



Greater
**LEHIGH
VALLEY**

Greenhouse Gas
INVENTORY | 2024

Allentown-Bethlehem-Easton PA-NJ
Metropolitan Statistical Area





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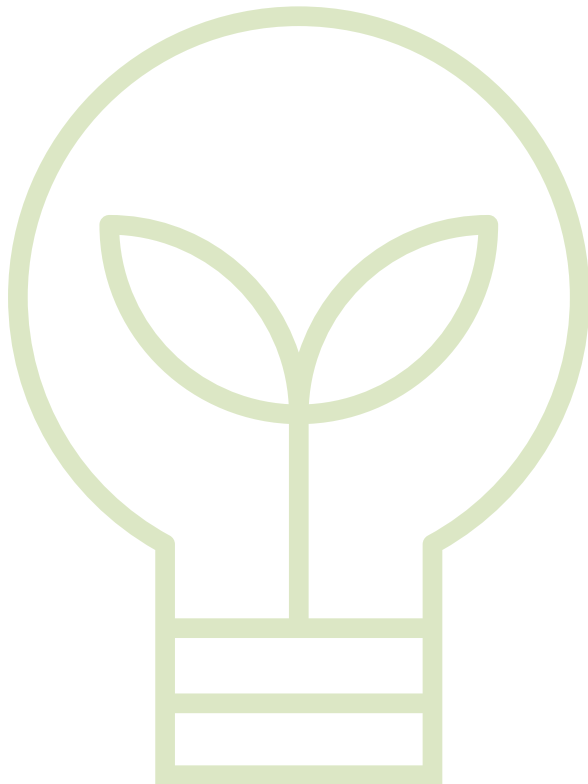
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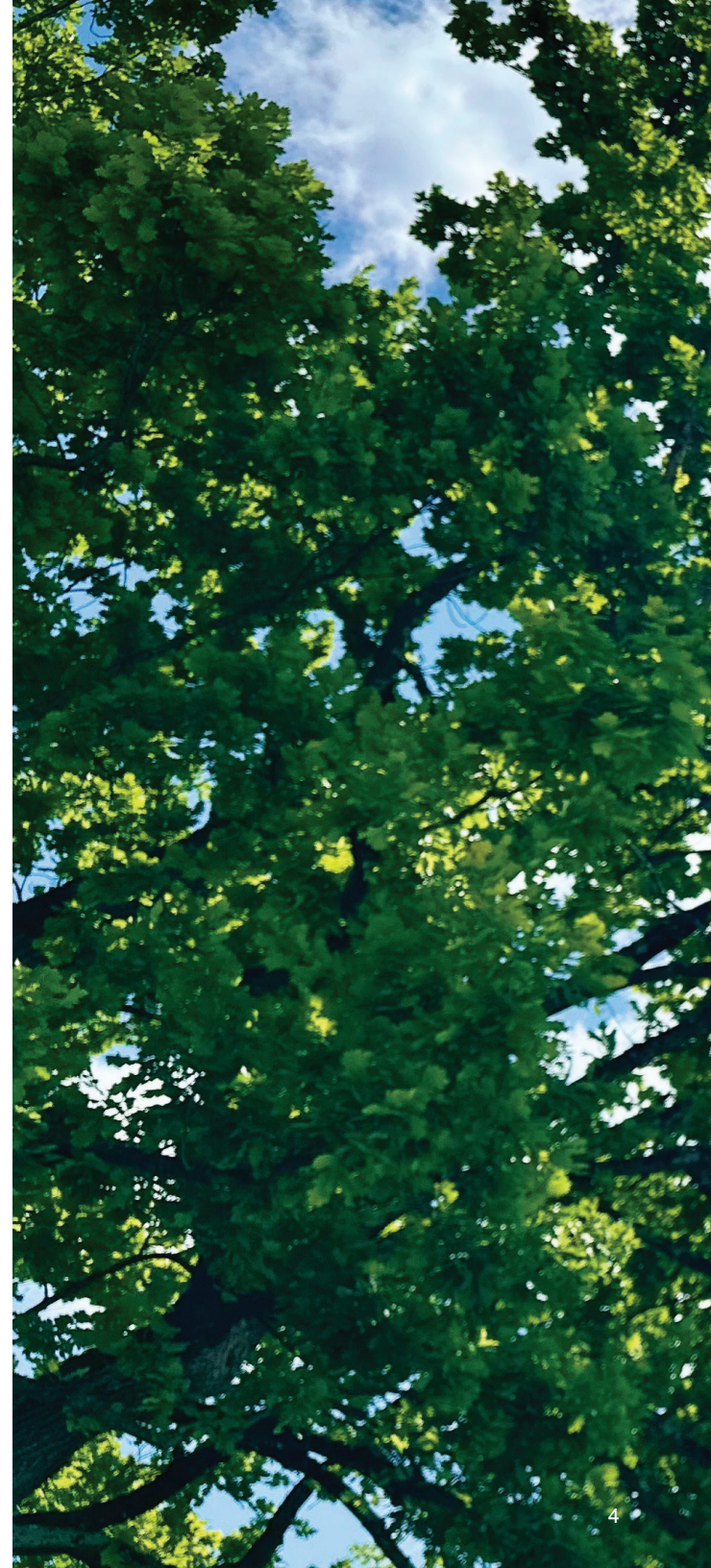




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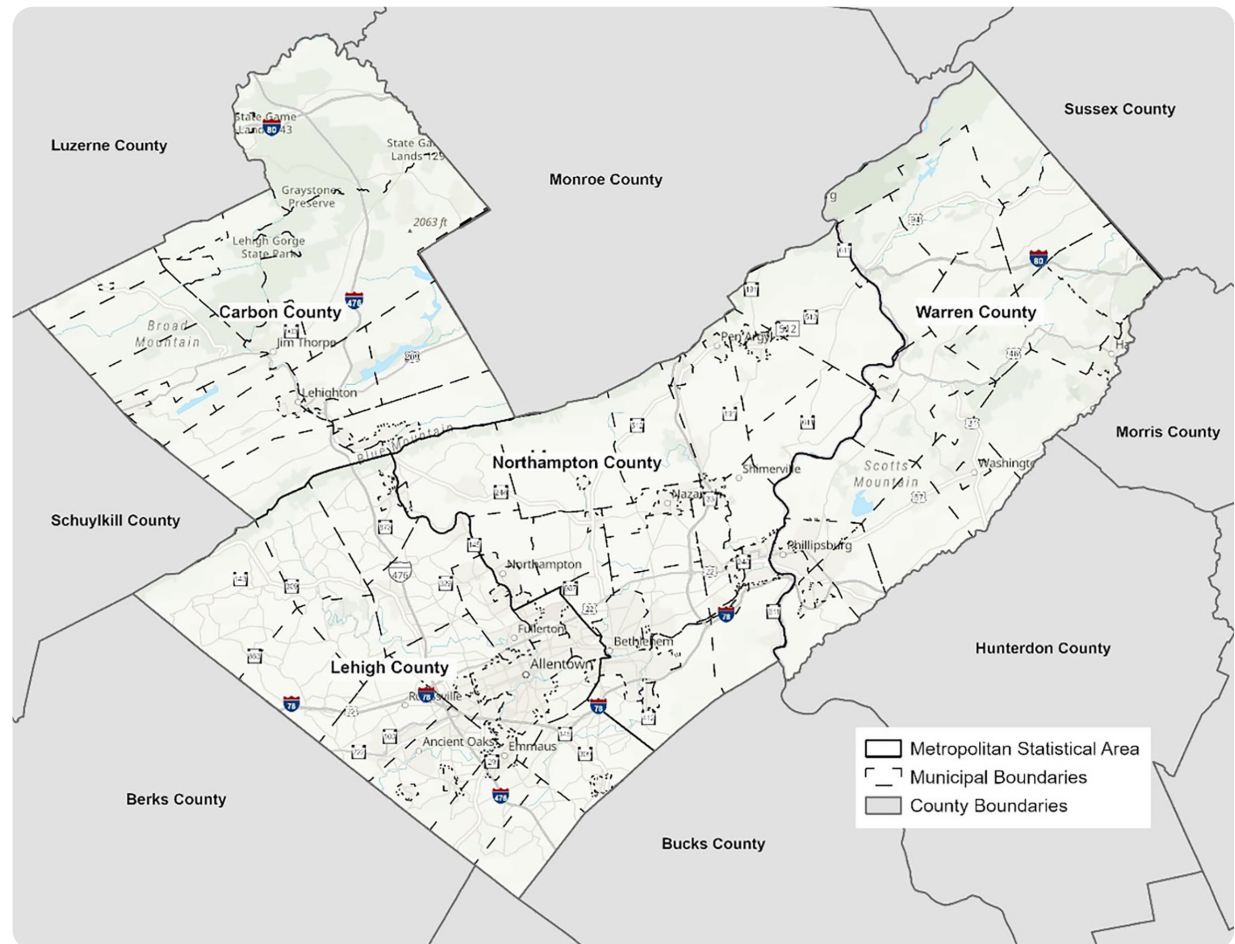
EXECUTIVE SUMMARY

Climate change presents a global threat to the health of our planet, but its impacts are felt locally in the form of higher temperatures, extreme weather, flooding, property damage and health risks to our most vulnerable residents. As greenhouse gas emissions are released, they build up in the atmosphere, trapping in heat, causing the temperature to rise.

The release of emissions is particularly important in a region of more than 863,000 people that is growing by thousands of new residents and businesses every year — all of them contributing to emission totals. But the growth that comes from being an attractive, successful region doesn't have to mean more emissions, more extreme weather and more health risks — not if steps are taken to reduce them.

This report is designed to measure the amount of greenhouse gas (GHG) emissions and where they originate, so that a plan can be designed to reduce them. Reducing the carbon footprint will be particularly important in a region that by 2050 is projected to have 37 days a year with temperatures exceeding 90 degrees.

The *Greater Lehigh Valley Greenhouse Gas Inventory* shows communitywide emissions by sector for Lehigh and Northampton Counties, Carbon County, PA and Warren County, NJ. The data shows why it is important to begin mitigation measures immediately.





THE INVENTORY SHOWS

The Greater Lehigh Valley region emits
12.7 MILLION METRIC TONS
of carbon dioxide equivalent (MTCO₂e).

THAT'S
14.7 MTCO₂e
for every resident in the region.

The Industrial and Transportation sectors
emit more than two-thirds of all emissions,
or **8.1 MILLION MTCO₂e**.

If steps are not taken to reduce the
region's carbon footprint, emissions
will increase to nearly

13.9 MILLION MTCO₂e
by **2050** — an increase of roughly **9%**.

This regional inventory update provides baseline greenhouse gas emission estimates and a business-as-usual scenario projection of emissions through 2050. The emission estimates and projections are based on activities within the entire Allentown-Bethlehem-Easton, PA-NJ Metropolitan Statistical Area (MSA), with 2022 serving as the baseline year.

The sectors included in the inventory are industrial, transportation, residential and commercial energy, solid waste, agriculture, and water and wastewater.

The inventory results provide a detailed profile of emissions sources within the Lehigh Valley and the Greater Lehigh Valley MSA region — information that is key to guiding regional and local reduction efforts. This data will also provide a baseline against which the region will be able to compare future performance and demonstrate progress in reducing emissions.

In this inventory, the Greater Lehigh Valley refers to the four-county MSA consisting of Lehigh, Northampton, Carbon and Warren counties, and the Lehigh Valley refers to the two-county region of Lehigh and Northampton Counties. MSA and region will also be used only in reference to the four-county region.

INTRODUCTION TO CLIMATE CHANGE

The Earth’s climate is largely controlled by a natural process called the greenhouse effect. During this process, heat-trapping gases that naturally exist in the Earth’s atmosphere act as a blanket around the planet, warming it to a temperature that can support life. Without this natural warming process, the Earth would be uninhabitable. However, it is a scientific consensus that human activities have increased the concentration of these greenhouse gases in the atmosphere, resulting in global climate change.

According to the Pennsylvania Climate Impacts Assessment 2021, climate change poses a growing threat to nearly every aspect of life in the Commonwealth, and the impacts are expected to increase in severity unless actions are taken.

The human activity that releases a substantial amount of greenhouse gases contributing to global warming is the burning of fossil fuels such as oil, natural gas and coal for heating, transportation, manufacturing and electricity generation. Scientists today believe that global climate change is occurring based on observing changes over time in average temperature increase, warming of the oceans, sea level rise, and severe weather events that are becoming more extreme. Scientific research has identified human activity as the primary cause of climate-warming trends over the past century and scientists believe that will continue.

While the global average temperature is expected to reach an increase of at least 1.5°C (2.7°F) in the coming two decades, warming in Pennsylvania and the Greater Lehigh Valley is expected to increase by 5.9°F by 2050, according to the state assessment.

Climate change is not just a future threat, but a current hazard from which we are already experiencing effects.

Since 2010,

The region has had **two years** with **below average annual temperatures.**

The region has had **eight summers** with at least **15 days** in which temperatures exceeded **90°F.**

Precipitation in the region has been on the rise as well, with an annual record of 40.92 inches set in 2019, and a record daily December rainfall of 8.17 inches in December of 2023. The region has also endured extreme weather events which may have been influenced by the changing climate such as Superstorm Sandy in 2012, Tropical Storm Isaias in 2020 and the Canada wildfires of 2023 that blanketed the region with smoke.

Increasing temperatures, flooding and more extreme rainfall and heat events are projected to continue to occur more frequently, affecting everything from human health, agriculture, infrastructure design, recreation, environment and the economy.

Over the past 20 years, the average annual rainfall in Pennsylvania increased by 4.6 inches, and the Commonwealth is expected to see continued increases in average



rainfall, more frequent extreme rainfall events and flooding, with those located in or near floodplains at particular risk. Flooding events are the costliest events in the state, impacting human health, agricultural production and the built infrastructure.

According to the 2021 Pennsylvania Climate Impacts Assessment, flooding is the highest risk hazard in Pennsylvania and the Greater Lehigh Valley region, and while the risk of flooding is expected to increase, rising temperatures and heat waves could become as significant a risk as flooding by mid-century. Across the United States, heat accounts for more fatalities than any other type of weather event.

By 2050,

The region is expected to have thirty-seven days per year reaching **90°F**, and twelve reaching **95°F**

These heat waves create health and economic risks for vulnerable populations such as the elderly, low-income populations and those with heart conditions. The risks to residents in urban areas, where the natural landscape is limited, will be significantly higher than in rural areas.

A climate with milder winters, earlier springs and warmer, wetter summers is favorable for pests like mosquitos and ticks, which carry and transmit dangerous illnesses such as Lyme Disease and West Nile Virus. Overall, a changing climate causes cascading effects that alter ecosystems and environments, from the smallest microorganisms to humans.

Such trends are projected to continue with an increase in severity and frequency. Climate change impacts will affect nearly every aspect of the Greater Lehigh Valley's economy, health and natural environment. However, it is not too late to act, and efforts to mitigate and adapt to climate change are underway at the local, regional and state level.

PLANNING FOR CLIMATE CHANGE

Cities, towns and counties are well placed to define coherent and inclusive plans that address integrated climate action that includes climate change adaptation, resilience and mitigation.

Climate change is a persistent environmental challenge of the 21st century that is impacting and will continue to impact the regional economy, natural resources and overall health of residents. Aside from avoiding adverse environmental impacts, reducing greenhouse gas emissions has many benefits that can be felt across the region. Using energy efficiently reduces costs to citizens by lowering utility and transportation costs. Providing diverse multimodal transportation options allows for enhanced ease of mobility for all people and increased economic activity. Planting more trees improves air quality and cools urban areas during hot days. Preserving open space and farmlands promotes carbon sequestration benefits in soils and improves recreation opportunities and property values. In short, reducing emissions use will provide a wide range of benefits that will improve quality of life in the region.

Facing the challenge of climate change requires the concerted efforts of local governments and their partners. Greenhouse gas inventories are a starting point, helping to identify emissions that amplify the “greenhouse effect” in the atmosphere, which triggers global warming. Governments across the region understand

the importance of addressing climate change and have completed their own greenhouse gas inventories or related plans.

RELATED GREENHOUSE GAS INVENTORIES AND RELATED PLANS		
LOCAL	REGIONAL	STATE
<ul style="list-style-type: none"> • City of Allentown Climate Action Report • City of Bethlehem Climate Action Plan • City of Easton Climate Action Plan • Lower Macungie Township Inventory of Communitywide Greenhouse Gas Emissions • Palmer Township Inventory of Communitywide Greenhouse Gas Emissions 	<ul style="list-style-type: none"> • Lehigh Valley Climate and Energy Element • Lehigh Valley Greenhouse Gas Assessment • Lehigh Valley Priority Climate Action Plan • Plan 2050: Transportation. People. Opportunity. (North Jersey Transportation Planning Authority) • Northeastern Pennsylvania Metropolitan Planning Organization 2050 Long Range Transportation Plan 	<ul style="list-style-type: none"> • New Jersey Department of Environmental Protection’s Strategic Climate Action Plan • New Jersey’s Priority Climate Action Plan • Pennsylvania Climate Action Plan • Pennsylvania Climate Impacts Assessment 2021 • Pennsylvania’s Priority Climate Action Plan

Existing targets and plans need to highlight and promote beneficial activities and build support to achieve net-zero emissions by 2050. Creating a roadmap for climate neutrality across the region requires the Greater Lehigh Valley to identify priority sectors for action, while considering climate justice, inclusiveness, local job creation and other benefits of sustainable development.

The following plans by Lehigh Valley Planning Commission (LVPC), Lehigh Valley Transportation Study (LVTS), Warren County and Carbon Counties explicitly address climate change through policies and actions. More broadly, however, these plans promote principles of smart growth, economic savings, natural resource protection, green infrastructure and sustainability, among others, that further reinforce climate change mitigation and adaptation. The assessment of many of these plans was done through *ClimateLV: A Regional Climate Action Assessment* in 2021.



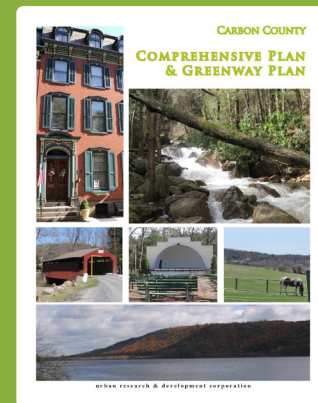


CLIMATE INITIATIVES

2013

Carbon County Comprehensive Plan and Greenway Plan

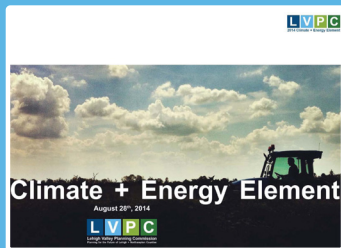
This *Comprehensive and Greenway Plan* provides an overall set of policies for the future development and conservation of Carbon County, to help ensure this change is positive and that Carbon County retains the qualities that make people want to live, work and visit the County. As of 2024, the County is in the process of updating the Comprehensive Plan and Greenways Plan.



2014

Climate + Energy Element

The LVPC's *Climate + Energy Element* provides an overview of climate change and energy use and projects their impacts on Pennsylvania's water resources, aquatic ecosystems, forests, agriculture, human health and economy.



2014

Lehigh Valley Return on Environment

The *Lehigh Valley Return on Environment* study prepared by the LVPC estimates the economic value generated by open space in the Lehigh Valley by providing natural system services, like flood mitigation, and improving air quality.



2016

Livable Landscapes: An Open Space Plan for Northampton County

Livable Landscapes: An Open Space Plan for Northampton County was developed as a guide for the conservation, restoration, and enhancement of the Northampton County's open space resources. It is designed to create linkages between the County's vast natural resources and actions that will support the mitigation of greenhouse gases in Northampton County. This plan is currently being updated.



2017

Green Infrastructure Guidelines

The *Green Infrastructure Guidelines* document was prepared by the LVPC in conjunction with the *Monocacy Creek Watershed Act 167 Stormwater Management Plan Update*. Green infrastructure is all the natural assets of a region — the interconnected network of woodlands, parks, wetlands, surface waters, meadows, agricultural soils and other open spaces — and site design practices using vegetation and soils.



2018

Livable Landscapes: A Park, Recreation, Open Space, Agricultural and Historic Lands Plan for Lehigh County

Livable Landscapes: A Park, Recreation, Open Space, Agricultural and Historic Lands Plan for Lehigh County was created to guide the conservation, restoration, and enhancement of Lehigh County's open space and cultural resources and to create linkages between these resources.



2018

Lehigh Valley Hazard Mitigation Plan

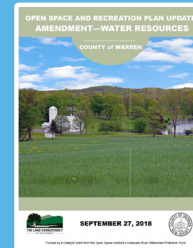
The Lehigh Valley Hazard Mitigation Plan was approved in October 2018 by the Federal Emergency Management Agency. The 2018 plan includes nearly 1,200 mitigation strategies designed to help protect every municipality in the Lehigh Valley from the hazards of the future. It lists multiple hazard profiles that occurred in the Lehigh Valley and that will likely increase in size and frequency because of climate change.



2018

Warren County Open Space and Recreation Plan

The Open Space Plan provides a blueprint of what the County Planning Board recommends as areas that should be preserved as public open space in Warren County, irrespective of the jurisdiction or ownership of the land. *The County Open Space Plan* discusses specific projects and target areas that should be pursued by the county's land preservation program, which help meet the goals and policies of the plan, such as establishing greenways and trails, interconnecting open space, and acquiring sensitive sites.



2019

FutureLV: The Regional Plan

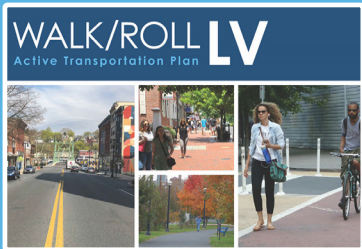
FutureLV: The Regional Plan was developed to support the current and future population, businesses, environment, and culture of the Lehigh Valley and it outlines actions to tackle complex issues so that the Lehigh Valley can capitalize, and preserve, its many assets. *FutureLV* has nine themes that connect the goals, policies, and actions: balance, mobility, resiliency, equity, health, culture, funding and finance, technology, and governance.



2020

Walk/Roll LV: Active Transportation Plan

The LVPC's *Walk/Roll LV: Active Transportation Plan* aims to coordinate public transit, trail, sidewalk, bikeway and roadway systems to create a robust and seamless regional transportation network that is safe and convenient, and that supports pedestrian and bicycle transportation.



2021

ClimateLV: A Regional Climate Action Assessment

The LVPC, and its sister organization, the Lehigh Valley Transportation Study (LVTS), promote the protection of the environment, focusing on reducing transportation related emissions, while protecting endangered species, floodplains and other environmental assets. *ClimateLV: A Regional Climate Action Assessment* took stock of several LVPC/LVTS plans completed over the past decade that included more than 500 goals policies, actions and strategies associated with addressing climate change.

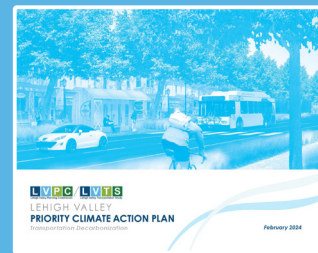


ClimateLV was another step in updating regionwide climate action policy.

2024

Lehigh Valley Priority Climate Action Plan

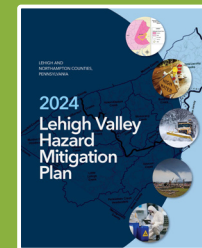
The *Lehigh Valley Priority Climate Action Plan* was the first deliverable in the US EPA's Climate Pollution Reduction Grant program. The plan is focused on transportation decarbonization in the Allentown-Bethlehem-Easton, PA-NJ MSA, and provides a detailed greenhouse gas inventory and projections for the transportation sector, goals and policies to reduce emissions, funding sources to implement emission reduction strategies, and a low income and disadvantaged communities benefits analysis.



2024

Lehigh Valley Hazard Mitigation Plan

The *2024 Lehigh Valley Hazard Mitigation Plan* was drafted by Lehigh and Northampton County Emergency Management and is undergoing final review by the Federal Emergency Management Agency (FEMA). The 2024 Plan covers the 25 natural and non-natural hazards identified in the 2018 plan, with two new hazards added to combat changes in a region that continues to grow. The new hazards are Gas/Liquid Pipelines and Cyber-Terrorism.







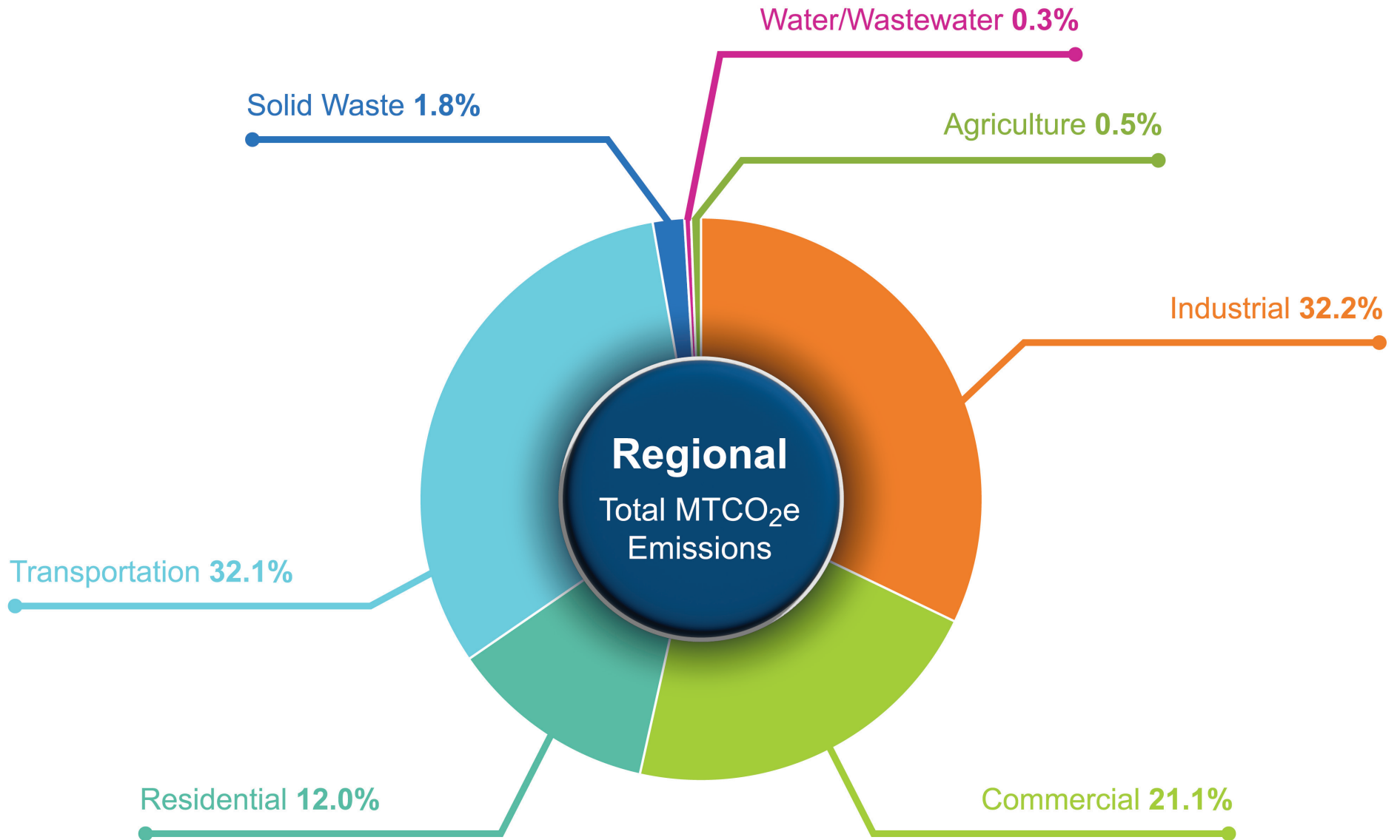
REGIONAL EMISSIONS INVENTORY RESULTS

To achieve ambitious emissions reduction and move toward net zero emissions, the Greater Lehigh Valley region will need to set clear goals and act rapidly following a holistic and integrated approach. Climate action is an opportunity for our community to experience a wide range of co-benefits, such as creating socio-economic opportunities, reducing poverty and inequality, and improving the health of people and nature.

This Greater Greenhouse Gas Inventory provides the information that communities need to inform strategic policy decisions that reduce emissions over time. Regionwide emissions represent an estimate of emissions produced within the Greater Lehigh Valley MSA, which includes Carbon, Lehigh and Northampton Counties in Pennsylvania and Warren County in New Jersey. This estimate represents emissions from energy consumption, as well as emissions from all major greenhouse gas emitting activities in the region.

From this data, a climate action plan will be created outlining specific actions that stakeholders across the region can take to reduce emissions. Many local governments may not possess the technical or financial means to accomplish a greenhouse gas inventory or climate action plan. For this reason, climate action planning at the county and regional scale can benefit our local governments.

GREENHOUSE GAS EMISSIONS BY SECTOR

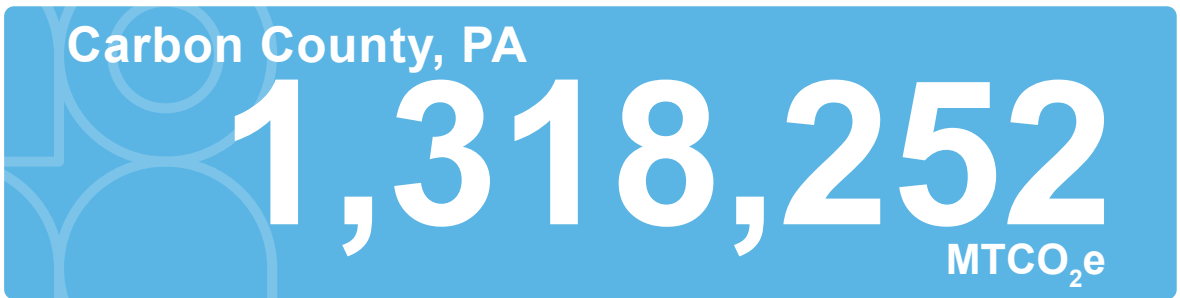


MTCO_{2e} - Metric Tons of Carbon Dioxide

In 2022, the Greater Lehigh Valley MSA had an estimated population of 863,166 residents and estimated emissions of 12,721,374 MTCO₂e, which equals about 14.7 MTCO₂e per resident. The industrial sector is the region's largest contributor, accounting for 32% of gross emissions, followed closely by the transportation sector, which also accounts for 32% of total emissions. The next largest sectors are commercial, residential, solid waste, agriculture and water and wastewater, in that order.

The results of the regional inventory indicate that an effective plan to reduce greenhouse gas emissions would need to emphasize actions to reduce emissions from industrial electricity and gas, transportation fuel uses, and vehicle miles traveled. As a starting point, in spring of 2024, the LVPC released the Lehigh Valley Priority Climate Action Plan focused on transportation decarbonization that featured an in-depth greenhouse gas inventory, transportation emission reduction targets and estimates, and strategies to reduce emissions from that sector. However, all other sources of emissions will need to be considered to reduce the effects of climate change.

ESTIMATED TOTAL GREENHOUSE GAS EMISSIONS





INDUSTRIAL ENERGY & PROCESSES

Industrial sector emissions consist of electricity and natural gas consumption of industrial users on a regional scale, as well as point source emissions from industrial activities at specific facilities.

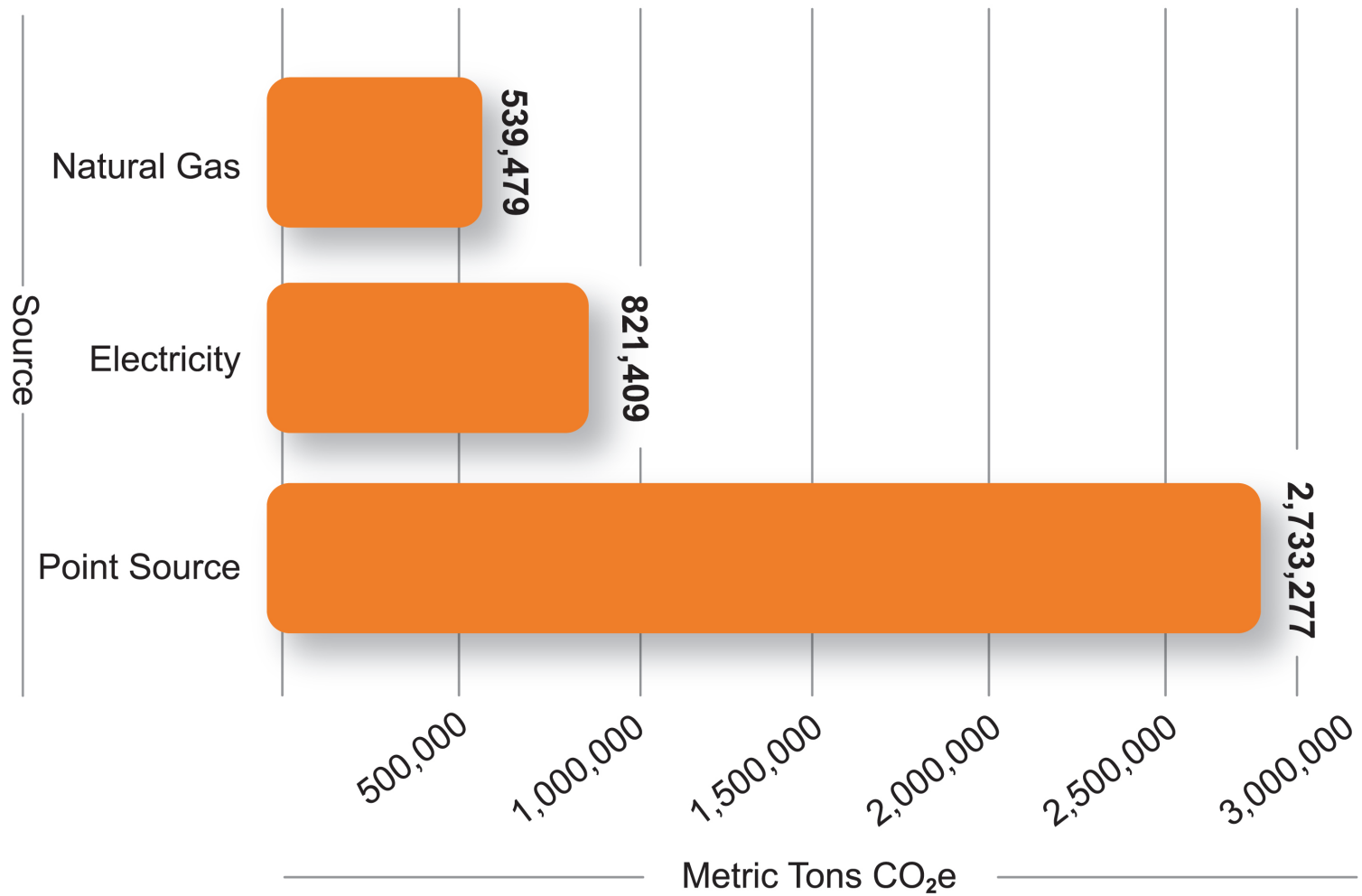
Emissions from electricity and natural gas consumption are estimated by using the emissions factor for the region's power grid. The data and the emissions factor are provided by the National Renewable Energy Laboratory (NREL) State and Local Planning for Energy (SLOPE) tool, while the point source data is from the EPA's National Emissions Inventory (NEI).

This sector requires large amounts of grid electricity, and also produces emissions from various unique industrial processes. Some of the industrial activities that create the most emissions in the MSA are cement production, iron and steel forging, manufacturing and food and beverage processing.

The **INDUSTRIAL** Sector is the region's **LARGEST** emitter of greenhouse gases, with **4,094,165** MTCO₂e emitted each year.



INDUSTRIAL SECTOR EMISSIONS





TRANSPORTATION & MOBILE SOURCES

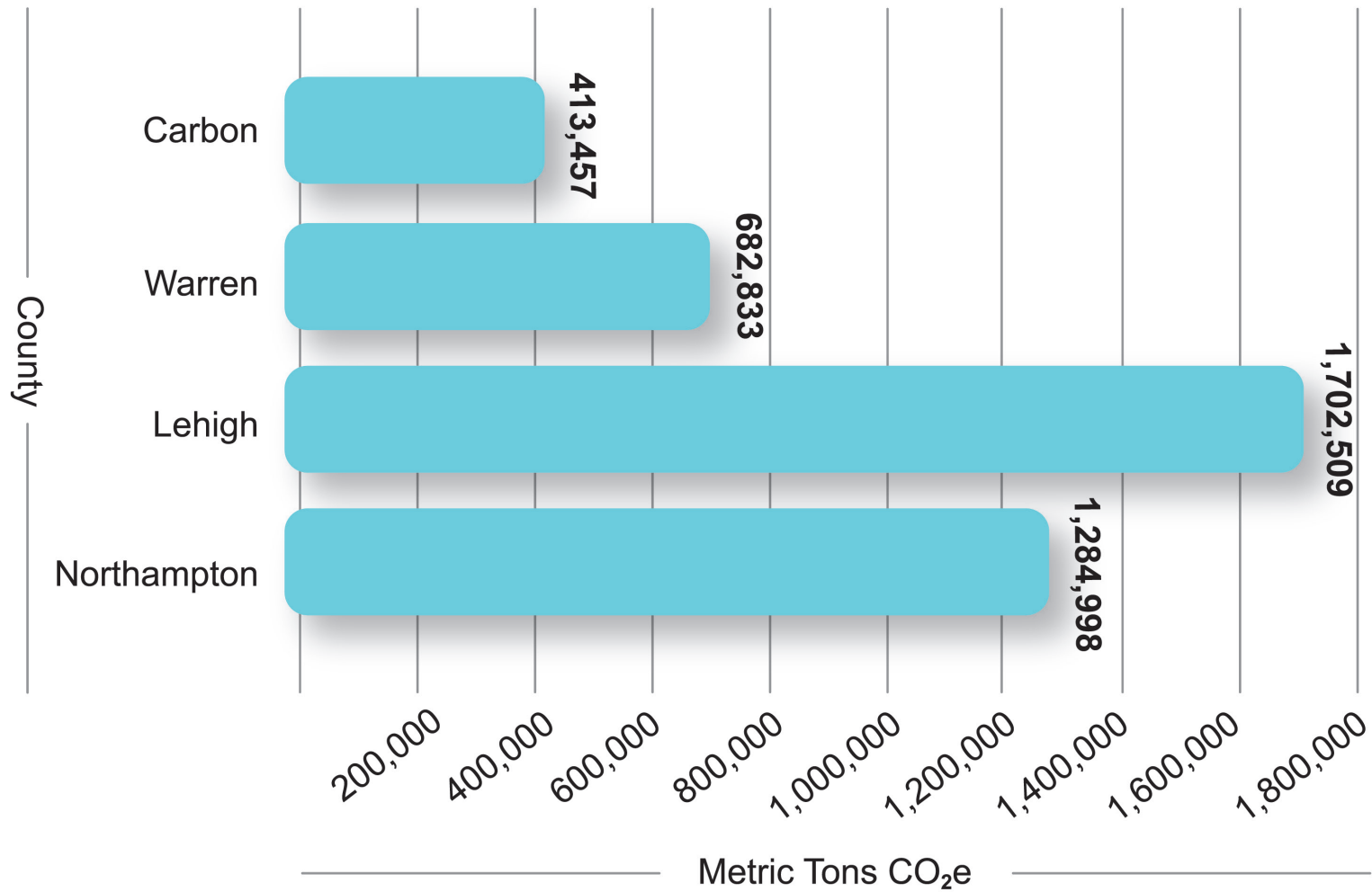
Emissions attributed to the transportation sector result from fuel combustion during on-road vehicle travel within the Greater Lehigh Valley.

Emissions attributed to the transportation sector result from fuel combustion during on-road vehicle travel within the Greater Lehigh Valley. The data within this sector was provided by the Lehigh Valley Planning Commission's (LVPC) Travel Demand Model, the US Environmental Protection Agency (EPA) Motor Vehicle Emission Simulator (MOVES) and the EPA's NEI. The Travel Demand Model is built using local data, including traffic counts and population information, and is shown in terms of daily vehicle miles traveled. The model provides very specific data and if necessary, can determine individual vehicle type emission information.

Despite improvements in vehicle fuel efficiency and the increasing adoption of electric vehicles, emissions from this sector remain high, and will continue to increase, due in part to increasing regional population and vehicle miles traveled (VMT), the emergence of the Lehigh Valley as a logistics hub with heavy tractor-trailer traffic, and historic car-centric planning practices. More information on transportation emissions in the region can be found in the Lehigh Valley Priority Climate Action Plan for Transportation Decarbonization.

The **TRANSPORTATION AND MOBILE Sources Sector** is the **SECOND-LARGEST** emitter of greenhouse gases with **4,083,797 MTCO₂e** emitted yearly.

TRANSPORTATION SECTOR EMISSIONS





COMMERCIAL ENERGY

The Commercial Energy sector including electricity and natural gas consumption estimates for commercial buildings within the MSA, and its associated emissions are calculated by the emissions factor for the region's power grid.

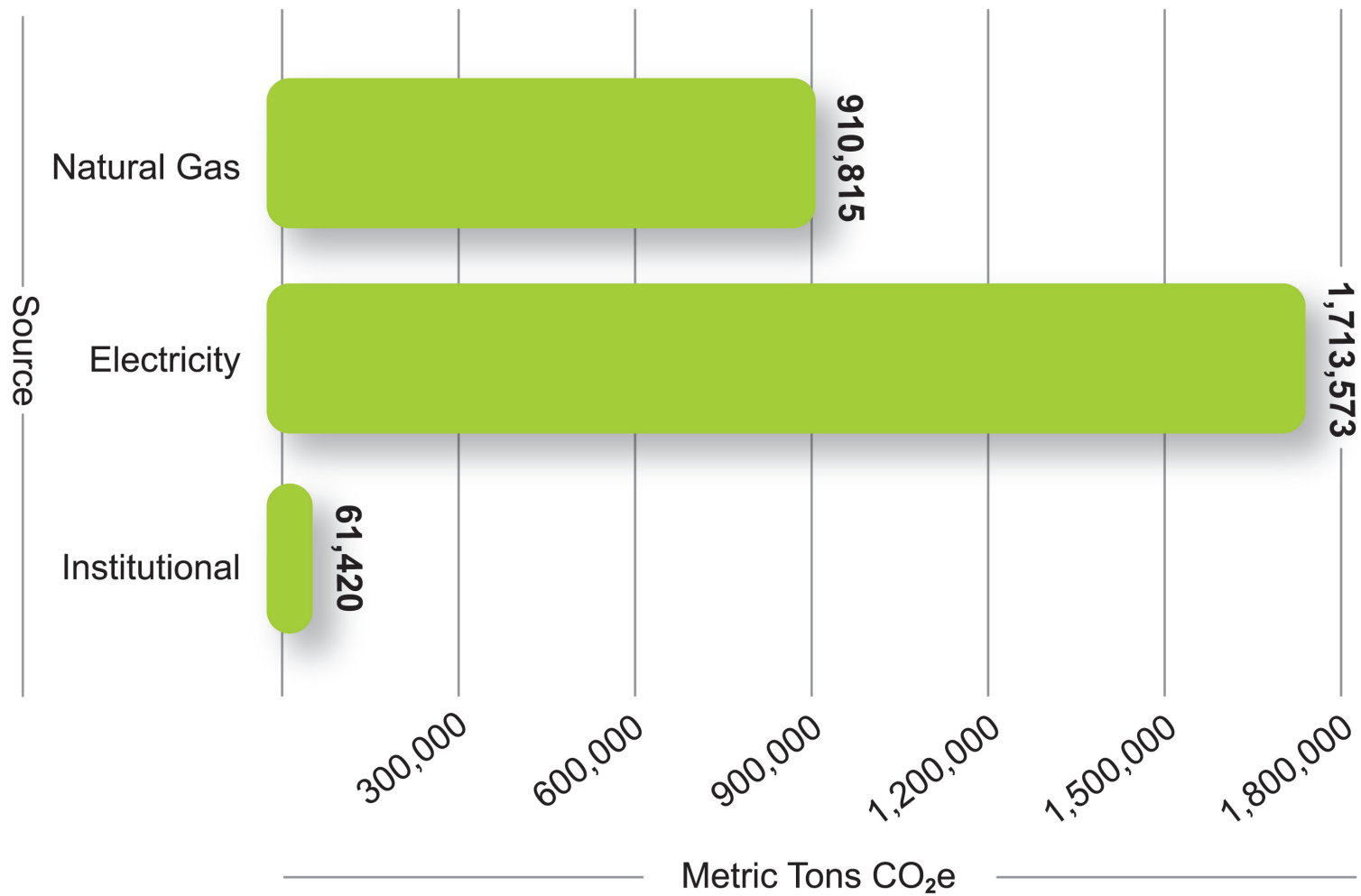
This data is provided by the NREL SLOPE tool. In addition, point source emissions from institutions such as hospitals and schools are considered. This point source data is also sourced from the EPA's NEI. Energy usage in the commercial sector is often

for space heating and cooling, ventilation and lighting. The largest consumers of commercial energy are generally offices, educational institutions, retail businesses and malls, lodging and warehousing.

The **COMMERCIAL ENERGY** Sector is the **THIRD-LARGEST** source of emissions of greenhouse gases, with **2,685,808 MTCO₂e** emitted yearly.



COMMERCIAL SECTOR EMISSIONS





RESIDENTIAL ENERGY

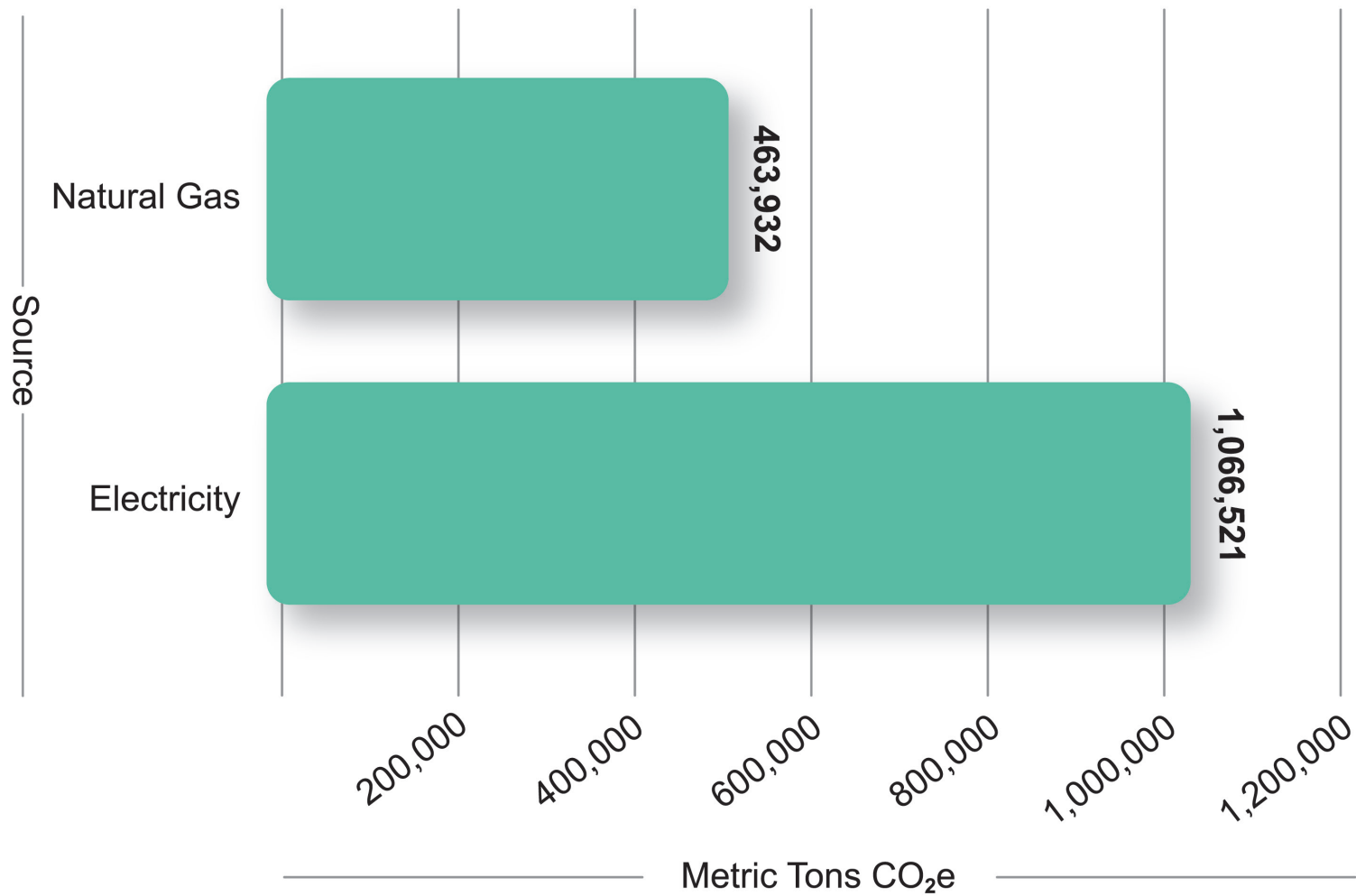
The Residential Energy sector including electricity and natural gas consumption estimates for residential buildings within the MSA, and its associated emissions are calculated by the emissions factor for the region's power grid. This data is provided

by the NREL SLOPE tool. Residential emissions generally stem from electricity demand for air conditioning, water heating, lighting, and appliances and natural gas usage for space and water heating.

RESIDENTIAL ENERGY is the **FOURTH-LARGEST** producer of greenhouse gases, with **1,530,452 MTCO₂e** emitted yearly.



RESIDENTIAL SECTOR EMISSIONS





SOLID WASTE

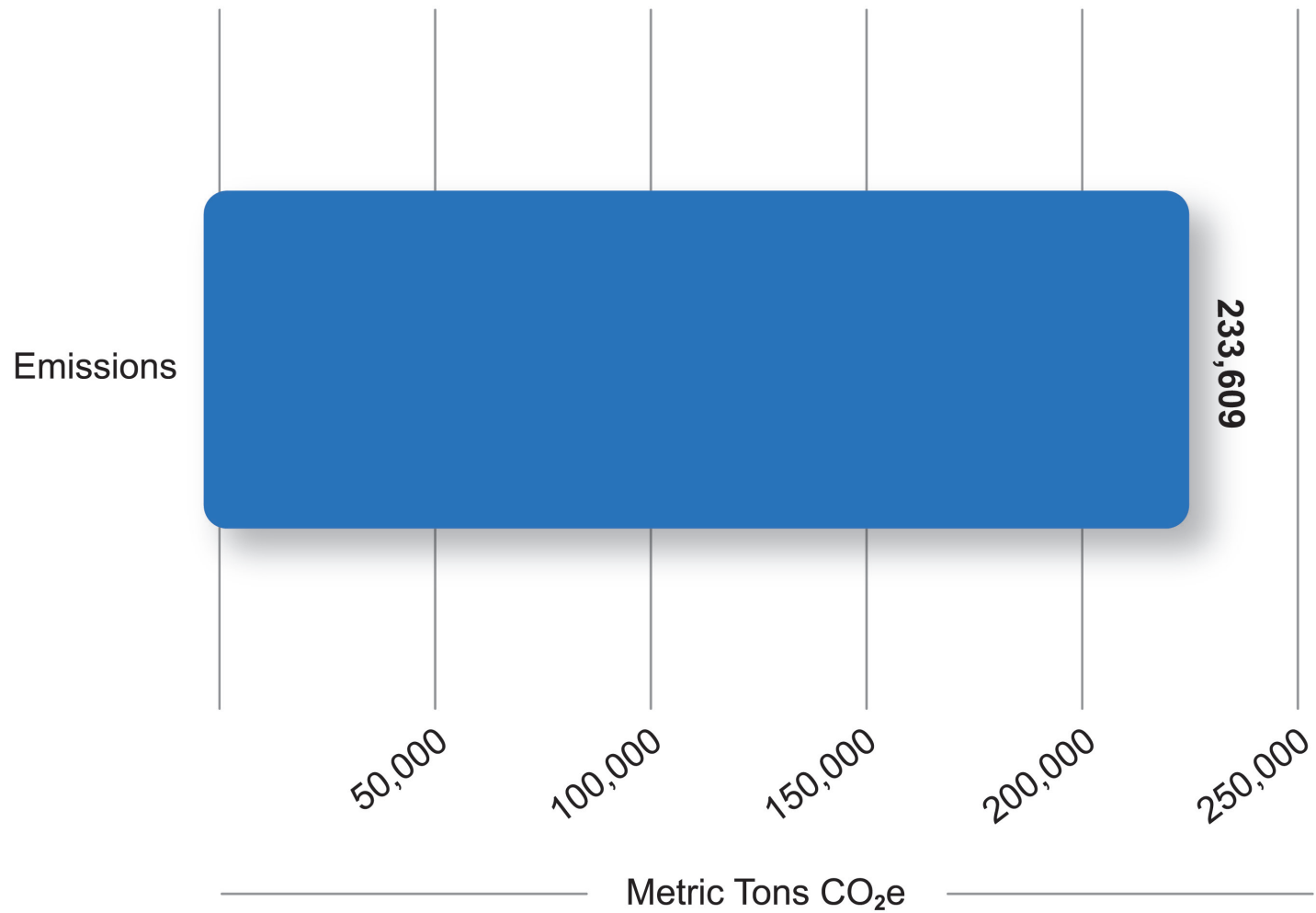
Emissions in this sector represent the total emissions from landfills in the region.

In the Lehigh Valley MSA, there are four landfills, with three located in Northampton County, and one in Warren County. Data for this sector was collected from the EPA's FLIGHT platform and supplemented by the National Emissions Inventory. This inventory

strictly measures the gross emissions from landfills within the MSA and does not consider where the waste in these landfills originated, nor waste generated in the MSA that is landfilled elsewhere.

Estimated emissions from the **SOLID WASTE** Sector are the **FIFTH-LARGEST** source of greenhouse gases emissions at **223,609 MTCO₂e** emitted yearly.

SOLID WASTE EMISSIONS





AGRICULTURE

Emissions in this sector consider emissions from agricultural fertilizer application and combustion from agricultural equipment and machinery.

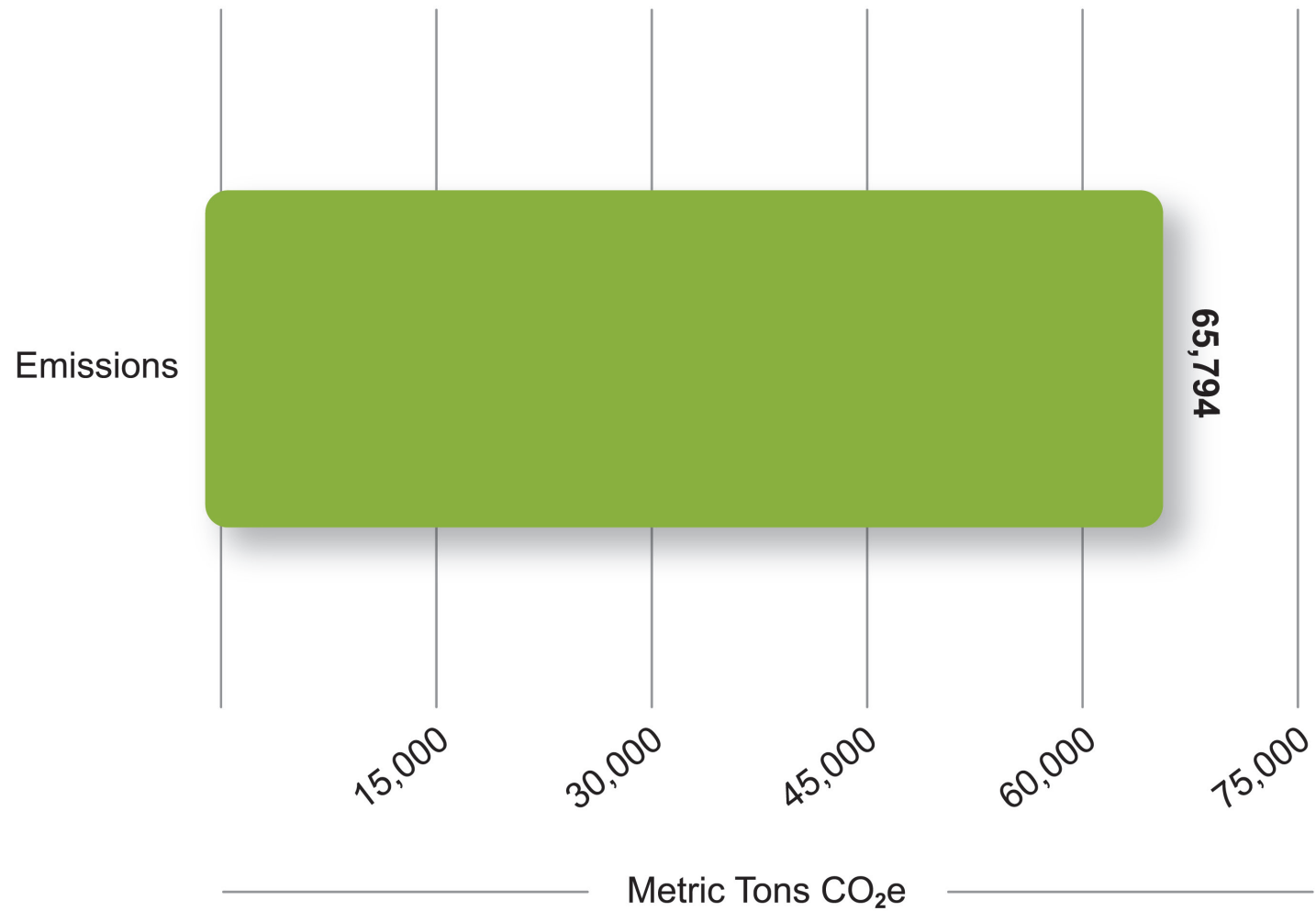
Fertilizer application can cause excess nitrogen to escape into the atmosphere as nitrous oxide. These emissions are estimated via reported statewide fertilizer application through the EPA's State Inventory Tool (SIT) and cropland acres

within the region through the USDA's Census of Agriculture. Emissions from agricultural machinery are reported to and estimated by the EPA's National Emissions Inventory.

Estimated emissions from the **AGRICULTURE** Sector are the **SIXTH-LARGEST** source of greenhouse gases emissions at **65,794 MTCO₂e** emitted yearly.



AGRICULTURAL SECTOR EMISSIONS





POTABLE WATER & WASTEWATER

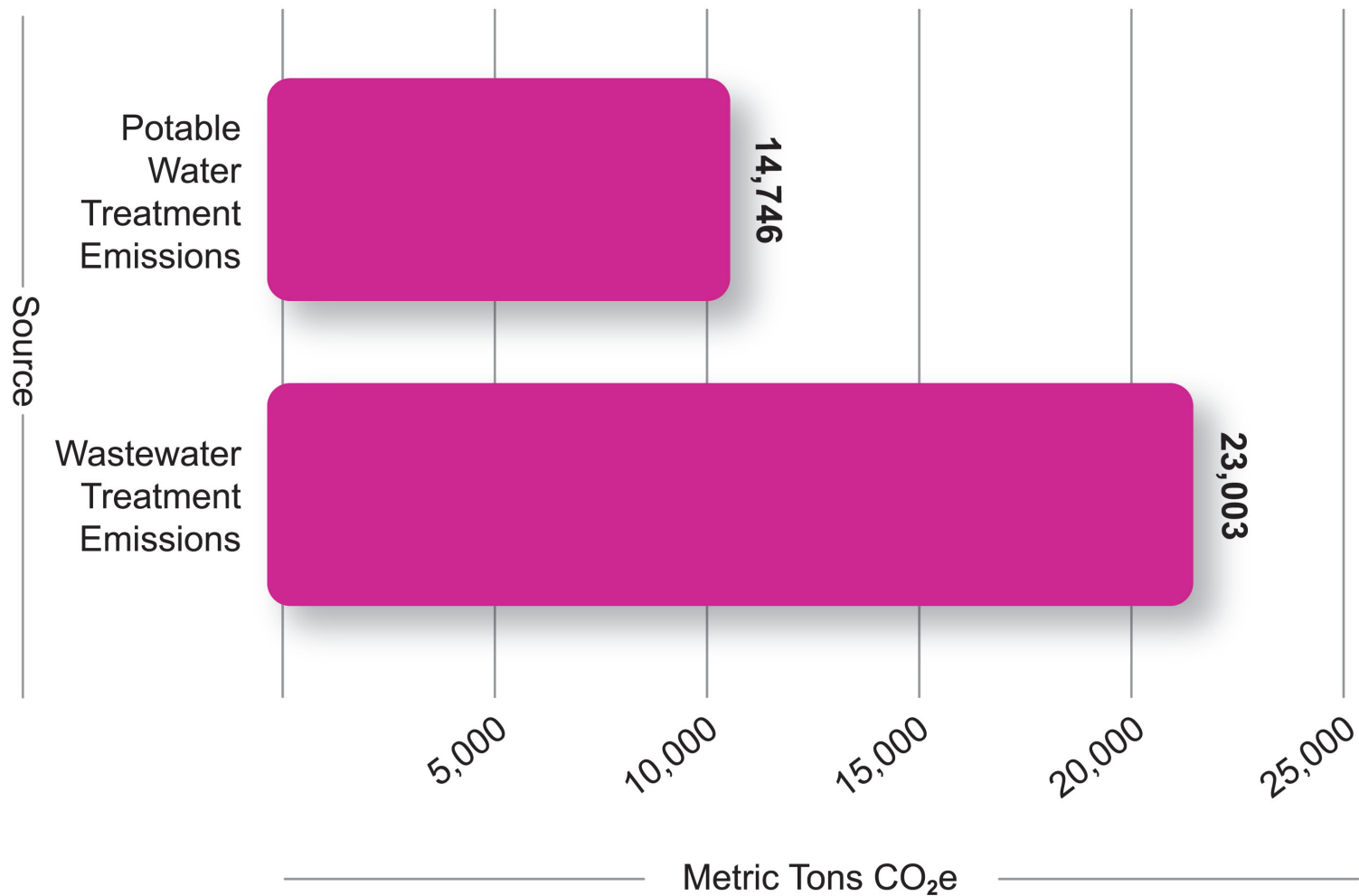
This sector measures the emissions associated with the treatment of potable water and wastewater.

The estimates in this inventory for potable water treatment and wastewater treatment were informed by the 2022 *Lehigh Valley Greenhouse Gas Assessment*.

Wastewater treatment emissions estimates for Carbon and Warren Counties were established by calculating an emissions per capita rate, and potable water treatment emissions estimates for those two counties were calculated through an emissions per unit of potable water usage factor.

The **SMALLEST** sector within the inventory is **POTABLE WATER & WASTEWATER** at 37,749 MTCO₂e emitted yearly.

WATER & WASTEWATER SECTOR EMISSIONS





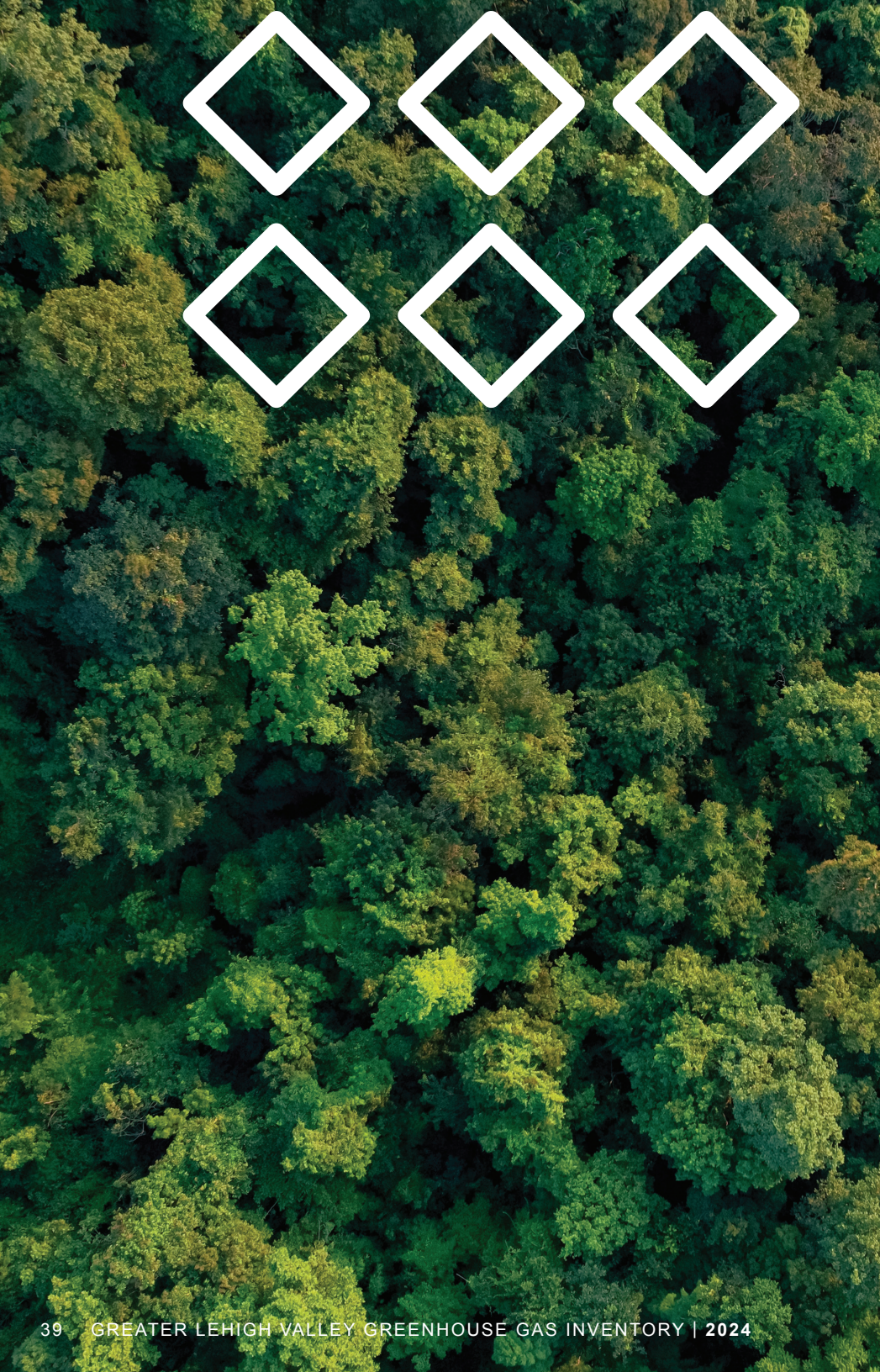


SEQUESTRATION AND CARBON STORAGE

Greenhouse gases and their component elements are part of a broader cycle of nutrient exchange and storage across air, soil and water.

Climate change is largely occurring because human activities have created an imbalance in this cycle, where more greenhouse gases are emitted than can be stored, so they continue to accumulate in the atmosphere and trap heat, raising global temperatures. Carbon is the main element of concern, as it is the building block for carbon dioxide and methane, the two most prevalent greenhouse gases. Places where carbon is stored and kept out of the atmosphere are

called carbon sinks. The largest carbon sinks on the planet are the ocean, plants and fungi, soil and rocks. This inventory estimates the amount of greenhouse gases that are sequestered annually and stored by some of the largest sinks in the Greater Lehigh Valley. Among the most effective carbon sinks are tree cover, agricultural lands and wetlands.



TREE COVER

All trees store carbon and established old-growth forests do so more efficiently than other types of tree habits. The Greater Lehigh Valley MSA has large swaths of carbon sequestering forests in the Poconos and on the Kittatinny Ridge, also known as Blue Mountain. Urban tree plantings also take in greenhouse gases and improve local air quality while providing shade.

The region's Tree Cover sequesters an additional
967,360 MTCO₂e
each year.

It is estimated that the region's Tree Cover is currently storing
158,591,556 MTCO₂e.

That's the equivalent of more than 12 years of emissions by the entire region.

AGRICULTURAL LAND

Agricultural land stores carbon in plant matter and soil. Soil carbon can be lost to the atmosphere as a greenhouse gas by tilling and other agricultural practices which disturb the soil. The estimates for carbon sequestration of agricultural land assume that all farmland uses best management practices (BMPs) that maximize carbon uptake. Not every farm utilizes these, so the figure is likely an overestimation, but demonstrates the potential of rigorous BMP implementation. Keeping land in agricultural use, especially with broad BMP usage, rather than developing it, presents potential net emissions savings by minimizing soil disturbance and expansion of impervious surfaces. The annual carbon sequestration using BMPs of agricultural land is 2,555,801 MTCO₂e. The annual carbon sequestration using BMPs in preserved farmland is 935,402 MTCO₂e.

It is estimated that the region's Agricultural Lands are currently storing **125,384,621 MTCO₂e**.

That's the equivalent of nearly
10 YEARS
of emissions in the region.





WETLANDS

While not covering as much area compared to forests or farmland, wetlands are efficient at sequestering carbon. Preserving them allows for carbon to stay stored away, while promoting development in better suited areas.

It is estimated that the region's Wetlands are currently storing **23,563,864 MTCO₂e.**

That's the equivalent of nearly **2 YEARS** of emissions in the region.

BUSINESS-AS-USUAL SCENARIO

Future greenhouse gas emissions within the Greater Lehigh Valley will be impacted by multiple factors, such as population, employment, land use and land development patterns, economic activity, energy efficiency and transportation habits.

The response to these changes will impact future emissions levels, and actions by residents, organizations, business and governments can influence the trajectory of such future emissions. This greenhouse gas emissions forecast projects future emissions based on current data, past trends and projected trends. While the forecast is an estimate showing how emissions could change over time given certain assumptions, it is not an exact prediction of the future.

The Lehigh Valley Region's Business-As-Usual Forecast is based on county population growth rates, federal Corporate Average Fuel Economy (CAFE) standards, and changes in county cropland acres. It serves as an estimation of future levels of emissions given the current trends maintain and no major steps are taken to reduce emissions. This scenario forecasts emissions from the 2022 base year through 2050, based on the data and sectors from this inventory.

Individually, all the sectors within the inventory are expected to grow through 2050, except for agriculture. Assuming current land use trends continue, the agriculture sector will see the largest percent reduction in emissions, as total cropland acreage in the region is projected to decline annually. Transportation emissions are forecast to shrink into the 2030s, which is largely due to the federal Corporate Average Fuel Economy (CAFE) standards that over time require reduced fuel consumption and better efficiency for light-duty vehicles, such as passenger cars and heavy-duty vehicles like trucks. However, emissions are projected to begin increasing again after reaching a low in the 2030s and eventually pass the 2022 baseline level, as increasing vehicle miles traveled may reverse the emission reductions seen from improved fuel standards. While this scenario accounts for the greater vehicle efficiency required by CAFE, it does not account for widespread electric vehicle adoption, which has the potential to achieve major emissions reductions in the sector.



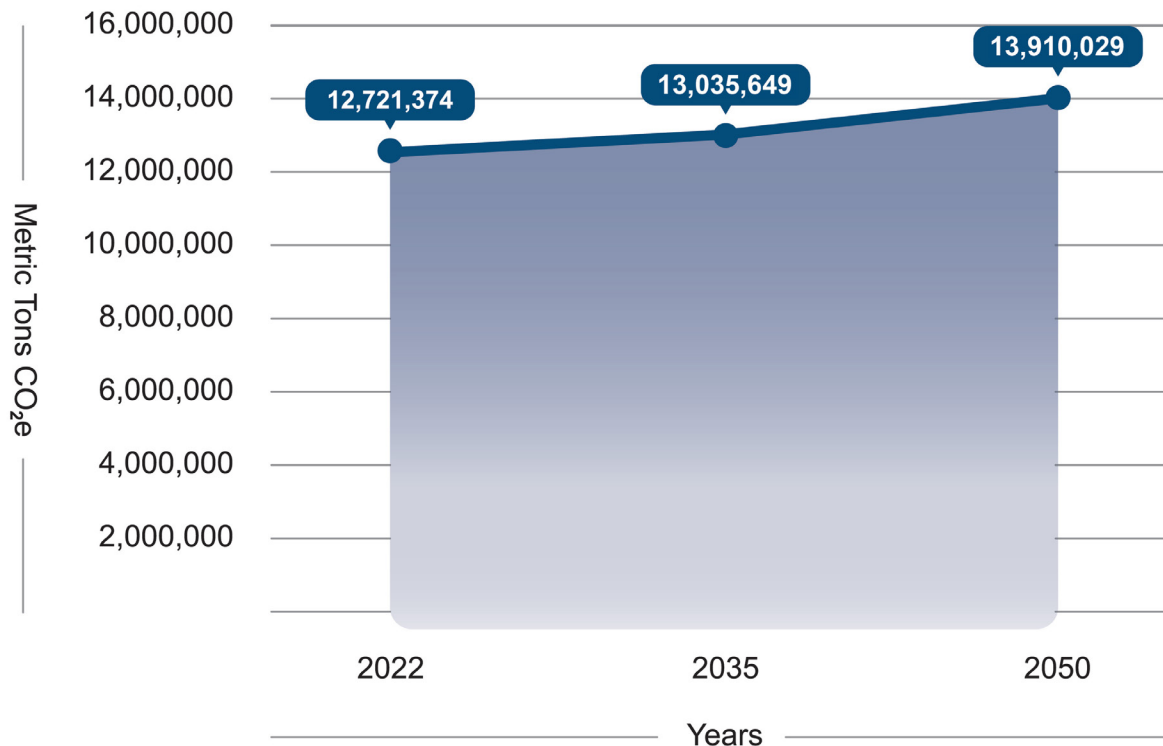


REGIONAL BUSINESS-AS-USUAL FORECAST

The business-as-usual forecast represents an estimate of future emissions if the same population trends are maintained and further policies and technologies to reduce emissions are not implemented. It demonstrates what regional emissions may look

like through 2050 if climate action is not taken. In this scenario, emissions are forecast to increase for every sector except for agriculture, as increasing demand for energy, more vehicle miles traveled, and greater waste generation will all produce

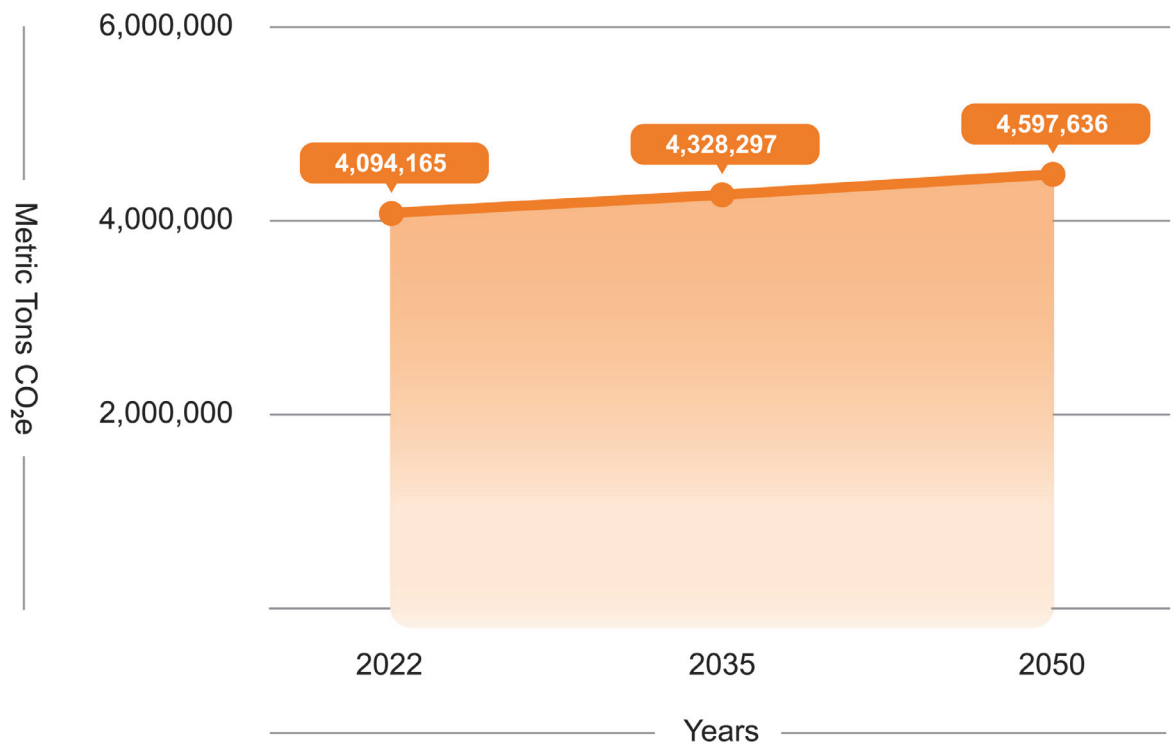
higher emissions. The agricultural sector is forecast to decrease, as development pressure may continue to convert land out of agricultural use.



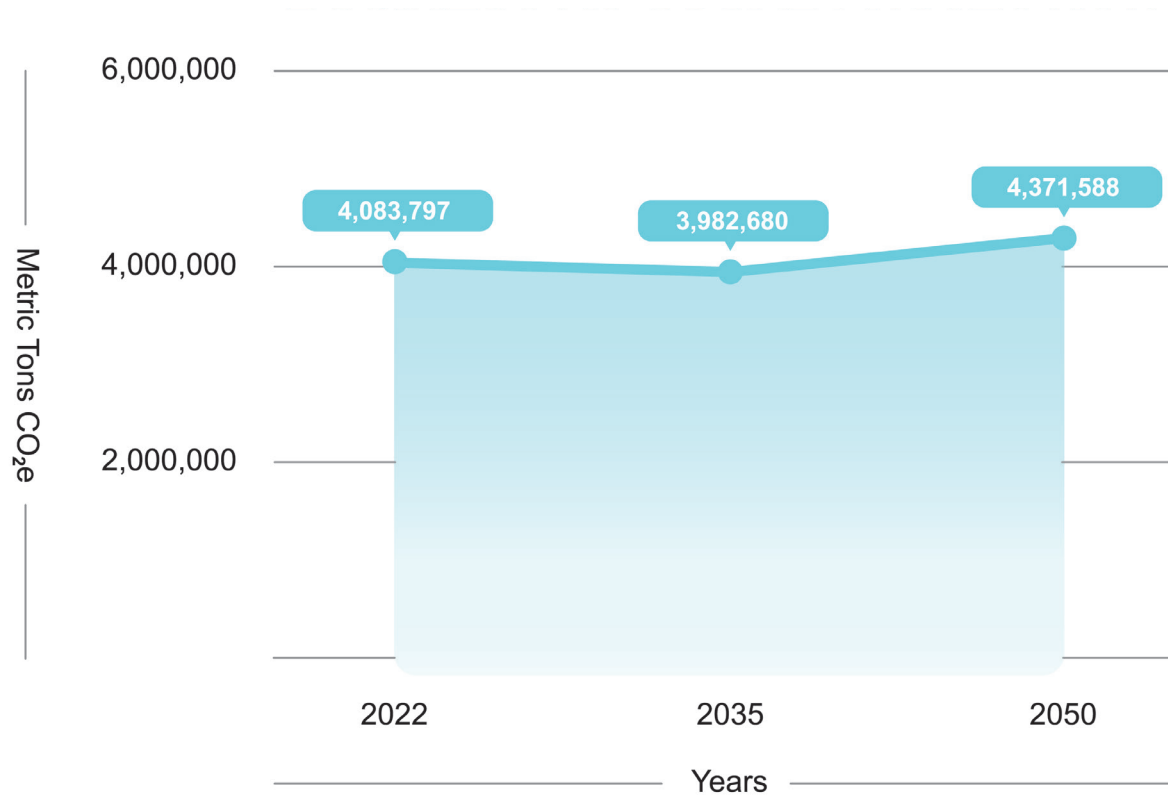
Unless we make changes, emissions will increase by **9.3% by 2050.**

INDUSTRIAL BUSINESS-AS-USUAL PROJECTION

Unless we make changes, emissions will increase by **12.3% by 2050.**



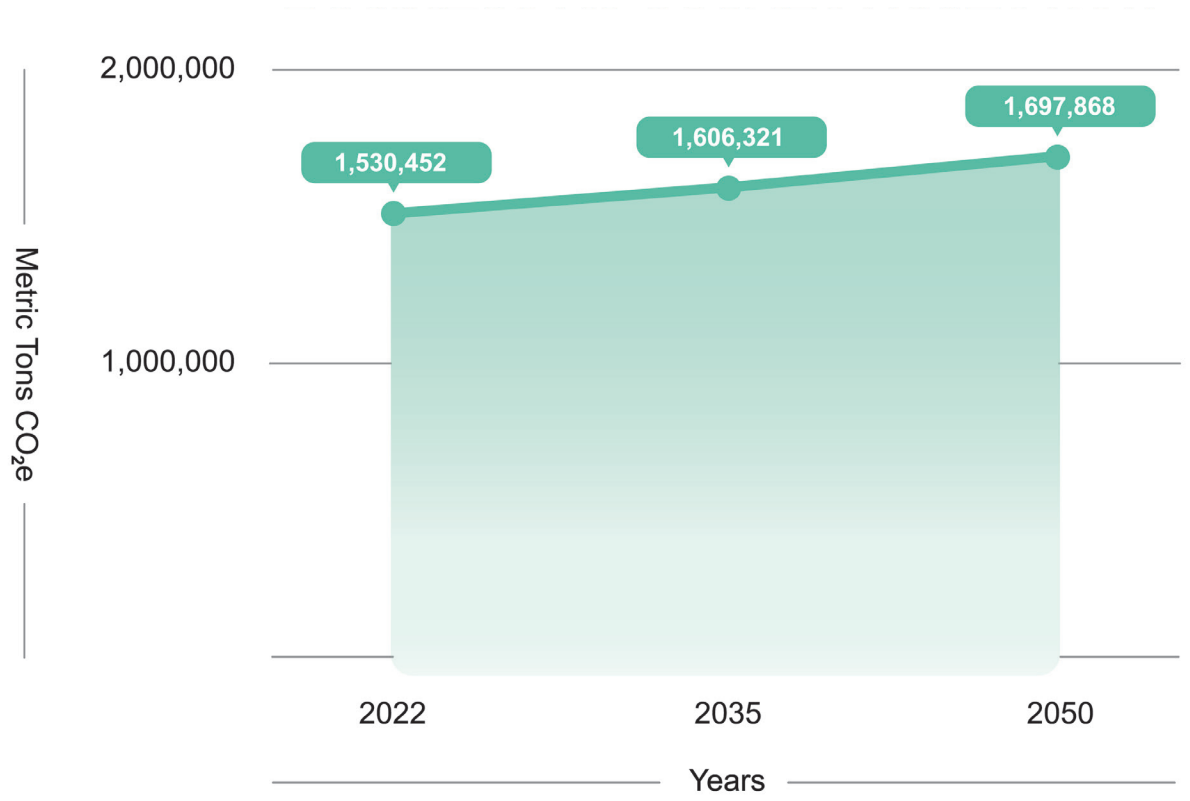
TRANSPORTATION BUSINESS-AS-USUAL PROJECTION



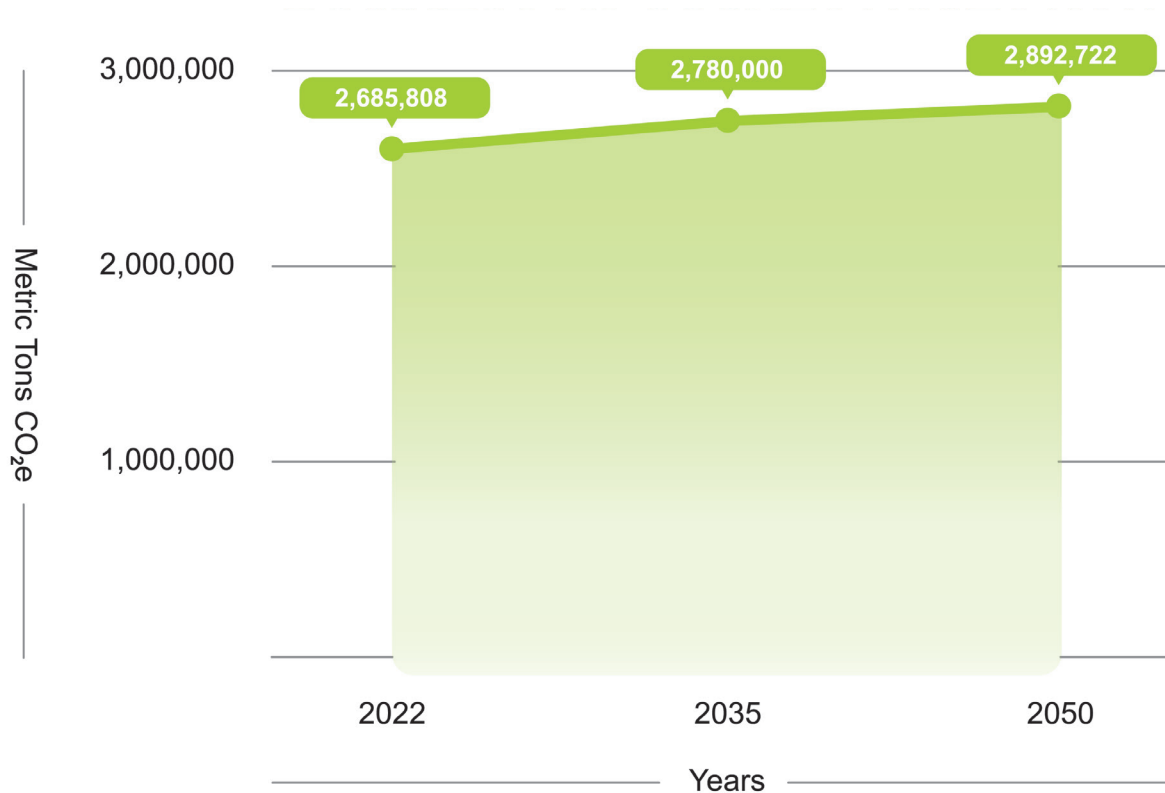
Unless we make changes, emissions will increase by **7.0% by 2050.**

RESIDENTIAL BUSINESS-AS-USUAL PROJECTION

Unless we make changes, emissions will increase by **10.9% by 2050.**



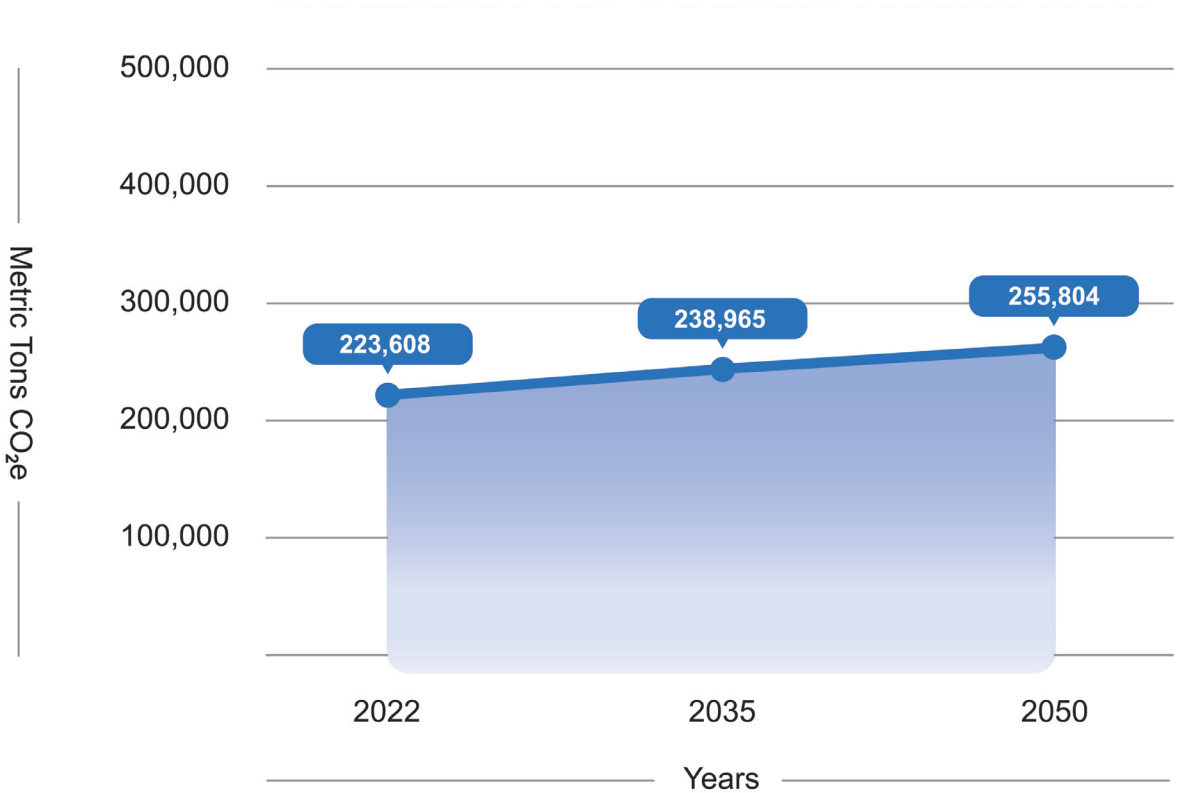
COMMERCIAL BUSINESS-AS-USUAL PROJECTION



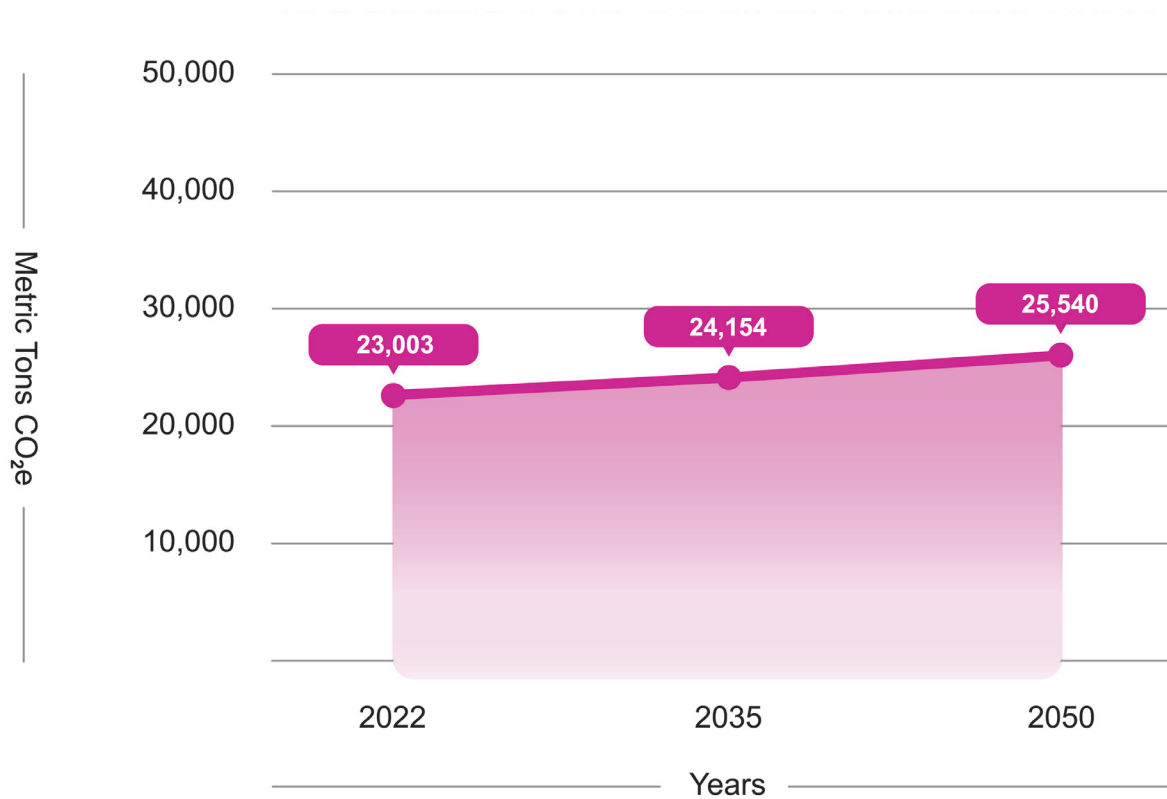
Unless we make changes, emissions will increase by **7.7% by 2050.**

SOLID WASTE BUSINESS-AS-USUAL PROJECTION

Unless we make changes, emissions will increase by **14.4% by 2050.**



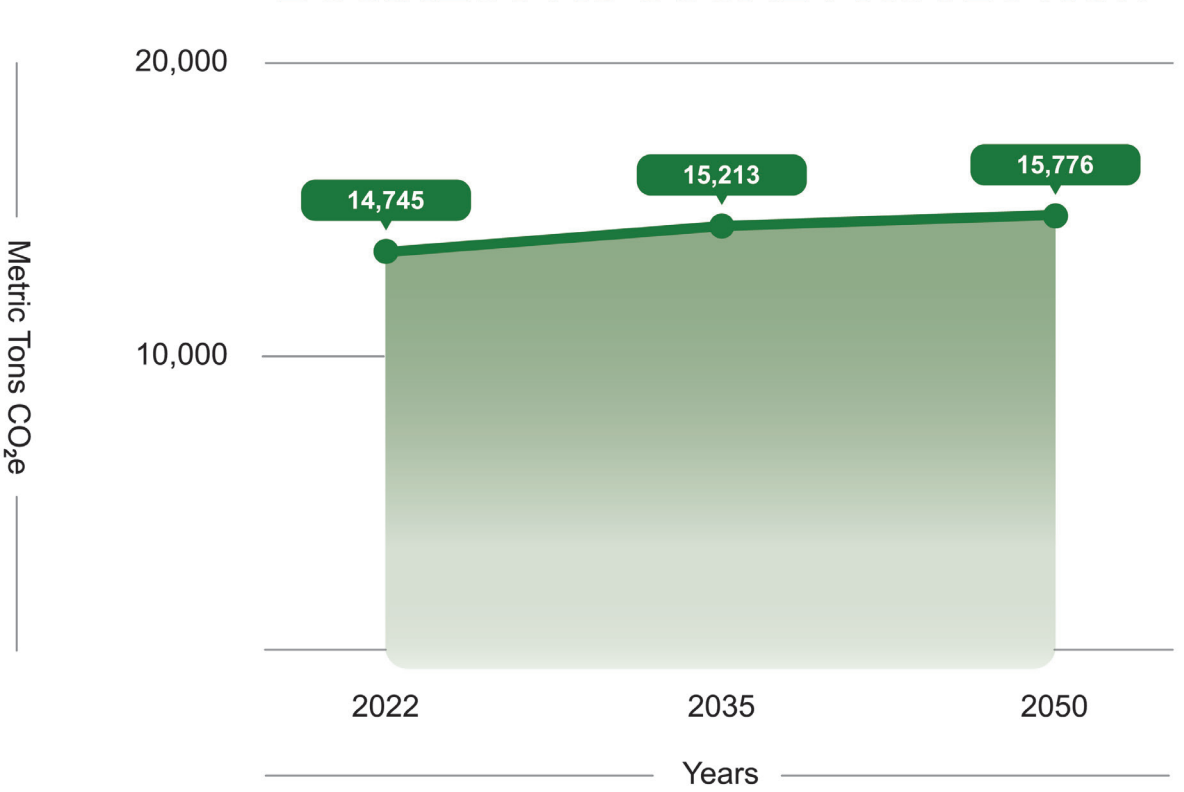
WASTEWATER TREATMENT BUSINESS-AS-USUAL PROJECTION



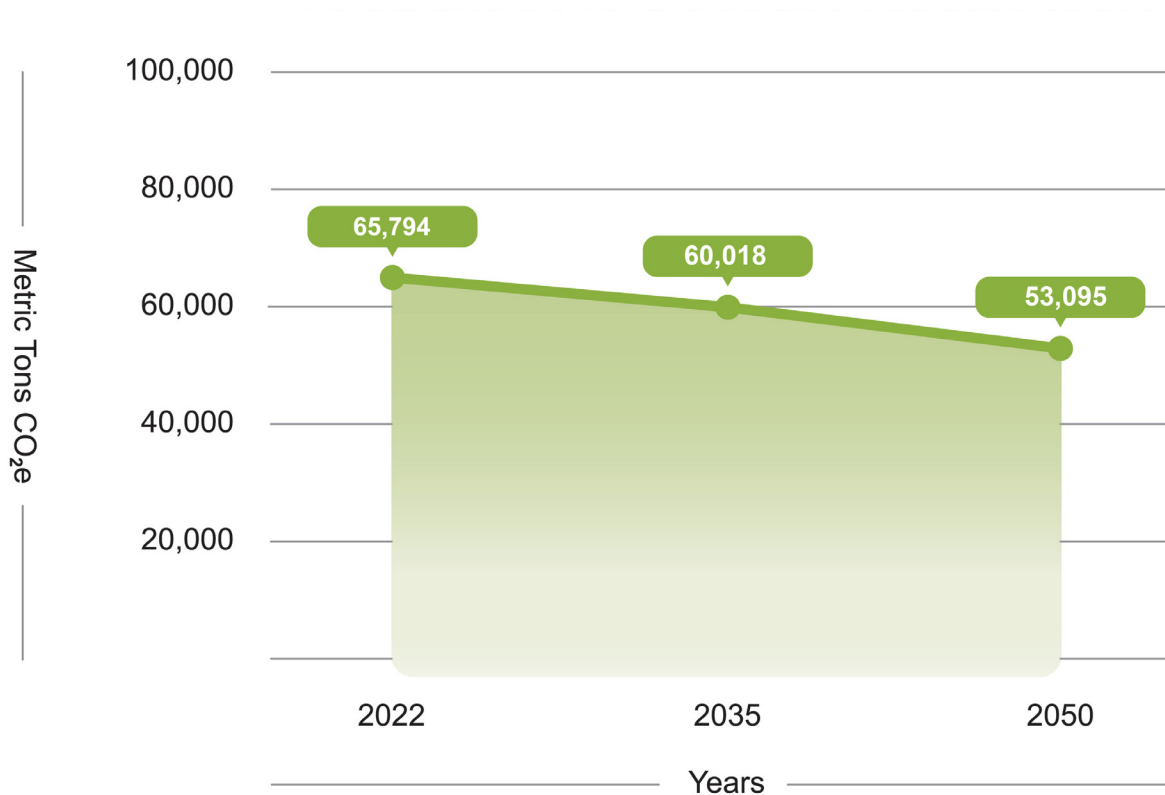
Unless we make changes, emissions will increase by **11.0% by 2050.**

POTABLE WATER TREATMENT BUSINESS-AS-USUAL PROJECTION

Unless we make changes, emissions will increase by **7.0% by 2050.**



AGRICULTURE BUSINESS-AS-USUAL PROJECTION

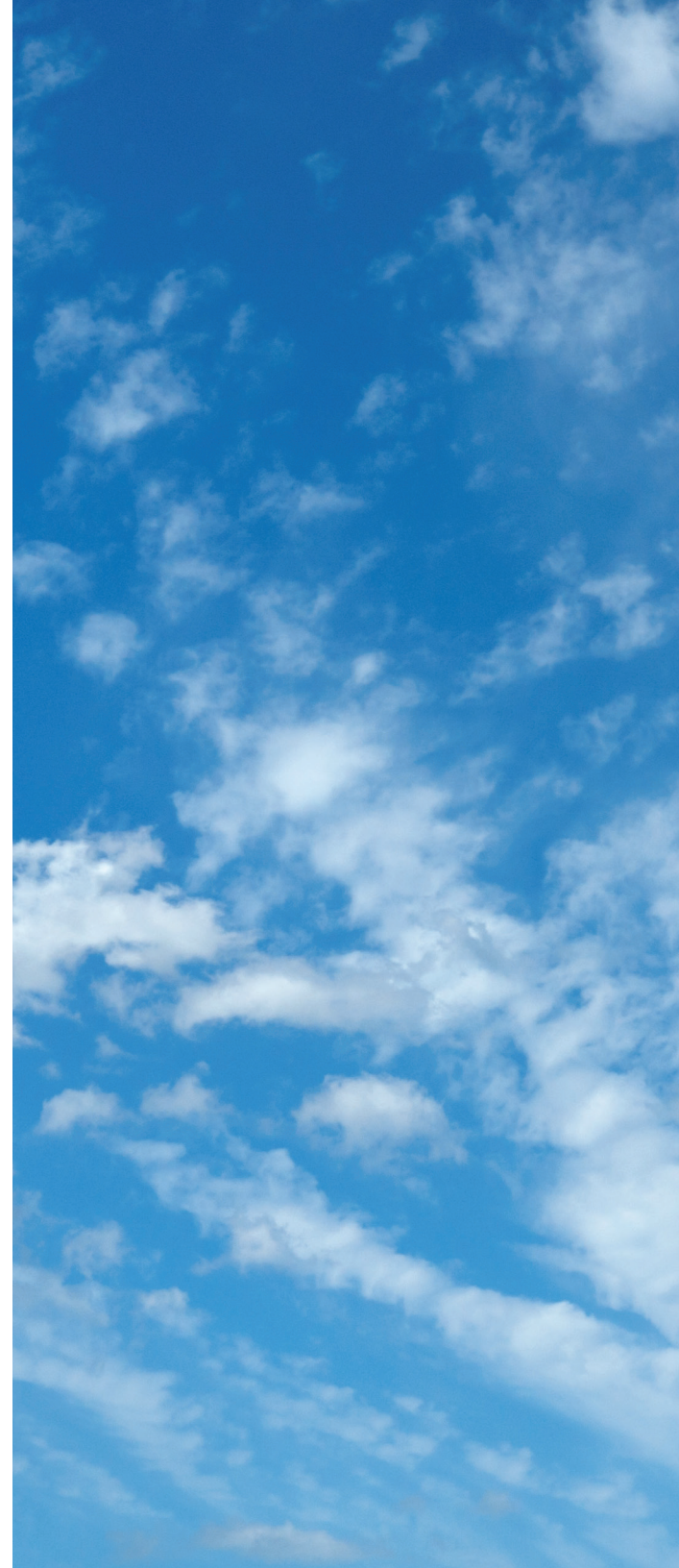


Because Agricultural lands are projected to reduce, emissions in this sector are projected to reduce by **19.3% by 2050.**

BUSINESS-AS-USUAL SUMMARY

This forecast demonstrates a high emissions scenario, which would amplify and hasten the damaging effects of climate change. However, Pennsylvania and New Jersey have ambitious climate goals that, if thoroughly pursued, would greatly reduce

future emissions and help avert the worst effects of climate change. Region-specific emission reduction targets and strategies will be described in the Comprehensive Climate Action Plan to be completed in 2025.









CONCLUSION/NEXT STEPS

This greenhouse gas inventory provides an understanding of current greenhouse gas emissions in the Greater Lehigh Valley Metropolitan Statistical Area, serving as a basis for analyzing, developing and prioritizing mitigation strategies for the region’s Comprehensive Climate Action Plan (CCAP).

The data in this report show that when it comes to GHG emissions, this region will be fighting the headwinds of success and growth, but it also provides encouragement that major emissions reductions are possible, particularly in the Industrial and Transportation sectors. That will be the purpose of the CCAP.

The upcoming comprehensive climate action plan will include GHG emission reduction measures, quantified emission reduction targets, a low-income and disadvantaged communities analysis and a workforce planning analysis, which will all be informed by the information from this inventory. The CCAP will expand upon the data, measures and targets from the PCAP and apply it to all major emission sectors within the region. Like the PCAP, the CCAP will be a resource for municipalities to develop policy from and identify potential funding sources, so they can most effectively and efficiently implement strategies that

reduce emissions and improve quality of life for all. As the CCAP is being implemented, a monitoring process will be developed that outlines how to measure the success of each action and the plan as a whole.

A draft CCAP will be prepared and released for public comment in the spring of 2025. Public input will then be incorporated into a final CCAP to be published in 2025. To get involved, please visit lvpc.org.

Interested in receiving help to create a greenhouse gas inventory and climate action plan for your specific community? Penn State University administers the Local Climate Action Program (LCAP), in partnership with the Pennsylvania DEP, ICLEI: Local Governments for Sustainability, the Centre Region Planning Agency, and CONNECT: Congress of Neighboring Communities. The program provides local governments and academic institutions with resources and technical assistance to create a GHG inventory and climate action plan.

APPENDICES

Baseline Inventory Methodology

Industrial

Facility level greenhouse gas emission data was pulled from the US EPA's National Emissions Inventory (NEI). All available facility types were included, except for electricity generation via combustion, institutional facilities, and landfills. The metric tonnage of these emissions in each greenhouse gas (carbon dioxide, methane, nitrous oxide) was multiplied by their respective Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Global Warming Potential Value to convert their emissions into metric tons of carbon dioxide equivalent (MTCO₂e). Industrial sector natural gas usage and electricity consumption data for each county was obtained from the National Renewable Energy Laboratory SLOPE tool. This data was plugged into the US EPA's Local Greenhouse Gas Inventory Tool (LGGIT) to convert the data into MTCO₂e. Once converted into MTCO₂e, all data was added together to calculate the CO₂e emissions from the industrial sector in the region.

Commercial

Facility level greenhouse gas emission data was pulled from the US EPA's NEI. The only facility type accounted for in this sector was institutional facilities. The metric tonnage of these emissions in each greenhouse gas was multiplied by their respective IPCC Fifth Assessment Global Warming Potential Value to convert their emissions into MTCO₂e. Commercial sector natural gas usage and electricity consumption data for each county was obtained from the NREL SLOPE tool. This data was plugged into the US EPA's LGGIT tool to convert this data into MTCO₂e. Once converted into MTCO₂e, all data was added together to calculate the CO₂e emissions from the commercial sector in the region.

Residential

Residential sector natural gas usage and electricity consumption data for each county was obtained from the National Renewable Energy Laboratory SLOPE tool. This data was entered into the US EPA's LGGIT tool to convert this data into MTCO₂e. Once converted into MTCO₂e, all data was added together to calculate the CO₂e emissions from the residential sector in the region.

Solid Waste

Data was obtained from the US EPA's Facility Level Information on Greenhouse gases Tool (FLIGHT). Emissions were calculated by adding up the MTCO₂e emitted from all landfills in the region.

Water and Wastewater

Potable water treatment emissions data was pulled from the Lehigh Valley Greenhouse Gas Assessment. The total CO₂e emissions described in the assessment were divided by the total water usage of Lehigh and Northampton Counties in the MSA in 2020 to get an emissions per unit of water usage ratio. This ratio was then multiplied by 2022 water usage in the MSA to update the estimate to the current base year. Wastewater treatment and wastewater flaring emissions data were pulled from the Lehigh Valley Greenhouse Gas Assessment. The total CO₂e emissions described in the assessment were divided by the population of Lehigh and Northampton Counties to get an emissions per capita ratio. Then, this ratio was multiplied by the population of the entire MSA to estimate potable water treatment emissions for the whole area. Using this calculation method, it is assumed

that Carbon and Warren counties have the same emissions per capita ratio as Lehigh and Northampton Counties.

Agriculture

Agricultural GHG emissions were calculated using EPA's LGGIT Agriculture and Land Management Guidance for County and Regional Inventories. Fertilizer application data was obtained from the EPA State Inventory Tool (SIT) Agriculture Model and scaled to the MSA level. This was accomplished by using the USDA Census of Agriculture to find the percentage of each state's cropland located in the MSA to create a ratio that was then multiplied by the SIT fertilizer application data to estimate MSA level fertilizer usage. This usage was then entered into the EPA LGGIT to estimate emissions from fertilizer application. Additional agricultural GHG emissions data was obtained from the EPA 2020 NEI. Specifically, emissions were collected within the MSA from mobile non-road agricultural equipment.





APPENDICES

Carbon Sequestration and Storage

Tree Cover

Carbon sequestration and storage data were gathered from the iTree Landscape tool on a county level. This data represents carbon in the biomass of trees in the region. In addition to trees, carbon content in the soil of forested area was calculated as well, using an estimated figure of carbon content in the general types of soil in the region (D'Amore and Kane, 2023). These two estimates were added together to calculate the carbon storage of trees and soil in forested areas of the region.

Agricultural Land

Using the total acreage of cropland and preserved farmland in the region, estimates for total carbon storage and annual carbon sequestration for both were calculated by multiplying acreage by a figure of both annual sequestration of carbon of soil in cropland and an estimate of total carbon storage in cropland (White et al, 2022).

Wetlands

Using the total acreage of wetlands in the region, an estimate of total carbon stored within them was calculated by multiplying the acreage by an estimated figure of the amount of carbon stored per acre in a Pennsylvania wetland. This figure was drawn from a 2018 Penn State University study titled, *Carbon Storage Dynamics of Temperate Freshwater Wetlands in Pennsylvania*.

Projection Methodology

Industrial

An emissions per capita figure was created by dividing the 2022 baseline industrial emissions by the MSA's 2022 population. Then, this per capita figure was multiplied by population projections for the MSA in 2035 and 2050 to estimate emissions from the sector in those years.

Commercial

An emissions per capita figure was created by dividing the 2022 baseline commercial sector emissions by the MSA's 2022 population. This per capita figure was multiplied by population projections for the MSA in 2035 and 2050 to estimate emissions from the sector in those years.

Residential

An emissions per capita figure was created by dividing the 2022 baseline residential emissions by the MSA's 2022 population. This per capita figure was multiplied by population projections for the MSA in 2035 and 2050 to estimate emissions from the sector in those years.

Transportation

Emissions projections for Lehigh and Northampton Counties were replicated from the Lehigh Valley Priority Climate Action Plan. Estimates for Carbon and Warren Counties were calculated by creating a ratio of emissions per vehicle mile traveled (VMT) and multiplying that figure by VMT projections in the counties for 2035 and 2050.

Solid Waste

An emissions per capita figure was created by dividing the 2022 baseline solid waste emissions by the MSA's 2022 population. Then, this per capita figure was multiplied by population projections for the MSA in 2035 and 2050 to estimate emissions from the sector in those years.

Water and Wastewater

An emissions per capita figure was created by dividing both the 2022 baseline water treatment and wastewater treatment emissions by the MSA's 2022 population. Then, this per capita figure was multiplied by population projections for the MSA in 2035 and 2050 to estimate emissions from the respective categories in those years.

Agriculture

An emissions per cropland acre value was calculated by dividing total MSA baseline agriculture emissions by MSA total cropland acreage. To make this calculation, it is assumed that this value will remain constant into the future. Historical cropland acreage data was analyzed to determine an annual rate of change of the number of acres in the region over the last 30 years. This rate of change was used to extrapolate current acreage data through 2050, and these acreage projections were multiplied by the emissions per cropland acre ratio to project future agricultural emissions.

APPENDICES

Sectors, Activities and Emission Sources and Gases in the Allentown Bethlehem Easton, PA-NJ Metropolitan Statistical Area

General Emissions

Generating Activities

- Use of electricity by the community
- Use of natural gas by the community
- Industrial and institutional activity, in addition to energy consumption
- On-road passenger and freight motor vehicle travel
- Use of energy in potable water and wastewater treatment, processing and distribution
- Decomposition of solid waste created by the community
- Agricultural machinery and fertilizer application

The inventory process requires the selection of a base year with which to compare current emissions. Except where noted in this report, the Lehigh Valley’s regional greenhouse gas emissions inventory utilizes 2022 as its baseline year.

Three greenhouse gases are included in the Lehigh Valley regional inventory: carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). This inventory represents emissions in “carbon dioxide equivalent” (CO₂e) values, calculated using the Global Warming Potentials (GWP) for methane and nitrous oxide from the Intergovernmental Panel on Climate Change (IPCC) 5th Assessment Report.

A carbon dioxide equivalent or CO₂e is a measure that converts the concentration or amounts of other gases within the atmosphere to the equivalent amount of carbon dioxide with the same global warming potential. These global warming potential values mean that methane is 28 times more powerful and nitrous oxide is 265 times more powerful of a greenhouse gas than carbon dioxide. Despite its weaker heat trapping ability, carbon dioxide still accounts for the overwhelming amount of total emissions and CO₂e emissions in this inventory, and it remains in the atmosphere longer than the other greenhouse gases.

GREENHOUSE GAS	GLOBAL WARMING POTENTIAL
Carbon Dioxide (CO ₂)	1
Methane (CH ₄)	28
Nitrous Oxide (N ₂ O)	265

This inventory considers greenhouse gas emission sources and activities. Standard greenhouse gas reporting protocol separates emissions into three categories:

SCOPE 1: Direct emissions from sources that are controlled or owned by an organization

SCOPE 2: Indirect emissions from the demand and purchase of energy

SCOPE 3: Downstream emissions stemming from activity within the region

Scope 1 and 2 emissions are estimated in this inventory, as most data available measures these. Scope 3 emissions are more difficult to quantify and are not considered but are still important to know to have a more comprehensive picture of total emissions by the region. Measures taken to reduce emissions should consider all scopes to have the greatest impact.

By reporting on both greenhouse gas emissions sources and activities, the Greater Lehigh Valley can develop and promote a

deeper understanding of greenhouse gas emissions associated with the community. A purely source based emissions inventory could be summed up to estimate total emissions released within the community's jurisdictional boundary. In contrast, a purely activity based emissions inventory could provide perspective on the efficiency of the community, even when the associated emissions occur outside the jurisdictional boundary.

CATEGORIES OF EMISSIONS

SOURCE

Any physical process inside the jurisdictional boundary that releases greenhouse gas emissions into the atmosphere.

ACTIVITY

The use of energy, materials, and/or services by members of the community that result in the creation of greenhouse gas emissions.

Greenhouse gas emissions were quantified in two ways

- 1 **MEASUREMENT-BASED METHODOLOGIES:** The direct measurement of greenhouse gas emissions (from a monitoring system) emitted from a source, such as landfill or industrial facility.
- 2 **CALCULATION-BASED METHODOLOGIES:** Calculated emissions using activity data and emission factors.

SECTOR	DATA SOURCES
INDUSTRIAL	<p>National Renewable Energy Laboratory (NREL) State and Local Planning for Energy (SLOPE) tool natural gas and electricity consumption for Carbon, Lehigh, Northampton, and Warren (NJ) counties (2022)</p> <p>US Environmental Protection Agency (EPA) National Emissions Inventory Facility Data (2020)</p>
COMMERCIAL	<p>National Renewable Energy Laboratory (NREL) State and Local Planning for Energy (SLOPE) tool natural gas and electricity consumption for Carbon, Lehigh, Northampton, and Warren (NJ) counties (2022)</p> <p>US Environmental Protection Agency (EPA) National Emissions Inventory Facility Data (2020)</p>
RESIDENTIAL	<p>National Renewable Energy Laboratory (NREL) State and Local Planning for Energy (SLOPE) tool natural gas and electricity consumption for Carbon, Lehigh, Northampton, and Warren (NJ) counties (2022)</p>
TRANSPORTATION	<p>Lehigh Valley Priority Climate Action Plan Greenhouse Gas Inventory (2021 data)</p> <p>EPA NEI County Data for on-road mobile sources (2020)</p>
SOLID WASTE	<p>EPA Facility Level Information on Greenhouse Gases (FLIGHT) for landfills (2022)</p> <p>EPA NEI Facility Data for landfills (2020)</p>
WATER & WASTEWATER	<p>Lehigh Valley Greenhouse Gas Assessment (2022) water and wastewater emissions</p> <p>US Census American Community Survey - county populations (2020 & 2022)</p> <p>Pennsylvania Department of Environmental Protection Water Use Data (2020 & 2022)</p> <p>New Jersey Department of Environmental Protection Annual Water Withdrawals (2020)</p>
AGRICULTURE	<p>US Environmental Protection Agency (EPA) National Emissions Inventory County Data (2020)</p> <p>EPA State Inventory Tool Agriculture Model (2020)</p> <p>USDA Census of Agriculture - county cropland acreage (2022)</p>
LAND USE	<p>iTree Landscape tool</p> <p>USDA Census of Agriculture - county cropland acreage (2022)</p> <p>White, A., Darby, H., & Ross, D. (2022). (rep.). Soil carbon storage and sequestration in Vermont agriculture. Retrieved from https://www.uvm.edu/sites/default/files/Northwest-Crops-and-Soils-Program/Articles_and_Factsheets/Soil_carbon_and_sequestration_2022_Research_brief.pdf.</p> <p>Mazurczyk, T., & Brooks, R. P. (2018). Carbon storage dynamics of temperate freshwater wetlands in Pennsylvania. <i>Wetlands Ecology and Management</i>, 26(5), 893-914. https://doi.org/10.1007/s11273-018-9619-6</p>

ACRONYMS

°C Degrees Celsius	FLIGHT Facility Level Information on Greenhouse Gases Tool	MT Metric Tons
CAFE Corporate Average Fuel Economy	GHG Greenhouse Gas	MTCO_{2e} Metric Tons of Carbon Dioxide Equivalent
CAP Climate Action Plan	GWP Global Warming Potential	N₂O Nitrous Oxide
CCAP Comprehensive Climate Action Plan	IPCC Intergovernmental Panel on Climate Change	NEI National Emissions Inventory
CH₄ Methane	LCAP Local Climate Action Program	NJDEP New Jersey Department of Environmental Protection
CO₂ Carbon Dioxide	LGGIT Local Greenhouse Gas Inventory Tool	NREL National Renewable Energy Laboratory
CO_{2e} Carbon Dioxide Equivalent	LVPC Lehigh Valley Planning Commission	PCAP Priority Climate Action Plan
DEP Pennsylvania Department of Environmental Protection	LVTS Lehigh Valley Transportation Study	SIT State Inventory Tool
EPA United States Environmental Protection Agency	MOVES Motor Vehicle Emission Simulator	SLOPE State and Local Planning for Energy
°F Degrees Fahrenheit	MSA Metropolitan Statistical Area	USDA United States Department of Agriculture
		VMT Vehicle Miles Traveled

CREDITS AND ACKNOWLEDGMENTS

Special Recognition and Gratitude to:

Susan Rockwell, Retired Senior Environmental Planner, Lehigh Valley Planning Commission

Dave Dech, PP, Director, Warren County, NJ Planning Department

Ryan Conklin, PP, AICP, GISP, Assistant Director, Warren County, NJ Planning Department

Catherine Tulley, Manager, Environmental Programs, Southwestern Pennsylvania Commission

Zenon Tech-Czarny, Principal Planner, Environmental Planning, North Jersey Transportation Planning Agency

Ron Ying, PE, HDR

for their knowledge, advice and work towards the Regional Greenhouse Gas Inventory and commitment to climate action.

Thank you to Carbon County, Lehigh County, Northampton County, Warren County (NJ), Lehigh Valley's local governments and their Environmental Advisory Councils and Planning Commissions, as well as the US Environmental Protection Agency for advancing climate action and environmental conservation planning efforts.



The 2024 Greater Lehigh Valley Greenhouse Gas Inventory: Allentown-Bethlehem-Easton, PA-NJ Metropolitan Statistical Area (MSA) supplements and expands on the 2022 Lehigh Valley Greenhouse Gas Assessment and was prepared by the Lehigh Valley Planning Commission (LVPC) to reflect the data from the entire Metropolitan Statistical Area, including Carbon County, Pennsylvania and Warren County, New Jersey. This inventory includes information from a variety of federal and state resources. This project supports implementation of the goals, policies and actions of *FutureLV: The Regional Plan*, the comprehensive plan of the Lehigh Valley.

This project has been funded wholly or in part by the United States Environmental Protection Agency under assistance agreement 95318301 to the Lehigh Valley Planning Commission. The contents of this document do not necessarily reflect the views and policies of the Environmental Protection Agency, nor does the EPA endorse trade names or recommend the use of commercial products mentioned in this document.



STAFF

Becky A. Bradley, AICP
Executive Director

Tracy L. Oscavich
Director of Administration

Scott Greenly
Director of Regional Planning

Matt Assad
Managing Editor

Vicki Weidenhammer
Controller

Geoffrey A. Reese, PE
Master Planner and Engineer

Susan Myerov, AICP
Director of Environmental Planning

Denjam Khadka
Senior Civil/Environmental Engineer

Jill Seitz
Chief Community Planner

Brian Hite
Transportation Planner

Joseph Dotta
Regional Planner

Evan Gardi
Transportation Planner

Ben Dinkel
Transportation Planner

Christian Martinez
Environmental Planner

MacKenzie Geisner
Geographic Information Systems Planner

Corinne Ruggiero
Environmental Planner

Hannah Milagio
Regional Planner for Community Engagement

Taylor Beasley
Graphic Design and Publications Coordinator

Angela Ellis
Administrative Assistant

Mary Grace Collins
Community Fellow

Design support from SWBR Marketing & Media

This document was prepared by the Lehigh Valley Planning Commission staff on behalf of the Allentown-Bethlehem-Easton, PA, NJ Metropolitan Statistical Area, with additional assistance from staff in Warren County, NJ and Carbon County, PA.







**THIS PUBLICATION AND ADDITIONAL INFORMATION ON THIS EFFORT
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