Palmetto Air Quality Collaborative (PAQC)

South Carolina Priority Climate Action Plan (PCAP)

March 1, 2024

dhec Healthy People. Healthy Communities.

SOUTH CAROLINA OFFICE OF RESILIENCE

Co-Lead Agencies

South Carolina Department of Health and Environmental Control (DHEC)
South Carolina Office of Resilience (SCOR)

PAQC Website: https://scor.sc.gov/paqc

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Acronyms

AFLEET	Alternative Fuel Life-Cycle Environmental and Economic Transportation
CCAP	Comprehensive Climate Action Plan
CEJST	Climate and Economic Justice Screening Tool
CFR	Code of Federal Regulations
CO_2e	Carbon Dioxide Equivalent
CO_2FFC	Carbon Dioxide Fossil Fuel Combustion
COG	Council of Governments
CPRG	Climate Pollution Reduction Grant
CSF	Climate-Smart Forestry
DER	Distributed Energy Resource
DERA	Diesel Emissions Reduction Act
DEQ	Diesel Emissions Quantifier
DHEC	Department of Health and Environmental Control
DOC	Department of Commerce
DOE	Department of Energy
DOT	Department of Transportation
DRO	Disaster Recovery Office
DWFSC	Don't Waste Food SC
EDA	Economic Development Administration
EIA	Energy Information Administration
EJ	Environmental Justice
EV	Electric Vehicle
EVSI	Electric Vehicle Stakeholder Initiative
EPA	Environmental Protection Agency
FIA	Forestry Inventory and Analysis
FLIGHT	Facility Level Information on Greenhouse Gases Tool
FY	Fiscal Year
GHG	Greenhouse Gas
GGI	Green Government Initiative
GREET	Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation

GWP	Global Warming Potential
HAP	Hazardous Air Pollutant
HFC	Hydrofluorocarbons
HP	Horsepower
IECC	International Energy Conservation Code
IOU	Investor-owned Utilities
IRA	Inflation Reduction Act
LIDAC	Low-Income and Disproportionately Burdened Communities
LULUCF	Land Use, Land Use Change, and Forestry
MMBtu	Million British Thermal Units
MMT	Million Metric Tons
$MMTCO_2e$	Million Metric Tons Carbon Dioxide Equivalent
MPO	Metropolitan Planning Organizations
MSA	Metropolitan Statistical Area
MSW	Municipal Solid Waste
$MTCO_2e$	Metric Tons Carbon Dioxide Equivalent
MW	Megawatt
NEVI	National Electric Vehicle Infrastructure
NGO	Non-governmental Organizations
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
NREL	National Renewable Energy Lab
ODS	Ozone Depleting Substances
OEO	Office of Economic Opportunity
PAQC	Palmetto Air Quality Collaborative
PCAP	Priority Climate Action Plan
PFC	Perfluorocarbons
RISES	Resilient, Innovative, Sustainable, and Efficiency Standards
RWEE	Residential Weatherization and Energy Efficiency
SCAGPO	South Carolina Association of Government Purchasing Officials
SCDES	South Carolina Department of Environmental Services
SCDOC	South Carolina Department of Commerce

SCOR	South Carolina Office of Resilience
SCPA	South Carolina Ports Authority
SIT	State Inventory Tool
TNC	The Nature Conservancy
USDA	United States Department of Agriculture
VFD	Variable Frequency Load Drives
VMT	Vehicle Miles Traveled
WARM	Waste Reduction Model

Key Terms

Climate: Describes what the weather is like over a long period of time in a specific area. Climate discussions often focus on averages of temperature, precipitation, humidity, sunshine, wind, and other measures over a thirty-year, or longer, period, and how those averages may be changing over time.[1]

Climate and Economic Justice Screening Tool (CEJST): A tool created by the Executive Office of the President's Council on Environmental Quality to identify communities with a high percentage of residents that have low incomes and limited access to resources and who experience disproportionate environmental and socioeconomic burdens. EPA strongly recommends use of CEJST[2] to assess community burdens associated with air quality, climate change, energy, environmental hazards, health, housing, legacy pollution, transportation, water and wastewater, and workforce development.

Climate Pollution Reduction Grant (CPRG) Program: A $5 billion program authorized and funded by the Inflation Reduction Act in 2022. Administered by the U.S. Environmental Protection Agency, the CPRG[3] program offers Phase I Planning Grants to support climate planning by states, local governments, tribes, and territories. Funds can be used to update existing climate, energy, or sustainability plans, or to develop new plans. Competitive Phase II Implementation Grants will support the implementation of greenhouse gas reduction measures identified in Phase I Priority Climate Action Plans.

Co-benefits: The multiple benefits that result when a policy or action to reduce greenhouse gas emissions are enacted. These other benefits may be related to public health (improved air quality), economic development, cost savings for governments and businesses, workforce training opportunities, enhanced greenspaces, flood mitigation, and community engagement.

Comprehensive Climate Action Plan (CCAP): A narrative report that provides an overview of the grantees' significant GHG sources/sinks and sectors, establishes near-term and long-term GHG emission reduction goals, and provides strategies and identifies measures that address the highest priority sectors to help the grantees meet those goals. The CCAP must include a comprehensive inventory of emissions and sinks for the following sectors: industry, electricity generation/use, transportation, commercial and residential buildings, agriculture, natural and working lands, and waste and materials management.

Greenhouse Gases (GHG): Gases that trap heat in the Earth's atmosphere. Earth would be uninhabitable without GHGs. Greenhouse gases are naturally present in the atmosphere as carbon circulates among the atmosphere, oceans, soil, plants, and animals. However, when GHGs in the atmosphere accumulate at very high levels, more heat is trapped in the atmosphere system and the Earth gets warmer. The principal greenhouse gases are carbon dioxide, methane, nitrous oxide, and fluorinated gases.[4]

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[1] National Oceanic and Atmospheric Administration (NOAA), National Centers for Environmental information, https://www.ncei.noaa.gov/news/weather-vs-climate.
[2] Executive Office of the President's Council on Environmental Quality, Climate and Economic Justice Screening Tool, https://screeningtool.geoplatform.gov/en/.
[3] U.S. Environmental Protection Agency (EPA), Climate Pollution Reduction Grants, https://www.epa.gov/inflation-reduction-act/climate-pollution-reduction-grants.
[4] EPA, Overview of Greenhouse Gases, https://www.epa.gov/ghgemissions/overview-greenhouse-gases.

Greenhouse Gas Inventory: A list of GHG emissions *sources* and *sinks* and the associated emissions quantified using standard methods. In the United States, sources of greenhouse gases include those from human activities, such as those coming from burning fossil fuels for electricity, heat, and transportation. A sink refers to any process, activity, or mechanism that prevents emissions or removes a GHG from the atmosphere. Managed forests, natural ecosystems, and other lands act as net sinks, sequestering and storing carbon, and serve to reduce overall emissions.

Greenhouse Gas Reduction Measure: Any policy, strategy, or action that reduces GHG emissions and/or enhances carbon sink.

MSA: Metropolitan statistical areas as defined by the U.S. Census Bureau based on the 2020 census. A list of eligible MSAs can be found in Appendix 15.2 of EPA's Climate Pollution Reduction Grant: Formula Grants for Planning, Program Guidance for States, Municipalities, and Air Control Agencies[5].

Palmetto Air Quality Collaborative (PAQC): A four-year planning initiative (July 2023 to June 2027) to develop greenhouse gas inventories, as well as innovative strategies to reduce greenhouse gases (GHG) and air pollution, for South Carolina. The PAQC is co-led by the SC Office of Resilience (SCOR) and SC Department of Health and Environmental Control (DHEC)[6] and prioritizes interagency coordination and community engagement. Funding comes from the U.S. Environmental Protection Agency (EPA) Climate Pollution Reduction Grant (CPRG) program.

Priority Climate Action Plan (PCAP): A narrative report that includes a GHG emissions inventory and a list of near-term, high-priority, and implementation-ready measures to reduce GHG pollution. This document, the ***South Carolina Priority Climate Action Plan***, is the first deliverable required by the CPRG program.

[5] EPA, Climate Pollution Reduction Grants Program: Formula Grants for Planning, Program Guidance for States, Municipalities, and Air Pollution Control Agencies, https://www.epa.gov/system/files/documents/2023-02/EPA%20CPRG%20Planning%20Grants%20Program%20Guidance%20for%20States-Municipalities-Air%20Agencies%2003-01-2023.pdf.

[6] Pursuant to Act 60 (2023), the South Carolina Department of Environmental Services (SCDES) will be created on July 1, 2024, which will restructure and transfer the programs, services, duties and authority of DHEC Environmental Affairs. As of July 1, 2024, SCDES and its divisions will participate in the PAQC with technical assistance, coordination, reporting and community and stakeholder engagement strategies.

Executive Summary

The Palmetto Air Quality Collaborative (PAQC) is a four-year planning initiative co-led by the South Carolina Department of Health and Environmental Control (DHEC) and the South Carolina Office of Resilience (SCOR). The EPA-funded initiative runs from July 2023 to June 2027. The PAQC prioritizes interagency coordination and community engagement. Additional key partners include the South Carolina Energy Office and South Carolina Ports Authority.

The PAQC is funded by the EPA Climate Pollution Reduction Grant (CPRG) program. Phase I Planning Grants support states, local governments, tribes, and territories to conduct climate planning. The State of South Carolina, the Catawba Nation, and the Charleston-North Charleston, Columbia, Greenville-Anderson, and Charlotte-Concord-Gastonia metropolitan areas qualified for and opted to receive the planning grants.

This document, the Priority Climate Action Plan (PCAP), is the first deliverable required by the CPRG program. The PCAP includes a greenhouse gas inventory, identifies near-term and implementation-ready measures to reduce GHG pollution, and assesses the multiple economic, environmental, and community benefits that can be achieved by reducing greenhouse gas (GHG) emissions.

Over 100 individuals participated in the PAQC "Action Teams." These groups assisted DHEC and SCOR in developing the PCAP and identifying and recommending measures to reduce GHG emissions in the state. Individuals represented state, regional, and local government agencies; utilities; industry, business, and private sector entities; non-profit organizations and community groups; and universities.

The South Carolina PCAP is intended to help decision makers and communities understand the state's GHG emissions and identify strategic and collaborative measures that can be taken to reduce emissions and enhance sinks. These measures will include actions that can be taken by all levels of government, the private sector, communities, other stakeholder groups, and private citizens. The PCAP identifies priority greenhouse gas reduction measures that can be implemented in the near term and have significant impact. Priority GHG reduction measures recommended in the PCAP are voluntary and build on existing activities occurring in the state.

Greenhouse gases are found in the atmosphere and are exceptionally good at trapping heat. Gases included in this inventory are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFC), perfluorocarbons (PFC), and sulfur hexafluoride (SF_6). Decision makers and planners use inventories to identify the primary sources of GHG emissions and which land uses, and land use types serve as sinks.

SCOR and DHEC used the EPA State Inventory Tool (SIT) to develop the South Carolina GHG inventory. The SIT consists of interactive spreadsheets and state-level default data obtained from federal and state agencies, trade and industry associations, and research and academic institutions. Emissions are measured by the weight of the gas emitted in million metric tons carbon dioxide equivalent (MMT CO_2e). One million metric ton is equal to 2.205 billion lbs.

As South Carolina does not have a designated agency or entity that collects GHG emissions data, the SIT provides a starting point to understand the relative contributions of different activities to the state's net GHG emissions. This initial inventory will help SCOR and DHEC identify data gaps and potential opportunities to improve future inventories.

In 2020, South Carolina's total gross GHG emissions were an estimated 73.746 $MMTCO_2e$. The major sources were transportation and electric power generation. Total net emissions are calculated by subtracting sinks from total gross emissions. In 2020, South Carolina's total net emissions were 50.179 $MMTCO_2e$.

South Carolina's natural resources are an important asset to our state. Our managed forests, natural ecosystems, and other lands act as "sinks", meaning they store carbon. Land conservation is thus an important tool for reducing our overall emissions.

The PCAP identifies and describes voluntary and broad-based measures that can act to reduce net GHG emissions and deliver other co-benefits. When selecting priority GHG reduction measures, the benefits and impacts to low income and disproportionately burdened communities were specifically considered. Selected strategies include the following.

1. Land Conservation and Restoration: The goal of this measure is to increase or protect carbon sinks throughout the region. Efforts will build on existing conservation activities by SCOR and other conservation agencies and organizations.

2. Climate Smart Agriculture and Forestry: This measure will expand the Climate Smart Commodities program, which is conducted by Clemson University and South Carolina State University and currently funded through a US Department of Agriculture grant. The goal is to expand the program to increase carbon sinks while benefiting low-income farming and forestry communities.

3. Residential Weatherization and Energy Efficiency: This proposed measure will focus on providing critical home repair, building envelope retrofits, energy efficiency upgrades, and the potential for installation of solar or other renewables. This will be a statewide application where homeowners apply directly to the program.

4. Organics Recovery and Food Waste: DHEC would run the proposed program and focus on developing a hub-and-spoke composting system throughout the state. It will double composting facilities (from 3 to 6) and then incorporate hauling of organic food waste from more rural areas into those sites.

5. State Agency Recycling Program: This proposed program will also be managed by DHEC and looks to increase recycling throughout the state by supplying recycling pickup and collection receptacles to state agencies.

6. Alternative and Multi-Modal Transportation: A proposed grant program to help local governments conduct and complete projects will reduce passenger vehicle trips. Projects that could be eligible for this grant include bicycle lanes, pedestrian walkways or sidewalks, greenspace development and walking path initiatives, public transit, or other projects related to alternative modes of transportation.

7. Vehicle Transitions: A number of proposed programs are intending to address vehicle transitions away from fossil fuels and promoting the electrification and alternative fuels economy. Proposed programs include:

a. Public Vehicle Fleets: A proposed grant or rebate program to assist state, local, and municipal government agencies would transition their fleets to EV, hybrid, or biogas. Grant applications for this program should include significant greenhouse gas reductions as well as large community benefits, such as improved air quality. Emphasis would be given to applications that are benefiting low-income and disproportionately burdened communities. Other public entities such as K-12 education or universities may be eligible to apply as well.

b. Sustainable Supply Chain Diesel Engine Transition: This grant program would allow industrial/logistics businesses to apply for a grant, rebate, or partial funding to transition their diesel engines to alternative fuels.

c. Locomotive Electrification: Palmetto Railways in conjunction with SC Ports Authority has electrified 2 switcher trains utilizing other federal funding, which also included a charging station. This grant would allow them to electrify 2 more switcher trains and would significantly improve air quality for nearby low-income communities.

8. Industrial-Scale Energy Use and Efficiency: This proposed grant program would allow industry and other institutions to apply for funding to replace industry-scale fossil-fuel equipment (e.g., steam boilers) with new technologies such as hydrogen fuel cells. It also could support energy efficiency upgrades in commercial buildings and industrial sites and provide rebates or grants to install variable frequency load drives.

1 Introduction

The Palmetto Air Quality Collaborative (PAQC) is a four-year planning initiative (July 2023 to June 2027) to develop innovative strategies to reduce greenhouse gases (GHG) and air pollution in South Carolina. This initiative intends to lay the groundwork for lowering air emissions, engaging communities, and supporting workforce and economic development opportunities. The PAQC is co-led by the SC Office of Resilience (SCOR) and the SC Department of Health and Environmental Control (DHEC) and is funded through the U.S. Environmental Protection Agency (EPA) Climate Pollution Reduction Grant (CPRG) program. This document, the ***South Carolina Priority Climate Action Plan***, is the first deliverable required by the CPRG program.

1.1 EPA Climate Pollution Reduction Grant Program

On August 16, 2022, the Inflation Reduction Act (IRA) was signed into law and established funding for greenhouse gas reduction planning and implementation efforts. The IRA authorized the EPA to establish the CPRG program.[7] States, the most populous metropolitan statistical areas (MSAs), tribes, and U.S. territories were eligible to receive CPRG funding to develop strategies for reducing GHG emissions and other harmful co-pollutants. Phase I of the CPRG program provided participating states with $3 million and MSAs with $1 million to develop GHG inventories and set priorities for reducing GHGs and achieving related community benefits. Phase II of the CPRG program will provide approximately $4.3 billion nationwide in competitive Implementation Grants.

South Carolina is one of 45 states in the country that accepted and received funds from the CPRG program.[8] Four MSAs in, or encompassing areas within, South Carolina also accepted and received CPRG funding: Charleston-North Charleston[9], Columbia, Greenville-Anderson, and Charlotte-Concord-Gastonia. The Berkeley-Charleston-Dorchester Council of Governments (COG), Central Midlands COG, Appalachian COG, and Centralina Regional Council (NC) are the lead organizations for each of the respective MSA efforts (Figure 1). The Catawba Regional COG (SC) represents the South Carolina counties located in the Charlotte MSA region. In addition, the Catawba Nation, South Carolina's only Federally Recognized Tribal Government, is a Tribal Grantee.

[7] EPA, Climate Pollution Reduction Grants, https://www.epa.gov/inflation-reduction-act/climate-pollution-reduction-grants

[8] See Appendix A for the Notice of Intent to Participate from Governor McMaster.

[9] The Charleston-North Charleston MSA became eligible for funding when Wyoming dropped out of the CPRG program. The Berkeley-Charleston-Dorchester anticipates receiving funding in 2024 and then starting the Comprehensive Climate Action Plan (Section 1.1.1).

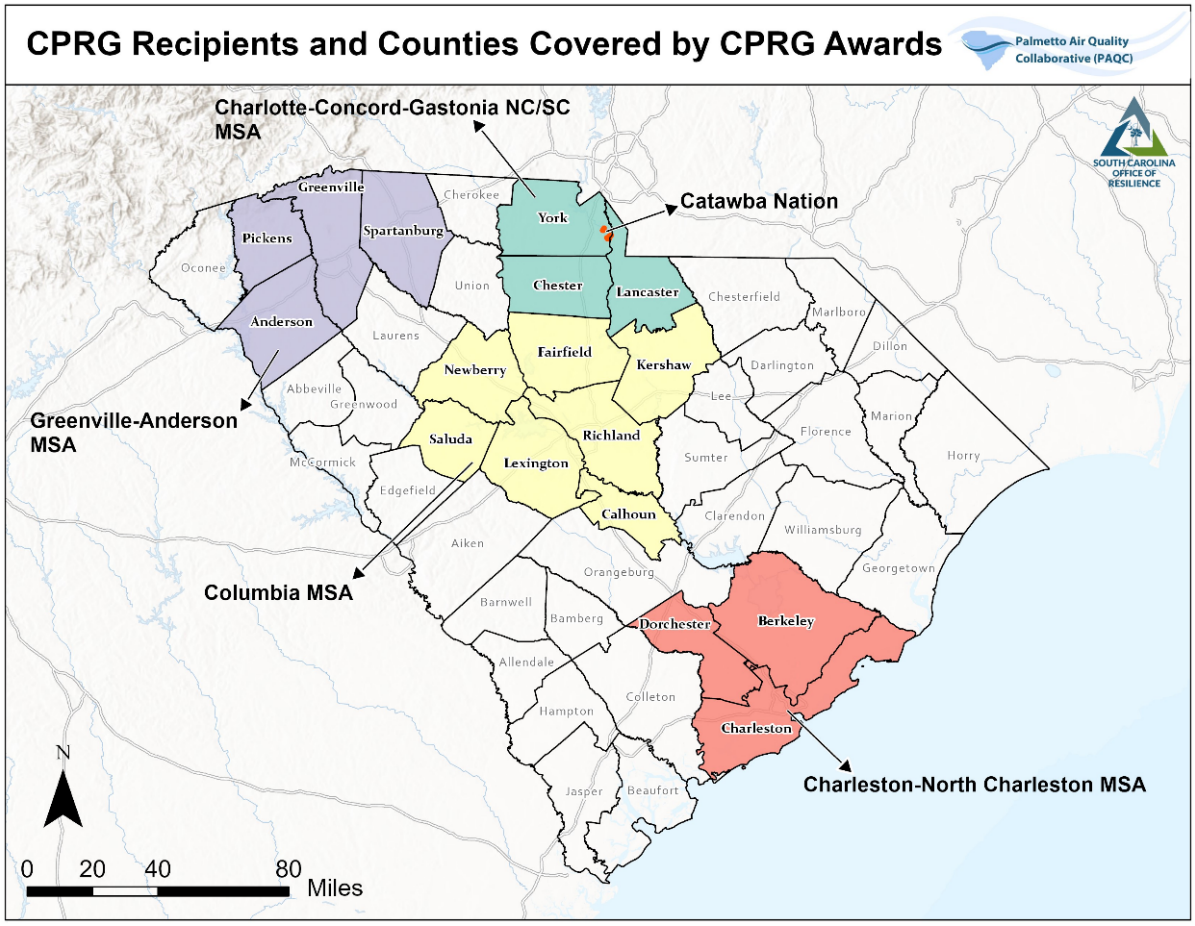


Figure 1. CPRG recipients and counties covered by CPRG awards, South Carolina

1.1.1 CPRG Phase I Requirements

During the four-year planning grant, recipients are required to submit several deliverables to the EPA. These include the Priority Climate Action Plan (due March 1, 2024), the Comprehensive Climate Action Plan (CCAP; due mid-2025), and a Status Report at the end of the grant period (mid-2027) (Figure 2).

This document comprises the Priority Climate Action Plan (PCAP) and includes the required elements: greenhouse gas (GHG) inventory; identification of near-term, priority measures to reduce greenhouse gases; assessment of benefits from reduction measures for low income and disproportionately burdened communities; and a review of agency or organization authority to implement specific measures.

The Comprehensive Climate Action Plan (CCAP) will build on the PCAP and include additional, required elements: more comprehensive assessments of GHG reduction measures and benefits, GHG emissions projections, GHG reduction targets, workforce planning analysis, and identification of funding opportunities.

The final Status Report will include information about the implementation status of GHG reduction measures included in the PCAP and CCAP, relevant updates to CCAP analyses and projections, and any next steps or future needs for funding or staffing.

The development of the PCAP, CCAP, and final Status Report also require interagency and intergovernmental coordination, as well as stakeholder and community engagement. Section Developing the Priority Climate Action Plan2, "Developing the Priority Climate Action Plan", describes the PAQC's approach to coordination and engagement for the development of the PCAP.

1.1.2 CPRG Phase II Implementation Grants

Phase II of the CPRG program entails a competitive funding process for states, municipalities[10], COGs, municipal planning organizations, tribes, and territories to implement measures identified in an applicable PCAP.

Approximately $4.3 billion will be available. EPA anticipates awarding approximately 30 to 115 grants, spread across five different funding tiers. Awards may range from $2 million to $500 million. Final selections will depend on the quality and quantity of applications and funding availability.

Implementation Grant applications are due to the EPA by April 1, 2024. Awards are expected to cover a five-year period, with an estimated start date of October 1, 2024 (Figure 2).

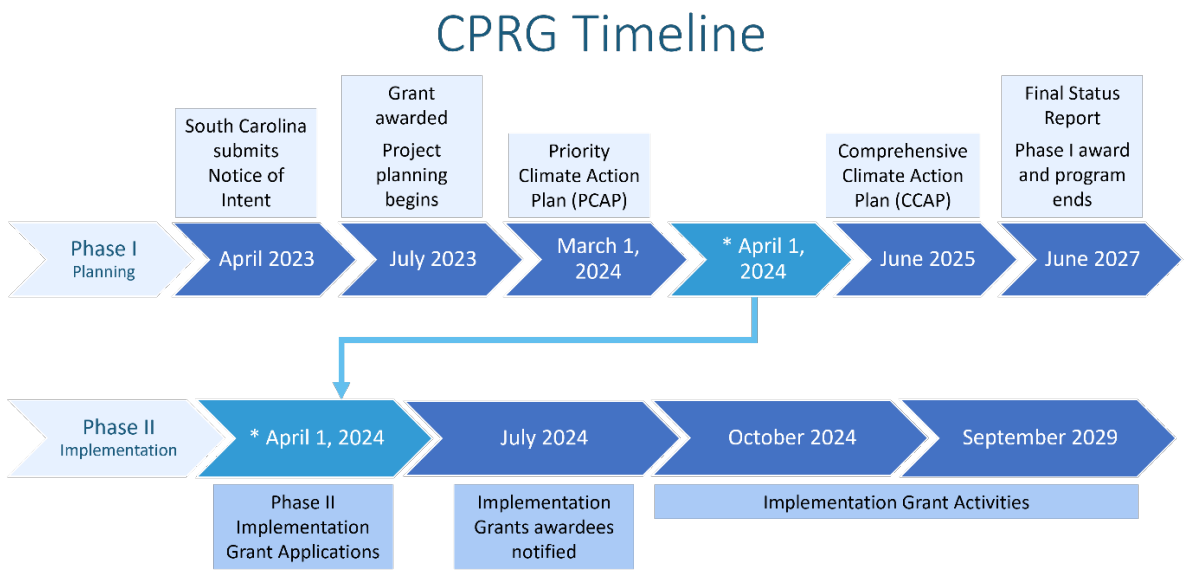


Figure 2. CPRG timeline

[10] As defined by the Clean Air Act section 302(f): "The term "municipality" means a city, town, borough, county, parish, district, or other public body created by or pursuant to State law."

1.2 The Palmetto Air Quality Collaborative

DHEC and SCOR are partnering as co-leads for the South Carolina CPRG program, and together formed the Palmetto Air Quality Collaborative (PAQC) after funding was awarded in July 2023. DHEC is the prime recipient of the grant, and SCOR is a sub-awardee. The South Carolina Ports Authority (SCPA) also received a sub-award to assess strategies and opportunities to reduce greenhouse gas emissions in its operations. The South Carolina Energy Office is also a key partner in this effort. Through the PAQC, SCOR and DHEC will complete the three EPA key deliverables and other program requirements.

The PAQC is intended to help decision makers and the communities of South Carolina understand our statewide GHG emissions and how GHG emission reductions can provide a wide range of co-benefits such as economic growth, improved public health, and enhanced community resilience. The PAQC seeks to reduce GHG emissions in South Carolina by identifying and pursuing strategic, collaborative, and voluntary actions that can be taken by all levels of government, the private sector, communities, other stakeholder groups, and private citizens. GHS reduction measures recommended in the PCAP are intended to be voluntary and incentive-based and achieve a wide range of benefits for the state.

The remainder of this section describes the various missions, interests, and roles of the lead agencies and key partners.

1.2.1 South Carolina Department of Health and Environmental Control

The mission of DHEC is to improve the quality of life for all South Carolinians by protecting and promoting the health of the public and the environment. DHEC Environmental Affairs encompasses five bureaus which have a range of regulatory and permitting authorities, as well as non-regulatory responsibilities for the environment in the state. These bureaus offer a wide range of applied science and technical expertise. They also provide education and outreach programs to local governments, schools, businesses, and the public.

Several DHEC programs participate in the PAQC. The Bureau of Air Quality's primary role in the PAQC is to provide technical assistance and review for the greenhouse gas inventories. The Bureau of Land & Waste Management leads and coordinates engagement efforts with waste management stakeholders, as well as oversees and manages South Carolina's adherence to EPA reporting requirements. DHEC's Collaborative Partnerships, Community Engagement, and Environmental Justice (EJ) teams have, over many years, built strong relationships, developed cross-cutting initiatives, and increased capacity among communities across South Carolina. Their leadership and existing relationships with communities across the state ensure meaningful engagement with a diverse group of stakeholders and the public.

Pursuant to Act 60 (2023), the South Carolina Department of Environmental Services (SCDES) will be created on July 1, 2024, which will restructure and transfer the programs, services, duties, and authority of DHEC Environmental Affairs. As of July 1, 2024, SCDES and its divisions will participate in the PAQC with technical assistance, coordination, reporting and community and stakeholder engagement strategies.

1.2.2 South Carolina Office of Resilience

SCOR was established in 2020 by the Disaster Relief and Resilience Act (S.C. Code Ann. § 48-62-10) and serves the state by coordinating post-disaster housing recovery, administering flood risk mitigation programs, implementing flood reduction projects, and leading statewide resilience planning efforts.

Overall, SCOR's mission centers on assisting low- and moderate-income households, under resourced communities, and other vulnerable groups to reduce their risks to the impacts of extreme events and build their resilience when faced with a range of burdens. SCOR does this through collaboration and coordination with sister state agencies, non-profits, foundations, and academic partners, and the communities themselves. SCOR frequently partners with other agencies to implement specific programs and projects and SCOR team members sit on many interagency committees and workgroups to provide a resilience perspective to those efforts.

SCOR developed the Strategic Statewide Resilience and Risk Reduction Plan (2023), a framework to guide state investment in programs and policies to protect South Carolina from extreme weather events. In developing the Plan, SCOR adopted this definition of resilience to guide the agency's work: "The ability of communities, economies, and ecosystems within South Carolina to anticipate, absorb, recover, and thrive when presented with environmental change and natural hazards."[11] The Plan includes a series of recommendations aimed at decreasing the vulnerabilities and adverse impacts related to environmental changes and natural hazards. Many of SCOR's activities have synergies and co-benefits with GHG reduction efforts. For example, land conservation provides an opportunity to enhance South Carolina's carbon storage capacity and mitigate flood impacts. SCOR's housing recovery program assists low-to-moderate income residents and communities by rebuilding or repairing storm-damaged homes, addressing critical safety needs and making energy efficient improvements, and providing individualized case management services to eligible households.

1.2.3 South Carolina Energy Office

The South Carolina Energy Office (Energy Office), housed within the South Carolina Office of Regulatory Staff, serves as the state's principal energy planning entity with a portfolio that encompasses energy efficiency, renewable energy, and clean transportation initiatives (S.C. Code Ann. § 48-52-410 et seq.). The Energy Office develops the State Energy Plan and provides technical assistance, financial assistance, and education and outreach to local communities and stakeholder groups. They are an important partner for engaging the public, local governments, and utilities and for identifying and implementing measures related to energy conservation and efficiency for the residential, commercial, electric generation, and transportation sectors.

1.2.4 South Carolina Ports Authority

SCPA (created by S.C. Code Ann. § 54-3-10) is an important asset for South Carolina, efficiently moving goods and connecting the state's economy to global markets with maritime terminals in the Charleston Harbor and Port of Georgetown, as well as inland ports in Dillon and Greer. SCPA promotes, develops, and facilitates waterborne commerce to meet the current and future needs of its customers and for the economic benefit of the citizens and businesses of South Carolina. SCPA fulfills this mission by delivering cost competitive facilities and services, collaborating with customers and stakeholders, and sustaining its financial self-sufficiency.

In 2021 SCPA was awarded an EPA Diesel Emissions Reduction Act grant to update their equipment, reduce diesel emissions, and monitor air quality. They are an important partner for identifying and implementing measures through studies on zero (tailpipe) emission equipment, conducting inventories

[11] South Carolina Office of Resilience, Strategic Statewide Resilience and Risk Reduction Plan, https://scor.sc.gov/resilience.

of air emissions from mobile sources, and developing and promoting incentive programs to reduce GHG emissions. SCPA is a sub-awardee on South Carolina's CPRG award; SCPA will use this sub-award for data collection and analysis to inform decision making around GHG reduction initiatives in port operations. This information will be incorporated into the CCAP.

1.3 Purpose and Organization of the South Carolina Priority Climate Action Plan

The purpose of the PCAP is to identify and recommend voluntary, incentive-based greenhouse gas reduction measures that will result in a wide variety of co-benefits for South Carolina. The scope of the PCAP is the entire state of South Carolina, including areas covered by other CPRG award recipients (i.e., the Catawba Nation and the Charleston-North Charleston, Columbia, Greenville-Anderson, and Charlotte-Concord-Gastonia MSAs). The South Carolina PCAP follows the requirements and guidance provided by EPA for CPRG recipients.[12]

The South Carolina PCAP is designed to be broad-based, identify and address diverse needs and interests, and facilitate engagement with available federal resources and opportunities. This approach will optimize community support and guide efforts across the state to reduce greenhouse gas emissions and other harmful air pollutants. Completing the South Carolina PCAP enables other state, regional, and local government agencies to apply for the CPRG Phase II Implementation Grant competition. In addition, SCOR and DHEC expect the PCAP to serve as a reference document for other agencies, communities, and organizations pursuing future funding opportunities.

Section 1 provides an overview of the CPRG program and EPA requirements and introduces the PAQC.

Section 2 of this document, "Developing the Priority Climate Action Plan," describes the PAQC approach to engagement and coordination during the PCAP phase of the grant. Due to the rapid timeline provided by EPA for CPRG recipients to develop PCAPs, SCOR and DHEC acknowledge that they were unable to engage directly with all communities and potential stakeholders. SCOR, DHEC, and the Energy Office will review and update coordination and engagement strategies after submission of the PCAP.

Section 3, "The Planning Context," provides an overview of relevant population, demographic, and climate conditions and trends to consider. This section also includes background information about greenhouse gases, discusses benefits associated with reducing GHG emissions, and describes examples of existing efforts happening in South Carolina to reduce climate and air pollution.

Section 5 provides the statewide greenhouse gas inventory for South Carolina. Because South Carolina does not have a comprehensive greenhouse gas inventory, SCOR and DHEC used the EPA State Inventory Tool (SIT) to develop an inventory.[13] The tool provides a series of interactive spreadsheets, pre-populated with default data from federal agencies and other sources covering fossil fuels, electricity consumption, agriculture, forestry, waste management, and industry. SIT provides a streamlined,

[12] EPA, Climate Pollution Reduction Grants Program: Formula Grants for Planning, Program Guidance for States, Municipalities, and Air Control Agencies, https://www.epa.gov/system/files/documents/2023-02/EPA%20CPRG%20Planning%20Grants%20Program%20Guidance%20for%20States-Municipalities-Air%20Agencies%2003-01-2023.pdf.

[13] EPA, State Inventory and Projection Tool, https://www.epa.gov/statelocalenergy/state-inventory-and-projection-tool.

standardized process for states to calculate GHG emissions, establish a baseline understanding of emission sources and amounts, and identify where to focus efforts to reduce emission with available resources.

Section 6 describes the approach to identifying priority GHG reduction measures for South Carolina. These recommendations follow EPA guidance for the PCAP, which requires that the lead organization(s) and other collaborating entities identify near-term, high-priority, implementation-ready measures that could be enacted directly by the lead organization(s) or by other governmental agencies within the state. Each priority measure should also include an assessment of the benefits of that measure for low-income and disproportionately burdened communities, discuss other co-benefits associated with that measure, and review agency authority to implement the measure.

Sections 6 through 13 detail the priority GHG reduction measures. The priority measures and goals are as follows:

- **Land Conservation and Restoration (Section 7)**: Improve South Carolina's ability to store carbon and reduce net GHG emissions through coordinated land acquisition, conservation, preservation, and restoration efforts.
- **Climate Smart Agriculture and Forestry (Section 8)**: Expand Clemson's existing Climate Smart Agriculture and Forestry pilot programs to increase carbon storage compared to current trends and provide benefits to a greater number of landowners.
- **Residential Weatherization and Energy Efficiency (Section 9)**: Expand and coordinate weatherization and energy efficiency programs for residential buildings.
- **Organics Recovery and Food Waste (Section 10)**: Reduce food waste and enhance organic recovery systems, infrastructure, and programs.
- **State Agency Recycling (Section 11)**: Establish recycling grant program to assist state agencies expand or enhance recycling infrastructure.
- **Alternative and Multi-Modal Transportation (Section 12)**: Reduce vehicle miles traveled by expanding and enhancing biking, walking, micromobility (i.e., electric-powered bikes and scooters), and public transit programs and projects.
- **Vehicle Transitions (Section 13)**: Reduce use of fossil fuel-powered vehicles by state, regional, and local government agencies, and industry.
- **Industrial-Scale Energy Use and Efficiency (Section 14)**: Adopt new technologies, processes, and/or equipment to reduce use of fossil fuel-generated energy and increase energy efficiency in industrial-scale processes.

Section 15 summarizes the benefits of estimated GHG emissions reductions and priority reduction measures for low-income and disproportionately burdened communities and presents a strategy for continuing to engage communities in South Carolina's CPRG planning process.

Section 16 summarizes the Review of Authority for each priority GHG reduction measure.

Section 17 discusses next steps for the PAQC, which includes developing the CCAP and investing additional recommended activities and GHG reduction measures identified during the process to develop the PCAP.

2 Developing the Priority Climate Action Plan

SCOR is the lead agency for drafting and producing the Priority Climate Action Plan (PCAP). SCOR staff, funded through South Carolina's CPRG award, produced the Greenhouse Gas Inventory (Section 5), compiled the priority GHG reduction measures, and developed other required PCAP elements, such as the community benefits analysis and review of authority.

SCOR and DHEC recognize that interagency and intergovernmental coordination and stakeholder engagement are essential for any successful planning process and subsequent implementation. Figure 3 illustrates the PAQC's framework for coordination and engagement. As the PAQC was established, initial efforts focused on communicating the CPRG program to key partners and obtaining feedback on the most effective mechanisms to connect with different communities and stakeholder groups.

Throughout the PCAP development phase, SCOR, DHEC, and the Energy Office participated in weekly meetings to plan and implement coordination and engagement strategies. This coordinating group then tapped existing networks and associations, to disseminate PAQC information to regional and local governments, community organizations, and other stakeholder groups. Of central focus was reaching low-income communities and groups disproportionately burdened by climate impacts through existing DHEC and Energy Office initiatives. For example, DHEC's Collaborative Partnerships, Community Engagement, and EJ staff convenes EJ Hub, a network of community leaders and stakeholders that collaborates to discuss and address timely topics. DHEC facilitates quarterly discussions, provides technical assistance, and shares resource opportunities with EJ communities. The Energy Office participates in a variety of initiatives to reduce inequitable energy burdens and enhance energy efficiency efforts in low-income communities.

This section describes the PAQC's coordination and engagement approach. A primary mechanism to obtain agency and stakeholder input on the PCAP was through Action Teams (Section 2.4).

Figure 3. PAQC coordination and engagement framework

2.1 Interagency and Intergovernmental Coordination and Collaboration

The purpose of the PAQC's interagency and intergovernmental coordination and collaboration efforts is to involve all levels of government in the planning process and ensure that the efforts undertaken through South Carolina's CPRG program connect and align with relevant activities occurring in the state.

For example, many state agencies currently receive, expect to receive, or are applying for grants and funds available through the federal Bipartisan Infrastructure Law and Inflation Reduction Act (Section 6.2). Many of these funding opportunities have GHG reduction goals and support priorities with potential to reduce greenhouse gases, such as energy efficiency measures, clean energy technology development, and electric vehicle infrastructure deployment. Interagency coordination can help to maximize funding opportunities, reduce duplication of efforts, and optimize benefits for South Carolina.

On the regional and local levels, government agencies are typically involved in land use planning and development decisions, transportation planning, air quality monitoring, water and wastewater management, zoning decisions and enforcement, and workforce development. These activities can have a role in managing and reducing greenhouse gas emissions. As COGs serve as a coordinating body for local governments within their regions, they can serve as a liaison between the statewide CPRG effort and local communities, encourage local government feedback on GHG reduction measures identified in the PCAP and CCAP, and help build awareness and support for the PAQC planning processes.

Interagency and intergovernmental coordination measures taken by the PAQC included:

- PAQC kickoff meeting on October 23, 2023, for state agencies, COGs, Municipal Association of South Carolina, and South Carolina Association of Counties
- Coordinating calls with the Appalachian, Berkeley-Charleston-Dorchester, Central Midlands, and Catawba Regional COGs to discuss other CPRG efforts in South Carolina
- Ongoing communications through a monthly newsletter, starting November 2023
- Invitations to participate in Action Teams (Section 2.4)

2.2 Stakeholder and Community Engagement

SCOR, DHEC, and the Energy Office use a variety of tools to publicize the PAQC and ensure that stakeholders have access to the program, information about the process, and means to provide input and feedback:

- The PAQC website (https://scor.sc.gov/paqc) provides other agencies, stakeholders, and the public with information and other resources pertinent to South Carolina's CPRG program and development of the PCAP.
- SCOR maintains a PAQC listserv and communicates progress and upcoming opportunities through a monthly newsletter.
- SCOR participated in and presented at several events to publicize the PAQC and learn of relevant efforts and networks occurring within the state. Examples include events sponsored by the South Department of Commerce (meetings of Allied Partners, SC NEXUS), Sustain SC, South Carolina Energy Justice Coalition, South Carolina Electric Transportation Network, Southeast Sustainability Directors Network, the City of Columbia Climate Protection Action Campaign, and the Upper Savannah COG.
- SCOR conducted two "Open House" webinars on January 30 and January 31, 2024. These webinars were open to the public and offered at evening and lunch time hours to reach audiences who may not be able to attend events scheduled for regular work hours. The webinars introduced the PAQC and PCAP to over 55 attendees and provided time for questions and discussion.
- SCOR developed an online survey to collect input from government agencies and stakeholders about emissions reduction priorities, current actions, and concerns. Specific reduction measure projects or ideas submitted through the survey were considered for inclusion in the PCAP and in the list of recommended and priority GHG reduction measures. The survey link is posted on the PAQC website and, beginning on November 27, 2023, was disseminated to the PAQC listserv, Action Teams, and other networks. As of February 28, 2024, PAQC had received survey responses from 154 individuals. Respondents represented 32 different counties and primarily local government and non-profit organizations. The survey will be open and accessible throughout South Carolina's CPRG planning effort.

2.3 Environmental Justice (EJ) Hub Engagement

DHEC's Environmental Justice Hub serves as an opportunity for Environmental Justice community leaders, the industry sector, academia, and other partners to network and collaborate on community revitalization and EJ efforts.

DHEC conducted an Environmental Justice (EJ) Hub hybrid meeting on February 1, 2024, to initiate discussions with that network about the PAQC and the CPRG planning process and requirements. The meeting was well attended with 32 attendees representing various communities and groups from across the state. Attendees had a robust dialogue regarding strategies to engage with and involve EJ and low-income communities in South Carolina's CPRG Phase I planning grant and in the Phase II Implementation Grant process. This discussion will inform the PAQC's ongoing efforts to engage EJ Hub stakeholders and communities throughout the climate planning process.

2.4 Action Teams

SCOR and DHEC formed Action Teams to be the primary mechanism to involve experts and other engaged stakeholders in the PAQC's efforts. Action Team members represent a range of organizations, including state, regional, and local government agencies; utilities; industry, business, and private sector entities; non-profit organizations and community groups; universities; and associations representing specific trades or interests (for example, manufacturing, electric transportation).

To develop the PCAP, Action Teams were asked to commit to three to four virtual meetings as SCOR and DHEC developed the PCAP and a statewide Implementation Grant application. Action Teams are organized by specific topics relevant to the development of the PCAP and assist SCOR and DHEC with identifying, assessing, and recommending GHG reduction measures (Table 1). As of December 29, 2023, 113 individuals, representing over 50 different organizations, had joined at least one Action Team. Appendix B. shows the list of participating organizations.

Table 1. PAQC action teams, topic areas, and greenhouse gas reduction measures considered

Action Team and Key Topic Area	GHG Reduction Measures Considered
Transportation: GHG emissions primarily come from burning fossil fuel for cars, trucks, ships, trains, and planes, as well as non-mobile equipment.	• Electric vehicle (EV) incentives, EV infrastructure (charging stations), vehicle fleet conversion • Reducing the carbon intensity of fuels used for ports, trucking, rail, airports, and non-mobile equipment • Reducing vehicle miles traveled • Multi-modal transportation
Industry: GHG emissions primarily come from burning fossil fuels for energy, as well as greenhouse gas emissions from certain chemical reactions necessary to produce goods from raw materials.	• Energy and material efficiency • Adoption of low/no carbon fuels, renewable energy, and electrification at facilities • Programs to develop, expand, and support markets for low carbon materials and sustainable products • Development of clean industry hubs • Carbon monitoring and management
Residential & Commercial Buildings: GHG emissions primarily come from fossil fuels burned for heating, air conditioning, lighting, and appliances and from gases used for refrigeration and cooling.	• Programs to increase energy efficiency and reduce energy demand • Weatherization and energy efficiency retrofits • Incentives for deploying efficient electric technologies in new buildings, adopting up-to-date energy codes, and adopting standards to enhance building performance
Waste & Materials Management: The production, packaging, transport, and disposal of goods significantly impacts GHG emissions. Landfill food waste is a significant source of methane, a powerful GHG.	• Recycling and reducing waste • Preventing food waste • Adopting local composting programs • Reducing water consumption
Agriculture, Forestry, & Land Use: GHG emissions from agriculture come from crop and livestock production. Managed forests and other lands can act as a net sink and reduce overall emissions.	• Adjusting methods for managing lands, applying fertilizer, growing crops, and improving soil health • Feeding and manure management practices • Increasing on-farm renewable energy and efficiency • Expanding use of biomass for energy • Adoption of sustainable forest management practices • Purchasing land to conserve natural environments • Implementing urban tree planting initiatives • Restoring wetlands and other ecosystems
Greenhouse Gas Inventory	• GHG Inventory Team assists with identifying and addressing data gaps, as well as opportunities to improve the measurement and monitoring of both emission sources and sinks

3 The Planning Context

To understand the need for climate planning, identification of GHG reduction measures, and program implementation, this section provides an overview of greenhouse gases, the benefits of reducing emissions, and strategies that will be most effective in South Carolina.

3.1 Greenhouse Gases and the Greenhouse Effect

This section describes the greenhouse gases found within the South Carolina statewide greenhouse gas emissions inventory (Section 5).[14]

3.1.1 What are Greenhouse Gases?

Greenhouse gases are found in the atmosphere and are exceptionally good at absorbing heat. These gases include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFC), perfluorocarbons (PFC), and sulfur hexafluoride (SF_6) (see Table 2, below).

GHGs are natural and important for life on Earth. Without them, Earth would be uninhabitable with global temperatures about 60°F colder than they are today. However, when greenhouse gases in the atmosphere accumulate at very high levels, more heat is trapped in Earth's atmosphere system by the Greenhouse Effect.[15]

3.1.2 What is the Greenhouse Effect?

The accumulation and fluctuations of greenhouse gases in the atmosphere, and their impact on the flux of solar radiation and heat on Earth, is referred to as the Greenhouse Effect. The sun sends solar energy in the form of shortwave radiation into the Earth-atmosphere system. The solar energy is either reflected to space by clouds and Earth's surface (about 30%), absorbed by the atmosphere (about 20%), or absorbed by Earth (about 50%). The energy absorbed by Earth warms Earth's surface, which then re-emits the energy towards space in the form of longwave, or infrared, radiation. Greenhouse gases in the atmosphere are very good at absorbing this longwave radiation, trapping the energy in the Earth-atmosphere system as heat. Similar to how a greenhouse lets light pass in through the glass but traps the heat inside, the gases in the atmosphere trap heat near Earth's surface. This is called the Greenhouse Effect. When atmospheric greenhouse gases increase, more heat is trapped in Earth's atmosphere system by the Greenhouse Effect, and global temperatures rise (Figure 4).

[14] SCOR used the EPA State Inventory Tool to develop the GHG inventory. This tool is based on national and international standards utilized by the EPA. The summary information provided here is available in more detail on the EPA's Overview of Greenhouse Gases webpage and in the Intergovernmental Panel on Climate Change (IPCC) Assessment Report 6 (AR6). The following websites provide more information: US EPA, State Inventory and Projection Tool, https://www.epa.gov/statelocalenergy/state-inventory-and-projection-tool; US EPA, Overview of Greenhouse Gases, https://www.epa.gov/ghgemissions/overview-greenhouse-gases; IPCC, AR6 Synthesis Report: Climate Change 2023, https://www.ipcc.ch/report/sixth-assessment-report-cycle/.

[15] EPA, The Greenhouse Effect, https://www.epa.gov/climatechange-science/basics-climate-change#greenhouse

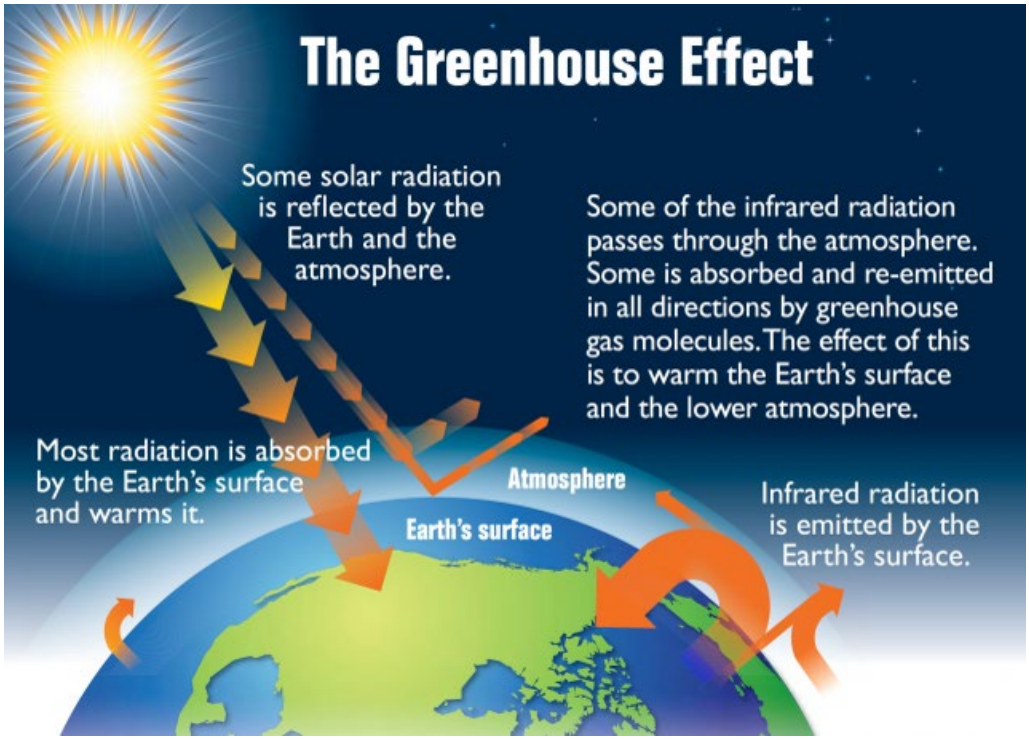


Figure 4. The greenhouse effect[16]

3.1.3 How do Humans Affect Greenhouse Gases?

The slow carbon cycle is a process that describes the movement of carbon from reservoir to reservoir on a millennial timescale. One of the reservoirs of carbon, where it may sit for hundreds of thousands up to millions of years, is deep within Earth's surface. When humans drill into these reservoirs and extract that carbon in the form of coal, oil, and natural gas, combust (or burn) the fuel, and then emit the fumes, they directly transfer stores of carbon into the atmosphere that would otherwise not be there. This alteration of the slow carbon cycle has led to an overall flux of carbon into the atmosphere. The increase of atmospheric carbon has since trapped increasing amounts of infrared heat into Earth's atmosphere system and has led to rising global temperatures at an unprecedented rate.

The primary source of greenhouse gases from human activities is the burning of fossil fuels. Fossil fuel combustion is used for generating electric power and for transportation. Electric power is used in industry and for heating and cooling commercial and residential buildings. Other sources of greenhouse gas emissions from human activities come from agriculture, waste, and land-use change (Table 2). These sources are represented in the South Carolina GHG emissions inventory (Section 5).

[16]Image source: U.S. Environmental Protection Agency, Basics of Climate Change, https://www.epa.gov/climatechange-science/basics-climate-change

Table 2. Greenhouse gases, chemical formula abbreviations, and common sources

Greenhouse Gas	Chemical Formula	Common Sources
Carbon dioxide	CO_2	Combustion through burning fossil fuels Land cover change
Methane	CH_4	Combustion through burning fossil fuels Agriculture (livestock, rice cultivation) Waste and landfill decomposition
Nitrous oxide	N_2O	Combustion through burning fossil fuels
Sulfur hexafluoride	SF_6	Electrical insulation
Hydrofluorocarbons	HFC	Refrigerants
Perfluorocarbons	PFC	Aluminum production and other industrial processes

3.1.4 For How Long Do GHGs Impact the Atmosphere?

Each gas remains in the atmosphere for different lengths of time, ranging from a few years (HFCs, about 5 years) to thousands of years (PFCs, about 50,000 years). Each gas also has its own level of efficiency at absorbing energy, or heat. A gas' lifetime and efficiency is used to calculate the effects of emitting 1 ton of each greenhouse gas. This is called their Global Warming Potential (GWP; Table 3).

Internationally accepted calculations based on GWPs are used to convert each gas to a standard unit. CO_2 remains in the atmosphere for thousands of years and has a GWP of 1 because it is used as a reference for the other GHGs. The other GHG global warming potentials measure how much heat or energy that gas will absorb compared to CO_2 over that same time period (100 years is most frequently used and is shown in Table 3). GWPs provide a standard measurement that allows decisionmakers and planners to compare reduction measures across sectors and gases.[17]

[17] EPA, Understanding Global Warming Potentials, https://www.epa.gov/ghgemissions/understanding-global-warming-potentials.

Table 3. 100-year global warming potentials by greenhouse gas
GWPs are a quantitative representation of the effects of a particular gas over a 100-year period after emitted. Data sources: EPA 18, IPCC AR6 Table 7.15 19

Greenhouse Gas	Global Warming Potential (GWP)
Carbon dioxide (CO_2)	1
Methane (CH_4)	27-29.8
Nitrous oxide (N_2O)	273
Sulfur hexafluoride (SF_6)	25,200
Hydrofluorocarbons (HFC)	771 - 1,526
Perfluorocarbons (PFC)	7,380

[18] EPA, Climate Change Indicators: Greenhouse Gases, https://www.epa.gov/climate-indicators/greenhouse-gases.
[19] IPCC AR6, Table 7.15 (pg. 1017), https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_FullReport_small.pdf.

3.2 South Carolina's Climate Trends and Impacts

Climate describes what the weather is like over a long period of time in a specific area. Climate includes averages of temperature, precipitation, humidity, sunshine, wind, and other measures over a thirty-year (or longer) period, and how those averages may be changing over time.[20] The increasing levels of greenhouse gases in the atmosphere have widespread impacts around the globe and in South Carolina as the climate of the Southeastern U.S. changes. These changes can alter rainfall, influence crop yields, change ecosystems and natural lands, and impact public health and the economy.[21]

3.2.1 Climate Trends[22]

In South Carolina, the average annual temperature has increased by approximately 1°F since 1895. While lower than the average global increase of approximately 2°F, South Carolina's statewide temperature increases over the past 60 years match or exceed global increases, and the past 30 years have been warmer than any other consecutive 30-year period. Most long-term, individual weather stations in the state show significant increases in a) maximum temperatures in winter, spring, and summer, and b) minimum temperatures in summer. Climate models project temperature increases of 5°F to 10°F by the year 2100, depending on future greenhouse gas emissions.

Historically, South Carolina's precipitation is quite variable. However, the state is seeing decreasing trends in summer precipitation and an increase in the number of precipitation days in the fall, and more extremes are expected in the future. Increasing temperatures can lead to higher evaporation rates and atmospheric moisture, while also contributing to more intense periods of drought.

South Carolina's location makes it vulnerable to tropical storms and hurricanes. While there is uncertainty about the number of future storms, those storms that do occur are expected to have greater intensity of wind and precipitation. Sea surface temperatures are also rising; high ocean temperature can increase the intensity of tropical systems. Precipitation amounts received during the extreme rainfall and flooding event of 2015, Hurricane Matthew (2016), and Hurricane Florence (2018), are consistent with expectations of a warming climate.

The South Carolina coast is also experiencing sea level rise. Sea levels have risen by approximately 1 foot during the past 100 years, with accelerated increases evident since 2000. Sea levels are expected to rise approximately another 1 foot by 2050. Sea level rise and extreme events exacerbate coastal flooding.

3.2.2 Climate Impacts

South Carolina is accustomed to climate variability (hot and cold temperatures, droughts, and heavy rainfall events) and natural hazards such as thunderstorms, hurricanes, and flooding. However, as the climate trends described above continue, it is likely that all sectors, groups, and regions of the state will

[20] National Oceanic and Atmospheric Administration (NOAA), National Centers for Environmental information, What's the Difference Between Weather and Climate? https://www.ncei.noaa.gov/news/weather-vs-climate

[21] For more information about climate trends in South Carolina, see Chapter 4 (Climate Trends) of South Carolina's Strategic Statewide Resilience and Risk Reduction Plan, available at https://scor.sc.gov/sites/scor/files/Documents/Chapter%204%20Climate%20Trends.pdf. For the most up-to-date assessment of climate risks and impacts for the Southeast U.S., please see Chapter 22 of the Fifth National Climate Assessment (2023), available at https://nca2023.globalchange.gov/chapter/22/.

[22] South Carolina Office of Resilience, South Carolina Strategic Statewide Resilience and Risk Reduction Plan, Chapter 4 (Climate Trends), https://scor.sc.gov/sites/scor/files/Documents/Chapter%204%20Climate%20Trends.pdf.

be affected in some way by changing conditions and extreme events. Already vulnerable communities and groups are more likely to experience disproportionate effects (Section 3.3). Studies indicate that the elderly, chronically ill individuals, households with lower incomes, and small and rural communities are particularly vulnerable and have less capacity and fewer resources to address climate impacts.[23]

Examples of current and expected impacts include the following:

- Increases in smog, wildfire emissions, and particulate matter
- Increases in pollen concentrations, earlier and longer pollen seasons
- Increased energy demand and higher energy costs for cooling
- Higher temperatures exacerbated in areas with urban heat islands
- Reduced crop production due to extreme temperature, precipitation, and storm events
- Increased threats to agriculture, forestry, and natural ecosystems from invasive species, weeds, and pests
- Disruption to economic systems and transportation during extreme events
- Decreased worker productivity during periods of extreme heat and high temperatures
- Increases in coastal flooding triggered by extreme events and sea level rise result in fatalities, business and quality of life disruptions, economic losses, and property damage

[23] Hoffman, J.S., S.G. McNulty, C. Brown, K.D. Dello, P.N. Knox, A. Lascurain, C. Mickalonis, G.T. Mitchum, L. Rivers III, M. Schaefer, G.P. Smith, J.S. Camp, and K.M. Wood, 2023: Ch. 22. Southeast. In: Fifth National Climate Assessment. Crimmins, A.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, B.C. Stewart, and T.K. Maycock, Eds. U.S. Global Change Research Program, Washington, DC, USA. https://doi.org/10.7930/NCA5.2023.CH22.

3.3 Low Income and Disproportionately Burdened Communities

EPA strongly recommends that CPRG grantees use the Climate and Environmental Justice Screening Tool (CEJST) to identify communities with a high percentage of residents that have limited access to resources and who experience disproportionate environmental and socioeconomic burdens.[24] CPRG investments and activities should be consistent with the Justice40 initiative, where the federal government made a goal that 40% of overall benefits of certain federal investments flow to communities that are underserved and overburdened by pollution.[25]

South Carolina census tracts that have low incomes and experience one or more burdens are represented in Figure 5. Appendix C lists South Carolina's disproportionately burdened communities according to Census Block ID number. Burdens relate to a number of factors including poor air quality and high exposure rates to diesel particulate matter; energy costs and housing costs as a percentage of annual income; low life expectancy; chronic health conditions such as asthma, diabetes, and heart disease; lack of green space; underinvestment and unemployment; proximity to high traffic areas; lack of access to public transit; and proximity to polluted sites and hazardous waste facilities. The climate trends and impacts described in Section 3.2 are expected to exacerbate these burdens and further reduce these communities' capacity to anticipate, absorb, recover, and thrive in the face of changing conditions and extreme events.

EPA requires that both the PCAP and CCAP include assessments of the benefits of GHG reduction measures for low income and disproportionately burdened communities. One important criterion for prioritizing GHG reduction measures for implementation will be the expected community benefits, such as those associated with reducing other air pollutants, reducing energy costs, reducing flood and wildfire risks, providing workforce and new transportation opportunities, and improving housing and greenspace (see Section 5). Sections 6 through 13 narratively describe the expected community benefits for each priority GHG reduction measure, and Section 14 summarizes those expected benefits. As the PAQC moves from the PCAP to CCAP phase of the planning grant, SCOR, DHEC, the Energy Office and other partners will build and evolve a plan to ensure meaningful engagement so that community needs, challenges, and priorities are incorporated throughout the CPRG planning process and in the implementation of specific GHG reduction measures.

[24] Council on Environmental Quality, Climate and Economic Justice Screening Tool (CEJST), https://screeningtool.geoplatform.gov/en/
[25] Information and FAQs about the Justice40 initiative are available through The White House website, https://www.whitehouse.gov/environmentaljustice/justice40/

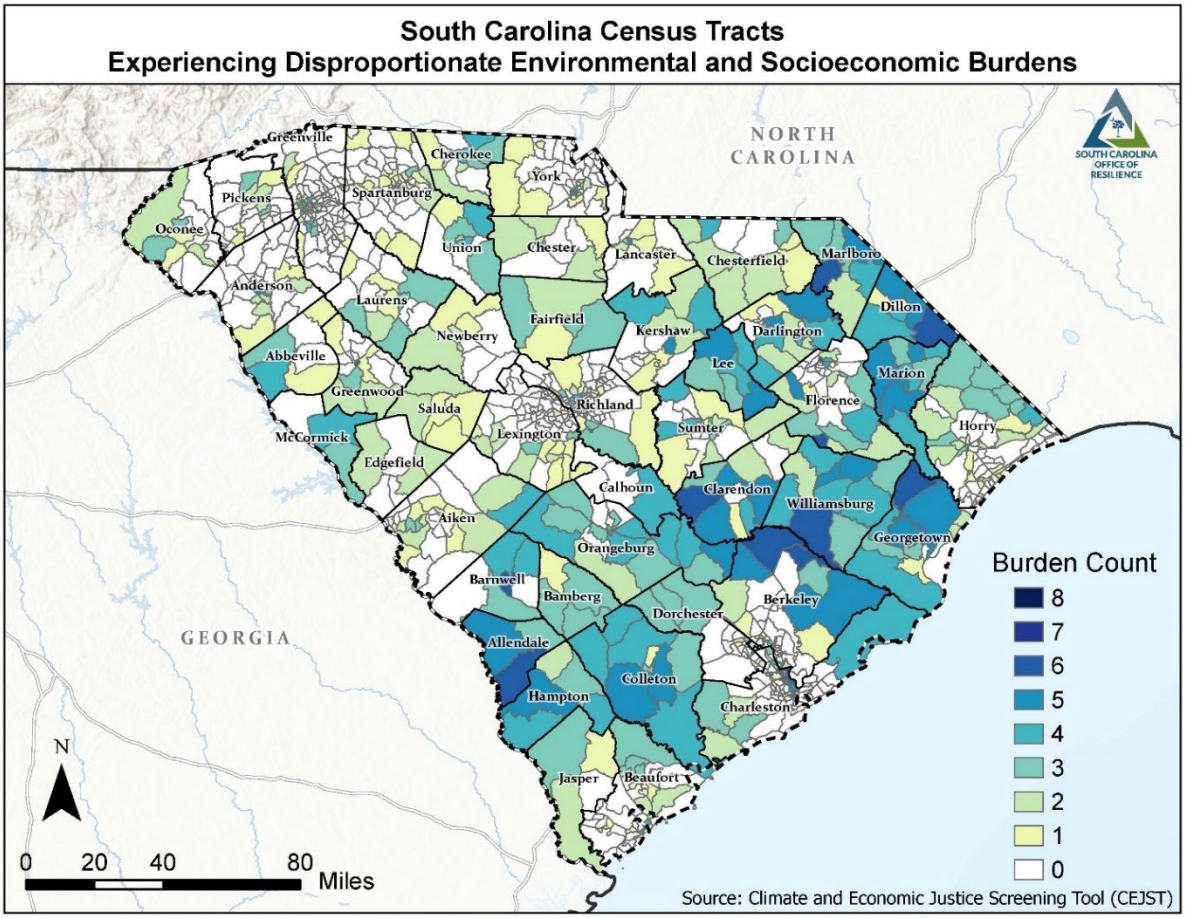


Figure 5. South Carolina census tracts experiencing disproportionate burdens

3.4 Population Trends

As of July 1, 2023, the U.S. Census Bureau estimated South Carolina's population to be 5.37 million, a 5% increase from April 1, 2020 (5.12 million).[26] South Carolina is one of the fastest growing states in the country, in terms of its percentage growth from year to year.

While the overall statewide trend indicates continued growth into the next decade, county-level changes vary considerably (Figure 6). In general, counties with or near larger urban areas (Charleston, Columbia, Greenville, Myrtle Beach, and Rock Hill) are experiencing dramatic population increases, while those in more rural areas are experiencing declines (Figure 7). These complex regional trends have implications for GHG emissions and a wide variety of options for reducing GHG emissions. For example, growing areas will continue to see increasing emissions due to growing energy demand, vehicle traffic, waste, wastewater treatment needs, and land conversion (from agricultural or natural lands to developed areas). Meanwhile, when rural counties lose populations, they also lose their tax base. Already under-resourced areas may have even less capacity to make critical investments needed to enhance community resilience, improve infrastructure, and reduce climate impacts.

[26] U.S. Census Bureau, Quick Facts, https://www.census.gov/quickfacts/fact/table/SC/PST040222#PST040222

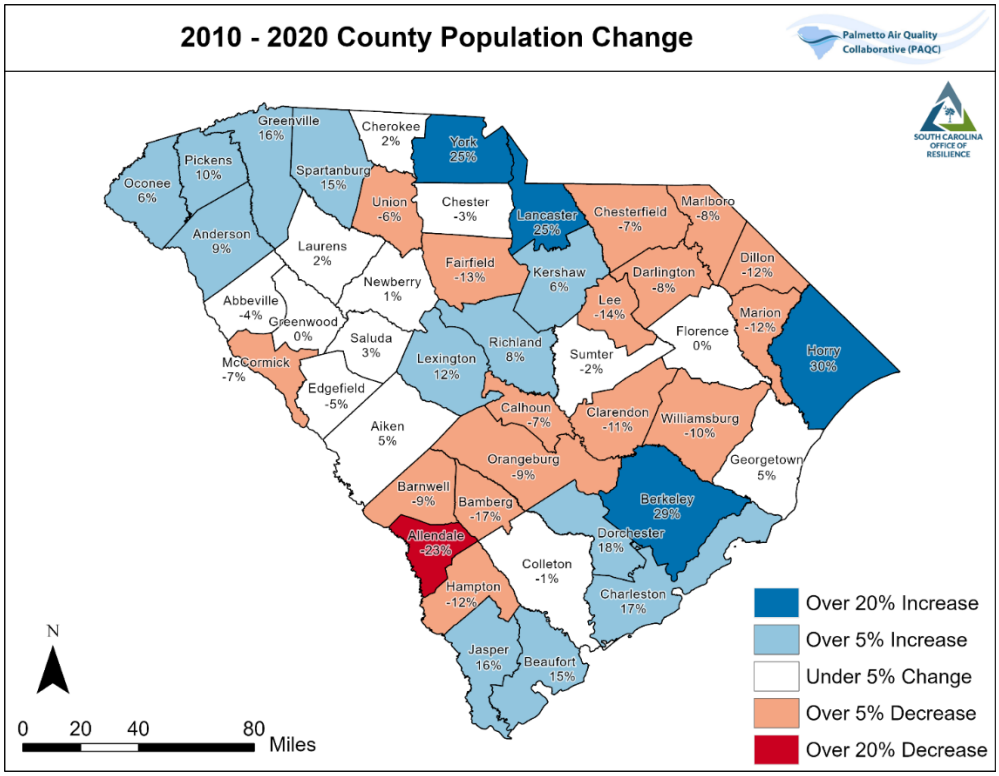


Figure 6. Population change in South Carolina by county, 2010-2020

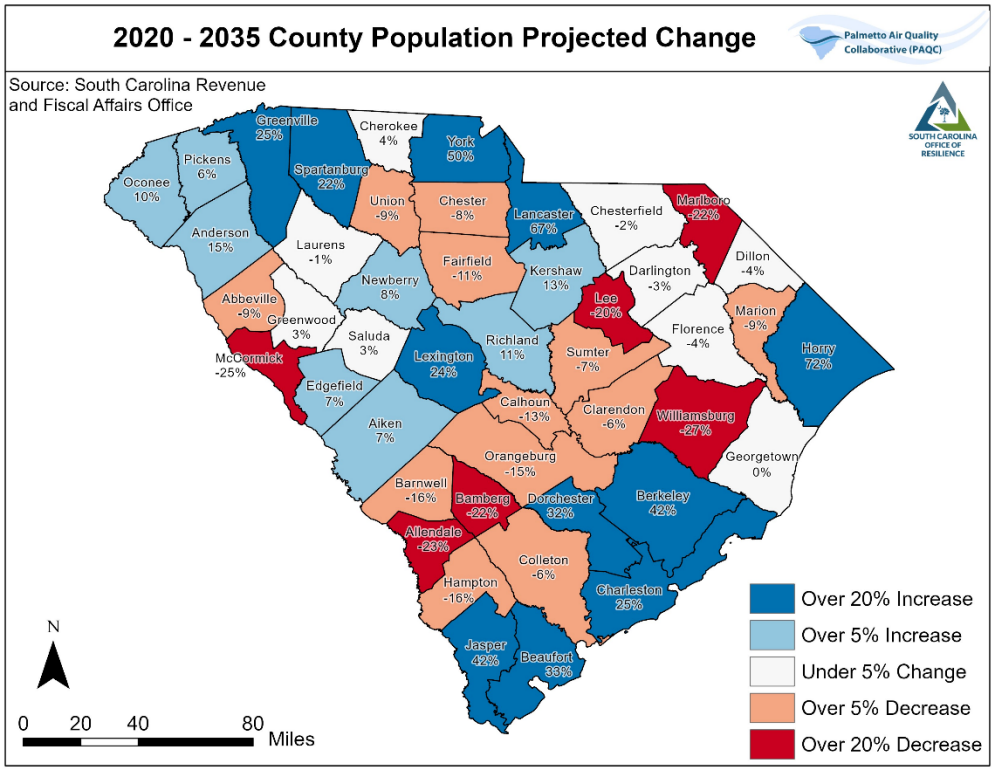


Figure 7. Projected population change in South Carolina by county, 2020-2035

3.5 Energy

From 2022 to 2023, South Carolina had the fastest growth rate (1.7%) of any state and added over 90,600 new residents.[27] As the population continues to climb, the need for reliable, resilient, clean, and affordable energy systems is essential for South Carolina residents and businesses.

At the writing of the South Carolina PCAP, many energy planning activities and other initiatives are underway to assess and address energy demands and needs across the state. This section highlights ongoing initiatives and provides an overview of the state's energy policy and planning landscape.

3.5.1 Energy Generation

South Carolina's energy generation comes from a mix of fuel sources. In 2022, South Carolina's power generation came predominantly from nuclear, natural gas, and coal sources (Table 4).[28]

Greenhouse gas emissions from the energy sector come primarily from the combustion of fossil fuels such as coal and natural gas. Although not a fossil fuel, biomass also generates GHG emissions. Other types of energy production do not produce emissions, such as nuclear, hydroelectric, and solar energy; 66.95% of the energy produced in state is from these sources. Solar energy provides a relatively small percentage of the state's energy generation mix (0.01%), demonstrating the potential to expand renewable energy as an effective means to reduce statewide greenhouse gas emissions.

Table 4. South Carolina in-state energy generation by percentage

South Carolina In-State Energy Generation	
Source	Percentage
Nuclear	65.94%
Natural Gas (Boiler and Combined Cycle)	17.98%
Coal	12.56%
Combustion Turbine (Natural Gas and Oil)	2%
Hydroelectric	1%
Pumped Storage	0.4%
Combined Heat and Power	0.08%
Biomass	0.03%
Solar	0.01%

[27] US Census Bureau, US Population Trends Return to Pre-Pandemic Norms as More States Gain Population, https://www.census.gov/newsroom/press-releases/2023/population-trends-return-to-pre-pandemic-norms.html.
[28] SC Energy Office, South Carolina Energy Landscape (data from EIA), https://south-carolina-energy-office-1-1-scors-eo.hub.arcgis.com/pages/electricity-data

Not all energy produced in South Carolina is consumed within the state, since two utilities (Duke Energy Carolinas and Duke Energy Progress) generate energy and provide it to customers in both South Carolina and North Carolina. Energy consumed in South Carolina came predominantly from nuclear, natural gas, and coal in 2022 (Table 5).[29]

When comparing the percentages of in-state energy generation and in-state energy consumption by source, South Carolinians are using significantly more fossil fuel combusted energy compared to zero emission energy. The consumption rate drops significantly for nuclear power while increasing for natural gas and coal.

Table 5. South Carolina consumed energy by generation source

South Carolina Consumed Energy by Generation Source	
Source	Percentage
Nuclear	38.06%
Natural Gas (Boiler and Combined Cycle)	27.05%
Coal	27.05%
Combustion Turbine (Natural Gas and Oil)	5.01%
Hydroelectric	2%
Pumped Storage	0.60%
Combined Heat and Power	0.03%
Biomass	0.10%
Solar	0.10%

3.5.2 South Carolina Codes and Statutes

In 1992 the South Carolina General Assembly passed the South Carolina Energy Conservation and Efficiency Act with the goal of "developing a comprehensive state energy plan that maximizes to the extent practical environmental quality and energy conservation and efficiency. . . ". (S.C. Code Ann § 48-52-10 et seq.) The Act created the State Energy Office which acts as the principal energy planning entity for the State and provided set objectives and responsibilities for comprehensive state energy planning, which includes "encourag[ing] the development and use of clean energy resources, including nuclear energy, energy conservation and efficiency, and indigenous, renewable energy resources (S.C. Code Ann. § 48-52-210). The Energy Office develops the State Energy Plan and provides annual updates to the Governor and South Carolina Legislature regarding the Energy Office's activities to implement the Plan.

In 2009, the South Carolina Legislature amended Chapter 10, Title 6, Code of Laws of South Carolina, renaming the Title of the Act to the Energy Standard Act. The Act adopted the 2006 Edition of the International Energy Conservation Code (IECC) for homes across the state (S.C. Code Ann. § 6-10-10 et seq.). This change provided that all new and renovated buildings and additions constructed within the state must comply with IECC standards. The authority to implement changes to these energy standards rests with the S.C. State Legislature. In 2012, The Legislature amended S.C. Code adopting the 2009

[29] SC Energy Office, South Carolina Energy Landscape (data from EIA), https://south-carolina-energy-office-1-1-scors-eo.hub.arcgis.com/pages/electricity-data

edition of the IECC. There have been updates issued by the International Codes Council. The most recent update to the IECC was in 2021, but South Carolina has not adopted these updates.

In 2014 the Distributed Energy Resource (DER) Program Act (Act 236) was passed, a result of collaborative stakeholder efforts to promote renewable energy access in the state. The Act was intended to "promote the establishment of a reliable, efficient, and diversified portfolio of distributed energy resources" for South Carolina (S.C. Code Ann. § 58-39-110). The DER Act directed the state's three largest Investor-Owned Utilities (IOUs; Duke Energy Carolinas, Duke Energy Progress, and South Carolina Electric & Gas Company [now Dominion Energy South Carolina]) to propose DER programs, with a goal of generation capacity equal to at least 2% of the previous five-year average of the electrical retail peak demand by 2021 (S.C. Code Ann. § 58-39-110 et seq.).

In 2019 the South Carolina Energy Freedom Act (Act 62) was passed, a result of continued collaborative stakeholder discussions around the implementation of the DER Program. The Act is intended to protect customers from rising utility costs, provide opportunities for customer measures to reduce or manage their electrical consumption from electrical utilities, and equip customers with the information and ability to manage their electric bills (S.C. Code Ann. § 58-27-845(A)). The overarching goal was to continue to enable the development of distributed energy resources and expand access to and transparency of DER programs. Important elements of the Act were new consumer protection regulations, changes to net metering tariffs, encouragement of neighborhood community solar, removal of the 2% cap on generation capacity from distributed energy resources, establishment of a voluntary renewable energy program to allow industrial and commercial customers to meet sustainability goals, requirements for the Public Service Commission of South Carolina to assess and improve interconnection processes and procedures, and expanded requirements for utilities' Integrated Resource Plans (IRPs) to consider future scenarios with higher levels of renewable energy and energy efficiency. Many of the accompanying regulations and programs required by this legislation have only recently been approved or are in the early stages of implementation (S.C. Code Ann. §§ 58-40-10 et seq., 58-27-2610, 58-37-40, 58-37-60).

3.5.3 South Carolina Energy Plan

The most recent State Energy Plan was published in 2016. The creation of this plan involved over 130 professionals and 45 subcommittees who carefully documented the current energy landscape in South Carolina and provided 80 policy recommendations to make South Carolina's energy system more reliable, resilient, clean, and affordable.

Top-tier recommendations from this plan include ensuring electric utilities' Integrated Resource Plans reflect access to energy resources at the lowest environmental and economic cost; investigating the impact of adopting most-current building efficiency standards (2015 IECC) on citizens' health, wellness, and energy costs; finding ways to finance energy efficiency improvements for homeowners; convening major IOU stakeholders to discuss their progress in fulfilling the goals of DER Act 236 and how renewable resources can be expanded across the state; proposing energy audits for state-owned or leased buildings; and diversifying state-owned fleet vehicles to include alternative fuel vehicles.[30]

[30] South Carolina Energy Office, Energy in Action: South Carolina State Energy Plan, https://energy.sc.gov/sites/energy/files/Documents/Energy%20Plan%2003.02.2018.pdf

In a 2021 update, the Energy Office noted that stakeholder work on top tier-recommendations from the 2016 Energy Plan had resulted in the creation of an Integrated Resource Plan best practices guide, online tools to provide the public with energy-saving recommendations, and reports, workshops, and trainings. Most notably, in 2021 the Energy Office and associated partners and stakeholders finalized the Energy Efficiency Roadmap (Section 3.5.4) and the Electric Vehicle Stakeholder Initiative (Section 3.5.5).

The Energy Office is in the process of developing a new State Energy Plan using data from 2022.

3.5.4 Energy Efficiency Roadmap

Energy efficiency is considered one of the lowest-cost options for meeting growing energy demands and reducing energy costs and GHG emissions. In response to the priorities and recommendations identified in the 2016 State Energy Plan, and with the hopes of deploying energy efficiency measures more significantly in South Carolina, a group of over 70 stakeholders contributed to the Energy Efficiency Roadmap (2019). [31] This document identifies energy efficiency policy goals and strategies.

Recommendations include:

- Adopting an updated version of the commercial energy code
- Assessing the feasibility, costs, and benefits of establishing a South Carolina Green Bank to provide loans for GHG-reduction projects for public entities and private-sector energy developers and flexible financing for residential customers
- Updating S.C. Code § 48-52-640 to require LEDs as lighting replacements
- Streamlining low-income residential weatherization programs
- Re-establishing energy conservation goals for state agencies, public colleges and universities, and public school districts.

The Energy Office has addressed and advanced several of these recommendations since 2019. In 2022 the Energy Office commissioned a Green Bank market and feasibility assessment. This comprehensive report included over 60 interviews with South Carolina organizations and demonstrated that having a dedicated institution like a green bank could accelerate the flow of capital to projects aiming to reduce carbon pollution and increase resilience to climate impacts. [32] The Energy Office is initiating the South Carolina Home Energy Labeling Pilot Program, the goal of which is to provide reliable, standardized information about a residential dwelling's estimated energy use and costs, as well as recommendations for improvements. [33]

3.5.5 Electric Vehicle Stakeholder Initiative

In response to the 2016 Energy Plan and in collaboration with the Palmetto Clean Fuels Coalition, the Energy Office created the SC Electric Vehicle Stakeholder Initiative (EVSI) in 2020. This initiative convened over 350 stakeholders to develop policy and programmatic recommendations to increase

[31] Jennifer Weiss, South Carolina Energy Efficiency Roadmap, https://energy.sc.gov/sites/energy/files/Documents/view/South-Carolina-Energy-Efficiency-Roadmap_0.pdf
[32] Fleming, J. & Windsor, C., The Role of a Green Bank in South Carolina: A Market & Feasibility Study (2022). University of South Carolina, https://scholarcommons.sc.edu/geog_facpub/231/.
[33] South Carolina Energy Office, Building Codes and Labeling Recommendations, https://energy.sc.gov/focus-area/energy-efficiency/building-ee-homes/building-codes-and-labeling-recommendations.

electric vehicle (EV) deployment in South Carolina. The overall goal of the initiative was to bring about a fair, efficient, and cost-effective transition to an electrified transportation sector.

The EVSI report (2022) identified challenges in South Carolina associated with EV expansion. Challenges included gaps in knowledge about EVs, high up-front costs of EVs for low to middle-income families, lack of a state plan for deployment of EVs and EV infrastructure, few standards for EV charging stations, and lack of knowledge surrounding public entity fleet electrification.[34] Policy and programmatic recommendations include building out the EV industry and workforce in South Carolina, ensuring equitable EV deployment across income levels, creating a statewide electrification roadmap for deploying EVs and EV infrastructure and attracting EV investments in SC, creating and expanding incentives for EV use, and deploying EV infrastructure along critical corridors.

The passage of Act 46 (2021) codified EVSI's work. South Carolina Code of Laws § 58-27-270(D) requires the SC Office of Regulatory Staff to convene and gather electric vehicle stakeholder initiatives and to report recommendations to the S.C. State Legislature every two years. EVSI is in the beginning stages of the second 2-year update with an open stakeholder survey through the SC Energy Office.[35] In addition, Governor McMaster's Executive Order 2022-31 established the Electric Vehicle and Interagency Working Group to facilitate coordination and strategic development of EV infrastructure in the state.[36]

3.5.6 Executive Order 2023-18 and powerSC

In 2023, Governor McMaster established the "powerSC" Energy Resources and Economic Development Interagency Working Group through Executive Order 2023-18 to assess and expand South Carolina's energy-related resources, as well as workforce and economic development activities.[37] This group was tasked with facilitating coordination between utility providers, recommending improvements to state licensing and permitting processes related to energy infrastructure, assessing ways to add nuclear power production and natural gas pipelines to the SC's energy portfolio, and recommending modifications to building codes to increase energy efficiency.

3.5.7 Utilities

South Carolina's energy generation, transmission, and distribution is provided by 46 electric utilities that vary considerably in terms of population served and governing structures. Of the 46 electric utilities, 4 are investor owned, one is state owned, 21 are Electric Cooperatives, and 20 are municipal utilities.

The Public Service Commission of South Carolina is charged with regulating the rates and services of four utilities that are investor owned and that service 56% of the state's energy customers: Duke Energy Carolinas (23%), Duke Energy Progress (6%), Dominion Energy South Carolina (27%), and Lockhart Power (0.4%).[38] The Public Service Commission of South Carolina oversees any changes to utility power

[34] South Carolina Energy Office, SC Electric Vehicle Stakeholder Initiative Report (2022), https://energy.sc.gov/sites/energy/files/Documents/view/EVSI%20Stakeholder%20Intiative.pdf
[35] SC Energy Office, Electric Vehicle Stakeholder Initiative, https://energy.sc.gov/focus-area/clean-transportation/electric-vehicles/electric-vehicle-stakeholder-initiative.
[36] South Office of the Governor, Executive Orders, https://governor.sc.gov/executive-branch/executive-orders.
[37] South Office of the Governor, Executive Orders, https://governor.sc.gov/executive-branch/executive-orders.
[38] South Carolina Energy Office https://south-carolina-energy-office-1-1-scors-eo.hub.arcgis.com/pages/generation

generation. Once changes are approved, utilities have the authority to implement new or existing programs or projects such as building new generation sites or power sources.

Santee Cooper is a state-owned utility, managed by a board of directors appointed by the Governor and approved by the State Senate and services 7% of the state's electric customers.

Central Electric Power Cooperative, Inc. is a not-for-profit generation and transmission cooperative and provides power to the Electric Cooperatives, primarily through long-term purchase agreements with Santee Cooper and Duke Energy Carolinas. Central Electric Power Cooperative, Inc. also designs and delivers programs, such as energy efficiency and rooftop solar programs, for the Electric Cooperatives. Self-governing distribution electric utilities include the Electric Cooperatives (serving 31% of customers) and 20 municipal electric utilities (5% of customers)[39]. Municipal electric utilities have purchase agreements with the larger IOUs, Santee Cooper, or individual Electric Cooperatives.

3.6 Federal Standards for Air Quality and Carbon Pollution

The Clean Air Act (42 U.S.C. 7401 et seq.) is the primary law governing air pollution control activities and defines the roles and responsibilities of federal, state, and local agencies in improving air quality and protecting public and environmental health. First enacted in 1955, major revisions were made in 1970, 1977, and 1990. The Act addresses both stationary and mobile sources of air emissions. This section briefly describes air quality and carbon pollution monitoring, reporting, and permitting activities established by the Clean Air Act and which are pertinent to PAQC efforts to inventory GHG and co-pollutant emissions and reductions.

The Division of Air Quality Analysis in DHEC's Bureau of Environmental Health Services operates and maintains the SC Ambient Air Monitoring Network as required by EPA under Title 40 of the Code of Federal Regulations (CFR) Part 58.[40] Since first established in 1959, the network has grown to 66 monitors and samplers at 22 sites. EPA requires that each state maintains a minimum number of monitors to properly characterize air quality based on MSA population and air monitoring design values. States are required to submit an annual monitoring network plan and develop measures and compliance schedules if an area exceeds allowable limits. The criteria pollutants monitored by the network include ozone, particulate matter ($PM_{2.5}$ and PM_{10}), lead, sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and carbon monoxide (CO).[41] This network does not monitor GHGs. DHEC works with local Air Quality Coalitions to develop and implement proactive, voluntary actions to reduce emissions and stay within air quality standards.[42]

The Clean Air Act Amendments of 1990 added Title V which requires states to develop plans and permitting programs for the operation of sources emitting air pollutants. The DHEC Bureau of Air Quality issues construction, operating, and general and registration permits for both minor and major sources of emissions. A major source facility potentially emits 100 tons per year or more of any criteria pollutant (CO, PM_{10}, $PM_{2.5}$, NO_X, SO_2, Pb, Volatile Organic Compounds) and/or 10 tons per year or more of any

[39]South Carolina Energy Office https://south-carolina-energy-office-1-1-scors-eo.hub.arcgis.com/pages/generation
[40] National Archives, Code of Federal Regulations, Ambient Air Quality Surveillance, https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-58.
[41] DHEC, State of South Carolina Annual Ambient Air Monitoring Network Plan, July 1, 2023 – December 31, 2024.
[42] DHEC, Advance Program and Air Quality Coalitions, https://scdhec.gov/environment/your-air/south-carolinas-energy-future/advance-program-air-quality-coalitions.

single hazardous air pollutant (HAP) or 25 tons per year of combined HAPs.[43] This permitting program does not include GHGs.

Mandatory GHG reporting requirements, codified at 40 CFR Part 98, went into effect in 2009 for large emission sources (>25,000 metric tons of CO_2e per year) and fuel and industrial gas suppliers.[44] Methodologies for calculating emissions are specified in 40 CFR Part 98 and facilities directly report data to EPA using the electronic Greenhouse Gas Reporting Tool.[45] EPA's Facility Level Information on Greenhouse gases Tool (FLIGHT) provides access to the report data. In 2022, 96 facilities in South Carolina reported emissions of 35 $MMTCO_2e$[46], almost half of the state's estimated gross emissions (Section 4.4).

In 2023, EPA proposed new Clean Air Act emission limits and guidelines for carbon dioxide from fossil fuel-fired power plants under Section 111(d). The new guidelines would require GHG reductions and new performance standards for electricity generating units.[47] The finalized, new regulation may have implications for South Carolina's emissions of greenhouse gases as well as other air pollutants.

3.7 Greenhouse Gas Reduction Targets

At the time of writing the PCAP, South Carolina has no statewide GHG reduction targets.

For the GHG emissions projections described in the CCAP, EPA requires near-term (2030-2035) and long-term (to 2050) projections of GHG emissions and sinks, using a scenario where no measures are taken and a scenario where the plan is fully implemented. For the reduction targets, EPA requires economy-wide near-term (2030-2035) and long-term (to 2050) emission reduction targets that align with United States commitments. EPA strongly recommends separate sector-based projections and reduction targets.[48]

[43] DHEC, Operating Permits (Air), https://scdhec.gov/index.php/environment/air-quality/air-quality-permits/operating-permits-air.
[44] National Archives, Code of Federal Regulations, Mandatory Greenhouse Gas Reporting, https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-98.
[45] EPA, Learn About the Greenhouse Gas Reporting Program (GHGRP), https://www.epa.gov/ghgreporting/learn-about-greenhouse-gas-reporting-program-ghgrp.
[46] EPA, Facility Level Information on GreenHouse gases Tool (FLIGHT), https://ghgdata.epa.gov/ghgp/main.do.
[47] EPA, Fact Sheet: Greenhouse Gas Standards and Guidelines for Fossil Fuel-Fired Power Plants Proposed Rule, https://www.epa.gov/system/files/documents/2023-05/FS-OVERVIEW-GHG-for%20Power%20Plants%20FINAL%20CLEAN.pdf.
[48] EPA, Climate Pollution Reduction Grants Program: Formula Grants for Planning, Program Guidance for States, Municipalities, and Air Pollution Control Agencies, available at https://www.epa.gov/inflation-reduction-act/about-cprg-planning-grant-information.

4 Greenhouse Gas Inventory

A greenhouse gas inventory is a tool used by planners and decision makers to understand where emissions come from, and what land uses and land use types serve as sinks, within the state. Understanding the primary sources of emissions allows planners to target the highest emissions with priority reduction measures for the greatest impact. This inventory reports emissions, organized by emission source, from 1990 to 2020, to give a comprehensive assessment of emissions for the past 30 years.

4.1 Scope

The inventory presented here is a statewide GHG inventory. The year 2005 was chosen as a base line year since this is the most common base year used by federal agencies and other states with developed inventories. The 2005 period also approximately represents the peak of emissions (Figure 10), which will be useful for tracking emission reductions over time and future planning. South Carolina used a source-based inventory, which includes emissions of greenhouse gases that are generated within the state and does not represent consumption-based emissions. Consumption-based inventories include indirect emissions that may come from outside of the geographic scope (for example, goods produced in another state that were used in South Carolina).

4.2 Methods and Data

SCOR used the EPA State Inventory Tool (SIT) to produce this inventory, following international methods and standards.[49] As South Carolina does not have one designated agency or entity that collects GHG emissions data, the SIT provides a starting point to identify and understand the relative contributions of different sectors and activities to the state's net GHG emissions.

The EPA SIT[50] is comprised of 11 modules, or interactive spreadsheet tools, developed to provide states with the ability to calculate statewide emissions for the years 1990-2020:

1. Agriculture
2. Fossil Fuel Combustion (CO_2 only)
3. Coal Mining
4. Electricity
5. Industrial Processes
6. Land Use, Land-Use Change, and Forest
7. Mobile Combustion (Transportation)
8. Natural Gas and Oil
9. Solid Waste
10. Stationary Combustion (CH_4 and N_2O)
11. Wastewater

The state-level default data provided by the SIT comes from EPA's annual report "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2021."[51] Data originates from a variety of federal and state agencies, trade and industry associations, and research and academic institutions. For example, the U.S. Energy Information Administration (EIA) provides energy consumption data, which comes from the EIA's State Energy Consumption, Price, and Expenditure Estimates.[52] The Federal Highway Administration

[49] IPCC, 2006 IPCC Guidelines for National Greenhouse Gas Inventories, https://www.ipcc.ch/report/2006-ipcc-guidelines-for-national-greenhouse-gas-inventories/

[50] US EPA, State Inventory and Projection Tool (SIT), https://www.epa.gov/statelocalenergy/state-inventory-and-projection-tool

[51] US EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2021, https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2021.

[52] US Energy Information Administration (EIA), State Energy Data System, https://www.eia.gov/state/seds/

provides vehicle class and vehicle miles traveled data, which it obtains from the states.[53] The modules include equations to estimate GHG emissions based on the pertinent data and emission factors that relate quantities of emissions to an activity (e.g., emissions based on energy consumption for space heating, water heating, lighting, or appliances; emissions based on miles traveled by a certain vehicle types).

One exception where South Carolina data was used for the SIT was in the Land Use, Land-Use Change, and Forest (LULUCF) module. The South Carolina Forestry Commission provided hectares burned per year, for the years 2006 to 2020.

4.2.1 Measuring and Reporting Greenhouse Gases

Greenhouse gases have different global warming potentials (GWP, see Section 3.1.4 and Table 3). GWPs were developed to allow comparisons of the warming impacts of different greenhouse gases. A GWP measures how much energy the emissions of 1 ton of a gas will absorb over a given time, relative to the emissions of 1 ton of carbon dioxide. The larger the GWP, the more that gas warms the Earth compared to CO_2 over the given time. GWPs allow for a common unit of measurement across all greenhouse gases, regardless of their radiative efficiency or lifespan in the atmosphere.

GWPs are used to convert emissions of all greenhouse gases into CO_2 equivalent (CO_2e). The conversion used is emissions of the gas multiplied by its GWP. Throughout South Carolina's PCAP, emissions are measured by the weight of the gas emitted in million metric tons (MMT) carbon dioxide equivalent (MMT CO_2e). One million metric ton is equal to 1 billion kilograms, or 2.205 billion pounds (2,205,000,000 lbs.).

4.3 Uncertainties

Greenhouse gas inventories are meant to provide a general understanding of emissions within their scope, and therefore include a level of uncertainty. The statewide inventory developed for this PCAP followed the standard practices that are consistent with national and international guidelines and methodologies and used by most other states. However, because GHG emissions are not directly measured or reported for use in the inventory, the SIT is considered a top-down approach to an emissions inventory. The SIT modules provide flexibility and allow the user to enter more specific data, if available.

Minor discrepancies between SIT modules demonstrate some uncertainty within the inventory based on data and calculations used, such as within the transportation sector (see section 5.9). To err on the side of caution, this inventory presents the higher of the two values when such inconsistencies occurred.

This initial inventory will help South Carolina identify gaps and areas for improvement in future inventories. During the process to develop the PCAP and GHG inventory, SCOR, DHEC, and Action Team members noted data gaps and questions that may be addressed during the development of the Comprehensive Climate Action Plan (CCAP) (Section 16.2; Appendix D).

[53] U.S. Department of Transportation Federal Highway Administration, Highway Statistics Series, https://www.fhwa.dot.gov/policyinformation/statistics.cfm

4.4 Statewide Total Gross GHG Emissions

In 2020, South Carolina's total gross GHG emissions were 73.746 million metric tons carbon dioxide equivalent ($MMTCO_2e$) (Table 6, Figure 8). This inventory is presented by source of GHG emissions, which means where the greenhouse gases are generated. Industry, commercial, and residential sources include energy generated on site. It is important to note that these categories also lead to indirect emissions through the use and demand of electric power, but these emissions are shown within the electric power generation source.

Table 6. South Carolina greenhouse gas emissions by source in 2020
Shown by total gross emissions in million metric tons carbon dioxide equivalent (MMTCO2e) and by percentage.

Source	Amount ($MMTCO_2e$)	Percentage
Transportation	29.406	39.87%
Electric Power Generation	22.935	31.10%
Industry (on site)	13.001	17.63%
Agriculture	2.318	3.14%
Commercial (on site)	2.140	2.90%
Waste	2.039	2.77%
Residential (on site)	1.907	2.59%
TOTAL GROSS EMISSIONS	73.746	100%

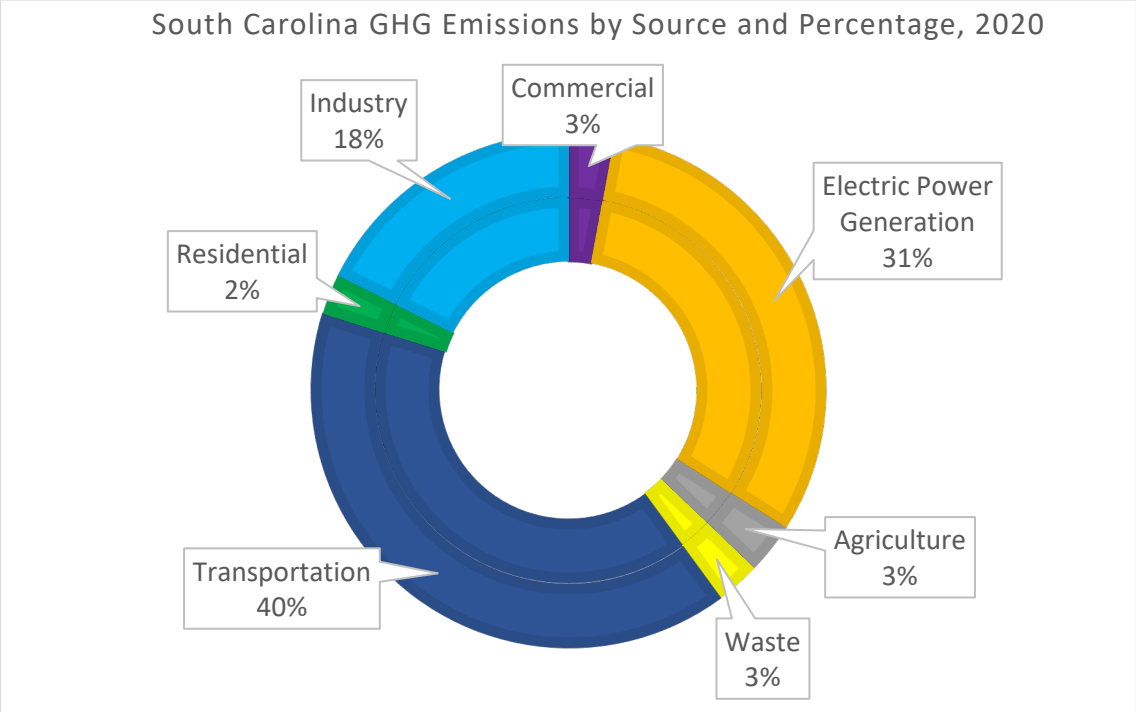


Figure 8. South Carolina gross total greenhouse gas emissions by source and percentage, 2020
Percentages shown in Table 4 have been rounded in this figure for simplification.

4.5 Statewide Total Net GHG Emissions

Total net emissions account for carbon storage, in addition to emissions. A carbon sink is an environment that takes in or sequesters carbon and stores it long term. Natural lands and forestry are a carbon sink because living things are made up of carbon. Biomass takes in carbon dioxide during the process of photosynthesis and stores it, making South Carolina's forests a major carbon sink (Figure 9). Total net emissions are calculated by subtracting sinks from total gross emissions. South Carolina's natural and working lands and forests sequestered a net of 23.567 $MMTCO_2e$, reducing the state's total net emissions to 50.179 $MMTCO_2e$.

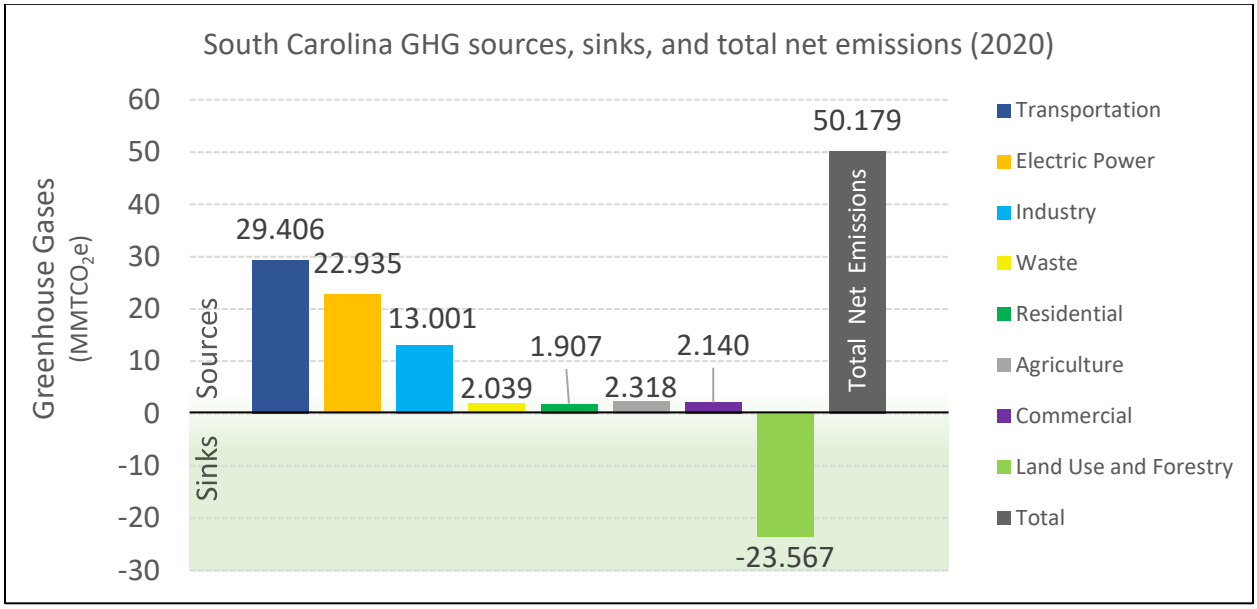


Figure 9. South Carolina greenhouse gas sources, sinks, and total net emissions, 2020
Net emissions are calculated by subtracting carbon sinks from total gross emissions. Land use and forestry sequesters carbon and stores it, making it a net sink. Total net emissions equal 50.179.

4.6 Statewide Total GHG Emissions, 1990 to 2020

Overall, statewide total gross emissions from 1990 to 2020 peak around 2005 and then begin to decrease (Figure 10). Technological innovations and energy efficiency measures are likely contributing factors. However, the major sources of emissions indicate differing trends. Emissions from the electric power generation source has declined as coal fired plants have been replaced. Transportation emissions have increased. Despite vehicle efficiency improvements and requirements, South Carolina's growing population places more vehicles on the state's roads. The state's carbon sinks, indicated by "Land Use, Land Use Change, and Forestry," exhibits smaller fluctuations and change over time.

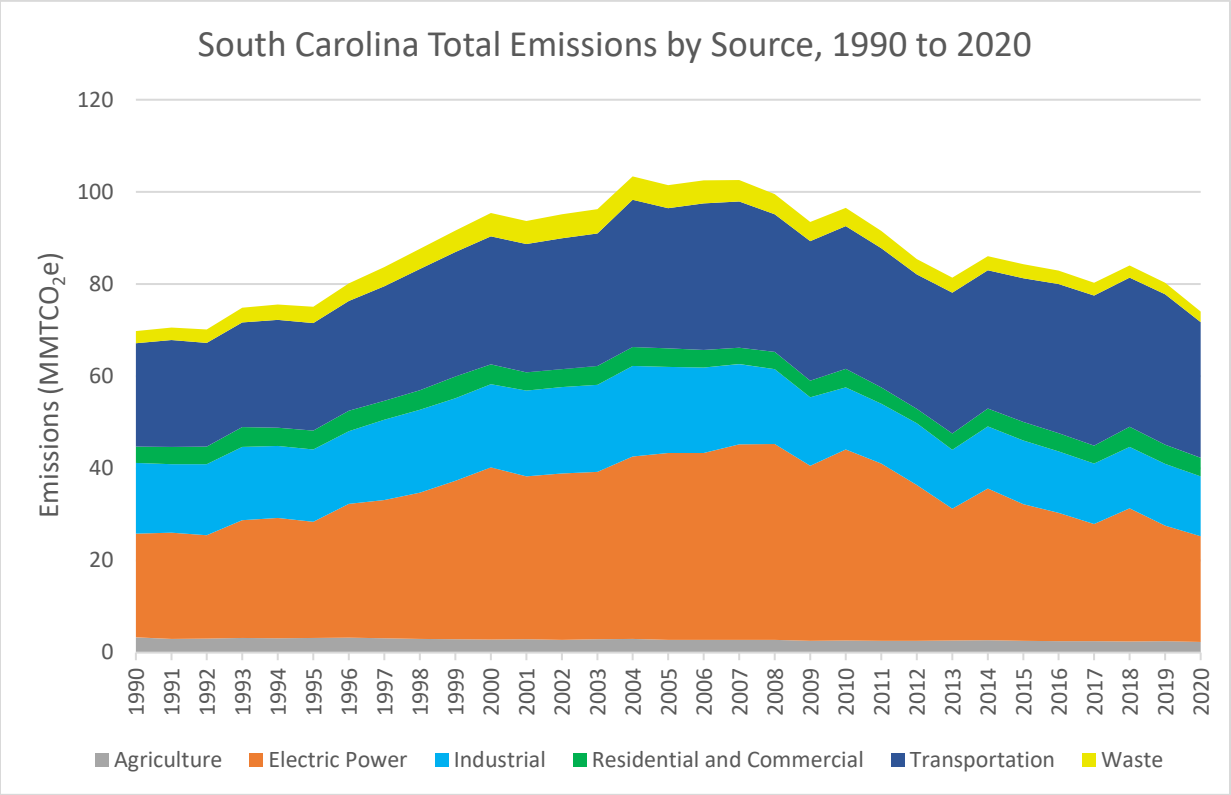


Figure 10. South Carolina total greenhouse gas emissions by source, 1990 to 2020

4.7 Statewide Emissions by Sources and Greenhouse Gas Types

Looking at each source of emissions in greater detail is useful for planning and decision making. Data presented within this inventory includes emissions for the years 1990, 2005, 2019, and 2020 (Table 7, Table 8). The years 1990 and 2020 are included because they are the initial and most recent years available in the SIT, respectively. South Carolina chose 2005 as a base year as it is the most used base year in other state inventories throughout the U.S.

The year 2019 is included in this inventory as a point of comparison with 2020, when the COVID-19 global pandemic likely had a significant impact on the lower levels of emissions seen in 2020. It is uncertain how significant the pandemic impact will be on emissions in subsequent years.

Table 7 shows total gross emissions by source and greenhouse gas. Gross emissions in 2020 (73.746 $MMTCO_2e$) decreased by 26.901 $MMTCO_2e$ from the 2005 base year emissions (100.647 $MMTCO_2e$). Additionally, gross emissions in 2020 decreased from 2019 levels (79.943 $MMTCO_2e$) by 6.197 $MMTCO_2e$, likely due to the global COVID-19 pandemic. Gross emissions in 2019 decreased by 20.704 $MMTCO_2e$ compared to the base year. This decrease was likely due to improved technological advances and enhanced standards and regulations regarding emissions and air pollution.

Table 8 shows the carbon sequestration benefits from natural lands, working lands, and forestry (23.567 $MMTCO_2e$ in 2020) and the net total GHG emissions for the state (50.179 $MMTCO_2e$), calculated by subtracting 23.567 $MMTCO_2e$ from the total gross emissions (73.746 $MMTCO_2e$).

Table 7. South Carolina gross total greenhouse gas emissions by source and greenhouse gas
All emissions are measured in MMTCO2e.

South Carolina Gross Total GHG Emissions, by Source and Greenhouse Gas					
SOURCE	**GHG**	**1990**	**2005**	**2019**	**2020**
TRANSPORTATION					
Highway and Non-Highway	CO_2	21.649	29.753	32.288	29.144
Highway and Non-Highway	CH_4	0.117	0.066	0.046	0.043
Highway and Non-Highway	N_2O	0.635	0.597	0.256	0.219
TRANSPORTATION TOTAL		22.401	30.416	32.590	29.406
ELECTRIC POWER GENERATION					
Coal	CO_2	21.976	37.511	14.960	12.812
Petroleum	CO_2	0.054	0.436	0.061	0.055
Natural Gas	CO_2	0.379	2.470	9.931	9.976
Additional Emissions from Fuel Combustion	CH_4	0.007	0.018	0.021	0.020
Additional Emissions from Fuel Combustion	N_2O	0.092	0.164	0.082	0.072
ELECTRIC POWER GENERATION TOTAL		22.508	40.599	25.055	22.935
INDUSTRY					
Fossil Fuel Combustion	CO_2	12.911	13.158	7.230	6.827
Additional Emissions from Fuel Combustion	CH_4	0.073	0.070	0.074	0.070
Additional Emissions from Fuel Combustion	N_2O	0.097	0.095	0.095	0.090
Industrial Wastewater	CH_4	0.006	0.008	0.005	0.006
Industrial Production	CO_2	1.433	2.950	2.508	2.409
Industrial Production	HFC, PFC, NF_3, SF_6	0.853	2.372	3.495	3.599
INDUSTRY TOTAL		15.373	18.653	13.407	13.001
WASTE					
Landfill Emissions	CH_4	1.830	3.603	1.559	1.402
Waste Combustion	CO_2	0.056	0.147	0.127	0.127
Waste Combustion	N_2O	0.002	0.003	0.002	0.002
Municipal Wastewater	CH_4	0.250	0.300	0.360	0.368
Municipal Wastewater	N_2O	0.090	0.120	0.140	0.140
WASTE TOTAL		2.225	4.170	2.190	2.039
AGRICULTURE					
Urea Fertilization	CO_2	0.004	0.006	0.015	0.017
Enteric Fermentation, Manure Management, Agricultural Residue Burning	CH_4	1.400	1.287	1.002	0.976
Manure Management, Agricultural Soils	N_2O	1.892	1.460	1.479	1.325
AGRICULTURE TOTAL		3.296	2.753	2.496	2.318

Table continues next page.

South Carolina Gross Total GHG Emissions, by Source and Greenhouse Gas					
SOURCE	**GHG**	**1990**	**2005**	**2019**	**2020**
RESIDENTIAL					
Fossil Fuel Combustion	CO_2	2.071	2.275	1.935	1.888
Additional Emissions from Fuel Combustion	CH_4	0.054	0.037	0.018	0.016
Additional Emissions from Fuel Combustion	N_2O	0.009	0.006	0.003	0.003
RESIDENTIAL TOTAL		2.134	2.318	1.956	1.907
COMMERCIAL					
Fossil Fuel Combustion	CO_2	1.428	1.721	2.237	2.128
Additional Emissions from Fuel Combustion	CH_4	0.010	0.010	0.009	0.009
Additional Emissions from Fuel Combustion	N_2O	0.002	0.002	0.003	0.003
COMMERCIAL TOTAL		1.440	1.733	2.249	2.140
TOTAL GROSS EMISSIONS		**69.377**	**100.647**	**79.943**	**73.746**

Table 8. South Carolina carbon sinks and net total emissions by source and greenhouse gas
Net total emissions are calculated by subtracting carbon sinks found in natural and working lands and forestry from net total gross emissions. All emissions are measured in MMTCO2e. Numbers in parentheses are negative and dashes represent years when data was not available.

South Carolina Carbon Sinks and Net Total GHG Emissions, by Source and Greenhouse Gas					
SOURCE	**GHG**	**1990**	**2005**	**2019**	**2020**
NATURAL & WORKING LANDS AND FORESTRY					
Net Forest Carbon Flux	CO_2	(20.975)	(21.317)	(21.497)	(20.907)
Urban Trees	CO_2	(1.647)	(2.467)	(3.306)	(3.366)
Landfilled Yard Trimmings and Food Scraps	CO_2	(0.264)	(0.074)	(0.107)	(0.109)
Forest Fires	CH_4	-	-	0.025	0.049
Forest Fires	N_2O	-	-	0.003	0.006
Settlement Soils	N_2O	0.030	0.025	0.025	0.025
Agricultural Soil Carbon Flux	N_2O	1.108	0.998	0.832	0.734
NATURAL & WORKING LANDS AND FORESTRY TOTAL		(21.748)	(22.835)	(24.025)	(23.567)
GROSS TOTAL EMISSIONS		69.377	100.647	79.943	73.746
NET NATURAL & WORKING LANDS & FORESTRY SINK		(21.748)	(22.835)	(24.025)	(23.567)
TOTAL NET EMISSIONS		**47.629**	**77.812**	**55.918**	**50.179**

4.8 Statewide Total Gross Emissions by Greenhouse Gas Type

Analyzing emissions by greenhouse gas is valuable because planners may target specific greenhouse gases during the implementation of reduction measures. It is also useful to compare GHG emissions by gas due to the wide variation of global warming potentials (GWP, see Section 3.1.4 and Table 3). All GHGs are measured with the same unit, $MMTCO_2e$, allowing analysis of the scale of emissions comparatively.

South Carolina's most widely emitted GHG in 2020 was CO_2, accounting for 89% of emissions (Table 9; Figure 11). Fluorinated gases, including HFCs, PFCs, NF_3, and SF_6, made up 5% of emissions, CH_4 was 4% of emissions, and N_2O made up 3% of South Carolina's emissions. Although nitrous oxide has a global warming potential 273 times more potent than carbon dioxide, comparison of total gross emissions demonstrates that carbon dioxide is still the largest source of global warming potential and is a top priority to address in South Carolina.[54]

[54] $MMTCO_2e$ is calculated using a greenhouse gas's global warming potential so that value is already accounted for within this inventory (Section 3.1.4).

Table 9. South Carolina total gross emissions by greenhouse gas
All emissions are measured in MMTCO2e.

South Carolina Total Gross Emissions by Greenhouse Gas				
GREENHOUSE GAS	**1990**	**2005**	**2019**	**2020**
Carbon Dioxide (CO_2)	61.961	90.427	71.292	65.383
Fluorinated Gases (HFC, PFC, NF_3, SF_6)	0.853	2.372	3.495	3.599
Methane (CH_4)	3.747	5.399	3.094	2.912
Nitrous Oxide (N_2O)	2.819	2.447	2.060	1.854

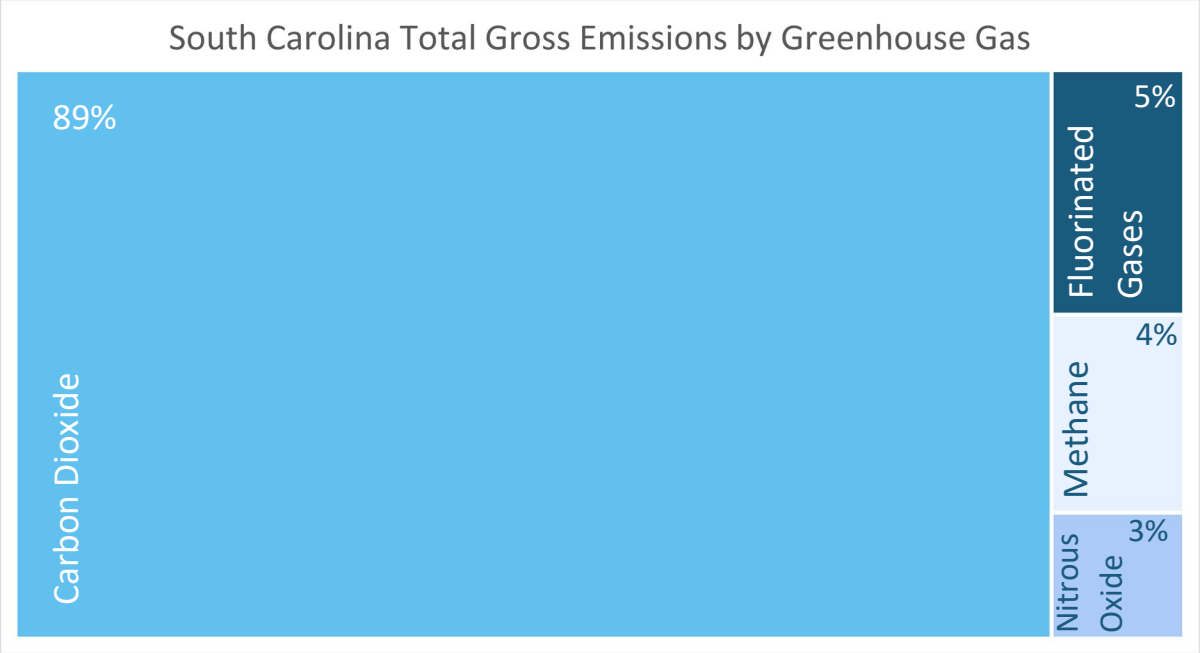
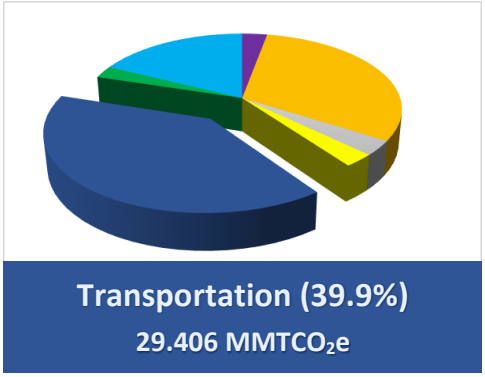


Figure 11. South Carolina total gross emissions by greenhouse gas, 2020
All emissions are measured in MMTCO2e
Percentages: carbon dioxide 89%, fluorinated gases (including HFC, PFC, NF3, SF6) 5%, methane 4%, nitrous oxide 3%.

4.9 Emissions from Transportation



Transportation is South Carolina's largest source of emissions, accounting for nearly 40% of the state's total gross emissions at 29.406 $MMTCO_2e$ in 2020. Total emissions reported from the transportation were calculated in the SIT CO_2 Fossil Fuel Combustion (CO_2FFC) module (Table 10). Additionally, the SIT Mobile Combustion module provided further detail and analysis of emissions from mobile sources (Table 11, Table 13, and Table 14).

Transportation emissions computed in the SIT CO_2FFC and Mobile Combustion modules vary somewhat (29.406 $MMTCO_2e$ and 28.328 $MMTCO_2e$, respectively), but both modules are useful for the purposes of this inventory and allow for different types of analysis. This difference is attributed to different data sources and calculations used in the two modules. The CO_2FFC module is based on fuel consumption data whereas the Mobile Combustion module is based on activity, including vehicle miles traveled (VMT), vehicle type, and fuel type. South Carolina's inventory reports calculations from the CO_2FFC module as the transportation sector's net total emissions, but the discrepancy between these two modules produces some uncertainty that may be addressed in future reports and inventories.

4.9.1 Emissions by Fossil Fuel

The SIT CO_2FFC module provides an emissions breakdown by fuel type based on levels of fuel use throughout the state. The predominant fuel type used in South Carolina is petroleum, accounting for 29.297 $MMTCO_2e$ or 99.6% of transportation emissions. Natural gas produces a small percentage of transportation emissions (Table 10).

Table 10. Transportation GHG emissions by fossil fuel

Transportation Greenhouse Gas Emissions by Fossil Fuel					
		Amounts of $MMTCO_2e$			
	GHG	**1990**	**2005**	**2019**	**2020**
FUEL TYPE					
Coal	CO_2	-	-	-	-
Petroleum	CO_2	21.493	29.619	32.162	29.035
Petroleum	CH_4	0.117	0.066	0.046	0.043
Petroleum	N_2O	0.635	0.597	0.256	0.219
Natural Gas	CO_2	0.156	0.134	0.126	0.109
TOTAL		22.401	30.416	32.590	29.406

4.9.2 Emissions by Vehicle Fuel

The SIT Mobile Combustion module shows emissions by highway and off-road vehicles by fuel type (Table 11). Most of these emissions come from gasoline and distillate fuel oil for highway vehicles (16.282 $MMTCO_2e$ and 6.947 $MMTCO_2e$, respectively) and emissions from off-road vehicles are predominantly attributed to gasoline, residual fuel oil, and jet fuel for off-road vehicles (1.747 $MMTCO_2e$, 1.554 $MMTCO_2e$, and 1.155 $MMTCO_2e$, respectively).

Table 11. Transportation GHG emissions by vehicle fuel

Transportation GHG Emissions by Vehicle Fuel					
		Amounts of $MMTCO_2e$			
	GHG	**1990**	**2005**	**2019**	**2020**
HIGHWAY					
Gasoline	CO_2	14.861	18.928	19.733	16.282
Distillate Fuel Oil	CO_2	4.255	5.326	7.257	6.947
CNG	CO_2	0.000	0.010	0.022	0.020
LNG	CO_2	0.000	0.000	0.000	0.000
LPG	CO_2	0.005	0.004	0.001	0.001
TOTAL		19.121	24.268	27.013	23.250
OFF-ROAD					
Jet Fuel, Kerosene	CO_2	0.397	0.659	1.492	1.135
Jet Fuel, Naphtha	CO_2	0.757	0.000	0.000	0.000
Aviation Gasoline	CO_2	0.035	0.034	0.023	0.020
Gasoline	CO_2	1.899	1.304	1.621	1.747
Residual Fuel Oil	CO_2	1.983	2.158	1.650	1.554
TOTAL		5.309	4.893	4.849	4.471

4.9.3 Emissions by Greenhouse Gas

Carbon dioxide is the primary GHG emitted in the transportation sector, with 28.066 $MMTCO_2e$ emitted (Table 12). These CO_2 emissions are largely from petroleum combustion (29.035 $MMTCO_2e$, Table 10). Data in this section were calculated in the Mobile Combustion SIT module.

Table 12. Transportation emissions by greenhouse gas
Source: SIT Mobile Combustion module.

Transportation Emissions by Greenhouse Gas				
Amounts of $MMTCO_2e$				
GHG	**1990**	**2005**	**2019**	**2020**
CO_2	24.582	29.328	32.309	28.066
CH_4	0.117	0.066	0.046	0.043
N_2O	0.635	0.597	0.256	0.219

4.9.4 Emissions by Vehicle Type

The SIT Mobile Combustion module provides an emissions breakdown by vehicle type (Table 13). This breakdown includes passenger vehicles, light-duty and heavy-duty vehicles, motorcycles, diesel vehicles, buses, boats, locomotives, aircraft, snowmobiles, and gasoline- or diesel-powered equipment including farm, construction, and utility equipment.

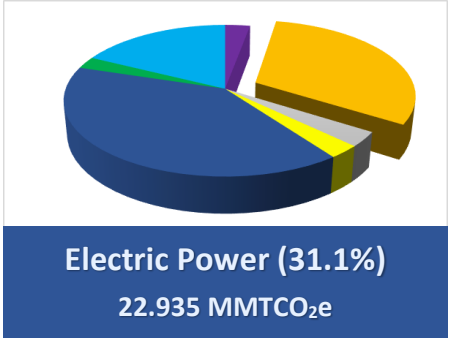
A significant source of transportation emissions is from passenger vehicles, with total emissions of 10.785 $MMTCO_2e$ in 2020. Heavy-duty vehicles emitted 7.568 $MMTCO_2$, light-duty trucks produced 4.984 $MMTCO_2e$, and aviation contributed another 1.165 $MMTCO_2e$ (Table 13).

Table 13. Greenhouse gas emissions from transportation by vehicle and fuel type

Greenhouse Gas Emissions from Transportation by Vehicle and Fuel Type					
		Amounts of $MMTCO_2e$			
VEHICLE AND FUEL TYPE	**GHG**	**1990**	**2005**	**2019**	**2020**
GASOLINE HIGHWAY					
Passenger Cars	All[55]	9.863	10.695	13.702	10.736
Light-Duty Trucks	All	4.805	8.103	5.116	4.782
Heavy-Duty Trucks	All	0.791	0.635	0.998	0.822
Motorcycles	All	0.025	0.030	0.058	0.048
TOTAL		15.485	19.464	19.874	16.389
DIESEL HIGHWAY					
Passenger Cars	All	0.078	0.053	0.060	0.048
Light-Duty Trucks	All	0.119	0.233	0.212	0.201
Heavy-Duty Trucks	All	4.062	5.046	7.034	6.746
Heavy-Duty Buses	All	0.152	0.167	0.451	0.349
TOTAL		4.411	5.498	7.757	7.344
NON-HIGHWAY					
Aviation	All	1.201	0.700	1.529	1.165
Boats	All	0.736	1.334	1.142	1.222
Locomotives	All	0.305	0.092	0.050	0.047
Farm Equipment	All	0.013	0.015	0.008	0.009
Construction Equipment	All	0.017	0.037	0.029	0.027
Other[56]	All	3.161	2.836	2.198	2.102
TOTAL		5.433	5.014	4.956	4.573
ALTERNATIVE FUEL VEHICLES					
Light-Duty Vehicles	All	0.000	0.001	0.000	0.000
Heavy-Duty Vehicles	All	0.005	0.004	0.002	0.001
Buses	All	0.000	0.010	0.022	0.020
TOTAL		0.005	0.015	0.024	0.022
TOTAL EMISSIONS		25.334	29.991	32.610	28.328

[55] "All" greenhouse gases refer to the three that were found within the SIT Mobile Combustion module: CO_2, CH_4, and N_2O. The SIT did not show other GHG emissions from transportation.
[56] "Other" includes tractors, small- and heavy-utility equipment, snowmobiles, and heavy-duty diesel-powered utility equipment.

4.10 Emissions from Electric Power Generation



Electric power generation is South Carolina's second major source of greenhouse gas emissions, making up 31% of the state's total gross emissions and emitting 22.935 $MMTCO_2e$ (Table 14). Emissions from electric power generation were calculated using the SIT CO_2 Fossil Fuel Combustion (CO2FFC) and Stationary Combustion modules.

The most significant source of emissions from electric power generation comes from burning coal, with 12.869 $MMTCO_2e$ emitted as CO_2, CH_4, and N_2O. Natural gas combustion contributed emissions of 9.986 $MMTCO_2e$ across all three reported GHGs within this sector. Other sources of GHG emissions in the electric power generation sector are petroleum and wood, but neither source contributed significant emissions to the inventory (Table 14).

Table 14. Greenhouse gas emissions from electric power generation

Greenhouse Gas Emissions from Electric Power Generation					
		Amounts of $MMTCO_2e$			
Source	**GHG**	**1990**	**2005**	**2019**	**2020**
Coal	CO_2	21.976	37.511	14.960	12.812
Petroleum	CO_2	0.054	0.436	0.061	0.055
Natural Gas	CO_2	0.379	2.470	9.931	9.976
Other	CO_2	0.000	0.000	0.000	0.000
TOTAL		22.409	40.418	24.953	22.843
Coal	CH_4	0.006	0.011	0.004	0.004
Petroleum	CH_4	0.000	0.000	0.000	0.000
Natural Gas	CH_4	0.000	0.001	0.005	0.005
Wood	CH_4	0.000	0.005	0.012	0.011
Other	CH_4	0.000	0.000	0.000	0.000
TOTAL		0.007	0.018	0.021	0.020
Coal	N_2O	0.092	0.156	0.062	0.053
Petroleum	N_2O	0.000	0.001	0.000	0.000
Natural Gas	N_2O	0.000	0.001	0.004	0.004
Wood	N_2O	0.000	0.006	0.015	0.014
Other	N_2O	0.000	0.000	0.000	0.000
TOTAL		0.092	0.164	0.082	0.072
TOTAL EMISSIONS		22.508	40.060	25.056	22.935

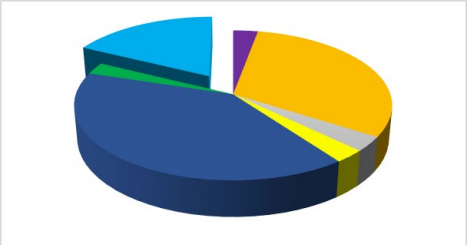
4.10.1 Emissions by Greenhouse Gas

Carbon dioxide is the largest greenhouse gas emitted by electric power generation, with 22.843 $MMTCO_2e$, followed by nitrous oxide (0.072 $MMTCO_2e$) and methane (0.020 $MMTCO_2e$) (Table 15).

Table 15. Emissions from electric power generation by greenhouse gas

Electric Power Generation Emissions by Greenhouse Gas				
	Amounts of $MMTCO_2e$			
GHG	**1990**	**2005**	**2019**	**2020**
CO_2	22.409	40.418	24.953	22.843
CH_4	0.007	0.018	0.021	0.020
N_2O	0.092	0.164	0.082	0.072

4.11 Emissions from Industry



Industry (17.6%)
13.001 MMTCO$_2$e

Industry is South Carolina's third largest source of greenhouse gas emissions, making up 17.6% of the state's emissions in 2020 with 13.001 MMTCO$_2$e in 2020 (Table 17). Emissions from industry sources were calculated using the SIT CO$_2$ Fossil Fuel Combustion (CO$_2$FFC), Stationary Combustion, Wastewater, and Industrial Process modules.

As an economic sector, industry intersects with transportation, waste, energy use, and commercial buildings as industrial firms produce, transport, and sell goods to South Carolinians. This inventory reports emissions that are created through industrial processes and on-site energy generation. Cross-cutting sectors such as waste and transportation may be related to industrial activities, but those emissions are counted as waste and transportation sources. Industrial production includes cement manufacture, limestone and dolomite use, soda ash, aluminum production, urea consumption, ozone depleting substances (ODS) substitutes, and electric power transmission and distribution systems. Some of this data was unavailable within the SIT and may be addressed in future inventories.

4.11.1 Emissions by Greenhouse Gas

Industry's most significant greenhouse gas is carbon dioxide with 9.236 MMTCO$_2$e emitted in 2020 (Table 16). Industry emits the most emissions of HFC, PFC, NF_3, and SF_6, with total emissions of 3.599 MMTCO$_2$e. N_2O emissions were 0.09 MMTCO$_2$e, and CH_4 emissions were 0.07 MMTCO$_2$e.

Table 16. Emissions from industry by greenhouse gas

Industry Emissions by Greenhouse Gas				
Amounts of MMTCO$_2$e				
GHG	**1990**	**2005**	**2019**	**2020**
CO_2	14.344	16.109	9.739	9.236
CH_4	0.079	0.079	0.079	0.076
N_2O	0.097	0.095	0.095	0.090
HFC, PFC, NF_3, SF_6	0.853	2.372	3.495	3.599

4.11.2 Emissions by Industrial Activity

Fossil fuel combustion in industry emitted 6.827 MMTCO$_2$e, predominantly from natural gas and petroleum (Table 17). Ozone-depleting substances (ODS) substitutes are the largest source of emissions from industrial production, as well as the largest source of fluorinated gases throughout this inventory with emissions of 3.185 MMTCO$_2$e. Cement manufacturing emitted 1.388 MMTCO$_2$e.

Table 17. Greenhouse gas emissions from industry by activity[57]

Greenhouse Gas Emissions from Industry by Activity					
		Amounts of $MMTCO_2e$			
SOURCE	**GHG**	**1990**	**2005**	**2019**	**2020**
FOSSIL FUEL COMBUSTION					
Coal	CO_2	5.367	3.442	0.357	0.295
Petroleum	CO_2	3.151	5.892	1.984	1.762
Natural Gas	CO_2	4.393	3.824	4.889	4.769
Other	CO_2	0.000	0.000	0.000	0.000
FOSSIL FUEL COMBUSTION TOTAL	CO_2	12.911	13.158	7.230	6.827
ADDITIONAL FUEL COMBUSTION: NON-CO_2					
Stationary Industrial Combustion	N_2O	0.097	0.095	0.095	0.090
Stationary Industrial Combustion	CH_4	0.073	0.070	0.074	0.070
ADDITIONAL FUEL COMBUSTION TOTAL		0.170	0.165	0.169	0.160
INDUSTRIAL WASTEWATER – TOTAL	CH_4	0.006	0.008	0.005	0.006
INDUSTRIAL PRODUCTION (CO_2)					
Cement Manufacture	CO_2	1.106	1.627	1.475	1.388
Lime Manufacture	CO_2	--	--	--	--
Limestone and Dolomite Use	CO_2	--	0.009	0.034	0.033
Soda Ash	CO_2	0.038	0.037	0.031	0.029
Aluminum Production	CO_2	0.288	0.242	0.150	0.138
Iron and Steel Production	CO_2	--	1.034	0.817	0.817
Ammonia Production	CO_2	--	--	--	--
Urea Consumption	CO_2	0.001	0.001	0.002	0.003
INDUSTRIAL PRODUCTION (CO_2) TOTAL		1.433	2.950	2.508	2.409
INDUSTRIAL PRODUCTION FLUORINATED GAS (FG) EMISSIONS[58]					
ODS Substitutes	FG	0.003	1.884	3.069	3.185
Semiconductor Manufacturing	FG	0.082	0.059	--	--
Magnesium Production	FG	--	--	--	--
Electric Power Transmission and Distribution Systems	FG	0.490	0.191	0.092	0.081
HCFC-22 Production	FG	--	--	--	--
Aluminum Production (PFCs)	FG	0.279	0.238	0.334	0.334
INDUSTRIAL PRODUCTION (FG) TOTAL		0.853	2.372	3.495	3.599
TOTAL INDUSTRIAL EMISSIONS		15.373	18.653	13.407	13.001

[57] Dashes (--) indicate that this industry is either not active in South Carolina, or there is no default data available.
[58] Fluorinated gases are potent greenhouse gases that include HFC, PFC, NF_3, and SF_6. For more information, see Section 3.1.4 and Table 3.

4.11.3 Indirect Industry Emissions

Indirect emissions are emissions that arise from electric power generation due to a demand for energy. Demand from the industrial sector (among others) creates the need for the supply of electric power, making it useful to attribute energy generation emissions to the industry sector and other sectors that also have a demand for electric power. It is important to note that these emissions are counted within the electric power generation sector and are not being double counted. Industrial indirect emissions were calculated through the SIT Energy Consumption module.

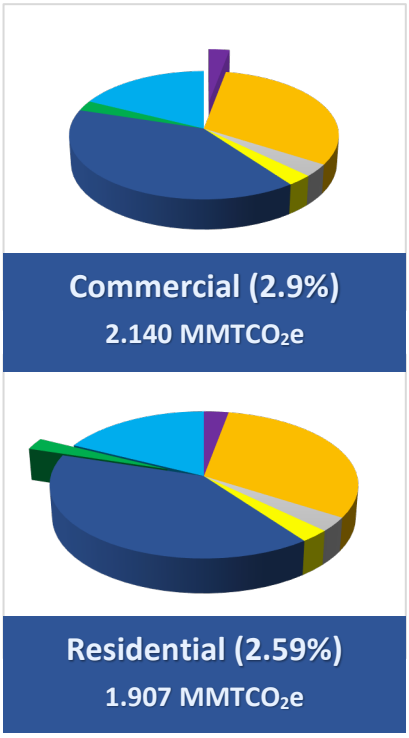
Industry requires a large amount of electricity for certain processes, facilities, and uses. The greatest indirect industrial emissions are attributed to direct use processes such as machine drive, process heating, cooling, and refrigeration, and electro-chemical processes (5.121 $MMTCO_2e$). Boiler fuel and non-process direct uses such as facility heating and cooling, lighting, and transportation also contributed to industrial indirect emissions. Table 18 shows the emissions by energy consumption and supplements Table 17 which shows direct emissions from fossil fuel combustion occurring at industrial facilities and from industrial processes.

Table 18. Industrial energy consumption by use types
Source: SIT Energy Consumption Module

Industrial Energy Consumption by Use Types				
	Amounts of $MMTCO_2e$			
ENERGY USE	1990	2005	2019	2020
INDIRECT USES – BOILER FUEL				
Conventional Boiler Use	0.036	0.408	0.096	0.086
CHP and/or Cogeneration Process	0.016	0.005	0.000	0.000
INDIRECT USES (BOILER FUEL) TOTAL	0.052	0.413	0.096	0.086
DIRECT USES -- PROCESS				
Process Heating	1.234	1.418	0.626	0.559
Process Cooling and Refrigeration	0.770	0.947	0.558	0.498
Machine Drive	5.503	7.206	3.682	3.285
Electro-Chemical Processes	1.048	1.440	0.748	0.668
Other Process Use	0.034	0.140	0.124	0.111
DIRECT USES (PROCESS) TOTAL	8.590	11.151	5.739	5.121
DIRECT USES – NON-PROCESS				
Facility HVAC	0.946	1.094	0.522	0.465
Facility Lighting	0.630	0.742	0.324	0.289
Other Facility Support	0.149	0.231	0.118	0.105
Onsite Transportation	0.014	0.029	0.026	0.023
Other Non-process Use	0.010	0.029	0.019	0.017
DIRECT USES (NON-PROCESS) TOTAL	1.750	2.125	1.009	0.900
OTHER	0.312	0.212	0.073	0.065
TOTAL INDUSTRIAL ENERGY CONSUMPTION	10.704	13.902	6.917	6.172

4.12 Emissions from Residential and Commercial Buildings

Residential and commercial emissions come from South Carolina's buildings. In 2020, residential buildings made up 2.59% of the state's total emissions with 1.907 $MMTCO_2e$, while commercial buildings consisted of 2.9% of total gross statewide emissions (2.140 $MMTCO_2e$). Together, residential, and commercial buildings accounted for 5.49% of South Carolina's 2020 emissions at 4.047 $MMTCO_2e$. The CO_2 Fossil Fuel Combustion (CO_2FFC) and Stationary Combustion SIT modules provided the emissions values for residential and commercial buildings.



There are almost 2.5 million homes within the state of South Carolina. Commercial buildings include institutions (i.e., schools, hospitals), office buildings, buildings used for industrial manufacturing, production, service, sales, and business, recreational buildings, and government buildings.

At first glance, buildings appear to be only a small source of emissions for South Carolina, but it is important to consider the indirect emissions associated with buildings. Section 4.12.3 discusses indirect emissions within these sectors, principally from the demand for electric power generation.

4.12.1 Emissions by Greenhouse Gas

Residential and commercial buildings' most significant GHG is CO_2 with 4.016 $MMTCO_2e$ emitted within the state, followed by methane and nitrous oxide (Table 19).

Table 19. Residential and commercial emissions by greenhouse gas

Residential and Commercial Emissions by Greenhouse Gas				
Amounts of $MMTCO_2e$				
GHG	**1990**	**2005**	**2019**	**2020**
CO_2	3.500	3.996	4.172	4.016
CH_4	0.064	0.047	0.027	0.025
N_2O	0.011	0.009	0.006	0.006

4.12.2 Emissions by Fuel Type

Commercial and residential GHG emissions are primarily attributed to the direct use of natural gas, petroleum, or wood, such as fossil fuel combustion or burning wood, for the energy need of the building (Table 20). The largest sources of emissions from these are natural gas (2.900 $MMTCO_2e$) and petroleum (1.132 $MMTCO_2e$).

Table 20. Residential and commercial greenhouse gas emissions by fossil fuel

Residential and Commercial Greenhouse Gas Emissions by Fossil Fuel					
		Amounts of $MMTCO_2e$			
Source	**GHG**	**1990**	**2005**	**2019**	**2020**
RESIDENTIAL					
Coal	All[59]	0.003	--	--	--
Natural Gas	All	1.006	1.575	1.653	1.593
Petroleum	All	1.072	0.709	0.289	0.301
Wood	All	0.053	0.034	0.015	0.013
RESIDENTIAL TOTAL		2.134	2.318	1.956	1.907
COMMERCIAL					
Coal	All	0.012	--	--	--
Natural Gas	All	0.842	1.217	1.401	1.307
Petroleum	All	0.580	0.511	0.845	0.831
Wood	All	0.006	0.006	0.002	0.002
COMMERCIAL TOTAL		1.440	1.733	2.249	2.140
TOTAL		3.574	4.051	4.205	4.047

[59] "All" greenhouse gases include those that were provided in the SIT modules. For residential and commercial buildings, this included CO2, CH4, and N2O (see Table 19).

4.12.3 Indirect Residential and Commercial Emissions

Indirect emissions are emissions that arise from electric power generation due to a demand for energy. Demand from the residential and commercial sectors (among others) creates the need for the supply of electric power, making it useful to attribute energy generation emissions to these sectors. These emissions are considered indirect because they are accounted for in electric power generation emissions, but the electric power is used for lighting, heating, cooling, ventilation, refrigeration, appliances, and other needs within residential and commercial buildings (Table 21). Emissions were calculated through the SIT Energy Consumption module.[60] It is important to note that these emissions are counted within the electric power generation sector and are not being double counted.

Table 21. Greenhouse gas emissions from residential and commercial sources by energy use type
Source: Energy Consumption Module

Greenhouse Gas Emissions from Residential and Commercial Sources by Energy Use Type					
		Amounts of $MMTCO_2e$			
Source	**GHG**	**1990**	**2005**	**2019**	**2020**
RESIDENTIAL					
Space Heating	CO_2	0.857	0.921	1.274	1.205
Air Conditioning	CO_2	1.771	3.398	1.820	1.722
Water Heating	CO_2	0.857	1.433	1.235	1.168
Refrigeration	CO_2	0.971	1.187	0.442	0.418
Other Appliances and Lighting[61]	CO_2	3.456	5.486	3.249	3.074
RESIDENTIAL TOTAL		7.912	12.426	8.019	7.588
COMMERCIAL					
Space Heating	CO_2	0.183	0.259	0.086	0.077
Cooling	CO_2	1.071	1.747	1.160	1.043
Ventilation	CO_2	0.633	1.077	0.817	0.734
Water Heating	CO_2	0.170	0.225	0.032	0.029
Lighting	CO_2	1.935	2.754	0.935	0.840
Cooking	CO_2	0.049	0.102	0.118	0.106
Refrigeration	CO_2	0.596	1.054	0.881	0.792
Office Equipment	CO_2	0.073	0.170	0.226	0.203
Computers	CO_2	0.207	0.427	0.483	0.435
Other[62]	CO_2	0.584	1.068	0.967	0.869
COMMERCIAL TOTAL		5.500	8.883	5.705	5.128
TOTAL EMISSIONS		13.412	21.309	13.724	12.716

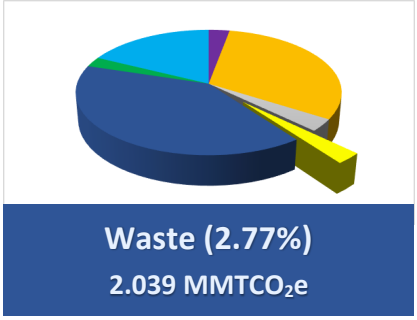
[60] Residential default data in the SIT comes from the Residential Energy Consumption Survey (RECS) (EIA 2023a). RECS provides information on the use of energy in residential housing units. Commercial default data in the SIT comes from the Commercial Building Energy Consumption Survey (CBECS) (EIA 2022). CBECS is a national sample survey that collects information on the stock of U.S. commercial buildings.

[61] "Other Appliances and Lighting" source includes ranges, cooktops, ovens, microwave ovens, outdoor grills, small kitchen appliances, dishwashers, clothes washers and dryers, and indoor and outdoor lighting.

[62] "Other" source includes miscellaneous plug loads, process equipment, motors, air compressors, and natural gas dryers.

4.13 Emissions from Waste and Wastewater

In 2020, South Carolina's waste emissions totaled 2.77% of gross state emissions at 2.039 $MMTCO_2e$. Emissions were calculated using the Solid Waste and the Wastewater SIT modules. Some data were not available in the SIT default settings, including methane emissions from fruits and vegetables, poultry, and pulp & paper. Future inventories may account for these sources of emissions to increase accuracy of accounting methods within the industry of waste and materials management.



Statewide total gross emissions from waste sources come from landfills, wastewater, municipal and industrial waste, and waste combustion. Some cross-cutting sources of indirect waste emissions include the transportation of hauling waste to facilities, emissions from industrial equipment in recycling and composting locations, and waste associated with residential and commercial buildings. These indirect emissions are accounted for within the waste source data, except for the hauling of waste to facilities, which is accounted for in the transportation data.

4.13.1 Waste Emissions by Greenhouse Gas

Methane is the largest greenhouse gas emitted in the waste sector (1.770 $MMTCO_2e$) coming from landfills and wastewater (Table 22). Relatively smaller amounts carbon dioxide and nitrous oxide also come from this sector. Within the waste sector, potential and net methane emissions differ due to several processes that avoid emitting CH_4 into the atmosphere. These processes include flaring, landfill gas-to-energy, and oxidation. Potential methane emissions are estimated at 4.507 $MMTCO_2e$, but after accounting for avoided methane, the estimated net methane emissions equals 1.770 $MMTCO_2e$.

Table 22. Waste emissions by greenhouse gas

Waste Emissions by Greenhouse Gas				
	Amounts of $MMTCO_2e$			
GHG	**1990**	**2005**	**2019**	**2020**
CH_4	2.076	3.905	1.923	1.770
CO_2	0.056	0.147	0.127	0.127
N_2O	0.093	0.118	0.140	0.142

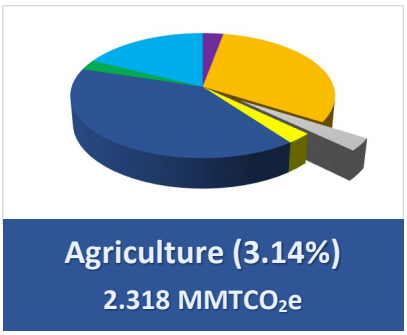
4.13.2 Waste Emissions from Landfills, Combustion, and Wastewater

Emissions from waste arise principally from landfills, waste combustion, and wastewater (Table 23).

Table 23. Greenhouse gas emissions from waste and wastewater sources

Greenhouse Gas Emissions from Waste and Wastewater Sources					
		Amounts of $MMTCO_2e$			
Source	**GHG**	**1990**	**2005**	**2019**	**2020**
LANDFILLS					
Potential CH_4					
MSW Generation	CH_4	1.900	4.650	4.237	4.212
Industrial Generation	CH_4	0.133	0.325	0.297	0.295
TOTAL	CH_4	2.033	4.975	4.533	4.507
CH_4 Avoided					
Flare	CH_4	--	(0.478)	(0.920)	(1.068)
Landfill Gas-to-Energy	CH_4	--	(0.493)	(1.880)	(1.880)
TOTAL		--	(0.972)	(2.801)	(2.949)
Oxidation					
MSW Landfill Oxidation	CH_4	(0.190)	(0.368)	(0.144)	(0.126)
Industrial Landfill Oxidation	CH_4	(0.013)	(0.033)	(0.030)	(0.029)
TOTAL		(0.203)	(0.401)	(0.174)	(0.155)
LANDFILL TOTAL		1.830	3.603	1.559	1.402
WASTE COMBUSTION					
Plastics	CO_2	0.038	0.102	0.083	0.083
Synthetic Rubber in MSW	CO_2	0.008	0.015	0.013	0.013
Synthetic Fibers	CO_2	0.010	0.030	0.031	0.031
Other	N_2O	0.002	0.003	0.002	0.002
COMBUSTION TOTAL		0.058	0.150	0.129	0.129
WASTEWATER					
Municipal	CH_4	0.247	0.301	0.364	0.368
Municipal	N_2O	0.091	0.116	0.138	0.140
WASTEWATER TOTAL		0.338	0.417	0.502	0.508
TOTAL EMISSIONS		2.225	4.170	2.190	2.039

4.14 Emissions from Agriculture



Emissions from the agriculture sector in South Carolina made up 3.14% of the state's total emissions with 2.318 $MMTCO_2e$ emitted. The largest sources of agriculture emissions are from enteric fermentation, manure management, rice cultivation, urea fertilization, agricultural residue burning, and agricultural soils (Table 25).

Emissions from agriculture were calculated using the SIT Agriculture module. Some data were not available in the SIT default settings, including emissions from rice cultivation and liming. The SIT default settings included liming emissions for about seven of the 30 years that data was provided, but the most recent year was 2018 and outside of the scope of this inventory. Future inventories may account for these sources of emissions to increase accuracy of accounting methods within agricultural practices.

4.14.1 Emissions by Greenhouse Gas

Nitrous oxide is the most predominant greenhouse gas emitted from agricultural practices in South Carolina (1.325 $MMTCO_2e$). Other GHGs emitted in agriculture include methane (0.976 $MMTCO_2e$) and a carbon dioxide (0.017 $MMTCO_2e$) (Table 24).

Table 24. Agricultural emissions by greenhouse gas[63]

Agricultural Emissions by Greenhouse Gas				
Amounts of $MMTCO_2e$				
GHG	**1990**	**2005**	**2019**	**2020**
N_2O	1.892	1.460	1.479	1.325
CH_4	1.400	1.287	1.002	0.976
CO_2	0.004	0.006	0.015	0.017

[63] Totals in Tables 24 and 25 are slightly different due to rounding methods used within the SIT tool.

4.14.2 Emissions by Agricultural Activity

Emissions by activity show that the largest source of agricultural emissions came from soils (1.156 $MMTCO_2e$). Enteric fermentation and manure management were also larger sources of emissions (0.653 $MMTCO_2e$ and 0.492 $MMTCO_2e$, respectively). Other sources of emissions included residue burning and urea fertilization (Table 25).

Table 25. Greenhouse gas emissions from agriculture by source[64]

Greenhouse Gas Emissions from Agriculture by Source					
		Amounts of $MMTCO_2e$			
SOURCE	**GHG**	**1990**	**2005**	**2019**	**2020**
Manure Management	N_2O	0.104	0.152	0.177	0.169
Agricultural Soils	N_2O	1.787	1.308	1.303	1.156
Enteric Fermentation	CH_4	1.029	0.867	0.664	0.653
Manure Management	CH_4	0.369	0.420	0.338	0.323
Rice Cultivation	CH_4	--	--	--	--
Agricultural Residue Burning	CH_4	0.002	0.001	0.000	0.001
Liming	CO_2	--	--	--	--
Urea Fertilization	CO_2	0.004	0.006	0.015	0.017
TOTAL EMISSIONS		**3.295**	**2.754**	**2.497**	**2.319**

[64] Dashes (--) indicate that there is no default data available for South Carolina in the SIT. Totals at the bottom of Tables 22 and 23 are slightly different due to rounding methods used within the SIT tool.

4.15 Emissions and Sequestration from Land Use and Forestry

Natural and working lands and forestry is a net sink for South Carolina, since the biomass in this sector sequesters or stores carbon. Emissions and sequestration were calculated using the Land Use, Land-Use Change, and Forestry (LULUCF) SIT module. Missing data included emissions from forest fires and drained organic soil. The South Carolina Forestry Commission provided data for forest fire emissions, but the drained organic soil data is an identified gap that may be addressed in future inventories.

In 2020, this sector stored a total of 23.567 $MMTCO_2e$, mostly in net forest carbon fluxes and urban trees (20.907 $MMTCO_2e$ and 3.366 $MMTCO_2e$ respectively, see Table 26). Forest fires and settlement soils were small sources of greenhouse gas emissions, including methane and nitrous oxide.

Forest carbon fluxes include sequestered carbon from forest land remaining forest and land converted to forest land. These classifications included above- and below-ground biomass, deadwood, litter, mineral and organic soil, and wood products and landfills. Emissions from forest carbon fluxes were from forest land converted to land for other uses (farming, urban, fields), including biomass, deadwood, litter, and mineral soil. Landfilled yard trimmings and food scraps also stored small amounts of carbon in grass, leaves, branches, and landfilled food scraps.

4.15.1 Sinks and Sources from Natural Lands, Working Lands, and Forestry

Natural lands, working lands, and forestry serve as a net carbon sink (Table 26). In 2020, these resources sequestered 23.567 $MMTCO_2e$.

Table 26. Land use, land-use change, and forestry (LULUCF) greenhouse gas emissions and sequestration

Land Use, Land-Use Change, and Forestry (LULUCF) GHG Emissions and Sequestration					
Note that parentheses indicate net sequestration		**Amounts of $MMTCO_2e$**			
EMISSIONS / SEQUESTRATION	**GHG**	**1990**	**2005**	**2019**	**2020**
NET FOREST CARBON FLUX					
Forest Land Remaining Forest Land					
Aboveground Biomass	CO_2	(9.640)	(9.460)	(9.590)	(9.140)
Belowground Biomass	CO_2	(2.080)	(1.980)	(1.940)	(1.840)
Deadwood	CO_2, CH_4	(0.760)	(0.940)	(1.260)	(1.250)
Litter	CO_2, CH_4	0.310	0.090	(0.040)	(0.020)
Soil (Mineral)	CO_2, CH_4	(0.050)	(0.290)	(0.400)	(0.390)
Soil (Organic)	CO_2, CH_4	--	--	0.010	0.010
Total Wood Products and Landfills	CO_2, CH_4	(8.645)	(9.057)	(9.057)	(9.057)
SUBTOTAL		(20.865)	(21.637)	(22.277)	(21.687)
Forest Land Remaining Forest Land					
Aboveground Biomass	CO_2	(1.430)	(1.420)	(1.410)	(1.410)
Belowground Biomass	CO_2	(0.280)	(0.280)	(0.280)	(0.280)
Deadwood	CO_2, CH_4	(0.190)	(0.180)	(0.180)	(0.180)
Litter	CO_2, CH_4	(0.400)	(0.400)	(0.400)	(0.400)
Soil (Mineral)	CO_2, CH_4	(0.020)	(0.020)	(0.010)	(0.010)
SUBTOTAL		(2.320)	(2.300)	(2.280)	(2.280)
Forest Land Converted to Land					
Aboveground Biomass	CO_2	1.540	1.810	2.120	2.120
Belowground Biomass	CO_2	0.300	0.360	0.420	0.420
Deadwood	CO_2, CH_4	0.100	0.120	0.140	0.140
Litter	CO_2, CH_4	0.240	0.280	0.330	0.330
Soil (Mineral)	CO_2, CH_4	0.030	0.050	0.050	0.050
SUBTOTAL		2.210	2.620	3.060	3.060
NET FOREST CARBON FLUX TOTAL		(20.975)	(21.317)	(21.497)	(20.907)
URBAN TREES					
	CO_2	(1.647)	(2.467)	(3.306)	(3.366)
URBAN TREES TOTAL		(1.647)	(2.467)	(3.306)	(3.366)
LANDFILLED YARD TRIMMINGS & FOOD SCRAPS					
Grass	CO_2, CH_4	(0.026)	(0.006)	(0.011)	(0.011)
Leaves	CO_2, CH_4	(0.067)	0.027	0.017	0.016
Branches	CO_2, CH_4	(0.136)	(0.043)	(0.049)	(0.050)
Landfilled Food Scraps	CO_2, CH_4	(0.035)	(0.051)	(0.064)	(0.064)
YARD TRIMMINGS & FOOD SCRAPS TOTAL		(0.264)	(0.074)	(0.107)	(0.109)
FOREST FIRES					
	CH_4	--	--	0.025	0.049
	N_2O	--	--	0.003	0.006
FOREST FIRES TOTAL		--	--	0.028	0.056
N_2O FROM SETTLEMENT SOILS					
	N_2O	0.030	0.025	0.025	0.025
SETTLEMENT SOILS TOTAL		0.030	0.025	0.025	0.025
AGRICULTURAL SOIL CARBON FLUX					
	CO_2	1.108	0.998	0.832	0.734
AGRICULTURAL SOIL FLUX TOTAL		1.108	0.998	0.832	0.734
TOTAL SEQUESTRATION		**(21.748)**	**(22.835)**	**(24.025)**	**(23.567)**

5 Greenhouse Gas Emissions Reductions

5.1 Introduction to Priority Reduction Measures

Sections 6 through 13 discuss the priority measures South Carolina may take to 1) increase carbon sequestration and storage or 2) reduce greenhouse gas and co-pollutant emissions.

EPA guidelines specify that priority measures should be implementation ready, achieve near-term GHG reductions, and demonstrate benefits for low income and disproportionately burdened communities.[65] "Implementation ready" refers to the presence of existing or planned programs that can be leveraged, expanded, or augmented by the Palmetto Air Quality Collaborative and through the CPRG award.

The PAQC received a variety of diverse, innovative, and beneficial reduction measures throughout the planning process. To identify priority measures, SCOR and DHEC considered input and feedback received from the Action Teams, the stakeholder survey, and state, regional, and local government agencies. SCOR and DHEC used the criteria listed in Table 27 to review and assess measure ideas.

Recommendations that were not selected as priority measures may have large emissions reduction potential and additional co-benefits, but funding, implementation, time requirements, or other constraints precluded their selection as priority measures for the PCAP. Measures that may be considered for the CCAP and/or implemented through other opportunities are presented in Section 16.3.

[65] EPA's Program Guidance (p. 53) states: "A PCAP must include a focused list of near-term, high-priority, implementation-ready measures that have been identified for implementation by the lead organization and any other collaborating entities (e.g., municipalities, tribes). For the lead organization, such measures should be those that it plans to implement directly and/or in partnership with collaborating agencies as described in their workplan. The PCAP should also indicate which measures could be implemented by other entities (e.g., air pollution control agencies, counties, and municipalities) within the state or metropolitan area. For each measure, the PCAP must provide an estimate of the quantifiable GHG emissions reductions, key implementing agency or agencies, implementation schedule and milestones, expected geographic location if applicable, milestones for obtaining legislative or regulatory authority as appropriate, identification of funding sources if relevant, and metrics for tracking progress." For more information, please see https://www.epa.gov/system/files/documents/2023-02/EPA%20CPRG%20Planning%20Grants%20Program%20Guidance%20for%20States-Municipalities-Air%20Agencies%2003-01-2023.pdf.

Table 27. Criteria to review and assess priority measures

Criteria	Considerations
Impact on GHG Emissions	
What is the potential impact on reducing GHG emissions?	• High potential reduction amount • Medium potential reduction amount • Low potential reduction amount
What are the estimated, quantified GHG reduction amounts?	• Estimated amount • Method(s) or tool(s) used to estimate
Is this measure implementation-ready (within 5 years)?	• Yes, related activities and/or plans currently in place • Possible, in development or in a planning process • No
How quickly could GHG emissions reductions be realized?	• Within 5 years (2025-2030) • Within 10 years (2025-2035) • Within 25 years (2025-2050)
Implementation Readiness	
Who has the authority and ability to implement? Who are the potential partners?	• State, regional (COGs), and/or local government • Private sector • Non-profit organizations • Professional associations • Academia • Community-based organizations • Other
What is the estimated cost of implementing this measure?	• Dollar amount
What are the potential opportunities and constraints?	• Cost effectiveness, commercial viability • Funding (including other investments or grant opportunities) • Policy • Public support • Technology • Workforce/staff capacity • Other
Benefits	
How will the measure benefit low income and disproportionately burdened communities?	• EPA requires use of the Climate and Economic Justice Screening Tool[66] to identify communities
What are the co-benefits?	• Co-pollutant reductions, air quality improvements • Community resilience • Cost savings, increased efficiency • Economic growth and diversity • Ecosystem and habitat restoration and/or conservation • Historic or cultural preservation • Public and community engagement • Other community priorities

[66] Executive Office of the President of the United States Council on Environmental Quality, Climate and Economic Justice Screening Tool, https://screeningtool.geoplatform.gov/en/#3/33.47/-97.5.

5.2 Reducing Greenhouse Gases: Benefits and Strategies

GHG reduction measures often have multiple co-benefits. Reducing greenhouse gas emissions can slow or reduce the climate trends and impacts discussed above (Section 3.2) and improve community safety and resilience. Reducing GHG emissions from transportation and industry sources can improve air quality and public health by reducing other air pollutants that are often co-emitted with GHGs. Deployment of new technologies can spur new innovations, create new jobs and workforce opportunities, and support economic growth and development. Enhancing and expanding carbon sinks through land conservation or land management practices can also provide flood mitigation, water quality, recreation, and habitat benefits.

There are many strategies available to reduce greenhouse gas emissions, and they can be implemented at any level of government, through organizational policies and practices, and by individual actions. Many GHG reduction measures and strategies are already being implemented voluntarily in South Carolina, while also providing other benefits. Examples of existing programs and planning activities are listed in Table 28 and Table 29.

The information provided in the tables are intended to be examples, not representative of all activities taking place in South Carolina. The PAQC will continue to collect information about strategies, programs, and specific activities occurring in the state and include those in the CCAP.

Table 28. Federal funding opportunities that align with greenhouse gas reductions

Implementing State Agency	Funding Program (funding amount)	Description/Connection to GHG Reductions	LINK
Energy Office	Home Efficiency Rebates Home Electrification and Appliance Rebates $136 million (expected)	Funded by the US Department of Energy, the South Carolina Energy Office will receive funding to implement the Home Efficiency Rebates and Home Electrification and Appliance Rebates programs. The programs provide rebates for energy efficiency retrofits, efficiency projects, and equipment. Individuals may be eligible for up to $18,000 in rebates between the two programs.	LINK
SC Ports Authority	Diesel Emissions Reduction Act (DERA) Grant[67] $1.3 million (2021) $2 million (2019)	SC Ports Authority has received several awards from the EPA DERA national and state programs to replace diesel equipment with hybrid and electric powered equipment.	
Department of Commerce / Palmetto Railways	Consolidated Rail Infrastructure and Safety Improvements Program Approximately $4.1 million	Funded by the US Department of Transportation, Palmetto Railways will deploy two zero-emission, lithium battery electric power locomotives and install associated charging technology.	LINK
Department of Commerce	Tech Hubs Program Seeking $75 million	The Department of Commerce is coordinating the SC NEXUS for Advanced Resilient Energy initiative, which was designated as a Tech Hub by the U.S. Economic Development Administration (EDA) in 2023. Commerce is currently seeking EDA funding for specific projects centered on grid resiliency and distributed energy systems. EDA funding will drive additional sustainable energy investment and technology development.	LINK

[67] DHEC provides EPA Diesel Emission Reduction Act (DERA) funding for projects that reduce diesel emissions in South Carolina. Funding for eligible project costs is available to universities, private organizations, businesses, and local government entities that reduce diesel emissions by retrofitting engines, installing idle reduction technologies, or replacing vehicles and equipment. https://scdhec.gov/environment/businesses-communities-go-green/environmental-loans-grants-businesses-communities/south

Implementing State Agency	Funding Program (funding amount)	Description/Connection to GHG Reductions	LINK
Department of Transportation (SCDOT)	National Electric Vehicle Infrastructure (NEVI) Formula Program Approximately $70 million total for 5 years (expected)	Funded by the USDOT, the NEVI program provides funding to states to strategically deploy electric vehicle (EV) infrastructure. SC's plan will prioritize deployment of passenger car EV charging equipment along the interstate highway system, to complement the national network, and or rural sections of the interstate where lack of urban facilities make private sector investments less feasible	LINK
	Carbon Reduction Program Approximately $112 total for 5 years (expected)	Funded by the US DOT, the Carbon Reduction Program provides funding to states to develop a Carbon Reduction Strategy and implement projects to reduce CO_2 emissions. In its Climate Reduction Strategy (Nov. 2023), SCDOT identified strategies and projects that will apply technological solutions to improve roadway operations through traffic control methods, information sharing and data analytics, and signal performance improvements.	
Department of Education	Clean School Bus Program $66 million	With EPA funding, the Department of Education has purchased 168 electric buses for 17 school districts. The new buses have led to fuel and maintenance cost savings, improve safety and efficiency, and reduced emissions of co-pollutants.	LINK

Table 29. Local plans and activities that align with greenhouse gas reductions

Agency or Organization	Plan or Activity	LINK
City of Charleston	Climate Action Plan	LINK
Charleston County	Greenhouse Gas Inventory	LINK
	Climate Action Planning	LINK
Charleston Area Regional Transportation Authority	Battery Electric Bus Master Plan & Roadmap	LINK
City of Columbia	Climate Protection Action Campaign	LINK
	Climate Action Plan	LINK
City of Greenville	Sustainable GVL: Vision for a Greener Greenville	LINK
Claflin University	Sustainability Action Plan	LINK
Clemson University	Sustainability Plan	LINK
	Net-Zero Goal	LINK
Coastal Carolina University	Sustain Coastal: Greenhouse Gas Inventory	LINK
Furman University	Climate Action Plan 2.0	LINK
College of Charleston	Sustainability Action Plan	LINK
Sustain SC	Roadmap to Sustain SC	LINK

5.3 South Carolina Priority Reduction Measures

The PAQC attempted to include priority reduction measures from every sector based on the criteria presented in Section 5.2 and that potentially related to other priority measures. Connections between priority measures increases their success and benefits throughout the state and spurs further progress as greenhouse gas reductions are realized.

The Priority Reduction Measures identified in this plan each have their own section and include:

- Land Conservation and Restoration (Section 6)
- Climate Smart Agriculture and Forestry (Section 7)
- Residential Weatherization and Energy Efficiency (Section 8)
- Organics Recovery and Food Waste (Section 9)
- State Agency Recycling (Section 10)
- Alternative and Multi-Modal Transportation (Section 11)
- Vehicle Transitions (Section 12)
- Industrial-Scale Energy Use and Efficiency (Section 13)

6 Land Conservation and Restoration

6.1 Objective

Improve South Carolina's ability to store carbon and reduce net GHG emissions through coordinated land acquisition, conservation, preservation, and restoration efforts.

6.2 Description

The state of South Carolina is a largely natural landscape, which is threatened by development and population growth. Preliminary analysis using the 2021 National Land Cover Database[68] and the US Geological Survey Protected Areas Database of the United States 3.0[69] shows South Carolina is 57% forested (11.4 million acres), with only 14% of that land considered protected. South Carolina's natural resources are an important asset to our state. Our managed forests, natural ecosystems, and other lands act as "sinks", meaning they store carbon. Land conservation and restoration is thus an important tool for reducing our overall statewide emissions. Each acre of forest can sequester up to .24 metric tons[70] of carbon per year, which totals 2,745,777.9 metric tons of CO_2 per year for South Carolina's forest land. Protecting and sustainably managing this resource is essential to reducing South Carolina's net emissions.

SCOR will coordinate and collaborate with other agencies and organizations to enhance carbon sequestration, reduce loss of effective carbon sinks, and optimize additional ecosystem and community benefits through land acquisition and restoration.

SCOR has an existing process to identify priority conservation areas, developed during the development of the South Carolina Strategic Statewide Resilience and Risk Reduction Plan (2023).[71] The Resilience Plan was developed in accordance with the principles identified in the South Carolina Floodwater Commission Report (2019)[72], which recommends that flood management programs recognize the beneficial functions of natural floodplains, salt marshes, beach dunes, forests, living shorelines and other natural features to reduce flood risk. The Statewide Resilience Plan highlights the important role that preservation and restoration of natural landscapes provide in protecting our communities and economies from flood hazards. Undeveloped lands provide the essential ecosystem services of water infiltration and stormwater conveyance. The Statewide Resilience Plan also recommends that the State identify priority flood mitigation areas for conservation. This provides a foundational methodology to collaborate with other state agencies and interest groups to leverage resources and identify opportunities that have co-benefits.

SCOR uses a combination of public and private datasets to better understand the landscape's role in flood mitigation across South Carolina (Figure 12). Flood risks (and whether mitigated or exacerbated)

[68] Multi-Resolution Land Characteristics Consortium, National Land Cover Database, https://www.mrlc.gov/data/nlcd-2021-land-cover-conus.
[69] U.S. Geological Survey, Gap Analysis Project (2020), Protected Areas Database of the United States 3.0, https://www.usgs.gov/programs/gap-analysis-project/science/pad-us-data-overview.
[70] EPA, Greenhouse Gases Equivalencies Calculator - Calculations and References, https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references.
[71] South Carolina Office of Resilience, South Carolina Strategic Statewide Resilience and Risk Reduction Plan (2023), https://scor.sc.gov/resilience.
[72] South Carolina Floodwater Commission Report Final Report (2019), https://governor.sc.gov/sites/governor/files/Documents/Floodwater%20Commission/SCFWC%20Report.pdf.

are influenced by natural land characteristics, the natural services that the land provides, and the pressures placed on those lands through land use change and population growth. The criteria SCOR uses to identify priority conservation areas center on flood hazard areas, flood mitigation benefits, marsh migration areas, current wetlands, and best infiltration areas. Protecting these areas will reduce community flood risks and allow for the natural storage and conveyance functions.

Operationally, the actual acquisition process can be lengthy and complicated. First, properties and parcels that meet conservation priorities and have flood mitigation benefits must be identified, along with a willing seller, landholder, or manager. The landowner may have a range of goals when considering opportunities associated with selling a property, entering into an easement arrangement, or implementing other conservation-minded land management practices. Second, If the land is to be purchased, arrangements need to be made for procurement and new land ownership and management. For example, a property could become part of the State Park Service or South Carolina Department of Natural Resources Heritage Trust program.[73] Finally, multiple funding sources may be necessary to afford an acquisition. Funders, such as state programs, federal grants, or private foundations, may have their own set of requirements and priorities which need to be addressed.

SCOR's primary programmatic focus of flooding, and identification of priority conservation areas to mitigate flood risk in the state, align with areas that sequester carbon. Figure 13 shows the overlap between SCOR's priority conservation areas and those areas identified as having carbon storage benefits by The Nature Conservancy's Resilient Land Mapping Tool.[74] Understanding the overlap of these datasets and using available data to ensure that acquisition decisions consider carbon potential will become critical to South Carolina's evolving conservation framework. Incorporating carbon reduction and sequestration potential criteria into the land prioritization and acquisition process could provide incentives for landowners interested in carbon credits to participate in these efforts.

[73] SCOR does not own or manage land resources.
[74] The Nature Conservancy Resilient Land Mapping Tool, https://www.maps.tnc.org/resilientland/.

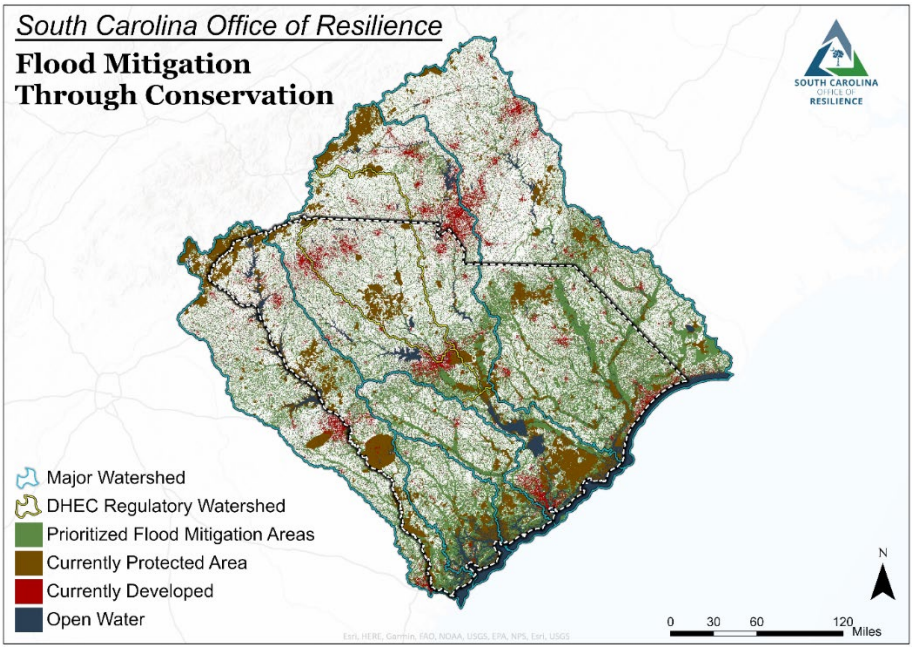


Figure 12. SCOR's statewide map of priority flood mitigation areas for conservation

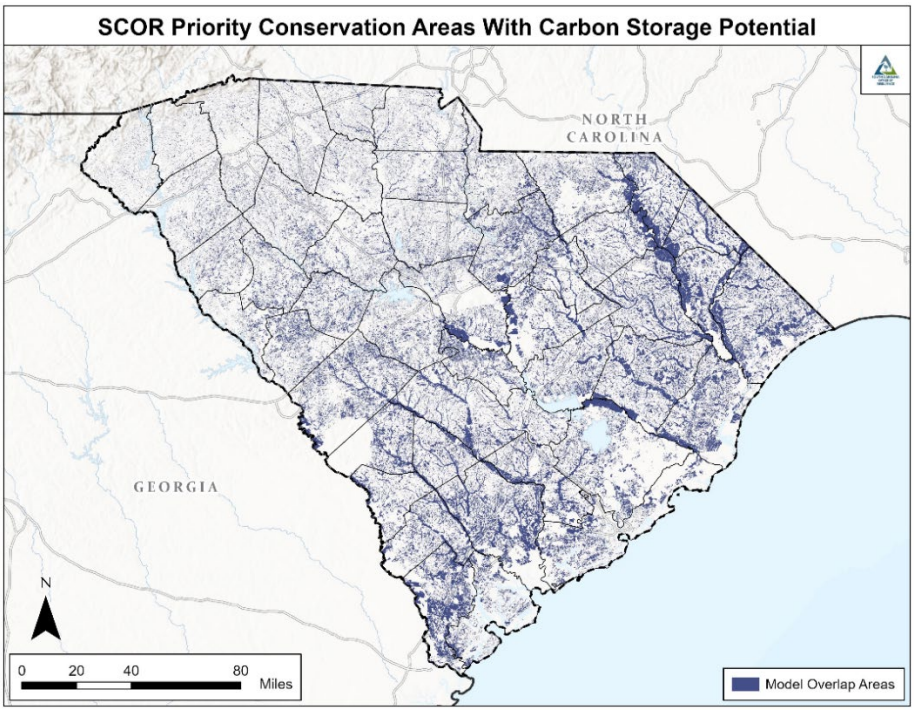


Figure 13. SCOR priority conservation areas with carbon storage potential
Sources: The Nature Conservancy[75] and SCOR[76]

[75] The Nature Conservancy, Resilient Land Mapping Tool. See the Core Concepts Carbon page for additional information, https://www.maps.tnc.org/resilientland/coreConcepts_carbon.html.
[76] SCOR, South Carolina Strategic Statewide Resilience and Risk Reduction Plan, Appendix G: Priority Flood Mitigation Areas for Conservation, available at https://scor.sc.gov/resilience.

6.3 Implementation

Lead/Coordinating Agency: SCOR

Expected/Potential Partners: Within South Carolina, SCOR expects to coordinate with state agencies with land conservation programs and projects (including the South Carolina Conservation Bank, South Carolina Department of Natural Resources, South Carolina Forestry Commission, and South Carolina Department of Parks, Recreation & Tourism). Additional partners may include Catawba Nation, S.C. Sea Grant Consortium, universities, Extension programs, non-profit and community-based organizations, land trusts, South Atlantic Salt Marsh Initiative[77], the South Carolina Lowcountry Sentinel Landscape[78], National Estuarine Research Reserve System programs and National Wildlife Refuges in South Carolina, and additional federal, regional, and local agencies.

SCOR is also working with a CPRG multi-state coalition including North Carolina, Virginia, and Maryland to develop a proposal for the CPRG Phase II Implementation Grant. The coalition will support state-specific priorities as well as the creation of a regional strategy to identify high-impact lands to conserve, measure and monitor carbon sequestration, and share lessons learned across the region.

Implementation schedule and milestones: Through the CPRG Phase I Planning Grant, SCOR is building staff capacity and obtaining a high-resolution land cover dataset for the state.[79] These additional resources will support efforts to identify high carbon-storage potential areas and benefits of various land conservation and restoration measures. The Planning Grant runs from July 2023 to June 2027.

Land acquisition and restoration measures could begin within one year of CPRG Implementation Grant funding, if awarded.

Metrics for tracking progress: Number of acres acquired or restored; amount of carbon sequestered and/or emissions avoided from land use change, per acre and total; cost effectiveness of measures, per acre and total; number of high impact acres acquired, to monitor co-benefits such as flood mitigation; incorporation of carbon sequestration analyses into SCOR's land acquisition and conservation decision making processes.

6.4 Emissions Reductions

SCOR conducted a preliminary analysis of 4 properties with high carbon storage potential using the analysis described in Appendix E1. The evaluated properties are diverse in geography, co-benefits, development pressure, and landcover, demonstrating the complexity associated with land acquisition. SCOR used The Nature Conservancy's Resilient Land Mapping Tool to estimate the carbon storage in these areas.[80] The tool's record begins in 2010, and it identifies the carbon sequestration potential if the forested area is left undisturbed until 2050. This allows for an estimate of total carbon stored per acre,

[77] South Atlantic Salt Marsh Initiative, https://marshforward.org/.
[78] South Carolina Lowcountry Sentinel Landscape, https://sentinellandscapes.org/landscapes/south-carolina-lowcountry/#about.
[79] National Oceanic and Atmospheric Administration, Office for Coastal Management, Digital Coast, C-CAP High-Resolution Land Cover, https://coast.noaa.gov/digitalcoast/data/ccaphighres.html.
[80] The Nature Conservancy, Resilient Land Mapping Tool, https://www.maps.tnc.org/resilientland/.

as well as understanding the change in that value over the 40-year time horizon. This translates into an estimate of annual carbon benefit, and the risk of loss if an area is developed.

As The Nature Conservancy's model only evaluates forest carbon, SCOR used an alternate approach to estimating the carbon sequestration potential of the saltmarsh property. The saltmarsh estimates were developed by using a coefficient of 0.8799 metric tons of CO_2 per acre of saltmarsh per year, and a coefficient of 0.24 metric tons per acre per year for any present forests[81, 82]

With these methods, and with the approximately 9,500 acres of potential property acquisitions, the additional carbon benefits of land conservation are estimated to be 28,835.9 and 144,179.4 metric tons in 2030 and 2050 respectively (Table 30).

Table 30. Carbon inventories and projected potential for conservation acquisition projects
Appendix E1 provides more information regarding the approach to generate these estimates.

Conservation Acquisition Project	Estimated Acres	Estimated Carbon Stored: 2025	Estimated Carbon Stored: 2030	Change from 2025 Carbon Sequestered	Estimated Carbon Stored: 2050	Change from 2025 Carbon Sequestered
					Estimated Carbon Sequestered (MTCO2e)	
Salt Marsh	1,100	23,572.26	27,250.1	3,677.9	41,961.7	18,389.4
Upstate Forest	1,000	81,579.9	84,661.7	3,081.8	96,988.9	15,409.0
Pee Dee Bottomland	5,000	332,594.4	348,035.2	15,440.8	409,798.4	77,204.0
Pee Dee Upland	2,400	189,925.2	196,560.6	6,635.4	223,102.2	33,177.0
TOTALS	9,580	627,658.9	656,490.5	28,835.9	771,816.9	144,179.4

6.5 Benefits

Land conservation and management measures will be prioritized based on their potential to reduce net GHG emissions, as well as achieve a range of environmental, economic, cultural, and social co-benefits. This priority measure is expected to result in increased climate resilience and other benefits for low-income communities, particularly those communities located in areas projected to be at high risk to floods and wildfires and agricultural and building losses due to future, extreme weather events. South Carolina's conservation efforts also target benefits related to conservation corridors, ecology, sustainable forestry, sustainable agriculture, water resources, and public access[83], which all serve as co-benefits to the direct goals of carbon storage potential and air quality improvement. In addition, conservation benefits, although difficult to quantify, are felt through their intrinsic cultural and community value, opportunity of physical activities, stress and blood pressure reduction, a local sense of place, protections of essential subsistence resources, and the economic benefits of ecotourism.[84]

[81]EPA, Greenhouse Gases Equivalencies Calculator - Calculations and References, https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references
[82] Mcleod, et al., 2011, A blueprint for blue carbon: toward an improved understanding of the role of vegetated coastal habitats in sequestering CO2, https://doi.org/10.1890/110004.
[83] South Carolina Conservation Bank Statewide Priorities, https://sccbank.sc.gov/statewide-priorities
[84] EPA, EnviroAtlas Benefit Category: Recreation, Culture, and Aesthetics, https://www.epa.gov/enviroatlas/enviroatlas-benefit-category-recreation-culture-and-aesthetics.

6.5.1 Floodplain Conservation and Restoration Benefits

Floodplain conservation and restoration are crucial for maintaining the ecological health of river systems and mitigating the impacts of flooding on surrounding communities. By preserving natural floodplains and restoring degraded areas, we can enhance water quality, recharge groundwater supplies, provide habitat for diverse plant and animal species, and act as carbon sinks. Additionally, well-managed floodplains act as valuable buffers during extreme weather events, reducing the severity of floods and protecting both human infrastructure and natural habitats.

6.5.2 Coastal Conservation Benefits

Restoring coastal habitats, wetlands, and forests to sink carbon will also help to restore ecosystem services; enhance local economic opportunities; protect culturally significant places, fish and wildlife habitat, recreational access, and subsistence food access; and prevent emissions from land-use change.[85] Additionally, these coastal ecosystems sequester significant amounts of carbon, helping to mitigate climate change by storing carbon dioxide. Ensuring the preservation and sustainable management of coastal areas is essential for safeguarding biodiversity, supporting livelihoods, and mitigating the impacts of climate change on both marine and human communities.

6.5.3 Blue Carbon and Wetland Protection Benefits

Blue carbon plays a crucial role in sequestering large amounts of carbon dioxide from the atmosphere, with salt marshes being significant contributors to this process. These marshes store carbon in their plant biomass and sediment, trapping carbon that would otherwise contribute to greenhouse gas emissions. Preserving and restoring salt marsh ecosystems is essential not only for their biodiversity but also for their capacity to act as powerful carbon sinks, emphasizing the importance of conservation efforts in maintaining these invaluable ecosystems for carbon sequestration.

6.6 Review of Authority

SCOR is tasked with the responsibility to develop, implement, and maintain the Statewide Resilience Plan and to lead and coordinate statewide resilience efforts with stakeholders to include federal, state, and local governmental agencies, regional governmental entities, private for-profit and non-profit organizations, industries, and academic institutions (S.C. Code Ann. § 48-62-10 et seq.). SCOR's statutory authority includes the management of the Disaster Relief and Resilience Reserve Fund (S.C. Code Ann. § 48-62-50 et seq.).

SCOR developed land conservation priorities and identified the role of nature-based solutions for flood mitigation received from land conservation and restoration efforts (S.C. Code Ann. § 48-62-30(1)(b) and (d)(iii)). These efforts also provide co-benefits for GHG reduction efforts, to include enhanced carbon sink capabilities.

6.7 Intersection with other programs, projects, and funding

SCOR coordinates with a wide variety of agencies and organizations to facilitate land acquisition and conservation for resilience and flood mitigation purposes. SCOR manages the Disaster Relief and Resilience Reserve Fund. These funds may be used to develop, implement, and maintain the Strategic

[85] The South Atlantic Salt Marsh Initiative's *Marsh Forward* Regional Plan highlights multiple benefits of salt marsh conservation, including carbon sequestration, protection of fish and wildlife habitat, and storm protection. Available at https://marshforward.org/media/4bvhppi3/sasmi-plan.pdf.

Statewide Resilience and Risk Reduction Plan, to provide disaster relief assistance, hazard mitigation, and infrastructure improvements as set forth in the statute (S.C. Code Ann. § 48-62-50 et seq.). The fund was initially capitalized with $44 million. $200 million was recently added to the Reserve Fund by the 2022-2023 state budget.

SCOR is currently initiating a watershed-based resilience planning program, which will assist communities in identifying, developing, and implementing resilience-building strategies and policies on the local level.

S.C. Sea Grant Consortium and many other organizations are developing blue carbon projects and strategies to enhance carbon sequestration in the state's coastal ecosystems including salt marsh, submerged aquatic vegetation, tidal freshwater forested wetlands, coastal peatlands, and maritime forests.

The Nature Conservancy, South Carolina Chapter, is starting the "Transforming the Scale and Equally of Living Shorelines in South Carolina" project in 2024. The Nature Conservancy (TNC), SCOR, and other partners will develop a methodology for funding and installing living shoreline projects in underserved communities. Paid Community Ambassadors positions will remove some of the financial barriers that often limits engagement. The program will also leverage existing relationships with local and regional groups like the Gullah Geechee.

The South Carolina Green Infrastructure Plan provides a roadmap and strategic plan for protecting the state's natural landscapes and habitats.[86] Many regional and local government entities have developed green infrastructure plans and urban forest initiatives, often as part of comprehensive planning processes. A comprehensive plan is the primary long-range plan adopted by a jurisdiction to guide the development of a community in decisions regarding growth and development, public investments, land use regulation, green space, and economic development.

Efforts focused on natural land conservation and restoration will work with the Climate-Smart Agriculture and Forestry (Section 14.1.28) initiative to find mutual areas of alignment and new opportunities for further development.

[86] South Carolina Forestry Commission, South Carolina Green Infrastructure Plan (2023), https://www.scfc.gov/management/urban-forestry/sc-green-infrastructure-plan-2023/.

7 Climate Smart Agriculture and Forestry

7.1 Objective

Expand the existing Climate Smart Agriculture and Forestry pilot programs to increase carbon storage compared to current trends and provide benefits to a greater number of landowners.

7.2 Description

Agriculture is the source of approximately 3.14% of GHG emissions in South Carolina. Sustainable forestry management practices, and forest land remaining forest, maintains carbon in the forest system. Land management practices such as afforestation, forest fires, deadwood, or clearing natural lands for farmland or urban development are a source of greenhouse gases. Many opportunities exist to reduce emissions from the agriculture, working lands, and forestry sectors, as well as to implement practices that can enhance the capacity of South Carolina's lands and soils to store carbon.

South Carolina's two land-grant institutions, Clemson University and South Carolina State University are partnering on a pilot project funded by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS), through the USDA-NRCS Partnership for Climate-Smart Commodities grant program.[87] The USDA-NRCS defines a "climate-smart commodity" as an agricultural commodity that is produced using agricultural (farming, ranching, or forestry) practices to reduce greenhouse gas emissions or sequester carbon. The goal of the program is to increase the acreage and number of farmers and landowners using climate-smart practices like cover cropping, prescribed grazing, reduced tillage, and other conservation tactics.

The Climate-Smart Agriculture pilot project currently provides incentives to participating producers to adopt practices such as planting cover crops, leaving crop residue in fields to limit soil disturbing activities, eliminating tillage practices, and planting legumes and other species (alfalfa, clover) in forage areas.

The Climate-Smart Forestry (CSF) program pilots an approach to forest management that supports traditional practices to enhance forest growth, such as planting, thinning, and harvesting, along with modern objectives for carbon storage and ecosystem resilience.[88] The state's forests have the capacity to sequester carbon from the atmosphere on an annual basis, and there is substantial opportunity to increase the rate of carbon sequestration through CSF practices. CSF incentives center on stand restoration, improvements, and maintenance practices while adhering to NRCS Conservation Practice Standards.[89]

The pilot project provides technical assistance and financial incentives to farmers and landowners to enable adoption of these climate-smart practices. The program also includes a market development component, where researchers, extension agents, and producers work together to explore opportunities for products associated with climate smart practices. The project employs marketing specialists to analyze new markets for the resulting products and help create new opportunities for the

[87] US Department of Agriculture, Partnerships for Climate-Smart Commodities, https://www.usda.gov/climate-solutions/climate-smart-commodities
[88] Shephard and Maggard, What Is Climate-Smart Forestry? https://www.aces.edu/blog/topics/forestry/what-is-climate-smart-forestry/
[89] US Department of Agriculture, Natural Resources Conservation Service, Conservation Practice Standards, https://www.nrcs.usda.gov/resources/guides-and-instructions/conservation-practice-standards

agricultural community across the state. Better utilization of wood products to favor long-term storage, such as in above-ground structures, has the potential to contribute to net carbon storage goals.

The initial round of funding occurred in the Fall of 2022 and has been an overwhelming success; the program is currently oversubscribed and additional funding is needed to expand access. Expansion of the Climate-Smart Agriculture and Forestry programs will deliver additional greenhouse gas emissions reductions by implementing scientifically justified, sustainable management practices and extending incentives so that a greater number of landowners (and acres) can enroll. A program expansion also leverages and builds upon the investments already made in partnerships and landowner relationships, extension programs, measurement capacity, and program administration.

7.3 Implementation

Lead/Coordinating Agency: Clemson University.

Expected/Potential Partners: SC State University, Clemson Extension, SC Department of Agriculture (SCDA), SC Farm Bureau, Longleaf Alliance, The Center for Heirs' Property Preservation, U.S. Endowment for Forestry and Communities, Catawba Nation, The Nature Conservancy, SC Office of Resilience, agribusinesses, landowners, and non-profit organizations.

Implementation schedule and milestones: Implementation could begin within one year of CPRG Implementation Grant funding, if awarded. Approximately 200 farmers and landowners currently participate, with 17,000 acres enrolled. The expanded Climate Smart Agriculture and Forestry program aims to enroll approximately 500 additional, unique landowners and 83,700 total acres within the first year of funding (2024-2025), to maximize GHG benefits.

Metrics for tracking progress: Total number of landowners and acres enrolled in the program; total GHG reductions; cost/ton of carbon; total carbon benefits/acre; total carbon benefits/acre/year.

7.4 Emissions Reductions

Agriculture estimates: Adopting climate-smart practices can contribute to GHG emissions reductions. Assuming an approximate $20 million additional investment in incentives to enroll 250 new producers and 72,700 acres, the Clemson Climate-Smart Commodities program annual GHG reduction benefits of 75,405 $MTCO_2e$ (Table 31; Appendix E2).

These estimates assume that producers receive annual incentive payments for 5 years to implement climate-smart practices. They continue those practices in part due to behavioral change and also because of the additional benefits they receive, for example, improved soil quality, improved water quality, increased crop productivity, additional cost savings or improved operational efficiencies, and business opportunities for their product(s).

Table 31. Estimated greenhouse gas reductions from Climate Smart Agriculture

Climate Smart Agriculture Practices	Estimated Acres	Estimated GHG Benefits (per acre/ year)	Estimated Annual Emissions Reduction	Estimated Emissions Reduction: 2025-2030	Estimated Emissions Reduction: 2025-2050
			Estimated Carbon Sequestered ($MTCO_2e$)		
Peanut (Cover Crop)	13,000	0.47	6,110	30,500	152,500
Peanut (Reduced Tillage)	30,000	1.38	41,400	207,000	1,035,000
Leafy Greens (Cover Crop)	900	0.47	423	2,115	10,575
Leafy Greens (Reduced Tillage)	900	0.36	324	1,620	8,100
Leafy Greens (Mulching)	900	0.32	288	1,440	7,200
Cattle (Legumes)	11,000	2.13	23,430	117,150	585,750
Cattle (Prescribed Grazing)	11,000	0.28	3,080	15,400	77,000
Cattle (Nutrient Management)	5,000	0.07	350	1,750	8,750
TOTALS	72,700	5.48	75,405	376,975	1,884,875

Forestry estimates: Climate-smart forestry contributions to GHG reduction estimates assume an investment of approximately $15 million for landowner incentives (between 230-250 new landowners; 11,000 total acres) and program implementation and management, with program expansion beginning in 2024. Acre estimates for the three main practice categories (restoration, improvement, maintenance) are based on current CSF pilot program activities. Not all practices are implemented on all 11,000 acres. The activities included in Table 32 do not include supporting practices such as prescribed fire and site preparation, which are often required to implement prior to the main practices. Annual GHG reduction benefits are estimated at 29,990 $MTCO_2e$ (Table 32; Appendix E2). The estimates assume that stand improvement practices made in 2025-2030 will continue to have GHG benefits for a 25-year period (i.e., through 2050).

Table 32. Estimated greenhouse gas reductions from Climate Smart Forestry

Climate Smart Forestry Practices	Estimated Acres	Estimated GHG Benefits (per acre/year)	Estimated Annual Emissions Reduction	Estimated Emissions Reduction: 2025-2030	Estimated Emissions Reduction: 2025-2050
			Estimated Carbon Sequestered ($MTCO_2e$)		
Restoration (Planting)	1,000	1.30	1,300	6,500	32,500
Stand Improvement (Planting)	870	1.30	1,131	5,655	28,275
Stand Improvement (Thinning)	2,174	2.66	5,783	28,914	144,571
Improvement (Tree/Shrub Establishment)	1,957	1.30	2,544	12,721	63,303
Stand Improvement (Maintenance)	4,808	4	19,232	96,160	480,800
TOTALS	10,809	11	29,990	149,950	749,449

7.5 Benefits

The Climate-Smart Commodities program is designed to serve a diverse range of farmers, ranchers, and landowners and provide direct, meaningful benefits for small-scale (less than 100 acres) and underserved producers.[90] Current enrollment in South Carolina's pilot program demonstrates the capacity to reach those audiences. Over half of participants are considered small-scale farmers and approximately one-third represent traditionally underserved communities (for example, Black and Native American farmers).

An expansion of the Climate-Smart Commodities program would allow more landowners into the program, including those located in underserved and low-income communities. New funding could expand the program's focus to include afforestation, longleaf pine restoration, biodiversity and forest health improvements, and forestry protection in rapidly developing counties. Climate smart agriculture practices can help to improve soil quality and crop productivity and expand commodity markets, ensuring that agriculture remains an economically viable option for smaller landowners. Building and maintaining agricultural and business opportunities may help to minimize conversion of agricultural and forest land and long-term benefits of those land resources for carbon storage. Implementing climate smart practices and encouraging forest growth also has benefits for water quality and quantity, flood mitigation, native wildlife and plant habitat, land restoration, and other ecosystem services.

Both agriculture and forestry are significant components of South Carolina's economy. Overall, the agribusiness sector (agriculture, forestry, and related goods and products) had a total economic impact of $51.8 billion in 2020. Agriculture contributed $28.6 billion, including more than 159,000 jobs and over $6.7 billion in labor income. Forestry contributed $23.2 billion, while providing more than 100,000 jobs and $5.5 billion in labor income. Despite this sizable impact, there remains significant opportunity for growth, particularly in new product and market development. The Climate-Smart Commodities program can help to expand local and global markets for new wood and agricultural products.[91]

7.6 Review of Authority

As land-grant universities and through their respective public service activities and extension services, Clemson University and South Carolina State University, provide educational opportunities, conduct research, and offer other services directly impacting, supporting, and enhancing South Carolina's agriculture and forestry sectors. See The Morrill Act of 1862, ch. 130, 12 Stat. 503 (1862) (codified as amended at 7 U.S.C.A §§ 301-308 (1980), S.C. Code Ann. § 46-7-70, and S.C. Code Ann. § 46-7-90.

S.C. Code Ann. § 48-62-10, et seq., statutorily mandates SCOR to develop and implement statewide resilience plan. This includes the responsibility to collaborate and coordinate with other resilience partners such as state academic institutions, federal and state government agencies, agribusinesses, non-profit entities, and landowners.

7.7 Intersection with other programs, projects, and funding

The US Department of Agriculture currently funds the Climate-Smart Commodities Program.

[90] US Department of Agriculture, Partnerships for Climate-Smart Commodities, https://www.usda.gov/climate-solutions/climate-smart-commodities.
[91] Von Nessen, J. C., The Economic Impact of Agribusiness in South Carolina (2022), South Carolina Department of Agriculture, https://agriculture.sc.gov/wp-content/uploads/2022/12/Economic-Impact-Study-Nov-2022.pdf.

The Center for Heirs' Property Preservation provides education and technical assistance to help historically underserved landowners access forest management programs and resources.[92] Organizations such as the Longleaf Alliance[93] and U.S. Endowment for Forestry and Communities[94] partner on efforts to maintain working forests and providing landowners with resources, technical assistance, and partnerships.

[92] The Center for Heirs' Property Preservation, Put Your Land To Work, https://www.heirsproperty.org/put-your-land-to-work/.
[93] The Longleaf Alliance, https://longleafalliance.org/.
[94] U.S. Endowment for Forestry and Communities, https://www.usendowment.org/.

8 Residential Weatherization and Energy Efficiency

8.1 Objective

Expand and coordinate weatherization and energy efficiency programs for residential buildings.

8.2 Description

There are almost 2.5 million homes within the state of South Carolina. Approximately 68.4% of the homes are single-family homes, 17.2% are multifamily homes, 14.2% are mobile homes, and 0.2% are RVs, vans, or boats. Over 62% of the homes in South Carolina are more than 25 years old, and 32% of the homes are more than 45 years old.[95]

From 2022 to 2023, South Carolina had the fastest growing population in the U.S. with a growth rate of 1.7% and over 90,600 new residents to the state.[96] However, like many states across the nation, South Carolina is experiencing a housing inventory shortage. As the population continues to climb, the need for energy efficient and affordable housing is critical.

Overall, almost 40% of all South Carolinians live in disadvantaged census tracts, and 10.5% live in energy burdened census tracts, according to the Climate and Economic Justice Screening Tool (CEJST; see Figure 2). The 2023 Palmetto State Housing Study found that housing repair is a significant need for both low- and medium-income households.[97]

Weatherization is the reduction of consumption by protecting the interior of the home from the exterior elements. Energy efficiency means using less energy to support the same output and building to the highest standard with modern, efficient appliances. Weatherization and energy efficiency are two major pathways that South Carolina can take to address its aging housing inventory. As the statewide population rapidly grows, so does the demand for homes, but the energy and money required to heat and cool older, less efficient, and less durable homes is a significant issue for many state residents.

The resident's financial burden of energy bills also creates a financial burden to update the home. Funding is available for certain weatherization or appliance upgrades, but gaps exist in funding critical home repairs, often necessary before weatherization can occur.

Several efforts across the state are working towards improving critical home repair, weatherization, and energy efficiency for the aging housing stock. For examples, in 2022-2023, the U.S. Department of Energy's (DOE) National Renewable Energy Lab (NREL) conducted a thorough analysis of the housing stock for the City of Columbia through the Communities Local Energy Action Program.[98] The

[95] US Census Bureau, South Carolina Selected Housing Characteristics (ACS 2022 1 Year Estimates), https://data.census.gov/table/ACSDP1Y2022.DP04?q=DP04&t=Families%20and%20Living%20Arrangements&g=040XX00US45

[96] US Census Bureau, US Population Trends Return to Pre-Pandemic Norms as More States Gain Population, https://www.census.gov/newsroom/press-releases/2023/population-trends-return-to-pre-pandemic-norms.html

[97] Von Nessen, J. C., Palmetto State Housing Study 2023, Supply and Demand Analysis, https://www.schousing.com/library/marketing/Palmetto-State-Housing-Study-2023.pdf.

[98] See the Central Midlands MSA PCAP, Measure FG.1, page 27. Through this program, Columbia sought NREL's assistance in addressing the energy burden for low- and middle-income residents, including renters. According to the Central Midlands Columbia MSA PCAP report, the "yearlong effort concluded in December 2023 and brought together residents, community organizations, and government to analyze pathways to energy efficiency.

Sustainability Institute is a nonprofit organization based in Charleston that advances sustainable, resilient, and equitable communities through three focus areas, including weatherization. The Sustainability Institute assists low-income households in the Charleston area who are struggling with high energy burdens to weatherize and retrofit their homes.[99]

With a variety of related efforts occurring across the state, there is a need to coordinate disparate programs (for example, those run by utilities, non-profits, government agencies), encourage consistent communications among service providers, and provide a more efficient and understandable process for households in need of assistance.

This priority measure follows recommendations made in the South Carolina Energy Office's Energy Efficiency Roadmap (2020), which highlights how a coordinated, statewide program could address these needs and gaps.[100] A Residential Weatherization and Energy Efficiency (RWEE) Hub would create a "one-stop-shop" (OSS) for applicants to receive beginning-to-end guidance on available services and a complete inventory of programs available to the homeowner, including grants, rebates, and tax incentives, in order to optimize funding available through state, federal, utility, private, and non-profit sources.

The program will aim to provide comprehensive services for eligible applicants, with options to address critical home repair and pre-weatherization needs, health and safety, energy efficiency, and indoor air quality. In addition, the program will seek to establish standard energy efficiency guidelines and/or a certification program (i.e., RWEE Program Standards) to encourage consistent and comprehensive program implementation by households, developers, and assistance providers. There may also be opportunities to leverage other funding sources to install solar on eligible structures.

8.3 Implementation

Lead/Coordinating Agency: SCOR

Expected/Potential Partners: South Carolina Energy Office, Catawba Nation, cities and municipalities, state agencies, local governments, non-profit organizations, housing authorities, utilities.

This program would be administered by SCOR, based on a program in place for remodeling and rebuilding homes post-disaster and providing case management services to participants. The program would also extend and expand the pre-weatherization repairs and weatherization improvements being done by non-profits organizations, housing authorities, and other organizations in the state. Home renovations would be contracted out to small local businesses that agree to meet program building standards to boost South Carolina's local economy. Audits on the builders' work would ensure standards are met. This program would increase jobs as new auditors are trained through established certification programs.

Implementation schedule and milestones: Implementation could begin within one year of receipt of CPRG funding, if awarded, after the creation of the RWEE Hub and completed program design. Major milestones include the creation and development of the RWEE Hub, contract signing for the primary

Stakeholder engagement under the Communities LEAP program included a housing summit in November 2023 to discuss the results and plan for next steps and implementation options."

[99] The Sustainability Institute, http://sustainabilityinstitutesc.org/.

[100] South Carolina Energy Office, https://energy.sc.gov/focus-area/energy-efficiency.

construction management team, the complete development of energy efficiency building standards and auditing process, the launch date for the OSS resources hub, the opening day for the application intake center, the first home renovation start and end dates, and the metrics for tracking progress described below.

Metrics for tracking progress: Number of households updated; types of improvements completed; total estimated energy savings based on post-construction energy audits; estimated GHG reductions, per home and total program; metrics on post-renovation energy audits.

8.4 Emissions Reductions

SCOR used data from NREL's "State Level Residential Building Stock and Energy Efficiency & Electrification Packages Analysis" (ResStock)[101] to calculate emissions reduction estimates and to inform a broader assessment of household and community benefits. Annual reductions per home were found in ResStock by including only data for South Carolina single-family detached homes that were built prior to 1980 and located in areas with a median income of 0-80%. The following equation was then used to calculate the estimated annual GHG emissions reductions for the program:

[(Annual reduction per year) x (# of years of program)] + (sum of reductions to date)

Annual emissions reductions, given 1,000 homes are renovated to RWEE Program Standards, are estimated to be approximately 3,877 $MTCO_2e$ (Table 33). Estimated reductions from 2025 through 2030 are approximately 81,417 $MTCO_2e$, and 1,360,827 $MTCO_2e$ (1.361 $MMTCO_2e$). These estimates were calculated using an average and may be higher if program emphasis is on retrofitting homes that are fueled by coal-fired power generation or propane, for example.

Table 33. Estimated emissions reductions from RWEE programs
This table uses data from NREL's ResStock energy efficiency modeling dashboard. All results are in MTCO2e.

RWEE Improvement	Average Annual Reduction per House ($MTCO_2e$)	Annual Emissions Reduction ($MTCO_2e$)	Emissions Reduction: 2025-2030 ($MTCO_2e$)	Emissions Reduction: 2025-2050 ($MTCO_2e$)
Enhanced enclosure (building envelope), plus high-efficiency heat pump and heat pump water heater	3.877	3,877	81,417	1,360,827

8.5 Benefits

The South Carolina housing inventory is aging, which contributes to a large energy burden for residents, especially in disproportionately burdened and low-income communities, where large percentages of income spent on the high energy costs to heat, cool, and electrify homes. Goals of this program will be to reduce household energy costs while also reducing energy consumption. Some benefits can be quantified through data obtained through NREL's ResStock tool, including the average annual utility bill savings and energy use reduction for the homeowner or tenant. Table 34 shows these quantified,

[101]Brossman, Jes, Lixi Liu, Ben Polly, Elaina Present, Jenny Erwin. 2023. "State Level Residential Building Stock and Energy Efficiency & Electrification Packages Analysis". Tableau Dashboard. Golden, CO: National Renewable Energy Laboratory.

annual benefits for the tenant of the home, based on the energy efficiency improvements presented in Section 8.4.

Table 34. Quantified benefits of the RWEE Hub and retrofitting program

RWEE Improvement	Average Annual Utility Bill Savings	Energy Savings Average (MMBtu)
Enhanced enclosure (building envelope)	$632	25
Enhanced enclosure with heat pump water heater and high-efficiency heat pump with electric heat backup	$753	52

8.6 Review of Authority

S.C. Code Ann. § 48-62-20(B) statutorily transferred the South Carolina Disaster Recovery Office to SCOR. The Disaster Recovery Office – now SCOR - is experienced in the management of federal housing relief funds and is responsible for the development and implementation of housing recovery programs for low-to-moderate income residents impacted by federally declared disasters. The program rebuilds or repairs storm-damaged homes utilizing energy efficiencies to address critical safety needs and provide safe, secure, and sanitary housing.

SCOR's purpose is to lead and to coordinate statewide resilience planning efforts with federal, state, and local governmental agencies, non-profit organizations, and other stakeholders (S.C. Code Ann. § 48-62-20 (A)).

S.C. Code Ann. § 48-52-410 established the State Energy Office and located the office within the South Carolina Office of Regulatory Staff. The Energy Office serves as the principal energy planning entity and functions in a non-regulatory manner for the State. Its primary purpose is to develop and implement a well-balanced energy strategy and increase the efficient use of all energy sources throughout South Carolina through the implementation of a Plan for State Energy Policy (S.C. Code Ann. §§ 48-52-410, 48-52-430).

S.C. Code Ann. § 43-45-10 et seq., created the South Carolina Office of Economic Opportunity. It is the state's administering agency for the Community Services Block Grant, Low-Income Home Energy Assistance Program, and Weatherization Program. The Office of Economic Opportunity functions include collaborating and coordinating with other state agencies in efforts to address the needs of the poor and reducing the impacts and effects of poverty upon the citizens.

8.7 Intersection with other programs, projects, and funding

The Energy Office's Energy Saver Tool serves as an online resource to communicate available funding for energy-related improvements for homes and businesses.[102]

Funding streams may include EPA CPRG Implementation Grants, IRA Energy Efficiency Home Rebate Program, IRA Tax Credits, Energy Efficiency and Conservation Block Grant Program, utility programs and incentives, and local municipality funding.

[102] South Carolina Energy Office, Energy Saver Tool, https://energysaver.sc.gov/tool.

9 Organics Recovery and Food Waste Prevention

9.1 Objective

Reduce food waste and enhance organic recovery systems, infrastructure, and programs.

9.2 Description

Food waste is the most common material disposed of in landfills nationwide according to the U.S. Environmental Protection Agency (EPA). EPA estimates that food waste made up 24.14% (35.2 million tons) of the 146.1 million tons of the material disposed of in the nation's municipal solid waste (MSW) landfills in 2018 (the latest number available).[103] The decay of organic waste under anaerobic conditions creates methane, a powerful greenhouse gas. The result is that MSW landfills are the third-largest source of methane emissions from human activities in the United States according to the EPA. In addition, food waste is responsible for an estimated 58% of landfill emissions.

Expanded infrastructure, technical assistance, outreach, education, and funding are necessary to improve food waste reduction and recovery rates and to reduce emissions generated from landfills. The state permits three types of facilities for organics recovery. Only Type 2 and Type 3 facilities (9 total) are allowed to accept food waste, but only three facilities are currently accepting food waste (Charleston County; Horry County; ReSoil Composting, located in Richland County). Positive steps are being taken in Beaufort, Charleston, Greenville, and Lexington counties to expand their capacity, for example through new grants, permit applications, infrastructure, and partnerships. The amount of food waste recovered increased 53.9% in fiscal year (FY) 2022 (July 1, 2021, to June 30, 2022) from the previous year.[104] Thirty-six counties reported recycling food waste in FY22, compared to only eleven counties in FY14. In addition, DHEC has a robust "Don't Waste Food SC" campaign in place to promote food waste prevention and donations. These positive signs reflect stakeholder interest in composting and food recovery initiatives, but funding is currently limited.

DHEC proposes to expand its existing "Don't Waste Food SC" (DWFSC) campaign and build out a more robust composting and food waste recovery ecosystem. The overall program will include strategies to reduce food waste through prevention and donation and employ an organics recovery subject matter expert to provide statewide technical assistance, education, and outreach. The subject matter expert will enhance DHEC's capacity to develop and implement a potential grant program focused on organics recovery. The grant program would provide funding to support investments in new or expanded infrastructure, funding, and technical assistance to local governments and generators to begin or enhance food waste recovery efforts, and incentives for haulers to move organic waste from generators to processors.

A key component of this program will be the development of a statewide network to target organics recovery and composting. The focus will be on developing a system consisting of hubs (regional recycling processing centers in larger communities where recyclables are prepared and sold to markets) and spokes (programs in smaller nearby communities that deliver their recyclables to the hub for processing). With smaller populations, rural communities nationwide struggle to provide cost-effective

[103] EPA, Facts and Figures about Materials, Waste and Recycling, https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling.
[104] DHEC, South Carolina Solid Waste Management Annual Report Fiscal Year 2022, https://scdhec.gov/environment/recycling-waste-reduction/solid-waste-recycling-reports.

recycling services because of the low volume of recyclable materials produced. Regional hub and spoke approaches allow spokes that cannot go it alone an opportunity to reduce operation costs or begin programs. Hubs benefit through better economies of scale and the consolidation of material for higher revenue. DHEC will also investigate opportunities to support new small-scale facilities and transfer stations in communities that may not be in close enough proximity to make participation in the regional hub and spoke system cost efficient.

In addition to reducing greenhouse gas emissions, this program will put South Carolina in position to reach EPA's 50% national recycling and 50% reduction in food waste goals by 2030.

9.3 Implementation

Lead/Coordinating Agency: DHEC

Expected/Potential Partners: SC Department of Commerce Recycling Market Development Program, SC Rural Infrastructure Authority, SC Department of Education, SCOR, Catawba Nation, Clemson University, regional solid waste authorities, local governments, and private businesses.

DHEC will administer this program and work with the partners listed above and other stakeholders. Public stakeholders will include grocery stores, farms, food manufacturers, food banks, food recovery organizations, restaurants, hospitals, corrections facilities, resorts, equestrian operations, music and sports venues, and colleges and universities. Private stakeholders will include haulers, processors, recyclers, composters, and technology development and research organizations.

Implementation schedule and milestones: Implementation will begin within one year of the CPRG Implementation Grant funding, if awarded.

The first year of the implementation will include:

- Hiring a subject matter expert to manage the program
- Collecting information from successful hub-and-spoke programs
- Assessing South Carolina's current organics recovery infrastructure
- Creating a workgroup of key stakeholders
- Developing a statewide plan with short-term to long-term strategies to prevent food waste, increase donation, and divert organics from MSW landfills.

The statewide organics recovery plan will include the creation of a grant program designed to be equitable and efficient. The plan will lay the foundation of a game-changing statewide program with the goal to maximize the amount of organics diverted from MSW landfills. Grant funding will focus on local governments working with the private sector. Grant-funded activities and projects also will involve outreach and education initiatives built around DHEC's Don't Waste Food SC program to raise the awareness of the negative economic, environmental, and social impacts of food waste and target prevention and donation.

The implementation of the grant program will begin no later than the end of the first year or beginning of beginning the second year of the CPRG Implementation Grant funding, if awarded.

Ongoing communication, outreach, education, and technical assistance will focus on building program awareness and recruiting participants, including food generators and the haulers to move organics to

processing facilities. A long-term goal will include adding residential programs that offer drop-off and/or curbside collection of organics.

Annual monitoring will track progress towards the statewide goals of a 50% recycling rate and 50% reduction in food waste.

Metrics for tracking progress: Amount of food diverted from landfills (in tons); number of commercial, governmental, and other generators participating in food recovery programs, participation over time, amount of food waste diverted, food waste diversion rates over time; number of local governments sponsoring food recovery programs, participation over time, food waste diversion amounts and rates over time; number of haulers engaged in organics transportation; amount of food waste being converted to value-added products such as mulch, compost, boiler fuel, biogas, and bio-based products; number of users of end products and participation over time.

9.4 Emissions Reductions

Using EPA's nationwide estimate that 24.14% of landfill disposal is food waste, South Carolina disposed of an estimated 992,565.59 tons of unwanted food in FY22. Counties reported recovery of only 28,107.49 tons, a 2.75 % food waste recycling rate.[105]

DHEC used EPA's Waste Reduction Model (WARM) version 16[106] to estimate GHG emission reductions associated with implementing an enhanced organic recovery and food waste reduction systems (Appendix E4). WARM calculates and totals GHG emissions associated with baseline and alternative waste management practices. Table 35 shows estimated GHG emissions reductions, based on achieving the 50% reduction of food waste goal by 2030 and continuing that annual level of organics recovery and food waste prevention through 2050.

Table 35. Estimated greenhouse gas reductions from organics recovery and food waste prevention

Food Waste Landfilled Per Year	Food Waste Composted Per Year	Annual Emissions Reduction	Emissions Reduction: 2025-2030	Emissions Reduction: 2025-2050
Tons	Tons	**Estimated GHG Reductions ($MTCO_2e$)**		
470,986.05	39,350.49	1,637,508.04	1,637,508.04	40,937,701

9.5 Benefits

An expanded "Don't Waste Food SC" program will delay needs for new landfills. The program will also address food insecurity issues in the state by coordinating with food banks and food donation programs and increasing awareness of the economic, environmental, and social impacts of wasted food.

In 2022, 38% of the nation's food supply went unsold or uneaten, the vast majority of which was sent to a landfill, incinerated, or put down the drain. Much of that waste is healthy, nutritious, edible food that

[105] DHEC, SC Solid Waste Management Annual Report for Fiscal Year 2022, https://scdhec.gov/sites/default/files/media/document/S.C.%20Solid%20Waste%20Management%20Annual%20Report%20for%20FY22%20%2812.19%29%20-%20OR-2405.pdf

[106] EPA, Waste Reduction Model, https://www.epa.gov/warm/versions-waste-reduction-model. WARM calculates and totals GHG emissions associated with baseline and alternative waste management practices.

could be given to help those in need. At the same time, an estimated one in 10 Americans, many of them children, are food insecure.[107] Food insecurity is defined by the U.S. Department of Agriculture as lacking access, at times, for an active, healthy life and is associated with numerous adverse social human health outcomes. While food insecurity happens in all communities, it is more common for people of color and those in rural areas to be food insecure because of factors such as poverty, unemployment, and the cost of living. In South Carolina, more than 515,000 residents (9.9% of the state's population) faced food insecurity in 2021. Minority, underserved communities are three times more likely to have shortages. Overall, 19% percent of the Black population and 7% of the White population of the state were food insecure.[108]

The expanded "Don't Waste Food SC" program will augment existing efforts by enhancing the existing outreach and education campaign, developing a community and business ambassador program, and providing trainings for communities and businesses to implement prevention and donation practices.

9.6 Review of Authority

The S.C. Solid Waste Policy and Management Act of 1991 (S.C. Code Ann. § 44-96-10 et seq.) establishes a comprehensive framework for the safe and efficient management of solid waste and authorizes DHEC to:

- Develop and implement a regulatory framework for the proper siting, design, construction, operation, and closure of solid waste management facilities (S.C. Code Ann. § 44-96-260)
- Promote waste reduction, recycling, and resource conservation before disposal (S.C. Code Ann. § 44-96-50)
- Set waste reduction and recycling goals (S.C. Code Ann. § 44-96-50)
- Develop a state solid waste management plan (State Plan) (S.C. Code Ann. § 44-96-60).

S.C. Code Ann. § 13-1-380, establishes within the South Carolina Department of Commerce, a Recycling Market Development Council. DHEC, in a collaborative partnership with Department of Commerce and others, are implementing programs establishing these markets for recovered materials and products within the state. A contractual agreement between DHEC and DOC allows for the creation of an annual workplan agreed upon by both agencies in furtherance of these recycling efforts.

S.C. Code Ann. § 48-62-10, et seq., statutorily authorizes SCOR to develop and implement a statewide resilience plan. This responsibility includes collaboration and coordination with other state and regional government agencies, private for-profit and non-profit entities, and other stakeholders involved in recycling endeavors. SCOR, as co-lead on the development of the State Priority Climate Action Plan, and to further the resilience plan mandate, will continue to work with DHEC and be an integral part of the work.

[107] ReFED, https://refed.org/food-waste/the-problem/
[108] Feeding America, Food Insecurity among Overall (all ages) Population in South Carolina, https://map.feedingamerica.org/county/2021/overall/south-carolina

9.7 Intersection with other programs, projects, and funding

DHEC has received funding from the EPA Solid Waste Infrastructure for Recycling Grant Program to grow its Don't Waste Food SC (DWFSC) outreach campaign. The funding will allow DHEC to

- Complete a waste characterization study that will provide much needed up-to-date data on the disposal and recovery of food waste and, in turn, use the numbers in update of the state solid waste plan
- Increase the promotion of the DWFSC campaign to raise awareness of the negative economic, environmental, and social impacts of wasted food and provide information and tools to prevent food waste to all stakeholders
- Increase the promotion of the DWFSC Ambassador Program where the ambassadors will be trained to carry the food waste prevention message to their own communities, businesses, organizations, colleges/universities, and schools.

DHEC has provided a K-12 curriculum supplement ("Action for a Cleaner Tomorrow") to schools and teachers since the early 1990s. Approximately 2,000 teachers were trained, and presentations were made to 44,000-plus classrooms in the 2021-2022 school year. A food waste lesson has been added. Grant funding is offered to schools with an emphasis on share tables and reducing food waste in the cafeteria. All this work has been done in partnership with the SC Department of Education.

Finally, DHEC works with key stakeholders on events, presentations, and other outreach activities targeting food waste prevention.

10 State Agency Recycling

10.1 Objective

Establish a recycling grant program to assist state agencies expand or enhance recycling infrastructure.

10.2 Description

South Carolina employs more than 59,000 individuals, has 136 state agencies and $38.8 billion in total expenditures in fiscal year (FY) 2022 (July 1, 2021, to June 30, 2022). State agencies have the opportunity and obligation to lead by example in multiple areas, including recycling. Conserving resources, saving energy, buying recycled products, and supporting a circular economy that benefits all are activities that state agencies can model and support.

The S.C. Solid Waste Policy and Management Act of 1991 ("Act"; S.C. Code Ann. § 44-96-140 et seq.) requires state agencies to:

- Provide recycling programs for the collection of selected materials including aluminum, cardboard, glass, lead-acid batteries, paper, plastic, tires and used motor oil
- Make necessary modifications to their programs to ensure material is recycled to the maximum extent possible
- Buy products with recycled content material and that are recyclables where practicable
- Report the type and amount of material recycled as well as all recycled-content products purchased each year to DHEC, which, in turn, publishes an annual report.

In fiscal year (FY) 2023 (July 1, 2022, to June 30, 2023), state agencies reported recycling 4,347.66 tons of material, a decrease of about 9% percent from FY22. That amount accounted for 0.37% of South Carolina's total recycling. Overall, paper comprised 50% (2,217.55 tons) of the recovered material, followed by items banned from disposal (i.e., appliances, electronics, lead-acid batteries, tires, and used motor oil) at 24% of the total. Glass, plastic, metal, and organics, as well as commingled and miscellaneous items make up the rest of the material recycled.[109]

In FY22, South Carolinians disposed of 4.3 pounds of waste per person per day. Given a typical work day is eight hours, an estimated 33.33% (1.43 pounds) of a person's waste happens at work. Applying that per capita estimation, South Carolina's 59,136 employees make 84,564.48 pounds of waste per day or 422,822.40 pounds per five-day week. Overall, in FY23 state agencies generated an estimated 10,933.38 tons of waste and reported recycling 4,234.66 tons of material resulting in a 38.73% recycling rate.

Recycling is convenient for state agencies. The majority of the material recycled by state agencies in Columbia, the state's capital, is picked up and processed by another state agency, the S.C. Department of Corrections. This service reduces costs and provides the Department of Corrections with revenue and opportunities for qualified prisoners. DHEC provides funding for trucks used for pickup. The Act provides no funding for state agencies for their programs.

The Act also encourages state agencies to buy recycled, sets a goal of 25% of all purchases to be of recycled-content products, and allows these products to exceed up to 7.5% the cost of alternative products. Currently, paper products and ink-jet toner cartridges are the majority of recycled-content

[109] DHEC, South Carolina State Agencies & College/Universities Recycling & Buying Recycled Annual Report, Fiscal Year 2023, https://scdhec.gov/sites/default/files/Library/OR-2551.pdf.

purchases. Data on the amount, cost and percentage of purchases is limited due to multiple measurement approaches.

DHEC is committed to advancing its Green Government Initiative[110] (GGI) and state agency recycling with assistance of potential funding. DHEC would evolve the existing program, in partnership with the South Carolina Department of Commerce Recycling Market Development Program. The first step would focus on agency leadership and expand the GGI partnership by:

- Encouraging each state agency to have a recycling contact
- Assisting each state agency to evaluate its waste stream to gather data and make more accurate waste and recycling assessments
- Assisting each state agency to provide adequate receptacles, signage, education, and staffing, and arrange for recycling services consistent with existing recycling requirements for each office building
- Encouraging each state agency include in its annual report a summary of its compliance with the Act
- Developing and implementing a grant program for state agencies to expand and promote recycling, increase access and participation within the agency and throughout South Carolina.

The second step would focus on training and outreach to agency staff. GGI partnership activities would include:

- Providing training through workshops and webinars
- Expanding the S.C. State Agency Recycling Professionals Certification program
- Promoting current information and state contracts on recycled-content products
- Promoting and providing signage, posters and other material to increase awareness of programs
- Providing quarterly e-newsletters
- Providing recognition through an annual awards program
- Using grant funding to support printing of material, special events, and recycling containers.

The third step would focus on environmentally preferred purchasing. Recycling will not work without the purchase of recycled-content products. GGI partnership activities will involve:

- Promoting and updating green purchasing options (e.g., look to add more state contracts on recycled products)
- Developing a workgroup to update South Carolina's environmentally preferred purchasing policy
- Developing and implementing strategies and methodologies to measure the type and amount of recycled-content products purchased
- Conducting annual events to connect vendors and their recycled-content products with state agencies but local governments that use South Carolina's procurement code
- Presenting at the annual SCAGPO conference.

[110] DHEC, State Agency Recycling Responsibilities, https://scdhec.gov/environment/recycling-waste-reduction/state-agency-recycling-responsibilities

10.3 Implementation

Lead/Coordinating Agency: DHEC

Expected/Potential Partners: State agencies wanting to expand recycling services or start a recycling program and receive free technical assistance and marketing support.

Implementation schedule and milestones: Implementation will begin within one year of receiving additional funding for the program.

Metrics for tracking progress: Number of participating agencies, participation over time; amount of recyclable materials diverted from landfills, amounts collected over time.

10.4 Emissions Reductions

DHEC used EPA's WARM version 16[111] to estimate GHG emission reductions associated with implementing an enhanced state agency recycling program (Appendix E5). Estimates are based on achieving the goal of increasing the tonnage recycled by state agencies by 50% by 2030 (compared to FY 2022 recycling amounts) and continuing that annual level of recycling through 2050 (Table 36).

Table 36. Estimated greenhouse gas emissions reductions from a state agency recycling program

Material Recycled Per Year	Annual Emissions Reduction	Emissions Reduction: 2025-2030	Emissions Reduction: 2025-2050
Tons	**Estimated GHG Reductions ($MTCO_2e$)**		
3263.33	11657.88	11657.88	291447.00

10.5 Benefits

Increasing the amount of material recycled and diverted from the landfill helps to conserve resources and serves as an example that South Carolina's government is environmentally responsible. According to the EPA[112], recycling items commonly used and available at state agencies can have the following benefits:

- Recycling one ton of office paper can save the energy equivalent of consuming 322 gallons of gasoline
- Recycling one ton of aluminum cans conserves more than 152 million Btu, the equivalent of 1,024 gallons of gasoline or 21 barrels of oil consumed
- Recycling 10 plastic bottles save enough energy to power a laptop for more than 25 hours.

Recycling has additional economic benefits. The recycled materials industry is a major contributor to the U.S economy, generating nearly $117 billion in economic activity while directly and indirectly supporting

[111] EPA, Waste Reduction Model (WARM), https://www.epa.gov/warm/versions-waste-reduction-model. WARM calculates and totals GHG emissions associated with baseline and alternative waste management practices.
[112] EPA, Frequent Questions on Recycling, https://www.epa.gov/recycle/frequent-questions-recycling.

more than 500,000 jobs.[113] A 2014 study estimated that recycling had a $13.5 billion annual impact on South Carolina's economy and was responsible for more than 54,000 jobs.[114]

The recycling industry also is an integral player in reducing greenhouse gas emissions. The use of recycled material instead of mining, drilling, harvesting, and other methods of extracting natural resources for manufacturing reduces energy consumption and produces fewer greenhouse gas emissions.

10.6 Review of Authority

The S.C. Solid Waste Policy and Management Act of 1991 (S.C. Code Ann. § 44-96-10 et seq.) establishes a comprehensive framework for the safe and efficient management of solid waste and authorizes DHEC to:

- Develop and implement a regulatory framework for the proper siting, design, construction, operation, and closure of solid waste management facilities (S.C. Code Ann. § Section 44-96-260)
- Promote waste reduction, recycling, and resource conservation before disposal (S.C. Code Ann. § 44-96-50)
- Set waste reduction and recycling goals (S.C. Code Ann. § 44-96-50)
- Develop a state solid waste management plan (State Plan) (S.C. Code Ann. §44-96-60).

S.C. Code Ann. § 13-1-380, establishes within the South Carolina Department of Commerce (DOC), a Recycling Market Development Council. The S.C. Recycling Market Development Advisory Council has specific responsibilities. RMDAC is required to submit an annual report to the Governor and General Assembly and include recommendations on material that should be added or deleted from recycling programs and any tax incentives to facilitate the development of recycling markets. DHEC provides funding to DOC for staff to assist the Council in its activities.

S.C. Code Ann. § 48-62-10, et seq., statutorily authorizes SCOR to develop and implement a statewide resilience plan. This responsibility includes collaboration and coordination with other state and regional government agencies, private for-profit and non-profit entities, and other stakeholders involved in organics and food waste recovery endeavors. SCOR, as co-lead on the development of the State Priority Climate Action Plan, and to further the resilience plan mandate, will continue to work with DHEC and be an integral part of the work.

10.7 Intersection with other programs, projects, and funding

With funding from the EPA Solid Waste Infrastructure for Recycling Grant Program, DHEC is conducting a waste characterization study in 2024. This study will provide up-to-date baseline data and increase the accuracy for commodity data used in evaluation tools. The funding will also be used for the development of a new solid waste plan which will include state agencies. Work will continue with the Recycling Market Development program housed at Commerce to assist with state agency recycling.

[113] Institute of Scrap Recycling Industries (ISRI), 2023 ISRI Recycled Materials Industry Yearbook, https://www.isri.org/yearbook.
[114] Hefner, F., The Economic Impact of the Recycling Industry in South Carolina (2014), https://scdhec.gov/sites/default/files/Library/CR-011380.pdf.

11 Alternative and Multi-Modal Transportation

11.1 Objective

Reduce vehicle miles traveled by expanding and enhancing biking, walking, micromobility (i.e., electric-powered bikes and scooters), and public transit programs and projects.

11.2 Description

Transportation is South Carolina's largest source of emissions, accounting for nearly 40% of the state's total gross emissions at 29.406 $MMTCO_2e$ in 2020. Many strategies exist to reduce use of fossil fuels in South Carolina's transportation sector. Fossil fuel use can be reduced through deployment of electric vehicles, development of alternative fuels, use of public transit, and development of pedestrian and bicycle infrastructure.[115] Promoting and supporting multiple modes of transportation and transit as a priority measure was widely supported by stakeholders and Action Team members. Specific measures and examples to reduce transportation-related greenhouse gas emissions aim to expand and/or fill funding gaps for existing initiatives and priorities.

Alternative Transportation: There is considerable interest from engaged stakeholders and the communities throughout the state in improving current bicycle and pedestrian infrastructure. Many statewide, regional, and local plans have identified this as a priority. A PAQC grant program focused on supporting alternative transportation options could augment existing programs by providing gap funding to ensure projects are completed, prioritizing activities that quickly enhance the quality and safety of bike and pedestrian networks without major construction. Such a program could also support design and pre-construction activities to help communities develop high-impact, shovel-ready projects so they may take advantage of funding opportunities when they arise.

South Carolina is currently one of the lowest ranking states in the nation for bicycle and pedestrian accessibility. According to the non-profit organization League of American Bicyclists, which ranks states on their bike friendliness based on infrastructure and funding, education, traffic laws and bicycle practices, policies, and planning, South Carolina ranked 43rd out of all 50 states and 11th out of the 13 southern states.[116] Infrastructure, education, increased safety, and policies or programs are needed throughout the state to increase this mode of transportation. The report card shows that only 0.22% of South Carolinians ride bicycles to work. Community engagement throughout the PCAP planning process showed that this is an extremely well-supported initiative throughout the state, and when planned appropriately and with funding, it can be very successful in getting individuals moving while reducing both GHG and co-pollutant emissions.

Case Study: City of Greenville. The City of Greenville has invested and supported efforts to build out its biking and walking infrastructure, through on-street bicycle lanes and through the Swamp Rabbit Trail.

[115] South Carolina Energy Office, Clean Transportation Focus Area. https://energy.sc.gov/focus-area/clean-transportation

[116] League of American Bicyclists, 2022 South Carolina Bicycle Friendly Report Card. Data is based on information obtained from a comprehensive survey completed by state departments of transportation and state bicycling advocates. https://bikeleague.org/sites/default/files/BFS_Report_Card_2022_South_Carolina.pdf

Greenville's first on-street city bike lane was built in 2005 and was just a mile long. [117] By 2018, there were 18.7 miles of on-street bike lanes, and 2024 city plans will increase this infrastructure to over 57 miles by the end of the 2024, meaning that 22% of Greenville's streets will have bicycle infrastructure.

A successful installation of alternative transportation is the Prisma Health Swamp Rabbit Trail located in Greenville. It is a 22-mile greenway system that runs through the city and opened in 2009. [118] It connects neighborhoods, schools, businesses, and parks and boasted over 700,000 users in 2022 (Johnson, 2023). [119] Data about the trail's use is tracked to help with planning and future expansion projects. In February 2022, a pedestrian and bike display counter was installed to provide data on the trail's annual year-to-date use. In addition to the data provided by the pedestrian and bike display counter, the non-profit organization Bike Walk Greenville acquired and studied StreetLight Data, which tracks anonymous cell phone data from cyclists and pedestrians, to report critical information about the uses of the trail. A major finding was that 9.7% of trail users used the trail to commute to work in 2022.[119] This equates to approximately 67,677 vehicle trips removed from Greenville's roads that year.

Public Transit: Stakeholders and community leaders expressed high interest in increasing the availability of public transit throughout South Carolina. Transit ridership is low statewide and has been decreasing since its peak in 2013 (12.27 million public transit trips taken) through 2022 (7.44 million public transit trips taken). During those same years, statewide vehicle miles traveled (VMT) have significantly increased, from 48.986 billion VMT in 2013 to 58.988 billion VMT in 2022. [120] According to the 2022 American Community Survey (ACS) conducted by the U.S. Census Bureau, only 0.38% of South Carolinians commuted to work via public transportation. [121]

Stakeholder and Action Team input demonstrated wide support of and recommended various methods to increase access and use of public transit. Both intercity and intracity options were popular GHG reduction ideas. Suggestions included high-speed rail connections between cities, expanded bus networks, intracity light rail, gondola operations for congested cross-city routes, and the establishment of microtransit services. Increased service frequency, as well as a comprehensive bus network redesign evaluation, may increase transit ridership with the existing fleet and operators. Fare-free pilot programs may increase ridership and lower cost barriers for low-income commuters in addition to reducing costs related to fare collection. Public-private partnerships may be useful for funding fare-free transit programs. Businesses or apartments may consider providing transit payments in lieu of vehicle parking.

Incentives for carpooling, ridesharing, and reducing miles traveled could be offered through the use of carpool lanes and toll roads. Businesses and government agencies may benefit from incentives to allow

[117] Bike Walk Greenville, November 2023. "The growth of bike infrastructure in the City of Greenville". https://bikewalkgreenville.org/2023/11/06/the-growth-of-bike-infrastructure-in-the-city-of-greenville/
[118] City of Greenville, South Carolina, November 2020. "Swamp Rabbit Extension Master Plan". https://www.greenvillesc.gov/DocumentCenter/View/16094/Swamp-Rabbit-Trail-Extension-Master-Plan-PDF?bidId=
[119] Danielle Johnson, January 2023. GVL Today: "New data shows us who is hitting Greenville, SC's Prisma Health Swamp Rabbit Trail and why." https://gvltoday.6amcity.com/prisma-health-swamp-rabbit-trail-counter-data-greenville-sc
[120] Bureau of Transportation Statistics, SC State Highway Travel. https://www.bts.gov/browse-statistical-products-and-data/state-transportation-statistics/state-highway-travel
[121] U.S. Census Bureau, 2022. "Commuting Characteristics." American Community Survey, ACS 1-Year Estimates Subject Tables, Table S0801 https://data.census.gov/table/ACSST1Y2022.S0801?q=S0801&g=040XX00US45

employees to telework. Public outreach and education could encourage individuals to carpool, use public transit or alternative transit, reduce vehicle miles traveled, and reduce vehicle idling, such as through the installation of no idling signs or zones. Bicycle lanes, sidewalks, and walking paths were also largely supported by community input.

11.3 Implementation

Lead/Coordinating Agencies: SCOR (grant program); Councils of Government (COG), Metropolitan Planning Organizations, municipal and county governments, transit authorities (implementation).

Expected/Potential Partners: SC Department of Transportation, Catawba Nation, non-governmental and community organizations.

Implementation schedule and milestones: Implementation would begin within one year of CPRG Implementation Grant funding, if awarded. The program would seek to disburse all grant funds within two years, to maximize greenhouse gas reductions and other co-benefits.

Metrics for tracking progress: Percentage of grant funds disbursed; amount of additional funding leveraged, invested, or obtained through other sources; number of projects and project miles completed; number of vehicle miles reduced; greenhouse gas reductions due to reduction in vehicle miles traveled; co-pollutant reductions due to reduction in vehicle miles reduced.

11.4 Emissions Reductions

Emissions were calculated under three scenarios with different assumptions (for more on calculation methods, see Appendix E6). Reductions do not begin until the year 2030 for walking and biking greenways but grow substantially over time. Total expected emissions reductions are 260,606 $MTCO_2e$ between 2025 – 2050 for alternative modes of transportation (Table 37).

Table 37. Estimated greenhouse gas emissions reductions from micromobility grant program

Implemented Reduction Measure	VMT Reductions by 2050 (miles)	Annual Emissions Reduction by 2050	Emissions Reduction: 2025-2030	Emissions Reduction: 2025-2050
		Estimated GHG Reductions ($MTCO_2e$)		
Walking and Biking Greenways	26,148,597	10,224	222	59,967
On-Street Bike Lane Infrastructure	144,301	56	113	851
Use of Public Transit	8,604,180	16,855	9,654	851
Totals	34,897,078	27,135	9,989	260,606

11.5 Benefits

Replacing vehicle trips with bicycle or pedestrian travel reduces GHG emissions and other air pollution. Robust biking and pedestrian infrastructure can support community priorities related to improved air quality and public health, public safety, recreation, economic opportunities for business, cost savings for travelers, and environmental amenities. This measure will increase connectivity and safety throughout South Carolina, reduce the heat island effect in urban areas, and reduce congestion and traffic.

Use of resources such as the Equitable Transportation Community Explorer[122] and CEJST[123] can be used in the CCAP and in implementation, to ensure that projects benefit low-income communities and address transportation access and equity considerations. Another important component includes coordination with land-use planning, housing and commercial development planning, greenspace, and trails initiatives to improve access, connectivity, and other community benefits.

11.6 Review of Authority

SCOR is tasked with the responsibility to develop, implement, and maintain the Statewide Resilience Plan and to coordinate statewide resilience efforts with stakeholders to include federal, state, and local governmental agencies, regional governmental entities, private for-profit and non-profit organizations, industries, and academic institutions (S.C. Code Ann. § 48-62-10 et seq.).

Furthermore, S.C. Code Ann. § 48-62-30(1)(d)(iv) requires SCOR to develop implement statewide resilience recommendations that have co-benefits beyond flood control. Co-benefits include tourism, public health, and recreational opportunities. The development of this collaborative project with SCOR as lead agency will provide an additional co-benefit of GHG reduction by reducing overall vehicle miles traveled.

If awarded a CPRG Implementation Grant, an Alternative and Multi-Modal Transportation Program may be coordinated in conjunction with Councils of Governments. COGs are authorized to coordinate cooperative programs affecting their citizenry in many areas, including public health, safety, welfare, recreational opportunities, pollution control measures, utilities, public planning, and development. See S.C. Code Ann. §§ 6-7-110 and 6-7-140.

S.C. Code Ann. §§ 57–1–370 (A) and 57-1-370 (B)(8), provides for the South Carolina Department of Transportation (SCDOT) to seek input from Metropolitan Planning Organizations (MPOs) and COGs in the creation of a multimodal transportation system for the State. This transportation system is to take into consideration, among other factors, alternative transportation systems, traffic volume and congestion, and environmental concerns; therefore, a multimodal system is viable to create bicycling and pedestrian accommodation plans that can serve as the basis for integrating bicycling onto the state system of roadways.

11.7 Intersection with other programs, projects, and funding

The initiatives described here are intended to complement and augment SC DOT opportunities, programs, and directives. Examples include SC DOT'S such as those through the Bicycle & Pedestrian, Transportation Alternatives, and Complete Streets Programs[124]; opportunities available through the Office of Public Transit; and engineering directives, such as SC DOT's Engineering Directive on Bicycling Accommodations on Resurfacing Projects[125].

[122] U.S. Department of Transportation, Equitable Transportation Community Explorer, https://experience.arcgis.com/experience/0920984aa80a4362b8778d779b090723/page/Homepage/
[123] Council on Environmental Quality, Climate and Economic Justice Screening Tool, https://experience.arcgis.com/experience/0920984aa80a4362b8778d779b090723/page/Homepage/
[124] South Carolina Department of Transportation, Specialty Programs, https://www.scdot.org/projects/programs-landing.aspx
[125] South Carolina Department of Transportation, http://info2.scdot.org/ED/ED/ED-22.pdF

The National Association of City Transportation Officials has a variety of programs, initiatives, and guidebooks to assist communities in the effective design and deployment of alternative and multi-modal transportation options.[126]

[126] National Association of City Transportation Officials, https://nacto.org/

12 Vehicle Transitions Program

12.1 Objective

Reduce use of fossil fuel-powered vehicles by public entities and the logistics sector.

12.2 Description

Transportation is South Carolina's largest source of greenhouse gas emissions; a large share of those emissions come from light- and heavy-duty vehicles. Cross-cutting measures could be utilized to reduce greenhouse gas emissions from transportation and industry by emphasizing reductions within the industrial supply chain and means of transportation for industrial goods and supplies, and for supporting the conversion of fleets to clean fuel vehicles.

A Vehicle Transitions Program would include five components. When possible, this program would also coordinate with other initiatives (e.g., the Electric Vehicle Stakeholder Initiative, Section 3.5.5) and partners (e.g., South Carolina Ports Authority, Section 1.2.4).

Vehicle Fleet Transition: Action Team members and community input demonstrated great support for a program to provide funding to assist state, tribal, municipal, and local governments with vehicle fleet conversion to clean fuels. Entities eligible to apply for the grant or rebate program would include state, regional, tribal, and local government agencies and other public entities (e.g., K-12 education, universities). Funding may also be used to deploy necessary charging infrastructure. The program would support and build on related outreach and assistance efforts conducted by the Energy Office, including already-developed guidance for state agencies considering EVs for their fleets.[127]

Heavy-Duty Diesel Engine Transition: Transportation is a cross-cutting source of emissions for many sectors, including industry. The movement of goods and supplies is a critical part of the economy and of community well-being. Reducing emissions from heavy-duty vehicles involved in the transport of products and materials is essential to improve air quality and public health, particularly in low-income and disproportionately burdened communities located near industrial facilities and their associated transport routes. A grant tiered program may be beneficial to address industrial transportation emissions. Entities eligible to apply for the grant program would include logistics operation companies, small businesses, and industrial firms. The grant could be provided as a rebate after the purchase of an HEV or hydrogen fuel cell vehicle with matching requirements for the business.

Clean School Buses: In 2022, South Carolina was awarded the largest EPA-funded electric school bus order in the nation to date through EPA's Clean School Bus Program.[128] The Clean School Bus Program replaces school buses with zero-emission and low-emission models and will run through the year 2026. The ongoing effort to transition South Carolina's school bus fleet is a priority for the state, reducing greenhouse gases and harmful tailpipe air pollutants that school children are exposed to with fossil-fuel burning buses. It is recommended that the Clean School Bus Program funding continue to be utilized by South Carolina school districts as they transition their fleets.

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[127] South Carolina Energy Office, Electric Vehicles for State Agencies, https://energy.sc.gov/focus-area/clean-transportation/electric-vehicles/electric-vehicles-for-state-agencies

[128] EPA, October 27, 2022. "Biden-Harris Administration announces nearly $59 million from EPA's Clean School Bus Program for South Carolina districts". https://www.epa.gov/newsreleases/biden-harris-administration-announces-nearly-59-million-epas-clean-school-bus-program

Locomotive Electrification: SC Ports Authority works closely with Palmetto Railways in the movement of goods and supplies. In an effort to continue the reduction of emissions from the ports and related transportation as SCPA applies for other federal funding (EPA Clean Ports Program), a grant could be utilized to provide Palmetto Railways with two electric switcher trains. Palmetto Railways operates 8 switcher trains on this line; 2 locomotives were replaced with electric alternatives through a US Department of Transportation grant, which also included the funding for a Level III charging station (Section 5.2). The replacement of 2 additional switcher trains would allow Palmetto Railways to operate the line almost completely electric, with the option to provide increased horsepower utilization through a hybrid electric-diesel pairing. Support of this program may spur other locomotive operations to make similar transitions.

Clean Ports: SC Ports Authority is a sub-recipient of the CPRG phase I planning grant and has offered several proposals to the PAQC to reduce GHG emissions in Ports operations. Priority measures for reducing Ports-related emissions include vehicle conversion to electric tugs, barges, and drayage trucks; deploying electric or hydrogen fuel cell ports equipment; and changing the movement of goods around the ports by transitioning to the use of the electric barge rather than heavy-duty vehicles that currently drive through Charleston. The latter measure would reduce VMT by tens of thousands of miles annually and reduce harmful co-pollutant emissions. SPCA intends to apply for the EPA Clean Ports Grant Program in 2024. Additionally, there may be opportunities to pilot and deploy alternative fuels such as hydrogen fuel cells at the Ports.

12.3 Implementation

Lead/Coordinating Agencies: SCOR (grant program); municipal, county, and state government agencies, public entities; individual companies and businesses (implementation).

Expected/Potential Partners: South Carolina Energy Office, Regional Councils of Governments, non-governmental and community organizations; professional and industry associations; SC Ports Authority; Palmetto Railways; utilities; DHEC Bureau of Air Quality and other state, regional, and local agencies; non-profit and community groups.

Implementation schedule and milestones: Implementation would begin within one year of CPRG Implementation Grant funding, if awarded. A program would seek to disburse all grant funds within two years, to maximize greenhouse gas reductions and other co-benefits.

Metrics for tracking progress: Percentage of grant funds disbursed; amount of additional funding leveraged, invested, or obtained through other sources; number of new vehicles obtained; greenhouse gas reductions, per vehicle and program total, implementing agency; co-pollutant reductions, per vehicle and program total, implementing agency; co-pollutant reductions, per project and program total.

12.4 Emissions Reductions

Greenhouse gas reduction estimates were calculated with two tools: EPA's Diesel Emissions Quantifier[129] for electrification of two switcher locomotives and the Department of Energy and Argonne National Laboratory's Alternative Fuel Life-Cycle Environmental and Economic Transportation (AFLEET) Tool for Clean Cities Coalition stakeholders[130] (Appendix E7). Calculation assumptions included a

[129] EPA, Diesel Emissions Quantifier, https://cfpub.epa.gov/quantifier/index.cfm?action=main.home.
[130] Argonne National Laboratory, AFLEET Online, https://afleet.es.anl.gov/afleet/public/

constant rate of vehicles converted annually between 2025 2050, except for the switcher trains. The two switcher trains were assumed to be converted in 2025. Annual GHG reductions are estimated at 48,572 $MTCO_2e$ (Table 38).

Table 38. Estimated greenhouse gas reductions from vehicle transition grant program

Implemented Reduction Measure	Vehicles Converted per year	Annual Reduction / Vehicle	Annual Reduction / Annual Target	Emissions Reduction: 2025-2030	Emissions Reduction: 2025-2050
Vehicle Transition Programs		**Estimated GHG Reductions ($MTCO_2e$)**			
Passenger Car	1,000	3.63	3,630	76,230	1,274,130
Single-Unit Long-Haul	100	31.48	3,148	66,108	1,104,948
Single-Unit Short-Haul	100	93.89	9,389	197,169	3,295,539
Refuse Truck	100	100.06	10,006	210,126	3,512,106
School Bus	100	14.06	1,406	29,526	493,506
Combination Short-Haul	100	93.89	9,389	197,169	3,295,539
Passenger Truck	200	2.36	472	9,912	165,672
Light Commercial	100	7.80	780	16,380	273,780
Transit Bus	100	51.26	5,126	107,646	1,799,226
Combination Long-Haul	100	40.01	4,001	84,021	1,404,351
Palmetto Railways Switcher Train Electrification[131]	2	612.4	1,224.7	7,348.2	31,842.2
TOTALS	2,000		48,572	1,001,635	16,650,639

12.5 Benefits

In addition to reducing greenhouse gas emissions, these programs will promote energy efficiency and energy resilience while reducing other harmful co-pollutants. Transitioning to EVs and/or alternative fuel vehicles will lead to cost savings for implementing agencies and offices and provide support for the state's manufacturing sector and EV workforce development initiatives. This program would additionally improve air quality and public health, especially in low-income and disproportionately burdened communities that are most at risk from harmful co-pollutants from vehicle tailpipe emissions. Expected co-benefits also include reduction of co-pollutants and improvement of air quality. Successful deployment of electric and alternative fuel vehicles in the supply chain and logistics sector may spur other industries and firms to take similar measures. Electrification of two switcher trains at the Charleston Port also reduces co-pollutants including NOx, PM2.5, HC, and CO, as well as fuel (Table 39).

[131] The purchase of 2 new train switchers would be a one-time purchase in 2025, not an annually recurring purchase and is not included in the vehicles converted per year total.

Table 39. Estimated co-pollutant emissions reductions from switcher train transition

Co-Pollutant Reductions	Annual Reduction	Reduction: 2025-2030	Reduction: 2025-2050
			Reductions in $MTCO_2e$ (fuel reductions in gallons)
NO_X	9.172	55.032	238.472
$PM_{2.5}$	0.269	1.614	6.994
HC	0.735	4.410	19.110
CO	1.468	8.808	38.168
Fuel	120,000	720,000	3,120,000

12.6 Review of Authority

The South Carolina Energy Office serves as the principal energy planning entity and functions in a non-regulatory manner (S.C. Code § 48-52-410). The Office promotes energy efficiency and energy resilience, advocates for the use of less-polluting transportation fuels, and public transportation, and advances the movement towards other alternatives by ongoing work with other state agencies, regional governmental entities, local governments, for-profit and non-profit entities, and industries. The Energy Office reports on its efforts to the S.C. State Legislature (S.C. Code Ann. § 48-52-420). The Energy Office is charged with advancing an EV Stakeholder Initiative to develop policy and programmatic recommendations to increase electric vehicle (EV) deployment in the state (S.C. Code Ann. § 58-27-270(D)).

Per S.C. Code Ann. § 1-11-310, state agencies are allowed to give preference to alternative vehicles to include hybrid, plug-in hybrid electric, biodiesel, hydrogen, fuel cell, or flexible fuel vehicles when the performance, quality, and anticipated life cycle costs are comparable to other available motor vehicles.

The State Legislature established a Joint Committee to study challenges and opportunities associated with transportation electrification. The investigation is to include the environmental, economic, and customer challenges associated with electric vehicles (EVs); the potential value of advancing the development and deployment of EVs, and associated infrastructure; and the impacts of EVs on current infrastructure, customers, utilities, and electricity grid (S.C. Code Ann. § 58-27-260 S.C.).

Other authorizations in the state include the issuance of Executive Order No 2022-31, which directs the Department of Commerce (DOC) to establish a South Carolina EV Economic Development Initiative to create and implement a strategic approach to identify, encourage, and incentivize EV research, development, and production in the state. The EV Economic Development Initiative must collaborate with the Interagency EV Working Group, also authorized by Executive Order No 2022-31, in the development of a comprehensive statewide EV deployment plan.

SCOR is statutorily mandated to develop and implement a statewide resilience plan. SCOR's responsibility is to lead collaborative and cooperative efforts with federal, state, regional and local governments, private for-profit and non-profit organizations, foundations, state, national and international industries, and academic institutions (S.C. Code Ann. § 48-62-10 et seq.).

The South Carolina Ports Authority is authorized to operate railroads of every kind or character (S.C. Code Ann. §§ 54-3-140, 54-3-200, et seq.). This authorization includes locomotive electrification.

12.7 Intersection with other programs, projects, and funding

A Vehicle Transitions Program can complement other efforts such as the South Carolina Energy Office Clean Transportation Focus Area, the Electric Vehicle Stakeholder Initiative, and the South Carolina Electric Transportation Network which is led by the Conservation Voters of South Carolina.

The program should also look to leverage tax incentive programs as well as other transportation-related grant opportunities, such as those offered by the EPA, US Department of Energy, and the US Department of Transportation.

13 Industrial Scale Energy Use and Efficiency

13.1 Objective

Adopt new technologies, processes, and/or equipment to reduce use of fossil fuel-generated energy and to increase energy efficiency in industrial-scale processes.

13.2 Description

The industrial sector is the third largest source of emissions in South Carolina, emitting 13.001 $MMTCO_2e$ or 17.63% of statewide emissions. A large share of industrial emissions come from the use of fossil-fuel based energy to generate process heat. There are approximately 21,000 manufacturing facilities with industrial boilers nationwide and 78% are fueled by natural gas.[132] Several reduction measures could be used to reduce emissions throughout the industry sector, including cross-cutting measures that would reduce emissions in other sectors such as transportation and commercial buildings.

Increasingly, many of South Carolina's major firms and employers are looking to invest in and adopt sustainable technologies and other innovations. Sustainable practices can help support economic growth and prosperity, while also conserving and protecting the state's natural resources and natural resources infrastructure. Business leaders and entrepreneurs are focusing more frequently on sustainability goals and initiatives as consumers become more interested in the practices used to create the products they buy and the businesses they support. Reducing emissions throughout industry may have widespread and lasting benefits for South Carolina's economy and global footprint and may broaden the reach of goods and supplies manufactured within the state. Exports to other states or even to other nations such as those in European Union (EU) may increase due to national and international investment in sustainable business practices.

Priority measures for industrial-scale carbon reductions include financial incentives aiming to support electrification, adoption of hydrogen fueled equipment, and/or other strategies to reduce greenhouse gas emissions at demonstration sites; installation of energy efficient equipment; and investing in a sustainable supply chain through industrial transportation operations.

OxyHydrogen Steam Boiler Scoping: An initial proposal by industrial partners during the PCAP planning process was well-supported by businesses and industry leaders throughout South Carolina to adopt this technology for facility heating and manufacturing processes. The OxyHydrogen steam boiler utilizes clean oxyhydrogen gas for combustion, generated through electrolysis of water. This process splits water into hydrogen and oxygen, which are then burned in the boiler's combustion chamber to produce heat energy for steam production without emitting GHGs. In industrial settings, there are potential uses for heating water in manufacturing, sterilization in pharmaceuticals, and space heating in factories. Businesses looking for emissions-free alternatives to essential industrial operations may transition to hydrogen technology as a means to enhance productivity and reduce emissions in alignment with their sustainability goals.

[132] U.S. Department of Energy, Energy and Environmental Analysis, Inc. "Characterization of the U.S. Industrial / Commercial Boiler Population." https://www.energy.gov/sites/prod/files/2013/11/f4/characterization_industrial_commerical_boiler_population.pdf

Variable Frequency Load Drives (VFD): Suggested by the Industry Action Team, variable frequency load drives run for an unlimited number of years, are affordable, and adjust energy output depending upon the load type. VFD can be utilized in both Industrial and Commercial buildings. They are commonly promoted by utilities; DOE has fact sheets and case studies on them, and it is likely Duke and Santee Cooper have data about their use. Energy and emissions estimates are highly dependent upon the specific project installing a VFD. A grant or rebate program to assist businesses in acquiring a VFD would look at calculations for each project application before determining if funding is appropriate.[133]

Sustainable Supply Chain: The supply chain is an intricate system that includes manufacturing and industry; energy use; the transportation of goods including through medium- and heavy-duty vehicles, trains, and the ports; and the sale of goods and services to the consumer. Building a "sustainable supply chain" is a cross-cutting activity that can benefit firms of all sizes, as well as employees and customers.[134] However, there remains a need for additional, strategic investment to support a more robust deployment of new technologies.

A "sustainable supply chain" program could include grants, rebates, and/or cost share opportunities to further advance development of that ecosystem within the state. The program would also seek to coordinate with related initiatives, such as those organized by Sustain SC, South Carolina Manufacturing Extension Partnership, utilities, and state agencies, in order to broadly disseminate lessons learned and best practices.[135] The intent of this measure is to invest in sustainable, energy efficient technologies, which will also support economic growth and business innovations, while conserving natural resources. For more on vehicle transitions related to the sustainable supply chain, see Section 12.

13.3 Implementation

Lead/Coordinating Agency: SCOR (grant program), manufacturing firms and businesses, other industrial-scale energy users (implementation).

Expected/Potential Partners: Manufacturing and industry associations, utilities, Department of Commerce, Sustain SC, state agencies and other public entities, non-profit and community organizations.

Implementation schedule and milestones: Implementation would begin within one year of CPRG Implementation Grant funding, if awarded. A program would seek to disburse all grant funds within two years, to maximize greenhouse gas reduction measures and other co-benefits. The overall goal will be to achieve reductions of at least 300,000 metric tons/year, approximately 5% of 2020 industrial scale energy use emissions.

[133] NREL's report "Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures", Chapter 18, would be used to determine whether a project would qualify for funding. (Report available at https://www.energy.gov/sites/prod/files/2015/01/f19/UMPChapter18-variable-frequency-drive.pdf).
[134] Sustain SC, https://www.sustainsouthcarolina.org/. More specific information is available in the *Roadmap to Sustain SC (*https://www.sustainsouthcarolina.org/roadmap) and in the commissioned report, *The Economic Impact of Sustainability.*

Metrics for tracking progress: Percentage of grant funds disbursed; amount of additional funding leveraged, invested, or obtained through other sources; greenhouse gas reductions, per project and program total; co-pollutant reductions, per project and program total.

13.4 Emissions Reductions

Emissions reductions will be site-specific based on the needs of the organization. An early project scope to replace natural gas-fired steam boilers with zero-emissions hydrogen fueled boilers has gone through a preliminary exploration for interest and viability. Initial emissions reductions are based on the number of units converted in the first year and will be used to guide further investigation. Using the Department of Energy's Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) model,[136] it is estimated that an immediate annual reduction of 5,500 $MTCO_2e$ per boiler conversion (Table 40).

Variable frequency load drives are again site-specific. Estimations below are based on a U.S. Department of Energy Better Buildings Case Study, in which JC Penney stores saved 47,800,000 kWh over 131 locations, a reduction of 22% from before the installation, saving up to $5 million in annual utility costs.[137] Emissions reductions from variable frequency load drives have large potential. A single VFD has a potential annual emission reduction of 1,241 $MTCO_2e$. A program that would install ten VFD per year through 2050 would have an estimated reduction of 4,356,342 $MTCO_2e$ based off of the above case study.

Sustainable supply chain emissions reduction calculations are included in the Vehicle Transitions Program (Section 12).

Table 40. Estimated greenhouse gas emissions reductions from industrial scale energy use program (Appendix E8)

Implemented Reduction Measure	Units Converted	Annual Emissions Reduction	Emissions Reduction: 2025-2030	Emissions Reduction: 2025-2050
Transition Programs		**Estimated GHG Reductions ($MTCO_2e$)**		
OxyHydrogen Boiler Replacement	1	5,545	27,727	138,634
	5	27,727	138,634	693,172
	10	55,454	277,269	1,386,343
Variable Frequency Load Drive	1	1,241	7,447	32,269
	10 per year	12,411	260,636	4,356,342

13.5 Benefits

Expected co-benefits include reduction of co-pollutants, improvement of air quality, and greater energy resilience at implementing sites. Additional benefits associated with the deployment of new

[136] https://www.energy.gov/eere/greet

[137] U.S. Department of Energy Better Buildings. "Case Study: Variable Frequency Drive (VFD) retrofit upgrade on rooftop units." https://betterbuildingssolutioncenter.energy.gov/sites/default/files/attachments/JCPenney%20ARC%20Case%20Study.pdf

technologies include education, training, and career opportunities for skilled workers. Successful implementation at demonstration sites can spur other industries and firms to take similar measures.

13.6 Review of Authority

SCOR is statutorily mandated to develop and implement a statewide resilience plan. SCOR's responsibility is to lead collaborative and cooperative efforts with federal, state, regional and local governments, private for-profit and non-profit organizations, foundations, state, national and international industries, and academic institutions (S.C. Code Ann. § 48-62-10 et seq.).

The intent of this measure is to invest in sustainable, energy efficient technologies on an industrial scale. Such investments will also support economic growth and business innovations, while increasing the resilience of the state's energy grid. SCOR, as the agency tasked with implementation and maintenance of the Statewide Resilience Plan, has the authority to partner with for-profit and non-profit entities, as well as federal, state, regional and local governmental agencies, and others, to advance innovations in energy usage across this sector, so as to provide co-benefits of economic and workforce development, as well as contribute to the state's overall resiliency conditions, and seek GHG reductions (S.C. Code Ann. § 48-62-30).

13.7 Intersection with other programs, projects, and funding

Achieving industrial decarbonization and energy efficiency goals will require large investments as well as collaborative efforts between the private, public, and academic sectors. Many different federal grants, rebate programs, and research activities exist to support efforts to decarbonize industry processes, improve system efficiencies, and advance technologies. Many of these opportunities and programs are offered by the US Department of Energy. Other assets include federal tax incentives, utility programs, and existing partnerships (e.g., trade associations, South Carolina Manufacturing Extension Partnership[138], Sustain SC) also exist and should be leveraged to the furthest extent possible to support energy-related efforts throughout South Carolina's manufacturing sector.

[138] South Carolina Manufacturing Extension Partnership, https://scmep.org/.

14 Community Benefits Analysis and Engagement

This section summarizes the expected benefits of estimated GHG emissions reductions and priority reduction measures for low-income and disproportionately burdened communities and presents a strategy for continuing to engage communities in South Carolina's CPRG planning process.

14.1 Benefits Analysis

One important criterion for selecting priority GHG reduction measures for implementation was the expected benefits for low income and disproportionately burdened communities. Example benefits include reduction in air pollutants, home energy savings, housing upgrades, and workforce opportunities (Section 6).

14.1.1 Land Conservation and Restoration

This measure is expected to result in increased climate resilience and other benefits for low-income communities, particularly those communities located in areas projected to be at disproportionately high risk to floods and wildfires and agricultural and building losses due to future, extreme weather events.

Conserving natural lands and forests in floodplains can help reduce flood risks for communities and mitigate the vulnerability of built infrastructure located in those areas.

Restoring coastal habitats, wetlands, and forests to sink carbon will also help to restore ecosystem services; enhance local economic opportunities and ecotourism; protect culturally significant places; fish and wildlife habitat and essential subsistence food access; provide recreational access; and prevent emissions from land-use change.

14.1.2 Climate Smart Agriculture and Forestry

An expansion of the Climate-Smart Commodities program[139] would allow more family foresters into the program, including those located in underserved and low-income communities. New funding could expand the program's focus to include afforestation, longleaf pine restoration, urban forest expansion, and forestry protection in rapidly developing counties. Individual landowners will benefit by gaining access to new tools, resources, reductions in agricultural losses, wildfire risk management, and financial incentives.

Implementing climate smart practices and encouraging forest growth also has benefits for water quality and quantity, flood mitigation, wildlife habitat, and restoration.

14.1.3 Residential Weatherization and Energy Efficiency

The South Carolina housing inventory is aging, which contributes to a large energy burden for residents, especially in disproportionately burdened and low-income communities, where large percentages of income spent on the high energy costs to heat, cool, and electrify homes. Program goals will be to reduce household energy costs while also reducing energy consumption. Some benefits can be quantified through data obtained through NREL's ResStock tool, including the average annual utility bill savings, energy use reduction, and energy burden percentage reductions for the homeowner or tenant.

[139] Climate-Smart Grown in SC, https://www.climatesmartsc.org/default.aspx

14.1.4 Organics Recovery and Food Waste Reduction

An expanded "Don't Waste Food SC" program will reduce needs for new landfills. The program will also address food insecurity issues in the state by coordinating with food banks and food donation programs and increasing awareness of the economic, environmental, and social impacts of wasted food.

In 2022, 38% of the nation's food supply went unsold or uneaten, the vast majority of which was sent to a landfill, incinerated, or put down the drain. Much of that waste is healthy, nutritious, edible food that could be given to help those in need. At the same time, an estimated one in 10 Americans, many of them children, are food insecure.[140] Food insecurity is defined by the U.S. Department of Agriculture as lacking access, at times, for an active, healthy life and is associated with numerous adverse social human health outcomes. While food insecurity happens in all communities, it is more common for people of color and those in rural areas to be food insecure because of factors such as poverty, unemployment, and the cost of living. In South Carolina, more than 515,000 residents (9.9% of the state's population) faced food insecurity in 2021. Minority, underserved communities are three times more likely to have shortages. Overall, 19% percent of the Black population and 7% of the White population of the state were food insecure.[141]

The expanded "Don't Waste Food SC" program will augment existing efforts by enhancing the existing outreach and education campaign, developing a community and business ambassador program, and providing trainings for communities and businesses to implement prevention and donation practices.

14.1.5 State Agency Recycling

Expected co-benefits include the reduced need for new landfills; economic development through an expanded demand for recycling services, market development of circularly produced goods, and job creation; natural resource conservation and energy savings; air quality improvements via reductions of extractive practices such as mining, drilling, and harvesting.

The program will increase the amount of materials diverted from the waste stream, as well as contribute to workforce development and new jobs in South Carolina.

14.1.6 Alternative and Multi-Modal Transportation

Replacing vehicle trips with bicycle or pedestrian travel reduces GHG emissions, $PM_{2.5}$, and other air pollution. Robust biking and pedestrian infrastructure can support community priorities related to improved air quality and public health, public safety, recreation, economic opportunities for business, cost savings for travelers, and environmental amenities. This measure will increase connectivity and safety throughout South Carolina, reduce the heat island effect in urban areas, reduce transportation barriers, reduce traffic volume, save individuals, businesses, and government offices money, promote economic growth, and develop the workforce within the state.

[140] ReFED, https://refed.org/food-waste/the-problem/
[141] Feeding America, Food Insecurity among Overall (all ages) Population in South Carolina, https://map.feedingamerica.org/county/2021/overall/south-carolina

Use of resources such as the Equitable Transportation Community Explorer[142] and CEJST[143] can be used to ensure that project benefit low-income communities and address transportation access and equity considerations. Another important component would include coordination with land use planning, housing and commercial development planning, greenspace, and trails initiatives to improve access, connectivity, and other community benefits.

14.1.7 Vehicle Fleet Transition

Transitioning to EVs and/or alternative fuel vehicles will lead to cost savings for implementing agencies and offices and provide support for the state's manufacturing sector and EV workforce development initiatives. This program would additionally improve air quality and public health, especially in low-income and disproportionately burdened communities that are most at risk from harmful co-pollutants such as $PM_{2.5}$ and diesel particulate matter from vehicle tailpipe emissions.

Expected co-benefits include reduction of co-pollutants and improvement of air quality. Successful deployment of electric and alternative fuel vehicles in the supply chain/logistics sector may spur other industries and firms to take similar measures.

These measures may promote improved public health throughout the state but especially in disproportionately burdened communities who are at greater risk of disease from poor air quality. Many of the recommended measures will increase connectivity and safety throughout South Carolina; reduce the heat island effect in urban areas; reduce congestion and traffic; save businesses, and government offices money; promote economic growth; and develop the workforce within the state.

The electrification of port equipment, vehicles, and other transportation modes for the movement of goods and products may have significant GHG, diesel particulate matter, and other co-pollutant reductions, bringing substantial benefits to the communities near the ports.

14.1.8 Industrial Scale Energy Use and Efficiency

Expected co-benefits include reduction of co-pollutants, improvement of air quality, and greater energy resilience at implementing sites. Additional benefits associated with the deployment of new technologies include education, training, and workforce development for skilled workers.

14.2 Engagement Plan

SCOR and DHEC seeks to advance the PAQC community engagement efforts through several strategies. These strategies may evolve as the PAQC learns more from community leaders and members about their priorities, needs, and challenges related to air quality and climate pollution.

First, the most valuable tools for meaningful engagement with EJ stakeholders and low income, disproportionately burdened communities are the established relationships and programs that already link many diverse communities across the state. The PAQC will continue to leverage existing meetings, trainings, and projects to continue conversations about the CPRG program. Networks and programs with whom the PAQC will engage include the following examples:

[142] U.S. Department of Transportation, Equitable Transportation Community Explorer, https://experience.arcgis.com/experience/0920984aa80a4362b8778d779b090723/page/Homepage/
[143] Council on Environmental Quality, Climate and Economic Justice Screening Tool, https://experience.arcgis.com/experience/0920984aa80a4362b8778d779b090723/page/Homepage/

- DHEC's EJ initiatives include the EJ Hub (Section 2.3) and EJ Strong, a program offering workshops, trainings, and capacity building tools to EJ communities for disaster preparedness and resiliency.[144] The EJ Strong network was established through an EPA grant and meets every two weeks, in addition to other in-person workshops and events. In November 2023, DHEC received an additional $1 million grant to continue the program.[145]
- The South Carolina Energy Office leads and participates in several EJ initiatives under its environmental justice focus area.[146] The Energy Office also convenes groups with EJ interests, such as the Palmetto Clean Fuels Coalition and Electric Vehicle Stakeholder Initiative.
- Through the Advance Program, DHEC collaborates with regional Air Quality Coalitions to reduce air pollution and develop effective strategies for stakeholder engagement and monitoring emission reduction efforts in local areas.[147]
- The South Carolina Energy Justice Coalition is a statewide network of over 50 organizations working to support communities dealing with high energy burdens, energy inequities, and related topics.
- EPA Region 4's Thriving Communities Technical Assistance Center provides trainings, technical assistance, and other support to communities working on EJ issues. The South Carolina lead organization is the University of South Carolina.[148]
- The South Carolina Institutes of Innovation and Information connects the state's seven Historically Black Colleges and Universities, fosters collaborative opportunities, and facilitates their efforts to form business and industry partnerships.[149]
- DHEC has built connections and relationships with schools, childcare programs, and their surrounding communities through a grant funded by EPA's Water Infrastructure Improvements for the Nation grant program.[150] The grant provides water lead testing, prioritizing facilities located in low-income and rural communities. This water quality program may provide an opportunity to extend community engagement efforts to include air quality topics as well.

Second, SCOR and DHEC will establish an Action Team that focuses specifically on community benefits and engagement, inviting and encouraging participation from EJ and other groups described above. The Community Benefits and Engagement Action Team will be asked to participate in monthly to bi-monthly meetings and assist the PAQC by developing and implementing engagement strategies for the CCAP (see below) and advising on community benefits analyses and implementation of GHG emissions reduction measures.

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[144] DHEC, EJ Strong, https://scdhec.gov/environment/environmental-justice-ej/ej-strong.
[145] DHEC, DHEC Receives $1 million Grant to Extend Efforts for Advancing Environmental Justice in South Carolina, https://scdhec.gov/news-releases/dhec-receives-1-million-epa-grant-extend-efforts-advancing-environmental-justice#:~:text=COLUMBIA%2C%20S.C.,Justice%20efforts%20in%20South%20Carolina.
[146] South Carolina Energy Office, Environmental Justice Focus Area, https://energy.sc.gov/focus-area/environmental-justice.
[147] DHEC, Advance Program and Air Quality Coalitions, https://scdhec.gov/environment/your-air/south-carolinas-energy-future/advance-program-air-quality-coalitions.
[148] REACT4EJ, Resource for Assistance and Community Training in Region 4 on Environmental Justice, https://www.react4ej.org/.
[149] South Carolina Institutes of Innovation and Information, https://sciii.net/.
[150] DHEC, Lead Testing in Schools and Child Care Programs, https://scdhec.gov/bow/lead-testing-schools-child-care-programs.

Third, to ensure that communities' concerns and priorities are addressed in the CCAP, the PAQC will also conduct local community stakeholder summits. These summits may be held in conjunction with EJ Hub or EJ Strong network meetings, or with other networks. SCOR and DHEC expect that some communities may be more interested in flooding, greenspace, family lands, and other environmental burdens, and less interested in directly addressing GHG emissions. By tapping into existing outreach efforts and integrating other community interests, the PAQC hopes to build a strong, connected network to support climate pollution reduction measures.

Virtual or hybrid summits will be held quarterly to share and discuss information about the ongoing CCAP development process and gather insights from community groups. A schedule for in-person summits will be developed, to coordinate with the CCAP process and other opportunities. The goal will be to conduct in-person summits in various locations across the state, for example at COGs or in the Upstate, Midlands, Pee Dee, and Lowcountry regions. Intended participants are the leaders and members of communities adversely impacted by GHG emissions and other environmental and economic burdens.

15 Review of Authority

Each priority measure's section in this report includes a "Review of Authority" subsection, summarized here (Table 41).

Table 41. Legal review of authority summary for priority measures

Section	Priority Measure
6	Land Conservation and Restoration
	• S.C. Code Ann. § 48-62-10 et seq., statutorily mandates SCOR to develop and implement a statewide resilience plan. This includes the responsibility to lead collaborative efforts with other partners in state and local governments, private for-profit and non-profit organizations, foundations, state, national and international industries, and academic institutions. • S.C. Code Ann. §§ 48-62-30(1)(b) and (d)(iii) SCOR developed land conservation priorities and prioritized the role of nature-based solutions in land conservation and restoration efforts which co-benefits for GHG reduction efforts, including enhanced carbon sink capabilities. • S.C. Code Ann § 48-62-50 et seq., SCOR is authorized to manage and distribute funding from the Disaster Relief and Resilience Reserve Fund which includes land conservation/restoration efforts.
7	Climate Smart Agriculture and Forestry
	• The Morrill Act of 1862, ch. 130, 12 Stat. 503 (1862) (codified as amended at 7 U.S.C.A §§ 301-308 (1980); S.C. Code Ann. § 46-7-70; and S.C. Code Ann. § 46-7-90 ; funding for land-grant institutions of Clemson University and South Carolina State University, and for the extension services provided to the public, are for the express purpose of benefitting natural resources and agricultural education, research, and implementation practices. • S.C. Code Ann. § 48-62-10 et seq., statutorily mandates SCOR to develop and implement a statewide resilience plan. This includes the responsibility to collaborate with other partners such as state academic institutions, federal and state government agencies, agribusinesses, and landowners.

Table continues on next page.

Section	Priority Measure
8	Residential Weatherization and Energy Efficiency
	• S.C. Code Ann. § 48-62-20(B) statutorily transferred the SC Disaster Recovery Office (DRO) to SCOR. The DRO, now SCOR, is experienced in successful management of federal disaster housing relief funds and solely responsible for development and implementation of housing recovery program for low-to-moderate income residents which rebuilds or repairs storm-damaged homes, thereby improving a home's energy efficiencies and addressing critical safety needs, and ensuring a safe, sanitary home for victims of declared natural disasters in the state. • S.C. Code Ann. § 48-62-10 et seq., statutorily mandates SCOR to develop and implement statewide resilience plan. This includes the responsibility to lead collaborative efforts with other resilience partners in state and local governments, private for-profit and non-profit organizations, foundations, state, national and international industries, and academic institutions. • S.C. Code Ann. 48-52-410, established the State Energy Office. The Energy Office serves as the principal energy planning entity and functions in a non-regulatory manner. Its primary purpose is to develop and implement energy strategies and increase the efficient use of all energy sources by way of implementation of a State Energy Plan. S.C. Code Ann. §§ 48-52-410, 48-52-430. • S.C. Code Ann. § 43-45-10 et seq., created the South Carolina Office of Economic Opportunity (OEO). The OEO is the state's administering agency for the Community Services Block Grant, Low-Income Home Energy Assistance Program, and the Weatherization Program. The OEO authorized functions include collaborating and coordinating with other state agencies to address the needs of the poor and reduce impacts of poverty

Section	Priority Measure
9	Organics Recovery and Food Waste
	• S.C. Solid Waste Policy and Management Act of 1991 (S.C. Code Ann. § 44-96-10 et seq.) establishes a comprehensive framework for the safe and efficient management of solid waste by DHEC. • S.C. Code Ann. § 44-96-260, authorizes DHEC to develop and implement a regulatory framework for the proper siting, design, construction, operation, and closure of solid waste management facilities. • S.C. Code Ann. § 44-96-50, authorizes DHEC to promote waste reduction, recycling, and resource conservation before disposal and to set waste reduction and recycling goals. • S.C. Code Ann. § 44-96-60, charges DHEC with the authority to develop a state solid waste management plan (State Plan). • S.C. Code Ann. § 13-1-380, DHEC in a collaborative partnership with S.C. Department of Commerce (DOC) and others are implementing a Recycling Market Development Program to provide markets for recovered materials and products within the State for which this implementation measure would support. • S.C. Code Ann. § 48-62-10, et seq., statutorily mandates SCOR to develop and implement a statewide resilience plan. This responsibility includes coordination with other resilience partners such as state government agencies, private for-profit and non-profit entities, and other stakeholders. SCOR is the lead agency on the development of the State Priority Climate Action Plan and as such will be an integral part of the work.
10	State Agency Recycling
	• S.C. Solid Waste Policy and Management Act of 1991 (S.C. Code Ann. § 44-96-10 et seq.) establishes a comprehensive framework for the safe and efficient management of solid waste by DHEC. • S.C. Code Ann. § 44-96-140 et seq., requires state agencies to provide recycling programs for the collection of selected materials including aluminum, cardboard, glass, lead-acid batteries, paper, plastic, tires and used motor oil; to make program modifications to ensure material is recycled; to buy recyclable products; and report to DHEC the annual amount of material/content recycled or purchased. • S.C. Solid Waste Policy and Management Act of 1991, S.C. Code Ann. § 44-96-140 et seq., lacks funding for state agencies to develop and implement recycling programs. • S.C. Code Ann. § 13-1-380, DHEC in a collaborative partnership with S.C. Department of Commerce (DOC) and others are implementing a Recycling Market Development Program to provide markets for recovered materials and products within the State for which this implementation measure would be foundational. • S.C. Code Ann. § 48-62-10 et seq., statutorily mandates SCOR to develop and implement a statewide resilience plan. This includes the responsibility to collaborate with other resilience partners in state agencies.

Table continues on next page.

Section	Priority Measure
11	Alternative and Multi-Modal Transportation
	• S.C. Code Ann. § 48-62-10 et seq., statutorily mandates SCOR to develop and implement a statewide resilience plan. This includes the responsibility to lead collaborative efforts with other resilience partners in state and local governments, private for-profit and non-profit organizations, foundations, state, national and international industries, and academic institutions. • S.C. Code Ann. § 48-62-30(1)(d)(iv) authorizes SCOR to develop and implement recommendations that have co-benefits beyond flood control, to include activities beneficial for the public health, welfare, safety, tourism, and recreational development. • S.C. Code Ann. §§ 6-7-110 and 6-7-140 authorizes State Councils of Government (COGs) to coordinate cooperative programs for the benefit of their citizens in several areas including public health, safety, welfare, recreational opportunities, pollution control measures, utilities, planning, and development. • S.C. Code Ann. § 57-5-10 et seq. establishes the framework for the SC Department of Transportation (SCDOT) for the development, maintenance, and improvement of the State Highway System. • S.C. Code Ann. §§ 57–1–370 (A) and 57-1-370 (B)(8), instruct the SCDOT to seek input from Metropolitan Planning Organizations (MPOs) and COGs in the creation of multimodal transportation system for the State. This system is to take into consideration, among other factors, alternative transportation systems, traffic volume and congestion, and environmental concerns. Therefore, a multimodal system is viable and can incorporate bicycling/pedestrian accommodation plans that can serve as the basis for integrating bicycling/pedestrian onto the state system of roadways.

Table continues on next page.

Section	Priority Measure
12	Vehicle Transitions
	• S.C. Code § 48-52-410, State Energy Office serves as the principal energy planning entity and functions in a non-regulatory manner. • S.C. Code Ann. § 48-52-420, State Energy Office promotes the use of less-polluting transportation fuels, public transportation, and other alternatives in conjunction with state and local entities. • S.C. Code Ann. § 58-27-270(D), EV Stakeholder Initiative is to develop policy and programmatic recommendations to increase electric vehicle (EV) deployment in the state. • S.C. Code Ann. § 1-11-310, allows for state agencies to give preference to alternative vehicles to include hybrid, plug-in hybrid electric, biodiesel, hydrogen, fuel cell, or flexible fuel vehicles when the performance, quality, and anticipated life cycle costs are comparable to other available motor vehicles. • S.C. Code Ann. § 58-27-260, State Legislature established a Joint Committee to study challenges and opportunities associated with transportation electrification. The investigation is to include environmental, economic, and customer challenges associated with electric vehicles (EVs); the potential value of advancing the development and deployment of EVs, and associated infrastructure; and the impacts of EVs on current infrastructure, customers, utilities, and electricity grid. • S.C. Code Ann. §§ 54-3-140, 54-3-200, et seq., S.C. Ports Authority is authorized to establish rail and access of any and every kind or character of motive power. • Executive Order No 2022-31, SC Department of Commerce (DOC) to establish a EV initiative to create and implement a strategic approach to identify, encourage, and incentivize EV research, development, and production in the state. Initiative must collaborate with the Interagency EV Working Group (which includes SCOR) to develop a comprehensive statewide EV deployment plan. • S.C. Code Ann. § 48-62-10 et seq., statutorily mandates SCOR to develop and implement a statewide resilience plan. This includes the responsibility to lead collaborative efforts with other resilience partners in state and local governments, private for-profit and non-profit organizations, foundations, state, national and international industries, and academic institutions.
13	Industrial-Scale Energy Use and Efficiency
	• S.C. Code Ann. § 48-62-10 et seq., statutorily mandates SCOR to develop and implement a statewide resilience plan. This includes the responsibility to lead collaborative efforts with other resilience partners in state and local governments, private for-profit and non-profit organizations, foundations, state, national and international industries, and academic institutions. • Per S.C. Code Ann. § 48-62-30, SCOR's plan and its recommendations for resilience measures include programs with co-benefits beyond hazard mitigation and embrace sustainable technological energy advancements on an industrial-scale that spur economic and workforce development, as well as provide for the reduction of GHG emissions.

16 Conclusions and Next Steps

16.1 Comprehensive Climate Action Plan

The second deliverable required of the EPA CPRG program is the Comprehensive Climate Action Plan (CCAP). The CCAP will build on the PCAP and include several additional, required elements. These additional elements include more comprehensive assessments of GHG reduction measures and benefits, GHG emissions projections, GHG reduction targets, workforce planning analysis, and identification of funding opportunities.

The process to develop the CCAP will begin in April 2024. The anticipated due date to EPA is June 2025. Similar to the PCAP process, coordination and engagement will be integral to creating a robust CCAP. SCOR and DHEC will evolve the PAQC coordination and engagement strategy and continue to work with state agency partners such as the Energy Office and SC Ports Authority and other levels of government. Action Teams will continue to be an important mechanism to engage with the wide range of stakeholders and communities who have indicated interest in the PAQC. SCOR and DHEC will also work to advance PAQC community engagement, so that communities most affected by climate pollution are able to participate in this planning grant.

In addition, SCOR and DHEC will use the CCAP process to begin addressing data and information gaps identified by Action Teams (Section 16.2) and to investigate in more detail the various GHG emission reduction ideas generated during the PCAP phase (Section 16.3).

16.2 Greenhouse Gas Emissions Measurement and Monitoring

As South Carolina does not have one designated agency or entity that collects GHG emissions data, the EPA SIT provided a starting point to identify and understand the relative contributions of different sectors and activities to the state's net GHG emissions. However, the SIT provides only a broad view of the state's emissions. The Action Teams identified many data gaps, information needs, and questions that the PAQC can begin address during the course of the CPRG program (Appendix D).

16.2.1 Coordinate Efforts to Improve GHG Measurement and Monitoring

The PAQC can look for ways to help coordinate existing activities in South Carolina as well as facilitate partnerships to leverage federal funding and other available opportunities to advance GHG measurement, monitoring, reporting, and verification capacity in the state. Both top-down and bottom-up approaches are needed. Top-down approaches include the monitoring of atmospheric concentrations of all sources and sinks, including natural sources, with new technologies and methods (e.g., satellite data). Bottom-up approaches measure emissions at specific sites and activities and allows direct attribution and more accurate analyses of emissions.

Efforts are underway in the state to improve GHG data collection and analysis, but they are disparate (e.g., funded through specific research programs or grants). It is unclear the extent to which different activities are currently coordinated, but the PAQC can provide opportunities for information sharing. Clemson's Climate Smart Agriculture and Forestry programs utilize sensors deployed to monitor greenhouse gas fluxes and assess the effectiveness of climate smart conservation practices in reducing GHG emissions. Through partial support from the CPRG program, SCOR is acquiring high-resolution NOAA C-CCAP data for the entire state. This data can be used in efforts to monitor carbon sequestration and inform land conservation decisions. The PAQC can provide a venue to ensure these various efforts communicate with one another and coordinate when possible. A more coordinated approach can help

agencies and researchers in the state learn about new opportunities (e.g., research, funding) and technological developments (e.g., remote sensing methods).

16.2.2 GHG Sensor Network

A statewide GHG sensor network could be deployed to better understand GHG emissions. The air quality monitoring networks currently in place do not have sites in every county within the state, nor do they measure GHG emissions. A sensor system that collects GHG and other air pollutant data could be established for non-regulatory purposes to supplement current data collection and would not be monitored by DHEC's Bureau of Air Quality. Expanding data collection throughout South Carolina by establishing a statewide greenhouse gas and air pollutant sensor network could address data gaps and provide a more comprehensive analysis of greenhouse gases and air pollutants, information that is critical for research, development, and decision making. GHG information may be useful to supplement future statewide GHG inventories. Data for other air pollutants may help disproportionately burdened communities better understand localized air pollution episodes.

Clemson University has the technology available to build out a GHG sensor network through the Intelligent River® program[151] and Intelligent Air™ sensor packs. The sensors collect CO_2, CH_4, $PM_{2.5}$, O_3, CO, NO_2 and SO_2 data. The Intelligent Air™ sensor packs store data in a professionally managed, enterprise-scale Intelligent River® data repository and can be seamlessly shared through data dashboards and geospatial web map services. The system leverages IoT cellular data networks with a low data transmission cost, making it easier to keep sensors active and reporting for extended periods. Importantly, the entire reporting system is designed to display data in real-time with no need for advanced data analysis or calibrations. The data accessibility is such that anyone can view and use the data, which has a great benefit to communities and stakeholders statewide. In a broad sense, these data can be used at all levels of education throughout the state to build a better workforce that is literate in issues of air quality and climate and encourage more participation in the STEM fields.

16.2.3 Methane Leak Monitoring

South Carolina currently does not measure or account for greenhouse gas leaks. Emerging technologies, such as satellite remote sensing, could be utilized to identify and measure methane leaks from pipelines, compressor stations, and infrastructure connection points. As utility-scale gas use increases, this monitoring is essential for accurate inventories as well as for addressing and repairing previously unidentified sources of emissions.

16.2.4 Technical Assistance for Businesses and Communities

Many organizations in South Carolina already conduct GHG emissions inventories or have expressed interest in improving their capacity to measure, monitor, report, and verify their emissions. The PAQC has collected several examples of existing efforts made by municipal and county governments (Section 5.2). EPA is supporting local-scale emissions inventories in those MSAs receiving CPRG funds, however those awards do not cover all of South Carolina's communities and local governments.

Many large firms and global companies operating in the state also track their GHG emissions, as part of communicating progress toward their sustainability and net zero emission goals, as well as other

[151] For more information see Clemson University's Water Resources Center, Research page, https://www.clemson.edu/public/water/scwater/research.html.

reporting requirements.[152] Smaller firms, businesses, and other entities may want to understand and reduce their emissions to identify cost efficient investments, realize energy efficiencies, and/or be more competitive in both existing and new markets. However, conducing a comprehensive assessment of Scope 1, Scope 2, and Scope 3 emissions can be challenging. Scope 1 emissions are direct emissions occurring from sources that are controlled or owned by an organization, such as emissions associated with fuel combustion in boilers, furnaces, and vehicles. Scope 2 emissions are indirect GHG emissions associated with the purchase of electricity, steam, heat, or cooling.[153] Scope 3 emissions, or value chain emissions, are those emissions an organization is indirectly responsible for when it buys, uses, and disposes of products from other suppliers.[154]

A future PAQC effort could provide support and technical assistance to entities required or interested in conducting consumption-based inventories (e.g., manufacturing firms). For example, the PAQC could help develop GHG measurement, monitoring, and reporting guidance that aligns with the priority GHG reduction measures and statewide inventory developed through the CPRG program. Potential partners include Coastal Carolina University, the South Carolina Manufacturing Extension Partnership, and Sustain SC.

16.3 Recommended GHG Reduction Measures

Sections 7 through 13 identified priority measures that South Carolina may take to 1) reduce greenhouse gas and co-pollutant emissions or 2) increase carbon sequestration and storage. Priority measures were selected based on a variety of criteria (Section 5), including the EPA guidelines that specify that priority measures should be implementation ready, achieve near-term GHG reductions, and demonstrate benefits for low income and disproportionately burdened communities.

The additional measures presented here are broader than the priority measures and include a variety of ways to reduce GHG emissions. Many of these measures were recommended and discussed by stakeholders and Action Team members during the process to develop the PCAP.

These recommendations may have large emissions reduction potential but may take longer to implement, require large amounts of funding, require extensive intergovernmental and community coordination, or may not have a clear authority to implement or determined implementation pathway. In addition, some may need further study and refinement prior to implementation.

SCOR and DHEC included these recommended measures in the PCAP as a way to document the diverse and innovative ideas provided by engaged stakeholders and Action Team members. These measures may be further considered and assessed in more detail during the development of the CCAP. They are also intended to provide information about community needs and interests that can be addressed as new funding and opportunities to reduce GHG emissions emerge.

[152] Sustain SC, The Roadmap to Sustain SC, https://www.sustainsouthcarolina.org/roadmap.
[153] EPA, EPA Center for Corporate Climate Leadership, Scope 1 and Scope 2 Inventory Guidance, https://www.epa.gov/climateleadership/scope-1-and-scope-2-inventory-guidance.
[154] EPA, EPA Center for Corporate Climate Leadership, Scope 3 Inventory Guidance, https://www.epa.gov/climateleadership/scope-3-inventory-guidance.

16.3.1 Transportation

Transportation is South Carolina's largest source of emissions, accounting for nearly 40% of the state's total gross emissions at 29.406 $MMTCO_2e$ in 2020. Many strategies exist to reduce use of fossil fuels in South Carolina's transportation sector. Fossil fuel use can be reduced through deployment of electric vehicles, development of alternative fuels, use of public transit, and development of pedestrian and bicycle infrastructure.[155]

Priority measures identified in this PCAP focus on South Carolina's recommended transportation reduction measures include public transit, electric vehicles (EVs), alternative fuels, EV infrastructure, alternative transportation, ports, rail, and air. Key partners for implementation and development of projects or programs in this sector may include SC Department of Transportation (DOT), SC Ports Authority (SCPA), Palmetto Railways, SC Aeronautics Commission, SC Councils of Government (COG), municipalities, communities, and non-governmental organizations (NGO).

16.3.1.1 Electric Vehicles (EVs) and EV Infrastructure

South Carolina's electric vehicle manufacturing industry is growing rapidly, yet EV ownership is very low within the state. Public outreach and education on the safety, ease of use, and affordability of EVs may be very beneficial in encouraging vehicle owners to electrify. In addition to federal rebates, state rebates may be offered to incentivize EV purchases. Vehicle conversion should include passenger, commercial, industrial, and government vehicles/ fleets.

The largest barrier in public opinion of EVs may be the lack of a well-developed charging network. Installation of EV infrastructure may spur the transition to electric vehicles. Public support for the installation of public, level 2, and fast-charging EV charging stations was high. EV infrastructure may be installed at community locations found throughout the state (such as government buildings, community centers, schools, and hospitals), heavily trafficked roads not covered by existing EV infrastructure programs, and at multi-family housing.

16.3.1.2 EV-Ready Construction

This cross-cutting measure could incentivize new single- and multifamily-residential buildings to meet "EV Ready" standards for each parking space provided, effectively providing expanded and equitable access to EV charging. EV Ready standards include providing panel capacity, an installed breaker, and an associated completed circuit that terminates at an installed charger or a wall plug. Ensuring new construction is EV Ready provides significant cost savings compared to retrofitting homes for EV infrastructure and provides convenient and affordable charging options. Additionally, EV Ready is less expensive for builders than "EV Installed" and leads to cost savings for both the builder and the homeowner.

16.3.1.3 EV-Specific Electricity Rates

Work with utilities providers to support EV-specific electricity rates for different charging use cases, including time of use rates for residential, workplace, and fleet charging. Support specific rates for public charging, especially direct current fast charging, to ensure predictable pricing for commuters and to avoid cost-prohibitive demand charges. EV-specific rates provide key incentives for EV users to shift

[155] South Carolina Energy Office, Clean Transportation Focus Area, https://energy.sc.gov/focus-area/clean-transportation.

loads where possible while supporting the development of a competitive private market for public EV charging through price certainty.

16.3.1.4 EV Batteries

Promoting the responsible end-of-life management and recycling of Li-ion batteries is critical as EV sales increase. EV manufacturing and battery recycling businesses are growing in South Carolina. Supporting responsible EV battery recycling not only reduces lifecycle emissions and environmental degradation at mining locations but also promotes economic growth and development within the state.

16.3.1.5 Alternative Fuels

Promoting the market development and deployment of alternative fuels and supporting infrastructure may be critical to reducing emissions from long-haul heavy-duty vehicles. Fully-loaded long-haul EVs may not yet be implementation-ready due to long charge-times and low mileage ranges. Alternative pilot programs such as hydrogen-fuel heavy-duty vehicles may be a successful solution.

16.3.1.6 Air

Supporting the use of a clean jet fuel was discussed during the Transportation Action Team webinars and may lead to reductions of GHG emissions and other co-pollutants. Airports usually have large areas dedicated to vehicle parking during travels. Surface lots could have solar canopies installed over them to generate renewable energy for the terminal, as well as to protect travelers' vehicles from extended exposure to sun and weather. Energy efficiency standards within the terminal could also reduce the demand for energy.

16.3.2 Electric Power Generation

The electric power generation industry is the second-largest source of GHG emissions in South Carolina, offering opportunities for both public and private utilities companies to decarbonize. Power generation is a cross-cutting area that impacts residential and commercial buildings, industry, and transportation.

Key partners for implementation and development of projects or programs in this sector may include the SC Energy Office; private, public, and co-op utilities; SC Councils of Government (COG); municipalities; communities; and non-governmental organizations (NGO).

These measures may promote improved public health throughout the state but especially in disproportionately burdened communities located near fossil fuel combustion energy generation sites who are at greater risk of disease from poor air quality.

16.3.2.1 Energy Transition

Transitioning grids that are currently reliant upon coal-fired power plants and other fossil fuels to alternative energy sources may greatly reduce emissions from the electric power generation sector. Action Team discussions during the PCAP process revealed some of the challenges utilities face in transitioning their energy mix away from fossil fuels and potential timelines for closing coal-burning plants.

16.3.2.2 Solar Energy

Deploying solar panels at locations such as government buildings and parking lots (e.g., solar canopies), multi-family homes, train stops and bus shelters, airports, hospitals, community centers, schools, and

alongside highways[156] may be a successful way to increase renewable energy while maximizing space availability, and minimizing impacts to natural and working lands. Similarly, deploying agrivoltaics,[157] also called dual-use solar, to generate energy on sites focused on agriculture, crop or livestock production, or pollinator habitats maximizes the use of space while creating renewable energy. Developing community solar[158] projects throughout the state using EPA Solar for All funding, if awarded, will bring affordable clean energy to low-income and disproportionately burdened communities. Throughout the stakeholder engagement process, public education and outreach about the safety and efficacy of solar were identified as needs for the growth of widescale support of solar. It is recommended that funding for education and outreach be made available to spur community support and increase solar energy throughout the state.

16.3.2.3 Wind Energy

There is considerable interest in developing wind energy in the Carolinas from academic institutions and non-profits. Although these projects tend to require a large amount of frontloaded expenditure, South Carolina has many areas that may be key locations for wind energy generation. It is recommended that these key locations be considered and assesses for viability and cost-benefit analyses to generate wind energy.[159]

16.3.2.4 Hydroelectric Power

Hydroelectric power is generated in South Carolina, but opportunities for new pump storage hydro projects could be considered and assessed.

16.3.2.5 Biogas

Many large landfills throughout South Carolina already have biogas collection facilities in place, but there may be opportunities to expand collections at other sites. Future plans may recommend considering and assessing opportunities for anaerobic digestion biogas collection facilities. Additionally, monitoring gas pipes from landfill biogas systems with regular audits and inspections, and repairing leaks to prevent methane emissions is a priority need within the state (for more on monitoring gas pipes for leaks, see section 16.2.2).

16.3.2.6 Geothermal Energy

There are no large-scale geothermal energy production sites in South Carolina, but it is a generation area that has room to expand in the future. The most viable use of harnessing Earth's constant temperature is to enhance the energy efficiency of heating and cooling systems with the installation of geothermal heat pump (GHP) systems.[160] There are geothermal incentives available for geothermal machinery through the SC Department of Revenue for up to $3,500 of tax credits per year.[161] This tax credit includes machinery or equipment owned by the taxpayer such as a heat pump that uses the

[156] The Ray, https://theray.org/.
[157] National Renewable Energy Laboratory, Agrivoltaics, https://www.nrel.gov/solar/market-research-analysis/agrivoltaics.html
[158] US Department of Energy's Office of Energy Efficiency and Renewable Energy, Community Solar Basics, https://www.energy.gov/eere/solar/community-solar-basics
[159] US Department of Energy's Office of Energy Efficiency and Renewable Energy, WINDExchange: Wind Energy in South Carolina, https://windexchange.energy.gov/states/sc
[160] SC Energy Office. Renewable Energy: Geothermal. https://energy.sc.gov/focus-area/renewable-energy/geothermal
[161] South Carolina Department of Revenue Tax Form. https://dor.sc.gov/forms-site/Forms/TC38.pdf

ground or groundwater as a thermal energy source to heat a structure or as a thermal energy sink to cool a structure, machinery that uses the internal heat of Earth as a substitute for traditional energy for water heating or space heating and cooling, or machinery that meets or exceeds federal Energy Star requirements.

16.3.2.7 Resilience Hubs

South Carolina is a leader in community resilience, and one of the first states to establish a state Office of Resilience. Building a Resilience Hub network throughout the state is recommended to increase community resilience to rising global temperatures, a changing climate, and natural hazards such as floods, hurricanes, extreme weather, and earthquakes. Resilience Hubs are locations that can be established statewide at a particular location that nearly every community has, such as a public school, community center, hospital, government office, or police station. These hubs comprise of renewable energy (e.g., solar panels) and microgrids (energy storage such as a battery) that would allow communities access to EV charging infrastructure, electricity for heat or cooling, or device charging such as for cell phones, radios, or emergency lighting systems. It is recommended that Resilience Hub locations be identified statewide and subsequently established through the installation of microgrids, solar panels or other renewable energy sources, EV charging infrastructure, and community gathering space throughout the state as part of establishing and building out a Resilience Hub network.

16.3.3 Industry

The industry sector accounts for approximately 17.6% of GHG emissions within the state. Many opportunities exist to reduce emissions from industrial process and operations. Additional reduction measures can be implemented with financial, marketing, logistics, and research support from a variety of entities.

Key partners for implementation and development of projects or programs in this sector may include SC Manufacturing Extension Partnership, SC Department of Commerce, trade and manufacturing associations, private sector businesses, academia, and non-governmental organizations (NGO).

Co-benefits include enhanced energy resilience and cost savings for businesses and firms, new economic investments and technological advancements, job creation, and improvements to air quality and public health for communities located near industrial sites.

16.3.3.1 Energy Efficiency

SC Manufacturing Extension Partnership and Sustain SC are two organizations in the state that work with small- to medium-sized local businesses to help them meet their sustainability goals. They also assist businesses with meeting sustainability metrics from corporate headquarters located in the EU or other countries or states that may have more stringent sustainability requirements or policies. It is recommended that this work be continued and expanded upon as a statewide initiative. Small, medium, and large businesses may benefit from public education and outreach about the savings they may benefit from through installing energy efficient non-process uses for facilities (e.g., LED lighting, sensors or timers, energy efficient appliance upgrades). Businesses may also benefit from electrifying vehicle fleets or by practicing load sharing with other firms (such as shared transportation services).

16.3.3.2 Electrification and the Reduction of Fossil-fuel Based Energy Sources

Incentives for industrial firms to install renewable energy on-site (such as solar panels on facility roofs or solar canopies over large parking lots) may accelerate the transition away from fossil fuel generated

energy. Battery and microgrid deployment on site at industrial sites will allow for energy storage and use even during outages. Additionally, new technologies may be piloted for process equipment or on-site energy production to test for viability and set a model for other businesses to follow.

16.3.3.3 Industrial Recycling and Material Efficiency

Industrial materials such as steel often end up in the landfill. Establishing a statewide industrial recycling program will reduce waste in landfills while creating a circular economy and requiring less new materials to be needed, significantly benefiting the environment through the conservation of natural resources. Promoting the use of low-carbon material in production processes may also reduce and avoid emissions, such as the use of biochar in cement (which sequesters carbon and reduces emissions through production),[162] promoting the use of recycled steel, and marketing carbon-storing building materials such as Climate Smart lumber (see Priority Measure Section 7).

16.3.3.4 Product Development and Market Support

Circular economies pull materials out of the waste stream and recycle them into reusable goods and products, creating less demand for new materials and conserving natural resources. Promoting a circular economy through the development and market support of sustainably sourced goods will reduce as well as avoid emissions. Public education and outreach is a key component of developing this measure as it requires community interest, support, and changes in group behaviors such as desiring to purchase sustainable goods.

16.3.4 Agriculture and Working Lands

Agriculture accounts for approximately 3.14% of GHG emissions in South Carolina. Sustainable forestry management practices, and forest land remaining forest, maintains carbon in the forest system. Land management practices such as afforestation, forest fires, deadwood, or clearing natural lands for farmland or urban development are a source of greenhouse gases. Many opportunities exist to reduce emissions from the agriculture, working lands, and forestry sectors, as well as to implement practices that can enhance the capacity of South Carolina's lands and soils to store carbon.

Key partners for implementation and development of projects or programs in this sector may include Clemson University, Clemson Extension, agribusinesses, landowners, manufacturers, and non-profit organizations.

16.3.4.1 Carbon-storing Wood Products

Clemson University's Climate Smart Forestry program includes research on the effectiveness of different types of products in storing carbon and quantifying their economic value and feasibility. A "Climate Smart" logo would allow purchasers to make informed decisions about the sustainability of their choices. Incentivizing carbon-storing product development as well as public outreach and education about the importance of sustainable products could develop a market for climate-smart products and materials, increasing demand which could drive growth in supplying these goods.

16.3.4.2 Reduce Fossil-Fuel Based Energy Use

Farms rely on fuel for a variety of activities, including farm equipment, vehicles, and electricity for facilities. Incentivizing alternative fuels for these needs may decrease indirect emissions from energy

[162] U.S. Department of Energy, National Renewable Energy Laboratory. "Biochar as a building material: sequestering carbon and strengthening concrete." https://www.nrel.gov/docs/fy22osti/82445.pdf

generation. Many farms are well-positioned to produce biomass and biofuel through farming waste, which may be used to operate farm activities without additional grid support. Assessing opportunities and tradeoffs related to site-generated energy and fuel may be beneficial. Incentivizing farm-to-farm cooperation for the transport of goods may reduce indirect emissions generation from transportation sources. This cross-cutting measure is also cost-effective and may result in large savings for farm owners and operators. Public education and outreach to farmers on these practices may be beneficial to ensure farmers can make informed decisions.

16.3.4.3 Use of Organic Materials to Capture Methane Emissions

Circular Farm is a mushroom farm located in Aiken that promotes sustainability through farming practice. The farm recycles organic agricultural waste byproducts through the growth of their mushrooms and promotes research on sustainable agriculture for community benefits. Applied research and demonstration projects would help to test the viability of using organic materials to capture methane emissions in smaller-scale landfills.

16.3.4.4 Woody Biomass Carbon Removal and Storage

Biomass is the materials that come from living things, including plants, animal manure, yard trimmings, pine needles, leaves, and branches. All life is made up of carbon, so biomass stores or sequesters carbon until it begins to decompose and releases the carbon it was storing into the atmosphere. Using woody biomass as a carbon dioxide removal and storage method has recently gained popularity as a potential piece of the puzzle for lowering atmospheric CO_2. Biomass is placed in subsurface sites to prevent carbon emissions during the decomposition phase, trapping that carbon belowground on a millennial timescale or beyond.

It is recommended that applied research and demonstration sites be supported or incentivized to assess the feasibility of woody biomass carbon removal and storage. Assessments should include cost-benefit analyses and measurements of carbon storage and sequestration, as well as any challenges that may arise. Potential partners include Clemson University and Clemson Extension.

16.3.5 Waste Management

In 2020, South Carolina's waste emissions totaled 2.77% of gross state emissions at 2.039 $MMTCO_2e$. South Carolina's recommended waste management reduction measures include recycling, waste reduction, materials management, and landfill gas to energy.

Key partners for development and implementation of statewide projects or programs in this sector may include DHEC, SC Department of Commerce, private and municipal waste management authorities, private sector, municipalities, and local communities.

16.3.5.1 Recycling and Waste Reduction Programs

Expanding and enhancing existing recycling programs throughout the state while encouraging public-private partnerships may effectively and significantly reduce the amount of waste in South Carolina's landfills. Where needed, the use of private sector capacity, including infrastructure, equipment, collection, transport, education and outreach, and market development may be essential to scaling up the statewide initiative, while also supporting the economy. Potential focus areas for refined development of recycling programs include multifamily homes, small- and medium-sized business, and industrial recycling.

16.3.5.2 Materials Management

Circular economies pull materials out of the waste stream and recycle them into reusable goods and products, creating less demand for new materials and conserving resources. Promoting a circular economy through the development and market support of sustainably sourced goods will reduce, as well as avoid, emissions. Public education and outreach is a key component of developing this measure as it requires community interest, support, and changes in group behaviors such as desiring to purchase sustainable goods. Coordinating with public and private sectors to incentivize the use of sustainable products and support markets may be an effective way to develop a circular economy.

16.3.6 Residential, Commercial, and Public Buildings

The commercial buildings sector is the source of 2.9% of GHG emissions in South Carolina and the residential buildings sector is the source of 2.6% of GHG emissions. Residential buildings also accounted for the end-use of approximately 17% of electric power generation in the state.

Key partners for implementation and development of projects or programs statewide in this sector may include SC Energy Office; SC Department of Commerce; other state agencies; academic institutions; Councils of Government (COG); private, cooperative, municipal, and investor-owned utilities (IOUs); state and local housing authorities; non-profit organizations; and local communities.

16.3.6.1 Energy Efficiency

In addition to the Residential Weatherization and Energy Efficiency (RWEE) priority measure (Section 8), additional opportunities may exist to increase energy efficiency in residential buildings. Establishing an energy efficiency certification program for all buildings in SC would encourage consistent building practices and retrofits by households, developers, and assistance providers. Incentivizing energy audits to make them more widely available, including to those who may not qualify for the RWEE program, will assist homeowners, landlords, and private, public, and non-profit entities in identifying priorities and goals for energy efficiency upgrades. Energy efficiency upgrades for multifamily homes and private, public, and non-profit buildings may be considered as a priority measure in future planning, such as in the CCAP. Public education and outreach is another key component of energy efficiency reduction measures and should be prioritized.

16.3.6.2 Reduce Use of Fossil-Fuel Based Energy Sources

Deploying solar panels, microgrids and batteries, and new technologies such as clean hydrogen in single family and multifamily housing, commercial, and public buildings would significantly reduce the demand for fossil-fuel based energy generation. Installing solar panels and solar canopies on commercial and government buildings, and over parking lots and parking garages is an innovative way to make use of space while generating zero emissions energy and should be prioritized in future state plans such as the CCAP.

16.3.6.3 Community Resilience and Sustainability

South Carolina is a leader in community resilience, and one of the first states to establish a state Office of Resilience. Building a Resilience Hub network throughout the state is recommended to increase community resilience to rising global temperatures, a changing climate, and natural hazards such as floods, hurricanes, extreme weather, and earthquakes. Resilience Hubs are locations that can be established statewide at a particular location that nearly every community has, such as a public school, community center, hospital, government office, or police station. These hubs comprise of renewable

energy (e.g., solar panels) and microgrids (energy storage such as a battery) that would allow communities access to EV charging infrastructure, electricity for heat or cooling, or device charging such as for cell phones, radios, or emergency lighting systems. It is recommended that Resilience Hub locations be identified statewide and subsequently established through the installation of microgrids, solar panels or other renewable energy sources, EV charging infrastructure, and community gathering space throughout the state as part of establishing and building out a Resilience Hub network.

16.3.6.4 Commercial Building Certification Program (RISES)

The Sustainability Institute's Charleston RISES – Resilient, Innovative, Sustainable, and Efficiency Standards (RISES) – is a certification program that promotes high-performance design and construction in commercial and multifamily buildings.[163] RISES promotes and recognizes development projects that achieve energy and water efficiency targets that are at least 30% better than projects built to code standards.[164] The program has a proven model and has demonstrated success in Charleston while being easily scalable from city up to state-level. It is a fully customizable program able to address localized priorities, strategies, and incentives. It can be stood up quickly and is cross-cutting as it also diverts waste from landfills, supports the deployment of EV charging infrastructure, and requires renewable energy systems.

16.3.6.5 Building Practices

Incentivizing sustainable building practices using sustainable carbon-storing materials may be supported through future plans such as the CCAP. Offering incentives to builders and contractors who meet criteria for energy efficiency standards such as Energy Star, Home Energy Score, Home Energy Rating System (HERS) Index, or Charleston RISES may increase sustainable building practices and assist in creating a demand for those practices as community awareness and education increases. Carbon-storing building materials and equipment such as sustainably sourced lumber and recycled materials should also be incentivized and encouraged.

16.3.7 Greenspace Development and Urban Forests

Forestry is a large carbon sink, including urban forests. All life is made up of carbon, and plants intake carbon dioxide through the process of photosynthesis. Increasing urban forests and other greenspaces in urban areas will not only result in carbon sequestration and reduction, but will also reduce the urban heat island effect, increase community beautification (a high-rated priority on the community input survey), increase public health from improved air quality and more opportunities for exercise, and provide means for alternative transportation such as walking or biking. It is recommended that this measure be considered a priority measure in future planning such as in the CCAP.

[163] The Sustainability Institute: Charleston RISES. http://sustainabilityinstitutesc.org/charleston-rises-green-building-design-certification/

[164] Using ASHRAE Standard 90.1 2013 as the baseline reference

Appendix A. Notice of Intent to Participate in the CPRG Planning Grant

HENRY MCMASTER
GOVERNOR

March 29, 2023

VIA ELECTRONIC MAIL
U.S. Environmental Protection Agency
Office of Air and Radiation
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460

RE: *Notice of Intent to Participate in the CPRG Planning Grant*

Dear Sir or Madam,

I write to express the State of South Carolina's intent to participate in the U.S. Environmental Protection Agency's ("EPA") Climate Pollution Reduction Grant ("CPRG") Planning Grant program and designate the South Carolina Department of Health and Environmental Control ("SC DHEC") with oversight and responsibility for managing the CPRG Planning Grant program. The designated contact person is Myra C. Reece, Director of Environmental Affairs, SC DHEC, and can be reached at reecemc@dhec.sc.gov or (803) 898-4102.

As the state's environmental regulatory authority, SC DHEC, working collaboratively with the South Carolina Office of Resilience, the South Carolina Energy Office, and other state agencies, as well as local government and community stakeholders, will use this grant to plan for innovative strategies that reduce greenhouse gases and co-pollutants. The state's plan will focus on land conservation actions to reduce pollution, implement improved EV-related industry permitting, and promote responsible end-of-life management and recycling for Li-ion batteries and other EV-related needs. Further, it will lay the groundwork for lowering air emissions, ensuring clean water, strengthening recycling markets, engaging communities, and capitalizing on workforce and economic development opportunities.

Should you have any questions or need any additional information, please do not hesitate to contact SC DHEC.

Yours very truly,

Henry McMaster

HDM/jm

STATE HOUSE • 1100 GERVAIS STREET • COLUMBIA, SOUTH CAROLINA 29201 • TELEPHONE: 803-734-2100

Appendix B. PAQC Action Teams

During the first phase of the CPRG Planning grant program, SCOR and DHEC formed Action Teams to work on specific topics relevant to the PAQC and to assist with identifying, assessing, and recommending GHG reduction measures to include in the PCAP. A publicly available stakeholder survey developed by SCOR for the PAQC was posted on the initiative's website, shared with interested parties, and promoted in SCOR's newsletter. This survey was a key source of project ideas and GHG reduction measures considered for the PCAP. Additionally, an information sheet was shared with stakeholders, partners, and organizations detailing the PAQC, CPRG program, requirements for the statewide PCAP and Implementation Grant application, and SCOR and DHEC's intent to form the Action Teams. Individuals and organizations interested in participating were instructed to contact PAQC via email.

Based on responses from interested parties, six Action Teams were created: Residential & Commercial Buildings, Agriculture/Natural & Working Lands, Greenhouse Gas Inventory, Waste and Materials Management, Industry, and Transportation.

The first series of webinars were held during December 11-15, 2023. Agenda items included a CPRG and PAQC overview, Action Team objectives and expectations, a draft of the state's GHG inventory, initial results from the stakeholder survey, discussion on current GHG reduction efforts being implemented across the state, potential reduction measures to include in the PCAP, and next steps. Subsequent Action Team Meetings were held January 10-12, 2024, and February 12-14, 2024. Agenda items for these series of meetings were the final results of the stakeholder survey, draft write-ups of the GHG inventory, continued discussion and analysis of GHG reduction measures, comments on the draft PCAP, and final projects and programs to consider for the plan.

The Action Teams provided SCOR and SC DHEC with subject-matter expertise and insight of members' organizational and community priorities as it pertains to GHG reduction. The teams also allowed SCOR and SC DHEC additional opportunities to broaden PAQC's reach and engage with individuals and organizations from across the state to ensure the measures in the PCAP and Implementation Grant application benefited citizens statewide. The table below (Table 42) lists the organizations and agencies represented by participating Action Team members.

Table 42. PAQC Action Team participating organizations

Action Team Participating Organizations	
Benore Logistics	Mid-Carolina Steel & Recycling
Berkeley Charleston Dorchester COG	Palmetto Railways
Busch Systems	Pratt Recycling
Carolina Recycling Association	Renewable Energy Wildlife Institute
Central Midlands COG	Republic Services of South Carolina, LLC
Charleston Climate Coalition	S.C. Sea Grant Consortium
Charleston County	Santee Cooper
Charleston Moves	SC Commerce

Charleston Parks Conservancy	SC Manufacturing Extension Partnership
Circular Farm Mycology	SC Ports Authority
City of Charleston	DHEC, Bureau of Air Quality
City of Columbia	DHEC, Bureau of Environmental Health Services
City of Greenville	DHEC, Bureau of Land and Waste Management
Clean Air Task Force	DHEC, Office of Environmental Affairs
Clemson University, Department of Animal & Veterinary Sciences	SC Department of Transportation
Clemson University, Department of Electrical & Computer Engineering	Sierra Club
Clemson University, Facilities	South Carolina Energy Office, Office of Regulatory Staff
Clemson University, Department of Forestry & Environmental Conservation	Southeast Energy Efficiency Alliance
Coastal Carolina University, Sustain Coastal	Southern Alliance for Clean Energy
Coastal Carolina University, RISE Center	Southern Environmental Law Center
Coastal Conservation League	Sunoco
Composting Technology	Surculus, LLC
Conservation Voters of SC	Sustain SC
Duke Energy	The Nature Conservancy
Generate Upcycle – Atlas Organics	The Ray
Giant Cement Holding, Inc.	The Sustainability Institute
Global Eco Adventures	University of South Carolina – Baruch Marine Field Laboratory
Horry County Solid Waste Authority	University of South Carolina – Department of Geography
Ingevity	Upper Savannah COG
Lexington County	Waccamaw Regional COG
Lowcountry COG	Waste Management
Medical University of South Carolina	York County

Appendix C. Low-Income and Disproportionately Burdened Communities Census Block IDs

The Inflation Reduction Act does not formally define "Low-Income and Disadvantaged Communities" (LIDACs). However, EPA strongly recommends grantees use the Climate and Economic Justice Screening Tool[165] and the Environmental Justice Screening and Mapping Tool[166] to identify low-income and disproportionately burdened block groups in their communities. These tools identify tracts by assessing indicators for categories of burden: air quality, climate change, energy, environmental hazards, health, housing, legacy pollution, transportation, water and wastewater, and workforce development[167].

All grantees should provide, at minimum, a list of identified LIDACs with Census Block ID numbers in an Excel spreadsheet or a comma-separated values (CSV) text file. Grantees who opt to use other tools or data sources should also provide a comparison of LIDAC and non LIDAC census tracts/blocks. Grantees should also ensure that these alternate tools are compliant with federal non-discrimination statutes.

There are 2,014 block groups that meet the criteria in South Carolina, which translates to 59% of the state's block groups.

County Name	GEOID
Abbeville County	450019501001
Abbeville County	450019501002
Abbeville County	450019501003
Abbeville County	450019503001
Abbeville County	450019503002
Abbeville County	450019503003
Abbeville County	450019504011
Abbeville County	450019505001
Abbeville County	450019505002
Abbeville County	450019505003
Abbeville County	450019505004
Abbeville County	450019505005
Abbeville County	450019506001
Abbeville County	450019506002
Abbeville County	450019506003
Aiken County	450030202003
Aiken County	450030203011
Aiken County	450030203031
Aiken County	450030203032
Aiken County	450030203041
Aiken County	450030203042
Aiken County	450030204011
Aiken County	450030204012
Aiken County	450030204021
Aiken County	450030204022
Aiken County	450030206031
Aiken County	450030206032
Aiken County	450030206041
Aiken County	450030206042
Aiken County	450030207021
Aiken County	450030207022
Aiken County	450030207023
Aiken County	450030207024
Aiken County	450030208021
Aiken County	450030208022
Aiken County	450030208023
Aiken County	450030209011

[165] Climate and Economic Justice Screening Tool, Explore the map - Climate & Economic Justice Screening Tool (geoplatform.gov)
[166] Environmental Justice Screening and Mapping Tool, EJScreen: Environmental Justice Screening and Mapping Tool | US EPA
[167] EPA Technical Reference Document for LIDAC Benefits, LIDAC Technical Guidance - Final 2.pdf (epa.gov)

Aiken County	450030209012
Aiken County	450030209031
Aiken County	450030209032
Aiken County	450030209041
Aiken County	450030209042
Aiken County	450030210011
Aiken County	450030210012
Aiken County	450030210013
Aiken County	450030210014
Aiken County	450030210031
Aiken County	450030210032
Aiken County	450030210041
Aiken County	450030211011
Aiken County	450030211012
Aiken County	450030211021
Aiken County	450030211022
Aiken County	450030211023
Aiken County	450030213002
Aiken County	450030214011
Aiken County	450030214012
Aiken County	450030214021
Aiken County	450030214022
Aiken County	450030214023
Aiken County	450030216011
Aiken County	450030216012
Aiken County	450030216013
Aiken County	450030216014
Aiken County	450030217001
Aiken County	450030217002
Aiken County	450030217003
Aiken County	450030217004
Aiken County	450030218001
Aiken County	450030218002
Aiken County	450030218003
Aiken County	450030219011
Aiken County	450030219012
Aiken County	450030219021
Aiken County	450030219022
Aiken County	450030220011
Aiken County	450030220012
Aiken County	450030220013

Aiken County	450030220014
Aiken County	450030220031
Aiken County	450030220041
Aiken County	450030221001
Aiken County	450030221002
Allendale County	450059702011
Allendale County	450059702012
Allendale County	450059702013
Allendale County	450059702014
Allendale County	450059702021
Allendale County	450059702022
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Appendix D. GHG Inventory Data Gaps and Questions

Action Teams identified information gaps in the GHG inventory, as well as questions to address in the CCAP (Table 43).

Table 43. Greenhouse gas inventory information gaps and questions

Relevant Action Team or Sector	Gaps, Limitations, Questions	Response
All	What is the difference between "source" and "sector"?	This inventory shows emissions by "source" rather than sector. Some "sector" information is available through the Mobile Combustion, CO_2FFC, and Electricity modules.
All	What can we attribute the change of emissions to between 1990-2005?	Look for other references and citations not included in the SIT. Many factors may contribute, such as growing population, industrial growth, changes in technology and emissions standards. Consider include details in the CCAP.
Identified by Industry Action Team		
Energy	Are pipeline leak emissions included?	Review SIT guidance to clarify in the CCAP.
Energy	Consider that measures addressing energy efficiency, storage, and demand management may provide a faster path to GHG benefits.	Consider addressing in CCAP.
Energy	Where does the SIT capture energy uses such as water heat recovery, combined heat, power/cogeneration processes?	Review SIT guidance to clarify in PCAP. Consider addressing further in CCAP.
Transportation	What is the total ownership cost of EVs, including carbon footprint and charging cost?	Need a total cost of ownership calculator/life cycle analysis. Look at Argonne's Greenhouse gases, Regulated Emissions, and Energy use in Transportation (GREET) for LCA. Consider addressing in CCAP.
Transportation	Can we be more specific about sub-sector contributions to transportation emissions for a better breakdown of different types of manufacturing firms/operations?	Consider addressing in CCAP and looking deeper into DOE data and resources.
Identified by Residential and Commercial Buildings Action Team		
Waste Agriculture Natural & Working Lands	Commercial logging: how much carbon ends up as wood products? SIT groups wood products and landfill emissions.	Consider addressing in CCAP: benefits of using high carbon storing/sustainable materials in construction, opportunities to deploy, implementation timeline.
Industry Residential & Commercial	Monitoring vs. Modeling: energy modeling is currently used for quantitative results but is not as accurate as monitoring.	The Sustainability Institute is working on energy monitoring in residential buildings to show actual consumption. Consider addressing in the CCAP.

All	Does the state inventory show regional emissions?	At this time, no.
	The "Other Appliances and lighting" category is too broad.	Separate into several categories; heating and cooling have largest emissions. Check user module to determine what is in the "other" category.
Identified by Waste and Materials Management Action Team		
	Does the inventory account for waste prevention? This could impact the way we prioritize waste/recycling efforts.	DHEC used EPA's Waste Reduction Model (WARM) to estimate GHG benefits of waste prevention.
Agriculture Natural & Working Lands	Are compost facilities sinks? Was carbon sequestration from land application of compost and mulch included as a "sink"?	Provide clarifying information about assumptions and data for the Agriculture Inventory. May need to look at other references and citations to explain soil fluxes (for example, the composting process itself emits GHGs).
Residential & Commercial	Waste/emissions footprint of construction materials.	
Transportation	Does the Source Worksheet for the Transportation and Waste categories double count off-road landfill trucks? Do waste emissions include transportation/energy?	Clarify how and where transportation is counted. In this case, transportation is not part of the waste source/sector. Address in CCAP; show waste sector contributions to transportation emissions.
Identified by Agriculture and Natural & Working Lands Action Team		
	SIT is missing data on rice cultivation and moist ground.	Over 200,000 acres (Pee Dee, Santee, A.C.E River Basins). Use NOAA CCAP datasets to inventory at local level.
	Does the inventory (SIT) include trees in above ground biomass?	Trees are included in the "Net Forest Carbon Flux" and "Urban Trees" categories. Clarify vegetation types that are included in the different SIT biomass categories and in the forest products/landfill category.
	Does the inventory show wetlands emissions and sequestration? How is blue carbon considered?	Clarify if and how SIT considers wetlands. Consider addressing in CCAP.

Identified by Transportation Action Team		
	How does the inventory (SIT) calculate actual state vehicle miles traveled (VMT). How do we account for tourists traveling through the state? What is the per capita rate of VMT?	SIT uses data from the Federal Highway Administration, which it obtains from the states. This data includes all vehicle traffic, and miles were driven within SC, regardless of home state of the driver.[168] Points to consider for the CCAP: • Horry County reports using traffic counts from SCDOT. Have challenges accounting for full-time population v. tourists. Traffic counts over time can be used to help understand growth impacts and volume of traffic changes over time. • Include VMT per capita in the inventory to better understand impacts of population growth, increased driving distances, and development patterns. • Look at passenger car and light-duty truck MMTCO2e emissions per capita to control for VMT. VMT is historically correlated with economy.
	Do we quantify reductions using a lifecycle approach or just with tailpipe emissions?	Tailpipe emissions. Most states do not have lifecycle inventories. Oregon has conducted a lifecycle analysis; review for CCAP application.
	Does aviation include all airports in the state? Which airports are included?	Clarify airport and aviation data used in the SIT.
Identified by Greenhouse Gas Inventory Action Team		
Industry	Inventory: are emissions with high GWP included? (e.g., medical field, anesthetics, foam, refrigerants)	Refrigerants are listed in the inventory, but output does not specify the specifics asked about here. Clarify data and level of specificity captured by the SIT.

[168] Additional data sources: Alternative Fuels Data Center has vehicle registration data by state and fuel type (https://afdc.energy.gov/vehicle-registration); Energy Office has vehicle data on their data hub (https://south-carolina-energy-office-1-1-scors-eo.hub.arcgis.com/pages/transportation).

Appendix E. Quantification of Priority Reduction Measures

Appendix E provides additional information about the approach, assumptions, and tools used throughout the PCAP to estimate emission reductions for the priority measures. SCOR and DHEC used established, peer-reviewed tools and resources available through federal agencies, non-profit organizations, and academic publications.

E1. Land Conservation and Restoration

Placing carbon estimates within the framework of known conservation acquisition opportunities allows for an understanding of nuances of development pressure and land cover types. Estimates use The Nature Conservancy's (TNC) Resilient Lands Mapping Tool[169]. The TNC tool contains a rasterized total forest and soil carbon estimates for 2010, 2050, and the total carbon sequestration potential between those two years if the land is left undisturbed.

To estimate a 2025 baseline for each property, the mean amount of Carbon sequestered for the area was divided by 40-year time period, multiplied by the acres on the property, and 15 years' worth of this carbon were added to the 2010 value.

For the Upstate Forest, Pee Dee Bottomland, and Pee Dee Upland opportunities which are dominated by forest land cover, this methodology was extended to estimate the carbon value for 2030 and 2050.

For the Southern Salt Marsh opportunity, which is 70% salt marsh and 7% forested according to the 2021 National Land Cover Database[170], an estimate of the annual carbon sequestration of 0.8799 metric tons of CO_2 per acre[171] was used for the marsh acreage and a value of .24 metric tons of CO_2 per acre[172] was used for the forested acreage. There was not sufficient data to estimate the total carbon stored for a southeast saltmarsh, so the 2025 baseline was calculated by using the 2010 TNC value and using the rates of carbon sequestration for the respective land types to arrive at reported intervals of 2025, 2030, and 2050. The TNC data is not meant for coastal carbon estimates, but research suggests that this might be an under-estimation of the amount of carbon stored in this type of system. [173]

This methodology provides estimates for benefits assuming these natural resources are undisturbed, but development pressure, especially for the Upstate Forest opportunity make the total carbon values at risk of loss. If these opportunities are developed instead of protected, which is not unreasonable given the growth rates of South Carolina's population, it is essential to account for the amount of carbon permanently stored in each opportunity

[169] The Nature Conservancy, Resilient Land Mapping Tool, https://www.maps.tnc.org/resilientland/
[170] National Land Cover Database, https://www.mrlc.gov/data/nlcd-2021-land-cover-conus
[171] McLeod, E., et al., A blueprint for blue carbon: toward an improved understanding of the role of vegetated coastal habitats in sequestering CO2, Frontiers n Ecology and the Environment (2011), https://doi.org/10.1890/110004.
[172] EPA, Greenhouse Gases Equivalencies Calculator - Calculations and References, https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references.
[173] McLeod, E., et al., A blueprint for blue carbon: toward an improved understanding of the role of vegetated coastal habitats in sequestering CO2, Frontiers n Ecology and the Environment (2011), https://doi.org/10.1890/110004.

E2. Climate Smart Agriculture and Forestry

Clemson University Climate-Smart Commodities program staff developed the GHG reduction estimates for the PCAP. These estimates were based on potential funding amounts and a scenario that would maximize the carbon efficiency of each climate-smart or conservation practice, while also providing benefits to a diverse group of landowners and agricultural producers. Pilot program findings thus far indicate that some practices are more accepted by underserved landowners and will have a higher rate of acceptance in an expanded program. In particular, practices such as those implemented in leafy greens and forest stand improvement benefit underserved landowners and provide necessary funding to mitigate land use change and sequester additional carbon. These practices enhance greenhouse gas reductions at the stand and farm level, and typically require additional supporting practices (such as prescribed fire and site preparation in the case of forestry) to make the main practices cost effective for the landowners.

Agriculture GHG estimates were made using the COMET-Farm tool.[174] The tool allows users to enter geographic information (state, county), agricultural activity or product (cropland, pasture, rangeland, orchards or vineyards, livestock, and on-farm energy use), the conservation practice being implemented, and number of acres. Inputs to the tool were based on the three activities being implemented in the South Carolina Climate Smart program (i.e., peanuts, leafy greens, cattle); the conservation practices being incentivized (cover crops, reduced tillage, mulching, legume planting, prescribed grazing, and nutrient management); and the estimated number of new program enrollees and acreage amounts, based on current program enrollment and interest. Clemson estimates that the peanut program will enroll between 10-20 unique landowners, leafy greens will enroll 135-145 unique landowners, and cattle management will enroll around 200 unique landowners.

Because the COMET-Farm tool does not include a forestry component, estimates of greenhouse gas reductions for the Climate-Smart Forestry program are based on the Forest Management to Carbon Tool V1.1. The Clemson project team developed this tool to compute CO_2 sequestration benefits of various forestry management practices in South Carolina.[175] The tool uses Forestry Inventory and Analysis (FIA)[176] data for different plots in South Carolina, as well as Forest Vegetation Simulator[177] to simulate growth of specific forest stands under different management practices (i.e., stand restoration, improvement, maintenance), for 100 years in the state's Piedmont, Midlands, and Coastal regions. The rate of sequestration is the current average carbon stock value divided by baseline carbon value. The baseline year is 2016, when the FIA plot data was obtained.

The benefits of implementing forestry management practices were categorized under three main umbrellas: restoration, improvement, and maintenance. Clemson computed average CO_2 sequestration/acre/year through for those three activities. Since supporting practices (including prescribed fire and site preparation) are required to be implemented prior to main practices

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[174] US Department of Agriculture, Natural Resources Conservation Service, COMET-Farm, https://comet-farm.com/
[175] Clay, L., Motallebi, M., Song, B. (2019). An Analysis of Common Forest Management Practices for Carbon Sequestration in South Carolina. Forests 10(11), 949. DOI: https://doi.org/10.3390/f10110949.
[176] US Department of Agriculture, U.S. Forest Service, Forest Inventory and Analysis, https://www.fs.usda.gov/research/programs/fia
[177] US Forest Service, Forest Vegetation Simulator, https://www.fs.usda.gov/fvs/

implementation, benefits associated with those practices were not estimated. Clemson estimated GHG reductions based on 230-250 new enrollees and 11,000 total acres for the forestry program.

E3. Residential Weatherization and Energy Efficiency

Assumptions were made in order to quantify reductions from an implemented Residential Weatherization and Energy Efficiency program. It was assumed that the goal of the program to retrofit 1,000 homes per year would be met and that efficiency rates remain consistent throughout 2050. Data was sourced from the U.S. Department of Energy (DOE) National Renewable Energy Laboratory (NREL) ResStock Analysis Tool. The ResStock webpage explains its use as such:

"Across the country, there's a vast diversity in the age, size, construction practices, installed equipment, appliances, and resident behavior of the housing stock, not to mention the range of climates. These variations have hindered the accuracy of predicting savings for existing homes."

With support from the U.S. Department of Energy (DOE), NREL developed ResStock. It's a versatile tool that takes a new approach to large-scale residential energy analysis by combining:

- Large public and private data sources
- Statistical sampling
- Detailed sub-hourly building simulations
- High-performance computing.

This combination achieves unprecedented granularity and, most importantly, accuracy in modeling the diversity of the housing stock and the distributional impacts of building technologies in different communities.

ResStock leverages DOE's open-source building energy modeling ecosystem of OpenStudio® [178] and EnergyPlus™ [179]. With NREL supercomputing, the ResStock team has run more than 20 million simulations using a statistical model of housing stock characteristics. This data has helped researchers uncover $49 billion in potential annual utility bill savings through cost-effective energy efficiency improvements.

Detailed information on the technical and economic potential of residential energy efficiency improvements and packages is available for 48 states domestically. Policymakers, program designers, and manufacturers can use these results to identify improvements with the highest potential for cost-effective savings in a particular state or region as well as identify customer segments for targeted marketing and deployment.

Publicly available ResStock analysis results—including the U.S. Building Stock Characterization Study and the End-Use Load Profiles dataset—are used by a broad set of analysts representing hundreds of cities, states, utilities, manufacturers, and other organizations to make decisions related to building decarbonization." [180]

Certain filters in ResStock were chosen to include relevant data for which homes would qualify for the RWEE program, including an emphasis on addressing low-income and disproportionately burdened

[178] NREL, OpenStudio, https://openstudio.net/.
[179] US DOE's Building Technologies Office and NREL, EnergyPlus, https://energyplus.net/.
[180] ResStock Analysis Tool, National Renewable Energy Laboratory (2023). https://www.nrel.gov/buildings/resstock.html#:~:text=With%20support%20from%20the%20U.S.%20Department%20of%20Energy,Statistical%20sampling%20Detailed%20subhourly%20building%20simulations%20High-performance%20computing.

communities' needs, older homes in need of retrofitting, and single-family homes. Data from ResStock's State Level Residential Building Stock and Energy Efficiency & Electrification Packages Analysis was found with the use of the following filters:

- Area Median Income: 0 – 80%
- Building Type: Single Family Detached
- Home Vintage: < 1980
- Energy Efficiency Package: Enhanced enclosure upgrade with heat pump water heater and high efficiency heat pump with electric backup.

The enhanced enclosure package includes the following standards for renovations:

- Attic insulation to 2021 IECC levels
- Reduce infiltration by 30%
- Seal ducts to 10% leakage with R-8 insulation
- Drill and fill wall insulation to R-13 for uninsulated wood stud walls only
- Add R-10 interior insulation to foundation walls and rim joists
- Seal crawlspace vents
- Insulate finished attic and cathedral ceilings to R-30

Each home that is retrofitted continues to have reduced emissions annually. As such, emissions reductions are larger each year as more homes are weatherized. The following equation was used to calculate reductions, based on data found in ResStock and assuming 1,000 renovations per year:

[(Annual reduction per year) x (# of years of program)] + (sum of reductions to date)

The average reduction per home per year with the above filters in place was 3.877 $MTCO_2e$. The average reduction multiplied by 1,000 homes per year gives an annual program-wide reduction equal to 3,877 $MTCO_2e$. The sum of reductions to date is equal to the reductions to date from the previous year (Table 44).

Applying 3,877 $MTCO_2e$ as the annual emissions reduction to the equation above, reductions were calculated to be 81,417 $MTCO_2e$ from 2025-2030 and 1,360,827 $MTCO_2e$ (1.361 $MMTCO_2e$) from 2025-2050.

With the available ResStock data, reductions at the 95th percentile were equal to 8.145 $MTCO_2e$ for an annual program-wide reduction of 8,145 $MTCO_2e$. If program requirements focus on addressing homes with the greatest need of retrofitting that are close to the 95th percentile (including older homes in low-income communities that receive electricity from coal-powered energy generation), reductions would potentially be much greater than those found using the average reduction estimates, with 171,045 $MTCO_2e$ from 2025-2030 and 2,858,895 $MTCO_2e$ (2.859 $MMTCO_2e$) from 2025-2050 (Table 44).

Table 44. RWEE program projected annual greenhouse gas reductions, 2025-2050

RWEE Program Projected Annual GHG Reductions, 2025 - 2050			
			Amount of $MTCO_2e$ reduced
Year	Program Year	Annual Reductions	Reductions to Date
2025	1	3,877	3,877
2026	2	7,754	11,631
2027	3	11,631	23,262
2028	4	15,508	38,770
2029	5	19,385	58,155
2030	6	23,262	81,417
2031	7	27,139	108,556
2032	8	31,016	139,572
2033	9	34,893	174,465
2034	10	38,770	213,235
2035	11	42,647	255,882
2036	12	46,524	302,406
2037	13	50,401	352,807
2038	14	54,278	407,085
2039	15	58,155	465,240
2040	16	62,032	527,272
2041	17	65,909	593,181
2042	18	69,786	662,967
2043	19	73,663	736,630
2044	20	77,540	814,170
2045	21	81,417	895,587
2046	22	85,294	980,881
2047	23	89,171	1,070,052
2048	24	93,048	1,163,100
2049	25	96,925	1,260,025
2050	26	100,802	1,360,827

E4. Organics Recovery and Food Waste Prevention

DHEC used EPA's WARM version 16[181] to estimate GHG emission reductions associated with implementing an enhanced organic recovery and food waste reduction systems. WARM calculates and totals GHG emissions associated with baseline and alternative waste management practices.

Baseline data inputs were derived from the South Carolina Solid Waste Management Annual Report of Fiscal Year 2022.[182] EPA default assumptions and data were also used for some inputs. According to the Solid Waste Management Annual Report, a total of 4,111,705 tons of Municipal Solid Waste (MSW) was reported landfilled, and 28,107.49 tons of food waste was reported composted. Using EPA's 2018 assumption that 24.14% of MSW landfilled is food waste[183], South Carolina landfilled approximately 992,565.59 tons of food waste. Composted food waste (28,107.49 tons) and estimated total food waste (992,565.59) to calculate 1,020,673.08 tons of food waste generated (Table 45).

The alternative management scenario was based on a 50% food reduction goal by 2030. During FY22, DHEC updated its statewide waste reduction and recycling goals to align with EPA's standards of recycling 50 percent of MSW and reducing food loss and waste by 50 percent by the year 2030. Using source reduction as the primary management practice, 510,336.54 tons (or 50% of the tons generated) was calculated for the "Tons Source Reduced" input. The secondary management practice aims to increase composting by 40%, which increased the "Tons Composted" input to 39,350.49 tons and subsequently decreased the "Tons Landfilled" input to 470,986.05 tons, a 52.5% decrease from baseline management practices.

Table 45. Food waste management scenarios and data inputs
Source: DHEC, EPA WARM

Food Waste Management Scenarios and Data Inputs				
	Food Waste in Tons			
Management Practice	Landfilled Food Waste	Composted Food Waste	Total Food Waste	Emissions in $MTCO_2e$
Baseline	992,565.59	28,107.49	1,020,673.08	493,458.03
Alternative	470,986.05	39,350.49	510,336.54	(1,637,508.04)
Change in Tons and Emissions	(521,579.54)	11,243.00	(510,336.54)	(2,130,966.07)

Through its Don't Waste Food SC campaign, DHEC works with food banks to prevent food waste and promote donation. Based on annual reports and interviews, DHEC estimates that that food not wasted through donation to South Carolina's four major food banks equals between 57 to 58 million pounds annually. This number, however, may or may not include food purchased or received through government programs, as well as food that that goes to waste if deemed unfit for distribution. Efforts to

[181] EPA, Waste Reduction Model, https://www.epa.gov/warm/versions-waste-reduction-model. WARM calculates and totals GHG emissions associated with baseline and alternative waste management practices.
[182] DHEC, South Carolina Solid Waste Management Annual Report Fiscal Year 2022, https://scdhec.gov/sites/default/files/Library/OR-2405.pdf.
[183] EPA, Facts and Figures about Materials, Waste and Recycling, https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling.

develop the CCAP will aim to improve food donation data and estimates of the impact on greenhouse gas emissions.

E5. State Agency Recycling

DHEC used EPA's WARM version 16[184] to estimate GHG emission reductions associated with implementing an enhanced state agency recycling program. WARM calculates and totals GHG emissions associated with baseline and alternative waste management practices.

Baseline data inputs were derived from the South Carolina State Agencies & Colleges/Universities Recycling & Buying Recycled Annual Report[185] and EPA default assumptions.

To simplify calculations, total paper materials, which includes cardboard, magazines, newspapers, office paper, paperboard, and mixed paper were calculated together. According to the SC Solid Waste Management Annual Report for Fiscal Year (FY) 2022 (July 1, 2021, to June 30, 2022), the latest data from DHEC, the average South Carolinian generated approximately 4.3 pounds of waste each day. For the purposes of this estimate, it is assumed that about one third of that per capita generation (1.43 pounds) is created at work.

DHEC used that per capita generation and applied it to the state's 59,136 employees, estimating that the overall work force creates 84,564.48 pounds of waste per day. That results in 422,822.40 pounds per week or 21,986,764.80 pounds per year. This converts to a total of 10,993.38 tons for FY22. Using EPA's 2018 assumption that 11.78% of MSW landfilled is paper, state agencies landfilled approximately 1,295.02 tons of paper materials.

The alternative management scenario was based on a goal of 50% increased recycling by 2030. During FY22, DHEC updated its statewide recycling goals to align with EPA's standards of recycling 50 percent of MSW by the year 2030. Increasing the tons recycled by 50% as the alternative management practice, 3,263.33 tons was calculated. This subsequently decreased the "Tons Landfilled" to 207.24 tons, an 84% decrease from baseline management practices (Table 46).

Table 46. State agency recycling scenarios and data inputs
Source: DHEC, EPA WARM

State Agency Recycling Scenarios and Data Inputs			
	Paper Material in Tons		
Management Practice	Tons Recycled	Tons Landfilled	Emissions in $MTCO_2e$
Baseline	2,175.55	1,295.02	(7,640.51)
Alternative	3,263.33	207.24	(11,657.88)
Change in Tons and Emissions	1,087.78	(1,087.78)	(4,017.38)

[184]EPA, Waste Reduction Model, https://www.epa.gov/warm/versions-waste-reduction-model. WARM calculates and totals GHG emissions associated with baseline and alternative waste management practices.
[185] DHEC, South Carolina State Agencies & Colleges/Universities Recycling & Buying Recycled Annual Report, Fiscal Year 2022, https://scdhec.gov/sites/default/files/Library/OR-2437.pdf.

E6. Alternative and Multi-Modal Transportation

Public Transit Calculations:

Since only 0.38% of South Carolinians currently commute via public transit, it was assumed that increasing ridership by 3% would be feasible with appropriate funding and planning. Using 2022 ridership data as the initial value, a basic exponential growth equation was used to calculate increasing annual ridership over a 26-year period (2025-2050):

$$X = P\left(1 + \frac{r}{100}\right)^{t}$$

Where X = annual ridership with growth, P = baseline ridership, r = rate of change, and t = time (in number of years). A total of 26 years of exponential growth in the annual number of transit rides saw an increase of 54% from the baseline of 2022 (7,439,257 rides)[186] to 16,043,437 public transit rides (Table 47).

Vehicle trips were next calculated by subtracting the baseline year number of rides from the annual growth ridership. Vehicle Miles Traveled (VMT) prevented was calculated by multiplying the avoided number of vehicle trips by the state average VMT per trip (5.01 miles).[187] CO_2e emissions reductions were calculated by multiplying VMT prevented by the EPA emissions per mile traveled. EPA calculations for emissions per mile traveled are described on EPA's website as such:

"To determine annual greenhouse gas emissions per mile, the following methodology was used: carbon dioxide emissions per gallon of gasoline were divided by the average fuel economy of vehicles to determine carbon dioxide emitted per mile traveled by a typical passenger vehicle. Carbon dioxide emissions were then divided by the ratio of carbon dioxide emissions to total vehicle greenhouse gas emissions to account for vehicle methane and nitrous oxide emissions.

"8.89×10^{-3} metric tons CO_2/gallon gasoline × 1/22.9 miles per gallon $_{car/truck\ average}$ × 1 CO_2, CH_4, and N_2O/0.993 CO_2 = **3.91×10^{-4} metric tons CO_2E/mile"[188] or 391 grams CO_2**

Where the amount of carbon dioxide emitted per gallon of motor gasoline burned is 8.89×10^{-3} metric tons and the weighted average combined fuel economy of cars and light trucks was 22.9 miles per gallon based on 2021 averages (FHWA 2023). In 2021, the ratio of carbon dioxide emissions to total greenhouse gas emissions (including carbon dioxide, methane, and nitrous oxide, all expressed as carbon dioxide equivalents) for passenger vehicles was 0.993 (EPA 2023)."

Finally, CO_2e emissions avoided to date was calculated by adding the annual avoided emissions to the sum of avoided emissions to date from the previous year (Table 47).

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[186] Bureau of Transportation Statistics, SC State Highway Travel. https://www.bts.gov/browse-statistical-products-and-data/state-transportation-statistics/state-highway-travel

[187] U.S. Department of Transportation, Bureau of Transportation Statistics. Vehicle miles traveled and vehicle trips by State. https://www.bts.gov/statistical-products/surveys/vehicle-miles-traveled-and-vehicle-trips-state VMT per trip was calculated by taking the average of urban, suburban, and rural trip miles.

[188] EPA, GHG equivalencies calculator, https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references.

Table 47. Emissions reduction calculations from increasing public transit by year, 2025 - 2050

Emissions Reduction Calculations from Increasing Public Transit by Year, 2025 - 2050							
						Emissions reduced in $MTCO_2e$	
Year	Program Year	Annual Ridership (millions)	Total % Increase	Vehicle Trips Prevented per year	VMT Prevented per year	Emissions Reduced per year	Emissions Reduced to date
2025	1	7.66	3%	223,178	1,118,120	437.19	437.19
2026	2	7.89	6%	453,051	2,269,784	887.49	1,324.67
2027	3	8.13	8%	689,820	3,455,998	1,351.30	2,675.97
2028	4	8.37	11%	933,692	4,677,798	1,829.02	4,504.99
2029	5	8.62	14%	1,184,881	5,936,253	2,321.07	6,826.06
2030	6	8.88	16%	1,443,605	7,232,461	2,827.89	9,653.95
2031	7	9.15	19%	1,710,091	8,567,555	3,349.91	13,003.87
2032	8	9.42	21%	1,984,571	9,942,702	3,887.60	16,891.46
2033	9	9.71	23%	2,267,286	11,359,103	4,441.41	21,332.87
2034	10	10.00	26%	2,558,482	12,817,996	5,011.84	26,344.71
2035	11	10.30	28%	2,858,415	14,320,657	5,599.38	31,944.08
2036	12	10.61	30%	3,167,345	15,868,397	6,204.54	38,148.63
2037	13	10.92	32%	3,485,543	17,462,569	6,827.86	44,976.49
2038	14	11.25	34%	3,813,287	19,104,566	7,469.89	52,446.38
2039	15	11.59	36%	4,150,863	20,795,824	8,131.17	60,577.55
2040	16	11.94	38%	4,498,567	22,537,819	8,812.29	69,389.83
2041	17	12.30	39%	4,856,701	24,332,074	9,513.84	78,903.67
2042	18	12.66	41%	5,225,580	26,180,156	10,236.44	89,140.11
2043	19	13.04	43%	5,605,525	28,083,681	10,980.72	100,120.83
2044	20	13.44	45%	5,996,869	30,044,312	11,747.33	111,868.16
2045	21	13.84	46%	6,399,952	32,063,762	12,536.93	124,405.09
2046	22	14.25	48%	6,815,129	34,143,795	13,350.22	137,755.31
2047	23	14.68	49%	7,242,760	36,286,229	14,187.92	151,943.23
2048	24	15.12	51%	7,683,221	38,492,936	15,050.74	166,993.97
2049	25	15.58	52%	8,136,895	40,765,845	15,939.45	182,933.41
2050	26	16.04	54%	8,604,180	43,106,940	16,854.81	199,788.23

Bike Lane Reduction Calculations:

Calculating emission reductions from adding bike lane infrastructure was based on California Air Resource Board's "Auto VMT Reductions (alternative method)"[189] equation:

Auto VMT Reduced = (D) * (BC) * (S) * (GF) * (AS) * (L)

Where D = days of use per year (default = 365); BC = average bike count, S = seasonal adjustment factor (1); GF = growth factor (1), AS = automobile substitution rate (default = 0.1), and L = bike trip length (default = 1.5 miles/trip in one direction). Default numbers were used where provided. A seasonal adjustment was not used since bike counts were averaged over the seasons, nor was a carpool factor.

[189] California Air Resource Board, March 25, 2019. "Quantifying reductions in vehicle miles traveled from new bike paths, lanes, and cycle tracks." https://ww2.arb.ca.gov/sites/default/files/auction-proceeds/bicycle%20facilities_summary_032519.pdf

Bicycle counts from the City of Columbia's 2022 Pedestrian & Bicyclist Counts Data Analysis Report were used (148.25 average daily cyclists; calculated by averaging four counts presented in the report).[190]

Auto VMT Reduced = 365 * 148.25 * 1 * 1 * 0.1 * 1.5 = 8,116.69 VMT reduced for the first year

Next, a basic exponential growth equation was used to calculate increasing annual ridership over a 25-year period (2026-2050):

$$X = P\left(1 + \frac{r}{100}\right)^{t}$$

Where X = annual ridership with growth, P = baseline ridership, r = rate of change, and t = time (in number of years). This assumes ridership will increase as the bike lanes become more well-known, riders see safety improvements, and community interest grows.

Table 48. Emissions reduction calculations from on-street bike lanes by year, 2025 - 2050

Emissions Reduction Calculations from On-Street Bike Lanes by Year, 2025 - 2050					
				Amount of $MTCO_2e$ reduced	
Year	Program Year	VMT Reduced (One Project)	VMT Reduced (Five Projects)	Emissions Reduced per year	Emissions Reduced to date
2025	1	8,116.69	40,583.44	15.87	15.87
2026	2	8,948.65	44,743.24	17.49	33.36
2027	3	9,396.08	46,980.40	18.37	51.73
2028	4	9,865.88	49,329,42	19.29	71.02
2029	5	10,359.18	51,795.89	20.25	91.27
2030	6	10,877.14	54,385.69	21.26	112.54
2031	7	11,420.99	57,104.97	22.33	134.86
2032	8	11,992.04	59,960.22	23.44	158.31
2033	9	12,591.65	62,958.23	24.62	182.93
2034	10	13,221.23	66,106.14	25.85	208.77
2035	11	13,882.29	69,411.45	27.14	235.91
2036	12	14,576.40	72,882.02	28.50	264.41
2037	13	15,305.22	76,526.12	29.92	294.33
2038	14	16,070.49	80,352.43	31.42	325.75
2039	15	16,874.01	84,370.05	32.99	358.74
2040	16	17,717.71	88,588.55	34.64	393.38
2041	17	18,603.60	93,017.98	36.37	429.75
2042	18	19,533.78	97,668.88	38.19	467.94
2043	19	20,510.47	102,552.33	40.10	508.03
2044	20	21,535.99	107,679.94	42.10	550.14
2045	21	22,612.79	113,063.94	44.21	594.34
2046	22	23,743.43	118,717.14	46.42	640.76
2047	23	24,930.60	124,652.99	48.74	689.50
2048	24	26,177.13	130,885.64	51.18	740.68
2049	25	27,485.98	137,429.92	53.74	794.41
2050	26	28,860.28	144,301.42	56.42	850.83

[190] City of Columbia, 2022 Pedestrian & Bicyclist Counts Data Analysis Report (pg. 9). https://planninganddevelopment.columbiasc.gov/wp-content/uploads/2023/03/2022-Bike-Ped-Count-Report-for-web.pdf

Pedestrian and Bicycle Greenway Calculations:

Calculations of emissions reductions from pedestrian and bicycle greenway infrastructure were based on Greenville SC's Swamp Rabbit Trail. Assuming infrastructure and facilities take approximately 5 years to construct, there are no emissions reductions until 2030. VMT reductions begin at 30% of Swamp Rabbit Trail's reductions and increase with exponential growth at a rate of 20% per year, similar to the growth seen on Swamp Rabbit Trail.[191]

From February 1, 2022 through February 1, 2023, Swamp Rabbit Trail's display counter recorded 701,755 trail users (Moss 2023).[192] Non-profit Bike Walk Greenville used StreetLight data, which tracks anonymous cell phone data from trail users, to determine that 9.7% of trips were for work commute (Johnson 2023).[193] Assuming only commute trip reductions and not other trip reductions such as traveling to restaurants or shops, the Swamp Rabbit Trail reduced 68,070 vehicle trips annually. Average VMT per trip for South Carolina was calculated with the average of VMT per trip for urban, suburban, and rural trips (5.01 miles).[194]

VMT Reductions = annual vehicle trips * average VMT per trip

VMT Reductions = 68,070 * 5.01 = 341,031 miles reduced by Swamp Rabbit Trail

341,031 / 3 = 113,676.9, beginning reduction for 2030 per project.

It was assumed that 5 projects would begin in 2025; VMT reductions were multiplied by 5 (Table 49). CO_2e emissions reduced were then calculated by multiplying VMT reductions by the EPA emissions per mile traveled. EPA calculations for emissions per mile traveled are described on EPA's website as such:

"To determine annual greenhouse gas emissions per mile, the following methodology was used: carbon dioxide emissions per gallon of gasoline were divided by the average fuel economy of vehicles to determine carbon dioxide emitted per mile traveled by a typical passenger vehicle. Carbon dioxide emissions were then divided by the ratio of carbon dioxide emissions to total vehicle greenhouse gas emissions to account for vehicle methane and nitrous oxide emissions.

"8.89×10^{-3} metric tons CO_2/gallon gasoline × 1/22.9 miles per gallon $_{car/truck\ average}$ × 1 CO_2, CH_4, and N_2O/0.993 CO_2 = **3.91×10^{-4} metric tons CO_2E/mile"[195] or 391 grams CO_2**

[191] Greenville Journal, December 3, 2014. "Swamp Rabbit Trail study's third year reports boost in business, users." https://upstatebusinessjournal.com/economic-development/swamp-rabbit-trail-studys-third-year-reports-boost-business-users/

[192] Savannah Moss, February 9, 2023. Greenville Journal: "More than 700,000 people used the Swamp Rabbit Trail in 2022." https://greenvillejournal.com/community/more-than-700000-people-used-the-swamp-rabbit-trail-in-2022/

[193] Danielle Johnson, January 2023. GVL Today: "New data shows us who is hitting Greenville, SC's Prisma Health Swamp Rabbit Trail and why." https://gvltoday.6amcity.com/prisma-health-swamp-rabbit-trail-counter-data-greenville-sc

[194] U.S. Department of Transportation, May 31, 2017. Bureau of Transportation Statistics: "Vehicle miles traveled and vehicle trips by State." https://www.bts.gov/statistical-products/surveys/vehicle-miles-traveled-and-vehicle-trips-state

[195]EPA, GHG equivalencies calculator, https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references.

Where the amount of carbon dioxide emitted per gallon of motor gasoline burned is 8.89×10^{-3} metric tons and the weighted average combined fuel economy of cars and light trucks was 22.9 miles per gallon based on 2021 averages (FHWA 2023). In 2021, the ratio of carbon dioxide emissions to total greenhouse gas emissions (including carbon dioxide, methane, and nitrous oxide, all expressed as carbon dioxide equivalents) for passenger vehicles was 0.993 (EPA 2023)."

Annual emissions were then added to the emissions reduced to date from the previous year in order to get a total reduction of emissions to date (Table 49).

Table 49. Emissions reduction calculations from Greenway Paths by year, 2025 - 2050

Emissions Reduction Calculations from Greenway Paths by Year, 2025 - 2050					
				Amount of $MTCO_2e$ reduced	
Year	Program Year	VMT Reduced (One Project)	VMT Reduced (Five Projects)	Emissions Reduced per year	Emissions Reduced to date
2025	1	0	0	0	0
2026	2	0	0	0	0
2027	3	0	0	0	0
2028	4	0	0	0	0
2029	5	0	0	0	0
2030	6	113,677	568,385	222	222
2031	7	163,695	818,474	320	542
2032	8	196,434	982,168	384	926
2033	9	235,720	1,178,602	461	1,387
2034	10	282,865	1,414,323	553	1,940
2035	11	339,437	1,697,187	664	2,604
2036	12	407,325	2,036,624	796	3,400
2037	13	488,790	2,443,949	956	4,356
2038	14	586,548	2,932,739	1,147	5,502
2039	15	703,857	3,519,287	1,376	6,878
2040	16	844,629	4,223,144	1,651	8,530
2041	17	1,013,555	5,067,773	1,981	10,511
2042	18	1,216,266	6,081,328	2,378	12,889
2043	19	1,459,519	7,297,594	2,853	15,742
2044	20	1,751,422	8,757,112	3,424	19,166
2045	21	2,101,707	10,508,535	4,109	23,275
2046	22	2,522,048	12,610,242	4,931	28,206
2047	23	3,026,458	15,132,290	5,917	34,122
2048	24	3,631,750	18,158,748	7,100	41,223
2049	25	4,358,100	21,790,498	8,520	49,743
2050	26	5,229,719	26,148,597	10,224	59,967

E7. Vehicle Transitions

There was a large interest from stakeholder and Action Teams in vehicle transitions throughout the state and for a wide variety of vehicle types. Multiple local governments, non-profit organizations, and individuals demonstrated support for a grant program to make EV or alternative fuel vehicles more accessible and affordable, and requested that the priority measure be broad to include specific community or company interests.

Due to this wide array of interests throughout the state, emissions reductions were calculated for each type of vehicle that may potentially be included in a vehicle transition program, including passenger cars, single-unit long-haul and short-haul vehicles, refuse trucks, school and transit buses, combination long-haul and short-haul vehicles, passenger trucks, light commercial trucks, and railway switcher trains.

Switcher Train Reductions: Switcher train emissions reductions were calculated using the EPA's Diesel Emissions Quantifier (DEQ)[196] with data provided by Palmetto Railways on the current engines that will be replaced with electric switcher trains (Table 50).

The calculator provides an annual emissions reduction for the project (including both switcher locomotives) measured in short tons CO_2e, NO_X, $PM_{2.5}$, HC, CO, and fuel. The annual CO_2e emissions were converted from short tons to metric tons using the conversion factor: 1 short ton = 0.907 metric tons.[197] *Assuming the switcher locomotive replacements occur in 2025, annual emissions was multiplied by the program year (time since the locomotive transition occurred) to calculate switcher locomotive reductions to date through the year 2050 (*

[196] EPA, Diesel Emissions Quantifier, https://cfpub.epa.gov/quantifier/index.cfm?action=main.home
[197] EPA, GHG Equivalencies Calculator, https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator#results

Table 51). Emissions reductions are expected to equal 7,350 $MTCO_2e$ by 2030 and 31,850 $MTCO_2e$ by 2050.

Table 50. Diesel Emissions Quantifier inputs for emissions reduction calculations of electrifying switcher trains

DEQ Inputs Required	Switch Locomotive 1	Switch Locomotive 2
Engine Model Year	1952	1956
Tier	Uncontrolled	Uncontrolled
Horsepower	2,000	2,000
Fuel Type	Diesel	Diesel
Annual Fuel Gallons	60,000	60,000
Annual Usage Hours	2,200	2,200
Upgrade Year	2028	2025
Remaining Life	4	1

Table 51. Switcher locomotive replacement reduction calculations by year, 2025-2050

Switcher Locomotive Reduction Calculations by Year, 2025-2050			
		Amount of $MTCO_2e$ reduced	
Year	Program Year	Annual Reductions, Switcher Trains	Reductions to Date, Switcher Trains
2025	1	1,225	1,225
2026	2	1,225	2,450
2027	3	1,225	3,675
2028	4	1,225	4,900
2029	5	1,225	6,125
2030	6	1,225	7,350
2031	7	1,225	8,575
2032	8	1,225	9,800
2033	9	1,225	11,025
2034	10	1,225	12,250
2035	11	1,225	13,475
2036	12	1,225	14,700
2037	13	1,225	15,925
2038	14	1,225	17,150
2039	15	1,225	18,375
2040	16	1,225	19,600
2041	17	1,225	20,825
2042	18	1,225	22,050
2043	19	1,225	23,275
2044	20	1,225	24,500
2045	21	1,225	25,725
2046	22	1,225	26,950
2047	23	1,225	28,175
2048	24	1,225	29,400
2049	25	1,225	30,625
2050	26	1,225	31,850

On-Road Vehicle Reductions:

Calculations for on-road vehicle emissions reductions were made with the Alternative Fuel Life-Cycle Environmental and Economic Transportation (AFLEET) Online Tool.[198] This tool was created by Argonne National Laboratory at the request of the U.S. Department of Energy to be used by Clean Cities Coalition stakeholders. The "Payback On-Road" calculator allows the user to choose the vehicle type, powertrain, annual mileage, fuel economy, purchase price, maintenance, fuel price, and other options to calculate annual petroleum use, annual greenhouse gas emissions, annual air pollutant emissions, and simple payback.

[198] Argonne National Laboratory, AFLEET Online, https://afleet.es.anl.gov/afleet/public/.

The AFLEET online tool was run for one vehicle from each vehicle type (i.e., passenger cars, single-unit long-haul and short-haul vehicles, refuse trucks, school and transit buses, combination long-haul and short-haul vehicles, passenger trucks, and light commercial trucks) with South Carolina state data. Default data was used for vehicle mileage per year, fuel economy (miles per gasoline gallon equivalent), and costs.

Each run of the calculator used gasoline, diesel, and all-electric powertrains. Results displayed in AFLEET included annual GHG emissions measured in short tons of CO_2e for each powertrain. Since the all-electric powertrain includes emissions from electric power generation for charging the vehicle, EV emissions were then subtracted from either the diesel or gasoline emissions depending on the vehicle type. This number was then used as the annual GHG reduction of transitioning one vehicle.

Annual diesel or gasoline GHG emissions - annual EV GHG emissions = annual GHG reduction per vehicle

Annual reductions for one vehicle were then converted from short tons to metric tons with the conversion factor: 1 short ton = 0.907 metric tons.[199] Next, projections were set for the number of conversions per vehicle type anticipated. Most vehicles were chosen to convert 100 per year beginning in 2025 and ending in 2050, with the exception of passenger vehicles (1,000/year), passenger trucks (200/year), and switcher trains (2 in 2025). The number of vehicles converted per year was then multiplied by the annual reduction per vehicle to get an overall annual reduction per year.

Since the vehicles converted in 2025 also reduce emissions in 2026 in addition to the vehicles converted in 2026, emissions reductions will increase substantially over time. Annual reductions were multiplied by the year of the program and then added to the sum from the previous year to calculate each year's reductions to date. On-road vehicle emissions reductions are expected to be 994,287 $MTCO_2e$ (0.994 $MMTCO_2e$) by 2030 and 16,618,797 $MTCO_2e$ (16.62 $MMTCO_2e$) by 2050 (Table 52).

To calculate total emissions reductions for all vehicle transitions, on-road vehicle reductions to date were added to switcher locomotive annual reductions. Since the switcher locomotives are only being electrified in the year 2025, their reductions do not increase over time. The emissions reductions for all vehicles are expected to be 1,001,637 $MTCO_2e$ (1.002 $MMTCO_2e$) by 2030 and 16,650,647 $MTCO_2e$ (16.65 $MMTCO_2e$) by 2050 (Table 52).

[199] U.S. EPA, GHG Equivalencies Calculator, https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator#results.

Table 52. Vehicle Transition Reduction Calculations
Emissions reductions per year, on-road vehicles, switcher trains, and all vehicles
All reductions are shown in MTCO2e. Calculations for switcher train annual reductions are available in
On-road vehicles include passenger cars, single-unit long-haul and short-haul vehicles, refuse trucks, school and transit buses, combination long-haul and short-haul vehicles, passenger trucks, and light commercial trucks.

Vehicle Transition Reduction Calculations					
					Amount of $MTCO_2e$ reduced
Year	Program Year	Annual Reductions, On-Road Vehicles	Reductions to Date, On-Road Vehicles	Annual Reductions, Switcher Trains	Reductions to Date, All Vehicles
2025	1	47,347	47,347	1,225	48,572
2026	2	94,694	142,041	2,450	144,491
2027	3	142,041	284,082	3,675	287,757
2028	4	189,388	473,470	4,900	478,370
2029	5	236,735	710,205	6,125	716,330
2030	6	284,082	994,287	7,350	1,001,637
2031	7	331,429	1,325,716	8,575	1,334,291
2032	8	378,776	1,704,492	9,800	1,714,292
2033	9	426,123	2,130,615	11,025	2,141,640
2034	10	473,470	2,604,085	12,250	2,616,335
2035	11	520,817	3,124,902	13,475	3,138,377
2036	12	568,164	3,693,066	14,700	3,707,766
2037	13	615,511	4,308,577	15,925	4,324,502
2038	14	662,858	4,971,435	17,150	4,988,585
2039	15	710,205	5,681,640	18,375	5,700,015
2040	16	757,552	6,439,192	19,600	6,458,792
2041	17	804,899	7,244,091	20,825	7,264,916
2042	18	852,246	8,096,337	22,050	8,118,387
2043	19	899,593	8,995,930	23,275	9,019,205
2044	20	946,940	9,942,870	24,500	9,967,370
2045	21	994,287	10,937,157	25,725	10,962,882
2046	22	1,041,634	11,978,791	26,950	12,005,741
2047	23	1,088,981	13,067,772	28,175	13,095,947
2048	24	1,136,328	14,204,100	29,400	14,233,500
2049	25	1,183,675	15,387,775	30,625	15,418,400
2050	26	1,231,022	16,618,797	31,850	16,650,647

E8. Industrial Scale Energy Use and Efficiency

Boiler Replacement:

Calculations for replacing a steam boiler with an OxyHydrogen steam boiler are based on Argonne National Lab's GREET model, which specifies that a 300 HP sized boiler emits approximately 53.7 kg CO2e/MMBtu of natural gas fired (Table 53).

Table 53. Emissions reduction calculations from natural gas to hydrogen boiler

Emissions Reduction from NG to Hydrogen Boiler							
Boiler Hp	Steam Flow #/hr	NG Flow DT/hr	NG Usage DT/yr	NG Usage Mwh/yr	NG Emissions MT CO2e/yr	NG Emissions Reduction MT CO2e 2025 - 2030	NG Emissions Reduction MT CO2e 2025 - 2050
300	10,200	12	105,120	30,808	5,545	27,727	138,634
		Boiler Efficiency	Load Factor	Conversion to Mwh	Conversion to MT CO2e emissions	years	years
		0.85	1.00	3.412142	0.18	5	25

Variable Frequency Load Drive:

Calculations came from the case study DOE conducted with JC Penney, reducing use of MMBtu by 22%. Given an annual usage of 30.808 Mwh/yr by an industry firm located in South Carolina as their usage per year, a simple conversion from Mwh to MMBtu was completed. Using the EPA conversion factor for kg CO2e emissions per MMBtu (53.7), the emissions were calculated for both the baseline and for the 22% reduction caused by installing a variable frequency load drive. This number was then used as the annual baseline for the installation of one unit (Table 54).

Table 54. Emissions reduction from variable frequency load drive

Emissions Reduction from Variable Frequency Load Drive						
Usage Mwh/yr	Usage MMBtu/yr	Kg CO2e /MMBtu	MTCO2e/ MMBtu	MMBtu savings	Emissions saved (kg CO2e/ MMBtu)	Emissions saved (MTCO2e/ MMBtu)
30,808	105,055.28	5,641,468.54	5,641.47	23,112.16	1,241,123.08	1,241.12