Carlisle Borough
Climate Action Plan

Local Actions and Policies to Reduce Carlisle Borough's Greenhouse Gas Emissions

Approved by Carlisle Borough Council

January 13, 2022

Version 1.0

Produced by Carlisle Borough Climate Action Commission

Through partnership with ICLEI – Local Government for Sustainability (ICLEI)

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- PPL (Electricity REP)
- UGI (Natural Gas utility)
- Carlisle Area School District (CASD)

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Introduction

Climate change is the greatest environmental challenge of the 21st century, with overwhelming evidence in the past decade. The most recent Intergovernmental Panel on Climate Change (IPCC) Assessment Report (AR6) removed any doubt as to the primary causes of rapid global warming,

"It is *unequivocal* that human influence has warmed the atmosphere, ocean and land. Widespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere have occurred." (Masson-Delmotte et al., 2021)

Climate change poses a serious threat not just to Carlisle Borough's natural resources, but also to our jobs and our health. Climate action also presents huge opportunities for creating a healthier, safer, and more equitable zero-carbon world. Carlisle Borough has an unparalleled opportunity to make changes in ways that create jobs and benefit all residents. Scientists expect that with the current trends in fossil fuel use, Americans may see more intense heat waves, droughts, rainstorms, floods, wildfires and landslides in the future. These impacts could drag down our economy, stress our natural resources and worsen inequities facing many Americans. Action is required at all levels, and local governments have a unique role to play in building low-carbon communities. In Pennsylvania, temperatures have increased by more than 1.8°F since the early 20th century and are expected to increase by an additional 5.9°F by 2050. Similarly, annual precipitation in Pennsylvania has increased by approximately 10% since the early 20th century and is expected to increase by another 8% by 2050, with a 14% increase during the winter season (*Pennsylvania Climate Impacts Assessment 2021*, 2021)

These impacts are caused by the accumulation of greenhouse gas (GHG) such as carbon dioxide (CO_2) and methane (CH_4) in the atmosphere, primarily resulting from burning fossil fuels and land use changes. Although the natural greenhouse effect is needed to keep the earth warm, a human enhanced greenhouse effect with the rapid accumulation of GHG in the atmosphere leads to too much heat and radiation being trapped. Global surface temperature in the first two decades of the 21st century (2001-2020) was 0.99 [0.84-1.10] °C higher than 1850-1900. Global surface temperature was 1.09 [0.95 to 1.20] °C higher in 2011–2020 than 1850–1900 (Masson-Delmotte et al., 2021).

The energy, industry and transportation sectors have dominated the rise in emissions. In Pennsylvania, the sectors responsible for the most GHG emissions are industrial at 31%, electricity production at 30%, and transportation at 23% (Pennsylvania Department of Environmental Protection (PA DEP), 2019). With the

current trajectory of population growth, urbanization, and reliance on personal vehicles, emissions will only continue to rise. Given the critical impacts of climate change on humanity, the time to act to reduce GHGs and our carbon footprint is now.

In addition to national and state efforts to make systemic changes that will reduce global emissions, local governments play a powerful role in addressing climate change. The design of American communities—how we use our land, how we design our buildings, how we get around—greatly impacts the amount of energy we use and the volume of GHG emissions we produce. It is critical that communities like Carlisle Borough demonstrate that it is possible to dramatically reduce GHG emissions while creating more vibrant and prosperous places to live and do business.

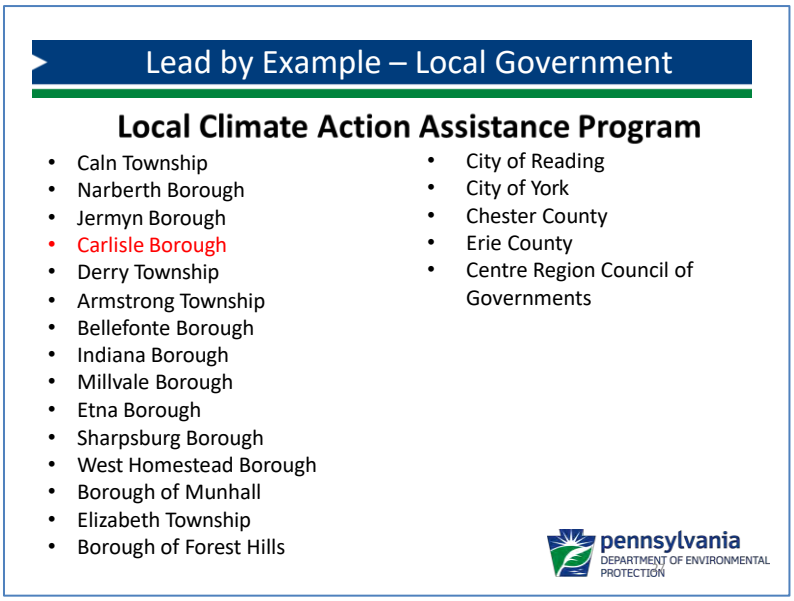
Statewide Climate Action

In 2008, the Pennsylvania Climate Change Act was passed, and requires the Department of Environmental Protection (DEP) to (1) develop an inventory of GHG emissions and update it annually; (2) administer a Climate Change Advisory Committee; (3) set up a voluntary registry of GHG emissions; and (4) prepare a Climate Change Action Plan and Climate Impacts Assessment, both to be updated once every three years. The most recent Climate Impacts Assessment was updated in 2021, as were the most recent PA Climate Action Plan and greenhouse gas inventory. These documents offer information and guidance for local climate action planning in the Commonwealth. The Climate Impacts Assessment provides a scientific basis for potential statewide impacts of global climate change, which can be used alongside available local data to inform community adaptation efforts. The PA Climate Action Plan summarizes statewide greenhouse gas emissions, sets an emissions reduction target, and describes potential mitigation and adaptation actions for residents and businesses, as well as local and state government. The reduction targets are 26% by 2025 and 80% by 2050 from 2005 levels, consistent with an executive order signed by Governor Wolf in 2019 (PA DEP, 2019).

To ensure consistency with the PA Climate Action Plan, Carlisle Borough's reduction targets meet or exceed the statewide targets. In addition, many of the statewide actions were incorporated into this plan, which is described further in Chapter 4: *Taking Action*.

Purpose and Scope of the Climate Action Plan

Carlisle Borough is joining an increasing number of local governments committed to addressing climate change at the local level. Along with a cohort of 19 other municipalities in the Commonwealth of Pennsylvania, Carlisle Borough began the climate action planning process in 2019 (Figure 1).



College students were matched with staff from each municipality and were trained by ICLEI USA on each component of the climate action planning process. They worked together to develop individual climate action plans. ICLEI's technical guidance was enabled via a grant from US Department of Energy State Energy Program through the PA Department of Environmental Protection.

The Carlisle Borough recognizes the risk that climate change poses to its residents and businesses and is acting now to reduce the GHG emissions of both its government operations and the community at-large through the innovative programs laid out in this Climate Action Plan. Furthermore, it is recognized that Carlisle Borough needs to address existing climate risks such as increased frequency and severity of weather events, as well as urban heat, ozone air pollution, inland flooding, extreme stormwater runoff events, increased disease and pests[1] and adapt its systems and infrastructure to new conditions. This Climate Action Plan takes advantage of common-sense approaches and policies that our local government is uniquely positioned to implement – actions that can reduce energy use and waste, create local jobs, improve air quality, preserve our local landscape and history, reduce risk to people and property, and in many other ways benefit Carlisle Borough for years to come.

[1] https://gis.dep.pa.gov/ClimateChange/index.htm

Purpose

By creating a clear course of action so that everyone has a role in creating and achieving climate and sustainability goals, our Climate Action Plan drives and coordinates local efforts toward a reduction in GHG emissions of 2005 levels by 26 percent (by 2025) and 80 percent (by 2050).

The Climate Action Plan is a framework for the development and implementation of actions that reduce Carlisle Borough's GHG emissions. The Plan provides guiding objectives and actions to realize Carlisle Borough's GHG reduction goal.

In addition to addressing mitigation concerns, the Climate Action Plan considers the vulnerability of Carlisle Borough to hazards that are and will continue to be exacerbated by climate change. The plan prioritizes GHG reduction measures that support climate adaptation and does not propose any actions that are maladaptive to foreseen climate change impacts.

Scope

This Plan covers objectives and actions for reducing GHG emissions resulting from local government and community-wide activities within the Carlisle Borough. It addresses the major sources of emissions in Carlisle Borough and sets forth objectives and actions in the following [XX] sectors that both the Carlisle Borough and community members can implement together to reduce greenhouse gas emissions:

Commercial and Industrial Buildings

Residential Buildings

Waste, Composting and Recycling

Water and Wastewater Management

Transportation

The Plan creates a framework to document, coordinate, measure, and adapt efforts moving forward.

Planning Process

While Carlisle Borough has already begun to reduce greenhouse gas emissions and climate risk through a variety of actions, this plan is a critical component of a comprehensive approach to reduce the Carlisle Borough's emissions. The planning process was based on the following overarching framework, developed by ICLEI – Local Governments for Sustainability, USA (ICLEI), and known as the Five Milestones for Climate Mitigation.

1

As indicated by the figure above, climate action planning is a continuing cycle and does not stop with the development of this document. However, this Climate Action Plan represents Carlisle Borough's first planning cycle, including the completion of the first three milestones:

Milestone 1: Chapter 3 summarizes the emissions inventory and forecast

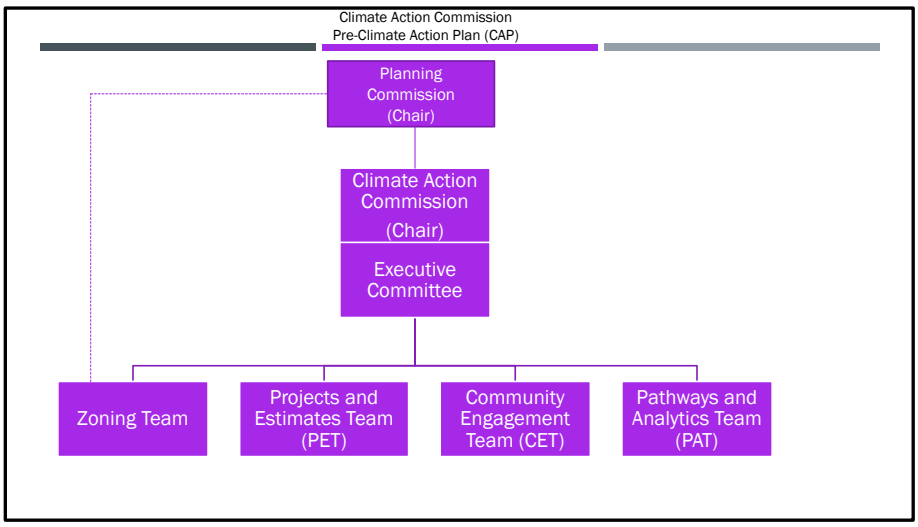
Milestone 2: Chapter 4 sets reduction targets

Milestone 3: Chapters 5-12 outline objectives and actions

Chapter 13 also describes the initial steps of milestones 4 and 5, monitoring and implementation.

Planning Team and Stakeholders

Borough Council approved the organization of the Climate Action Commission in Fall of 2020 (Figure 2).



Executive Committee:

- Membership: Chair + Team Leads + Borough Manager + Councilmember + Carlisle Borough Resident (at large)
- Duties:
    - Assigns specific tasks to teams, as needed
    - Provides schedule and timelines for CAP draft
    - Approves PAT candidate pathways for CAC review and final recommendation
    - Committee Chair briefs Council on final recommendations, or as required
    - Approves requests for coordination input with Borough Staff who are not assigned to CAC
    - Determines Borough activities requiring CAC approval (addendum to CAP)
    - Drafts Climate Action Plan (CAP) for Planning Commission (Chair) Co-signature

Pathways and Analytics Team (PAT)

Function: Conducts GHG Inventory and Generates Alternative Pathways for CAC Evaluation

- Duties:
    - Conducts GHG Inventories, as required
    - Generates Alternative Pathways for Evaluation by CAC Teams

Zoning Team

Function: Makes zoning recommendations for implementation of potential projects. Primary interface with external partners in developing draft ordinances that comport with the goals of the CAP.

- Duties:
    - Provides zoning advice concerning implementation of specific projects
    - Primary interface to Planning Commission regarding potential changes required to Zoning Ordinance
    - Primary legal advisor for potential implementation of CAP
    - Maintains and updates applicable changes to ordinances resulting from implementation of CAP

Projects and Estimates team (PET)

Function: Primary Costs/Benefits Analysis for Potential Mitigation/Resiliency Projects

- Duties:
    - Coordinate and determine costs and benefits of potential projects
    - Identify potential funding strategies, including loans, grants, and subsidies for projects
    - Conduct assessment reviews/lessons learned of similar projects conducted by other municipalities or cities

Community Engagement Team (CET)

Function: Provides primary communication function with Carlisle community, soliciting inputs and reporting activity within the CAC. Responsible for ensuring the climate action plan (CAP) reflects community values and maintains community support including:

- Issues of racial and socio-economic equity
- Aesthetics
- Fairness
- Economic development

- Duties:
    - Conduct community surveys to understand attitudes and perceptions regarding the Climate Action Plan

- Evaluate how equitable costs/benefits are of potential CAP activities
- Organize/execute public hearings for non-CAC members
- CAC information documentation, media and public relations campaigns, social marketing/media communication, educational meetings and workshops, exhibitions and events, and email notices
- Primary interface with NGO's and interest groups

The CAC reached out to several partners, called external stakeholders, to encourage their participation in the development of the plan. The following were participants in the development of the CAP.

- Public utilities
    - Electricity: PPL
    - Natural Gas: UGI
- Carlisle Area School Board (CASD)
- Dickinson College
- Widener Law School

Social Equity

Climate equity was a core component of the planning process and will continue to be through implementation. Climate Equity ensures the just distribution of the benefits of climate protection efforts and alleviates unequal burdens created by climate change. Implementation of this concept requires intentional policies and projects that simultaneously address the effects of and the systems that perpetuate both climate change and inequity. Under the status quo, however, not everyone is given the opportunity to participate and benefit.

Communities of color and low-income populations have historically been under-served by programs and investments and under-represented in decision-making, including for the development and implementation of climate policy. These exclusionary processes maintain or exacerbate disparities in public health; food, energy, and housing security; air and water quality; economic prosperity, and overall quality of life. These inequities primarily stem from ongoing institutional racial bias and historical discriminatory practices that have resulted in the inequitable distribution of resources and limited access to opportunities.

Climate change is likely to amplify the impacts of these existing inequities. Residents of frontline communities which often include lower income neighborhoods, communities of color, immigrants, unhoused, outdoor

workers, the very young, and the elderly will disproportionately bear the burdens of climate change impacts. In addition, the many economic and health benefits of carbon reduction investments are not shared equitably across the city, especially among people of color and low-income communities.

To ensure an equitable climate action plan, the Carlisle Borough had a community-driven process, which is described in the following section.

Community-Driven Planning Process

To be completed in next revision

Vision Statements and Objectives

To be completed in next revision

Mitigation Objectives

Below is a summary of sector-specific GHG reduction targets that, by year, are required to ensure that Carlisle Borough meets its overall GHG reduction targets. Specific programs required to implement these targets are discussed in sector-specific chapters.

By 2025

- Objective R1: Reduce energy use in residential buildings by XX%.
    - R1b: Net-Zero New Residential Homes. Increase the percentage of new residential building areas that produce as much energy on-site as it uses to 5%
- Objective R4: Increase the percentage of households with rooftop PV solar installations -or- residents who are participants in commercial solar projects to 10%

By 2035

- R1a: Energy Efficiency Retrofits for Existing Homes - 40% of existing residential homes participating in energy efficiency programs
- R1b: Net-Zero New Residential Homes. Increase the percentage of new residential building areas that produce as much energy on-site as it uses to 35%
- Objective R2: Residential Electrification. Reduce use of natural gas, fuel oil, or propane for space and/or water heating (60% of Carlisle households in 2017) by switching 50% to electricity.
- Objective R4: Increase the percentage of households with rooftop PV solar installations -or- residents who are participants in commercial solar projects to 25%

- Objective C2: Reduce energy use in commercial buildings by 20%.
- Objective C3: Reduce fossil fuel use in existing commercial buildings by 25%
- Objective C4: Maximize large scale lawn potential by 50%
- Objective M2: Reduce energy use in municipal buildings by 50%
- Objective WR2: Improve community composting facilities to include food waste and divert 50% of compostable waste from landfills
- T1a: Promote adoption of electric and alternative-fueled vehicles by households and businesses to achieve 30% of the light-duty fleet
- T1b: Promote adoption of electric and alternative fueled vehicles in commercial and industrial uses to achieve 15% of the medium and heavy-duty fleet
- Objective T2: Convert the entire municipal light-duty vehicle fleet to electric and alternative fueled vehicles
- T2b: Convert the CASD bus fleet to electric/low-carbon
- Objective T3: Reduce community vehicles miles travelled (VMT) by 10%

By 2040

- Objective C3: Reduce fossil fuel use in existing commercial buildings by 50%.

By 2050

- Objective R1: Reduce energy use in residential buildings by 40%
    - R1a: Energy Efficiency Retrofits for Existing Homes. 70% of existing residential homes participating in energy efficiency programs
    - R1b: Net-Zero New Residential Homes. Increase the percentage of new residential building areas that produce as much energy on-site as it uses to 65%.
- Objective R2: Residential Electrification. Reduce use of natural gas, fuel oil, or propane for space and/or water heating (60% of Carlisle households in 2017) by switching 80% to electricity
- Objective R4: Increase the percentage of households with rooftop PV solar installations -or- residents who are participants in commercial solar projects to 40%
- Objective R1: Reduce energy use in residential buildings by 70%

- Objective C2: Reduce energy use in commercial buildings by 40%
- Objective C3: Reduce fossil fuel use in existing commercial buildings by 80%
- Objective C4: Maximize large scale lawn potential by 75%
- Objective M2: Achieve net-neutrality in municipal buildings
- M2a: Transition to 100% renewable energy consumption at all Borough facilities
- Objective WR2: Improve community composting facilities to include food waste and divert 100% of compostable waste from landfills
- T1a: Promote adoption of electric and alternative fueled vehicles by households and businesses to achieve 90% of the light-duty fleet
- T1b: Promote adoption of electric and alternative fueled vehicles in commercial and industrial uses to achieve 45% of the medium and heavy-duty fleet
- Objective T2: Convert the entire medium and heavy-duty municipal vehicle fleet to electric or alternative fueled vehicles
- Objective T3: Reduce community vehicles miles travelled (VMT) by 25%

2. Co-Benefits of Climate Action

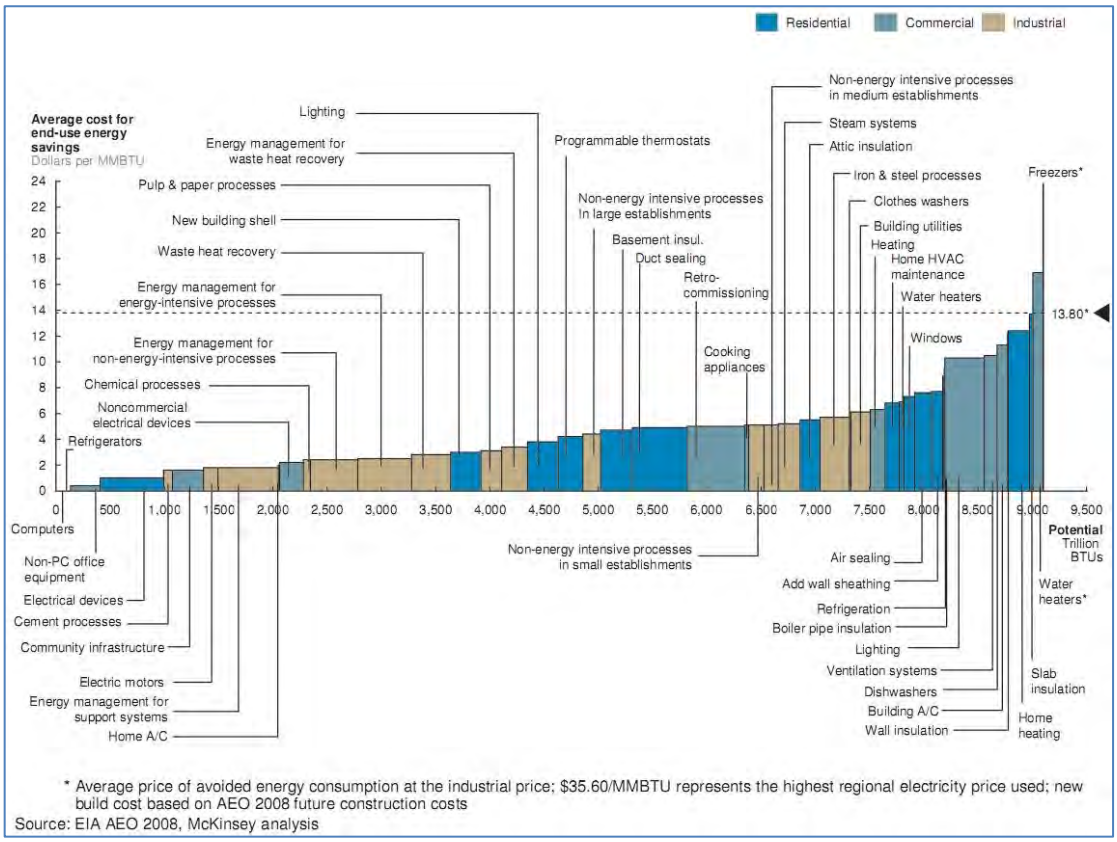
Greenhouse gas reduction and climate resilience are not the only beneficial outcomes of climate action plans. The following outcomes are referred to as "co-benefits," and they illustrate how taking action on climate change results in a more prosperous community.

Improving Public Health

Climate change mitigation activities, particularly those related to transportation, help to clean the air by reducing vehicle emissions and therefore improve public health. Mitigation activities help to engender a greater degree of choice for Carlisle Borough's residents. More transit options combined with transit-oriented development practices make for a more vibrant, livable community with shorter commute times and more opportunities for active transport. This creates more connected and resilient neighborhoods.

Saving Money and Reducing Risk

In addition to addressing climate change, measures taken to reduce greenhouse gas emissions have other important benefits. The most obvious of these is the potential for significant cost savings. Many of the measures in this plan pay for themselves quickly by reducing direct costs, such as fuel or energy used, and also indirect costs such as maintenance. For instance, a "right-sized" vehicle fleet is less expensive to purchase and fuel, while also being less costly to maintain. Encouraging energy efficiency, public transit use, building improvements, and other measures will also result in lower energy and water bills for residents and employers as well. Table 1 shows a range of energy efficiency investments that yield cost savings in switching to more energy efficiency products.



Acting now will also save on runaway costs on climate change, especially in the longer term. These costs range from infrastructure damage in extreme storms and pest control to industry losses, particularly for industries that depend on environmental conditions, such as winter sports.

Enhancing Resource Security

A key strategic side benefit of climate change mitigation activities is enhanced energy security through reduction in total demand. This will put less strain on the energy system as a whole as we transition to clean renewable energy. Similarly, demand shifts can help with improving water and food security as well.

Many of the actions identified here to mitigate GHG emissions will also help Carlisle Borough's government, businesses, and residents to adapt to a changing climate. For example, extreme and prolonged heat waves can put considerable strain on the reliability of energy delivery in peak periods, possibly leading to service disruption during times when cooling is most needed. By increasing efficiency across the Carlisle Borough, such service disruptions are less likely and the Carlisle Borough will be able to better cope with those situations. Similarly, climate actions can secure food and water sources and prevent damage and service disruptions to these systems from drought, flooding, and fire.

Creating Jobs

Renewable energy is a growing sector. The U.S. Department of Energy reports that sustainable tourism, green construction, and urban agriculture can provide job opportunities that didn't exist in the past. These climate protection measures can spur business and job growth during the design, manufacture, and installation of energy efficient technologies, which presents a particular opportunity to reinvest in the local economy and generate green jobs within Carlisle Borough.

Currently, one borough councilmember is a board member of Clean Jobs for Pennsylvania (CJFP), an advocacy group committed to increasing the number of green, high-paying jobs throughout the Commonwealth.

Fostering Social Equity

Social equity and justice are major concerns for addressing climate change, and thus were established as core values behind this plan. Equity is when all individuals have access to the opportunities necessary to satisfy their essential needs, advance their well-being and achieve their full potential. Environmental justice ensures fair treatment and meaningful involvement in the development of laws, policies and regulations and the identification of issues impacting vulnerable communities.

3. Carlisle Borough's GHG Emissions

Since the early 1990s, U.S. cities have developed community-wide and local government operations greenhouse gas (GHG) inventories based on accounting protocols created by ICLEI. Known as the U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions and the Local Government Operations Protocol, these standards created a credible and defensible methodology which accelerated the number of inventories created and provides consistency within and across U.S. communities. In 2014, ICLEI partnered with the World Resources Institute and C40 Climate Leadership Group to create the Global Protocol for Community Scale GHG Emissions, which allows communities around the world to compare their emissions footprint.

Community-wide greenhouse gas emissions were estimated for the Borough of Carlisle by Dickinson College students and staff, assisted by ICLEI Local Governments for Sustainability through the Local Government Climate Action Assistance Program of the Pennsylvania Department of Environmental Protection (DEP). GHG inventories were produced for two years, 2005 and 2017, and future emissions were projected to the year 2050 using ICLEI's ClearPath software tool (ICLEI 2014). Details of the inventory analysis are described in Appendix A: *Carlisle's Greenhouse Gas Emissions, Past and Future* (Leary et al. 2020), which is the source of the past and future emission estimates summarized below.

Through the completion of a local emissions study, or "greenhouse gas inventory," our Carlisle Borough has determined emissions levels for the community as a whole. Community-wide emissions represent the sum total of emissions produced within Carlisle Borough limits as well as emissions resulting from electricity use within the Carlisle Borough, even if said electricity is generated elsewhere. In this way, the community-wide figures represent all emissions for which the community is responsible.

Carlisle Borough Community-Wide GHG Emissions

The inventory of Carlisle's GHG emissions includes emissions of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), each of which add to the capacity of the atmosphere to absorb heat. The emissions are produced by a variety of activities of Borough residents, businesses, organizations and government agencies that include consuming electricity, natural gas, fuel oil and other energy sources for heating, cooling and powering appliances; burning motor fuels for transportation; landfilling solid waste; and

treating drinking water and wastewater. Emissions of each type of greenhouse gas produced by these activities are converted into metric tons of carbon dioxide equivalent ($MTCO_2e$) to provide a standard measurement of their contributions to climate change.

Emissions were estimated for five sectors for the years 2005 and 2017: commercial and industrial energy, residential energy, transportation, municipal solid waste, and water and wastewater. 2017 is the most recent year for which complete data is available to estimate emissions for Carlisle. Emissions were also estimated for 2005 because 2005 is the year used in the Pennsylvania Climate Action Plan as a benchmark against which emission reductions are measured for the state. 2005 is also the year Carlisle has chosen as the benchmark against which to measure the Borough's emission reductions.

Carlisle's total GHG emissions in 2005 are estimated to be equivalent to just over 291,000 metric tons of carbon dioxide ($MTCO_2e$), or 16.1 metric tons per resident (see Figure 3). From 2005 to 2017, estimated emissions declined 17.1% to roughly 241,000 $MTCO_2e$, or 12.7 metric tons per resident. The decrease resulted primarily from a reduction in the share of electricity generated with coal, which produces high emissions per kilowatt hour (kWh) of electricity, and an increase in the share generated with natural gas, which produces less emissions per kWh.

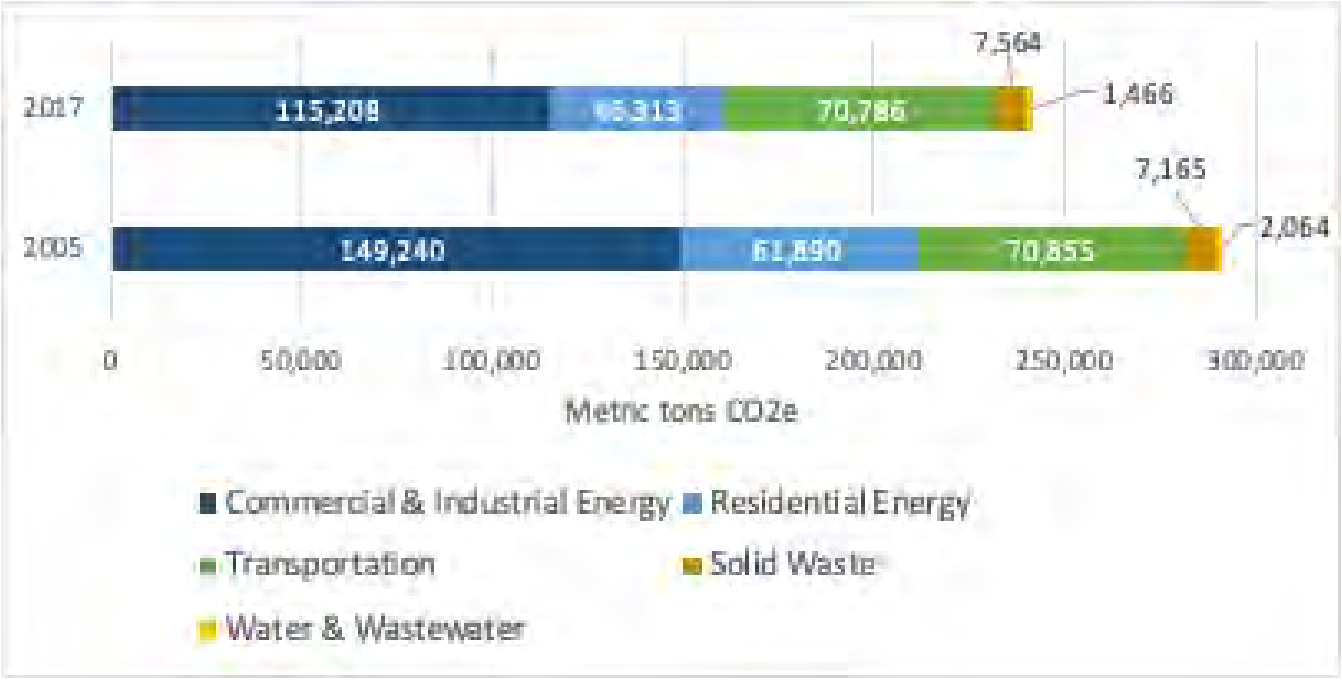


Figure 3: Emissions by sector, 2005 and 2017

Forecasting Carlisle Borough's GHG Emissions

While recognizing that the future is uncertain, a scenario of future emissions was constructed for 2020–2050, assuming that no new policies or actions would be implemented to limit emissions. This "No Action" forecast is a scenario estimating future emissions levels if no further local, state, or federal action (i.e. projects within this Climate Action Plan) were to take place. Under this and other assumptions, Carlisle's emissions are projected to grow slowly to almost 242,000 $MTCO_2e$ by 2025 and 257,000 $MTCO_2e$ by 2050, as shown in Figure 4.

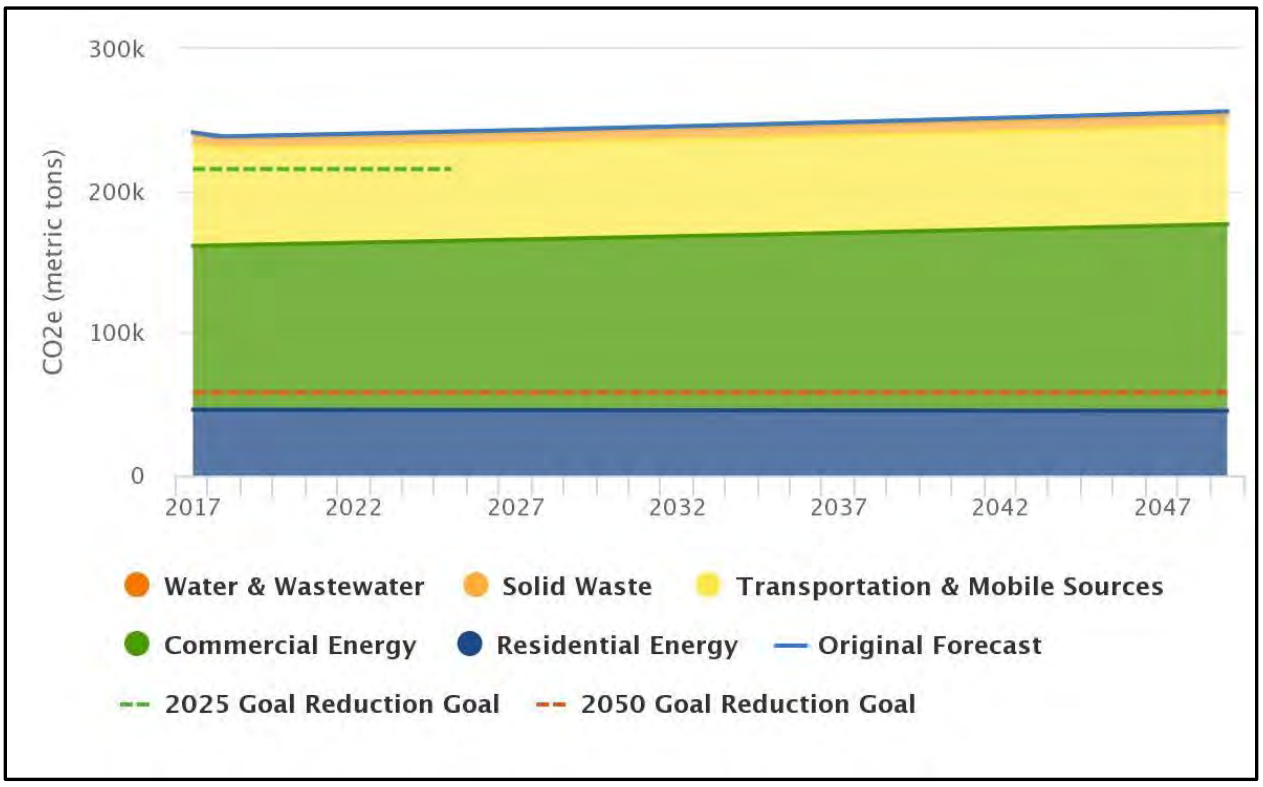


Figure 4: Emission forecasts under "No Action" Scenario

The No Action scenario of future emissions assumes that no new policies or actions are taken at local, state or national levels that are designed to limit GHG emissions, promote fuel switching, or accelerate energy efficiency and conservation. Energy use in Carlisle is assumed to grow over the 2020 to 2050 time period at the same rate as has been projected for the state of Pennsylvania if there are no new policies or actions (PA DEP 2019). The amount of GHG emissions per kWh of electricity used in Carlisle is assumed to match the carbon intensity as was projected for the state, which rises slightly under assumptions that the share of nuclear power generated electricity declines and is replaced primarily by electricity generated with natural gas. Vehicle miles traveled in Carlisle is assumed to grow at the same rate as projected for the nation by the U.S. Energy Information Agency if there are no new policies or actions (USEIA 2020). Emissions from landfilling solid waste and from treating water and wastewater are assumed to grow at the same rate as Carlisle's population is projected to grow by the Cumberland County Planning Department (Cumberland County Planning Commission, 2017).

Carlisle Borough's GHG Reduction Target

Through a Borough Council Resolution approved in July 2020, Carlisle Borough set targets to reduce its emissions to **26 percent below 2005 levels by 2025** and to **80 percent below 2005 levels by 2050**. Those targets are included in the No Action Scenario of Figure 4. The Climate Action Commission also considered a carbon-neutral scenario by 2050 in anticipation of more stringent state or federal standards. The combination of measures that Carlisle Borough has already implemented, are currently planned, and are presented through this Climate Action Plan are designed to achieve the 2025 targets. Reductions in 2035 and 2050 rely on the best information currently available pertaining to population forecasts, future changes to building codes, and vehicle fuel efficiency standards among other information.

The Carlisle Borough Climate Action Plan

Local government policies and practices can reduce greenhouse gas emissions from a range of sources and help prepare Carlisle Borough for the anticipated impacts of climate change. In addition, Carlisle Borough will assist residents and businesses in their endeavors to reduce emissions through programs explained in this Plan. By working together, Carlisle Borough can not only do its part toward achieving a stable climate - we can reap the benefits of healthier air, lower costs for utilities and services, improved transportation and accessibility, a more vibrant local economy, and many other positive co-benefits of reducing our carbon footprint. Meeting climate stabilization goals will require an energy transition using three broad strategies: reducing the carbon intensity of electricity generation by switching away from fossil fuels and replacing them with clean, renewable energy sources; switching away from fossil fuels and to electricity and other alternative energy sources for transportation and residential, commercial and industrial energy uses; and accelerating energy efficiency improvements.

Advancing a transition to a low carbon future will require actions by residents, businesses, utility providers, and local government. Also required are significant policy actions by both federal and state governments and widespread collaboration and partnerships with local government and other stakeholders. The modeling assumptions associated with these actions are laid out in Table 1. These assumptions were informed by careful consideration of the 2018 Pennsylvania Climate Action Plan and actions included in Climate Action Plans from municipalities throughout Pennsylvania (Etna, Lancaster, Millvale, and Bellefonte) and the nation (Bedford, NY; Northfield, MN; Park Forest, IL). State and federal policymaking will be particularly critical in determining the rate at which we can decarbonize the electric

grid (through fuel-switching and renewable energy) and how quickly electric vehicles (EV) can displace internal combustion engine (ICE) vehicles in the vehicle fleet.

The summary table below identifies the sectors within the Carlisle Borough Climate Action Plan, the number of actions within each sector, and the contribution of each sector toward the GHG reduction goal. Each sector has a dedicated section within this document where objectives and specific actions (both new and those already employed) are described.

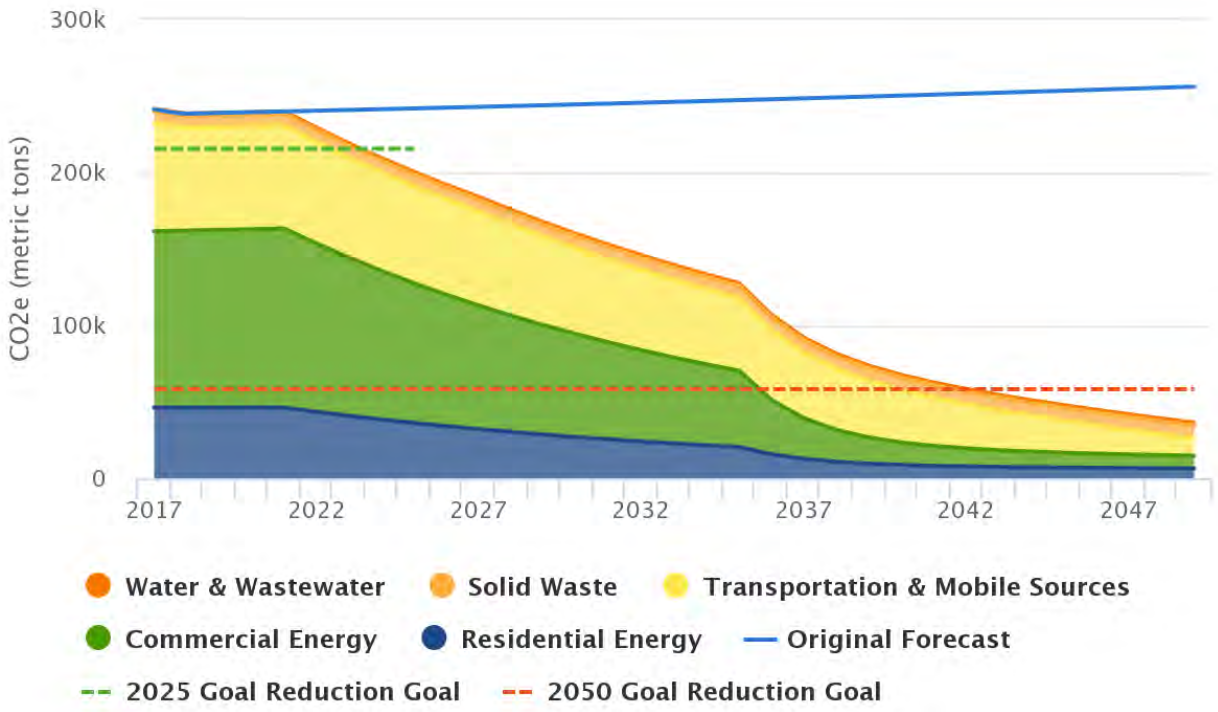
Carlisle Borough Climate Action Plan Summary Table – Sectors

Sector	Description	Number of Distinct Actions	Anticipated MTCO2e Reduction by 2050	Percentage of Total Reduction at 2050
Commercial & Industrial Buildings	Policies and programs to reduce commercial, municipal, and industrial sector energy use and emissions through grid decarbonization, fuel-switching, and conservation.	13	~140,918	55%
Residential Buildings	Policies and programs to reduce residential sector energy use and emissions through grid decarbonization, fuel-switching, and conservation.	9	~55,458	22%
Waste, Composting and Recycling	Policies and programs to reduce solid waste generation.	4	~1,500	2-3%
Water and Wastewater Management	Policies and programs to reduce water demands and corresponding wastewater treatment needs.	0	~336	<1%
Transportation	Policies and programs to reduce on-road vehicle miles traveled and promote electric or low emission vehicles.	5	~59,574	23%

*MTCO2e (Metric tons of CO_2 equivalent)

The Impact on Emissions

The figure below depicts historic GHG emissions, forecasted growth in emissions, and target emissions from 2020 to 2050. The color wedges represent the projected reductions in emissions based on state and local programs. This pathway exceeds the emission reduction targets, achieving **31%** (below 2005 levels) in 2025 and **88%** in 2050.


300k
200k
100k
0
CO2e (metric tons)
2017
2022
2027
2032
2037
2042
2047
Water & Wastewater
Solid Waste
Transportation & Mobile Sources
Commercial Energy
Residential Energy
Original Forecast
2025 Goal Reduction Goal
2050 Goal Reduction Goal

4. Taking Action

In the following chapters, a series of objectives with supporting actions are explored for each emissions sector. An "Objective" is a goal, end result, or target, and an "Action" is a means of realizing the objective. Each sector draws on the actions of the local government, residents, and businesses, although some areas may be largely one or the other.

Emissions Reduction Potential

Calculating expected emissions reductions for each objective and action requires making assumptions about degree of implementation, technology, and individual behavioral changes several years into the future. The uncertainty associated with these assumptions makes it difficult to assign exact reduction totals to each objective or action. To address this uncertainty and provide a simple but useful reference for reduction potential, a series of symbols and percentage ranges has been devised to represent the emission reductions associated with each objective and its actions:

Symbol	GHG Reduction by 2050
	[0 – 24,999 mtCO2e] [Small Impact]
	[25,000 – 74,999 mtCO2e] [Medium Impact]
	[>75,000 mtCO2e] [Significant Impact]

Evaluating Co-Benefits

In addition to measuring the GHG reduction potential, each objective and action is also evaluated for other benefits such as public health, equity and justice, jobs and prosperity, and environmental conservation. The symbols below will indicate which co-benefits a measure will generate.

Symbol	Co-Benefit
	Supports jobs and economic prosperity
	Advances social equity
	Fosters resource security
	Improves public health and local environmental quality

Supporting Actions

Certain actions might be supportive of more than one objective within the same or another sector. These cross-cutting actions will be indicated in the "Supporting Actions" column for each objective.

Consistency with Statewide Climate Action Plan

The Commonwealth of Pennsylvania's 2018 Climate Action Plan includes many actions that are meant to be implemented by local governments as well as on the state-level. This Climate Action Plan incorporates as many of those actions as possible and appropriate. The tables in the following chapters will indicate whether an action is adapted from the statewide plan.

Climate Adaptation

Some of the proposed actions reduce risk to climate hazards as well as greenhouse gas emissions, which is explicitly identified in the "Reduces Climate Risks" column. This assessment anticipates the need for a Climate Adaptation Plan to be developed at a later date. The "Climate Adaptation" chapter describes climate hazards and related actions in more detail.

Pennsylvania's most recent Climate Action Plan (CAP) was issued in September 2021. It recommends that local jurisdictions consider these programs and policies, as appropriate, for inclusion in their climate action plans. Carlisle Borough considered many of these and are explicitly identified several in Chapters x-x. Others will be implemented implicitly in the execution of individual objectives and programs.

Increase end use energy conservation and efficiency

- Implement and require codes beyond the State Code such as the International Green Construction Code (lgCC), Zero Code and NetZero Codes.
- Update building codes
- Increase adoption of energy efficiency
- Expand energy assessments and provide more trainings on energy efficiency for industry
- Expand home weatherization programs
- Increase support for market trends for energy efficient technologies
- Replace high carbon and GHG producing fuels or energy sources with less environmentally impactful options
- Educate consumers about the benefits of occupant performance and low energy usage improvements in building system technologies

Implement sustainable transportation planning and practices

- Reduce vehicle miles traveled for single-occupancy vehicles
- Implement a strategic plan and incentives for increasing electric vehicle use
- Increase the use of clean public transportation through electric municipal bus fleets
- Develop people-mover systems, such as West Virginia University's Personal Rapid Transit system
- Continue and expand efforts to assess climate risks to transportation and land use planning, and incorporate expected future conditions into capital planning, project design, and routine operations, maintenance, and inspection practices
- Improve preparedness for increased frequency of extreme events by improving coordination between agencies and other stakeholders and by improving real-time monitoring of flooding, traffic, and other conditions
- Prioritize transportation and land use planning that promotes efficient use of public resources, reduces congestion, and minimizes GHG emissions through multi-modal transportation networks and compact, transit-oriented development that uses smart growth practices and complete streets
- Educate citizens and business on the benefits of transportation demand-side management measures and clean and efficient transport options

- Increase adoption of people-powered transportation options such as walking, school buses, or commuter bicycle paths
- Reduce non-CO2 emissions (hydrofluorocarbons) from truck and stationary refrigeration systems
- Help develop and implement regional market-based policies that would both reduce carbon pollution from the transportation sector and fund clean transportation investments

Develop, promote, and use financing options to encourage energy efficiency

- Expand use of performance contracting
- Create local clean energy tax incentives
- Evaluate options for and engage in public-private partnerships and capitalize on them
- Encourage broad implementation of recent commercial PACE legislation

Increase use of clean, distributed electricity generation resources

- Invest in and promote building-scale solar
- Incentivize and increase use of combined heat and power (CHP)
- Support community solar legislation and develop model local ordinances

Create a diverse portfolio of clean, utility-scale electricity generation

- Further increase local generation and use of renewables
- Establish a workgroup to help optimize siting of renewables, and to review and streamline permitting and regulations at the local level. Focus on high value, implementable actions such as community choice aggregation and battery storage.

Increase production and use of alternative fuels

- Increase recovery and use of gas from coal mines, agriculture, wastewater, and landfills for energy
- Increase sustainable biofuel production
- Support the sustainable harvest and use of biomass feedstocks for thermal energy

Use agricultural best practices

- Increase adoption rate of and provide training for no-till farming practices
- Facilitate information sharing networks for farmers and the agricultural research community to share experiences and best practices

Protect ecosystem resilience, including forest systems where species will shift

- Conserve and enhance areas representing the full range of wildlife and fish habitats and promote connectivity (e.g., using land exchanges, conservation easements, leases; by removing barriers) to allow species to migrate to suitable habitat

- Promote forest conservation, reforestation and urban tree canopy expansion on private and public lands through various means, including forest conservation easement programs
- Restore wetlands and riparian areas, expand or revise current minimum riparian buffer zones, and implement living shoreline programs to provide natural flood abatement, breeding habitat, and improved stream conditions (including improved thermal conditions)
- Preserve and create open spaces, parks, and trails that allow people to engage in outdoor activities and maintain connectivity to natural resources. Protect wildlife and fish habitat and species that support recreational opportunities like hunting, fishing, and wildlife viewing.
- Educate recreational land users about the importance of climate change impacts on ecosystems and the dangers of illegal hunting and fishing, pollution, and development
- Retrofit existing parks and trails and create new parks and trails to strengthen the community, improve habitat connectivity, provide more water sources for human users recreating in higher temperatures, enhance natural stormwater and flood management, and connect paths to schools, workplaces, and retail centers to promote pedestrian use
- Promote alternatives to mowing, including meadows, native plants, and trees

Monitor, identify, and address ecosystem vulnerabilities

- Identify and prioritize species, habitat, and ecosystems most vulnerable to climate change and other stressors to better target protection and management actions

Help the outdoor tourism industry manage shifting climate patterns

- Help public parks adapt to climate change by designing park infrastructure to be adaptable to changes in use, allocating funds to match recreation demand, and expanding operations at ski resorts to allow for warmweather recreation
- Explore developing new collaboratives with surrounding communities
- Create a business ombudsman or technical assistance center for affected recreational industries and establish a source of grant funding or tax incentives to help industry and municipalities transition from winter to summer activities

Reduce waste generation by citizens and business thereby reducing waste sent to landfills, and WTE facilities, and expand the beneficial use of waste

- Implement programs to encourage citizens and business to reduce waste (including food waste) and use recycling and composting programs through reduce, reuse, and recycle actions
- Encourage the use of digesters for methane capture and recovery
- Support solar projects on landfill land

Use stormwater best management practices

- Incorporate PA DEP's Stormwater Best Management Practices Manual as standard operating procedure

- Provide incentives for the installation and use of gray water and rainwater harvesting and consider existing international guidelines for increased reclaimed, recycled, and gray water use for non-potable applications (e.g., irrigation, toilet flushing)
- Promote green infrastructure by instituting laws, regulations, and local ordinances requiring implementation of green infrastructure with new development or substantial redevelopment
- Reduce impervious surfaces by requiring installation of permeable surfaces, buffers, and vegetated filters for all transportation-related projects; developing and enforcing a stormwater retention standard for new development and redevelopment; and/or implementing a fee for impervious surfaces

Promote integrated water resources management and water conservation

- Assess the impact of climate change on critical water supply and wastewater infrastructure, and encourage the development of facility-specific adaptation plans
- Include climate change projections and modeling results in water supply and water quality planning to enhance reliability, improve quality, and improve instream flows and fish passage

Improve reliability and accessibility of public information about climate-related health risks

- Update Community Health Assessments to include climate change and health tracking metrics
- Help local health departments assess their capacity to respond to health threats and to integrate climate preparedness into their hazard response plans and daily operations
- Work locally with vulnerable groups to assist at-risk communities with the development, adoption, practice, and evaluation of response, evacuation, and recovery plan
- Regularly map locations of vulnerable populations and use the information to focus interventions and outreach

Bolster emergency preparedness and response

- Review existing emergency response, preparedness, evacuation, and management plans
- Expand the scope of the local hazard mitigation plan to factor in expected vulnerabilities from climate change impacts
- Evaluate and improve the adequacy, effectiveness, accuracy, and technological capabilities of forecasting, earlywarning, and emergency-preparedness systems
- Foster collaboration between communication service providers and agencies to provide reliable communications in times of power outages and emergencies
- Establish heat advisories, increase availability of cooling stations, invest in efficient HVAC systems at targeted Recreation Centers which are provided with renewable energy backup systems, and implement other preventive measures to reduce the impact of extreme heat events
- Restructure disaster-recovery policies to ensure that redevelopment efforts strive to reduce long-term risk

Lead by example in local government practices and assets

- Establish a strategic energy management plan for public facilities that includes benchmarking and specific energy, water, and transportation emissions reductions targets and goals
- Maximize onsite renewable energy generation and purchase additional renewable power through renewable energy certificates (RECs) direct purchasing
- Incorporate climate change considerations into decision making processes and criteria. For example, add climate change resilience as a prioritization factor for new capital projects.
- Consider ENERGYSTAR certification, Leadership in Energy and Environmental Design (LEED) Gold, Net Zero Buildings, Zero Energy Codes, Passive House standards, and climate resilience design guidelines as higherperformance basis of design for new construction and major renovation projects in public buildings
- Inventory public buildings and energy use patterns to identify savings opportunities
- Implement emissions reduction and climate resilience activities in public facilities, including distributed generation, least impact backup power generation, energy efficiency, water efficiency, climate resilient vegetation, and proper tree maintenanc
- Require energy efficient and alternative fuels use in fleet vehicles and equipment
- Conduct more training, education, and outreach for facility managers and the workforce
- Ensure that key government operations have planned to provide least impact backup power supply on-site to protect important security features in the case of more frequent or prolonged blackouts

Incorporate historical and projected climate conditions into siting and design decisions for longterm infrastructure

- Implement new or modified policies (e.g., zoning regulations, tax incentives, and rolling easements) that encourage appropriate land use and reduce repetitive losses

5. Commercial Buildings

Broadly speaking, the use of fossil fuels for energy (including electricity, heating, transportation, and other uses) is the single largest contributor to greenhouse gas emissions and climate change. Fossil fuels still supply a considerable share of energy for electricity, heating, transportation, and other energy-producing uses. Emissions from fossil fuel combustion for energy, including transportation, represent 96% of the community's total GHG emissions. Energy Production is a cross-cutting sector in that nearly all activities that take place in the community require energy of some sort. For this reason, grid decarbonization and fuel switching are included as elements of these sector reductions. The transition of the electricity grid to more carbon-free sources of electricity and the switching of natural gas to cleaner fuels, such as hydrogen, reduce the carbon intensity of Carlisle's economy. Although those transitions primarily occur *outside* of the borough's limits, they are considered critical Type 2 sources of carbon and are integrated into these objectives and plans.

Energy consumed in commercial buildings and industrial processes account for 47.7 percent of Carlisle Borough's total GHG emissions. Improving the efficiency of our commercial building stock and reducing the energy intensity of the local industrial sector will contribute significantly to achieving Carlisle Borough's greenhouse gas reduction target. This chapter focuses on opportunities to retrofit existing commercial and industrial buildings and to ensure that future activities in these sectors are compatible with our community's climate protection goals.

Borough government is either reviewing or intends to review aspects of the Comprehensive Plan, Subdivision and Land Development Ordinances (SALDOs), and other related ordinances pertaining to this chapter as described in the Chapter 5 annex.

Objective	Supporting Actions	Co-Benefits	Reduction Potential
C1: Increase rooftop efficiency and solar potential on warehouses and other commercial businesses over a 25-year time span as roofs are replaced.	C1a, C1b, C1c		
C2: Reduce energy use in commercial buildings by 20% in 2035 and 40% in 2050.	C2a, C2b		

C3: Reduce fossil fuel use in existing commercial buildings by at least 25% by 2035, 50% by 2040, and 80% by 2050.	C3a		
C4: Improve stormwater management, incl. agricultural carbon sinks	C4a, C4b		

C1: Increase rooftop efficiency and solar potential on warehouses and other commercial businesses over a 25-year time span as roofs are replaced.

Action Number	Action	New (N) or Existing (E) or Both (B)	Statewide CAP Action	Reduces Climate Risk	Co-Benefits	Lead Actor	Metric
C1a	Warehouse Solar Installations	E	Y	N		TBD	Installed Power (MWs)
C1b	New/Current Commercial Building Solar Installations	B	Y	N		TBD	Installed Power (MWs)
C1c	"Green" Rooftop Modifications	E	N	Y		TBD	Square footage of retrofitted surface

C2: Reduce energy use in commercial buildings by 20% in 2035 and 40% in 2050.

Action Number	Action	New (N) or Existing (E) or Both (B)	Statewide CAP Action	Reduces Climate Risk	Co-Benefits	Lead Actor	Metric
C2a	Establish Energy Use Intensity (EUI) Benchmark for New Commercial	N	Y			TBD	Included in SALDO and applicable ordinances
C2b	Develop Green Building Standards for Commercial Building Construction and Renovation.	B	Y			TBD	Included in SALDO and applicable ordinances

C3: Reduce fossil fuel use in existing commercial buildings by at least 25% by 2035, 50% by 2040, and 80% by 2050.

Action Number	Action	New (N) or Existing (E) or Both (B)	Statewide CAP Action	Reduces Climate Risk	Co-Benefits	Lead Actor	Metric
C3a	Electrification and Fuel-Switching. Reduce use of fossil gas, fuel oil, or propane by switching to electricity and/or renewable gas.	E	Y			TBD	Observed changes in BTU consumption for selected buildings
C4: Improve stormwater management, incl. agricultural carbon sinks							
Action Number	Action	New (N) or Existing (E) or Both (B)	Statewide CAP Action	Reduces Climate Risk	Co-Benefits	Lead Actor	Metric
C4a	Urban Forest Potential	N	Y			SCED Director	Installed foliage
C4b	Riparian Buffer Zoning	E	Y			CAC or designated official, Letort Regional Authority (LRA)	Added acreage to riparian zones

6. Residential Buildings

Energy consumed in residential buildings accounts for 19.2% of Carlisle Borough's total GHG emissions. Improving the efficiency of our residential building stock will contribute significantly to achieving Carlisle Borough's greenhouse gas reduction target, while saving residents money on utility bills and reducing the need for new infrastructure. This chapter focuses on opportunities to retrofit existing residential buildings, increase the quality of new construction, and to ensure that future activities in these sectors are compatible with our community's climate protection goals.

Borough government is either reviewing or intends to review aspects of the Comprehensive Plan, Subdivision and Land Development Ordinances (SALDOs), and other related ordinances pertaining to this chapter as described in the Chapter 6 annex.

Objective	Supporting Actions	Benefits	Reduction Potential
R1 – Reduce energy use in residential buildings by 40% in 2050.	R1a, R1b, R1c		
R2 – Residential Electrification. Reduce use of natural gas, fuel oil, or propane for space and/or water heating (60% of Carlisle households in 2017) by switching 50% to electricity by 2035 and 80% by 2050.			
R3: Increase residential and commercial awareness of renewable generation providers, including through PAPowerSwitch			
R4 - Increase the percentage of households with rooftop PV solar installations -or- residents who are participants in commercial solar projects to 10% by 2025, 25% by 2035, and 40% by 2050. (see Pennsylvania's Solar Future Plan)	R4a, R4b, R4c		
R5 - Tree planting, natural landscapes and reduction of lawn maintenance.	R5a, R5b		

Objective R1: Reduce energy use in residential buildings by 40% in 2050.							
Action Number	Action	New (N) or Existing (E)	Statewide CAP Action	Reduces Climate Risk	Co-Benefits	Lead Actor	Metric
R1a	Energy Efficiency Retrofits for Existing Homes. 40% of existing residential homes participating in energy efficiency programs by 2035 and 70% by 2050.	E	N	Y		TBD	Mix of surveys and information from PPL/UGI
R1b	Net-Zero New Residential Homes. Increase the percentage of new residential building areas that produce as much energy on-site as it uses to 5% by 2025, 35% by 2035, and to 65% by 2050.	N	N	Y		SCED Director	# of new homes that are net-zero
R1c	Establish Energy Use Intensity (EUI) Benchmark for New Residential Buildings.	N	N	Y		TBD	TBD
Objective R2: Residential Electrification. Reduce use of natural gas, fuel oil, or propane for space and/or water heating (60% of Carlisle households in 2017) by switching 50% to electricity by 2035 and 80% by 2050.							
Objective R3: Increase residential and commercial awareness of renewable generation providers, including through PAPowerSwitch							

Objective R4 - Increase the percentage of households with rooftop PV solar installations -or- residents who are participants in commercial solar projects to 10% by 2025, 25% by 2035, and 40% by 2050. (see Pennsylvania's Solar Future Plan)							
Action Number	Action	New (N) or Existing (E)	Statewide CAP Action	Reduces Climate Risk	Co-Benefits	Lead Actor	Metric
R4a	Increase knowledge and uptake of existing incentive programs.	E	N	Y		TBD	TBD
R4b	Host workshops on purchasing power agreements, perhaps hold vendor fairs.	N	N	Y		TBD	TBD
R4c	Research the potential for Community Solar fields	N	N	Y		TBD	TBD

Objective R5: Tree planting, natural landscapes and reduction of lawn maintenance.							
Action Number	Action	New (N) or Existing (E)	Statewide CAP Action	Reduces Climate Risk	Co-Benefits	Lead Actor	Metric
R5a	Reimagine the tree planting program for the Borough	E	N	Y		SCED Director	TBD
R5b	Reduce community emissions from lawn care.	N	N	Y		SCED Director	TBD

7. Municipal Energy Use and Production

While PPL and UGI, Carlisle's electricity and natural gas providers, respectively, are working hard to increase the percentage of energy generated through renewable sources, opportunities also exist for citizens and Carlisle Borough's local government to produce small-scale renewable energy or fuels, offsetting the need for fossil fuels. This sector is limited to energy production exclusively – objectives and actions that focus on end-use energy efficiency are included in other sectors. The programs and projects within this sector are designed to spur local government and community investment in renewable energy sources including those that produce electricity, heat, and mobile fuels.

Borough government is either reviewing or intends to review aspects of the Comprehensive Plan, Subdivision and Land Development Ordinances (SALDOs), and other related ordinances pertaining to this chapter as described in the Community Planning/Zoning Annex.

It is recognized that the borough is already making significant progress toward many of these objectives/goals. For instance, regarding M2a (below), 1) it is working with APPI Energy to formulate a competitive Request for Proposal in order to install a substantial capacity of solar generation throughout the borough's public facilities, and 2) it is currently procuring all of its electricity from 100 percent renewable energy through a contract with Engie Resources.

Note that GHG reduction potential here is blank, reflecting the fact that this CAP is a Community-Wide Plan and energy use for municipal operations is reflected in the other sector-specific areas. These objectives are intended to be targeted goals for municipal operations, which the borough has direct discretion to implement.

Objective	Supporting Actions	Benefits	Reduction Potential
M1 – Adapt local ordinances and regulations to encourage carbon reduction strategies.	M1a, M1b		
M2 – Reduce energy use in municipal buildings by 50% in 2035 and achieve net-neutrality by 2050.	M2a, M2b, M2c		

Objective M1: Adapt local ordinances and regulations to encourage carbon reduction strategies.							
Action Number	Action	New (N) or Existing (E)	Statewide CAP Action	Reduces Climate Risk	Co-Benefits	Lead Actor	Metric
M1a	Reduce local regulatory barriers to renewable energy installation and use.	N	Y	N/A		SCED Director	TBD
M1b	Incorporate a Model Lighting Ordinance (MLO) to reduce light pollution and encourage transition to more efficient lighting.	N	Y	N/A		SCED Director	TBD

Objective M2: Reduce energy use in municipal buildings by 50% in 2035 and achieve net-neutrality by 2050.							
Action Number	Action	New (N) or Existing (E)	Statewide CAP Action	Reduces Climate Risk	Co-Benefits	Lead Actor	Metric
M2a	Transition to 100% renewable energy consumption at all Borough facilities by 2050.	N	Y	N/A	$	Dir. SCED	% of total energy consumption from renewables
M2b	Reduce municipal energy consumption through energy efficiency improvements.	N	Y	Y	$	Dir. SCED	Energy Use Reduction (BTUs + KWhs)
M2c	Ensure all new construction of municipal facilities be built to highest efficiency standards (IECC), and a percentage of renewable energy sourced, with a progressive goal of carbon neutral/net zero buildings.	N	Y	N/A	$	Dir. SCED	TBD

8. Waste, Composting, & Recycling

Carlisle Borough's solid waste is disposed of, primarily, by Advanced Disposal at their landfill located in Newville, PA. Emissions from decaying putrescible material directly contribute <4% of Carlisle Borough's total GHG emissions and contribute to emissions in the Transportation sector via hauling of waste to and from facilities. Additionally, embodied energy within the items that we throw away might be harnessed through reuse and recycling of materials. It is in Carlisle Borough's long-term interest to reduce waste at its source, expand recycling facilities, reduce food waste, and enable re-use of materials. This chapter focuses on opportunities to reduce waste, reuse materials, recycle what cannot be reused, and to convert biosolids and landfill methane for potential electricity generation.

Food Waste

An estimated 35% of food that is produced is uneaten, with losses occurring along the supply chain from farms to consumers. When food waste decomposes in landfills, it releases methane, a greenhouse gas (GHG) with at least 25 times the warming potential of carbon dioxide. Many municipalities and organizations are beginning to prioritize diverting food waste from landfills by either preventing waste, rerouting edible food to the nearly 14 million food insecure households, or recycling waste through composting, animal feeding operations, or anaerobic digestion. Of these recycling methods, anaerobic digestion (AD) – a process in which microorganisms break down organic material and create biogas and digestate that can be turned into valuable renewable energy or soil amendment and nutrient products – has substantial potential, but is still in the early stages of development and implementation in the United States.

Furthermore, many types of foods, including beef and pork, contribute substantial amounts of GHGs through grazing and feeding patterns. This plan does NOT account for these "Scope 3", or indirect, emissions. However, any efforts to minimize food waste can effectively reduce these additional concerns regarding the food sector's contribution to GHG emissions.

Objective	Supporting Actions	Benefits	Reduction Potential
WR1 – Reduce amount of non-recyclable materials	WR1a, WR1b, WR1c		

WR2 – Improve community composting facilities to include food waste and divert 50% of compostable waste from landfills by 2035 and 100% by 2050	WR2a, WR2b		

Objective WR1: Reduce amount of non-recyclable materials							
Action Number	Action	New (N) or Existing (E)	Statewide CAP Action	Reduces Climate Risk	Co-Benefits	Lead Actor	Metric
WR1a	Reduce single-use plastic bags	N	N	N/A		SCED Director	# of SUP bags
WR1b	Establish Borough bag limit	-	-	-	$	SCED Director	TBD

Objective WR2: Improve community composting facilities to include food waste and divert 50% of compostable waste from landfills by 2035 and 100% by 2050							
Action Number	Action	New (N) or Existing (E)	Statewide CAP Action	Reduces Climate Risk	Co-Benefits	Lead Actor	Metric
WR2a	Food Waste Education	N	N	N/A		TBD	TBD
WR2b	Compostable Facilities Development and Integration	-	-	-	$	SCED Director	TBD

9. Transportation

Emissions from transportation is a common sight to nearly everyone in Carlisle Borough. Besides emitting greenhouse gases, transportation fossil fuels also produce a host of criteria air pollutants when combusted, reducing local air quality and affecting our health. Transportation accounts for 29.3% of Carlisle Borough's total GHG emissions. This chapter focuses on programs and policies to reduce emissions from transportation and includes design-oriented approaches as well as expansion of alternate modes such as walking, biking, or public transportation to and from the most common destinations in Carlisle Borough.

Transportation is a critical sector for Carlisle to focus on because it has witnessed virtually no reductions in estimated GHG emissions since 2005, less than 0.1 percent [70,855 mtCO2 (2005) – 70,786 mtCO2 (2017)].

Borough government is either reviewing or intends to review aspects of the Comprehensive Plan, Subdivision and Land Development Ordinances (SALDOs), and other related ordinances pertaining to this chapter as described in the Chapter 9 annex.

PA State Transportation Objectives and Actions

Implement sustainable transportation planning and practices

- Reduce vehicle miles traveled for single-occupancy vehicles
- Implement a strategic plan and incentives for increasing electric vehicle use
- Increase the use of clean public transportation through electric municipal bus fleets
- Develop people-mover systems, such as West Virginia University's Personal Rapid Transit system
- Continue and expand efforts to assess climate risks to transportation and land use planning, and incorporate expected future conditions into capital planning, project design, and routine operations, maintenance, and inspection practices
- Improve preparedness for increased frequency of extreme events by improving coordination between agencies and other stakeholders and by improving real-time monitoring of flooding, traffic, and other conditions
- Prioritize transportation and land use planning that promotes efficient use of public resources, reduces congestion, and minimizes GHG emissions through multi-modal transportation networks and compact, transit-oriented development that uses smart growth practices and complete streets

- Educate citizens and business on the benefits of transportation demand-side management measures and clean and efficient transport options
- Increase adoption of people-powered transportation options such as walking, school buses, or commuter bicycle paths
- Reduce non-CO2 emissions (hydrofluorocarbons) from truck and stationary refrigeration systems
- Help develop and implement regional market-based policies that would both reduce carbon pollution from the transportation sector and fund clean transportation investments

Carlisle as a Hub for Vehicle Elecrification

Carlisle is in a unique position to promote the conversion of vehicle fleets from fossil fuels to alternative fuels. Carlisle is host to some of the largest car show venues on the east coast with various annual events, many of which highlight new transportation technologies and trends. The Borough is also home to a significant amount of logistics infrastructure and a transit point for long-distance trucking. This provides the borough with a great opportunity to partner with venue and industry partners to introduce and showcase the features of emerging alternative fueled vehicles at both the consumer and commercial level.

Objective	Supporting Actions	Benefits	Reduction Potential
T1: Incentivize and accelerate adoption of electric and alternative energy vehicles in the vehicle fleet.	T1a, T1b		
T2: Convert the entire municipal light-duty vehicle fleet to electric or alternative fueled vehicles by 2035 and convert remaining medium and heavy-duty municipal vehicle fleet to electric or alternative fueled by 2050.	T2a, T2b		
T3: Reduce community vehicles miles travelled (VMT) 10% by 2035 and 25% by 2050.	T3a		

Objective T1: Increase the adoption of electric and alternative energy vehicles in the vehicle fleet.							
Action Number	Action	New (N) or Existing (E)	Statewide CAP Action	Reduces Climate Risk	Co-Benefits	Lead Actor	Metric
T1a	Incentivize and accelerate adoption of electric and alternative energy vehicles by households and businesses to achieve 30% of the light-duty fleet by 2035 and 90% by 2050;		Implement a strategic plan and incentives for increasing electric vehicle use	N		TBD	Est. # of AFVs
T1b	Incentivize and accelerate adoption of electric and alternative energy vehicles in commercial and industrial uses to achieve 15% of the medium and heavy-duty fleet by 2035 and 45% by 2050	-	-	N		TBD	EST # of AFVs

Objective T2: Convert the entire municipal light-duty vehicle fleet to electric or alternative energy by 2035 and convert remaining medium and heavy-duty municipal vehicle fleet to electric or alternative energy by 2050.							
Action Number	Action	New (N) or Existing (E)	Statewide CAP Action	Reduces Climate Risk	Co-Benefits	Lead Actor	Metric
T2a	Use existing incentives to complete a comprehensive fleet assessment of all municipal light, medium, and heavy-duty fleet vehicles to inform the development and implementation of a multi-year	-	Increase the use of clean public transportation through electric	N		Dir. SCED	Percentage of Vehicle fleet replaced by year

	strategy, including procurement benchmarks.		municipal bus fleets				
T2b	T2b: Convert the CASD bus fleet to electric/low-carbon by 2035.	-	-	N		CASD Rep.	# of Converted school buses

Objective T3: Reduce community vehicles miles travelled (VMT) 10% by 2035 and 25% by 2050.  							
Action Number	Action	Programs	Statewide CAP Action	Reduces Climate Risk	Co-Benefits	Lead Actor	Metric
T3a	Participation in telework programs, both part-time and full-time	-	Reduce vehicle miles traveled for single-occupancy vehicles	Y		TBD	# of reduced VMTs

State and Federal Incentive Programs:

State

Alternative Fuels Incentive Grant (AFIG) Program: The AFIG Program provides financial assistance for innovative, advanced fuel and vehicle technology projects. Access information about current program funding opportunities.

AFV Rebate: The AFV Program provides rebates to assist eligible residents with purchasing or leasing new AFVs, including BEVs, PHEVs, and hydrogen FCEVs, among others. Rebate amounts by vehicle type. An additional rebate of $1,000 is available for applicants meeting the low-income requirement.

EVSE Grants and Rebates: Pennsylvania is using a portion of its Volkswagen Environmental Mitigation Trust funds to support EVSE deployment in the state. The state will fund selected DC fast charging projects along transportation corridors over a five-year period. It will also fund rebates for publicly

accessible Level 2 chargers installed at workplaces, and multiunit buildings among other locations. Find additional information about clean transportation programs funded by the Mitigation Trust.

Medium- and Heavy-Duty Vehicle Rebates - The Pennsylvania Department of Environmental Protection (DEP) offers rebates for the replacement or repower of Class 4-8 local freight trucks and port drayage trucks, school buses, transit buses, and shuttle buses with new diesel, electric, or alternative fuel vehicles or technologies.

Alternative Fuel Infrastructure Funding

Alternative Fuel and Idle Reduction Grants

Alternative Fuel Infrastructure and Energy Production Grant Program

Idle Reduction and Natural Gas Vehicle (NGV) Weight Exemption

Federal

Advanced Biofuel Feedstock Incentives

Advanced Biofuel Production Grants and Loan Guarantees

Advanced Biofuel Production Payments

Advanced Energy Research Project Grants

Advanced Technology Vehicle (ATV) and Alternative Fuel Infrastructure Manufacturing Incentives

Airport Zero Emission Vehicle (ZEV) and Infrastructure Incentives

Alternative Fuel Excise Tax Credit

Alternative Fuel Infrastructure Tax Credit

Alternative Fuel Mixture Excise Tax Credit

Alternative Fuel Tax Exemption

Alternative Fuel and Advanced Vehicle Technology Research and Demonstration Bonds

Biodiesel Education Grants

Biodiesel Income Tax Credit

Biodiesel Mixture Excise Tax Credit

Biodiesel and Ethanol Infrastructure Grants

Biomass Research and Development Initiative

Ethanol Infrastructure Grants and Loan Guarantees

Freight Efficiency and Zero-Emission Vehicle Infrastructure Grants

Fuel Cell Motor Vehicle Tax Credit

Idle Reduction Equipment Excise Tax Exemption

Improved Energy Technology Loans

Low and Zero Emission Public Transportation Research, Demonstration, and Deployment Funding

Natural Gas Vehicle (NGV) and Plug-In Electric Vehicle (PEV) Weight Exemption

Qualified Plug-In Electric Vehicle (PEV) Tax Credit - - All-electric and plug-in hybrid cars purchased new in or after 2010 may be eligible for a federal income tax credit of up to $7,500. The credit amount will vary based on the capacity of the battery used to power the vehicle. State and/or local incentives may also apply.

Qualified Two-Wheeled Plug-In Electric Drive Motor Vehicle Tax Credit

Second Generation Biofuel Plant Depreciation Deduction Allowance

Second Generation Biofuel Producer Tax Credit

Small Agri-Biodiesel Producer Tax Credit

Value-Added Producer Grants (VAPG)

10. Climate Adaptation

While the Climate Action Commission was not directed to develop climate adaptation goals or objectives through the 2020 GHG reduction resolution, it must be recognized that a) climate adaptation planning should be a complementary planning activity that should be considered in the near term, and b) many of the goals of this plan are complementary to achieving resiliency and energy security. For instance, lowering energy demand puts less stress on the region's transmission and distribution networks, thus reducing the likelihood of brownouts and even blackouts. Similarly, the increase in green streets and parks, as well as green roofs, can reduce heating effects that can reduce heat stress as well as reduce energy consumption.

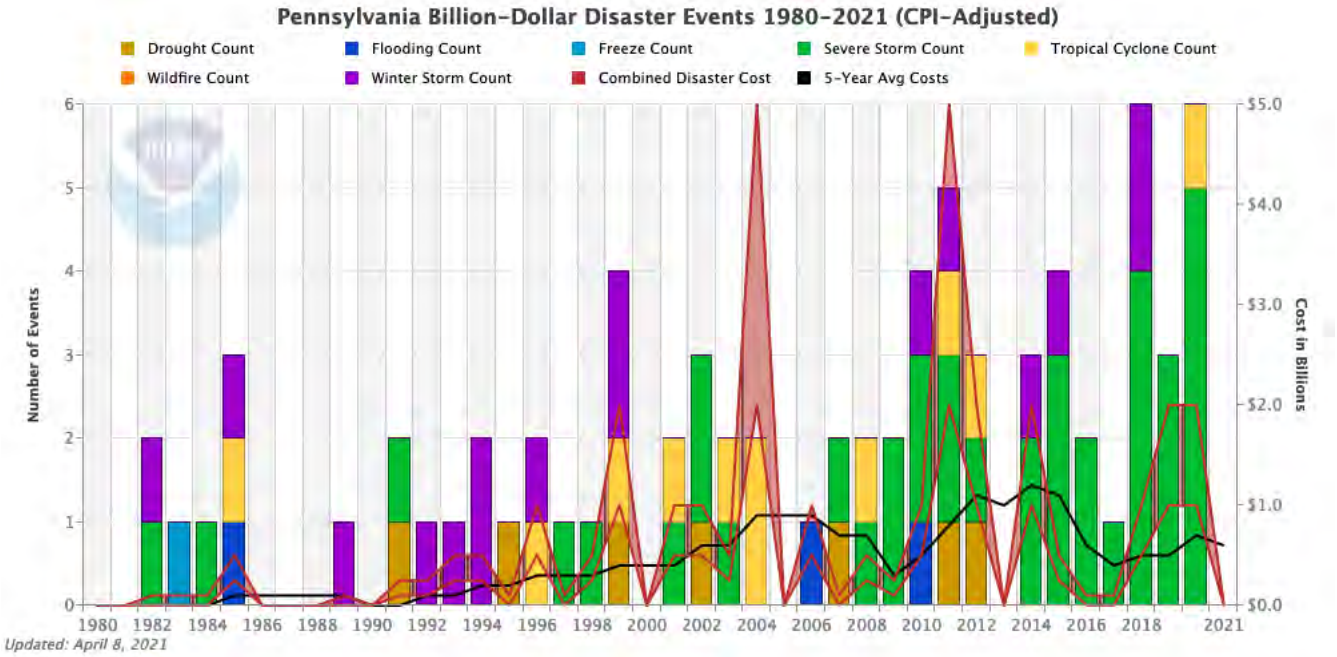
This section provides a high-level assessment of potential climate impacts and highlights those greenhouse gas reduction actions that support adaptation for each type of hazard. It can also be used to educate the public on local impacts and inform future efforts.

Anticipated Climate Impacts

Over the last 110 years, the Commonwealth of Pennsylvania has experienced a long-term warming of more than 1.8°F (1.2°F from 2000 to 2020 alone), as well as an increasing number of wet months. Under an RCP 8.5 scenario, Pennsylvania will be about 5.9°F warmer[2] by mid-century than it was at the end of the 20th century and 9.4 °F warmer by the end-of-century. Annual precipitation will increase about 8%. While the likelihood of meteorological drought is projected to decrease, months with above-average precipitation will continue to rise. These changes will have a variety of ecological, economic, and social impacts on the Commonwealth, particularly related to agriculture, energy, forests, human health, outdoor recreation, water, wetlands and aquatic ecosystems, and coastal resources (*Pennsylvania Climate Impacts Assessment 2021*, 2021)

From 2000 to 2020, 45 "billion-dollar" disaster events occurred in Pennsylvania as a result of tropical cyclones, severe storms, and winter storms (Smith, 2020). Figure 5 highlights the change in the number of billion-dollar disaster events over the last 40 years. Heavy rains, flooding and damages from wind are significant driver of damage during these events. Overall, climate change is projected to alter the frequency and intensity of extreme weather events.

[2] (this estimate has increased by 0.5°F since the 2015 PA assessment)

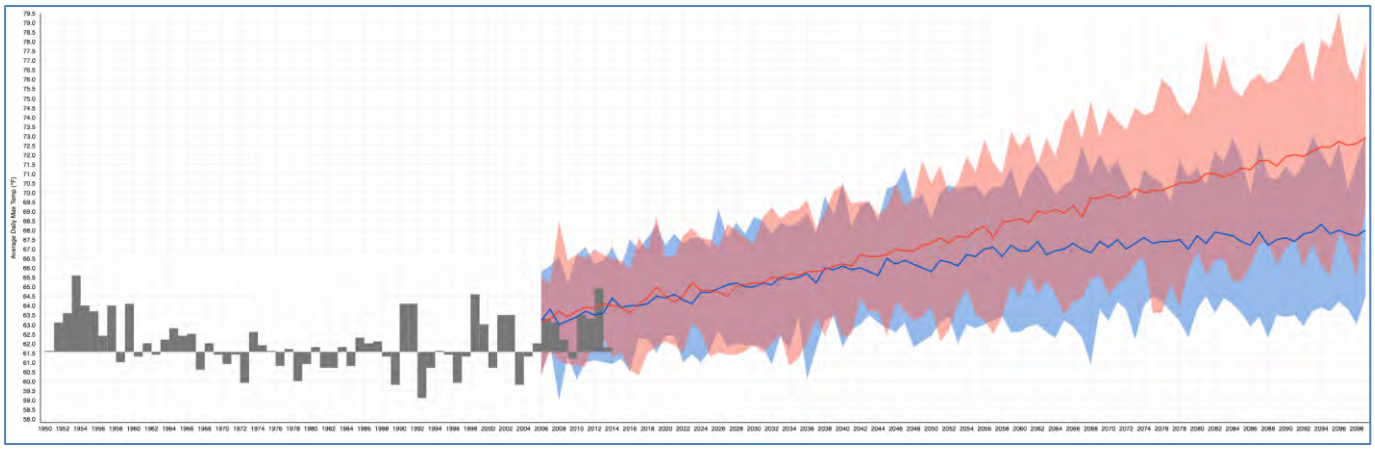


Pennsylvania Climate Impacts Assessment 2021 outlines several risks to the Commonwealth that are attributable to climate change. Of particular concern are climate hazards associated with 1) increasing average temperatures, 2) heavy precipitation and inland flooding, and 3) heat waves (Table 2).

	Climate Hazard	Current Risk Rating	Mid-century Risk Rating
1	Increasing average temperatures	Medium	High
2	Heavy precipitation and inland flooding	High	High
3	Heat waves	Medium	High
4	Landslides	Medium	Medium
4	Sea level rise	Low	Medium
6	Severe tropical and extra-tropical cyclones	Medium	Medium

Rising Temperatures & Heat

Figure 6 is derived from U.S. Climate Explorer and provides a view of projected "Average Daily Max Temperatures" for Carlisle Barracks.



Increasing average temperatures will cause more frequent and intense extreme heat events such as hot days or heat waves. For example, days per year where temperatures reach at least 90°F are expected to increase from 5 days at baseline to 37 days by mid-century and 66 days by end of century. Some parts of the state could experience more than 60 days over 90°F by mid-century. Days over 95°F are projected to increase from an average of 0.6 days during 1971-2000 to 11.5 days by mid-century and 30.5 by end of century. These events increase the minimum electricity capacity required on the electricity grid to service the increased demand. "Peaker" plants are generally more expensive to operate and tend to have higher emission profiles.

Precipitation

In addition to an overall annual precipitation increase of about 8% (under an RCP 8.5 scenario). The amount of rainfall during "extremely heavy" precipitation events (which occur less than 1% of the time) is also projected to rise—a 13% increase by mid-century and 20% increase by end-of-century. Rainfall during "extremely heavy" precipitation events will increase from 30.2 mm (1.2 inch) (historical baseline) to 34.1 mm (1.3 inch) and 36.1 mm (1.4 inch) by mid-century and end-of-century respectively. Finally, the magnitude of precipitation during longer rain events will also increase. The annual maximum amount of precipitation during an annual 3-day precipitation event is projected to increase by 11% by mid-century and 16% by end-of-century.

[3] The blue band shows projections for a future in which humans **significantly reduce emissions of heat-trapping gases in the near future**. Achieving this **Lower Emissions** future—also known as RCP4.5—would require humans to stabilize emissions by 2040 and reduce them to almost zero after that. They might also need to invent and deploy innovative technology to remove heat-trapping gases from the atmosphere. the light red band shows projections for a future in which human emissions of heat-trapping gases **continue increasing through this century**. This **Higher Emissions** future—also known as RCP8.5—assumes that people will not make substantial efforts to reduce the abundance of heat-trapping gases in the atmosphere.

Adaptive Greenhouse Gas Reduction Measures

Some greenhouse gas reduction measures also reduce risk to climate hazards. The following are a few of many examples of how these outcomes can be related to one another:

- Actions that improve energy efficiency and distribute renewable energy can (1) reduce pressure on the grid when there is higher energy demand for heating and air conditioning during extreme heat events, and (2) increase energy independence for households and businesses, as opposed to complete reliance on centralized power infrastructure that could fail during a catastrophic event. These types of actions include, but are not limited to:
    - Energy-efficient building design for new construction, and retrofits for existing buildings (e.g. weatherization)
    - Onsite combined heat and power (CHP)
    - Smart grid technologies
    - Microgrids
- Actions that reduce impervious surfaces can reduce the potential for flooding by retaining stormwater in place. These types of actions include, but are not limited to:
    - Expanding or restoring green space
    - Installing green roofs, rain gardens, bioswales, pervious pavers, and other green infrastructure (as well as requiring them for future development)
- Installing green roofs and planting trees adjacent to buildings can regulate indoor temperatures during extreme heat events
- Expanding and protecting alternative transportation routes (bicycle, pedestrian, bus, and rail) provides network redundancies and alternative routes for emergency evacuation
- Water efficiency and conservation actions can (1) reduce pressure on the grid from energy used for pumping, treating, and distributing water, and (2) make the community less vulnerable to drought

11. Monitoring Plan

Carlisle Borough is committed to making this Climate Action Plan (CAP) a *living* document, to be updated and revised frequently. Planning is more important than plans, and implementation of any plan must be responsive of new facts, changing priorities and new opportunities.

Beginning in November 2021 Carlisle Borough will reorganize its Climate Action Commission (CAC) to engage with community members, businesses, institutions, and other stakeholders through a series of Climate Action Task Forces (CATFs), Transportation, Energy Decarbonization, and Energy Efficiency and Behavior. This will be done in close coordination with the Borough's new Director of Sustainable Community and Economic Growth. The purpose of the task forces is to conduct policy analyses to collect information, community, economic, and legal, to provide actionable recommendations for Council relating to one or more objectives or goals. A course of action for each project/goal would precipitate one or more activities, including: 1) ordinance changes, 2) new budget items, 3) grant requests, 4) media outreach, 5) education activities, and other possible actions. This structure provides an opportunity to understand barriers to implementation and identify best practices or new opportunities in moving forward. For instance, the potential benefits of partnering with local municipalities and neighboring businesses on climate mitigation/adaptation projects may prove to be the most cost-effective option to achieve one or more goals.

The Community Engagement Team will continue to communicate the CAP's status and progress to the wider community while also collecting input to inform the Climate Action Task Force's work.

The Pathways and Analytics Team (PAT) will continue to develop a long-term monitoring process that enables Carlisle Borough to track the impacts of the actions included in the plan and compare estimated impacts to what is actually achieved in terms of energy savings, renewable energy production, and GHG emissions reduction. Assessing the implementation status of the actions will allow determination of whether the action is performing well and to identify corrective measures.

A **formal** monitoring plan for this CAP will be addressed at a later date, in close consultation with the incoming Director on Borough staff. Also, it may be appropriate to conduct a partial assessment and/or GHG inventory as plans and priorities evolve. Those plans will amend this document as they are developed.

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Appendix A: Carlisle GHG Emissions, Past and Future

Carlisle's Greenhouse Gas Emissions, Past and Future

May 1, 2020

Neil Leary, Olivia Kubaska, Sam Lavine, and Mark Frenzel-Sulyok, Dickinson College*

Introduction

The Borough of Carlisle is one of twenty municipalities planning for climate change as part of the *Local Government Climate Action Assistance Program* of the Pennsylvania Department of Environmental Protection (DEP). Carlisle is receiving assistance from DEP, ICLEI Local Governments for Sustainability, and Dickinson College to develop a local climate action plan to benefit the Carlisle community and help advance goals of Pennsylvania's Climate Action Plan (PA Department of Environmental Protection, 2019).

In the first phase of the program, greenhouse gas emissions produced by activities of Carlisle residents, businesses, government offices and other entities were estimated for 2005 and 2017 and a scenario of potential future emissions was constructed. Results of the analyses from the first phase, summarized in this report, provide information intended for use in a subsequent phase of local climate action planning.

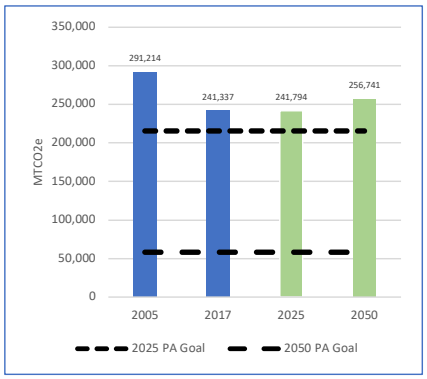
Greenhouse gases such as carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) are emitted by burning fossil fuels and other activities. The gases accumulate in the atmosphere where they amplify the capacity of the atmosphere to absorb and retain thermal energy and cause the climate to warm and change in other ways.

Carlisle's emissions of greenhouse gases are estimated from activity data for Carlisle (e.g. electricity and other energy use, travel by car and truck, and disposal of municipal solid waste) and average rates of emissions from the activities that were input to ClearPath, an online greenhouse gas inventory tool (ICLEI, 2014). Emissions of each type of greenhouse gas are converted into metric tons of carbon dioxide equivalent ($MTCO_2e$) to provide a standard measurement of their contributions to climate change. The methodology and data sources for estimating Carlisle's emissions are described in the appendix.

Total Emissions

Carlisle's total greenhouse gas emissions in 2005 are estimated to be equivalent to just over 291,000 metric tons of carbon dioxide ($MTCO_2e$), or 16.1 metric tons per resident (Figure 1). From 2005 to 2017, the most recent year for which complete data are available, estimated emissions declined 17.1 percent to roughly 241,000 $MTCO_2e$, or 12.7 metric tons per resident. The decrease resulted primarily from a reduction in the share of electricity generated with coal, which produces high emissions per kilowatt hour (kWh) of electricity, and an increase in the share generated with natural gas, which produces less emissions per kWh.

Figure 1. Total greenhouse gas emissions, past and future



To put these numbers in perspective, emissions in 2017 are equivalent to every Carlisle resident

* Numerous collaborators provided technical support, data, and other assistance to estimate Carlisle's greenhouse gas emissions. Borough Council members Sean Shultz and Joel Hicks oversaw the project and Heidi Kunka, PA Department of Environmental Protection, and Jesse Carpentier and Calyn Hart of ICLEI Local Governments for Sustainability provided technical support. Susan Armstrong, Borough of Carlisle, Kathryn Frazier, PPL Electric Utilities, Dusty Hilbert, Advanced Disposal, Mark Malarich, Borough of Carlisle, Brian Meilinger, UGI Utilities, Justin Miller, Cumberland County Recycling and Waste Authority, Sean Shultz, Borough of Carlisle, Jeff Smith, Carlisle Airport, and Dan Szekeres, Michael Baker International provided data for the project. Funding was provided by the Borough of Carlisle and by the PA Department of Environmental Protection.

disposing 13 Borough Bags of carbon dioxide into the atmosphere *every week*. Adding this over the year for all residents, we are collectively putting 13.3 million Borough Bags of greenhouse gases into the atmosphere each year.[†]

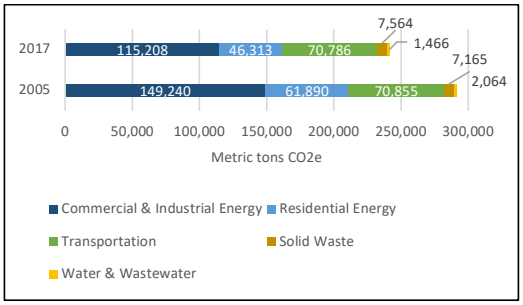
While recognizing that the future is uncertain, a scenario of future emissions was constructed for 2020 – 2050, assuming that no new policies or actions would be implemented to limit emissions. Under this and other assumptions, Carlisle's emissions are projected to grow slowly to almost 242,000 $MTCO_2e$ by 2025 and 257,000 $MTCO_2e$ by 2050.

Past and projected future emissions are shown in Figure 1. For comparison, the figure also displays emission levels that correspond to statewide goals of the Pennsylvania Climate Action Plan: 26 percent reduction from 2005 by 2025 and 80 percent reduction by 2050. Estimates of past emissions, the projection of future emissions for a "No Action" scenario, and the state-level goals provide benchmarks that can be used to evaluate strategies for reducing Carlisle's greenhouse gas emissions.

Emissions by Sector

Emissions wre estimated for five sectors for the years 2005 and 2017: commercial and industrial energy, residential energy, transportation, municipal solid waste, and water and wastewater. 2017 is the most recent year for which complete data is available to estimate emissions for Carlisle. Emissions were also estimated for 2005 because 2005 is the year used in the Pennsylvania Climate Action Plan as a benchmark against which emission reductions are measured for the state.

Figure 2. Emissions by sector, 2005 and 2017



Commercial and industrial energy use produced the largest share of Carlisle's emissions in both 2005 and 2017, followed by transportation, residential energy, solid waste, and water and wastewater (Figure 2). In 2017, commercial and industrial energy accounted for 47.7% of total emissions, transportation for 29.3%, and residential energy for 19.2%. Solid waste, water, and wastewater combined account for less than 4% of emissions.

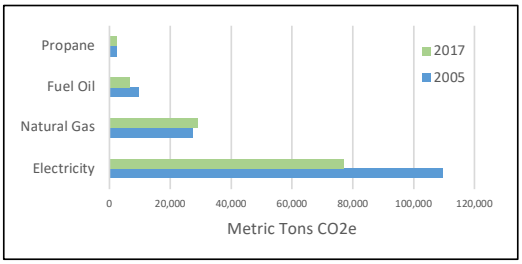
Commercial and Industrial Energy

Carlisle's commercial and industrial establishments use over 1,400 billion British thermal units (Btus) of energy per year. Use of this energy generated nearly 150,000 $MTCO_2e$ of greenhouse gas emissions in 2005 and roughly 115,000 $MTCO_2e$ in 2017 (Table 1; Figure 3). Electricity use is the biggest contributor to these emissions. 223 million kWh of electricity was used by Carlisle's commercial and industrial establishments in 2017, up 5.6% from 2005. Despite the rise in commercial and industrial electricity use in Carlisle, emissions produced by electric utilities to supply this electric power decreased from about 110,000 $MTCO_2e$ to 77,000 $MTCO_2e$. The decline in emissions is attributable to natural gas displacing coal in generating electric power.

Table 1. Commercial and industrial energy use and emissions

		2005		2017	
	Usage Units	Usage	GHG Emissions (MTCO2e)	Usage	GHG Emissions (MTCO2e)
Electricity	Million kWh	211.2	109,650	223.0	77,066
Natural Gas	Billion Btu	516.7	27,483	545.7	29,022
Fuel Oil	Billion Btu	128.2	9,547	88.3	6,572
Propane	Billion Btu	41.3	2,561	41.1	2,549
Total	Billion Btu	1,406.7	149,241	1,435.8	115,209

Figure 3. Emissions from commercial and industrial energy use by energy type



[†] This calculation assumes that the carbon dioxide gas is compressed to a density equal to that of municipal solid waste and each Borough Bag is filled to its maximum allowed 40 pounds.

Natural gas is the second largest energy source for Carlisle's commercial and industrial establishments and is also the second largest source of greenhouse emissions for the sector. Relatively small amounts of fuel oil and propane are used by Carlisle's commercial and industrial sector and account for small shares of emissions.

Residential Energy

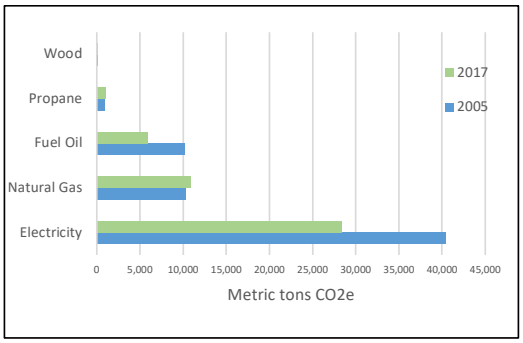
Carlisle residents used 617 billion Btus of energy in 2005 and 594 billion Btus in 2017 to heat and cool their homes, power appliances, and for other purposes. Of Carlisle's 7,475 occupied households, 45% used natural gas as their primary heating fuel in 2017, 38% used electricity, 12% used distillate fuel oil, nearly 3% used propane, and 1% used wood.

Energy use by Carlisle's residential sector emitted close to 62,000 $MTCO_2e$ of greenhouse gases in 2005 and 46,000 $MTCO_2e$ in 2017, a decrease of 25% (Table 2; Figure 4). Electricity use is the largest source of emissions for Carlisle's residences, 61.3% in 2017, followed by natural gas, 23.5%, and fuel oil, 12.6%. The decrease in emissions from residential energy use is largely due to lower emissions per kWh of electricity generation.

Table 2. Residential energy use and emissions

		2005		2017	
	Usage Units	Usage	GHG Emissions (MTCO2e)	Usage	GHG Emissions (MTCO2e)
Electricity	Million kWh	77.8	40,395	82.2	28,391
Natural Gas	Billion Btu	193.7	10,301	204.5	10,877
Fuel Oil	Billion Btu	134.9	10,212	77.2	5,846
Propane	Billion Btu	14.5	903	17.0	1,054
Wood	Billion Btu	8.0	79	14.5	145
Total	Billion Btu	616.5	61,890	593.5	46,313

Figure 4. Emissions from residential energy use by energy type



Transportation

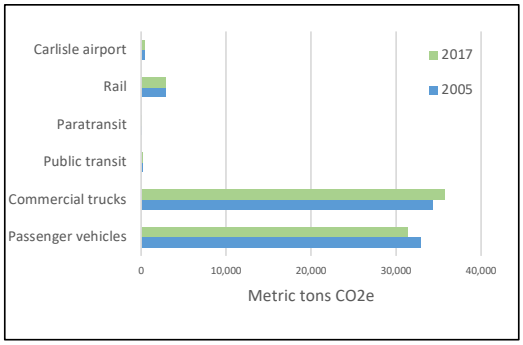
Roughly 100 million miles are driven annually for trips that begin or end in Carlisle. This includes nearly 84 million miles driven in passenger vehicles and light trucks and 21.7 million miles driven in commercial trucks in 2017. Road and other transportation resulted in emissions of nearly 71,000 $MTCO_2e$ in both years (Table 3; Figure 5). Excluded from these estimates are trips that just pass through Carlisle.

While vehicle miles traveled in passenger vehicles and light trucks are nearly four-times greater than miles traveled by commercial trucks, commercial trucks are a larger source of greenhouse gas emissions. This is because commercial trucks have much lower fuel economy and consequently burn more fuel than passenger vehicles. Commercial trucks emitted nearly 36,000 $MTCO_2e$ in 2017 and passenger vehicles emitted slightly more than 31,000 $MTCO_2e$ that year.

Table 3. Transportation emissions

	2005		2017	
	Vehicle Miles Traveled	GHG Emissions (MTCO2e)	Vehicle Miles Traveled	GHG Emissions (MTCO2e)
Passenger vehicles	79,536,980	32,852	83,988,726	31,380
Commercial trucks	20,593,429	34,366	21,746,059	35,753
Public transit	64,910	184	68,543	194
Paratransit	49,485	87	52,255	92
Rail	NA	2,919	NA	2,919
Carlisle Airport	NA	448	NA	448
Total	100,244,804	70,856	105,855,583	70,786

Figure 5. Emissions from transportation



Public transit and paratransit bus revenue miles are much smaller in comparison to passenger and commercial vehicle travel. They contributed less than 300 $MTCO_2e$ to emissions. Rail added a bit less than 3,000 $MTCO_2e$ and fuel use at the Carlisle Airport added close to 450 $MTCO_2e$.

Municipal Solid Waste, Water, and Wastewater

Landfilling municipal solid waste, distributing drinking water, and treating wastewater contribute emissions of greenhouse gases that are small in comparison to emissions from energy use and transportation (Table 4). Municipal solid waste generated by Carlisle residents, businesses and other establishments is taken to the Cumberland County Landfill where organic components decompose and produce methane, a greenhouse gas that is 25 times more powerful than carbon dioxide. Some of the landfill gas is captured and either combusted to generate electricity or flared, which converts the methane to the less powerful greenhouse gas carbon dioxide.

In 2017, nearly 13,000 tons of solid waste was generated by Carlisle and landfilled. Emissions of methane from the landfilled waste are estimated at roughly 7,500 $MTCO_2e$, slightly more than in 2005. Combustion and flaring of landfill gas contribute an additional 20 $MTCO_2e$.

Table 4. Solid waste, water, and wastewater emissions

	2005	2017
Municipal Solid Waste		
Landfilled waste (short tons)	12,095	12,772
GHG emissions - fugitive (MTCO2e)	7,145	7,545
GHG emissions - combustion & flaring (MTCO2e)	20	20
Total MSW emissions (MTCO2e)	7,165	7,565
Drinking water		
Water use (millions gals)	493	521
Electricity use (kWh)	1,647,038	1,739,224
GHG emissions - electricity (MTCO2e)	855	601
Wastewater		
Electricity use (kWh)	2,248,320	2,374,160
GHG emissions - electricity (MTCO2e)	1,167	821
GHG emissions - fugitive (MTCO2e)	42	44
Total wastewater emissions (MTCO2e)	2,064	1,466

Carlisle residents and establishments used an estimated 493 million gallons of drinking water in 2005 and 521 million gallons in 2017. 1.7 million kWh of electricity was used to pump and treat the water in 2017, the generation of which produced 601 $MTCO_2e$ of emissions, which was down from 855 $MTCO_2e$ in 2005.

The treatment of Carlisle's wastewater consumed an estimated 2.25 million kWh of electricity in 2005 and 2.37 million kWh in 2017. Generation of this electricity produced 1,167 $MTCO_2e$ of emissions in 2005 and 821 $MTCO_2e$ in 2017. In addition, the nitrification/denitrification process used to treat the wastewater emitted nitrous oxide equivalent to 42 and 44 $MTCO_2e$ in 2005 and 2017, respectively.

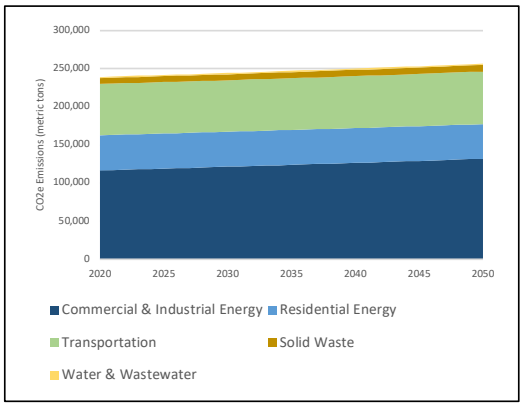
Future Emissions

A scenario of Carlisle's future emissions was constructed for 2020 – 2050 to provide a comparison case for evaluating emission reduction strategies. To construct the scenario, it was assumed that no new policies or actions would be implemented to limit emissions. Additionally, it was assumed that changes in energy use and other variables in Carlisle would track closely with changes at the state level as projected for the Pennsylvania Climate Action Plan.

Future emissions are uncertain, and the "No Action" scenario represents one possible future for Carlisle. The methodology used to construct Carlisle's "No Action" scenario is described in the appendix.

For the "No Action" scenario, Carlisle's total greenhouse gas emissions grow at a compound annual rate of 0.002, increasing from 239,000 metric tons of carbon dioxide ($MTCO_2e$) in 2020 to 257,000 $MTCO_2e$ in 2050 (Figure 7). The cumulative increase is 7.3%. The shares of emissions contributed by each sector remain close to current levels, with commercial and industrial energy as the largest source of emissions throughout the forecast period, followed by transportation, residential energy, solid waste, and water and wastewater.

Figure 6. Future emissions: No Action Scenario



Appendix: Methodology and Data Sources

2017 and 2005 Emission Inventories

Greenhouse gas emissions were estimated for Carlisle by collecting activity data and average emission rates for the activities and entering them into ClearPath, an online tool developed by ICLEI for calculating greenhouse gas emission inventories (ICLEI, 2014). The calculations performed by ClearPath are consistent with the U.S. Community Protocol for greenhouse gas inventories (ICLEI, 2012).

Emissions were initially estimated for 2017, the most recent year for which complete data are available for Carlisle's. Emissions were also estimated for 2005 using activity data that is available for that year and by scaling other activity data from 2017 using population and other measures from 2005. Estimates for both years provide rough approximations of Carlisle's greenhouse gas emissions that are more accurate for 2017 than for 2005.

The estimates capture most of the emissions for which Carlisle residents, businesses and institutions are responsible, but not all. Not included, to give one example, are emissions that are generated by producing goods and services outside of Carlisle that are transported to Carlisle for our consumption. Another example are emissions generated by Carlisle residents' air travel to and from airports other than the Carlisle airport.

Commercial and Industrial Energy

Electricity use in 2017 by commercial and industrial users in the 17013 zip code service area was provided by PPL Utilities. The percentage of employees in the 17013 service area who worked in Carlisle in 2012, the most recent year for which data is available, was 59.6 percent and was used to estimate commercial and industrial electricity use that is attributable to Carlisle.

Natural gas use for commercial and industrial users in Carlisle for 2017 was provided by UGI. Use of fuel oil and propane by commercial and industrial users in Carlisle was estimated using state level data from the U.S. Energy Information Agency. A portion of the consumption of fuel oil and propane in Pennsylvania was allocated to Carlisle using Carlisle's percentage of the value of sales, shipments, receipts, revenue and business in Pennsylvania from the U.S. Census Bureau, which was 0.15 percent in 2012, the most recent year for which data is available.

Energy use for the sector in 2005 was estimated using Carlisle population data and assuming per capita use of each type of energy was the same in 2005 as in 2017.

Emissions per kWh of electricity used depend on the mix of energy sources used to generate electricity, which vary by region of the country. Carlisle is located in the RFC East utility region. Emission factors for the RFC East region for 2005 and 2017 were obtained from the USEPA's eGrid data set and input to ClearPath. Default emission factors for other energy sources are provided by the ClearPath tool.

Residential Energy

Electricity use in 2017 by residential users in the 17013 zip code service area was provided by PPL Utilities. The percentage of population in the 17013 service area who lived in Carlisle in 2017, 53.4 percent, is used to estimate Carlisle's residential electricity use.

UGI provided natural gas use for residential users in Carlisle. Data for use of fuel oil, propane, and wood by Carlisle residences are not directly available and had to be estimated. Estimates were calculated from data on total residential energy use in Pennsylvania by fuel type, the number of households in Pennsylvania using each fuel as a primary heating source, their average use of these fuels, and the number of households in Carlisle using each fuel as a heating source.

Residential use of electricity and natural gas in 2005 was estimated using Carlisle population data and assuming per capita use of each was the same in 2005 as in 2017. For fuel oil, propane, and wood, it was assumed that Carlisle used the same percentages of statewide consumption in 2005 as in 2017. Emission factors for residential energy are the same as for the commercial and industrial sector.

Transportation

Emissions of greenhouse gases for on-road transportation are calculated from estimates of vehicle miles traveled within Carlisle for different vehicle and fuel types, vehicle fuel efficiencies, and average emissions per gallon of fuel or per mile traveled. Estimates of vehicle miles traveled (VMT) for passenger and commercial freight vehicles by fuel

type were provided by Michael Baker International, a contractor for the Harrisburg Metropolitan Planning Organization. They estimate VMT for Carlisle using data available from PennDOT and information about trip origins and destinations derived from the South-Central Travel Demand Model. Estimates of VMT for Carlisle include 100 percent of miles for trips that start and end in Carlisle and 50 percent of miles for trips that either start or end in Carlisle but not both. Vehicles traveling on I-81 and other throughways that neither start or stop in Carlisle are excluded.

Capital Area Transit and Rabittransit provide bus service to the region, including Carlisle. Data on vehicle revenue miles and fuel use for their entire service areas were obtained from the 2017 Annual Agency Profile of the Cumberland Dauphin-Harrisburg Transit Authority. Miles and fuel use attributable to Carlisle were estimated using Carlisle's population as a percentage of the total population served by Transit Authority, 3.73 percent.

National data for average fuel economy and emission factors for methane and nitrous oxide for passenger cars, light trucks, heavy trucks, transit buses, and paratransit buses are input to ClearPath to calculate emissions from these transportation modes. Emissions per mile traveled declined from 2005 to 2017 as average fuel economy increased.

Norfolk Southern Railway, which owns and operates the freight rail line that passes through Carlisle, reports that 15.8 million $MTCO_2e$ of greenhouse gases were emitted by their national rail operations in 2017. Emissions attributable to Carlisle are estimated using the percentage of Norfolk Southern's route miles that lie within Carlisle, 0.02 percent. Emissions produced by flights in and out of the Carlisle airport are estimated using volumes of aviation gasoline and jet fuel that are loaded on planes at the airport.

Transportation emissions in 2005 were estimated assuming that they are proportional to population.

Solid Waste, Water, and Wastewater

Waste generation is not measured directly for Carlisle but is estimated using the average weight per county resident of municipal solid waste received at the county landfill. Organic wastes decompose in the landfill, a process the emits methane, a powerful greenhouse gas. Different types of waste emit methane at different rates. The percentage of waste by type (e.g. corrugated cardboard, newspaper, office paper, food and yard waste) were derived from a 2003 DEP study of waste composition in Pennsylvania.

A portion of the landfill gas, typically ranging from 40 to 60 percent, is captured and either combusted to generate electricity or flared. This reduces the amount of methane that reaches the atmosphere but produces emissions of the less powerful greenhouse gas carbon dioxide. Quantities of landfill gas flared and combusted were provided by Advanced Disposal, the operator of the landfill.

Distribution and treatment of drinking water and wastewater uses electricity, the generation of which produces greenhouse gases. In addition, Carlisle's wastewater treatment plant uses a process that produces nitrous oxide, a greenhouse gas that is 298 times more powerful than carbon dioxide. Date for electricity consumption and treatment processes for Carlisle's water and wastewater treatment plants were provided by the Carlisle Borough Office.

Future Emissions

A scenario of future greenhouse gas emissions is constructed for Carlisle for the period 2020 through 2050. The scenario incorporates existing policies but assumes that no new policies are implemented at local, state, or federal levels that would influence the borough's future emissions of GHGs. The effects of state level measures envisioned in Pennsylvania's Climate Action Plan are excluded, as are the effects of recent rollbacks in federal regulations for vehicle fuel economy.

The No Action Scenario is constructed using the forecasting module of ICLEI's ClearPath tool. Inputs to the analysis include Carlisle's 2017 greenhouse gas inventory, population forecasts for Carlisle from the *Cumberland County Comprehensive Plan* (Cumberland County Planning Commission, 2017), projections of future state-level energy consumption from the *Energy Assessment Report for the Commonwealth of Pennsylvania* (Pennsylvania Department of Environmental Protection, 2019), and national-level transportation forecasts from the *Annual Energy Outlook 2020* (U.S. Energy Information Administration, 2020).

Energy Consumption

The *Energy Assessment Report for the Commonwealth of Pennsylvania* projects future energy consumption for the period 2015 to 2050 for a 'business as usual' scenario. Growth rates from the report are applied to extrapolate energy consumption in Carlisle to the year 250. This imposes an assumption that energy consumption by Carlisle's residents, businesses and

other institutions will grow at the same rate as a projected for the state.

The mix of energy sources used to generate electricity in Pennsylvania is also projected to change. The share of electricity generated with natural gas is projected to grow substantially, nuclear to decline by half, renewables to increase marginally, and coal to be flat. The projected changes would increase emissions of greenhouse gases per kWh of electricity in Pennsylvania by 6.8% from 2015 to 2050.

Transportation

Projections of vehicle miles traveled and energy consumed per mile are not contained in the *Energy Assessment Report for the Commonwealth of Pennsylvania.* But national level forecasts are available from the *Annual Energy Outlook 2020* (USEIA, 2020). Growth rates from the national forecasts are applied to extrapolate vehicle miles traveled and carbon intensity of travel for Carlisle. Vehicle miles traveled in the U.S. are projected to grow for light duty vehicles, heavy trucks, and transit buses, while energy intensity is projected to decline. The declining energy intensity incorporates projected changes in fuel economy based on implementation of the national clean car standards that the USEPA now plans to roll back. If the rollback is maintained, future emissions from transportation would likely be greater than projected for the Carlisle No Action Scenario forecast.

Solid Waste, Water and Wastewater

For Carlisle's No Action Scenario, GHG emissions from solid waste, water, and wastewater are assumed to grow at the same rate as Carlisle's population. The 2017 Cumberland County Comprehensive Plan includes projections of populations to the year 2040 for Carlisle and other municipalities in the county. The population forecast for 2040 is extrapolated to 2050 by applying the compound annual growth rate for the period 2020 to 2040.

Data Sources

Demographic Data

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Carlisle Airport fuel use: Carlisle Airport, personal communication by email from Jeff Smith, Airport Manager.

Municipal Solid Waste

Municipal solid waste generation, Cumberland County and Carlisle: Cumberland County Recycling and Waste Authority, personal communication by email from Justin Miller, Recycling Coordinator.

Municipal waste composition: Pennsylvania Department of Environmental Protection, *Final Report, Statewide Waste Composition Study,* April, 2003. http://files.dep.state.pa.us/Waste/Recycling/RecyclingPortalFiles/Documents/wastecompositionstudy.pdf

Landfill gas flaring and combustion: Advanced Disposal, personal communication by email from Dusty Hilbert, General Manager.

Water and Wastewater

Water and wastewater volumes, service populations and electricity use: Borough of Carlisle, personal email communications from Susan Armstrong, Borough Manager; Mark Malarich, Director of Public Works; and Sean Shultz, Council Member.

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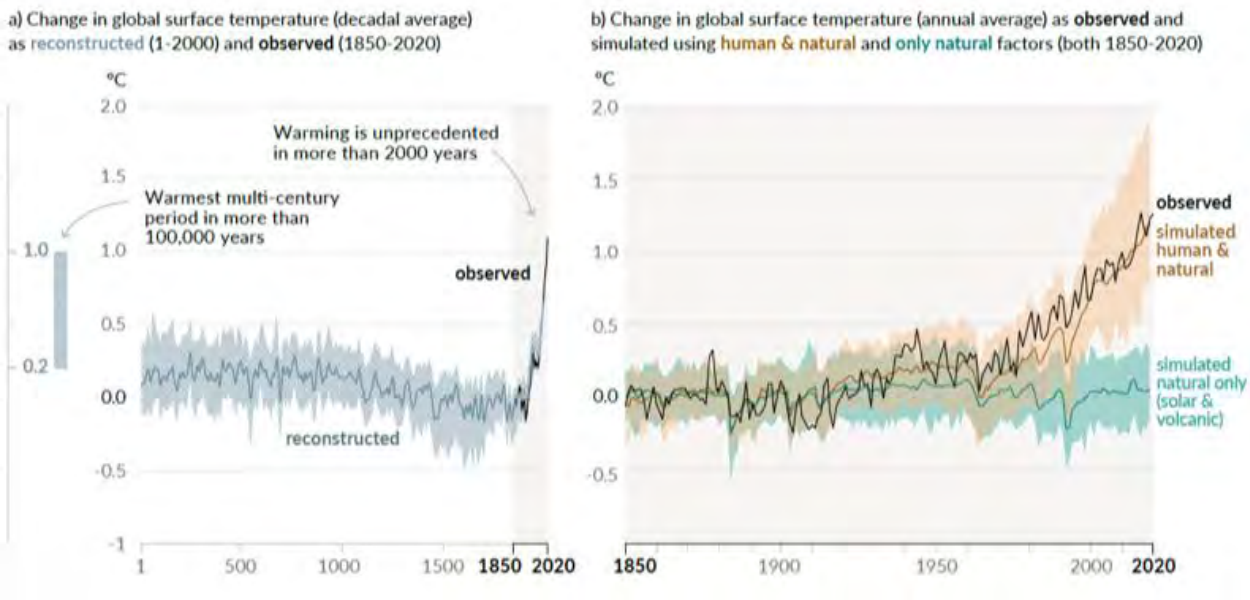
Appendix B: Climate Change Science

The 2021 Intergovernmental Panel on Climate Change (IPCC)'s Sixth Assessment Report, Summary for Policymakers, states for the first time that "it is *unequivocal* that human influence has warmed the atmosphere, ocean and land. Widespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere have occurred" (Masson-Delmotte et al., 2021). In other words, it is a scientific *statement of fact* that humans are contributing to climate change. Researchers have made progress in their understanding of how the Earth's climate is changing in space and time through improvements and extensions of numerous datasets and data analyses, broader geographical coverage, better understanding of uncertainties and a wider variety of measurements (IPCC, 2014). These refinements expand upon the findings of previous IPCC Assessments – today, observational evidence from all continents and most oceans shows that "regional changes in temperature have had discernible impacts on physical and biological systems" (IPCC, 2014, p. 151).



The Fifth Assessment also asserts that "it is *extremely likely* that more than half of the observed increase in global average surface temperature from 1951 to 2010 was caused by the anthropogenic increase in GHG

[4] **Panel a):** Changes in global surface temperature reconstructed from paleoclimate archives (solid grey line, 1–2000) and from direct observations (solid black line, 1850–2020), both relative to 1850–1900 and decadally averaged. The vertical bar on the left shows the estimated temperature (very likely range) during the warmest multi-century period in at least the last 100,000 years, which occurred around 6500 years ago during the current interglacial period (Holocene). The Last Interglacial, around 125,000 years ago, is the next most recent

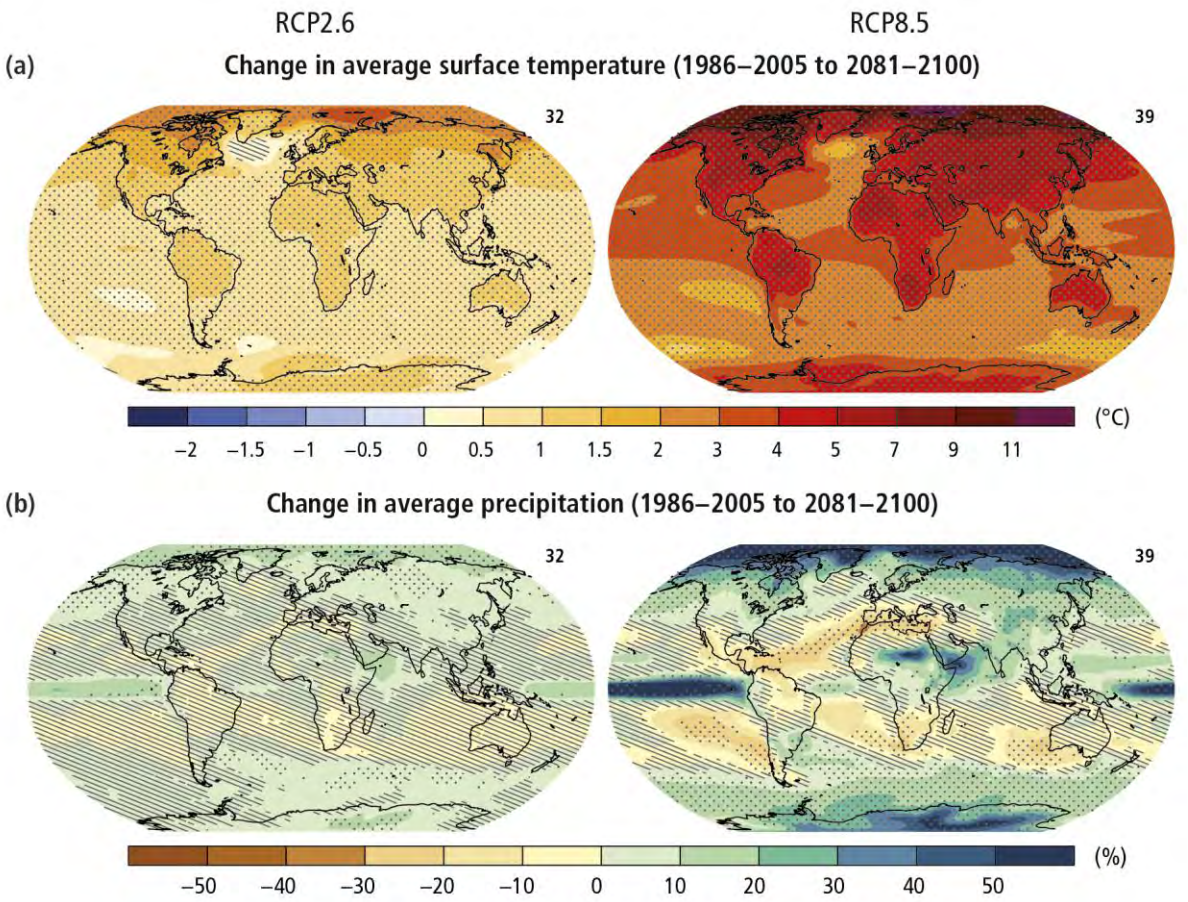
concentrations and other anthropogenic forcings together. Globally, economic and population growth continued to be the most important drivers of increases in CO2 emissions from fossil fuel combustion. Changes in many extreme weather and climate events have been observed since about 1950. Some of these changes have been linked to human influences, including a decrease in cold temperature extremes, an increase in warm temperature extremes, an increase in extreme high sea levels and an increase in the number of heavy precipitation events in a number of regions" (IPCC, 2014, p. 151).

In short, the Earth is already responding to climate change drivers introduced by mankind.

candidate for a period of higher temperature. These past warm periods were caused by slow (multi-millennial) orbital variations. The grey shading with white diagonal lines shows the very likely ranges for the temperature reconstructions.

Panel b): Changes in global surface temperature over the past 170 years (black line) relative to 1850–1900 and annually averaged, compared to CMIP6 climate model simulations (see Box SPM.1) of the temperature response to both human and natural drivers (brown), and to only natural drivers (solar and volcanic activity, green). Solid coloured lines show the multi-model average, and coloured shades show the very likely range of simulations.

Temperatures and Extreme Events are Increasing Globally



Surface temperature is projected to rise over the 21st century under all assessed emission scenarios. It is very likely that heat waves will occur more often and last longer, and that extreme precipitation events will become more intense and frequent in many regions. The ocean will continue to warm and acidify, and global mean sea level to rise. Changes in many extreme weather and climate events have been observed since about 1950. Some of these changes have been linked to human influences, including a decrease in cold temperature extremes, an increase in warm temperature extremes, an increase in extreme high sea levels and an increase in the number of heavy precipitation events in a number of regions (IPCC, 2014).

Climate Risks

Climate change is projected to undermine food security. Due to projected climate change by the mid-21st century and beyond, global marine species redistribution and marine biodiversity reduction in sensitive regions will challenge the sustained provision of fisheries productivity and other ecosystem services. For wheat, rice and maize in tropical and temperate regions, climate change without adaptation is projected to negatively

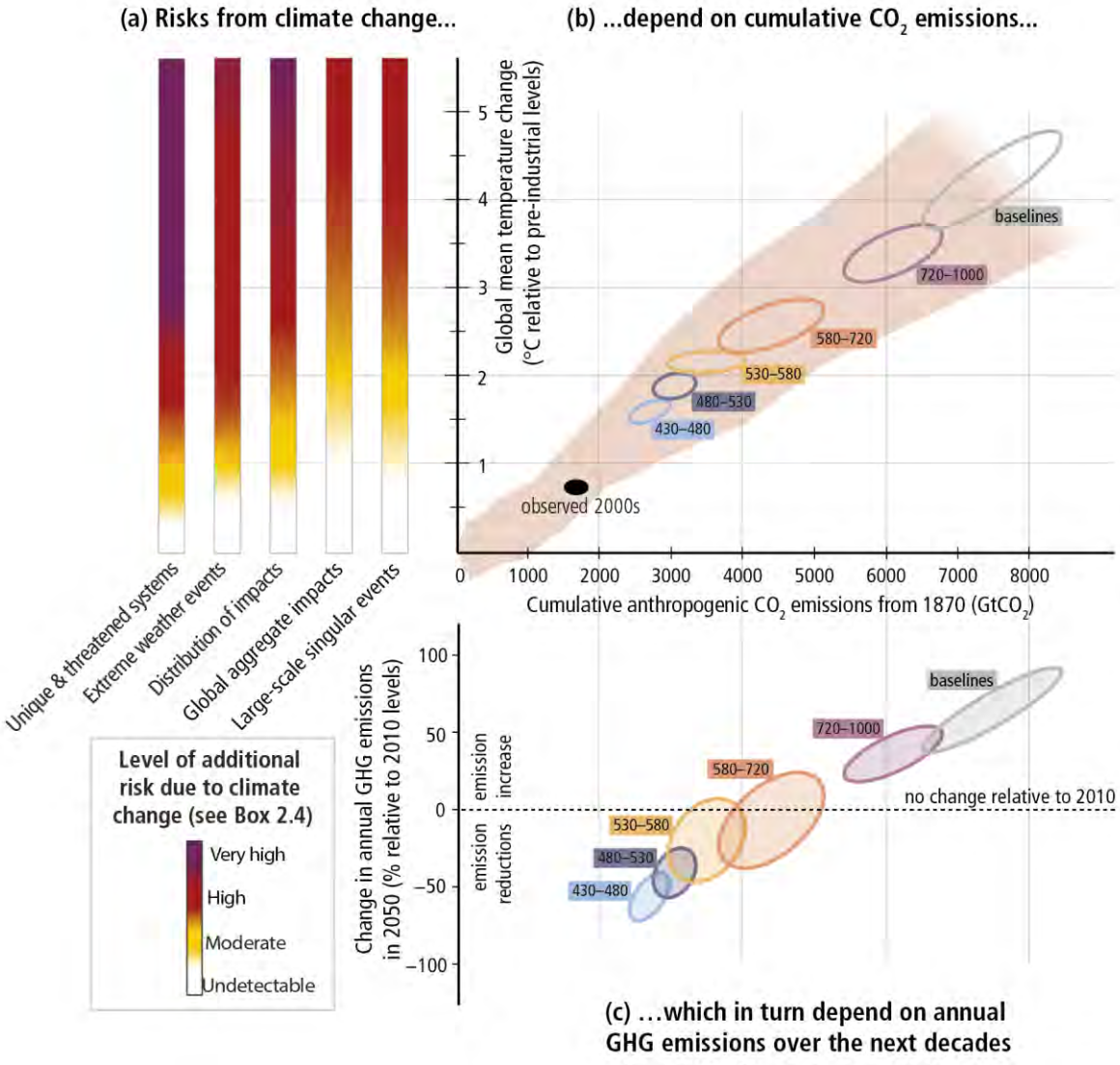
impact production for local temperature increases of 2°C or more above late 20th century levels, although individual locations may benefit. Global temperature increases of ~4°C or more above late 20th century levels, combined with increasing food demand, would pose large risks to food security globally. Climate change is projected to reduce renewable surface water and groundwater resources in most dry subtropical region, intensifying competition for water among sectors.

Until mid-century, projected climate change will impact human health mainly by exacerbating health problems that already exist. Throughout the 21st century, climate change is expected to lead to increases in ill-health in many regions and especially in developing countries with low income, as compared to a baseline without climate change. Health impacts include greater likelihood of injury and death due to more intense heat waves and fires, increased risks from foodborne and waterborne diseases and loss of work capacity and reduced labor productivity in vulnerable populations. Risks of undernutrition in poor regions will increase. Risks from vector-borne diseases are projected to generally increase with warming, due to the extension of the infection area and season, despite reductions in some areas that become too hot for disease vectors.

In urban areas climate change is projected to increase risks for people, assets, economies and ecosystems, including risks from heat stress, storms and extreme precipitation, inland and coastal flooding, landslides, air pollution, drought, water scarcity, sea level rise and storm surges. These risks are amplified for those lacking essential infrastructure and services or living in exposed areas. Rural areas are expected to experience major impacts on water availability and supply, food security, infrastructure and agricultural incomes, including shifts in the production areas of food and non-food crops around the world.

Climate change is projected to increase displacement of people. Populations that lack the resources for planned migration experience higher exposure to extreme weather events, particularly in developing countries with low income. Climate change can indirectly increase risks of violent conflicts by amplifying well-documented drivers of these conflicts such as poverty and economic shocks (IPCC, 2014).

Greenhouse Gas Emissions Must be Reduced



Limiting risks across Reasons For Concern (a) would imply a limit for cumulative emissions of CO2 (b) which would constrain annual GHG emissions over the next few decades (c). Panel A reproduces the five Reasons For Concern. Panel b links temperature changes to cumulative CO2 emissions (in GtCO2) from 1870. They are based on Coupled Model Intercomparison Project Phase 5 simulations (pink plume) and on a simple climate model (median climate response in 2100), for the baselines and five mitigation scenario categories (six ellipses). Panel C shows the relationship between the cumulative CO2 emissions (in GtCO2) of the scenario categories and their associated change in annual GHG emissions by 2050, expressed in percentage change (in percent GtCO2-eq per year) relative to 2010. The ellipses correspond to the same scenario categories as in Panel B, and are built with a similar method (IPCC, 2014).

The recent and massive buildup of greenhouse gases in our atmosphere is conceivably even more extraordinary than changes observed thus far regarding temperature, sea level, and snow cover in the Northern hemisphere in that current levels greatly exceed recorded precedent going back much further than the modern temperature record.

Anthropogenic greenhouse gas emissions have increased since the pre-industrial era driven largely by economic and population growth. From 2000 to 2010 emissions were the highest in history. Historical emissions have driven atmospheric concentrations of carbon dioxide, methane and nitrous oxide to levels that are unprecedented in at least the last 800,000 years, leading to an uptake of energy by the climate system (IPCC, 2014).

In response to the problem of climate change, many communities in the United States are taking responsibility for addressing emissions at the local level. Since many of the major sources of greenhouse gas emissions are directly or indirectly controlled through local policies, local governments have a strong role to play in reducing greenhouse gas emissions within their boundaries. Through proactive measures around land use patterns, transportation demand management, energy efficiency, green building, and waste diversion, local governments can dramatically reduce emissions in their communities. In addition, local governments are primarily responsible for the provision of emergency services and the mitigation of natural disaster impacts. While this Plan is designed to reduce overall emissions levels, as the effects of climate change become more common and severe, local government adaptation policies will be fundamental in preserving the welfare of residents and businesses.

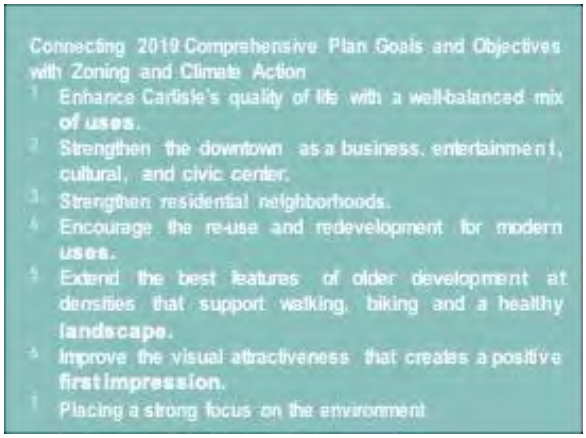
Community Planning/Zoning Annex

Introduction

The Community Planning/Zoning Annex is a summary of the work completed by the Carlisle Climate Action Commission Zoning Team between October 2020 and November 2021. The team reviewed Carlisle Borough Ordinances, Climate Action Plans from other small cities and boroughs, sample and example ordinances designed to minimize greenhouse gas emissions, publications and documents pertaining to reducing greenhouse gas emissions on a local and regional level, and documents and publications that provide strategies to generate resilient communities. The team utilized the Pathways & Analytics Team's supporting actions matrix to generate community planning and zoning strategies related to the transportation, residential energy, commercial energy and municipal operations and waste sectors. From this matrix, priorities were generated and incorporated into Chapters 5,6,7 and 9 of the Plan. However, the other policies and ideas are worthy of documentation and further discussion and are included in this Annex.

Making Connections

Pennsylvania Acts 67 and 68 require municipalities to consider and rely upon comprehensive plans, including implementing zoning ordinances, when making infrastructure decisions that impact land use. Changes in ordinances and plans are more easily accepted by the community if it can be illustrated that changes are developed to be consistent with an approved Comprehensive Plan. The CAC Zoning Team's first reviewed the Carlisle Borough 2019 Comprehensive Plan Goals and Objectives, drawing connections between what the community envisioned for their future, and those goals and objectives related to Climate Adaption, and Greenhouse Gas Emission reduction (Table 3).



Climate Action Strategies

There are typical strategies contemplated when determining what community planning programming and policies to incorporate a Climate Action Plan. The following strategies were discussed by the CAC Zoning Team:

- Require Complete Streets – Complete Streets are designed to prioritize safety, comfort, and access to destinations for all people who use the street, especially people who have experienced systemic underinvestment or whose needs have not been met through a traditional transportation approach. The creation of more complete and walkable neighborhoods, and reduction of barriers on form and use in service is key to curbing our carbon emissions and cannot be overstated. Complete streets generate healthier residents. PA Health reports repeatedly summarize policies to prevent obesity, which includes creating streets that are safe, comfortable, and convenient for travel by automobile, foot, bicycle, transit, regardless of age and ability. Provide clear design standards that provide for pedestrians over motor vehicles. A complete street may include sidewalks, bike, comfortable and accessible public transportation stops, frequent and safe crossing opportunities, median islands, accessible pedestrian signals, curb extensions, narrower travel lanes, roundabouts, and more. Complete streets create an environment that promotes the safe use of alternative means of transportation which may reduce the use of fossil fuels.

- Encourage alternative transportation modes - The provision of charging stations and designated parking spaces for clean fuel, low-emitting, vehicles including bicycles will encourage the community to use cleaner power or pedal power, reducing dependence on greenhouse emitting fossil fuels.

- Reduce the amount of impervious area – Revise the zoning ordinance to change the minimum parking space requirements to maximum number of spaces per use as specified in the zoning ordinance. Provide opportunity for shared parking areas that are flexible and developer friendly, rather than requiring an additional layer of approval. Provide incentives for property owners to remove impervious area rather than add it. Reducing the space required for parking and other impervious surfaces reduces the overall land area required for a given land use thereby providing more space for trees that ameliorate the negative effects of climate change.
- Achieve higher-density, mixed-use, infill development - the combined household and transportation energy consumption of an energy-efficient 'green' suburban home is still 10 per cent higher than that of a comparable-sized home in a mixed-use urban neighborhood, 20 percent higher than that of an urban green home, and 30 per cent higher than that of a multi-family urban green home. It isn't just about making green buildings, but about making complete communities.
- Remove zoning obstacles to higher density - Zoning can create obstacles for those trying to remain in their neighborhoods as they age. When a home becomes difficult to maintain, older adults cannot "downsize" to remain in their community, and zoning regulations make it difficult to convert a garage or other accessory space into caregiver space. This transition from parent to children would be easier if there were more flexible options for accessory dwellings. Existing zoning that only allows a single-family dwelling per lot restricts this type of community care. Higher density provides more opportunity for equity and allows for mixed use income communities and diversity.
- Increase accessibility between work, home, and play - Facilitate accessibility between residential, commercial, and office districts.
- Increase Tree Canopy in strategic areas - Increase tree plantings where they will effectively shade improvements and reduce energy demands. One study showed that for every $1 spent to maintain trees, $2.62 worth of benefits was returned in the form of air-conditioning energy savings, dust reduction, and the slowing of storm water runoff. Consider the urban heat islands first, particularly those areas that have a larger share of modest income families, where lower air temperatures can significantly reduce energy bills.
- Encourage more ecologically appropriate and sustainable land management. Allow for conservation landscaping that reduces manicured lawn areas and change management

strategies/mowing practices on borough facilities. Remove barriers to residential and community agriculture. Rewrite the 'weed' ordinance to allow for natural plantings. Reduce the need for "green space" in areas where it is only generating a high maintenance lawn area without providing a benefit. Reduction of lawn can be directly tied to reductions in GHG emissions by reducing mowing needs. Consider Chesapeake Bay Landscape Professional training to encourage adoption of these practices and education about the linkage to improved water quality.

- Provide Equitable socio-economic opportunities - Climate change disproportionately affects those who suffer from socioeconomic inequalities, including many people of color. Climate change programs and policies need to consider those neighborhoods where infrastructure improvements have not been prioritized in the past.

- Consider Form-Based Zoning – Regulate development by controlling building form first and building use second with the purpose of achieving a particular type of "place" or built environment based on a community vision. This can enhance walkable corridors and prioritize 'placemaking', contributing to, rather than controlling the result to produce a more complete human environment and public realm. Conventional zoning focuses on privately owned land and ignores the "public realm" — that part of a town or city that belongs to all of us. In many cities, over one-third of the publicly owned land area is located in the public right-of-way — the streets and sidewalks — but it is typically treated, not as a hospitable human environment, but as a "traffic sewer" toward which new buildings turn their backs. The public realm is a valuable asset that promotes community identity, creates a sense of place, and provides economic development opportunities. By improving the public realm, we create places where pedestrians and bicyclists feel safe and welcomed.

- Revise existing Subdivision and Land Development Ordinance – As with the Zoning ordinance, there are outdated design guidelines and regulations that impede the goals of the Comprehensive plan and typical Climate Action Plans. Once the Zoning Ordinance is updated, other land planning ordinances need to be updated to support community goals and objectives.

- Priorities and low hanging fruit - It is assumed that the CAC will be reviewed and updated at least every five years, therefore priorities should be identified and include tasks that could be completed in less than five years. While some community planning priorities may not be the most emission reducing tasks, they are chosen for their ability to put the community on the

right path towards climate resiliency, or their ability to improve social, environmental, and economic conditions with one activity or effort.

Pathways and Actions

Pathways & Analytics Team, in conjunction with the Executive Committee, generated a Proposed Pathways & Actions report that identified the key objectives and actions by Sector. Summary charts were developed for priority Transportation, Residential, Commercial and Municipal actions. The Zoning Team used the summary charts then added Comprehensive Plan goals and objectives related to the priorities. The Zoning Team also added columns to indicate Potential Ordinance/Design Guidelines, team comments, and priority vote indication. The attached charts include ideas and comments that may not have been determined as priorities for the short term but might be incorporated into later efforts.

Projects

The following were identified as immediate community planning projects that should be considered in the near future:

1. Capitalize on existing infrastructure to promote electric vehicle use and multi-modal and active transportation by improving the Pomfret Street parking Garage, transforming it into a Multi- modal transportation Hub. Repurposing the garage standard parking stalls into electric charging stations and covered bicycle parking will help convert internal combustion engine trips into electric vehicle and human powered trips. Engage with Capital Area Transit to help make convenient and clear pedestrian connections between the Garage and bus stop areas. Promote the Garage as a Multi-Modal Hub on Borough and Economic Development websites. Businesses near the Garage will also benefit from increased pedestrian activity at the Garage.

2. Change Zoning for the York Street corridor from the SW Carlisle Borough limits to the intersection with East Street from Shopping Center/General Commercial/General Industrial to a Mixed-Use district that would generate the character of High Street from the center of town. Generate sketch plans or host a design charette to show how the corridor would function better as an extension of the aesthetics and lower speeds that citizens enjoy from the Central Business/Town Center Districts. The corridor's extensive parking areas are largely unused and not shared.

3. Rewrite Ordinance No. 2335, §160-4.B. to allow conservation landscaping that might include vegetation and grasses that grow taller than six inches.

4. Rewrite Ordinance §255-202 through §255-209 to reduce the number of required spaces and provide better flexibility for shared parking.

Commercial Objectives/Actions

Objectives Comprehensive Plan Goals and Objectives as they relate to Climate Action	objective	Potential Ordinances/ Design Guidelines	Community Planning/Zoning comments
Enhance Carlisle's quality of life with a well balanced mix of uses	Objective C1: Increase rooftop efficiency and solar potential on warehouses and other commercial businesses over a 25 year time span as roofs are replaced.	Require new commercial space to be net-zero emissions.	historic district is more complicated.
Strengthen the downtown as a business, entertainment, cultural and civic center		Support the construction of solar canopies with EV charging stations in large parking lots of malls (Walmart, Home Depot, Lowes).	
Strengthen residential neighborhoods			there's a lot of waste in knocking things down. retrofits- what do we want for carlisle as a whole?
Encourage the re-use and redevelopment for modern uses extend the best features of older development at densities that support walking, biking and a healthy landscape	"Green" Rooftop Modifications	require green roofs or high reflectance roofs on new buildings and other reflectance and shading techniques.	
	Objective C2: Reduce energy use in commercial buildings by 20% in 2035 and 40% in 2050.	ENERGY STAR certification for eligible facilities; require energy audit for low performing buildings.	
improve the visual attractiveness that creates a positive first impression	Objective C3: Reduce fossil fuel use in existing commercial buildings by at least 25% by 2035, 50% by 2040, and 80% by 2050.	For existing buildings, adopt a commercial building benchmarking ordinance for buildings larger than 15,000 square feet.	non-conforming properties - makes it harder.
place a strong focus on the environment		Implement a mandatory or voluntary green building code for new or substantially reconstructed buildings. Require any new building that receives public funding or incentives to be constructed to green building standards best practice.	
	Electrification and Fuel-Switching. Reduce use of fossil gas, fuel oil, or propane by switching to electricity and/or renewable gas.	Implement and require codes beyond the State Code such as the International Green Construction Code (IgCC), Zero Code and NetZero Codes.	
	Objective C4: Minimize lawn areas. 50% by 2035 and 75% by 2050	Update and adopt the Urban Forestry Asset Management Plan to include climate mitigation best practices for carbon sequestration in vegetation and soil.	
		Support neighborhood planting programs through support in provision of trees and materials, sidewalk cutting and removal, planting labor, technical advice, and organizational assistance.	don't remove public sidewalk unless there is a very good reason.
	Urban Forest Potential	Incorporate a model riparian buffer zoning ordinance.	
	Riparian Buffer Zoning	Prohibit development immediately adjacent to streams, rivers, lakes, wetlands and other water bodies. Avoid land disturbance, pavement and other impervious cover.	development regulated in floodplains by federal and state
	Objective C5: Increase flexibility in land use/zoning	Work with ALLARM and Chesapeake Bay Foundation (CBF) to develop standards for healthy riparian buffer zones.	corridor from East street to lowes- change to mix use? 2/3 empty. stretch between spring garden and east- sprawl
		sidewalk cafe ordiance	there are some ordinances that require the furntiture be removed each night. why a prejudice against bar height tables?
		tables and chair there for everyone. the veterans square is the most contencious. the borough owns the sidewalks, so why couldn't that just be public sidewalk cafes? in order for it to be equitable, it actually shouldn't be attached to specific restaurants. trash is going to be a task.	carlisle zoning - too many special exceptions.

Residential Objectives/Actions

Objectives Comprehensive Plan Goals and Objectives as they relate to Climate Action	objective	Potential Ordinances/ Design Guidelines	Community Planning/Zoning Comments
Enhance Carlisle's quality of life with a well balanced mix of uses	Objective R1: Reduce energy use in residential buildings by and 40% in 2050.	Pass ordinances for inspections and mandatory energy upgrades for rentals	Would need to balance this with affordablity
Strengthen the downtown as a business, entertainment, cultural and civic center	Energy Efficiency Retrofits for Existing Homes. 40% of existing residential homes participating in energy efficiency programs by 2035 and 70% by 2050.		
Strengthen residential neighborhoods	Net-Zero New Residential Homes. Increase the percentage of new residential building areas that produce as much energy on-site as it uses to 5% by 2025, 35% by 2035, and to 65% by 2050.	Develop rules, regulations, and permitting necessary for homes with limited yard space and access to utilize sidewalks and parking space for ground source heat.	Is it legal- to put private structures in a public space?
Encourage the re-use and redevelopment for modern uses	Establish Energy Use Intensity (EUI) Benchmark for New Residential Buildings.		
extend the best features of older development at densities that support walking, biking and a healthy landscape	Objective R2: Residential Electrification. Reduce use of natural gas, fuel oil, or propane for space and/or water heating (60% of Carlisle households in 2017) by switching 50% to electricity by 2035 and 80% by 2050.		
improve the visual attractiveness that creates a positive first impression	Objective R3: Increase the percentage of households with rooftop PV solar installations to 10% by 2025, 25% by 2035, and 40% by 2050. (see Pennsylvania's Solar Future Plan)		
place a strong focus on the environment	Objective R4: Tree planting, natural landscapes and reduction of lawn maintenance.	Revisit the present list of acceptable trees that can be planted in the median between sidewalks and streets. Include and/or incentivize the planting of rapidly growing (but stable) trees with high carbon uptake. As dead and decaying trees are removed, replace them with these types of trees.	When a development is approved, grass will be planted unless there is a requirement for something else. Remove single family, large lot zoning will make spaces that are less likely to need mowing. An ordinance that requires a lawn will continue to be planted and mowed.
	Reimagine the tree planting program for the Borough	Create a tree planting program for the Borough parks, e.g. planting evergreens along the periphery of the park. Work with utilities to move power transmission and telecom lines underground to protect infrastructure from severe weather and allow tree canopies to grow to their	stay away from rapidly growing trees. (weak-wooded) Focus on areas with no trees and change the program from resident request but targeted investment which would give trees to underserved neighborhoods There are many places the borough owns that are mowed: berms and open lots that are unused but are
	R4b: Reduce community emissions from lawn care.		
	Encourage local food production by removing barriers to residential and community agriculture.	rewrite 'weed' ordinance CONSERVATION LANDSCAPE	see municipal
	flexibility in home based businesses	change no impact to low impact	too much detail. certain number of employees; noise, smell: no impact verses low impact.

Objectives Comprehensive Plan Goals and Objectives as they relate to Climate Action	objective	Potential Ordinances/ Design Guidelines	Community Planning/Zoning Comments
		more mixed use. More of what is allowed in the R-4 in more areas. Remove the difference between the various residential districts for a low impact business.	Time of day Number of employees. we are saying it's okay to get lots of packages from amazon, but not okay to have local businesses compete with Amazon ?
	Objective R5 – Increase allowable density in low Density residential Zoning Districts.		
	objective R6 – Increase land use flexibility in Residential areas.	housing- density. expand affordabilty. more flexibilty within the small pockets of undeveloped property.	reduce segregation, lessen the divisions of lot sizes.

Municipal Objectives/Actions

Objectives Comprehensive Plan Goals and Objectives as they relate to Climate Action	Objective	Potential Ordinances/ Design Guidelines	Community Planning/Zoning Comments
Enhance Carlisle's quality of life with a well balanced mix of uses	**Objective M1: Adapt local ordinances and regulations to encourage carbon reduction strategies.**	Increase tree planting where they will effectively shade infrastructure and reduce energy demands.	consider the 22 benefits of street trees. see walkable.org/download/22_benefits.pdf
Strengthen the downtown as a business, entertainment, cultural and civic center	Reduce local regulatory barriers to renewable energy installation and use.	For existing buildings, adopt a commercial building benchmarking ordinance for buildings larger than 15,000 square feet.	
Strengthen residential neighborhoods		Remove project barriers and discincentives.	
Encourage the re-use and redevelopment for modern uses extend the best features of older development at densities that support walking, biking and a healthy landscape		Do human servies need to be on the main Street? Does it make sense to put it 1/2 block off the main block. Consider partnerships with South Middleton and Cumberland County.	
improve the visual attractiveness that creates a positive first impression	Incorporate a Model Lighting Ordinance (MLO) to reduce light pollution and encourage transition to more efficient lighting.		
place a strong focus on the environment		preserve and enhance the LeTort	update floodplain ordinance
	Transition to 100% renewable energy consumption at all Borough facilities by 2050.	Require new space to be net-zero emissions.	
	Reduce local regulatory barriers to residential and community agriculture make it more visible and accessible	conservation landscaping. Remove the weed ordinance	
	Revision to Zoning Ordinance- consider form-based code to create flexibility in land use and walkability,	put zoning in place that would require the character and land forms desired. (the property next to Molly's)	

Transportation Objectives/Actions

Objectives Comprehensive Plan Goals and Objectives as they relate to Climate Action	Objective	Potential Ordinances/ Design Guidelines	Community Planning/Zoning Comments
Enhance Carlisle's quality of life with a well balanced mix of uses	Objective T1: Increase the adoption of electric and alternative energy vehicles in the vehicle fleet.	Encourage the provision of charging stations and designated parking spaces for clean fuel, low-emitting, vehicles including bicycles.	generally need to be wholistic in changes we make.
Strengthen the downtown as a business, entertainment, cultural and civic center	Make it safer and more pleasant to walk/bike to school, work, and errand running. Improve walkability	Require traffic calming and other complete street design specifications	strong towns, the evils of cul-de-sacs
Strengthen residential neighborhoods		increase the number of days when High Street is closed for pedestrian access.	outlining strategies for lower income bike riders. identify where there is a 'pile' of bikes.
Encourage the re-use and redevelopment for modern uses extend the best features of older development at densities that support walking, biking and a healthy landscape			covered bus stops.
improve the visual attractiveness that creates a positive first impression	Objective T3: Reduce community vehicles miles travelled (VMT) 10% by 2035 and 25% by 2050.	reduce parking minimums. consider parking maximums	be more specific: need to make specific recommendations. JGB recommended priority.
place a strong focus on the environment	achieve higher-density, mixed-use, infill development thorugh updated regulations.	revisit setbacks for all zoning districts	inclusivity, affordable housing, missing middle housing, parking- pomfret st parking garage- mulit-modal hub. also outreach and ecuation hub.
	facilitiate increased accessibility between homes, jobs and transit.		pomfret street parking garage: provide covered bike parking
	reduce reliance on fossil fuel transportation	Adopt zoning ordinances that facilitate electric vehicle growth and adoption.	spaces, EV parking. multi-modal- should be a bus stop at the parking garage. (last mile). JGB recommended priority
	increase walking and biking.	Consider charging infrastructure requirements or incentives for multi-unit dwellings.	vehicle trips into VMT. Combine with Row 26 and JGB recommended priority
	Designing for transit dependent persons and families, providing convenient connections between people and work places. (covered bike and bus stops)	Incentivize large parking lot owners to install solar arrays with EV charging stations.	install multi-use paths when feasible. multi-use paths combine peds and bikes and other active transportation modes in the same real estate. don't need quite as much width. JGB recommeded priority
		including the following: adopt a complete streets ordinance, revising the design standards for streets to incorporate complete street specifications. generate a streets design guidebook that incorporate recommendations from NACTO	Where do E-bikes fit in? pilot projects- consider the lower income areas FIRST.
		generate a traffic study (done by a firm who specializes in complete street planning) to determine changes to street circulation and intersection changes. (there are safety and social reasons not to go to one way streets.)	bike riding education- elementary school (existing programs)
		Establish car sharing and/or bike sharing services at key locations. Create a complete streets design guide generated for Carlisle's street conditions. (right of way, existing infrastructure, sidewalk widths, lighting, furnishings)	review the bus routes. radius issues, access issues, revisit why the stops are where they are? mid block crossings? scramble crossings. lead ped interval advance.

Transportation Objectives/Actions

Objectives Comprehensive Plan Goals and Objectives as they relate to Climate Action	Objective	Potential Ordinances/ Design Guidelines	Community Planning/Zoning Comments
		Develop rules that clarify use of e-bikes on Borough roads and bike routes.	Protected lanes were not allowed by Penndot with the 12 inch parking rule. Was looking to be changed.
		Continue to improve cycling infrastructure to include protected lanes and sidewalks	updated design guidelines for bus stops (rabbit transit)
		reduce the need for unneeded impervious area	helps with SWM, adaptive reuse, etc
		bike infrastructure assessement to determine what is existing and what is needed. funding available.	also setting maximums: Urban land institute may have information for these. phoenixville borough.
		pair bike parking and bus stops for covered stops/parking	compilation
	convert motor vehicle trips to bike trips by improving bike infrastructure.		modify borough parking areas for bike parking.
	reduce emissions in idleling	updating traffic signalization time ehancing. in-sync system. optimize signal cooridors. vehicle detection. (currently, high and hanover are getting the priority. use of round-a-bouts, chicanes: evaluate as road improvements are proposed. look at Lititz for form based code overlay https://www.lititzborough.org/sites/g/files/vyhlif801/f/uploads/zo_codified_version_6.29.2021.pdf	JVC temps bike rack is not well located. the G-man rack works better. dickenson has good bike racks. triangles are small enough for a u-bolt. hold a decent amount of bikes. easy to lock and unlock. economy of how many bikes fit in the space. pilot /incremental approach to improving infrastructure. traffic light sequencing.
		flipping the max and min parking requirements	use of temporary traffic control (rubber stops, curbs) for pilot projects. if works, seek funding. traffic bumpouts on W. Penn. (temp then permanent) Priorities: Bicycle infrastructure (including multi-use paths), Pomfret Street Garage Active Transportation Multi-modal hub (including charging stations), Parking min/max (considering curb access management), increase density.
Reduce auto / bus / truck emissions	Reduce idling time at intersections	1. Synchronize traffic lights 2. Install sensors on traffic lights 3. More traffic circles	
	Encourage EV use	1. More / coveredd EV ccharging stations 2. Build / modify multi-modal transfer points 3. Ordinance that encourage EV adoption & guse	These will both reduce useless / avoidable emissions & expedite traffic flow