goal CE 2
Attract, create, and support businesses that are committed to sustainability and climate goals.

Goal CE 3
Develop new mechanisms for financing City climate action plan implementation.

Goal CE 1 Build marketplace climate resilience.

Strategy CE 1-A:

Evaluate climate risks to businesses.

How We'll Measure Progress:

Status of Climate Economic Impacts Study; Status of technical assistance program; Number of businesses engaged

Projected climate change impacts pose potential challenges to businesses in the form of supply chain interruptions, property damage from extreme weather, labor productivity impacts of extreme temperatures, and potential increased operational costs associated with increasing energy demands. Identification of the risks by economic sector can support businesses in making appropriate plans to avoid or mitigate potential negative impacts.

Co-Benefits of Strategy:

Reduced Costs

Improved Community Resilience

	Actions	Implementation Phase
CE1-A-1	Collaborate with businesses to identify industry specific economic impacts Bloomington businesses (particularly small businesses and disadvantaged group businesses) face based on the climate change based on risks and hazards identified in this report, the Climate Risk and Vulnerability Assessment, and the City/County emergency management response plan. Collaborate with businesses to Identify economic resilience strategies in response to those economic vulnerabilities and conduct outreach to industry groups and public-private partnerships to promote private sector investment addressing them.	1
CE1-A-2	Conduct a study to Identify economic opportunities possible through the successful implementation of the CAP plan and achievement of its goals, especially those which can provide opportunity for the city's vulnerable populations. https://www.eda.gov/ceds/	2
CE1-A-3	Strengthen public-private economic communications in support of climate resilience, climate economic opportunities, and the goals of this CAP. Effort should focus particularly on communications with disadvantaged group businesses (minority-owned, veteran owned, economically disadvantaged, etc.), and small businesses.	2
CE1-A-4	Collaborate with local and regional partners including the County, and Indiana University to establish a technical assistance or Climate Resilient Business concierge service and to work with businesses to assess their climate change vulnerability and plan for the future.	2
CE1-A-5	Support climate resilience of local economy by preparing water, road, utilities, and other public infrastructure for increased demands from climate change based on Bloomington Climate Risk and Vulnerability Assessment, Emergency Management Plan, and State climate change data and projections.	3

Climate Economy

Strategy CE 1-B:

Accelerate the transition to a carbon free local economy.

How We'll Measure Progress:
Status of permitting process streamlining; Status of "Green contractor" resource/database

When businesses understand the need for addressing climate mitigation strategies and embrace the opportunities of improved energy efficiency and renewable energy will play a significant role in achieving the City's Climate Action Plan goals. These organizations will also benefit the most from the economic savings potential these strategies represent. Supporting that transition is key to helping Bloomington businesses leverage the advantages of climate action.

Co-Benefits of Strategy:

Improved Energy Resilience

Reduced GHG Emissions

	Actions	Implementation Phase
CE1-B-1	Work with local unions and businesses to ensure that apprenticeship program includes solar training.	1
CE1-B-2	Explore the development of a job training and entrepreneurial development program similar to Operation Fresh Start. Program to focus on developing green jobs skills within vulnerable and underserved populations in local sustainable agriculture, energy efficiency audits and upgrades, renewable energy, and other skills that support the goals of the CAP. (http://www.operationfreshstart.org/)	1
CE1-B-3	Explore supporting local low income solar installations through the development of a local SREC market and financing mechanisms to offset solar installation costs for low income residents and small businesses.	1
CE1-B-4	Provide assistance vetting contractors, offering energy, waste, and water audits, and EV readiness assessments to local businesses.	2
CE1-B-5	Promote Bloomington as an environmentally friendly destination by highlighting the businesses that are taking steps to reduce resource consumption.	2

Goal CE 2 Attract, create, and support businesses that are committed to sustainability and climate goals.

Strategy CE 2-A:

Increase workforce development for the climate economy.

How We'll Measure Progress:
Status of job training and entrepreneurial program development; Number of residents trained and employed

Strengthening development of a workforce capable of participating in climate economy businesses such as renewable energy and building energy efficiency strategies is critical to supporting the development and expansion of these economic sectors and meeting the implementation goals of the Climate Action Plan. Focusing workforce development and training on underserved and vulnerable populations within Bloomington will have the added benefit of improving the economic stability of those most vulnerable and improving equity.

Co-Benefits of Strategy:

Improved Community Equity

Jobs / Economic Development

	Actions	Implementation Phase
CE2-A-1	Establish a job training and entrepreneurial development program focused on jobs that reduce GHG emissions, or support climate adaptation and community resilience. Explore Operation Fresh Start as a model (http://www.operationfreshstart.org/)	1

	Actions	Implementation Phase
CE2-A-2	Develop job training programs focused on building resiliency- solar construction, weatherization, etc. Potential example program: Colorado solar training program. Potential partners: Solar For All, Ivy Tech Community College and local solar installers. Coordinate with the City of Bloomington's Recover Forward program.	2
CE2-A-3	Develop specific programs to train residents of low and middle income communities for jobs in the green economy. Coordinate with Work One, Department of Workforce Development, Good Will Excel Center, Hoosier Hills Career Center, Ivy Tech Community College, and Regional Opportunities Initiative.	2
CE2-A-4	Collaborate with the School District, local community colleges, unions, and employers to establish a Green Jobs apprenticeship and internship program and facilitate the hiring of graduates through the promotion and subsidized internship placement with local employers.	3

Strategy CE 2-B:

Support Climate Economy economic development and new business creation.

Establishing an economic environment that encourages and supports entrepreneurs in identifying, launching, and growing businesses which supports the transitions needed to successfully implement the Climate Action Plan can hasten the transition and maximize the economic potential for local job creation.

How We'll Measure Progress:

Status of Clean Energy business incubator; Status of implementation of Renewable Energy Potentials Study recommendations; Number businesses and jobs created

Co-Benefits of Strategy:

Improved Community Equity

Jobs / Economic Development

	Actions	Implementation Phase
CE2-B-1	Establish a Clean Energy business incubator to support the establishment of innovative energy efficiency and renewable energy business models within the community. Explore incorporation with the Ivy Tech Community College.	1
CE2-B-2	Implement recommendations from the City of Bloomington Renewable Energy Potentials Study 2020. Prioritize utilization of local workforce and local renewable energy companies.	1
CE2-B-3	Partner with State and County waste management and local and regional recycling centers to establish a program to encourage and promote new entrepreneurial businesses advancing the use of recycled material feed stock, the utilization of organics composting, and "Circular Economy" concepts which further the goals of the CAP.	1
CE2-B-4	Explore opportunities to broaden the City's economic base with diversification initiatives, such as targeting the development of emerging clusters or industries that (a) build on the region's unique assets and competitive strengths; and (b) provide stability during downturns that disproportionately impact any single cluster or industry.	2
CE2-B-5	Focus business development efforts on businesses that have lower impacts on natural resources. Example: Trades District Technology Center.	2
CE2-B-6	Leverage city policy, purchasing, and regulation, and deepen local and regional partnerships including Indiana University to promote local research, development, and production of green technology and products.	2

	Actions	Implementation Phase
CE2-B-7	Establish a policy to prioritize use of local businesses for City financed energy efficiency and renewable energy projects, with special consideration given to businesses owned by women and minorities.	2
CE2-B-8	Consider climate change-related risks to local supply chains in implementation of the City's economic development strategy.	3
CE2-B-9	Work with community businesses to explore the creation of an incentivized “buy local” campaign to enhance resilience of small local businesses.	3

Goal CE 3 Develop new mechanisms for financing City climate action plan implementation.

Strategy CE 3-A:

Leverage existing financing pathways.

How We'll Measure Progress:

Status of policy development; Status of identification of dedicated Climate Action implementation funding sources

Existing financing structures represent opportunities to establish dedicated financial pathways supporting successful Climate Action implementation.

Co-Benefits of Strategy:

Reduced GHG Emissions

Jobs / Economic Development

	Actions	Implementation Phase
CE3-A-1	Explore adopting a tax financing mechanism such as a "resilience penny" property tax increase of $0.01 per $100 of assessed value and dedicate additional funds for climate mitigation and climate adaptation strategies. Funds may be used directly, or may be used as a repayment source for a bond issue.	1
CE3-A-2	Establish a policy that designates City Electric and Natural Gas Franchise Fee Income as funding source for Climate Initiatives. https://ilsr.org/energy/utility-franchise-fees/	1
CE3-A-3	Explore opportunities to utilize Tax increment Financing (TIF) to incentivize Mitigation and Adaptation actions. Options include the establishment of a Renewable Energy TIF district incentivizing on-site renewable energy utilization or a Net Zero TIF funding mechanism incentivizing high energy efficiency and Net Zero buildings.	2

Climate Economy

Strategy CE 3-B:

Develop new financing pathways.

How We'll Measure Progress:
Status of identification of dedicated Climate Action implementation funding sources

New financing structures represent opportunities to establish dedicated financial pathways supporting successful Climate Action implementation.

Co-Benefits of Strategy:

Reduced GHG Emissions

Jobs / Economic Development

	Actions	Implementation Phase
CE3-B-1	Adopt a "resilience penny" property tax increase of $0.01 per $100 of assessed value and dedicate additional funds for climate mitigation and climate adaptation strategies. Funds may be used directly, or may be used as a repayment source for a bond issue.	1
CE3-B-2	Explore the potential of developing a "Carbon Impact Fee" similar to the City of Watsonville CA. Additional funds raised to be used for Climate Mitigation and Adaptation implementation. Increased revenue to be used to fund Climate Mitigation and Adaptation implementation with a focus on the actions and strategies which increase the community's equity. https://www.cityofwatsonville.org/DocumentCenter/View/198/Frequently-Asked-Questions-About-the-Carbon-Fund-Ordinance-PDF https://www.cityofwatsonville.org/DocumentCenter/View/3944/Carbon-Fund-Voluntary-Compliance-Worksheet?bidId=	1
CE3-B-3	Explore Issuing “resilience bonds” that generate risk-reduction rebates from a city’s catastrophe insurance premiums to pay for resilience projects, prioritizing projects with high resilience, GHG mitigation, and climate adaptation potential.	2

Climate Economy

Climate Economy At Work In Bloomington

A number of businesses in Bloomington have demonstrated progress in centering their operations on promoting environmental well-being. Notable examples include:

- ***Manufacturing***- Cook Medical reduced landfilled waste from their Park 48 and Ellettsville facilities by 364,200 pounds in the last two years.
- ***Life sciences***- Catalent has committed to a 15% emissions decrease energy management program is in broad alignment with the ISO50001:2018 energy management standard and has completed water, energy, and waste audits.
- ***Health services***- IU Health system is building a system wide road map with energy teams at each of its hospitals and is switching bulbs at facilities to LED lighting.
- ***Education***- Indiana University Bloomington has over 25 LEED certified buildings and continues to reaffirm the commitment that all new construction receives a minimum LEED Gold certification or higher. https://cpf.iu.edu/capital-projects/leed-projects/index.html
- ***Government***- City of Bloomington made a $17 million investment to install rooftop solar on 32 facilities, generating 5.71 GWh since 2018.
- ***Restaurant***- Lennie's received Bicycle Friendly Business certification in 2019, as well as the parent company One World Enterprise being recognized for "Governor's Award for Excellence in Recycling" from the State of Indiana.

Section 10
Climate Action Implementation

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Climate Action Implementation

The first few years after plan adoption are critical to its success. Establishing roles, both internal and external, and identifying funding will help establish the implementation phase of the plan and ensure the community is on track to achieve its goals. This plan includes robust goals for significant GHG emission reductions and addressing climate resilience. This vision require commitment and integration of the CAP into City operations, functions, and services.

Implementation is For Everyone

Implementation actions are detailed items that should be completed in order to carry out the vision and strategies identified in the plan. Some actions will need to be led by City Council, city departments, and/or the business community; and there are some things that households and individuals can do to make an impact. While many actions will require City Council to amend a policy there will be opportunities for businesses, organizations, households, and individuals to support the City Council policy changes and provide input on and feedback on those policies. Ultimately, achieving the visionary energy efficiency, renewable energy, alternative transportation, and climate resilience goals outlined in this plan will require engagement and a sense of responsibility not only by the City of Bloomington leadership and government, but by the community itself as well. It is critical for all to remain engaged and active, advancing and advocating for actions you feel are important.

General Implementation Recommendations

The following are foundational recommendations to support the long-range implementation of the CAP:

Building Internal Capacity

Continuing to build internal capacity will be important to help establish the CAP as a priority integral to internal operations as well as fostering connections to community partners, businesses, and individuals through outreach, education, special projects, and service delivery.

1. Establish clear guidance and direction for the participation in and support of the CAP implementation actions by all City of Bloomington departments.
2. Fund and support Sustainability staffing required to:
    - Facilitate discussion among large users to reduce emissions through business and industrial strategies.
    - Participate in technical resource programs as they are available through County, State, Federal, and non-profit provider partners.
    - Support City of Bloomington department managers and staff as they implement CAP actions within their service area or area of expertise.
    - Convene an internal City climate working group that meets regularly and provides updates on progress and success, identifies additional support or resources needed to advance actions of the CAP, and collaboratively discusses strategies for more complex challenges.
    - Ensure the establishment and maintenance of a City of Bloomington Climate Action webpage supporting CAP resources for the community.
    - Coordinate and organize volunteer groups and events.
    - Engage city boards and commissions (e.g., Environmental Commission, Tree Commission, Commission on Sustainability, Park Department's Environmental Resources Advisory Council, Planning Commission, City Council Climate Action & Resilience Committee, etc.) to ensure the CAP is integrated into their work plans.
3. Review Climate Action Plan implementation progress and impacts on a regular basis (1-2 year cycle). Review should include development of an updated community wide GHG inventory. Strategies and actions should be reviewed for implementation progress and for continued appropriateness. Based on the review, adjust, add, and remove detailed CAP actions as appropriate.

Climate Action Implementation

External Support

City staff and elected officials will not be able to implement this plan without robust support from community members and coordination with jurisdictional, institutional, and organizational partners.

1. Establish the Commission on Sustainability as the main citizen-body to support the implementation of the CAP:
    - Form subcommittees that focus on particular areas of the CAP.
    - Coordinate with City staff in all relevant departments to receive updates on City projects and progress.
2. Establish a designated Council representative participant in the City's internal climate working group in support of CAP implementation.
3. Establish a coordinated communication and education campaign supporting the educational and informational actions included in each of the CAP sections. The campaign should also look to help community members:
    - Understand why change at the individual, community, city, and business level needs to occur,
    - How to make those changes correctly, and
    - What the benefit/incentive to them might be, for example, articulating that switching to solar energy and or an electric bus fleet might help reduce bills
2. Establish jurisdictional partnerships that advance CAP strategies to advance and accelerate action. This can include government entities like Monroe County, the State of Indiana, conservation districts, utilities like Duke Energy and Vectren; institutions like Indiana University; Bloomington businesses, and community groups.

Funding

Funding the implementation of the CAP will require reallocation/reconsideration of existing City funds, raising new City funds, and identifying outside resources and funding opportunities. Some funds will need to be dedicated toward long-term support like staffing, while other funding will be on a project-by-project basis.

1. Maintain a budget and identify funding sources for staff dedicated to the implementation of the CAP.
2. Identify a budget necessary to support projects on an annual basis as per the detailed actions outlined in the Climate Economy section of the plan and climate actions.
3. Utilize no-cost technical assistance offerings as available.

Climate Action Implementation Support Tools

To support the City in its initial implementation phase, the paleBLUEdot team has created a number of tools including:

- Bloomington Climate Community Messaging Strategy
  Bloomington Net Zero Energy Building Guide (https://palebluedot.llc/bloomington-net-zero-energy-guide)
- Bloomington Solar Ready Guide (https://palebluedot.llc/bloomington-solar-ready-guide)
- Example Climate Action Policies and Ordinances (https://palebluedot.llc/bloomington-cap-policies)

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Section A1

GHG Forecast Assumptions

Bloomington Business as Usual GHG Methodology

Jen McGraw, Center for Neighborhood Technology

September 25, 2020

Bloomington GHG Emissions Today

Bloomington's 2008 and 2018 greenhouse gas (GHG) inventories as recorded in the ICLEI ClearPath online tool and shown in Table 1 are the starting point for projecting future communitywide emissions.[1] The largest share of GHG emissions today come from electricity use, followed by transportation and natural gas use.

Table 1. Bloomington GHG Inventories 2008 & 2018

	GHG Emissions ($MTCO_2e$)	
	Year	
Source	2008	2018
Electricity	1,045,212	777,859
Natural Gas	92,245	100,082
Other Industrial Energy	57,785	84,540
Transportation	184,030	198,141
Waste	69,899	81,786
Water & Wastewater	21,380	14,751
Other	61,567	33,334
Total	1,532,117	1,290,493

Business as Usual to 2050

Business as Usual (BAU) GHG emissions are modeled by applying demographic and other trend data to the emissions inventory to develop projected emissions levels that could occur in 2025, 2030 and 2050 without additional climate action in Bloomington. These years were chosen because they are the years of Bloomington's emissions reduction targets.

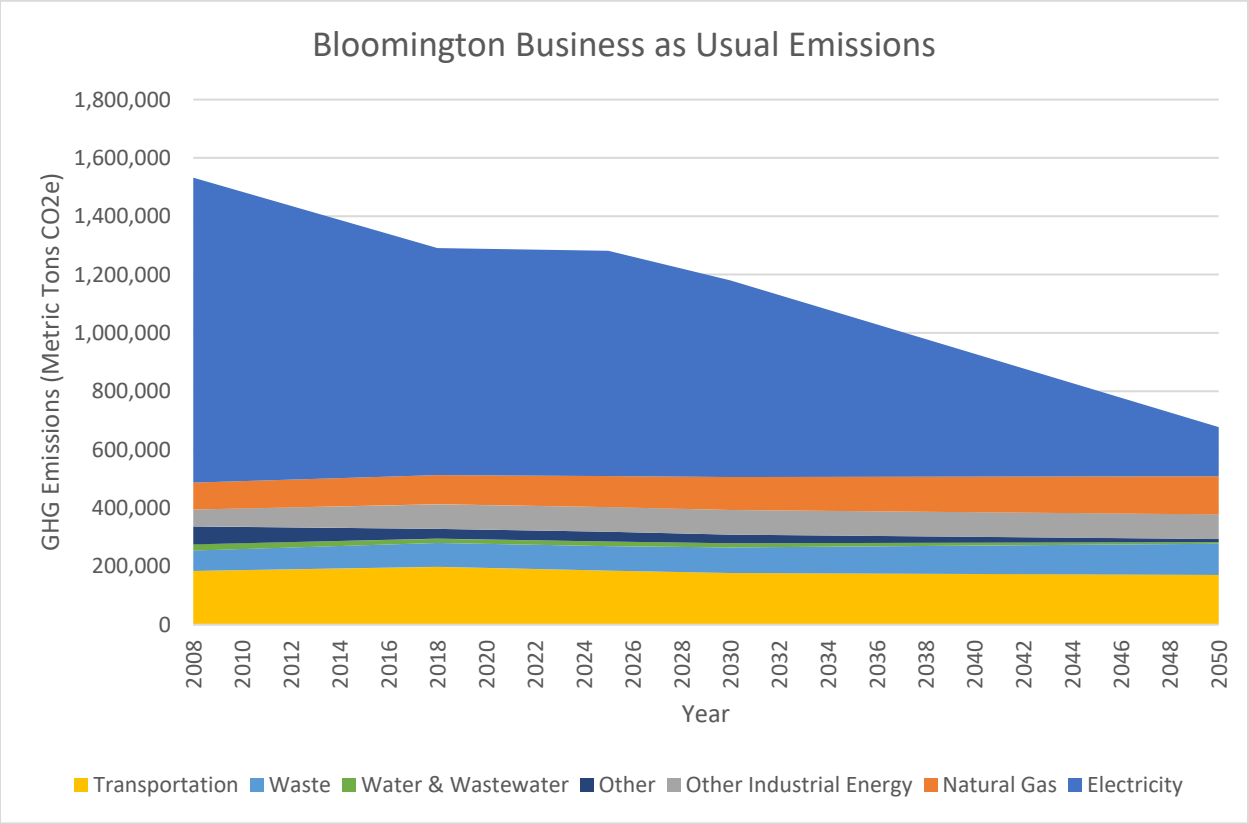
The BAU shows that the city's community-wide emissions footprint could fall to 677,164 metric tons of carbon dioxide equivalent ($MTCO_2e$) by 2050 (Figure 1 & Table 2). This would be less than half of Bloomington's 2008 emissions. These changes come from a national move away from fossil fuels in the electricity grid, increased automobile and appliance efficiencies, and changes energy demand. These trends are due to technology improvements, corporate climate commitments, federal regulations, climate shifts, and other systemic changes. The projected emissions decrease will be important in supporting Bloomington's climate commitments, but Bloomington will not meet its stated goals without taking further action to reduce emissions.

The BAU projection is meant to be a guide for action planning by showing the general direction of emissions by sector. There is significant uncertainty in the BAU. Furthermore, the BAU is not a replacement for regular emissions tracking and program evaluation. As Bloomington implements

[1] Bloomington ClearPath Account. Data accessed August 2020.

climate action it should inventory emissions and make sure climate strategies are achieving intended savings.

Figure 1. Bloomington Business as Usual GHG Projection (MT CO_2e)



Electricity Carbon Intensity the Biggest Change

By far, the largest source of change in emissions in the BAU comes from the decarbonization of the electricity grid that serves Bloomington. As carbon-intensive sources of power, like coal, have been decommissioned the average GHG emissions associated with a kilowatt-hour (kWh) of electricity used in Bloomington has fallen in recent years. This is expected to continue if the major electricity supplier for the area, Duke Energy, meets its goals of cutting GHG emissions 50% below 2005 levels by 2030 and to "net zero" emissions by 2050.[2] This projected change in the electricity supply also impacts Bloomington's Water & Wastewater emissions, which include emissions associated with electricity to operate the water and wastewater systems.

Waste Emissions Largest Projected BAU Increase

The largest increase in GHG emissions in the BAU is from solid waste. Bloomington is projected to have significant population growth through 2050, so if waste generation and management practices are not changed the emissions from solid waste will grow too.

[2] https://www.duke-energy.com/_/media/pdfs/our-company/climate-report-2020.pdf

Table 2. Bloomington BAU GHG Emissions ($MTCO_2e$)

	Year			Change	Change	Share of Total Change
Source	2025	2030	2050	2008-2050	2008-2050	
Electricity	772,099	674,354	168,363	(876,849)	-84%	103%
Natural Gas	106,524	112,645	130,816	38,571	42%	-5%
Other Industrial Energy	84,540	84,540	84,540	26,755	46%	-3%
Transportation	185,255	176,704	170,720	(13,310)	-7%	2%
Waste	83,478	87,651	106,541	36,642	52%	-4%
Water & Wastewater	16,264	14,403	5,408	(15,972)	-75%	2%
Other	33,322	29,743	10,776	(50,791)	-82%	6%
Business as Usual Total	**1,281,481**	**1,180,041**	**677,164**	**(854,953)**	**-56%**	**100%**

Data and Assumptions

The assumptions for each projection by emissions source are described below.

Population

Bloomington is projected to see a 52% population growth between 2008 and 2050 to over 118,000 residents in the BAU scenario. This will impact the level of activity throughout the city. The BAU uses Bloomington's 2018 population of 86,522 and applies a 1% annual increase to that value. This is in line with recent growth and the average growth in Monroe County from STATS Indiana from 2000-2050.[3]

Electricity

The Bloomington GHG Inventory uses the grid average emissions factor from the US EPA's eGRID database for the RFC West subregion. As mentioned, the BAU incorporates Duke Energy's 50% reduction below 2005 by 2030 and net zero by 2050 climate goals. Net zero typically means that there are still some fossil fuel emissions in the system that are being offset some other way. The BAU assumes 10% of GHG emissions per kWh remaining in 2050 based on Duke Energy's plan to maintain 6% natural gas and 30% other energy sources.[4]

[3] http://www.stats.indiana.edu/pop_proj/ An alternative method for projecting Bloomington's population would be a proportional value of the county projection. STATS Indiana projects a population of 180,159 residents for Monroe County in 2050, which if weighted proportionally to 2018 would mean 106,000 Bloomington residents in 2050. The BAU uses the higher number of 118,000 for the sake of capturing the full potential climate impact of population growth.

[4] https://www.axios.com/duke-energy-carbon-free-18a6b5b7-2829-4fe5-a445-e940edf26b76.html

Table 3. Electricity Carbon Intensity

Year	2005	2008	2018	2025	2030	2050
Electricity Emissions Factor ($MTCO_2e$/kWh)	0.000703	0.000702	0.000532	0.000427	0.000351	0.000070
Change from 2005	0%	0%	-24%	-39%	-50%	-90%

As climate change increases high heat days in Bloomington the demand for air conditioning is expected to increase electricity use. This is measured in "cooling degree days", which are projected to rise 42% by 2050.[5] The BAU applies this change to 20% of the electricity activity to approximate the share of electricity use that may be for space cooling.

The electricity BAU projection incorporates the projected population growth for Bloomington. Combining these factors, the electricity demand in Bloomington is projected to increase from 1.5 million kWh in 2018 to 1.9 million kWh in 2030 and 2.4 million kWh in 2050, but emissions associated with this activity decline as the electricity grid becomes less carbon intensive.

Natural Gas

Climate change is anticipated to reduce the need for space heating in Bloomington. "Heating degree days" are projected to decline 14% by 2050. The BAU applies this change to 75% of the natural gas use to approximate the share of natural gas used for heating.[6]

The natural gas BAU estimate incorporates the projected population growth for Bloomington and total usage grows to 25 million therms by 2050. The carbon-intensity of natural gas stays constant through the BAU projection.

Other Industrial Energy

In the Bloomington GHG inventory "Other Industrial Energy" is energy used at the IU Central Heating Plant. As described in the 2018 GHG Inventory, emissions at this facility have decreased with fuel switching from coal to natural gas in recent years. The 2018 emission level is projected to stay flat through 2050 under BAU.

[5] See weighted mean of RCP 8.5 projections https://crt-climate-explorer.nemac.org/local-climate-charts/?county=Monroe%2BCounty&city=Bloomington%2C%20IN&fips=18105&lat=39.165325&lon=-86.52638569999999&zoom=7&nav=local-climate-charts&id=cdd_65f

[6] See weighted mean of RCP 8.5 projections https://crt-climate-explorer.nemac.org/local-climate-charts/?county=Monroe%2BCounty&city=Bloomington%2C%20IN&fips=18105&lat=39.165325&lon=-86.52638569999999&zoom=7&nav=local-climate-charts&id=cdd_65f

Transportation

Transportation emissions in the Bloomington GHG Inventory are comprised of gasoline and diesel use by on-road vehicle travel, transit vehicle fuel use, aviation emissions at the Monroe County Airport, and off-road activities, such as construction equipment.

Emissions from non-transit gasoline and diesel vehicles were 70% of Bloomington's transportation emissions in 2018. On-road vehicle miles traveled (VMT) in Bloomington were 293 million miles in 2018 and the BAU scenario applies the average annual population increase to this going forward, resulting in 415 million miles in 2050.

Vehicle efficiency has been improving nationwide, and the Energy Information Agency's Annual Energy Outlook (EIA AEO) projects that trend will continue. The BAU projection uses a weighted average fuel economy for gasoline passenger vehicles and diesel heavy trucks to estimate that fossil fuel vehicles on the road in 2050 will average 31.5 miles per gallon (mpg).[7] The carbon-intensity of gasoline and diesel fuel stay constant through the BAU projection.

In addition, national projections expect an increased uptake of electric vehicles in coming years. The Edison Electric Institute has estimated that electric vehicle will be 7% of all vehicles on the road in the country by 2030.[8] Sales of electric vehicles in Indiana have been lower than national averages to-date, so the BAU projection assumes a lower share of EVs in Bloomington—2% of vehicle miles traveled by 2025, 3.5% by 2030, and 9% by 2050.[9] The efficiency of electric vehicles is held constant at 30 kWh per 100 miles.[10]

The emissions associated with other transportation sources are held constant at 2018 levels. Taken together these trends result in a decrease in transportation-related emissions even as VMT grows in the city.

[7] https://www.eia.gov/outlooks/aeo/pdf/appa.pdf
[8] http://www.ehcar.net/library/rapport/rapport233.pdf
[9] https://autoalliance.org/energy-environment/advanced-technology-vehicle-sales-dashboard/
[10] https://www.fueleconomy.gov/feg/PowerSearch.do?action=noform&path=1&year1=2019&year2=2020&vtype=Electric&pageno=4&sortBy=Comb&tabView=0&rowLimit=10 Efficiency of EVs will improve over coming years but will also be counter-weighted by the introduction of additional larger vehicle types.

Table 4. Transportation Emissions Projections

Year	2008	2018	2025	2030	2050
VMT	272,403,655	293,007,400	325,320,930	341,586,976	415,201,105
Average On-Road MPG	19.1	19.5	23.5	26.2	31.5
Gallons of Fuel (Gasoline & Diesel)	14,237,620	15,040,733	13,550,057	12,576,835	11,975,859
On Road Gas/Diesel Emissions ($MTCO_2e$)	130,093	138,553	124,821	115,856	110,320
Electric Emissions ($MTCO_2e$)			846	1,260	812
Other Emissions ($MTCO_2e$)	53,937	59,588	59,588	59,588	59,588
Total Transportation Emissions	**184,030**	**198,141**	**185,255**	**176,704**	**170,720**
Change from 2008	0%	8%	1%	-4%	-7%

Waste

Emissions associated with solid waste disposal and treatment are scaled based on population growth projections.

Water and Wastewater

In 2018, 88% of the emissions associated with water and wastewater are due to electricity use in the system. As discussed in the electricity section above, the decarbonization of the electricity grid is projected to eliminate many of these emissions. The BAU links future water and wastewater electricity use and wastewater N2O emissions to population growth in Bloomington. The net result is a 63% reduction in emissions from these sources to 5,408 $MTCO_2e$ in 2050.

Other Emissions

The fugitive emissions associated with natural gas and the transmission and distribution emissions associated with electricity were 3.26% and 3.87% respectively in 2018. The BAU projection applies these same shares to natural gas and electricity going forward.

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Section A2

Glossary of Terms

A

Activity Data

Data on the magnitude of a human activity resulting in emissions or removals taking place during a given period of time. Data on energy use, metal production, land areas, management systems, lime and fertilizer use and waste arisings are examples of activity data. (IPCC)

Aerosols

A collection of airborne solid or liquid particles, with a typical size between 0.01 and 10 micrometer that reside in the atmosphere for at least several hours. Aerosols may be of either natural or anthropogenic origin. Aerosols may influence climate in several ways: directly through scattering and absorbing radiation, and indirectly by acting as cloud condensation nuclei or modifying the optical properties and lifetime of clouds. (IPCC2)

Afforestation

Planting of new forests on lands that historically have not contained forests. (IPCC2)

Air Pollutant

Any man-made and/or natural substance occurring in the atmosphere that may result in adverse effects to humans, animals, vegetation, and/or materials. (CARB)

Anthropogenic

The term "anthropogenic", in the context of greenhouse gas inventories, refers to greenhouse gas emissions and removals that are a direct result of human activities or are the result of natural processes that have been affected by human activities. (USEPA2)

Atmosphere

The gaseous envelope surrounding the Earth. The dry atmosphere consists almost entirely of nitrogen (78.1% volume mixing ratio) and oxygen (20.9% volume mixing ratio), together with a number of trace gases, such as argon (0.93% volume mixing ratio), helium and radiatively active greenhouse gases such as carbon dioxide (0.035% volume mixing ratio) and ozone. In addition, the atmosphere contains the greenhouse gas water vapor, whose amounts are highly variable but typically around 1% volume mixing ratio. The atmosphere also contains clouds and aerosols. (IPCC2)

B

Baseline Emissions

A baseline is a measurement, calculation, or time used as a basis for comparison. Baseline emissions are the level of emissions that would occur without policy intervention or without implementation of a project. Baseline estimates are needed to determine the effectiveness of emission reduction programs (also called mitigation strategies).

Base Year

The starting year for the inventory. Targets for reducing GHG emissions are often defined in relation to the base year.

Biogenic

Produced by the biological processes of living organisms. Note that we use the term "biogenic" to refer only to recently produced (that is non-fossil) material of biological origin. IPCC guidelines recommend that peat be treated as a fossil carbon because it takes a long time to replace harvested peat.

Biogeochemical Cycle

Movements through the Earth system of key chemical constituents essential to life, such as carbon, nitrogen, oxygen, and phosphorus. (NASA)

Biomass
Either (1) the total mass of living organisms in a given area or of a given species usually expressed as dry weight; or (2) Organic matter consisting of or recently derived from living organisms (especially regarded as fuel) excluding peat. Includes products, by-products and waste derived from such material. (IPCC1)

Biomass Waste
Organic non-fossil material of biological origin that is a byproduct or a discarded product. "Biomass waste" includes municipal solid waste from biogenic sources, landfill gas, sludge waste, agricultural crop byproducts, straw, and other biomass solids, liquids, and gases; but excludes wood and wood-derived fuels (including black liquor), biofuels feedstock, biodiesel, and fuel ethanol. Note: EIA "biomass waste" data also include energy crops grown specifically for energy production, which would not normally constitute waste. (EIA)

Black Carbon
Operationally defined aerosol species based on measurement of light absorption and chemical reactivity and/or thermal stability; consists of soot, charcoal and/or possible light absorbing refractory organic matter (Charlson and Heintzenberg, 1995, p. 401). (IPCC2)

C

Carbon Cycle
All parts (reservoirs) and fluxes of carbon. The cycle is usually thought of as four main reservoirs of carbon interconnected by pathways of exchange. The reservoirs are the atmosphere, terrestrial biosphere (usually includes freshwater systems), oceans, and sediments (includes fossil fuels). The annual movements of carbon, the carbon exchanges between reservoirs, occur because of various chemical, physical, geological, and biological processes. The ocean contains the largest pool of carbon near the surface of the Earth, but most of that pool is not involved with rapid exchange with the atmosphere. (NASA)

Carbon Dioxide (CO_2)
A naturally occurring gas, and also a by-product of burning fossil fuels and biomass, as well as land-use changes and other industrial processes. It is the principal anthropogenic greenhouse gas that affects the Earth's radiative balance. It is the reference gas against which other greenhouse gases are measured and therefore has a Global Warming Potential of 1. (IPCC2)\

Carbon Dioxide Equivalent (CO_2e)
A metric used to compare emissions of various greenhouse gases. It is the mass of carbon dioxide that would produce the same estimated radiative forcing as a given mass of another greenhouse gas. Carbon dioxide equivalents are computed by multiplying the mass of the gas emitted by its global warming potential.

Carbon Disclosure Project (CDP)
An international organization that administers a platform for organizations and cities to publicly disclose their environmental impacts, such as climate risk. CDP is one of the approved disclosure platforms utilized by GCoM.

Carbon Emissions
The release of carbon dioxide into the atmosphere. Primary human sources of the release of carbon dioxide occur from burning oil, coal, and gas for energy use.

Carbon Equivalent (CE)
A metric measure used to compare the emissions of the different greenhouse gases based upon their global warming potential. Carbon equivalents can be calculated from to carbon dioxide equivalents by multiplying the carbon dioxide equivalents by 12/44 (the ratio of the molecular weight of carbon to that of carbon dioxide). The use of carbon equivalent is declining in GHG inventories.

Carbon Intensity
The amount of carbon by weight emitted per unit of energy consumed. A common measure of carbon intensity is weight of carbon per British thermal unit (Btu) of energy. When there is only one fossil fuel under consideration, the carbon intensity and the emissions coefficient are identical. When there are several fuels, carbon intensity is based on their combined emissions coefficients weighted by their energy consumption levels. (EIA)

Carbon Neutrality
For the purposes of the Plan, Carbon Neutrality refers to the point at which the organization / organization's net greenhouse gas emissions reach 0. This will likely be achieved through a combination of reducing emission sources and offsetting and sequestering any remaining emissions.

Carbon Sinks
A forest, ocean, or other natural environment viewed in terms of its ability to absorb carbon dioxide from the atmosphere.

Carbon Sequestration
This refers to the capture of CO_2 from the atmosphere and its long term storage in oceans (oceanic carbon sequestration), in biomass and soils (terrestrial carbon sequestration) or in underground reservoirs (geologic carbon sequestration).

Chlorofluorocarbons (CFCs)
Greenhouse gases covered under the 1987 Montreal Protocol and used for refrigeration, air conditioning, packaging, insulation, solvents, or aerosol propellants. Because they are not destroyed in the lower atmosphere, CFCs drift into the upper atmosphere where, given suitable conditions, they break down ozone. These gases are being replaced by other compounds, including hydrochlorofluorocarbons and hydrofluorocarbons, which are greenhouse gases covered under the Kyoto Protocol. (IPCC3)

Circular Economy
An alternative to a traditional linear economy (make, use, dispose) in which an economy is a regenerative system where resource input and waste are minimized. This is achieved through long-lasting product design, repair, reuse, remanufacturing, and recycling. Circular economy strategies are often cited as systems level approaches to reducing waste generation through product and system design.

Climate
Climate in a narrow sense is usually defined as the "average weather" or more rigorously as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. The classical period is 30 years, as defined by the World Meteorological Organization (WMO). These relevant quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including a statistical description, of the climate system. (IPCC2)

Climate Adaptation or Resilience
The capacity of a natural environment to prevent, withstand, respond to, and recover from a disruption. The process of adjusting to new climate conditions in order to reduce risks to valued assets.

Climate Change
Climate change refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use. (IPCC2)

Climate Hazard
An extreme climate event or condition that can harm human health, livelihoods, or natural resources. It can include abrupt changes to the climate system such as extreme precipitation, storms, droughts, and heat waves.

Climate Risk
The potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values. Risk is often represented as probability of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur. Risk results from the interaction of vulnerability and hazard. (IPCC):

Climate Vulnerability
Is the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude and rate of climate change and variation to which a system is exposed, its sensitivity, and its capacity to adapt. Vulnerability = potential impact (sensitivity x exposure) – adaptive capacity (IPCC):

Climate Vulnerability Assessment
A report used to identify and define the risks posed by climate change and inform adaptation measures needed to combat climate change. Reports can be about a wide range of fields including food security, poverty analysis, and extreme weather events.

Cogeneration
Cogeneration is an industrial structure, installation, plant, building, or self-generating facility that has sequential or simultaneous generation of multiple forms of useful energy (usually mechanical and thermal) in a single, integrated system. (CARB)

Combined Heat and Power (CHP)
Combined heat and power is the simultaneous production of both electricity and useful heat for application by the producer or to be sold to other users with the aim of better utilisation of the energy used. Public utilities may utilise part of the heat produced in power plants and sell it for public heating purposes. Industries as auto-producers may sell part of the excess electricity produced to other industries or to electric utilities. (IPCC)

Community Solar
Solar facilities shared by multiple community subscribers who receive credit on their electricity bills for their share of the power produced. Community solar allows members of a community to share the benefits of solar power on their property without installing it on their own property. Electricity generated by the community solar farm typically costs less than the price from utility companies.

Consistency
Consistency means that an inventory should be internally consistent in all its elements over a period of years. An inventory is consistent if the same methodologies are used for the base and all subsequent years and if consistent data sets are used to estimate emissions or removals from sources or sinks. (IPCC)

Continuous Emission Monitor (CEM)
A type of air emission monitoring system installed to operate continuously inside of a smokestack or other emission source. (CARB)

Criteria Air Pollutant
An air pollutant for which acceptable levels of exposure can be determined and for which an ambient air quality standard has been set. Examples include: ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, and PM10 and

PM2.5. The term "criteria air pollutants" derives from the requirement that the U.S. EPA must describe the characteristics and potential health and welfare effects of these pollutants. The U.S. EPA and CARB periodically review new scientific data and may propose revisions to the standards as a result. (CARB)

D

Deforestation

Those practices or processes that result in the change of forested lands to non-forest uses. This is often cited as one of the major causes of the enhanced greenhouse effect for two reasons: 1) the burning or decomposition of the wood releases carbon dioxide; and 2) trees that once removed carbon dioxide from the atmosphere in the process of photosynthesis are no longer present and contributing to carbon storage. (UNFCC)

Distillate Fuel Oil

A general classification for one of the petroleum fractions produced in conventional distillation operations. It includes diesel fuels and fuel oils. Products known as No. 1, No. 2, and No. 4 diesel fuel are used in on-highway diesel engines, such as those in trucks and automobiles, as well as off-highway engines, such as those in railroad locomotives and agricultural machinery. Products known as No. 1, No. 2, and No. 4 fuel oils are used primarily for space heating and electric power generation. (EIA)

E

Emissions

The release of a substance (usually a gas when referring to the subject of climate change) into the atmosphere. (USEPA1)

Emission Factor

A coefficient that quantifies the emissions or removals of a gas per unit activity. Emission factors are often based on a sample of measurement data, averaged to develop a representative rate of emission for a given activity level under a given set of operating conditions. (IPCC)

Emission Inventory

An estimate of the amount of pollutants emitted into the atmosphere from major mobile, stationary, area-wide, and natural source categories over a specific period of time such as a day or a year. (CARB)

Emission Rate

The weight of a pollutant emitted per unit of time (e.g., tons / year). (CARB)

Environmental Justice

The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation and enforcement of environmental laws, regulations and policies

Estimation

Estimation is the assessment of the value of an unmeasurable quantity using available data and knowledge within stated computational formulas or mathematical models.

F

Fluorocarbons

Carbon-fluorine compounds that often contain other elements such as hydrogen, chlorine, or bromine. Common fluorocarbons include chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs). (UNFCC)

Flux
Either (1) Raw materials, such as limestone, dolomite, lime, and silica sand, which are used to reduce the heat or other energy requirements of thermal processing of minerals (such as the smelting of metals). Fluxes also may serve a dual function as a slagging agent. (2) The rate of flow of any liquid or gas, across a given area; the amount of this crossing a given area in a given time. (e.g., "Flux of CO2 absorbed by forests"). (IPCC)

Fossil Fuel
Geologic deposits of hydrocarbons from ancient biological origin, such as coal, petroleum and natural gas.

Fuel Combustion
Fuel combustion is the intentional oxidation of materials within an apparatus that is designed to provide heat or mechanical work to a process, or for use away from the apparatus. (IPCC)

Fugitive Emissions
Emissions that are not emitted through an intentional release through stack or vent. This can include leaks from industrial plant and pipelines. (IPCC)

G
Geologic Carbon Sequestration
It is the process of injecting CO_2 from a source, such as coal-fired electric generating power plant, through a well into the deep subsurface. With proper site selection and management, geologic sequestration could play a major role in reducing emissions of CO_2. Research efforts to evaluate the technical aspects of CO_2 geologic sequestration are underway. (USEPA4)

Global Warming
Global warming is an average increase in the temperature of the atmosphere near the Earth's surface and in the troposphere, which can contribute to changes in global climate patterns. Global warming can occur from a variety of causes, both natural and human induced. In common usage, "global warming" often refers to the warming that can occur as a result of increased emissions of greenhouse gases from human activities. Also see Climate Change (USEPA1)

Global Warming Potential (GWP)
An index, based upon radiative properties of well-mixed greenhouse gases, measuring the radiative forcing of a unit mass of a given well-mixed greenhouse gas in the present-day atmosphere integrated over a chosen time horizon, relative to that of carbon dioxide. The GWP represents the combined effect of the differing times these gases remain in the atmosphere and their relative effectiveness in absorbing outgoing thermal infrared radiation. The Kyoto Protocol is based on GWPs from pulse emissions over a 100-year time frame. (IPCC2)

GCOM Global Covenant of Mayors:
GCoM is the largest global alliance for city climate leadership, built upon the commitment of over 10,000 cities and local governments. The alliance's mission is to mobilize and support climate and energy action in communities across the world.

Greenhouse Effect
Trapping and build-up of heat in the atmosphere (troposphere) near the earth's surface. Some of the heat flowing back toward space from the earth's surface is absorbed by water vapor, carbon dioxide, ozone, and several other gases in the atmosphere and then reradiated back toward the earth's surface. If the atmospheric concentrations of these greenhouse gases rise, the average temperature of the lower atmosphere will gradually increase. (UNFCC)

Global Protocol for Community-Scale Greenhouse Gas Emissions Inventories:
A robust, transparent and globally-accepted framework that cities and local governments can use to consistently identify, calculate and report on city greenhouse gas emissions.

Greenhouse Gas
Any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include, but are not limited to, water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrochlorofluorocarbons (HCFCs), ozone (O_3), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). (UNFCC)

Green Infrastructure
An approach to managing precipitation by reducing and treating stormwater at its source while delivering environmental, social, and economic benefits. Stormwater runoff can carry trash, bacteria, and other pollutants and is a major cause of water pollution in urban areas.

Gross Domestic Product (GDP)
The sum of gross value added, at purchasers' prices, by all resident and non-resident producers in the economy, plus any taxes and minus any subsidies not included in the value of the products in a country or a geographic region for a given period, normally one year. It is calculated without deducting for depreciation of fabricated assets or depletion and degradation of natural resources. (IPCC3)

H

Halocarbons
A collective term for the group of partially halogenated organic species, including the chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs), halons, methyl chloride, methyl bromide, etc. Many of the halocarbons have large Global Warming Potentials. The chlorine and bromine-containing halocarbons are also involved in the depletion of the ozone layer. (IPCC2)

Hydrocarbons
Strictly defined as molecules containing only hydrogen and carbon. The term is often used more broadly to include any molecules in petroleum which also contains molecules with S, N, or O An unsaturated hydrocarbon is any hydrocarbon containing olefinic or aromatic structures. (IPCC)

Hydrofluorocarbons (HFCs)
Compounds containing only hydrogen, fluorine, and carbon atoms. They were introduced as alternatives to ozone depleting substances in serving many industrial, commercial, and personal needs. HFCs are emitted as by-products of industrial processes and are also used in manufacturing. They do not significantly deplete the stratospheric ozone layer, but they are powerful greenhouse gases with global warming potentials ranging from 140 (HFC-152a) to 11,700 (HFC-23). (USEPA1)

I

ICLEI Local Governments for Sustainability:
A membership organization for local governments to pursue reductions in carbon pollution and improvements in advancing sustainable urban development. ICLEI's members and team of experts work together through peer exchange, partnerships and capacity building to create systemic change for urban sustainability.

Intergovernmental Panel on Climate Change
The IPCC was established jointly by the United Nations Environment Programme and the World Meteorological Organization in 1988. The purpose of the IPCC is to assess information in the scientific and technical literature related to all significant components of the issue of climate change. The IPCC draws upon hundreds of the world's expert scientists as authors and thousands as expert reviewers. Leading experts on climate change and environmental, social, and economic sciences from some 60 nations have helped the IPCC to prepare periodic assessments of the scientific underpinnings for understanding global climate change and its consequences. With its

capacity for reporting on climate change, its consequences, and the viability of adaptation and mitigation measures, the IPCC is also looked to as the official advisory body to the world's governments on the state of the science of the climate change issue. For example, the IPCC organized the development of internationally accepted methods for conducting national greenhouse gas emission inventories. (USEPA1)

K

Kilowatt Hour (kWh):
A measure of electrical energy equivalent to a power consumption of 1,000 watts for one hour.

Kyoto Protocol
The Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) was adopted in 1997 in Kyoto, Japan, at the Third Session of the Conference of the Parties (COP) to the UNFCCC. It contains legally binding commitments, in addition to those included in the UNFCCC. Countries included in Annex B of the Protocol (most Organisation for Economic Cooperation and Development countries and countries with economies in transition) agreed to reduce their anthropogenic greenhouse gas emissions (carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulphur hexafluoride) by at least 5% below 1990 levels in the commitment period 2008 to 2012. The Kyoto Protocol entered into force on 16 February 2005. (IPCC2)

L

Land Use and Land Use Change
Land use refers to the total of arrangements, activities and inputs undertaken in a certain land cover type (a set of human actions). The term land use is also used in the sense of the social and economic purposes for which land is managed (e.g., grazing, timber extraction and conservation). Land use change refers to a change in the use or management of land by humans, which may lead to a change in land cover. Land cover and land use change may have an impact on the surface albedo, evapotranspiration, sources and sinks of greenhouse gases, or other properties of the climate system and may thus have a radiative forcing and/or other impacts on climate, locally or globally. (IPCC2)

LULUCF
Acronym for "Land Use, Land Use Change and Forestry", a category of activities in GHG inventories.

M

Megawatt Hour (MWH):
A measure of electrical energy equivalent to a power consumption of 1,000,000 watts for one hour.

Methane (CH_4)
A hydrocarbon that is a greenhouse gas with a global warming potential most recently estimated at 25 times that of carbon dioxide (CO_2). Methane is produced through anaerobic (without oxygen) decomposition of waste in landfills, flooded rice fields, animal digestion, decomposition of animal wastes, production and distribution of natural gas and petroleum, coal production, and incomplete fossil fuel combustion. The GWP is from the IPCC's Fourth Assessment Report (AR4).

Metric Ton
The tonne (t) or metric ton, sometimes referred to as a metric tonne, is an international unit of mass. A metric ton is equal to a Megagram (Mg), 1000 kilograms, 2204.6 pounds, or 1.1023 short tons.

Million Metric Tons (MMT)
Common measurement used in GHG inventories. It is equal to a Teragram (Tg).

Mitigation:
Actions taken to limit the magnitude or rate of long-term global warming and its related effects. Climate change mitigation generally involves reductions in human emissions of greenhouse gases.

Mobile Sources
Sources of air pollution such as automobiles, motorcycles, trucks, off-road vehicles, boats, and airplanes. (CARB)

Mode Share
The percentage of travelers using a particular type of transportation. Modal share is an important component in developing sustainable transport within a city or region because it reveals the level of utilization of various transportation methods. The percentage reflects how well infrastructure, policies, investments, and land-use patterns support different types of travel.

Model
A model is a quantitatively-based abstraction of a real-world situation which may simplify or neglect certain features to better focus on its more important elements. (IPCC)

Municipal Solid Waste (MSW)
Residential solid waste and some non-hazardous commercial, institutional, and industrial wastes. This material is generally sent to municipal landfills for disposal. (USEPA1)

N
Natural Sources
Non-manmade emission sources, including biological and geological sources, wildfires, and windblown dust. (CARB)

Net-zero Emissions (NZE)
Building A building or property that generates or offsets all energy consumed. If the City develops a NZE building code, this definition will have to be refined to provide additional guidance on calculating emissions and offsets to achieve net-zero emissions.

Nitrogen Fixation
Conversion of atmospheric nitrogen gas into forms useful to plants and other organisms by lightning, bacteria, and blue-green algae; it is part of the nitrogen cycle. (UNFCC)

Nitrogen Oxides (NO_x)
Gases consisting of one molecule of nitrogen and varying numbers of oxygen molecules. Nitrogen oxides are produced in the emissions of vehicle exhausts and from power stations. In the atmosphere, nitrogen oxides can contribute to formation of photochemical ozone (smog), can impair visibility, and have health consequences; they are thus considered pollutants. (NASA)

Nitrous Oxide (N_2O)
A powerful greenhouse gas with a global warming potential of 298 times that of carbon dioxide (CO_2). Major sources of nitrous oxide include soil cultivation practices, especially the use of commercial and organic fertilizers, manure management, fossil fuel combustion, nitric acid production, and biomass burning. The GWP is from the IPCC's Fourth Assessment Report (AR4).

O
Ozone (O_3)
Ozone, the triatomic form of oxygen (O_3), is a gaseous atmospheric constituent. In the troposphere, it is created both naturally and by photochemical reactions involving gases resulting from human activities (smog).

Tropospheric ozone acts as a greenhouse gas. In the stratosphere, it is created by the interaction between solar ultraviolet radiation and molecular oxygen (O_2). Stratospheric ozone plays a dominant role in the stratospheric radiative balance. Its concentration is highest in the ozone layer. (IPCC2)

Ozone Depleting Substances (ODS)
A compound that contributes to stratospheric ozone depletion. Ozone-depleting substances (ODS) include CFCs, HCFCs, halons, methyl bromide, carbon tetrachloride, and methyl chloroform. ODS are generally very stable in the troposphere and only degrade under intense ultraviolet light in the stratosphere. When they break down, they release chlorine or bromine atoms, which then deplete ozone. (IPCC)

P
Perfluorocarbons (PFCs)
A group of human-made chemicals composed of carbon and fluorine only. These chemicals (predominantly CF_4 and C_2F_6) were introduced as alternatives, along with hydrofluorocarbons, to the ozone depleting substances. In addition, PFCs are emitted as by-products of industrial processes and are also used in manufacturing. PFCs do not harm the stratospheric ozone layer, but they are powerful greenhouse gases: CF_4 has a global warming potential (GWP) of 7,390 and C_2F_6 has a GWP of 12,200. The GWP is from the IPCC's Fourth Assessment Report (AR4).

Photosynthesis
The process by which plants take carbon dioxide from the air (or bicarbonate in water) to build carbohydrates, releasing oxygen in the process. There are several pathways of photosynthesis with different responses to atmospheric carbon dioxide concentrations. (IPCC2)

Point Sources
Specific points of origin where pollutants are emitted into the atmosphere such as factory smokestacks. (CARB)

Power Purchase Agreement (PPA)
A power purchase agreement (PPA), or electricity power agreement, is a contract between two parties; one party generates electricity (the seller) and the other party looks to purchase electricity (the buyer). Individual customers and organizations may enter into PPAs with individual developers or may join together to seek better prices as a group. PPAs can allow longer term commitments to renewable energy as well as a form of “direct” investing in new renewable energy generation.

Property-Assessed Clean Energy (PACE)
A program created for financing energy efficiency and renewable improvements on private property. Private property can include residential, commercial or industrial properties. Improvements can include energy efficiency, renewable energy and water conservation upgrades to a building.

Process Emissions
Emissions from industrial processes involving chemical transformations other than combustion. (IPCC)

R
Radiative Forcing
A change in the balance between incoming solar radiation and outgoing infrared (i.e., thermal) radiation. Without any radiative forcing, solar radiation coming to the Earth would continue to be approximately equal to the infrared radiation emitted from the Earth. The addition of greenhouse gases to the atmosphere traps an increased fraction of the infrared radiation, reradiating it back toward the surface of the Earth and thereby creates a warming influence. (UNFCC)

Reforestation
Planting of forests on lands that have previously contained forests but that have been converted to some other use. (IPCC2)

Regeneration
The act of renewing tree cover by establishing young trees, naturally or artificially - note regeneration usually maintains the same forest type and is done promptly after the previous stand or forest was removed. (CSU)

Renewable Energy
Energy resources that are naturally replenishing such as solar, wind, hydro and geothermal energy.

Renewable Energy Credits (RECs)
A market-based instrument that represents the property rights to the environmental, social and other non-power attributes of renewable electricity generation. RECs are issued when one megawatt-hour (MWh) of electricity is generated and delivered to the electricity grid from a renewable energy resource. The single largest category of reductions in Evanston's emissions has been through the purchase of RECs.

Residence Time
Average time spent in a reservoir by an individual atom or molecule. Also, this term is used to define the age of a molecule when it leaves the reservoir. With respect to greenhouse gases, residence time usually refers to how long a particular molecule remains in the atmosphere. (UNFCC)

Reservoir
Either (1) a component or components of the climate system where a greenhouse gas or a precursor of a greenhouse gas is stored; or (2) Water bodies regulated for human activities (energy production, irrigation, navigation, recreation etc.) where substantial changes in water area due to water level regulation may occur. (IPCC)

Respiration
The process whereby living organisms convert organic matter to carbon dioxide, releasing energy and consuming molecular oxygen. (IPCC2)

Retro-commissioning
The systematic process to improve an existing building's performance ensuring the building controls are running efficiently and balancing the designed use and the actual use of the building.

Ride-share
The practice of sharing transportation in the form of carpooling or vanpooling. It is typically an arrangement made through a ride-matching service that connects drivers with riders.

S
Scope 1:
Scope 1 includes emissions being released within the city limits resulting from combustion of fossil fuels and from waste decomposition in the landfill and wastewater treatment plant.

Scope 2:
Scope 2 includes emissions produced outside the city that are induced by consumption of electrical energy within the city limits.

Scope 3:
Scope 3 includes emissions of potential policy relevance to local government operations that can be measured and

reported but do not qualify as Scope 1 or 2. This includes, but is not limited to, outsourced operations and employee commute.

Short Ton
Common measurement for a ton in the United States. A short ton is equal to 2,000 lbs or 0.907 metric tons. (USEPA1)

Sink
Any process, activity or mechanism that removes a greenhouse gas, an aerosol or a precursor of a greenhouse gas or aerosol from the atmosphere. (IPCC2)

Social Cost of Carbon
The social cost of carbon is a measure of the economic harm from climate change impacts, expressed as the dollar value of the total damages from emitting one ton of carbon dioxide into the atmosphere.

Solar Radiation
Electromagnetic radiation emitted by the Sun. It is also referred to as shortwave radiation. Solar radiation has a distinctive range of wavelengths (spectrum) determined by the temperature of the Sun, peaking in visible wavelengths. (IPCC2)

Source
Any process, activity or mechanism that releases a greenhouse gas, an aerosol or a precursor of a greenhouse gas or aerosol into the atmosphere. (IPCC2)

Stationary Sources
Non-mobile sources such as power plants, refineries, and manufacturing facilities which emit air pollutants. (CARB)

Sulfur Dioxide (SO_2)
A compound composed of one sulfur and two oxygen molecules. Sulfur dioxide emitted into the atmosphere through natural and anthropogenic processes is changed in a complex series of chemical reactions in the atmosphere to sulfate aerosols. These aerosols are believed to result in negative radiative forcing (i.e., tending to cool the Earth's surface) and do result in acid deposition (e.g., acid rain). (UNFCC)

Sulfur Hexafluoride (SF_6)
A colorless gas soluble in alcohol and ether, slightly soluble in water. A very powerful greenhouse gas with a global warming potential most recently estimated at 22,800 times that of carbon dioxide (CO_2). SF_6 is used primarily in electrical transmission and distribution systems and as a dielectric in electronics. This GWP is from the IPCC's Fourth Assessment Report (AR4).

T

Terrestrial Carbon Sequestration
It is the process through which carbon dioxide (CO_2) from the atmosphere is absorbed by trees, plants and crops through photosynthesis, and stored as carbon in biomass (tree trunks, branches, foliage and roots) and soils. The term "sinks" is also used to refer to forests, croplands, and grazing lands, and their ability to sequester carbon. Agriculture and forestry activities can also release CO_2 to the atmosphere. Therefore, a carbon sink occurs when carbon sequestration is greater than carbon releases over some time period. (USEPA3)

Therm:
A unit of measure for energy that is equivalent to 100,000 British Thermal units, or roughly the energy in 100 cubic feet of natural gas. Often used for measuring natural gas usage for billing purposes.

Total Organic Gases (TOG)
Gaseous organic compounds, including reactive organic gases and the relatively unreactive organic gases such as methane. (CARB)

Transparency
Transparency means that the assumptions and methodologies used for an inventory should be clearly explained to facilitate replication and assessment of the inventory by users of the reported information. The transparency of inventories is fundamental to the success of the process for the communication and consideration of information. (IPCC)

Trend
The trend of a quantity measures its change over a time period, with a positive trend value indicating growth in the quantity, and a negative value indicating a decrease. It is defined as the ratio of the change in the quantity over the time period, divided by the initial value of the quantity, and is usually expressed either as a percentage or a fraction. (IPCC)

U
Urban Tree Canopy
Describes the makeup and characteristics of trees within the urban environment.

V
VMT Vehicle Miles Traveled:
A unit used to measure vehicle travel made by private vehicles, including passenger vehicles, truck, vans and motorcycles. Each mile traveled is counted as one vehicle mile regardless of the number of persons in the vehicle.

W
Water Vapor
The most abundant greenhouse gas; it is the water present in the atmosphere in gaseous form. Water vapor is an important part of the natural greenhouse effect. While humans are not significantly increasing its concentration, it contributes to the enhanced greenhouse effect because the warming influence of greenhouse gases leads to a positive water vapor feedback. In addition to its role as a natural greenhouse gas, water vapor plays an important role in regulating the temperature of the planet because clouds form when excess water vapor in the atmosphere condenses to form ice and water droplets and precipitation. (UNFCC)

Weather
Atmospheric condition at any given time or place. It is measured in terms of such things as wind, temperature, humidity, atmospheric pressure, cloudiness, and precipitation. In most places, weather can change from hour-to-hour, day-to-day, and season-to-season. Climate in a narrow sense is usually defined as the "average weather", or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. The classical period is 30 years, as defined by the World Meteorological Organization (WMO). These quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including a statistical description, of the climate system. A simple way of remembering the difference is that climate is what you expect (e.g. cold winters) and 'weather' is what you get (e.g. a blizzard). (USEPA1)

Z
Zero Emission Vehicles (ZEV)
A vehicle that does not emit harmful emissions during operation. Harmful emissions can have a negative impact on human health and the environment. Electric (battery-powered) cars, electric trains, hydrogen-fueled vehicles, bicycles, and carriages are considered to produce zero emissions.

Zero Waste
A cyclical system in which products are designed for reuse, which creates no waste. A zero waste system eliminates the volume and toxicity of waste and materials and conserves current resources through reuse.

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Section A3

Supporting Research

Supporting Research

Climate Risk and Vulnerability Assessment

At the beginning of the Climate Action Planning effort, The paleBLUEdot team developed a Climate Risk and Vulnerability Assessment for the City of Bloomington. The assessment included the identification of vulnerable populations within the community and possible impacts and risks associated with projected climate change for the region. paleBLUEdot mapped the vulnerable populations within the City as well as existing City infrastructure and resources which may be capable of supporting climate adaptation strategies. These assessments provided a basis for understanding vulnerabilities and resources which supported the decision making process needed for identifying and prioritizing climate adaptation measures to be included in the final Climate Action Plan. The Assessment focused on City-Wide vulnerabilities with a particular focus on climate vulnerable populations to ensure all populations benefit from proposed implementation measures.

Broad Climate Change Impacts and Risk Factors

The paleBLUEdot identified and summarized the broad climate change metrics already experienced, projected climate change impacts, and risk factors at a regional level. Data on Midwest was collected from the US National Climate Assessment as well as Indiana University, Purdue University, and the University of Michigan Climate Center. State of Indiana specific data was collected and summarized from State and National agencies, and regional university data sources. In addition, detailed climate projections, based on National Center for Atmospheric Research, was developed for the City of Bloomington.

Click on the link below or scan the QR code to access the vulnerability assessment:
https://view.publitas.com/palebluedot/bloomington-climate-risk-and-vulnerability-assessment/

Renewable Energy Potentials Study

At the beginning of the Climate Action Planning effort, In support of development of effective renewable energy goalsetting and to establish strategies addressing renewable energy development, paleBLUEdot conducted a Community-Wide solar pv potentials study including economic and environmental benefits. Through study of community-wide potential, the City of Bloomington was provided data enabling the creation of near and long-term renewable energy targets and implementation strategies based on community specific opportunity. This effort included:

1) Collect city-wide satellite data (NREL, NOAA, and NASA data).
2) Determine building roof stock characteristics and solar suitable buildings, calculate total suitable areas by roof configuration/orientation.
3) Calculate total rooftop solar capacity and annual energy generation by roof configuration/orientation
4) Identify cost efficient annual energy generation potential.
5) Research solar market at national, State and regional levels. Identify low, medium, and high solar market absorption rates and city-wide solar pv goals.
6) Identify environmental and economic benefit of solar including economic development and job creation potential (NREL JEDI model)
7) Develop City-Wide Renewable Solar Energy Potentials report.

Click on the link below or scan the QR code to access the renewable energy study:
https://view.publitas.com/palebluedot/city-of-bloomington-renewable-energy-potentials-study/

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Section A4

Bloomington Climate Infographics

Bloomington Climate Infographics

Below are infographics developed during the Climate Action Plan planning effort in support of the City's communications. Click on or scan the QR code to access the infographics.

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Section A5

Cumulative Potential Cost Savings

Bloomington CAP Cost Savings

Population	85071	County	147,230	0.577810229	
Households	30897				
Jobs	50700				

otes	**Transportation**																Cumulative
1	**Goal TL 1**						year 10	9	8	7	6	5	4	3	2	1	0	
	VMT saved	23,564,853	gas saved	586,503	Cost per car	0.7 total savin	$16,495,397	$14,845,857	$13,196,318	$11,546,778	$9,897,238	$8,247,699	$6,598,159	$4,948,619	$3,299,079	$1,649,540	$0	$90,724,684
	monthly Pub Transit cost	30	ave miles c	400	cost per mil	0.075 Total costs	$1,674,979	$1,507,481	$1,339,983	$1,172,485	$1,004,987	$837,489	$669,992	$502,494	$334,996	$167,498	$0	$9,212,384
																		$81,512,300
2	**Goal TL2**						year 10	9	8	7	6	5	4	3	2	1	0	
	VMT converted	34,978,506	gas saved	1,080,699	EV sav/mile	0.106166667 total savin	$3,713,551	$3,342,196	$2,970,841	$2,599,486	$2,228,131	$1,856,776	$1,485,421	$1,114,065	$742,710	$371,355	$0	$20,424,533
	monthly Pub Transit cost																	**$20,424,533**
																		$101,936,832

	Energy																**Cumulative**
	Goal EB 1					year 10	9	8	7	6	5	4	3	2	1	0	
3	Residential savings - electrical to solar	73,869,663	0.0515	Savings per kwh	total savin	$3,804,288	$3,423,859	$3,043,430	$2,663,001	$2,282,573	$1,902,144	$1,521,715	$1,141,286	$760,858	$380,429	$0	$20,923,582
4	Residential savings - electrical EE	90,798,235	0.1	Savings per kwh		$9,079,824	$8,171,841	$7,263,859	$6,355,876	$5,447,894	$4,539,912	$3,631,929	$2,723,947	$1,815,965	$907,982	$0	$49,939,029
5	Residential savings - NG EE	1,913,831	0.3055	Savings per therm		$584,675	$526,208	$467,740	$409,273	$350,805	$292,338	$233,870	$175,403	$116,935	$58,468	$0	$3,215,714
	Residential total			**total**		**$13,468,786**	**$12,121,908**	**$10,775,029**	**$9,428,151**	**$8,081,272**	**$6,734,393**	**$5,387,515**	**$4,040,636**	**$2,693,757**	**$1,346,879**		**$74,078,326**
3	Comm/Ind savings - electrical to solar	118,964,534	0.02265	Savings per kwh		$2,694,547	$2,425,092	$2,155,637	$1,886,183	$1,616,728	$1,347,273	$1,077,819	$808,364	$538,909	$269,455	$0	$14,820,007
4	Comm/Ind savings - electrical EE	135,550,042	0.0755	Savings per kwh		$10,234,028	$9,210,625	$8,187,223	$7,163,820	$6,140,417	$5,117,014	$4,093,611	$3,070,208	$2,046,806	$1,023,403	$0	$56,287,155
5	Comm/Ind savings - NG EE	908,763	0.2696	Savings per therm		$245,002	$220,502	$196,002	$171,502	$147,001	$122,501	$98,001	$73,501	$49,000	$24,500	$0	$1,347,514
	Comm/Ind - Total			**total**		**$13,173,577**	**$11,856,220**	**$10,538,862**	**$9,221,504**	**$7,904,146**	**$6,586,789**	**$5,269,431**	**$3,952,073**	**$2,634,715**	**$1,317,358**		**$72,454,675**
																	$146,533,001

	Solid waste															**Cumulative**
	Residential food waste diversion					year 10	9	8	7	6	5	4	3	2	1	0	
	Calculation based on per capita food savings budget of 30% diversion																
6	Estimated food tons thrown (from Monroe Co report)	19050.34		Organics thrown		13335.2352	13,907	14,478	15,050	15,621	16,193	16,764	17,336	17,907	18,479	19050.34	
				Organics saved		5715.1008	5143.59072	4572.08064	4000.57056	3429.06048	2857.5504	2286.04032	1714.53024	1143.02016	571.51008	0	31,433
7	Value per ton			**Value/Saved**	**2469**	**$14,110,584**	**$12,699,525**	**$11,288,467**	**$9,877,409**	**$8,466,350**	**$7,055,292**	**$5,644,234**	**$4,233,175**	**$2,822,117**	**$1,411,058**	**$0**	**$77,608,211**
8	Commercial waste diversion - businesses per year					600	540	480	420	360	300	240	180	120	60	0	
8	Cost based on MN WasteWise reported average business savings ($431) escallated to 5 year			Value	475	**$285,000**	**$256,500**	**$228,000**	**$199,500**	**$171,000**	**$142,500**	**$114,000**	**$85,500**	**$57,000**	**$28,500**	**$0**	**$1,567,500**
				Businesses included by 2030	30.00%												$79,175,711

																		Cumulative
							year 10	9	8	7	6	5	4	3	2	1	0	
	SubTotal						**$59,571,917**	**$53,614,725**	**$47,657,534**	**$41,700,342**	**$35,743,150**	**$29,785,959**	**$23,828,767**	**$17,871,575**	**$11,914,383**	**$5,957,192**	**$0**	**$327,645,544**
																		$0
	Social Cost of Carbon						year 10	9	8	7	6	5	4	3	2	1	0	
	Avoided GHG						208471.9147	187,625	166,778	145,930	125,083	104,236	83,389	62,542	41,694	20,847	0	1,146,596
10	**Cost per ton**	150,581,910	2100 annu	1290494	GHG mTons	$116.69 cost per to	**$24,325,645**	**$21,893,081**	**$19,460,516**	**$17,027,952**	**$14,595,387**	**$12,162,823**	**$9,730,258**	**$7,297,694**	**$4,865,129**	**$2,432,565**	**$0**	**$133,791,048**

	GrandTotal						**$83,897,562**	**$75,507,806**	**$67,118,050**	**$58,728,294**	**$50,338,537**	**$41,948,781**	**$33,559,025**	**$25,169,269**	**$16,779,512**	**$8,389,756**	**$0**	**$461,436,592**

Notes and Sources

1. Savings per VMT based on AAA estimates https://www.slashgear.com/aaa-says-it-costs-about-74-cents-per-mile-to-drive-23496316/ https://www.thesimpledollar.com/save-money/is-it-really-cheaper-to-ride-the-bus/
2. Savings per VMT converted from ICE to EV https://www.energy.gov/eere/electricvehicles/saving-fuel-and-vehicle-costs
3. The average cost savings per kWh consumed through on-site solar is calculated at 50% of the retail solar rate for residential and 30% for commercial. This assumes an average solar array payback period of 15 years (note, average residential payback period is estimated at 8 to 12 years and average commercial at 8 to 10 years see: https://www.solarreviews.com/blog/how-to-calculate-your-solar-payback-period and: https://www.paradisesolarenergy.com/blog/payback-and-roi-of-solar-energy-for-farms-businesses). The average solar array effective life span is typically anticipated as 30 years (see: https://www.solarpowerworldonline.com/2017/01/life-expectancy-solar-array/)
4. Energy efficiency savings per kWh saved basded on average electricity cost per kWh: https://www.electricitylocal.com/states/indiana/bloomington/
5. Energy efficiency savings for natural gas is based on Vectren therm rates: https://www.vectren.com/assets/downloads/rates/IGCHistoricaltrackingfactors.pdf#search=indiana%20therm%20rate
6. Food waste tonnage saved is calculated on achieving a 30% diversion by 2030 and includes waste annual waste reduction calculaions in line with overall waste reduction goals. Food waste share of organics based on "MONROE COUNTY SOLID WASTE MANAGEMENT DISTRICT MIXED WASTE PROCESSING FEASIBILITY STUDY JANUARY 2018" see:http://gogreendistrict.com/public-info_33_463535807.pdf
7. Value per ton based on average for Prevent and Recover strategies by ReFED "A ROADMAP TO REDUCE U.S. FOOD WASTE " See https://www.refed.com/downloads/ReFED_Report_2016.pdf
8. Savings per business engaged in waste reduction programs are based on MN WasteWise reported average business savings ($431) escallated to 5 year (mid point) Cumulative savings assume businesses remain. See https://www.mnchamber.com/your-opportunity/waste-wise operating within savings regime
9. Social Cost of Carbon is based on pro rata Bloomington share of projected Monroe County annual economic impacts by 2100 divided by the City's 2018 GHG emissions. Projected annual economic impacts are from Estimating economic damage from climate change in the United States By Solomon Hsiang, Robert Kopp, Amir Jina, James Rising, Michael Delgado, Shashank Mohan, D. J. Rasmussen, Robert Muir-Wood, Paul Wilson, Michael Oppenheimer, Kate Larsen, Trevor Houser Science30 Jun 2017 : 1362-1369 See: https://science.sciencemag.org/content/356/6345/1362

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