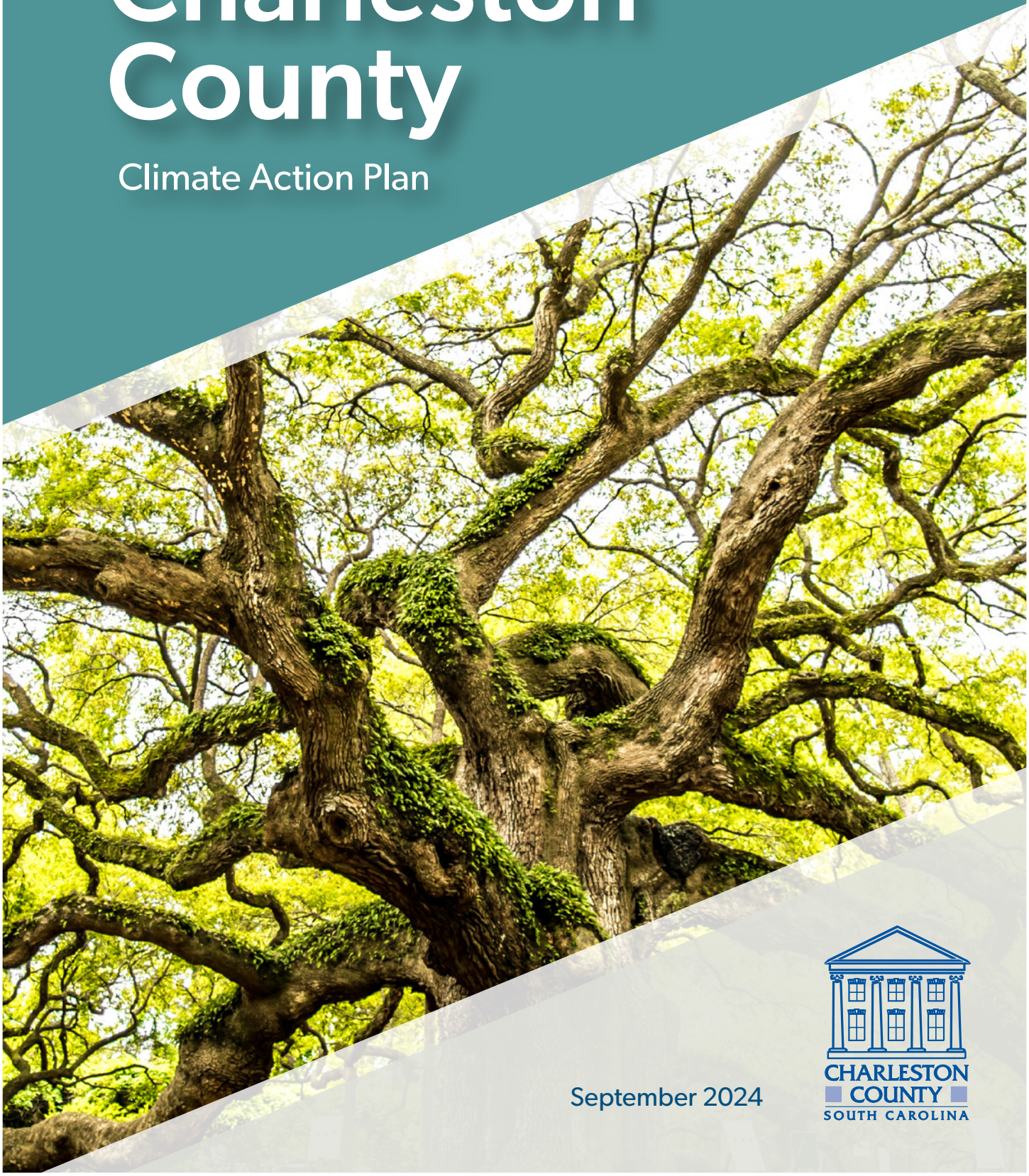
Charleston County

Climate Action Plan



September 2024

CHARLESTON COUNTY
SOUTH CAROLINA

CHARLESTON COUNTY
SOUTH CAROLINA

Prepared for

Charleston County

Authors

Sustainability Solutions Group (SSG)

CIVIX

Asiko Group

Designed by SSG

September 2024

Cover image: Angel Oak, Charleston

SSG CIVIX THE Asiko Group

Acknowledgements

Charleston County would like to acknowledge the community members and staff from across the county that contributed to the development of the Climate Action Plan.

Charleston County Project Team

- Arielle Gerstein

Consulting Team

SSG

- Yuill Herbert
- Naomi Devine
- Camilla Melrose
- Amber Nicol
- Erica Brooks
- Aishah Mohd Isa
- Bernarda Di Girolamo

Civix

- Jared Genova
- Maggie Calmes
- Michele Plaugic

Asiko Group

- Thetyka Robinson

Charleston County RSAC Members

- Joe Boykin - Charleston County Council
- Sally Brooks - Charleston County Staff
- Diamond Curry - Chamber of Commerce
- Kyle James - Berkeley-Charleston-Dorchester COG
- Adrian Cain - Homebuilders Association
- Scott Curtis - Resilience Technical Expert
- Scott Runyon - Energy Expert
- Stewart Weinberg - Sustainability Technical Expert

Charleston County SECAT Members

- Katie McKain - City of Charleston
- Christine Von Kolnitz - MUSC
- Kristin Miguez - Berkeley-Charleston-Dorchester COG
- Belvin Olasov - Charleston Climate Coalition
- Flannery Wood - Town of James Island
- Cris Taylor - Charleston County Fleet
- Sally Brooks - Charleston County Zoning & Planning
- Kip Watson - Charleston County Economic Development
- Michael Kennedy/Glenn Hill - Charleston County Facilities
- Melissa Gilroy - Charleston County Finance
- Shannon Whitehead - Town of Mt. Pleasant
- Adam MacConnell - City of North Charleston
- Rowan Emerson - Charleston Climate Coalition

Disclaimer

Reasonable skill, care, and diligence have been exercised to assess the information acquired during the preparation of this analysis, but no guarantees or warranties are made regarding the accuracy or completeness of this information. This document, the information it contains, the information and basis on which it relies, and the associated factors are subject to changes that are beyond the control of the author. The information provided by others is believed to be accurate but has not been verified.

This analysis includes strategic-level estimates of greenhouse gas emissions reductions that should not be relied upon for design or other purposes without verification. The authors do not accept responsibility for the use of this analysis for any purpose other than that stated above and do not accept responsibility for any third-party use, in whole or in part, of the contents of this document. This analysis applies to the geographic area of Charleston county and its residents and cannot be applied to other jurisdictions without analysis. Any use by Charleston County, its sub-consultants, or any third party, or any reliance on or decisions based on this document, are the responsibility of the user or third party.

Definitions and Acronyms

Acronym	Definition
BAP	Business-as-Planned
BAU	Business-as-Usual
BCDCOG	Berkeley-Charleston-Dorchester Council of Governments
BPS	Building Performance Standard
CAP	Climate Action Plan
CO_2e	Carbon dioxide equivalent
DE	District energy
DOT	Department of Transportation
ESCO	Energy service company
EUI	Energy use intensity
EV	Electric vehicle
FHWA	Federal Highway Administration
GDP	Gross Domestic Product
GHG	Greenhouse gas
GPC	Global Protocol for Community-Scale GHG Emissions Inventories
GWP	Global Warming Potential
HVAC	Heating, ventilation, and air-conditioning [equipment]
ICE	Internal combustion engine
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
IRA	Inflation Reduction Act
LC	Low-Carbon
LIDC	Low-income, disadvantaged communities
MACC	Marginal abatement cost curve
MMBtu	Million British thermal unit [measurement]

Acronym	Definition
$MtCO_2e$	Metric ton of carbon dioxide equivalent
NPV	Net present value
PACE	Property assessed clean energy [financing mechanism]
PHEV	Plug-in hybrid electric vehicles
PV	Photovoltaics
SCC	Social cost of carbon
TEDI	Thermal energy demand intensity
UNFCCC	United Nations Framework Convention on Climate Change
US DOE	United States Department of Energy
US EPA	United States Environmental Protection Agency
VMT	Vehicle miles traveled
ZEV	Zero-emissions vehicle

Key Energy and Emissions Units

GHG emissions

1 $kMtCO_2e$ = 1,000 $MtCO_2e$

1 $MMtCO_2e$ = 1,000,000 $MtCO_2e$

Energy

1 MMBTU = 1.055 GJ

1 MJ = 0.0001 GJ

1 TJ = 1,000 GJ

1 PJ = 1,000,000 GJ

1 GJ = 278 kWh

1 MMBTU = 293 kWh

1 MWh = 1,000 kWh

1 GWh =1,000,000 kWh

In the Numbers, for Charleston County

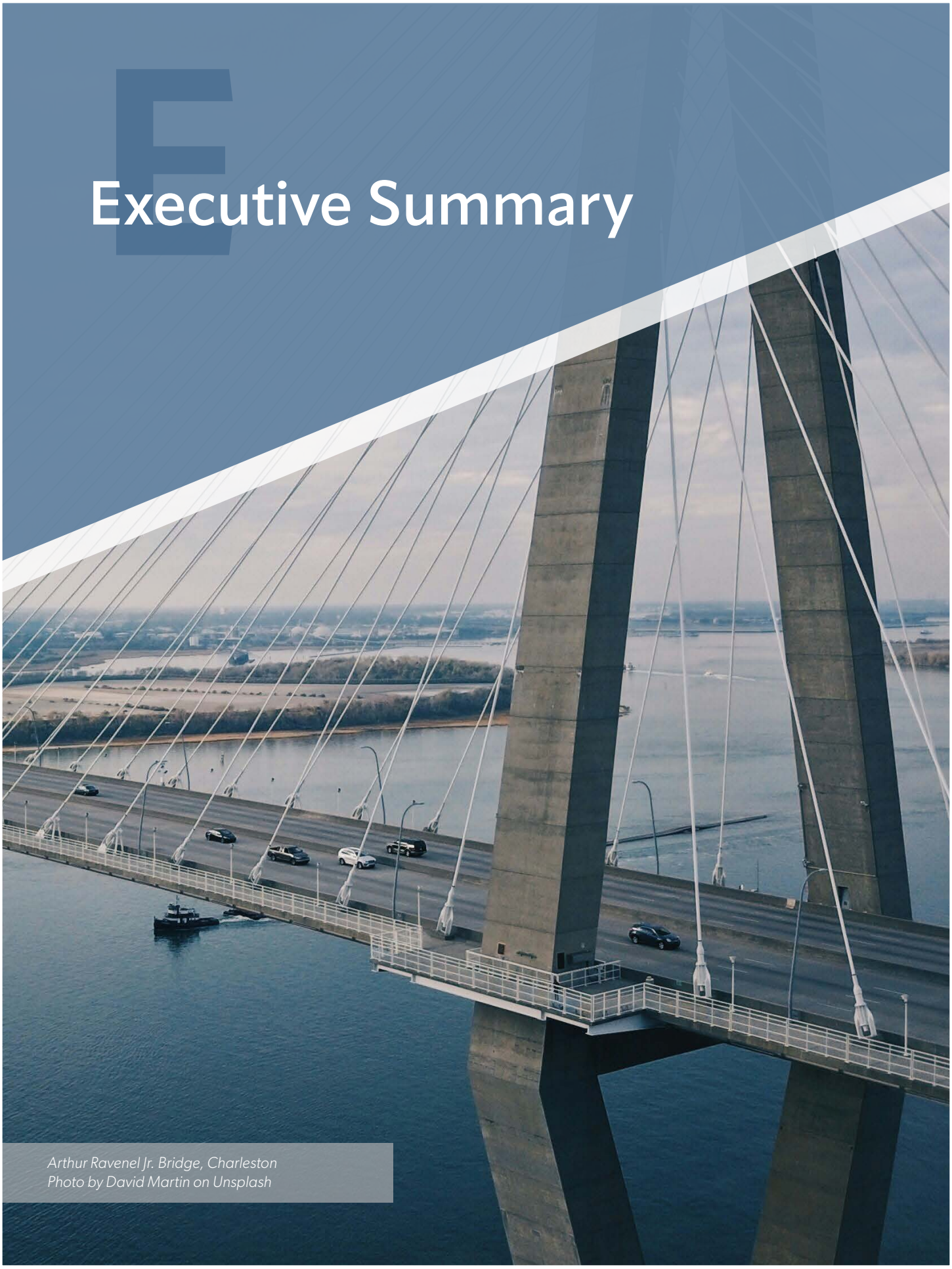
- Population, 2020: 413,000
- Population, 2050: 524,000
- New dwellings, 2021–2050: 83,700 units
- New non-residential floor space, 2021–2050: 22.5 million ft^2
- Per capita GHG emissions in 2020: 15.5 $MtCO_2e$/person
- Per capita GHG emissions in 2050, if the Low-Carbon Scenario is implemented: 0.7 $MtCO_2e$/person
- Total energy consumption in 2020: 83.8 millions MMBTU
- Total energy consumption in 2050, under the Business-as-Planned Scenario: 74.5 millions MMBTU
- Total energy consumption in 2050, under the Low-Carbon Scenario: 33.6 millions MMBTU
- Total expenditures on energy, 2024: $1.7 billion
- Savings on energy expenditures under the Low-Carbon Scenario: $1.1 billion in savings annually by 2050
- Average energy expenditures per household in 2020 (including transportation): $5,100
- Average energy savings per household per year in 2050: $1,640
- Total investment required for the Low-Carbon Scenario, 2023–2050: $14.2 billion
- Approximate annual share of Charleston County's GDP: 1.5%[1]
- Person-years of employment[2] generated as a result of the low-carbon investments, 2023–2050: 87,900
- Total GHG emissions, 2020: 6,410 kMt CO_2e
- Total GHG emissions in the absence of action, 2050: 5,980 kMt CO_2e
- Total GHG emissions if the County implements the Low-Carbon Scenario, 2050: 380 kMt CO_2e

[1] *Based on a GDP of $34.5 billion, in 2021. Charleston County Economic Development. Retrieved from: https://www.charlestoncountydevelopment.org/data-center/economic-data/*

[2] *A person-year of employment represents the number of hours of one person working full-time for one year. This could be from a single person working for a year or, for example, three people working full-time for four months.*

Contents

Executive Summary



Arthur Ravenel Jr. Bridge, Charleston
Photo by David Martin on Unsplash

Executive Summary

The Charleston County Climate Action Plan (CAP) seeks to accelerate the transition to a clean energy economy, while simultaneously achieving multiple health, equity, economic, and resilience benefits. The energy system is in the midst of a transformation, with the increasing introduction of decentralized electricity production and energy storage, the electrification of transportation, and the advancement of policies and investments by governments to mitigate greenhouse gas (GHG) emissions and advance clean energy.

The transition to a cleaner energy economy requires using energy more efficiently, moving from fossil fuels to electricity wherever possible, and generating electricity with low- or zero-carbon emissions. The effort requires extensively retrofitting the existing building stock, significantly increasing the energy performance of new buildings, constructing new sources of zero- and low-carbon energy, and electrifying vehicles and heating systems. The result of this combination of efforts is a reduction of GHG emissions with a marginal net cost to society as a whole, and these investments represent significant opportunities for the public and private sector, with many projects both generating financial returns and improving quality of life.

E.1 The Process

The development of Charleston County's CAP involved a dance between an engagement process and a technical analysis.

The technical analysis aimed to provide an investment roadmap using a detailed energy and emissions model. The analysis began by considering the drivers that determine energy consumption and greenhouse gas emissions to answer the question, "Where are we now?" Analysis of future trajectories included a Business-as-Planned (BAP) Scenario, which evaluated what might happen if no additional policies or actions are put in place. A Low Carbon (LC) Scenario explored the implications of achieving deep GHG reductions.

The engagement process provided insights and guidance on which strategies make sense for Charleston County and which mechanisms can be used to implement the Low-Carbon Scenario.

E.2 The Pathway

Embarking on this pathway will dramatically change how energy is used in Charleston County, as summarized in the following figure.

Reduce	Improve	Switch
Reducing or avoiding energy consumption in the first place	Improving the efficiency of the energy system (supply and consumption)	Fuel switch to zero-carbon sources
Energy use per capita	Energy used versus lost	Energy source

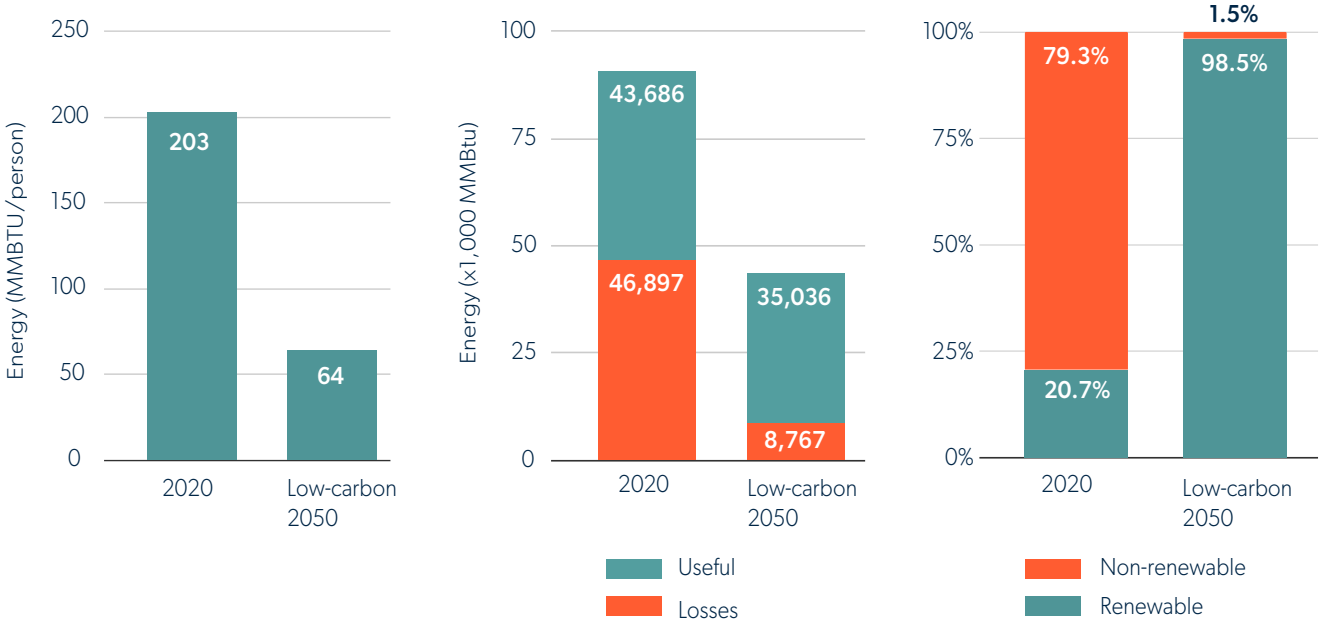


Figure 1. The transformation of Charleston County's energy system in three charts.

Charleston County's population is projected to grow by one quarter between 2023 and 2050. Despite this growth, the modeling results indicate that the Low-Carbon Scenario is technically and economically possible but also challenging. In this scenario, GHG emissions decline from 6,410 $kMtCO_2e$ in 2020 to 380 $kMtCO_2e$ in 2050, a decrease of 94% over that period.

The Low-Carbon Scenario focuses on investments in technologies available today. While future technological developments may enable additional GHG reductions and efficiency gains, their future costs and benefits are uncertain.

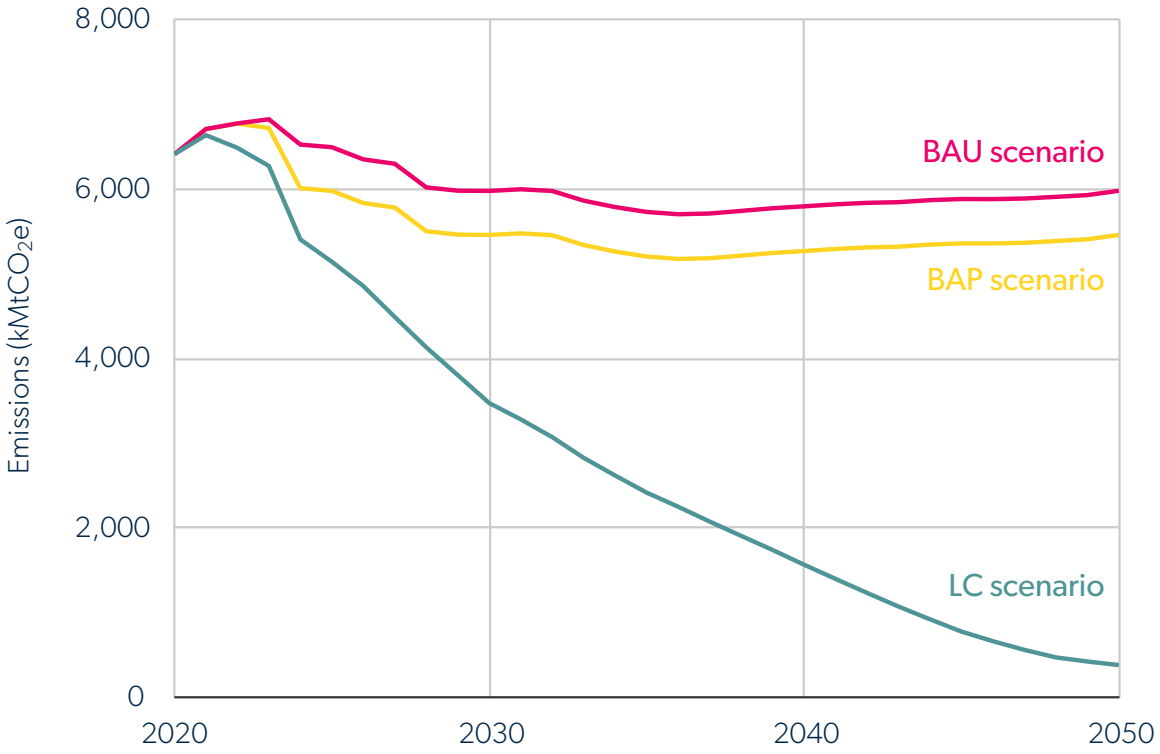


Figure 2. The Low-Carbon Scenario trajectory.

These investments in the Low-Carbon Scenario represent major opportunities for new and existing businesses, including companies providing heat pumps, building retrofits, renewable energy technologies, energy storage, electric vehicles (EVs), energy controls, etc.— a $14 billion opportunity over 30 years, or approximately $500 million per year, equivalent to approximately 1.5% of Charleston County's annual GDP. Some of these investments will occur as a result of natural turnover of stocks—they have their own momentum and require no additional action (for example, each EV purchased represents a $5,000 incremental investment or each home that is weatherized by someone making an upgrade contributes approximately $60,000 to this total investment).

Figure 3 illustrates the total investments as a share of the investments in the Low-Carbon Scenario. The Inflation Reduction Act (IRA) will help stimulate and reinforce many aspects of Charleston County's CAP by providing opportunities for the County to raise funds and by providing grants and incentives to individuals and businesses to support low-carbon investments. The analysis in this paper indicates that the IRA could inject approximately $150 million per year over the next 10 years. Securing these grants and investments will require active participation of residents and coordination by the County and other partners.

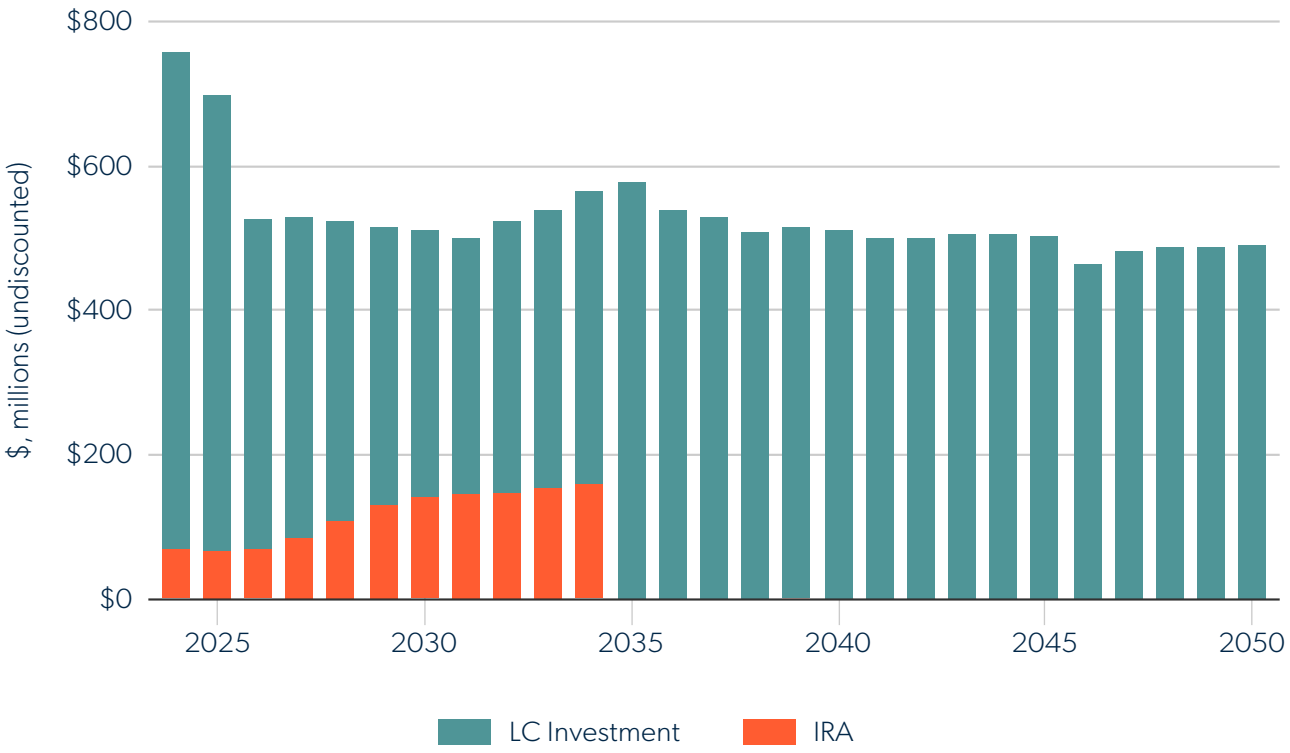


Figure 3. Potential contribution of the IRA to the investments in the Low-Carbon Scenario.

Active engagement of the County and other partners is necessary to advance equity objectives, including ensuring that low-income and disadvantaged community members can help shape implementation of the CAP.

The investments in the Low-Carbon Scenario will generate new jobs in the retrofits, renewable energy, and associated sectors. Total person-years of employment is estimated to be 88,000 by 2050, or approximately 3,300 per year.

E.3 Targets

Specific targets have been identified to track the Low-Carbon Scenario's implementation for the years 2035 and 2050. This information enables the County to monitor progress against the pathway described in the scenario.

The pathway to Charleston County's 2035 target aligns with the global GHG reduction required to prevent climate change.[3] However, the 2035 target does not quite align with a fair-share target, which distributes the global GHG emissions reductions according to the economic capabilities of the jurisdiction.[4] As a result, the County can continue to identify new technologies or opportunities to reduce GHG emissions beyond what is identified in the CAP.

Table 1. GHG targets.

	Baseline 2020	2035	2050	Cumulative (2024–2050)
Business-as-Planned Scenario				
Total ($MtCO_2e$)	6,410,000	5,202,000	5,457,000	146,401,000
% change over 2020		-19%	-15%	
Low-Carbon Scenario				
Total ($MtCO_2e$)	6,410,000	2,415,000	379,000	62,899,000
% change over 2020		-62%	-94%	
Per capita ($MtCO_2e$/capita)	15.5	5.2	0.7	
% change over 2020		-67%	-95%	

[3] *The IPCC identifies global reductions of 40–45% by 2030, Charleston County's low-carbon pathway achieves reductions of -46% by 2030.*

[4] *The science-based targets' guidance recommends -70% over 2015 levels by 2030 for municipalities such as Charleston County. See: Science Based Targets Network (2022). Science-based Climate Targets—A Guide for Cities. Retrieved from: https://sciencebasedtargetsnetwork.org/wp-content/uploads/2020/11/SBTs-for-cities-guide-nov-2020.pdf*

E.4 Findings

The CAP envisions a transition to a low-carbon or decarbonized economy. The analysis indicates that this transition is technically and economically possible using existing technologies.

1. The transition focuses on reducing energy consumption first through high-performance buildings and land-use planning, then by improving the energy system by retrofitting existing buildings, and finally, by switching to renewable energy (primarily electricity) and, to a lesser degree, renewable natural gas and hydrogen. This pathway maximizes efficiency gains and therefore, minimizes the capital and operating costs of the energy transition.
2. The CAP is an economic development strategy, requiring major investments. The investments in the energy system will generate employment in building design, retrofits/weatherization, renewable energy, electric vehicle maintenance, and other sectors. Using sector-specific employment generation rates, the plan can result in a total of 88,000 person-years of employment over the period, or an average of 3,300 person-years of employment per year.
3. The capital investments should be made by multiple actors—the County, households, businesses, and other levels of government. The incremental capital costs of the Low-Carbon Scenario are approximately 1.5% of the GDP of Charleston County. These capital investments result in energy savings and new revenues from renewable energy.
4. Energy is a major expenditure in Charleston County, totaling nearly $2 billion per year. Efficiency gains due to the adoption of electric vehicles, heat pumps, building weatherization, and other measures can reduce these costs significantly, with the most benefit for low-income households. Household energy costs fall from over $5,000 per household to less than $2,000 per household by 2050 in the Low-Carbon Scenario.
5. Equity and resilience are threads that run throughout the engagement process, the technical analysis, and the implementation strategies, with many implementation strategies specifically focused on equity objectives.
6. The engagement process and the technical analysis identified 53 actions bundled into five Big Moves. These actions have varying return on investments and risk profiles. Some investments are more suited to the municipality, whereas others will be more appropriate for private businesses. Which action is best associated with which entity has yet to be determined, but there are many promising investment opportunities.
7. Reduction in energy use and GHG emissions that occur as a result of land-use planning are essentially free in that they require no investment and deliver a range of other co-benefits. Therefore, the County should continue to advance densification strategies to enable GHG emissions reduction.

8. County interventions will be foundational in unlocking key strategies to advance the Low-Carbon Scenario. Potential interventions include creating policies to support intensification, enhancing building performance, supporting access to building weatherization/retrofits and IRA tax credits, encouraging renewable energy use, and providing education and support. Charleston County will need to hire additional staff in order to seize this opportunity.

E.5 Implementation

An implementation program has been developed, with recommended policies, initiatives, and programs, that will put the County on track to achieve the emissions reduction pathway modeled in this analysis. The program focuses on the following Big Moves:

1. Affordable and resilient buildings
2. Sustainable and inclusive transportation
3. Clean energy for all
4. Innovative industrial and agricultural sectors
5. Circular economy

E.6 Conclusion

The climate action response has shifted from a historical emphasis on sacrifice to a new paradigm of opportunity. Climate action now represents new business, new jobs, innovation, and an enhanced quality of life, and these themes are all evident in Charleston County's CAP.

This plan describes a pathway to decarbonize the County that aligns with the latest science. A process that will generate new jobs, stimulate innovation, increase resilience, provide energy security, reduce household energy costs, advance equity, and improve quality of life. As a community plan, the pathway includes actions and investments by households, businesses, and the County. The County is responsible for providing policies, education, and incentives that stimulate these investments; ensuring the investments advance equity and improve the quality of life for County residents; coordinating partners; and tracking progress.

Charleston County's CAP enables the community to address climate change, engage in the energy transition on its own terms, and future-proof the county against technological and climatic megatrends.

Notes and Limitations

The analysis described in this report uses an integrated, multi-fuel, multi-sector, spatially disaggregated energy systems, emissions and finance model designed specifically for climate planning. The model uses bottom-up accounting for energy supply and demand, including renewable resources, conventional fuels, energy-consuming technology stocks (vehicles, appliances, dwellings, buildings, and industry) and all intermediate energy flows. The model incorporates spatial resolution, enabling, for example, the testing of strategies for a specific area of geography, for a specific vintage of buildings, for a specific type of dwelling, for specific types of equipment within buildings, or for a specific technology for transportation or energy provision.The model traces the flows and transformations of energy from sources through energy carriers (e.g., gasoline and electricity) to end uses (e.g., personal vehicle use, space heating) to energy costs and GHG emissions. An energy balance is achieved by accounting for efficiencies, conservation rates, and trade and losses at each stage in the journey from source to end use. The model can be used to analyze energy and emissions associated with customized policies over time and includes modeled financial information, which can inform financial decision-making related to energy and emissions actions.

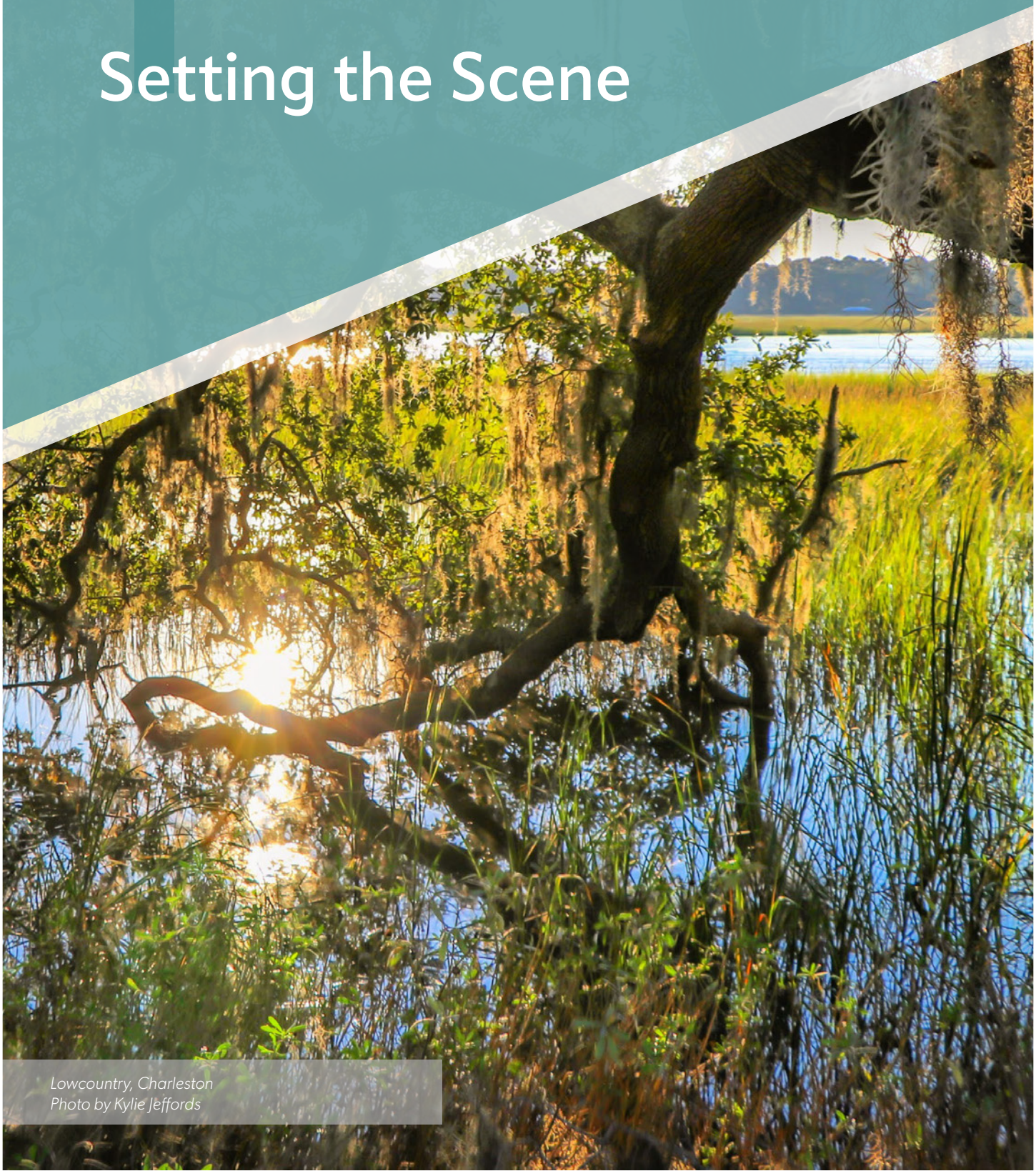
In this project, the model was used to:

- Evaluate pathways to decarbonize the county over a 30-year time horizon;
- Explore diverse scenarios that represent a range of possible futures, including system transformations in energy, using and emissions generating sectors;
- Evaluate the feasibility of specific actions (physical transformations) to deliver GHG emissions reductions;
- Represent the spatial evolution of the county as a system that uses energy and generates emissions; and
- Assess the societal costs and benefits of the pathways and actions.

The analysis undertaken in this study does not:

- Evaluate the physical impacts of climate change and the adaptive measures that will be required, although opportunities for implementing GHG mitigation actions that also increase resilience are noted;
- Specify specific policies or incentives required to implement the actions. In many cases, policies can be inferred from the actions;
- Assess individual actions from the perspective of a specific stakeholder, such as an investor or household, which would involve applying varying discount rates, according to a mapping of which entity makes which investment; and
- Evaluate the implications of decarbonization pathways on hourly demand (all electricity consumption is reported on an annual basis). This is an important consideration for electricity system planning but involves a more complex analysis.

1 Setting the Scene



Lowcountry, Charleston
Photo by Kylie Jeffords

1 Setting the Scene

1.1 A Global Energy Transition

The global energy system is transitioning due to rapid technological change and the evolution of sub-national, national, and international policies. Indicators of this change include the growth of clean electricity[5] and the adoption of electric vehicles[6] and heat pumps.[7] Combined with emerging technologies, these trends are stimulating new opportunities.

The Transformation of the Energy System[8]

"The energy world is in the early phase of a new industrial age—the age of clean energy technology manufacturing. Industries that were in their infancy in the early 2000s, such as solar photovoltaic and wind, and the 2010s, such as EVs and batteries, have mushroomed into vast manufacturing operations today. The scale and significance of these and other key clean energy industries are set for further rapid growth. Countries around the world are stepping up efforts to expand clean energy technology manufacturing with the overlapping aims of advancing net zero transitions, strengthening energy security and competing in the new global energy economy. The current global energy crisis is a pivotal moment for clean energy transitions worldwide, driving a wave of investment that is set to flow into a range of industries over the coming years. In this context, developing secure, resilient and sustainable supply chains for clean energy is vital."

IEA (2023). Energy Technology Perspectives 2023, P. 4

[5] *IRENA (2023). Record Growth in Renewables Achieved Despite Energy Crisis. Retrieved from: https://www.irena.org/News/pressreleases/2023/Mar/Record-9-point-6-Percentage-Growth-in-Renewables-Achieved-Despite-Energy-Crisis*

[6] *Bloomberg (2022). US Crosses the Electric-Car Tipping Point for Mass Adoption. Retrieved from: https://www.bloomberg.com/news/articles/2022-07-09/us-electric-car-sales-reach-key-milestone?leadSource=uverify%20wall*

[7] *IEA (2023). Global heat pump sales continue double-digit growth. Retrieved from: https://www.iea.org/commentaries/global-heat-pump-sales-continue-double-digit-growth*

[8] *IEA (2023). Energy Technology Perspectives 2023, P. 4*

1.2 The Climate is Changing

Scientists around the world agree that human activity is changing the climate, primarily through greenhouse gas (GHG) emissions.[9] GHGs act as a heat-trapping blanket around Earth. Too little GHGs makes Earth too cold, too much and Earth becomes too warm. Average global temperatures, along with associated indicators, are accelerating.[10]

In 2015, the international community came together and signed the Paris Agreement, a landmark international climate treaty to "pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels." The 1.5° Celsius or 2.7° Fahrenheit marker was chosen as a "defense line"—going beyond this limit dramatically increases the risk of extreme weather events, more frequent wildfires with higher intensity, sea level rise, and changes in flood and drought patterns that would have adverse, irreversible impacts for people and ecosystems.

January 2024 marked the first time global temperatures averaged 1.5° Celsius or 2.7° Fahrenheit above pre-industrial levels for a 12-month period.[11] This is an alarm bell, amplified by the climate disruptions experienced worldwide, ranging from the raging wildfires in Canada and California, floods in Germany and China, and rain instead of snow in Greenland. The climate is not just a day or even a single year, but it is clear that the world is dangerously close to that "defense line."

In South Carolina, the average annual temperature has increased by approximately 1° Fahrenheit since 1895.[12] While South Carolina's historical precipitation is variable, the state is experiencing less rain in summer and more rainy days in the fall. South Carolina's location makes it vulnerable to tropical storms and hurricanes, and while there is uncertainty about the number of future storms, future storms are expected to have greater wind and precipitation intensities as global temperatures continue to increase.

Charleston County, located in the low-lying coastal region of the state, has an added risk where the county is also highly susceptible to sea-level rise. Charleston County residents are already experiencing more floods now compared to even 10 years ago—between 2019 and 2023, the county had an average of 13 flood-days annually, compared to an average of three flood-days between 2009 and 2003.

Figure 4 shows the projected changes to average temperatures, precipitation, heating degree days[13] (HDD), and cooling degree days (CDD) anticipated for Charleston County up to 2010. Weather patterns are a good predictor for future energy demand—hotter days will require more space cooling, which, in turn, will require more energy use.

---

[9] *Herring, David, 2020. Isn't there a lot of disagreement among climate scientists about global warming? US National Oceanic and Atmospheric Administration (NOAA). Retrieved from https://www.climate.gov/news-features/climate-qa/isnt-there-lot-disagreement-among-climate-scientists-about-global-warming*

[10] *See: NOAA (2023). Global Climate Dashboard. Retrieved from: https://www.climate.gov/*

[11] *Abnett, Kate, 2024. Climate change drives world to first 12-month spell over 1.5°C. Reuters. February 8, 2024. Retrieved from https://www.reuters.com/business/environment/january-was-worlds-warmest-record-eu-scientists-say-2024-02-08/*

[12] *South Carolina Office of Resilience (2023). Strategic Statewide Resilience and Risk Reduction Plan. Retrieved from: https://scor.sc.gov/resilience*

[13] *US EIA uses degree days as a measure of how cold or warm a location is. A degree day compares the mean outdoor temperature for a location to a standard temperature, in this case 65°F. A higher number of degree days results in higher energy use for space heating or cooling.*

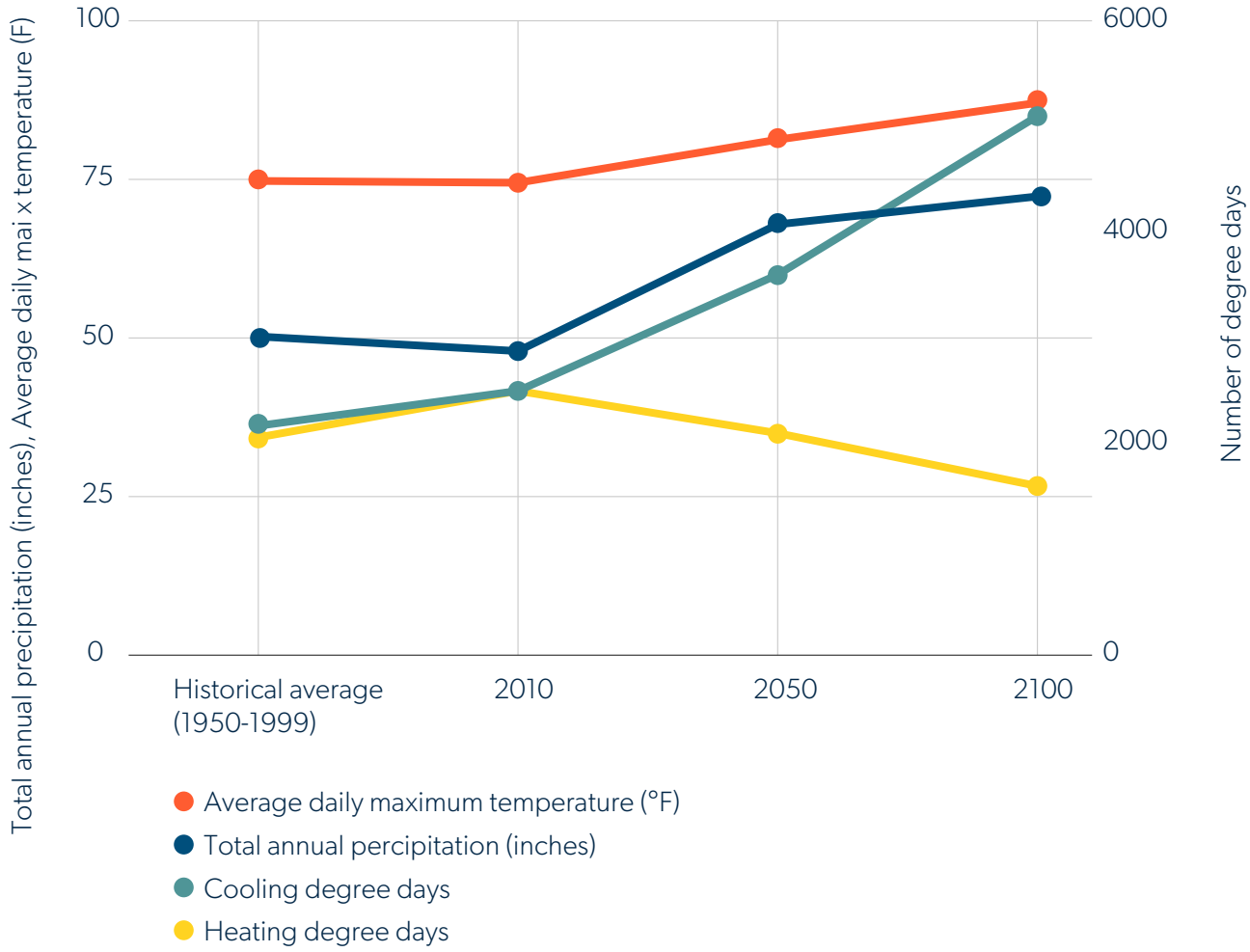


Figure 4. Climate change impacts to 2100 under a high-global-emissions scenario.[14]

[14] *The Climate Explorer (2022). NOAA. Retrieved from https://crt-climate-explorer.nemac.org/climate_graphs/?area-id=45019&zoom=7&lat=32.7833163&lon=-79.9319664&id=tmax&city=Charleston%2C+SC&County=Charleston%2BCounty&fips=45019*

The Impacts of Climate Change

Climate change is impacting everyone, with varying levels of severity, disrupting people's lives and local economies. The following excerpts from the Fifth National Climate Assessment describe the impacts and risks:[15]

One of the most direct ways that people experience climate change is through changes in extreme events. Harmful impacts from more frequent and severe extremes are increasing across the country—including increases in heat-related illnesses and death, costlier storm damages, longer droughts that reduce agricultural productivity and strain water systems, and larger, more severe wildfires that threaten homes and degrade air quality.

Each additional increment of warming is expected to lead to more damage and greater economic losses compared to previous increments of warming, while the risk of catastrophic or unforeseen consequences also increases.

In the 1980s, the country experienced, on average, one (inflation-adjusted) billion-dollar disaster every four months. Now, there is one every three weeks, on average. Between 2018 and 2022, the US experienced 89 billion-dollar events. Extreme events cost the US close to $150 billion each year—a conservative estimate that does not account for loss of life, healthcare-related costs, or damages to ecosystem services.

The impacts and risks of climate change unfold across interacting sectors and regions. For example, wildfires in one region can affect air quality and human health in other regions, depending on where winds transport smoke. Further, climate change impacts interact with other stressors, such as the COVID-19 pandemic, environmental degradation, or socioeconomic stressors like poverty and lack of adequate housing that disproportionately impact overburdened communities. These interactions and interdependencies can lead to cascading impacts and sudden failures. For example, climate-related shocks to the food supply chain have led to local to global impacts on food security and human migration patterns that affect US economic and national security interests.

The risk of two or more extreme events occurring simultaneously or in quick succession in the same region—known as compound events—is increasing. Climate change is also increasing the risk of multiple extremes occurring simultaneously in different locations that are connected by complex human and natural systems. For instance, simultaneous megafires across multiple western states and record back-to-back Atlantic hurricanes in 2020 caused unprecedented demand on federal emergency response resources.

Some communities are at higher risk of negative impacts from climate change due to social and economic inequities caused by ongoing systemic discrimination, exclusion, and under- or disinvestment. Many such communities are also already overburdened by the cumulative effects of adverse environmental, health, economic, or social conditions. Climate change worsens these long-standing inequities, contributing to persistent disparities in the resources needed to prepare for, respond to, and recover from climate impacts.

---

[15] *USGCRP, 2023: 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*

1.3 2035 and 2050 Targets

The pathway to a 2050 emissions target can vary (Figure 5). Different pathways result in much more (trajectory on the right) or much fewer (trajectory on the left) GHG emissions being released overall between now and 2050. The cumulative GHG emissions released over the next 30 years is just as significant for staying within the 1.5° Celsius warming threshold as reaching net zero by 2050. In the quest to limit GHG emissions to 1.5° Celsius warming, every ton counts. Delaying action results in more emissions released, but it also requires a more rapid, costly, and disruptive transition, forfeiting much of the energy savings that can be achieved through low-carbon actions.

Figure 5. GHG emissions reductions with the same target vary according to the timing of actions and the result trajectory.

In order to ensure a more gradual pathway, the technical committee aimed to align itself with general science-based targets, specifically:

- A 60% reduction in GHG emissions from 2020 levels by 2035; and
- Net-zero emissions by 2050.

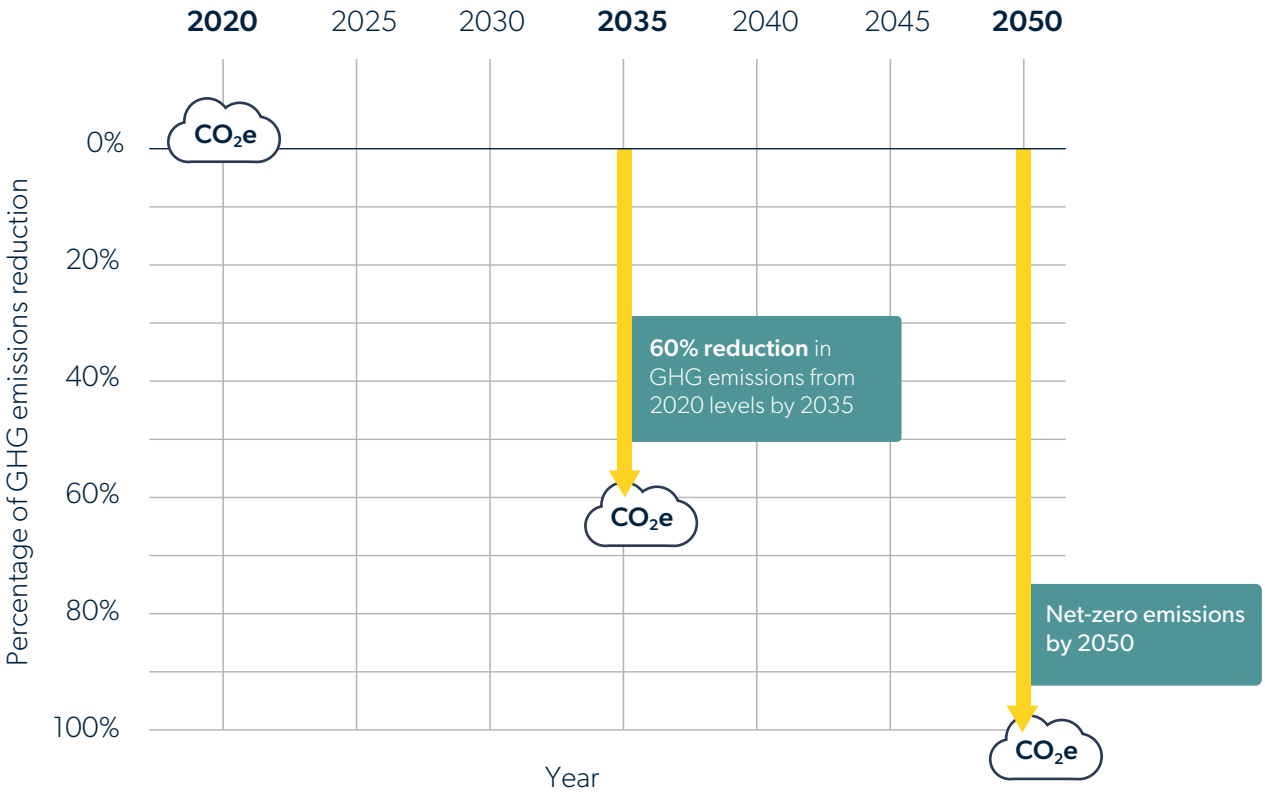


Figure 6. Percentage of reduction in GHG emissions from 2020 levels by 2030, 2035 and 2050.

The pathway to Charleston County's 2035 target (-60% by 2035), as defined by the Low-Carbon Scenario, includes a milestone that aligns with the global average reductions identified by the IPCC (-40% to 45% by 2030). The pathway is short, however, of the level of reductions recommended as per a fair-share target (-70% by 2030). A fair-share target distributes the GHG emissions reductions that scientists have identified according to the economic capacities of the jurisdiction.[16] As a result, Charleston County should continue to identify opportunities to reduce GHG emissions more rapidly than the Low-Carbon Scenario in this report.

[16] *The science-based targets guidance recommends -70% over 2015 levels by 2030 for municipalities such as Charleston County. See: Science Based Targets Network (2022). Science-based Climate Targets- A Guide for Cities. Retrieved from: https://sciencebasedtargetsnetwork.org/wp-content/uploads/2020/11/SBTs-for-cities-guide-nov-2020.pdf*

Achieving Charleston County's 2035 and 2050 targets requires unprecedented coordination and investments. As this report demonstrates, these investments are simultaneously an economic opportunity and an opportunity to advance equity and public health objectives. For example, many actions can also increase the resilience of the community to climate change impacts (Figure 7).

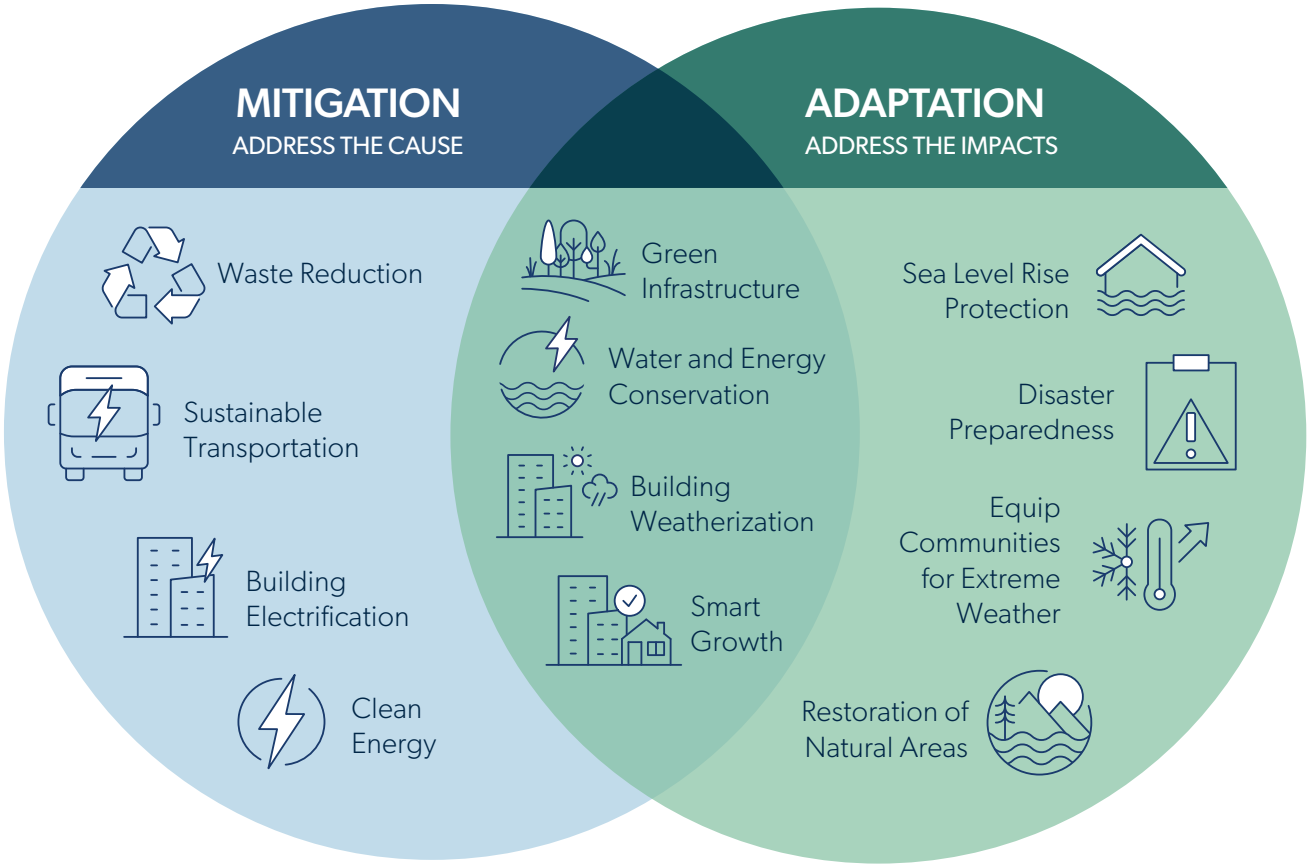


Figure 7. Mitigation and adaptation actions. Some actions both reduce GHG emissions (mitigation) and adapt to the impacts of climate change.

1.4 Federal Context

The United States recently rejoined the Paris Agreement and developed a new Nationally Determined Contributions (NDC)[17] in line with Article 4 of the Paris Agreement. The NDC includes a new target to achieve a 50–52% reduction in greenhouse emissions from 2005 levels by 2030, a 60% reduction by 2035, and net-zero emissions by 2050. The current federal administration has set some key measures to reach their target, including:

- Working towards 100% carbon-free electricity by 2035;
- Supporting energy efficiency upgrades and electrification in buildings;
- Ensuring 50% of personal and light-duty vehicles sales are electric by 2035;
- Researching, developing, demonstrating, commercializing, and deploying very low-carbon and zero-carbon industrial processes and products; and
- Supporting scaling of climate-smart agricultural practices, including reforestation, rotational grazing, and nutrient management practices.

If implemented successfully at the federal level, these measures would ease the burden on municipalities to act. However, from past experience, it is unrealistic to expect all targets to be achieved at the national level and changes in administration can derail climate action, so it is critical that municipalities continue to pursue action at the local level and collaborate with higher orders of government and other local governments.

With these goals to reach, this has become a unique moment for federal funding for climate, with unprecedented investments from the Bipartisan Infrastructure Investment and Jobs Act (IIJA) and the IRA. Details of these investments and the scope of opportunity for Charleston County is analyzed in this report.

[17] *The NDCs are non-binding national plans that communicate a nation's intended climate target and the climate policies and actions the government intends to implement to reach their stated target.*

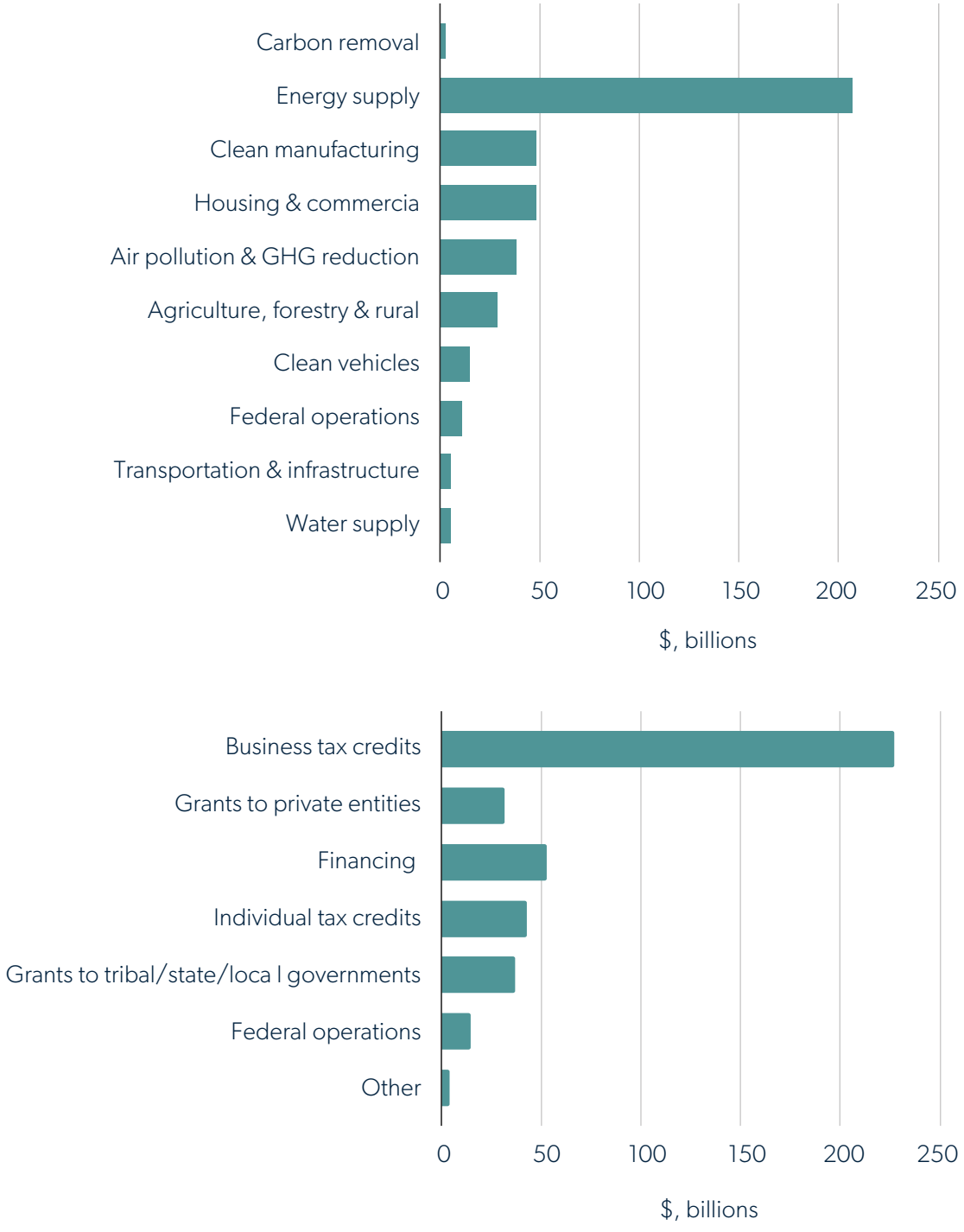


Figure 8. Federal investments in climate action under the Inflation Reduction Act.[18]

[18] *C40 (2023). A roadmap for maximizing Inflation Reduction Act opportunities and community benefits. Retrieved from: https://www.c40knowledgehub.org/s/article/A-roadmap-for-maximizing-Inflation-Reduction-Act-opportunities-and-community-benefits?language=en_US*

1.5 State Context

The South Carolina Energy Office (SC Energy Office) is responsible for advancing South Carolina's State Energy Plan[19] by providing education, outreach, and technical assistance and funding and financial assistance and by collecting and reporting on statewide energy data. The SC Energy Office offers two revolving loan programs—the ConserFund and Conserfund Plus—that supported over 50 energy-saving projects, and it manages South Carolina's Weatherization Assistance Program, which has weatherized over 2,300 homes since 2015, with funding from the federal and state governments totaling $25.3 million.[20] The SC Energy Office hosts online information portals on solar energy and energy efficiency in South Carolina.

1.6 Local Context

Charleston County, spanning 1,358 square miles along the South Carolina coast, has a diverse landscape from sandy beaches to inland marshes. Its subtropical climate offers mild winters and warm summers, attracting visitors year-round. Vulnerable to tropical storms and hurricanes, the county faces risks of flooding, storm surges, wind damage, coastal erosion, and earthquakes. Its historic charm, vibrant communities, and economic vitality make it a premier destination for tourism and commerce. Charleston County's blend of natural beauty and cultural heritage shapes its identity as a resilient and cherished region along the southeastern coast of the United States.

The Charleston economy is anchored by four traditional engines: maritime-related business, the medical sector, military, and tourism, and now, a booming manufacturing industry. Port of Charleston is one of the busiest and most significant seaports on the East Coast, and the Medical University of South Carolina is a leading research and teaching hospital, managing more than $300 million in research funds in 2023.

A county with a rapidly growing population and prosperity, Charleston County aims to build a climate-resilient society that embraces sustainable development practices, promotes renewable energy, prioritizes environmental justice[21] for all residents, and preserves the beauty of its coastal environment for generations to come. In March 2021, the County Council adopted a Climate Action Resolution that "encourages the development and implementation of an equity-centered, community-based, integrated climate action plan; and commits to work closely with municipal governments within Charleston County on their plans to address climate mitigation."[22] Charleston County is now developing a CAP to translate the vision of the Climate Action Resolution into an actionable plan. This CAP will be the County's first comprehensive climate action strategy and provides the pathway towards achieving net-zero emissions by 2050.

---

[19] *SC Energy Office. South Carolina State Energy Plan. Retrieved from https://energy.sc.gov/focus-area/state-energy-plan*

[20] *US DOE (2023). State and Community Energy Programs Project Map - South Carolina. Retrieved from https://www.energy.gov/scep/articles/state-and-community-energy-programs-project-map-south-carolina*

[21] *Environmental justice is the idea that people of all cultures, races, ethnicities, and socioeconomic backgrounds deserve fair protection from environmental and health hazards, as well as equal access to the decision-making processes behind environmental policies and development.*

[22] *Charleston County (2021). Climate Action Resolution. Retrieved from https://www.charlestonCounty.org/ccrs/files/Climate-Action-Resolution.pdf*

Charleston County has 16 municipalities located within its geographic boundaries. One of its local municipalities,[23] the City of Charleston, unanimously approved its Climate Action Plan in May 2021,[24] with a goal to reduce emissions 56% below 2018 levels by 2030 and achieve net-zero emissions by 2050. The County took the initiative to prepare GHG inventories for all 16 municipalities and unincorporated areas for the years 2018 and 2020.

In the face of rising seawater and regular "sunny day" flooding, there is growing support for investments in resilience and climate action in the County, galvanized by organizations like the Charleston Climate Coalition, the Coastal Conservation League, and the Sustainability Institute.

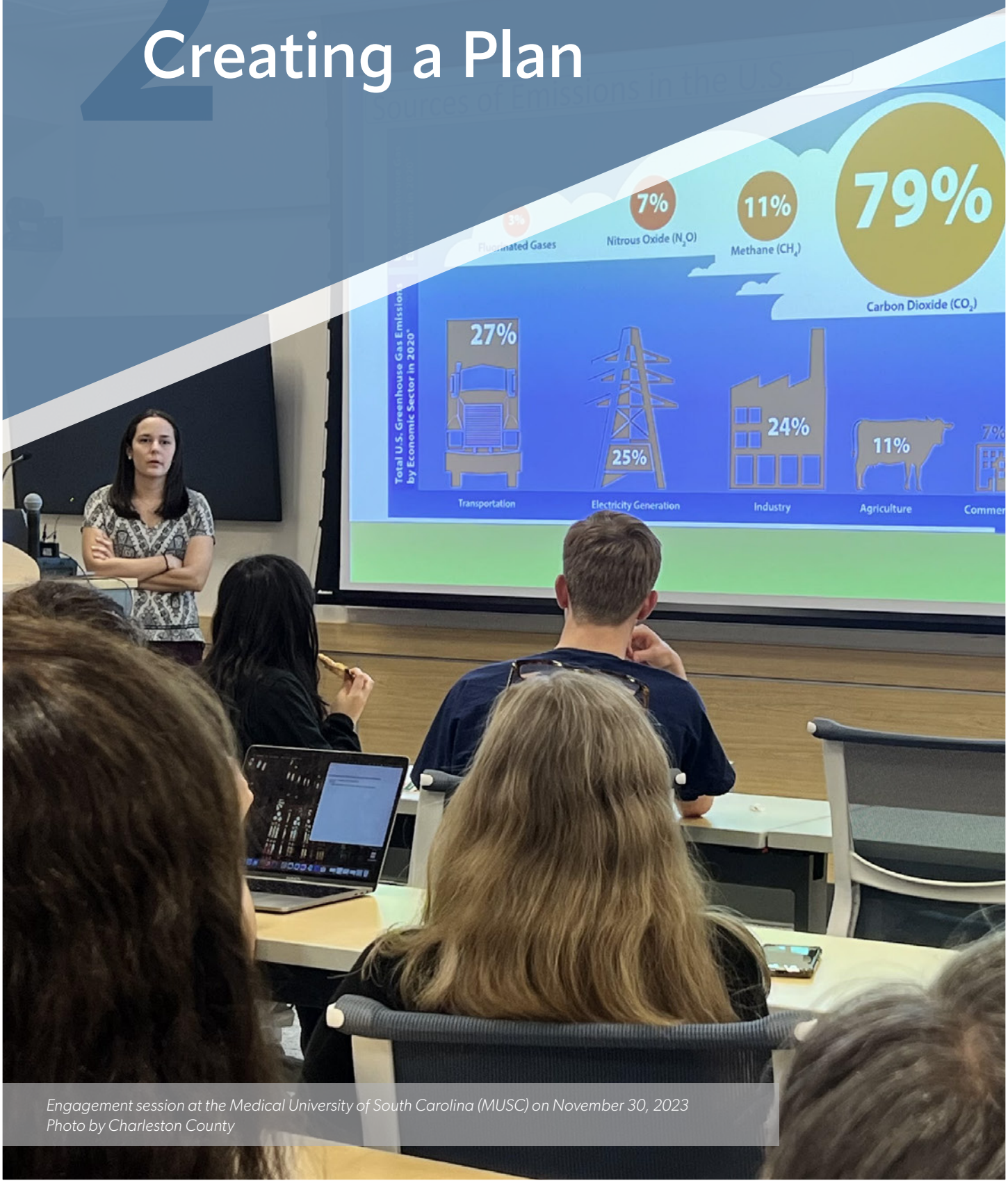
Charleston County faces three key challenges that have shaped the development of the CAP:

1. Authorities: The County's jurisdiction is primarily over the unincorporated areas. The County has no regulatory authority over electricity generation, building energy codes, or transportation behavior. It can, however, coordinate and facilitate the efforts of the public and private sectors, develop and implement programs, and invest in infrastructure, essentially acting as a quarterback for the CAP.
2. Climate adversity: The County is already confronting significant climate adversity as a result of sea-level rise, extreme rain and flooding, and high winds. These events are imposing additional financial stress on governments and households.
3. Inequities: Historically, segregation laws have caused economic, social, political, and geographic inequities in African-American communities.

[23] *Local municipalities in this document refers to municipalities located within the geographic boundaries of Charleston County.*

[24] *City of Charleston (2021) Charleston Climate Action Plan: An equitable strategy for a healthier future. Retrieved from: https://www.charleston-sc.gov/DocumentCenter/View/29030/Climate-Action-Plan-May-2021*

2 Creating a Plan



Engagement session at the Medical University of South Carolina (MUSC) on November 30, 2023
Photo by Charleston County

2 Creating a Plan

Charleston County seeks to develop a Climate Action Plan that is equity-centered, community-based, integrated, and capable of achieving deep emissions reductions. A systematic approach was applied that integrates technical modeling with a comprehensive engagement process, as illustrated in Figure 9. The interaction between these two processes ensures that the plan is achievable and evidence-based, while being rooted in the local context and responsive to community concerns.

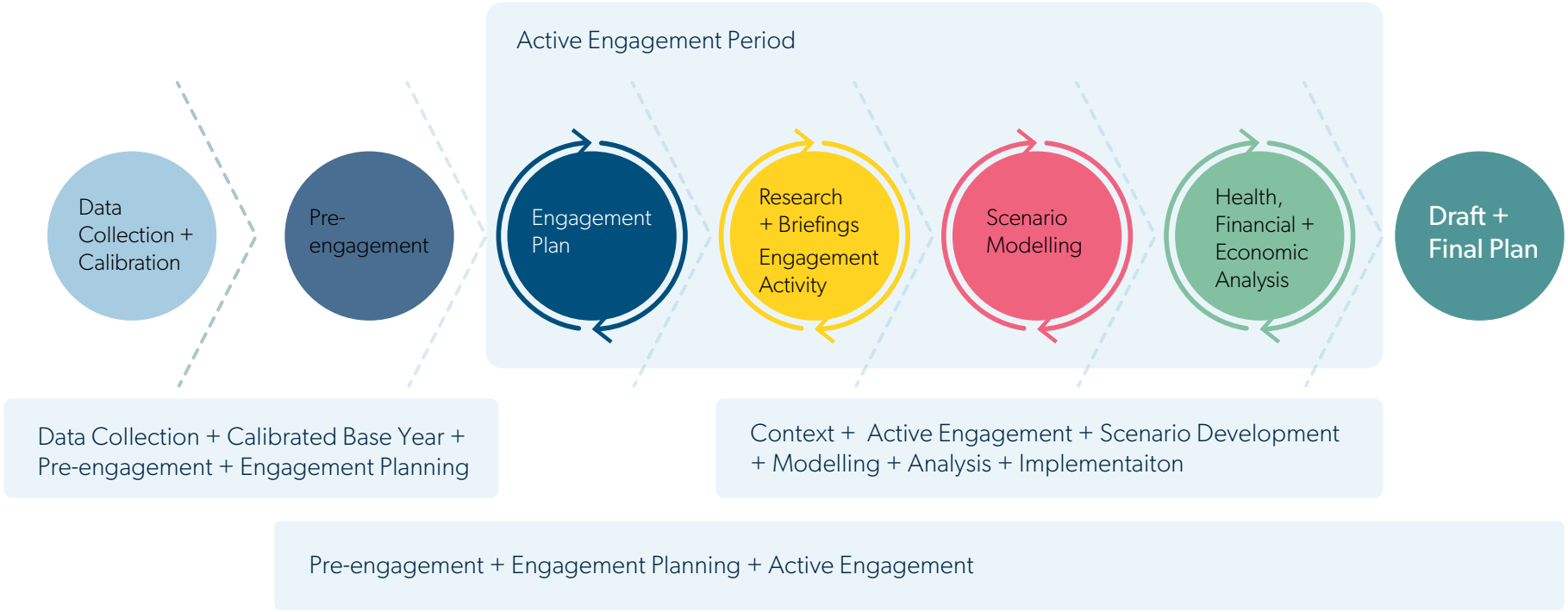


Figure 9. The process for developing Charleston County's CAP.

2.1 A Framework for Climate Action Planning

"Reduce, Switch, Produce, and Offset, and Sequester" is a simple mantra to follow in energy and emissions planning (Figure 10). Adapted from similar approaches, such as Reduce-Reuse-Recycle (from the waste sector) and Avoid-Shift-Improve (from the transportation sector), this framework provides guidance on an overall approach to community energy and emissions planning.

To start, prioritizing reductions in energy consumption brings down the level of needed investment in renewable energy and results in energy cost savings. Maximizing energy consumption reductions and energy efficiency opportunities reduces total energy costs and per-unit energy costs by reducing the overall build-out of the electricity system, which is logistically complex and capital-intensive.

The second and third steps are to switch to locally-produced renewable electricity, which maximizes local economic benefits and the resilience of the electricity system. The final step is to offset and sequester any remaining emissions to reach net zero.

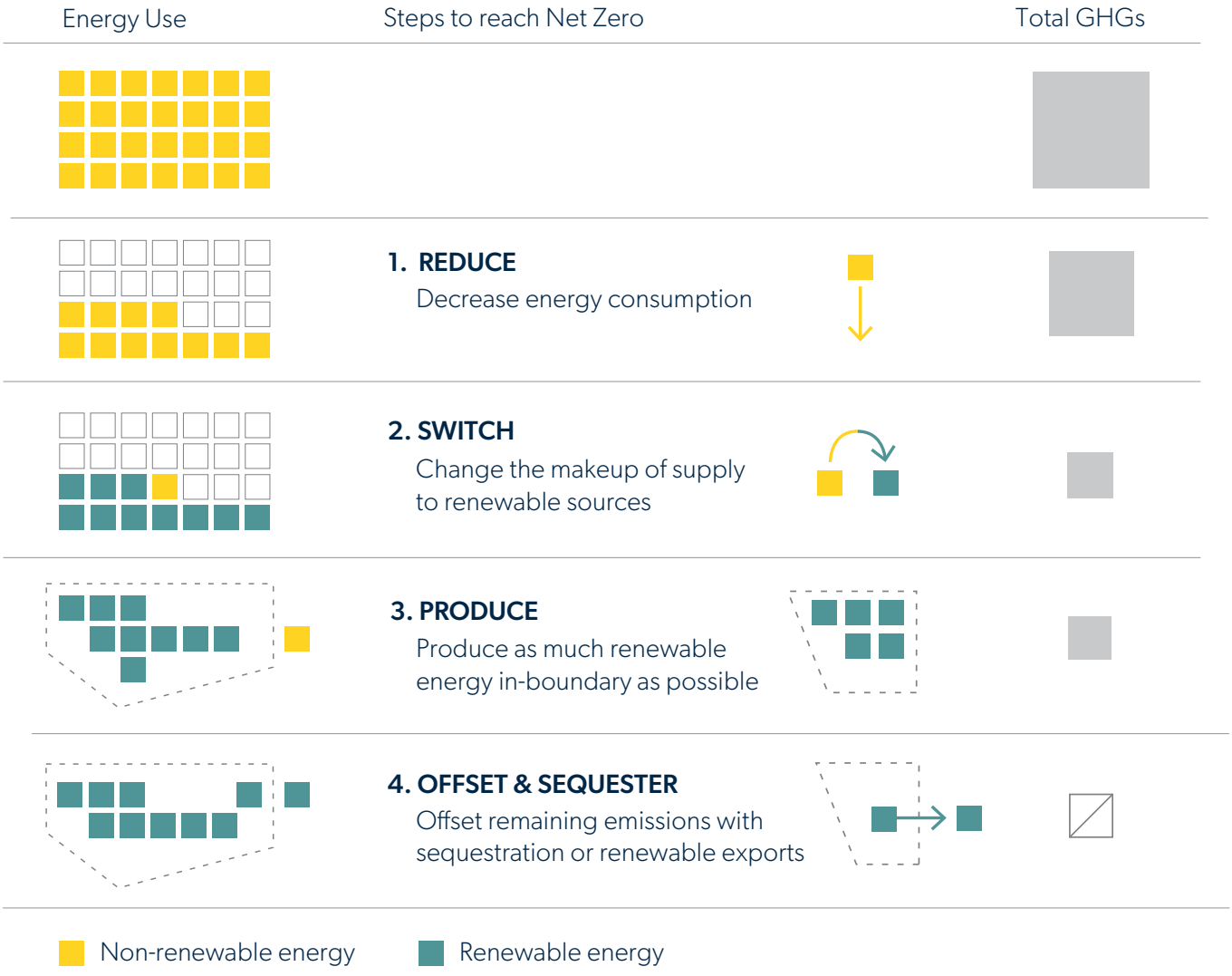


Figure 10. A systematic approach to reducing GHG emissions.

2.2 Climate Action is Economic Development

Decarbonizing Charleston County's transportation, buildings, waste management, and energy supply requires new investments. Many of these investments can save local residents, businesses, and governments money, primarily as a result of efficiency gains, while stimulating innovation and new business opportunities. The investments also require work—and workers—to install heat pumps, retrofit homes, and build infrastructure. The scale of the investment and work required means that the Climate Action Plan is also a major economic development strategy for a region.

2.3 Advancing Equity and Justice

The evolution of the local and state energy systems have imposed a disproportionate impact on communities of color and/or low-income communities ("low-income, disadvantaged communities" or LIDC). These communities also tend to be those most harmed by the impacts of climate change.

An equitable approach to climate action ensures that measures, policies, and investments target these communities to ensure they can secure benefits, including access to new jobs, access to affordable energy, low-carbon energy, reduced air pollution, and improved transportation systems.

Three key elements are required to advance equity objectives:

1. Ensuring that the voices of the LIDC are invited into the planning process on their terms (through the engagement process);
2. Ensuring that the technical analysis accounts for the context of LIDC communities; and
3. Ensuring that the implementation mechanisms specifically address the needs of LIDC communities.

An equitable and sustainable response to climate change has the potential to reduce climate impacts while improving well-being, strengthening resilience, benefiting the economy, and, in part, redressing legacies of racism and injustice.

2.4 Guiding Principles

The CAP incorporates a robust process of best practices research, public engagement input from the engagement process, and technical modeling of future scenarios. The CAP has been guided by the principles displayed in Figure 11.

Figure 11. CAP guiding principles.

2.5 Engagement

The engagement strategy for the Charleston County CAP is firmly grounded in the International Association for Public Participation (IAP2) framework, featuring the following three principal components. It incorporates a public-invitation approach, using webinar workshops to engage residents in discussions about climate action planning and equity. The strategy also includes proactive outreach efforts, where the team actively attends various County events, meetings, and gatherings. This approach is designed to capture feedback directly from residents in their own communities. Lastly, the strategy is bolstered by a multi-stakeholder approach, encompassing two pivotal advisory groups.

The Resilience and Sustainability Advisory Committee (RSAC) comprises diverse sectors, including county staff, a county council member, and representatives from the chamber of commerce, a higher education institution, a regional planning agency, a homebuilders' association, as well as technical experts in resilience, energy, and sustainability.

The Staff + Expert Climate Action Team (SECAT) is another integral component, bringing together experts from the City of Charleston; medical universities; a regional planning agency; environmental coalitions; local towns; county departments, including fleet, planning, economic development, facilities, and finance; and other municipal representatives.

Both the RSAC and SECAT play crucial roles in guiding the Climate Action Plan and related County ordinances, providing valuable insights and recommendations to the County Council and Project Team (SSG + Charleston County) on technical aspects, action items, and ongoing sustainability and resilience efforts. This comprehensive engagement strategy ensures that a wide array of perspectives, including those from government bodies, residents, businesses, environmental and social justice groups, faith-based organizations, non-profits, and educational institutions are considered in the development of the Charleston County CAP.

2.5.1 Engagement Activities

The project has included many engagement activities, including:

- Pre-engagement interviews with selected representatives of key interested and affected groups in the community (representing a cross-section of the county) to inform the design of the engagement process;
- Webinars on the climate action planning process to inform community members about the plan and how they can be involved in the process;
- Outreach through emails and newsletter articles for the Homebuilders' Association, Edisto Island Preservation Alliance, and the Alhambra Garden Club;
- Outreach activities at various community events and spaces, including the MUSC Earth Day Fair, Charleston County Hazards Expo, Green Drinks Climate Change Month, Sea Islands Farmers Market, Mingle with Your Mayoral Candidates, etc.;
- Six meetings with the Resilience and Sustainability Action Committee (RSAC);
- Six meetings with the Staff Expert Climate Advisory Team (SECAT); and
- A Town Hall with community members on climate action implementation.

Community members were also able to provide input over the course of the development of the CAP via email, website, and direct communication with county staff.

2.5.2 Recommendations

The RSAC and SECAT have actively engaged in discussions, raised critical questions, and provided insightful feedback on several vital issues, with a particular emphasis on equity, a paramount concern for the Council, RSAC, SECAT, and the broader community.

- Major Initiatives and Goals: They have discussed and questioned how current major initiatives in transportation, buildings, energy, and land use could be aligned with climate action goals, emphasizing the need for equitable resource distribution and access.

- Existing Climate Actions and Expertise: The groups have examined the County's past and present climate actions, highlighting areas where equity was well addressed and where improvements are needed.
- Leveraging Partnerships: They have scrutinized existing partnerships, asking how these can be used more effectively for implementing climate actions, particularly in ways that promote equity.
- Funding Sources and Opportunities: The committees have delved into current funding sources and queried potential new avenues, with a focus on funding equitable climate initiatives.
- IRA- or BIL-Funded Initiatives: Discussions have included the County's approach to these funding opportunities, with a lens on how they can be used to support equitable climate solutions.
- Areas of Interest for Mayors and City Councils: The emphasis here has been on how the interest areas of the mayors and city councils within the county can be aligned with equity-centered sustainability and resilience actions.
- Capacity for Large Grants: The committees have discussed whether there is staff capacity for large grants, like the Safe Streets for All Multimodal program, and how these opportunities can address equity concerns.
- Workforce Training Programs: The County's involvement in workforce training programs has been reviewed, with questions raised about their inclusivity and accessibility, particularly in green industries.
- Bicycle and Pedestrian Plans: The groups have explored existing plans, asking how they cater to diverse communities and promote equitable access to transportation.
- EV Charging Station Pilot Program: The evaluation of this program has included questions about its accessibility and affordability for all community members.
- Role in Regional or State Working Groups: They have discussed the County's participation in working groups, emphasizing the need for these groups to focus on equitable resilience and sustainability strategies.
- Green Energy in Property Taxes and Incentives: The possibility of adding a sustainability component to property taxes and incentives has been debated, with a focus on how these incentives can be structured equitably.
- Housing Programs: The committees have examined the County's housing programs, especially weatherization and utilities, questioning how they address the needs of underserved populations.
- Review of Past Community Engagement: Past community engagement efforts have been reviewed, with a critical eye on how effectively they have incorporated equity and what can be done better in future efforts.

2.6 Technical Modeling

The technical analysis process began by compiling data about local demographics, buildings, transportation, land use, industry, waste, and wastewater. This data is used to create a picture of Charleston County's energy use and GHG emissions from stocks (e.g., cars, furnaces, waste), which changes over time based on changes in population, jobs, and land-use patterns. The baseline year energy and emissions inventory, developed for the year 2020, is calibrated against observed data from utilities and other sources.

The New Normal

The year 2020 was impacted by the COVID-19 pandemic, a global health crisis that transformed nearly every aspect of human life. Widespread lockdowns, reduced industrial activities, and decreased travel led to a significant reduction in carbon emissions and local air pollution for the short term. However, concentrations of GHG emissions in the atmosphere continue to climb and global temperatures continue to increase, even in 2020.[25]

The year 2020 was used as the baseline for Charleston County, as this was the most recent year with a robust and complete dataset. Due to the impacts of COVID-19, GHG emissions in South Carolina were approximately 8% lower than in 2019,[26] and preliminary estimates for 2021 indicate emissions have increased back to 2019 levels (82 $MMtCO_2e$). The impact of using 2020 as a baseline with its unusually low GHG emissions total is that the inventory results will be depressed, particularly GHG emissions from the transportation sector. Targets, which are set on a percentage basis, will be more ambitious.

The next step was to model future emissions up to 2050 under different scenarios. The scenarios are shaped by the key drivers for energy and emissions in Charleston County, including economic and demographic trends, industrial activities, energy supply, land-use changes, technological advancement, policy, and regulations. Understanding these key drivers enables us to assemble a preliminary list of low-carbon measures and assign modeling assumptions and parameters. Low-carbon measures were informed by literature and best practices in North America.

The technical modeling process and its inputs and assumptions are detailed in the Data, Methods, and Assumptions manual attached as an annex.

---

[25] *World Meteorological Organization (2023). State of the Global Climate 2022. Retrieved from https://library.wmo.int/viewer/66214/download?file=Statement_2022.pdf&type=pdf&navigator=1*

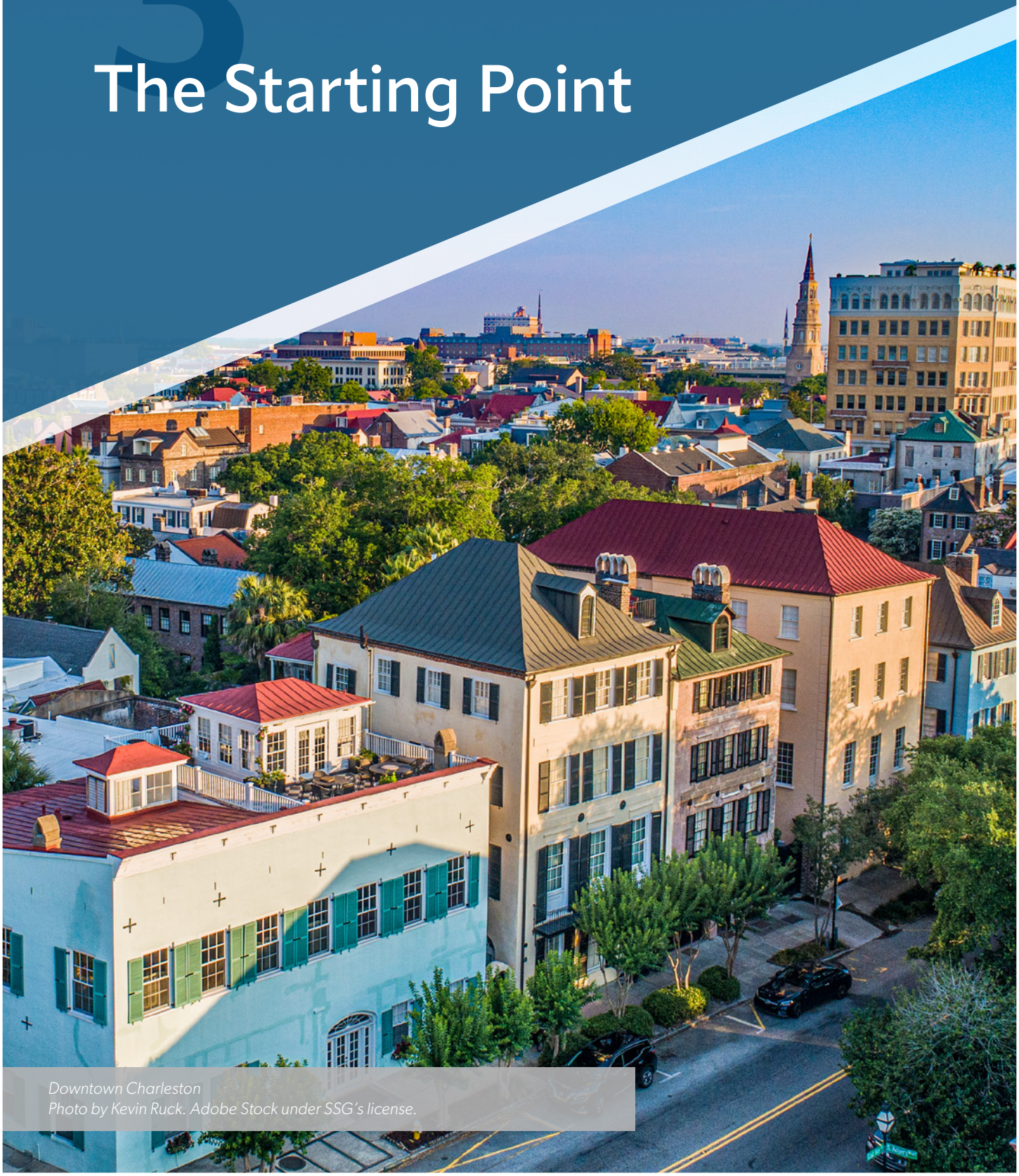
[26] *EPA (2023). Greenhouse Gas Inventory Data Explorer. Retrieved from: https://cfpub.epa.gov/ghgdata/inventoryexplorer/#iallsectors/allsectors/allgas/inventsect/all*

A Systems Dynamics Model

The relationship between land-use planning, the built environment, transportation systems, energy consumption, and GHG emissions is complex and varies from one community to the next. While there are common themes and specific actions that likely make sense in every context, in order to relate potential outcomes from actions to targets and policies—and to understand the financial implications—a model is required to represent the complexity.

Our analysis applied a bottom-up, stock rollover model that projects energy demand as a result of representing the evolution of energy-consuming activities in Charleston County and the energy supply to address the demand. The model estimates the changes in investments, fuel expenses, and other operating expenses of low-carbon pathways relative to a reference or Business-as-Planned Scenario. The model combines changes in annualized investments, fuel costs, and operating expenses to estimate the annual net cost of a pathway. The model incorporates the accounting framework of the Global Protocol for City-Scale GHG Emissions Inventories.

3 The Starting Point



Downtown Charleston
Photo by Kevin Ruck. Adobe Stock under SSG's license.

3 The Starting Point

In 2020, Charleston County consumed 83.8 million MMBtu of energy to:

- Cool space and heat water;
- Run appliances and equipment;
- Fuel vehicles;
- Operate machinery inside all types of buildings—from homes to schools to office towers and industrial facilities; and
- Provide municipal services like water and waste and to move people and goods around.

These processes, combined with emissions from the waste sector, generated 6,410 $kMtCO_2e$,equivalent to burning 33,000 railcars worth of coal.[27]

Approximately 44% of the county's GHG emissions can be attributed to the transportation sector, which consumes diesel and gasoline to move people and goods. The next largest emissions source was energy used in residential, commercial, and industrial buildings, each accounting for 17–18% of the total greenhouse gas emissions. When combined as the building sector, these three sub-sectors constitute about half of the GHG emissions in Charleston County, overtaking the transportation sector as the largest source of GHG emissions. The waste sector and agriculture sector generated 179 $kMtCO_2e$ and 171 $kMtCO_2e$, respectively, about 3% each of the total. The final 1% comes from municipal facilities and fugitive emissions.[28]

[27] *Computed using US Environmental Protection Agency's Greenhouse Gas Equivalencies Calculator.*

[28] *In this analysis, fugitive emissions are the emissions that result from the transportation and distribution of natural gas. During the transportation and distribution processes, small amounts of emissions from methane leak into the atmosphere from valves, casings, and pipes.*

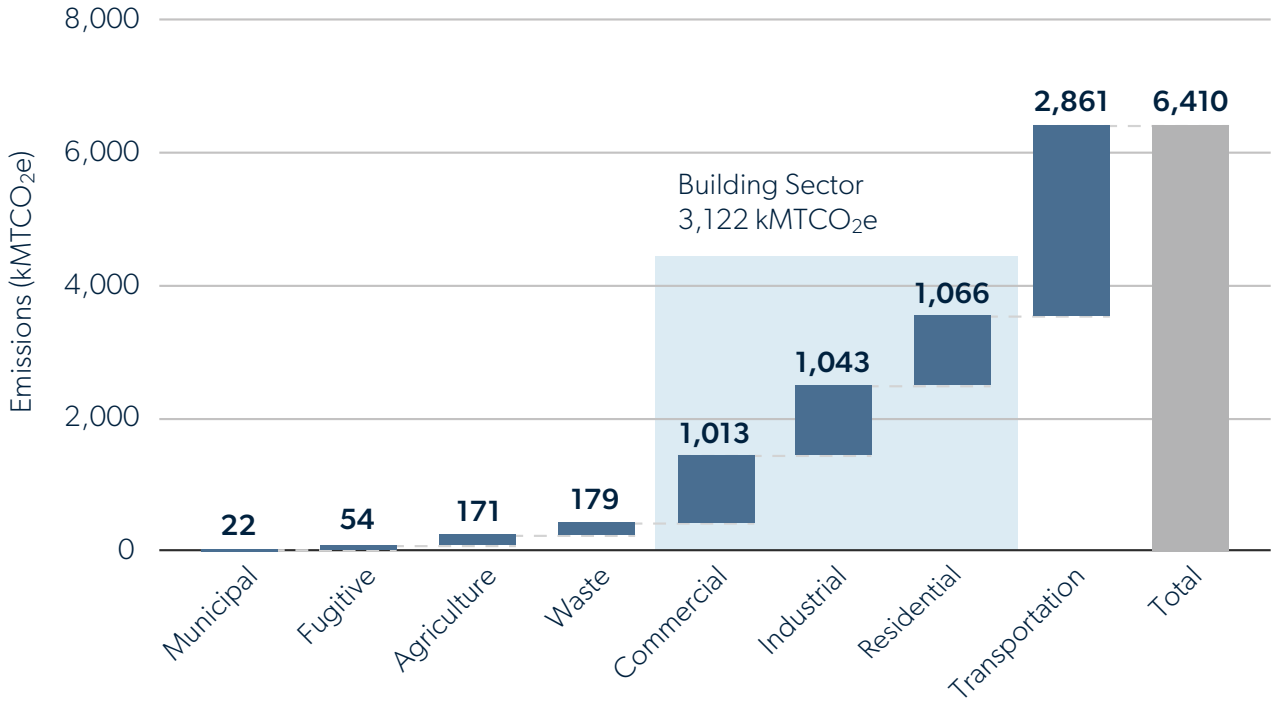


Figure 12. Charleston County GHG emissions by sector in baseline year 2020.[29]

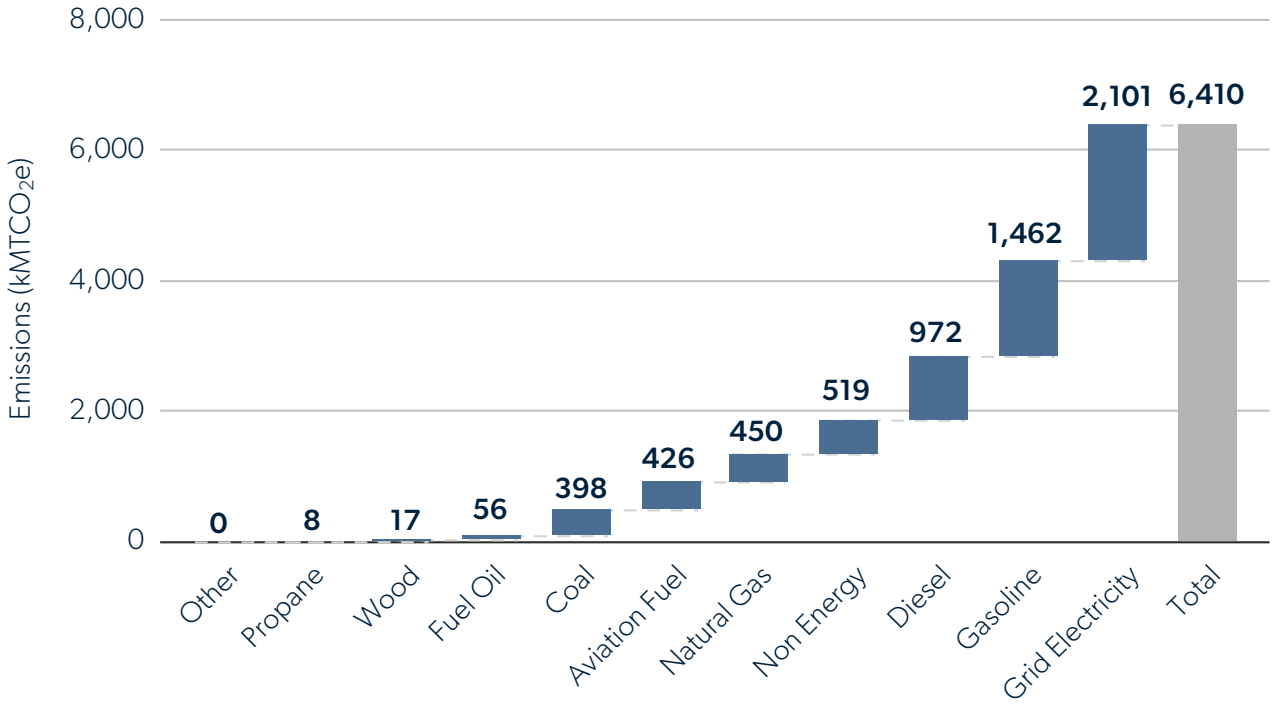


Figure 13. Charleston County GHG emissions by fuel type in baseline year 2020.[30]

[29] *Fugitive emissions are emissions that are released from the natural gas distribution system in the form of methane (CH_4).*

[30] *Non-energy emissions refer to GHG emissions released from landfills, wastewater treatment or other non-energy sources.*

Based on Charleston County's 2020 population, this translates to 15.5 $MtCO_2e$ generated per person, which is less than the GHG emissions per capita for the United States—18.2 $MtCO_2e$ generated per person in 2020.[31]

3.1 Charleston County's Future Emissions

To explore the potential futures for Charleston County, three scenarios were developed and modeled. These scenarios are not a prediction, but plausible, evidence-based projections on how the future may evolve based on data and assumptions about the key drivers for emissions and critical trends in Charleston County, augmented by feedback from engagement activities with RSAC, SECAT and the community.

Table 2. Descriptions of the scenarios.

Scenario	Title	Description
BAU	Business-as-Usual	A reference scenario that illustrates the impact of population growth without any additional measures, policies, or investments. This scenario answers the question, "What would happen if no further actions are taken?"
BAP	Business-as-Planned	A reference scenario that extrapolates current demographic patterns into the future while taking into account existing and approved plans, legislation, and targets that would affect energy use and emissions, and it assumes no additional climate action interventions. This scenario answers the question, "What would happen if only current actions, plans, and policies are implemented?"
LC	Low-Carbon	A scenario that selects and models actions to dramatically decrease GHG emissions and improve energy efficiency across all sectors, with a target of achieving net-zero emissions by 2050.

[31] *Calculated based on data from the US EPA's Climate Change Indicators and the US Census Bureau.*

3.1.1 Low-Carbon Scenario

To determine the most effective way for Charleston County to achieve net zero, potential measures were identified within county, local municipalities, and regional government plans, as well as from an extensive catalog of climate actions. A variety of factors determine the level of ambition and timing for each measure. These factors include, but are not limited to:

- The necessity of the measure (in the sense of there being no alternatives) to reduce emissions and to optimize the potential impact of other measures;
- The "Reduce, Switch, Produce, Offset, and Sequester" framework;
- Charleston County's authority or ability to carry out the measure;
- Insights from county staff and members of the community; and
- Alignment with state and federal targets and regulations, municipal plans, and plans of shared service operators.

Collectively, the measures identified represent Charleston County's modeled LC Scenario.

3.1.2 Low-Carbon Measures

The assumptions for low-carbon measures are described in the following table.

Table 3. Low-carbon measures.

Measure	BAP Scenario	Low-Carbon Scenario	Impact
High-performance building standards for new buildings	New buildings are constructed to current energy performance standards.	All new residential, commercial, municipal, and industrial buildings are net-zero ready by 2035.	Avoided/reduced energy use
Retrofit existing buildings	Existing building stock efficiency remains constant.	All existing residential, commercial, municipal, and industrial buildings are retrofitted to achieve thermal standards of net-zero ready and 30% electrical by 2050.	Avoided/reduced energy use
New and existing buildings switch to heat pumps, heat pump water heaters and equipment and appliances are electrified	Current equipment fuel shares and efficiency held constant from base year.	Replace space heating, space cooling, and water heating systems with heat pumps. Electrify appliances and auxiliary equipment.	Avoided/reduced energy use and fuel switching

Measure	BAP Scenario	Low-Carbon Scenario	Impact
Zero-emissions municipal fleet	Two electric vehicles in the fleet in 2023.	All light-duty vehicles are electric by 2035. Mid-to-heavy duty vehicles are 50% electric and 50% zero-emission vehicles (ZEVs) by 2050.	Fuel switching
Electrify personal-use vehicles	Five percent of low-duty vehicle stock is electric by 2050.	By 2035, all new personal, light-duty vehicles sold are electric.	Fuel switching
Switch commercial vehicles to low-emissions fuel	Five percent of low-duty vehicle stock is electric by 2050.	By 2035, all new commercial, light-duty vehicles sold are electric. By 2045, for all new mid-to-heavy duty vehicles, 50% will be electric, 50% will be ZEV.	Fuel switching
Switch mid-to-heavy duty vehicles to zero-emissions fuel	No change.	Shift to ZEV.	Fuel switching
Expand transit and active infrastructure	No change in travel mode share.	By 2050, 20% of trips below one mile are completed by walking, and 10% of trips between 1-6 miles are completed by biking.	Avoided/reduced energy use
Zero-emissions marine, air, and rail transportation	No change in marine, air, and rail transportation fuels.	By 2050, aviation and marine fuel converted to zero-emissions fuel, freight rail fully electrified.	Fuel switching
Grid updates	Emissions factors are held constant.	Grid provider retires fossil-fuel power generation plants and replaces the plants with zero-emission power.	Fuel switching
Rooftop solar	Installed 30 MW of solar PV systems by 2020, assumes no new installations from 2022 to 2050.	Increase solar rooftop PV installations for residential and commercial buildings.	Fuel switching
Renewable energy installations	No wind installation.	Install 390 MW of wind and 780 MW of ground- mount solar farms by 2040.	Fuel switching

Measure	BAP Scenario	Low-Carbon Scenario	Impact
Industrial sector processes improvements	Current efficiency held constant from base year.	Industrial processes are 20% more efficient by 2030 and 30% by 2050, relative to the 2020 baseline.	Avoided/reduced energy use
Agricultural sector improvements	Current equipment shares and efficiency held constant from base year.	Improved agricultural practices reduce emissions by 30%. Shift agriculture motive fuel use to electricity.	Avoided/reduced energy use
Waste management improvements	No change to waste or water management strategies.	Divert 95% of organics and 75% of remaining waste from landfill.	Avoided/reduced energy use

3.1.3 Scenario Results

The total impact of the all three scenarios on community-wide emissions is illustrated in Figure 14.

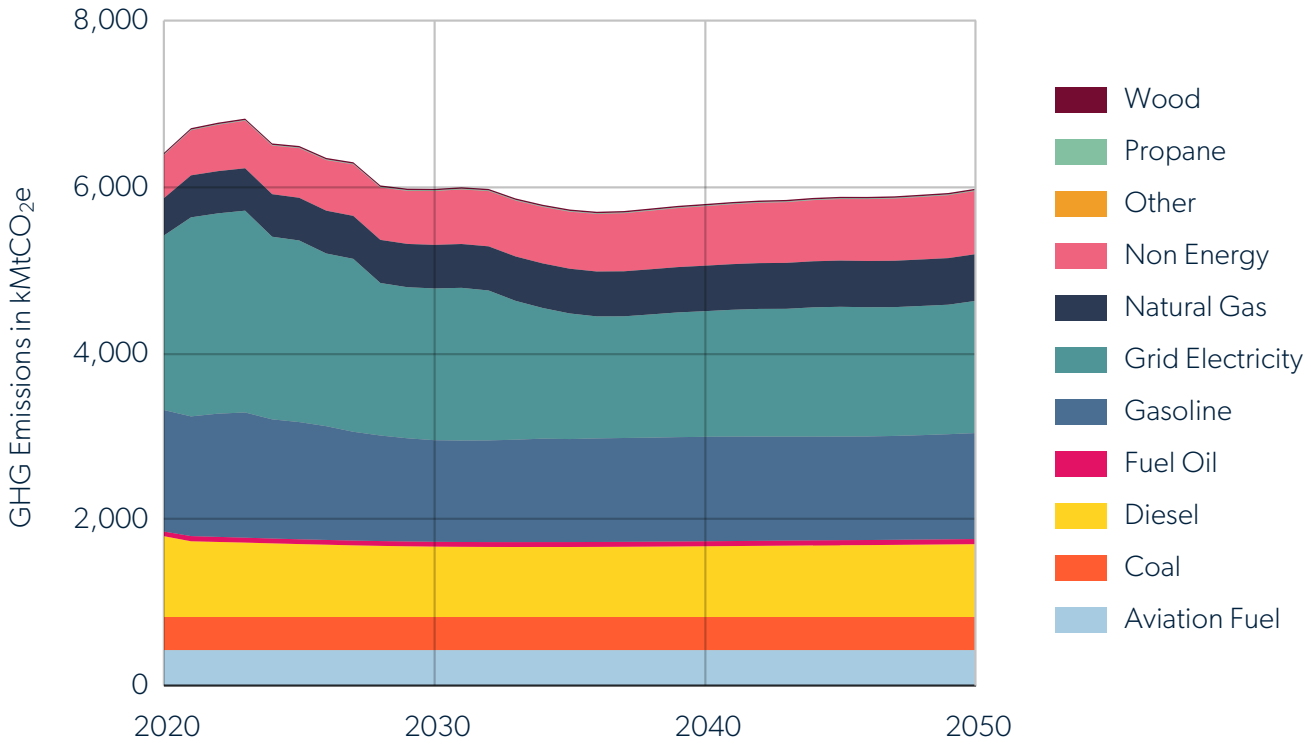


Figure 14. Charleston County's GHG emissions in the BAU scenario, by energy source, 2020-2050.

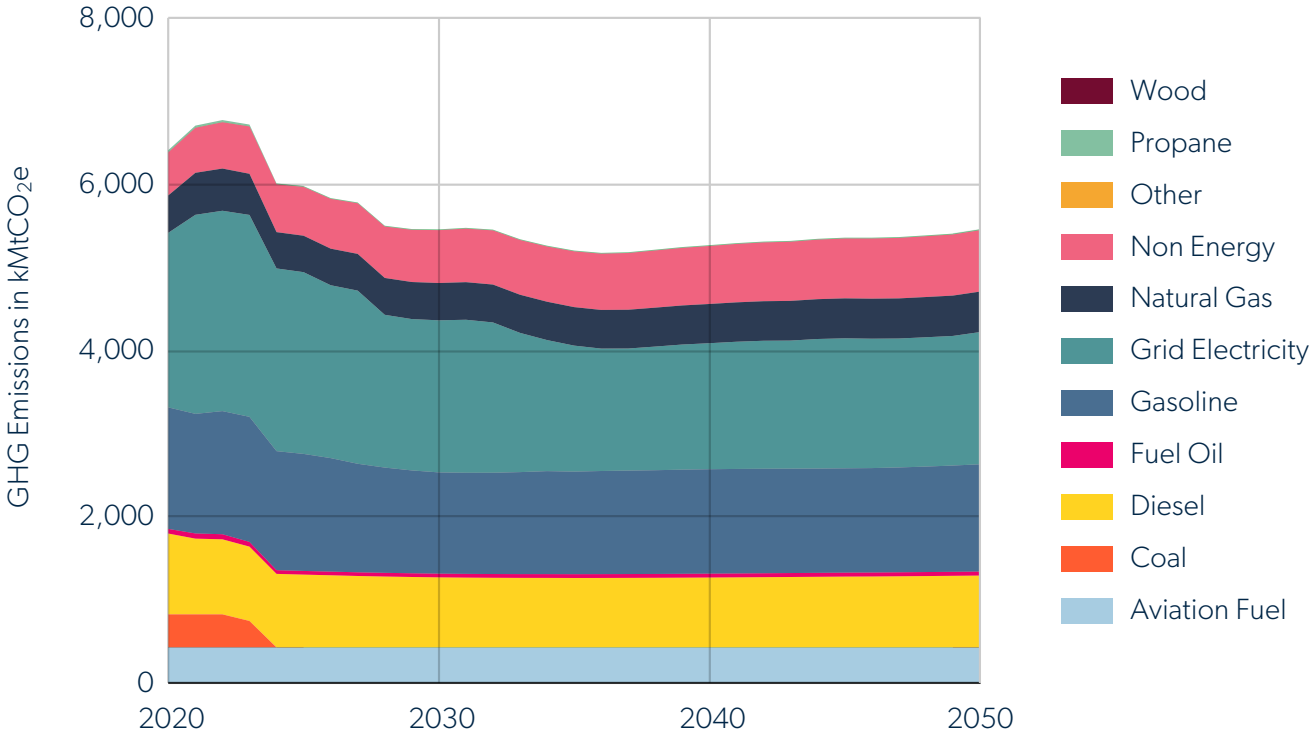


Figure 15. Charleston County's GHG emissions in the BAP scenario, by energy source, 2020-2050.

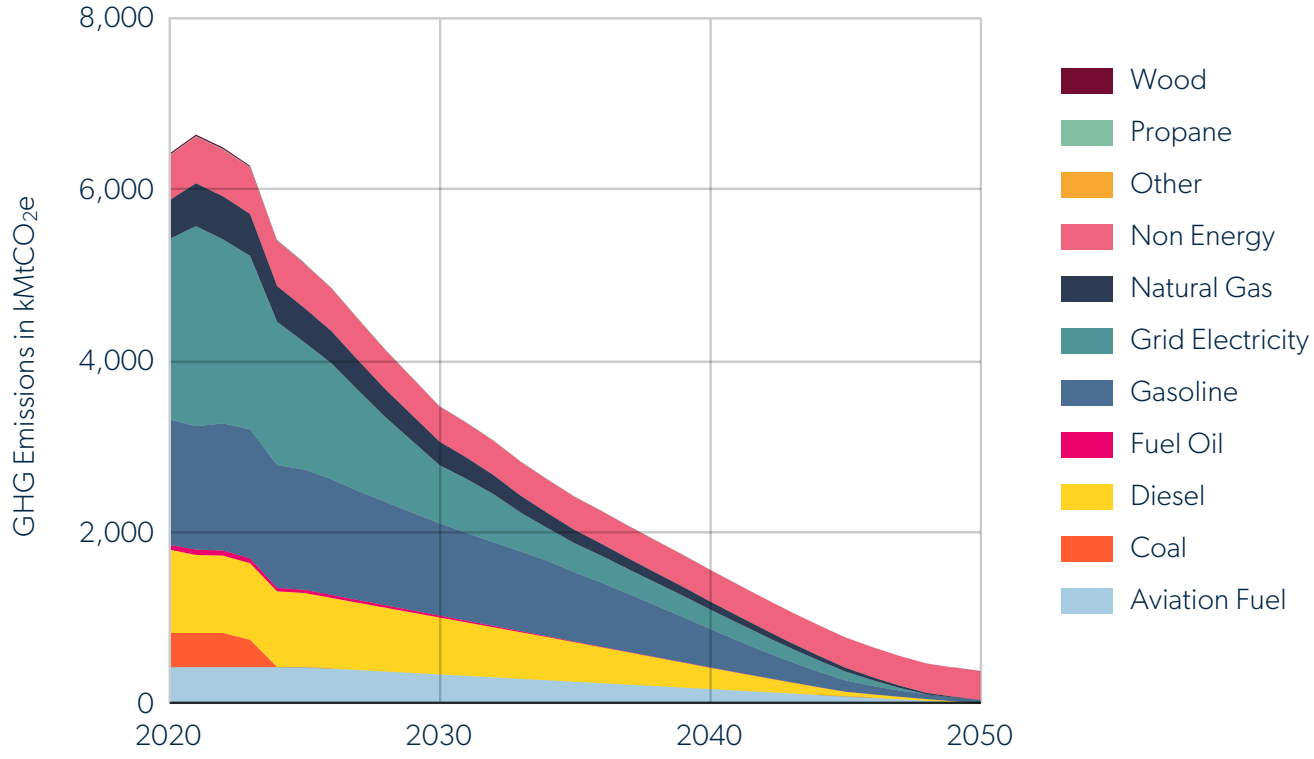


Figure 16. Charleston County's GHG emissions in the Low-Carbon Scenario, by energy source, 2020–2050.

In the BAU scenario, GHG emissions are projected to grow from 2020 to 2023. From 2024, emissions decline gradually to 2036, when emissions start to slowly rise again to reach about 5,000 $ktCO_2e$ in 2050. This projection demonstrates the interplay between several factors—the growing population trends and warming climate trends combined with improved vehicle efficiency, improved equipment efficiency, and increased cooling demand.[32]

Modeling results for the BAP Scenario show a similar trending pattern, with a sharp dip in 2024 due to the closure of WestRock's paper mill along the Cooper River in August 2023.[33] The BAU and BAP modeling results demonstrate that existing policies, regulations, market trends, and efficiency improvements are not enough to realize Charleston County's ambitions to reach net-zero emissions by 2050. To eliminate as many GHG emissions as possible by 2050, comprehensive changes across all sectors are necessary.

This is reflected in the Low-Carbon Scenario where low-carbon measures are introduced with targets and timelines. When implemented together and in a specific order, Charleston County's total annual GHG emissions is projected to drop by 64% by 2035 and 82% by 2050, relative to the 2020 baseline. All sectors show a decrease in GHG emissions in the Low-Carbon Scenario from 2020 to 2050. Residential, commercial, and municipal buildings are almost entirely decarbonized by 2050. About 380 $ktCO_2e$ of annual GHG emissions still remain from industrial, transportation, agricultural, and waste sectors. These residual emissions could be addressed through additional measures such as carbon sequestration, new regulations, or deployment of new technologies.

---

[32] *Increased cooling demand is a reasonable outcome of a warming climate.*

[33] *Mcdermott, John. "News Stories of 2023: North Charleston Paper Mill Shuts Down." The Post and Courier. December 20th, 2023. Retrieved from: https://www.postandcourier.com/news-stories-2023/north-charleston-paper-mill-shuts-down/article_a52da22a-945e-11ee-864c-3333ee016955.html*

Carbon Offsets—A Last Resort

Offsets were originally designed to fund carbon reduction projects that were not yet independently financially feasible. Purchasing an offset effectively pays for someone else to achieve emissions reductions that the purchaser could not achieve themselves. Offsets have come under increasing scrutiny and were most recently criticized in a White Paper from the Penn Center for Science, Sustainability and the Media,which concluded that, "The voluntary carbon market undermines the objectives of the Paris Climate Agreement instead of supporting the required transformational change."[34]

While purchasing offsets is not recommended for Charleston County, it should be noted that for the present, offset purchases are still considered by the United Nations Framework Convention on Climate Change (UNFCCC) to be an acceptable element of climate action planning providing:

a. That all local emissions that can be eliminated are eliminated before purchasing offsets;

b. That offset investments prioritize emissions reduction projects where the nature and impact of the work is as transparent as possible;

c. That the offsets are audited to ensure that they meet best practice standards and only fund emissions reductions that would not otherwise have been made;

d. That all offsets are retired as soon as they are purchased; and

e. That they are replaced as soon as possible with local emissions reductions.

[34] *Romm, J. (2023) "Are carbon offsets unscalable, unjust, and unfixable—and a threat to the Paris Climate Agreement?". Penn Center for Science, Sustainability and the Media. https://bpb-us-w2.wpmucdn.com/web.sas.upenn.edu/dist/0/896/files/2023/06/OffsetPaper7.0-6-27-23-FINAL2.pdf. Accessed August 3, 2023.*

3.1.4 An Energy Transition

The evolution of Charleston County's energy system is illustrated in Figure 17. Total energy use is more than halved from 90,600 MMBtu in 2020 to 43,800 MMBtu in 2050. The system transitions from a predominantly fossil-fuel-powered system in 2020 to a localized, renewable-energy-powered system, primarily from solar and wind in 2050 with some green hydrogen for heavy-duty vehicles in the transportation sector. Ambient energy is energy from the environment that is used by heat pumps for cooling and heating.

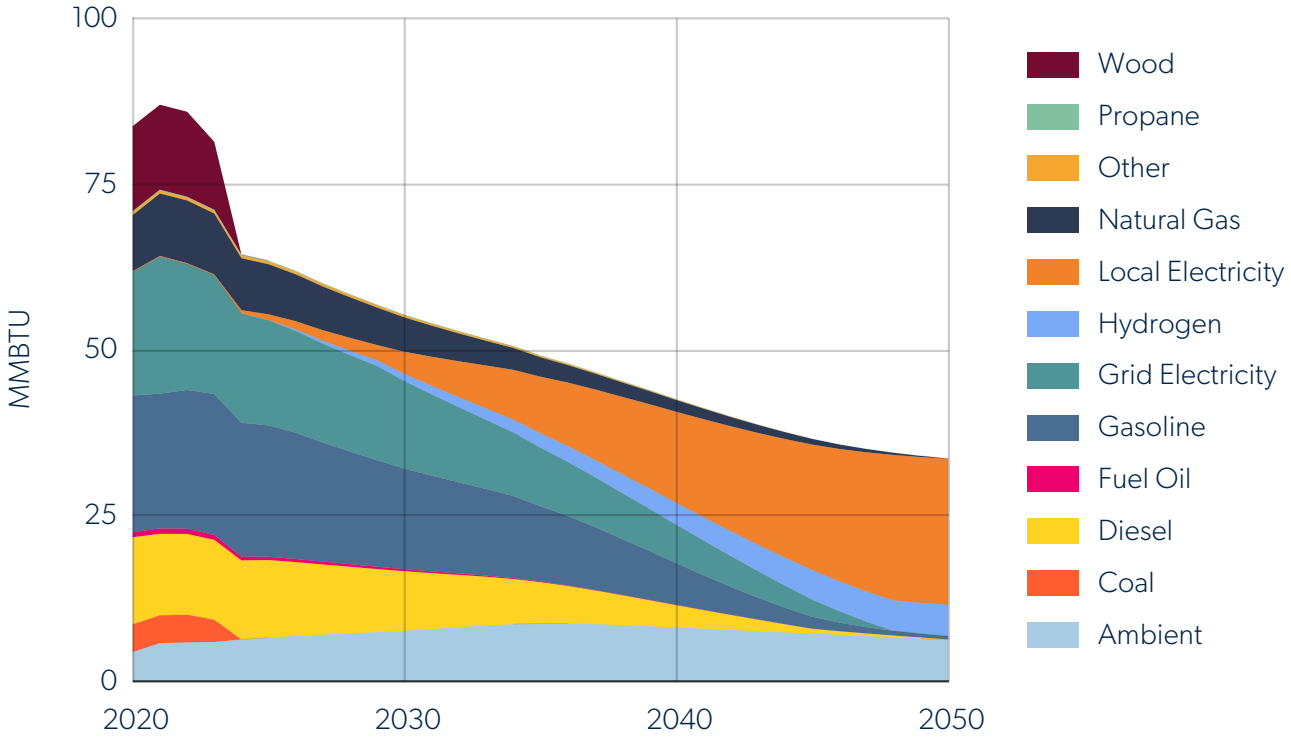


Figure 17. The evolution of Charleston County's energy mix in the Low-Carbon Scenario, by energy source, 2020–2050.

Sankey diagrams further describe the transition of the energy system in Charleston County. The Sankey diagrams track energy flows from source (on the left) to end use (middle section) to useful energy or conversion losses (on the right). The width of each section is proportional to the quantity represented.

The two snapshots, 2020 and 2050, reveal a transformed energy system as a result of the Low-Carbon Scenario. The overall energy system is more efficient, with conversion losses constituting 52% of the total energy in 2020; by 2050, this is estimated to be reduced to 20%. This reduction indicates that more energy is being used for its intended purposes, thus reducing the need for additional generation, which would reduce the overall cost of the energy system.

Efficiency Gains From EVs and Heat Pumps

Heat pumps deliver three or more units of heat for every unit of electricity they consume, a ratio known as the coefficient of performance (COP). In contrast, a natural gas furnace produces 0.9 units of heat for every unit of energy consumed and electric baseboards consume one unit of heat for each unit of energy consumed. In periods of extreme cold, the COP for gas furnaces may decline below this level, but the COP of cold weather air-source heat pumps continues to improve in cold temperatures.[35,36]

EVs are three times more efficient than gasoline vehicles when operated. An EV transfers about 59–62% of the electrical energy from the grid to turning the wheels, whereas gas combustion vehicles only convert about 17–21% of energy from burning fuel into moving the car.[37]

Gasoline, diesel and natural gas are prominent energy sources in 2020, whereas by 2050, the energy sources have shifted to solar; other, which is wind and green hydrogen; and ambient, which is heating or cooling in the environment that is used by heat pumps.

[35] *US Department of Energy (2022). DOE Announces Breakthrough in Residential Cold Climate Heat Pump Technology. Retrieved from: https://www.energy.gov/articles/doe-announces-breakthrough-residential-cold-climate-heat-pump-technology*

[36] *Glacier Media (2023). Heat pumps outperform gas even in coldest temperatures, finds Canadian researcher. Business Intelligence in BC. September 11, 2023. Retrieved from https://www.biv.com/news/economy-law-politics/heat-pumps-outperform-gas-even-coldest-temperatures-finds-canadian-researcher-8273254*

[37] *Department of Energy (n.d.). All-electric Vehicles. https://www.fueleconomy.gov/feg/evtech.shtml*

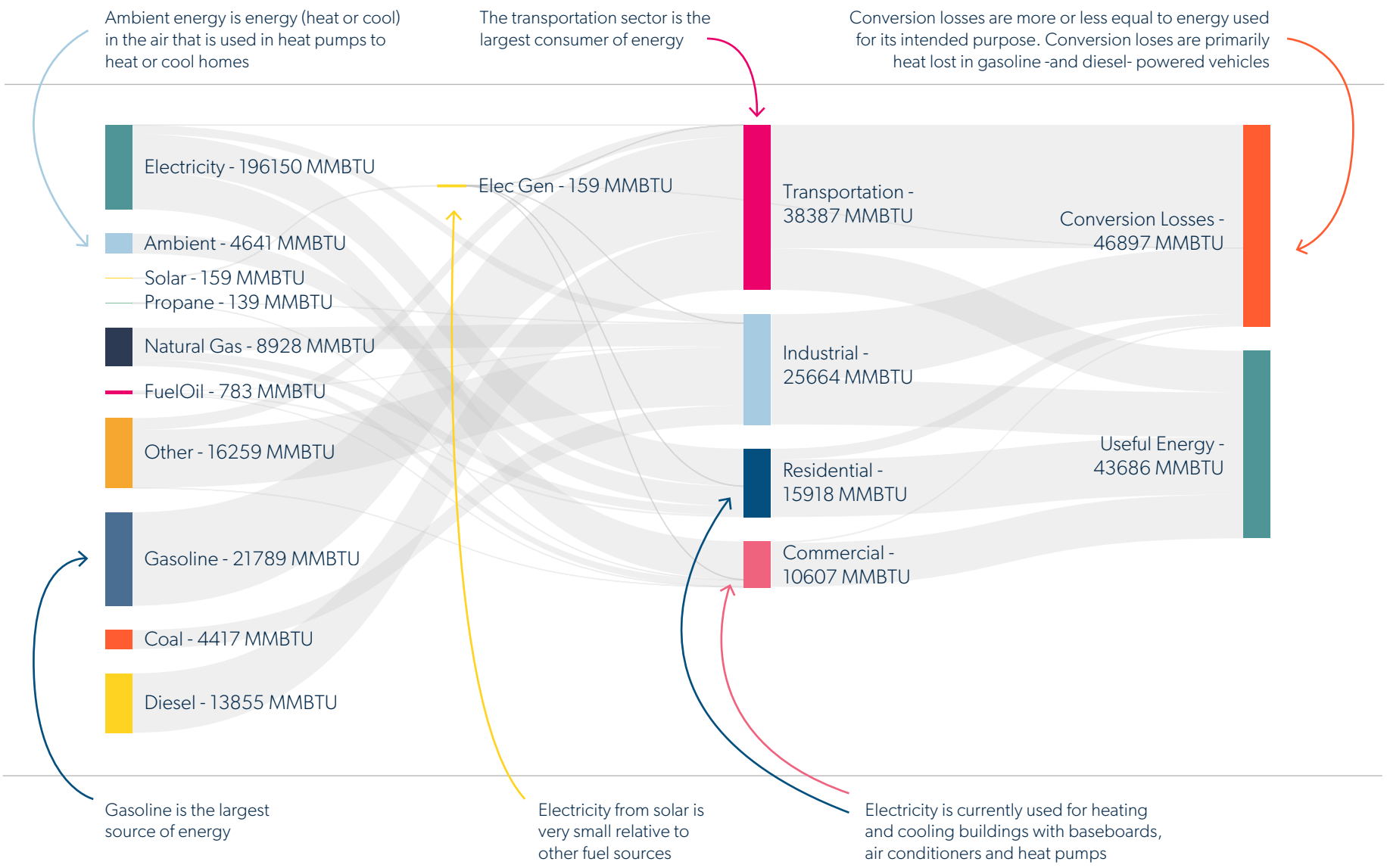


Figure 18. Sankey diagram for baseline year 2020.

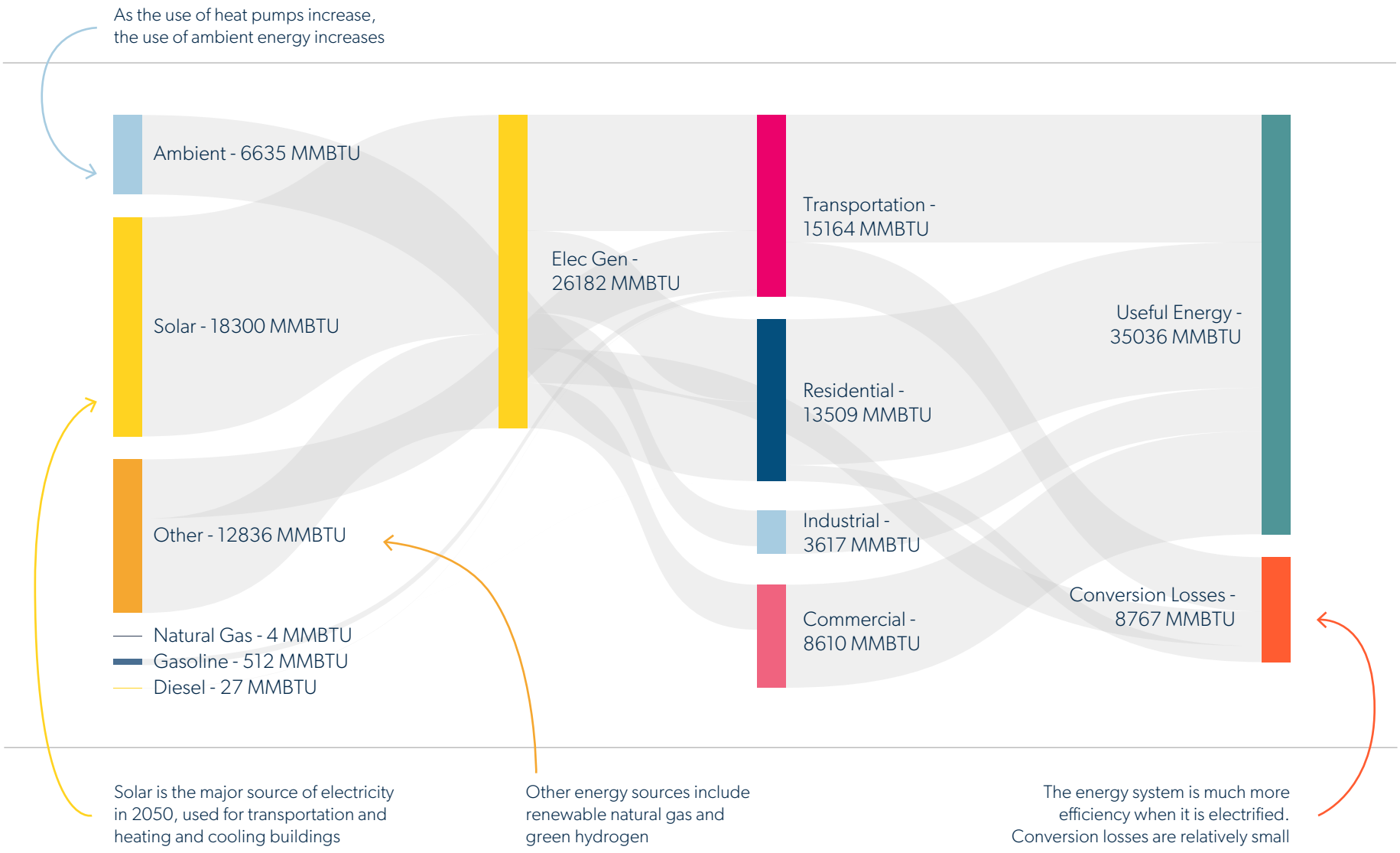
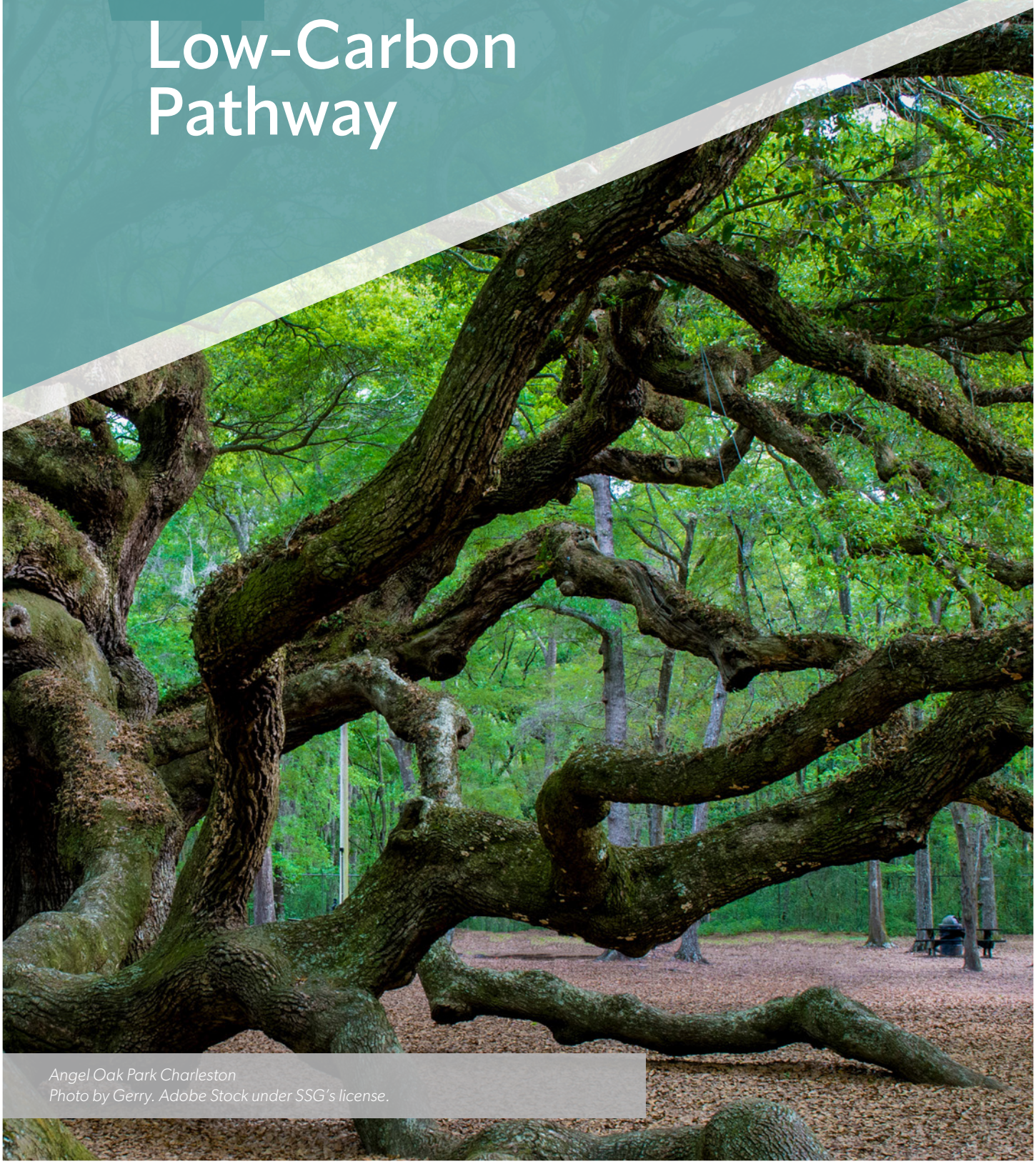


Figure 19. Sankey diagram for Low-Carbon Scenario in 2050.

4 Low-Carbon Pathway



Angel Oak Park Charleston
Photo by Gerry. Adobe Stock under SSG's license.

4 Low-Carbon Pathway

Meeting Charleston County's goal for net-zero emissions by 2050 demands deep reductions in GHG emissions across all sectors. Identified measures for Charleston County draw from best practices and existing and available technologies, or "safe bets." These measures have been ground truthed to Charleston County's context through a robust community engagement process.

Key Trends

Municipalities around the world are creating innovative policies and strategies to support or engage with these trends while advancing local priorities such as reducing air pollution, stimulating economic development and new employment opportunities, increasing the livability of the community, and improving affordability.

- Renewable energy is becoming increasingly accessible: It is becoming easier for households and businesses to generate their own energy. As the cost of solar systems declines, solar PV systems will become more accessible. New financing mechanisms are also reducing barriers by reducing the requirement for upfront capital costs.
- Energy storage technologies are changing the grid: Energy storage technologies such as batteries are already available for houses and businesses, and as the costs continue to decline, the number of installations will increase rapidly.
- New electric vehicle models are available every day: As the purchase price decreases and the range increases, there are compelling reasons why the number of electric vehicles on the road will increase exponentially.
- Heat pumps continue to improve in efficiency and are gaining traction for both cooling and heating.
- Microgrids are breaking down the barriers between heating and electricity: Microgrids include electricity generation from solar or combined heat and power, converting excess power to hot water, which is then used for heating with electric batteries and other technologies.
- New financing strategies are increasing participation: Municipalities and financial institutions are offering mechanisms that reduce financial barriers to energy retrofits and renewable technologies.

Many measures exhibit synergistic effects, amplifying one another's efficacy. For instance, densification facilitates more efficient and affordable transit and active transportation infrastructure, consequently reducing reliance on personal vehicles for short trips. These strategies yield benefits beyond emissions, such as improved air quality, reduced noise pollution, and enhanced health outcomes encompassing respiratory, mental, and physical well-being.

In essence, this pathway embodies a multifaceted approach, harnessing interconnected measures to mitigate emissions and fortify Charleston County's resilience against climate change.

4.1 The Big Moves

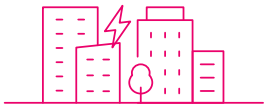
The key focus areas for Charleston County's CAP align with the following five "Big Moves" identified through technical modeling, thorough reviews of best practices and local context, and engagement activities:

Figure 20. The five "Big Moves" of the Charleston County's CAP.

Implementing the low-carbon pathway described in this CAP requires sustained efforts across all sectors of the community, including residents, businesses, all levels of government, institutions and organizations, and industry. The Big Moves provide a structure on how to organize the different actors and implementation actions.

Big Moves
of the Charleston County's CAP

Big Move 1: Affordable and resilient buildings



- Construct new buildings to net-zero standards
- Deep retrofit existing buildings

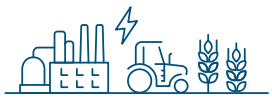
Big Move 2: Sustainable and inclusive transportation

- Create complete communities
- Expand transit and active infrastructures
- Switch to zero-or-low emission vehicles

Big Move 3: Clean energy for all

- Advocate for grid decarbonization
- Increase local, renewable energy generation capacity

Big Move 4: Innovative industrial and agricultural sectors



- Improve industrial sector processes
- Improve and electrify agricultural sector processes

Big Move 5: Circular economy

- Reduce waste generation
- Increase waste diversion from landfill

Figure 21. The five "Big Moves" of the Charleston County's CAP and the implementation actions of each one.

4.2 The Big Picture

If the Big Moves are implemented in full, GHG emissions in Charleston County are projected to follow the trajectory illustrated in Figure 22. The top line represents the BAP Scenario pathway, which models a future where no additional actions are taken. Each colored wedge or section represents the emissions reduction from each measure, which is interdependent on the other measures. Collectively, these measures enable the Low-Carbon Scenario pathway. The gray area represents the residual GHG emissions.

Following the growth of a colored wedge from left to right shows that initially, each measure eliminates only a small amount of emissions. However, the measures build on each other, and their impacts increase over time. Each measure is more impactful 15 years into the Plan than it was at the beginning. This demonstrates how important it is for Charleston County to begin these actions as soon possible and to avoid delays throughout the CAP. Furthermore, since many of the measures are integrated, if the magnitude is reduced or the timeline is delayed for any one measure, the impact of the other measures will also be reduced.

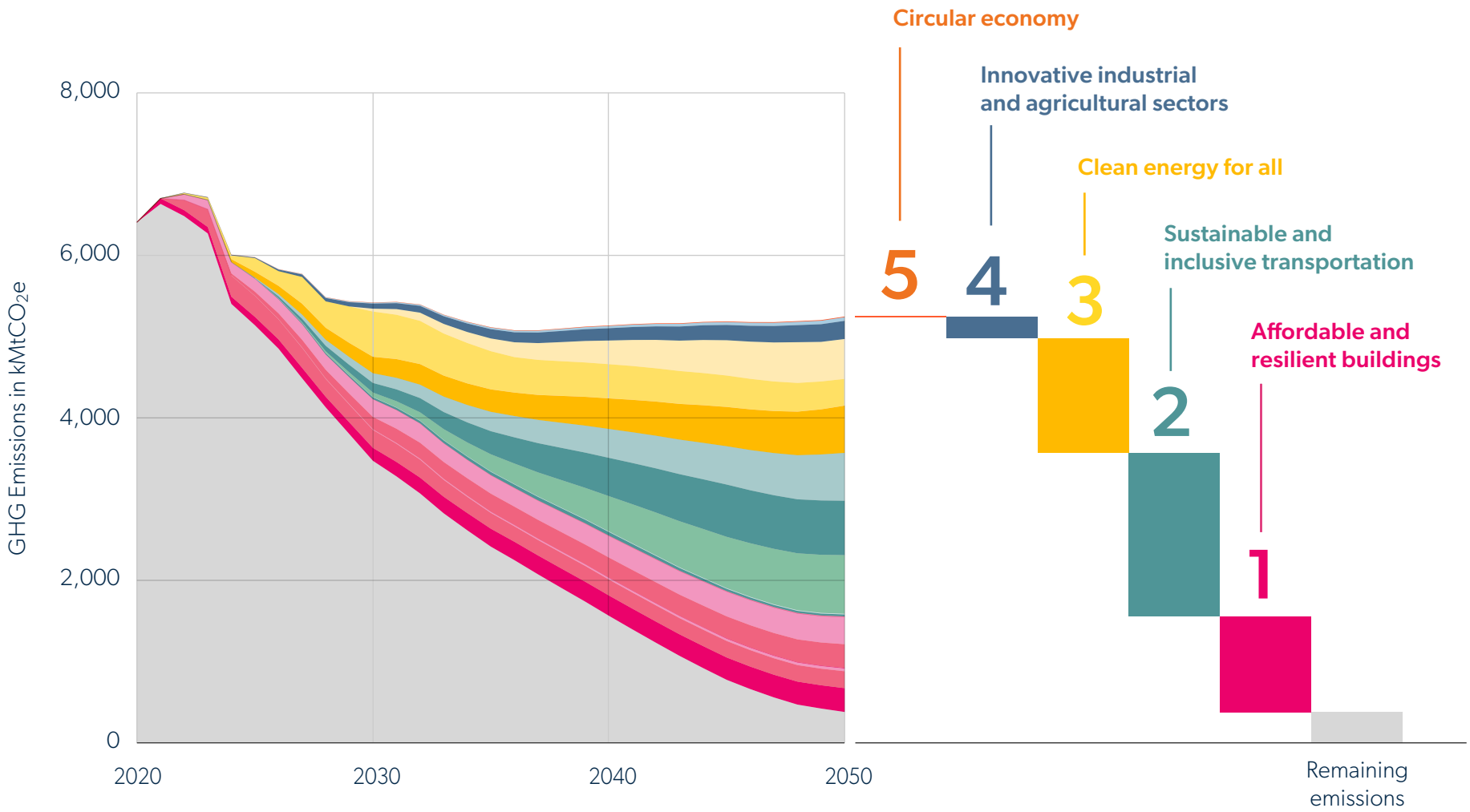


Figure 22. The emissions reduction impact of each Big Move in the Low Carbon scenario

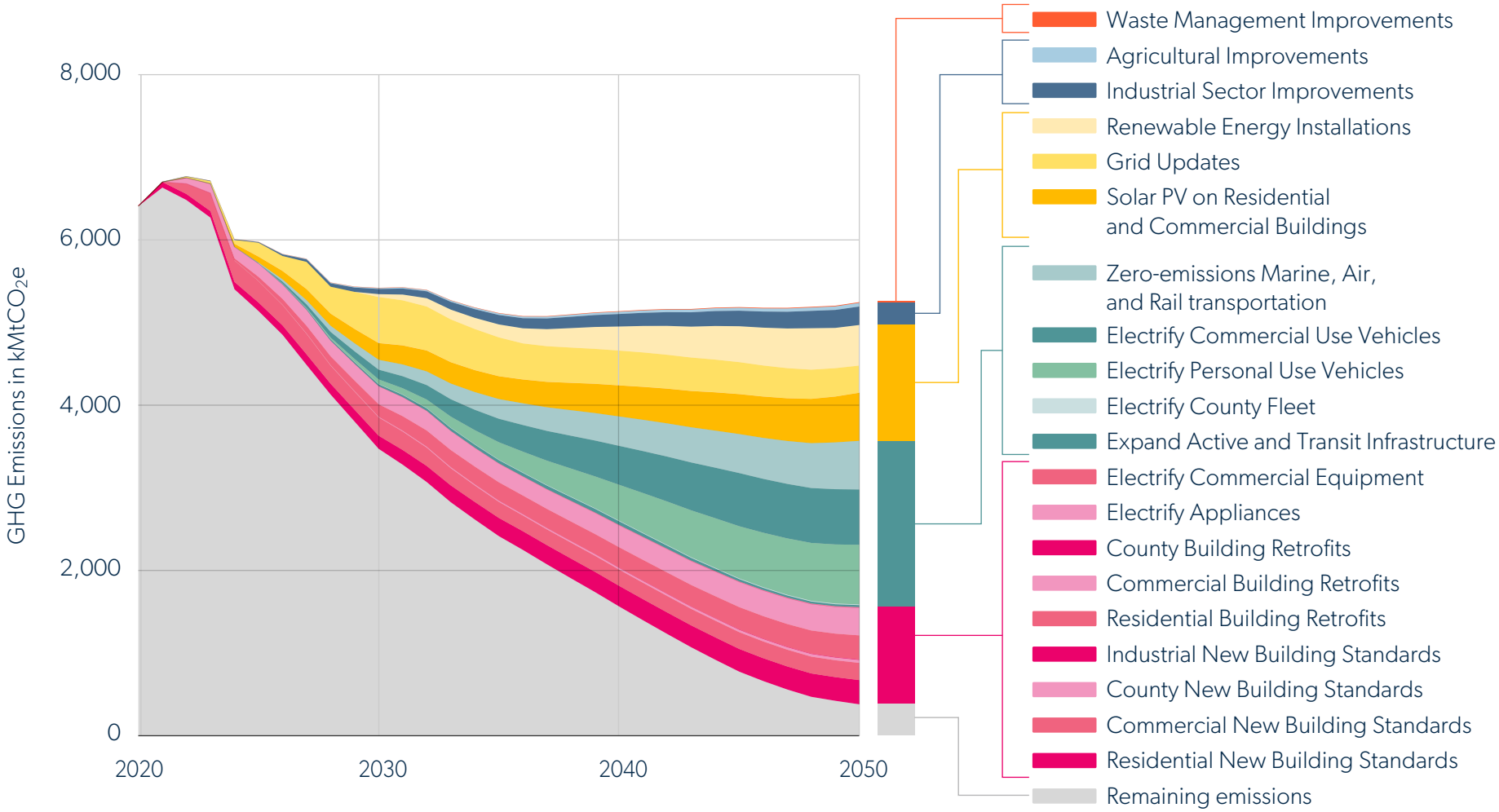
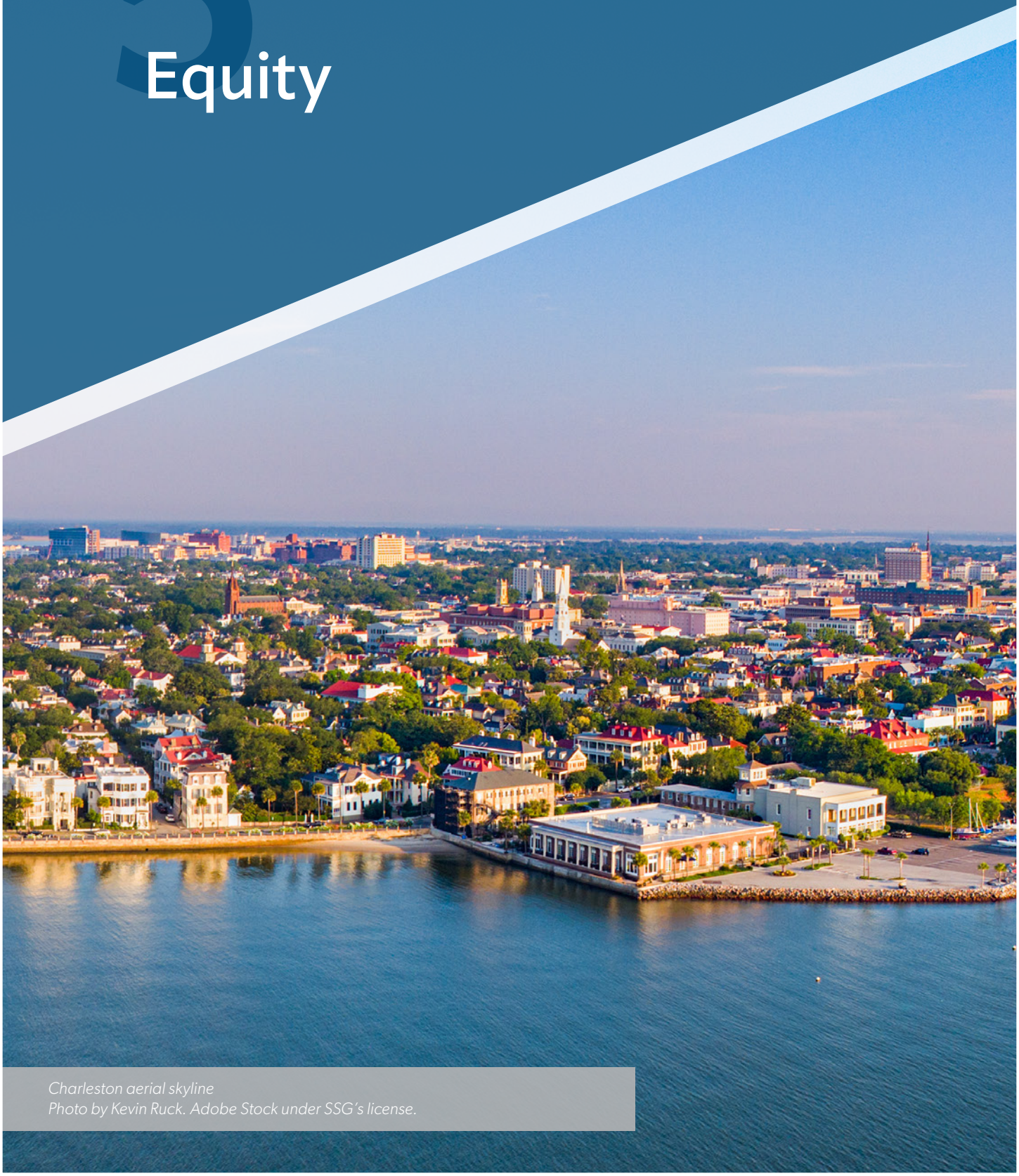


Figure 23. The emissions reduction impact of each measure in the Low-Carbon Scenario.

5 Equity



Charleston aerial skyline
Photo by Kevin Ruck. Adobe Stock under SSG's license.

5 Equity

Charleston County's CAP responds directly to social inequities by assessing the current context and relevant identifying actions and policies that reduce GHG emissions, increase resilience, and improve quality of life.

The United States Environmental Protection Agency's (EPA) Environmental Justice Screening and Mapping Tool (EJScreen Version 2.2) was used to identify disadvantaged communities in Charleston County.[38] The EJScreen contains specific environmental and demographic indicators (Table 4) that are designed to be a proxy for a community's health status and potential susceptibility to pollution. They do not capture all of the challenges that communities face.

Table 4. Summary of the EPA's EJScreen indicators.

Key Medium	Indicator	Details	Source	Data Year
Air	Particulate matter 2.5 (PM 2.5)	Annual average PM2.5 levels in air	EPA's Office of Air and Radiation, fusion of modeled and monitored data	2019
Air	Ozone	Average of the annual top 10 daily maximum eight-hour ozone concentrations in air	EPA's Office of Air and Radiation, fusion of modeled and monitored data	2019
Air	Diesel particulate matter	Diesel particulate matter level in air	*EPA Hazardous Air Pollutants*	2019
Air	Air toxics cancer risk	Lifetime cancer risk from inhalation of air toxics	*EPA Hazardous Air Pollutants*	2019
Air	Air toxics respiratory hazard index	Ratio of exposure concentration to health-based reference concentration	*EPA Hazardous Air Pollutants*	2019

[38] *EPA (2024). EJScreen: Environmental Justice Screening and Mapping Tool. Retrieved from: https://www.epa.gov/ejscreen*

Key Medium	Indicator	Details	Source	Data Year
Air	Toxic Releases to Air	Risk-Screening Environmental Indicators (RSEI) modeled toxicity-weighted concentrations in air of TRI listed chemicals	Calculated from 2021 RSEI Geographic Microdata results for the air pathway, retrieved 5/16/2023	2021
Air/other	Traffic proximity and volume	Count of vehicles (average annual daily traffic [AADT]) at major roads within 500 meters, divided by distance in meters (not km)	Calculated from 2020 U.S. Department of Transportation traffic data, retrieved 1/19/2023	2020
Dust/ lead paint	Lead paint	Percent of housing units built pre-1960, as indicator of potential lead paint exposure	*Calculated based on Census/ American Community Survey (ACS) data, retrieved 2023*	2017-2021
Waste/ air/ water	Superfund proximity	Count of proposed or listed National Priorities List (NPL)—also known as superfund—sites within 5 km (or nearest one beyond 5 km), each divided by distance in kilometers	*Calculated from EPA CERCLIS database, retrieved 11/23/2022*	2022
Waste/ air/ water	Risk management plan (RMP) facility proximity	Count of RMP (potential chemical accident management plan) facilities within 5 km (or nearest one beyond 5 km), each divided by distance in kilometers	Calculated from EPA RMP database, retrieved 10/22/2022	2022
Waste/ air/ water	Hazardous waste proximity	Count of hazardous waste facilities (treatment, storage, and disposal facilities [TSDF] and large quantity generators [LQGs]) within 5 km (or nearest beyond 5 km), each divided by distance in kilometers	*TSDF data calculated from EPA RCRAInfo database, retrieved 2/9/2023*	2022

Key Medium	Indicator	Details	Source	Data Year
Waste/ air/ water	Underground storage tanks (UST) and leaking UST (LUST)	Count of LUSTs (multiplied by a factor of 7.7) and the number of USTs within a 1,500-foot buffered block group	*Calculated from EPA UST Finder, retrieved 2/2/2023*	2022
Water	Wastewater discharge	RSEI modeled toxic concentrations at stream segments within 500 meters, divided by distance in kilometers	*Calculated from RSEI modeled toxic concentrations to stream reach segments, created 11/23/2022*	2020

The analysis of tracts in Charleston County indicated a high degree of overlap. A subset of tracts have higher exposure to environmental hazards, which is illustrated by their exposure to particulate matter, lead paint, tracts with a relatively low life expectancy, and higher rates of asthma.

Climate Equity

Climate change impacts are not felt equally by all members of society. People living in low-income households may have reduced ability to prepare for and evacuate during emergencies, relying heavily on emergency services where available, as they may lack the financial resources for preparedness measures and may lack access to vehicles and funding to evacuate.[39] Those living in low-income households are also more likely to be renters or homeowners who are "house poor," living in a home with an unaffordable mortgage. People living in these situations may have reduced abilities to protect their homes from climate emergency impacts and may have difficulty recovering from the financial hardships associated with emergency or disruptive events.

People over 65 are more at risk of negative impacts and death from flooding because of physical disabilities, reduced mobility, the need for access to medicine and medical equipment, and the style of housing that allows accessibility (single-floor buildings). Additionally, studies have found that older people are less likely to respond to evacuation or public safety orders and may have physical difficulties with preparing their homes to protect against damages from flooding. After a flood, many people experience trauma or struggle with the aftermath of damages. Older people, especially those who are socially isolated, may experience stress due to the disruption, the loss of property, or the challenges associated with insurance claims and repairs.

Vulnerability to heat echoes vulnerability to other climate hazards. People over 65 and those with lower incomes are more at risk of serious consequences or death during heat events because they are more physically vulnerable and/or have reduced access to space cooling. Climate change is increasing the frequency of heat waves that put people at risk, including high daytime temperatures and warm nights.

Prioritizing those most vulnerable to climate change impacts, including people with disabilities, people living in low-income households, people with reduced mobility, and those who are experiencing social isolation, is critical to developing an equitable climate plan.

A composite of multiple indicators illustrates which tracts have disproportionate exposures (they are in the 80th to 100th percentile range). These are the zones for which measures and policies should be targeted in the CAP in order to advance equity outcomes, and they are referred to as the LIDC neighborhoods.

[39] *Substance Abuse and Mental Health Services Administration (2017). Greater Impact: How Disasters Affect People of Low Socioeconomic Status. Disaster Technical Assistance Center Supplemental Research Bulletin.*

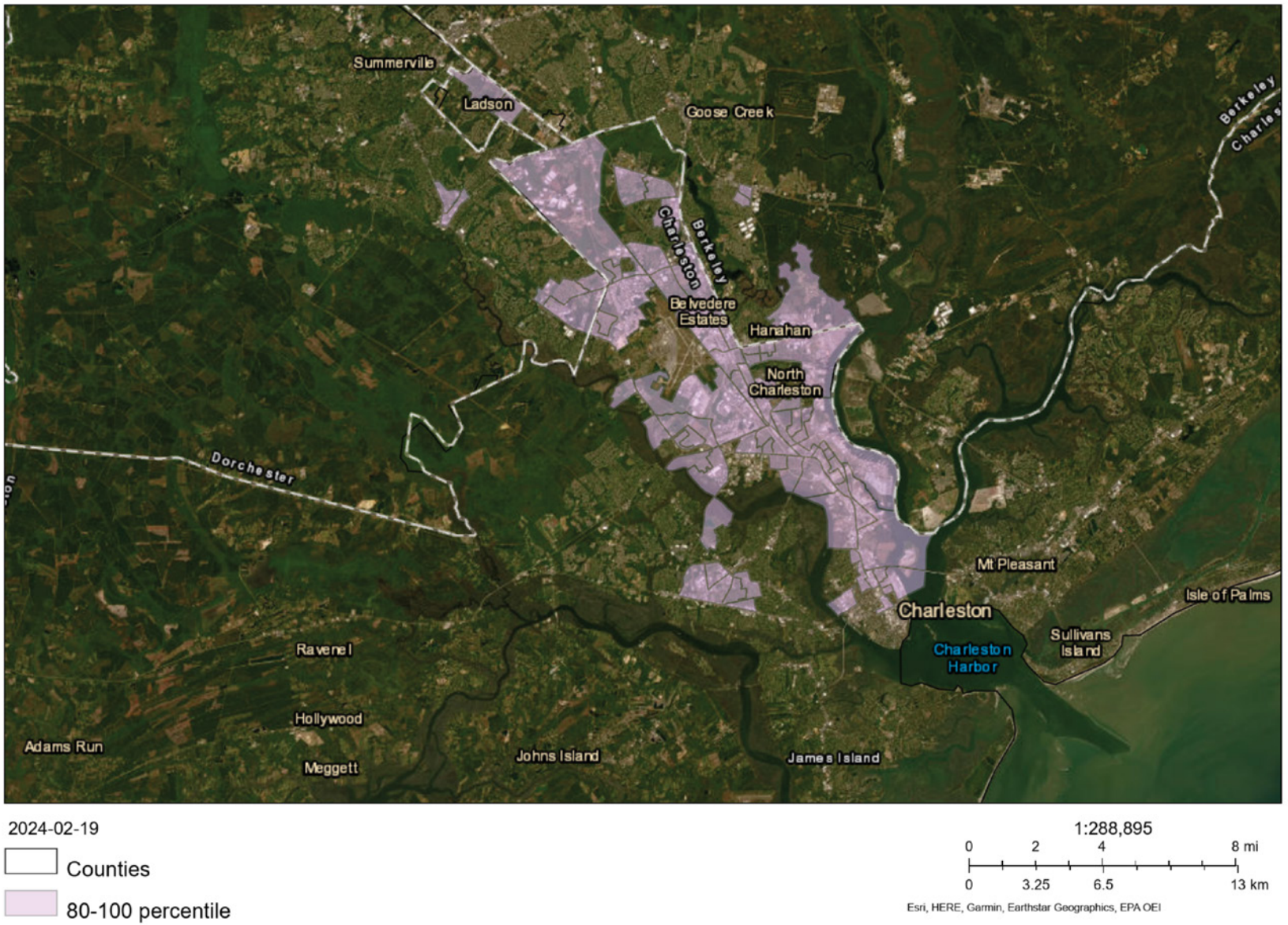


Figure 24. Tracts with high levels of exposure to six or more environmental indicators.

5.1 Reduced Energy Insecurity

Households facing energy insecurity face challenges such as "pay the rent or feed the kids," "heat or eat," or "cool or eat."[40] In particular, energy insecurity disempowers vulnerable residents, such as single parents, the elderly, the disabled, and others with low or fixed incomes,[41] resulting in stresses such as utility-related debt, shutoffs, inefficient heating systems, antiquated appliances, and extreme home temperatures with significant health impacts.[42] Children experience nutritional deficiencies, higher risks of burns from non-conventional heating sources, higher risks for cognitive and developmental behavior deficiencies, and increased incidences of carbon monoxide poisoning.[43] Subsequent impacts include parents being unable to work in order to look after children, missed school days, and lost productivity.

Energy Insecurity in the South[44]

- The South has the lowest electric rates in the contiguous United States, but the highest residential bills.
- Fifty-three percent of all residential buildings in the South were built before the nation's first energy codes—which require builders to meet minimum acceptable standards for comfort and efficiency— were developed.
- On average, low-income energy burdens are three times higher than energy burdens for higher-income households.
- One out of three people in the South struggles to pay their bills month to month.
- In the South, 7.5 million households (17% of all) are estimated to have received disconnection or stop service notices, and paying utility bills is one of the leading reasons people take out exploitative high-interest payday loans.
- In the South, 5 million households (11% of all) have had to leave their home at an unhealthy temperature because of the cost of energy.
- In the South, 3.9 million households (9% of all) are estimated to lack access to working cooling equipment, putting them at an elevated risk for heat-related illness.

---

[40] *Cook, J. T., Frank, D. A., Casey, P. H., Rose-Jacobs, R., Black, M. M., Chilton, M., ... Cutts, D. B. (2008). A brief indicator of household energy security: Associations with food security, child health, and child development in US infants and toddlers. PEDIATRICS, 122(4), e867–e875. https://doi.org/10.1542/peds.2008-0286*

[41] *Hernández, D. (2013). Energy insecurity: A framework for understanding energy, the built environment, and health among vulnerable populations in the context of climate change. American Journal of Public Health, 103(4), e32–e34. https://doi.org/10.2105/AJPH.2012.301179*

[42] *Hernández, D., & Bird, S. (2010). Energy burden and the need for integrated low-income housing and energy policy. Poverty & Public Policy, 2(4), 5–25. https://doi.org/10.2202/1944-2858.1095*

[43] *Ibid.*

[44] *Southeast Energy Efficiency Alliance (2023). Energy Insecurity in the South. Retrieved from: https://www.seealliance.org/initiatives/energy-insecurity/*

Energy retrofits and weatherization can result in improved thermal satisfaction, fewer reported financial difficulties, increased satisfaction among participants with the repair of their homes, fewer reported housing-related problems, and more social interactions.[45] In addition to the reduction in financial stress and fuel poverty, households can be less socially isolated, as residents may feel more comfortable inviting people to their homes.

Relevant Actions

- Net-Zero New Buildings
- Resilient Homes and Buildings
- Enhanced Accessibility
- Zero-Emissions Vehicles for All
- Clean Energy for All

5.2 Resilient Homes During Periods of Extreme Heat

Heat has major impacts on people in Charleston County.[46] Both seasonal and extreme heat events can impact the ability of people to function by causing minor issues such as heat edema (swelling), heat rash, and heat cramps and more severe issues such as heat syncope (fainting), heat exhaustion, and heat stroke. Relative death rates can begin to increase at temperatures starting at 68° Fahrenheit. These rates are also influenced by pre-existing conditions, social isolation, living conditions, and other factors.[47] Improved building envelopes can better regulate temperature and therefore protect inhabitants in periods of extreme weather, which the US Green Building Council has defined as passive survivability or thermal safety. Thermal safety is defined as maintaining thermally safe conditions during a power outage that lasts four days during peak summertime and wintertime conditions.

[45] *Poortinga, W., Rodgers, S. E., Lyons, R. A., Anderson, P., Tweed, C., Grey, C., … Winfield, T. G. (2018). The health impacts of energy performance investments in low-income areas: a mixed-methods approach. Public Health Research, 6(5), 1–182. https://doi.org/10.3310/phr06050*

[46] *Barnes, J. (2023). Charleston Extreme Heat Initiatives Overview. Retrieved from: https://www.nrcc.cornell.edu/workshops/webinars/2023/06/present_2.pdf*

[47] *Health Canada. (2012). Extreme heat events guidelines: Technical guide for health care workers. Ottawa.*

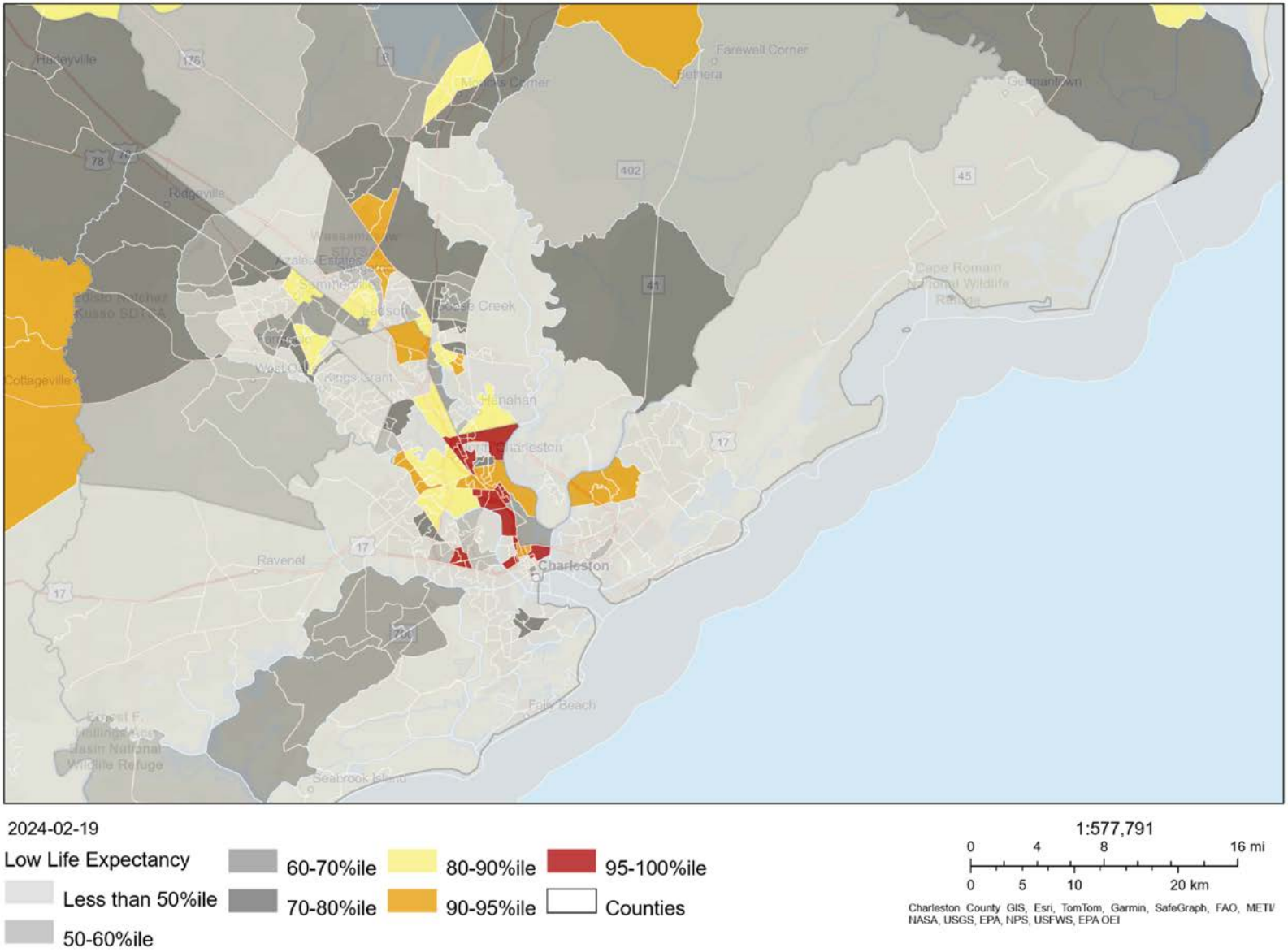


Figure 25. Tracts with a low life expectancy indicate areas of Charleston County vulnerable to risks such as extreme heat.

Relevant Actions

- Net-Zero New Buildings
- Resilient Homes and Buildings
- Clean Energy for All

5.3 Improved Indoor Environment

The indoor environment can provide thermally comfortable conditions, limit the concentration of airborne contaminants such as lead, protect inhabitants from precipitation, and provide amenities such as light, power, and food storage.

A building with improved indoor environmental quality can better manage chronic heat stress, dampness, mold, ozone exposures, and wildfire smoke exposure,[48] conditions which can increase as a result of climate change.

Improved thermal comfort can improve quality of life by mitigating financial difficulties, improving thermal satisfaction,[49] and improving health outcomes, particularly for the elderly, those with poor health, and the economically disadvantaged.[50]

If not carefully implemented, energy retrofits can result in tight buildings that can concentrate hazards such as volatile organic compounds (VOCs).

Relevant Actions

- Net-Zero New Buildings
- Resilient Homes and Buildings

[48] *Fisk, W. J. (2015). Review of some effects of climate change on indoor environmental quality and health and associated no-regrets mitigation measures. Building and Environment, 86, 70–80. https://doi.org/10.1016/j.buildenv.2014.12.024*

[49] *Poortinga, W., Rodgers, S. E., Lyons, R. A., Anderson, P., Tweed, C., Grey, C., … Winfield, T. G. (2018). The health impacts of energy performance investments in low-income areas: a mixed-methods approach. Public Health Research, 6(5), 1–182. https://doi.org/10.3310/phr06050*

[50] *Opp. cit.*

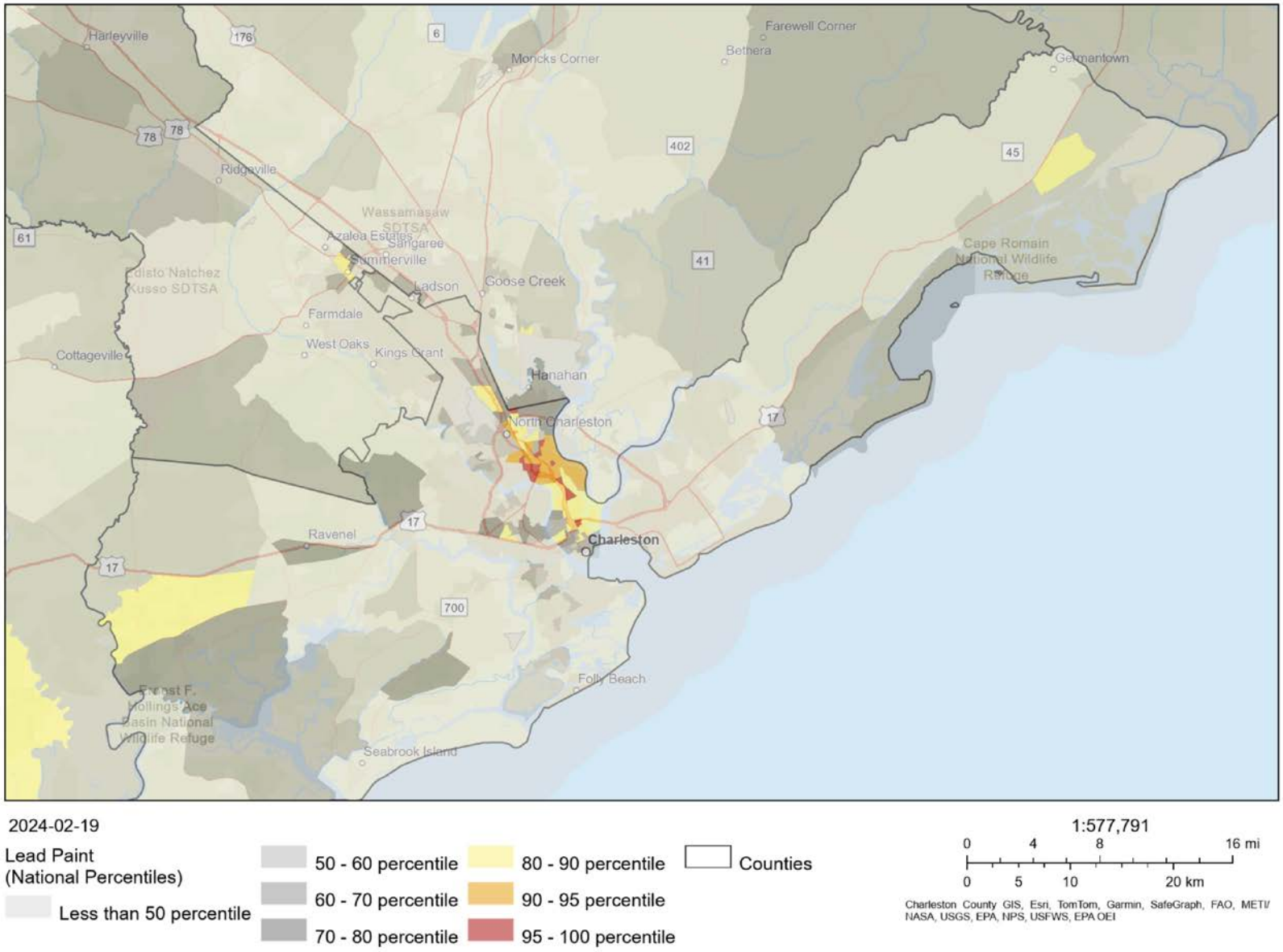


Figure 26. Tracts exposed to lead paint indicate areas with low-quality or older housing in Charleston County.

5.4 Reduced Energy Use Results in a More Resilient Grid

Energy retrofits decrease electricity demand in buildings, reducing strain on the electricity system as well as the risk of blackouts in periods of high demand.[51] During extreme weather events (heating or cooling), electricity demand peaks. Any failure in the transmission lines further strains other lines, which can cause a blackout. Electricity operators plan for higher electricity demand and unexpected periods of loss by maintaining reserve capacity, although periods where demand may exceed supply can still happen.

Many utilities opt to apply rolling blackouts during periods of high energy demand. During rolling blackouts, planned outages minimize overall grid strain to prevent a total electricity grid blackout, which can be detrimental to the electricity system, costly, and time consuming to repair. Heat waves are associated with rolling blackouts, as greater electricity demands from air conditioning puts demand pressure on the grid. High demand is costly because it requires greater generation and transmission infrastructure. From this perspective, the benefit of energy demand reductions can be quantified by using the value of avoided peak demand.

Relevant Actions

- Net-Zero New Buildings
- Resilient Homes and Buildings
- Enhanced Accessibility
- Clean Energy for All

5.5 Residents Are Safer During Extreme Weather or Power Outage

If large buildings have high energy performance coupled with on-site power generation, storage, or a back-up energy system, the building may be more sufficient in the event of an outage. This is especially important for critical infrastructure such as hospitals, water treatment facilities, etc.

[51] *Ibid.*

Relevant Actions

- Net-Zero New Buildings
- Resilient Homes and Buildings
- Clean Energy for All

5.6 Increased Affordable Mobility Options

Well-connected transit systems contribute to community safety and connectedness, which increases the resilience of communities. Greater access to active transit increases transportation options, which influences resilience because other modes can still be used in case one mode is disrupted.[52]

Access to safe bicycle networks is an important motivator for using bicycles. Bike lane disconnectivity discourages cycling because of safety concerns for cyclists.[53] In many instances, a lack of cycling infrastructure at a few key points in a commute, often near heavily used arterial roads, can discourage the use of biking.[54]

Access to active transit networks also provides affordability benefits because of its negligible costs, which can be particularly important for low-income households.

Relevant Actions

- Enhanced Accessibility
- Zero-Emissions Vehicles for All

[52] *IISD. (2017). Building a Climate-Resilient City: Transportation Infrastructure. Retrieved from: https://www.iisd.org/library/building-climate-resilient-city-transportation-infrastructure*
[53] *Waljasper, J. (2017). Bike breakthrough: Connecting neighborhoods through low stress routes. Resilience. Retrieved from: https://www.resilience.org/stories/2017-10-25/bike-breakthrough/.*
[54] *Ibid.*

5.7 Nature-Based Solutions

Green infrastructure for active transit can include bioswales, stormwater tree trenches, tree-lined sidewalks and paths, and permeable pavements and green space in close proximity to active transit networks.

Tree-lined active transportation networks can create a more stable microclimate, which can minimize heat risk from direct sunlight on users. The inclusion of constructed wetlands and permeable surfaces improves natural drainage and can reduce the occurrence and risk of flooding from rainfall and stormwater runoff.[55] By including green infrastructure in public areas across the whole county, the health benefits and the improvement in the liveability of the county can be applied across all socioeconomic groups.[56] Furthermore, the public is more likely to use active transportation networks when combined with green infrastructure, such as tree cover and green spaces.[57]

Relevant Actions

- Enhanced Accessibility
- Innovative Industrial and Agricultural Sectors

[55] *Vega, O. (2018). Application of Stormwater Tree Trenches in the City of Vancouver. Prepared for City of Vancouver. Retrieved from: https://sustain.ubc.ca/sites/sustain.ubc.ca/files/GCS/2018_GCS/Reports/2018-52%20Application%20of%20 Stormwater%20Tree%20Trenches%20in%20the%20City%20of%20Vancouver_Vega.pdf*

[56] *Hughey, S. M., K. M. Walsemann, S. Child, A. Powers, J. A. Reed and A. T. Kaczynski (2016). Using an environmental justice approach to examine the relationships between park availability and quality indicators, neighborhood disadvantage, and racial/ethnic composition. Landscape and Urban Planning. Vol. 148, pp. 159-169.*

[57] *Yngve, L., K. Beyer, K. Malecki, and L. Jackson. (2016). Street-scale green infrastructure and physical activity. Intl Society of Environmental Epidemiology (ISEE) Annual Meeting, Rome, ITALY, September 01 - 04, 2016.*

5.8 Improved Health Outcomes

Systematic reviews of health outcomes from increased physical activity show a reduced risk of cardiovascular disease, some cancers, depression, and dementia.[58] Active commuting, and commuting by bicycle in particular, has been shown to reduce overall mortality.[59] Initiatives that promote the use of active infrastructure can reduce the burden placed on health-care systems by chronic conditions and can reduce the risk of death.

By increasing the use of active transportation for short and medium trips, congestion is eased and air quality improves. Additionally, those who use separated bike infrastructure are less exposed to air pollutants, reducing the health risks of this exposure.[60] Policies that reduce the number of car trips and replace them with other transit options, particularly active transportation, can have important health benefits, including reduced mortality and risk of certain diseases.[61]

Relevant Actions

- Net-Zero New Buildings
- Resilient Homes and Buildings
- Enhanced Accessibility
- Zero-Emissions Vehicles for All
- Clean Energy for All

[58] *Woodcock, J., Edwards, P., Tonne, C., Armstrong, B. G., Ashiru, O., Banister, D., … Roberts, I. (2009). Public health benefits of strategies to reduce greenhouse-gas emissions: urban land transport. The Lancet, 374(9705), 1930–1943.*

[59] *Celis-Morales, C. A., Lyall, D. M., Welsh, P., Anderson, J., Steell, L., Guo, Y., … Gill, J. M. R. (2017). Association between active commuting and incident cardiovascular disease, cancer, and mortality: prospective cohort study. BMJ, 357, j1456.*

[60] *Cole, C. A., Carlsten, C., Koehle, M., & Brauer, M. (2018). Particulate matter exposure and health impacts of urban cyclists: a randomized crossover study. Environmental Health, 17(1), 78.*

[61] *Rojas-Rueda, D., de Nazelle, A., Teixidó, O., & Nieuwenhuijsen, M. (2013). Health impact assessment of increasing public transport and cycling use in Barcelona: A morbidity and burden of disease approach. Preventive Medicine, 57(5), 573–579.*

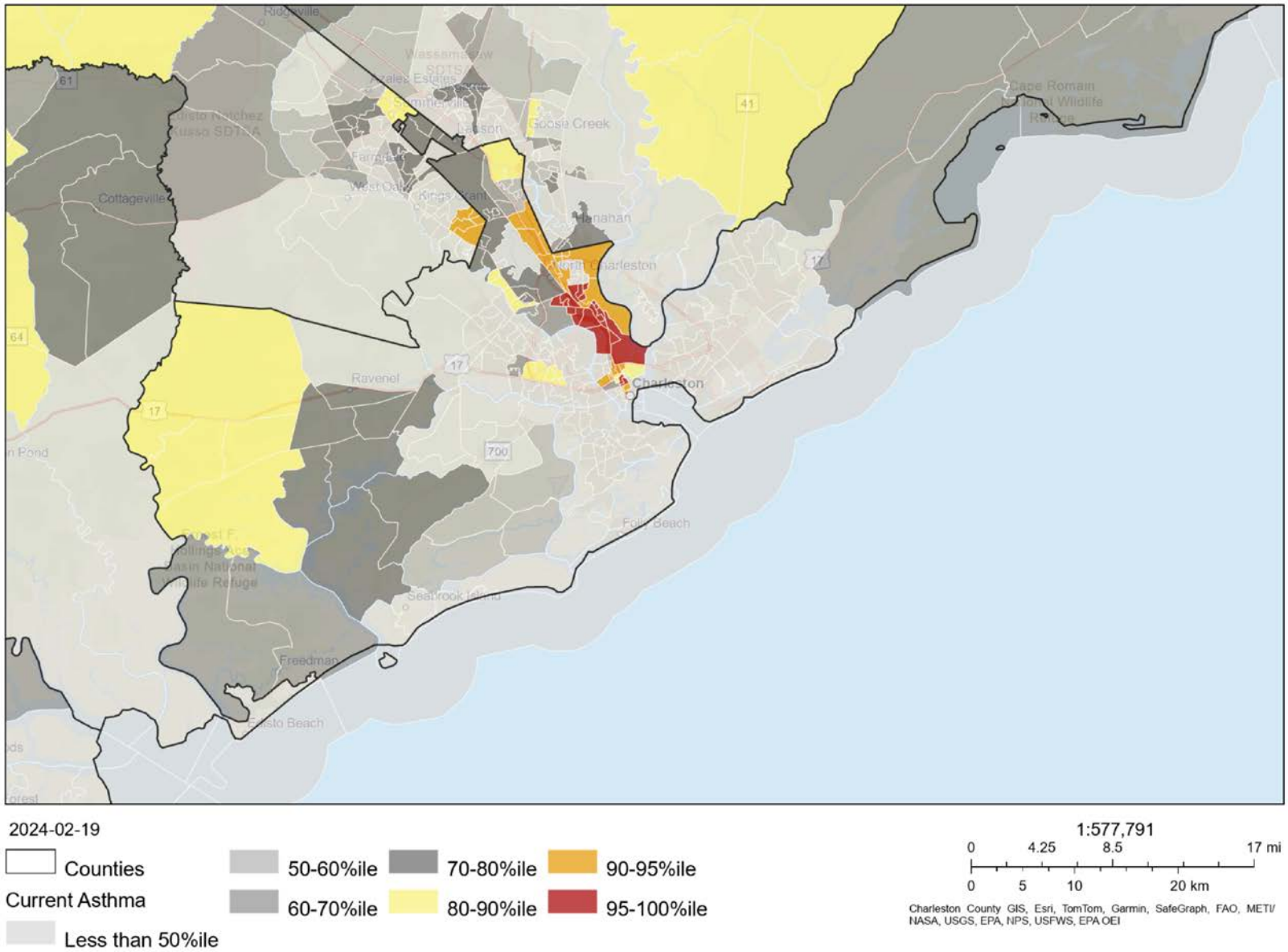


Figure 27. Tracts with high levels of asthma in Charleston County.

5.9 Improved Health From Reduced Air Pollution and Noise Makes People More Resilient to Other Climate Stressors

Air pollutants from vehicle emissions that are harmful to human health include ground-level ozone, particulate matter, carbon monoxide, sulfur dioxide, and nitrogen dioxide. Illnesses and diseases associated with exposure to vehicle-related air pollution include respiratory illnesses, cardiovascular disease, certain cancers, etc. Air pollution from vehicles disproportionately impacts the elderly, children, and persons with existing health conditions.[62]

Replacing gas- and diesel-powered vehicles with electric vehicles reduces air pollution associated with vehicle exhaust. Under EPA emissions standards, light-duty vehicles can emit approximately 2.33g/km estimated over a five-year period from 2016 to 2020.[63] In contrast, electric vehicles have no tailpipe emissions.

Air pollution and extreme heat events are interrelated—reducing air pollution and improving health can increase resilience in response to extreme heat events.[64]

Relevant Actions

- Net-Zero New Buildings
- Resilient Homes and Buildings
- Enhanced Accessibility
- Zero-Emissions Vehicles for All
- Clean Energy for All

[62] *Ibid.*

[63] *California Air Resource Board. (2018). Emission Factor Tables. In Methods to Find the Cost-Effectiveness of Funding Air Quality Projects. Retrieved from: https://www.arb.ca.gov/planning/tsaq/eval/evaltables.pdf*

[64] *De Sario, M., Katsouyanni, K., Michelozzi, P. (2013). Climate change, extreme weather events, air pollution and respiratory health in Europe. European Respiratory Journal, 42, 826-843.*

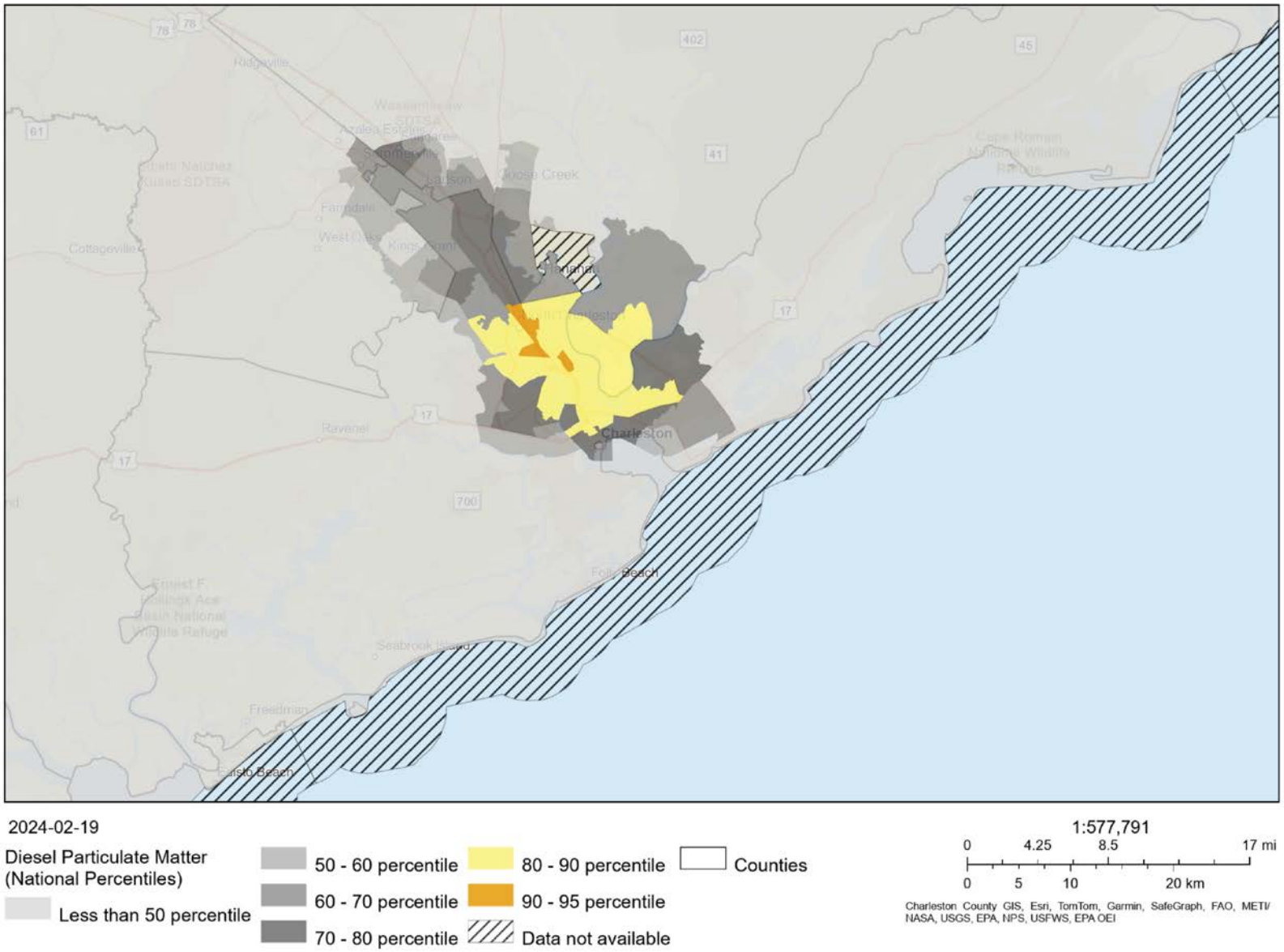


Figure 28. Tracts exposed to particulate matter from diesel combustion, an indication of exposure to pollution from vehicular traffic.

6 The Economic Opportunity

Green lowcountry marsh grasses in Charleston
Photo by lazyllama. Adobe Stock under SSG's license.

6 The Economic Opportunity

6.1 Financial Concepts

Key concepts that are used to analyze the financial impacts of the pathways are summarized below.[65]

Table 5. Useful financial term definitions and concepts.

Concept	Explanation
Costs are relative to the BAP Scenario	This financial analysis tracks projected costs and savings associated with low-carbon measures above and beyond the costs in the BAP Scenario.
Discount rate	The discount rate is the baseline growth value an investor places on their investment dollar. A project is considered financially beneficial by an investor if it generates a real rate of return equal to or greater than their discount rate. An investor's discount rate varies with the type of project, duration of the investment, risk, and the scarcity of capital. This CAP applies a 3% discount rate for investments in a low-carbon future, which is aligned with a social discounting rate.
Net present value	The net present value (NPV) of an investment is the difference between the present value of the capital investment and the present value of the future stream of savings and revenue generated by the investment. Four aggregate categories are used to track the financial performance of the low-carbon measures in this analysis: capital expenditures, energy savings (or costs), operations and maintenance savings, and revenue generation (associated with renewable energy production facilities and some transit actions). Administrative costs associated with implementing programs, as well as any energy system infrastructure upgrades that may be required, are excluded. Similarly, the broader social costs that are avoided from mitigating climate change, such as avoided health costs or avoided damages from climate change, are not included in this financial analysis.
Abatement cost	The abatement cost of an action is the estimated cost for that action to reduce one metric ton of GHG emissions, calculated by dividing the action's NPV by the total GHG emissions reductions (tCO_2e) resulting from the action. For example, if a project has an NPV of $1,000 and generates 10 tCO_2e of savings, its abatement cost is $100 per tCO_2e reduced.

[65] *Detailed financial assumptions are described in the Data, Methods, and Assumptions Manual.*

Concept	Explanation
Amortization	The costs of major capital investments are typically spread over a period of time (e.g., a mortgage on a house commonly has a 25-year mortgage period). Amortization refers to the process of paying off capital expenditures (debt) through regular principal and interest payments over time. In this analysis, we have applied a 25-year amortization rate to all investments.[66]

6.2 Economic Benefits

Historically, the prevailing narrative has been that climate action costs money and requires sacrifices. An economic analysis of the costs and benefits of climate action in Charleston County finds that the opposite is true. There are compelling economic reasons to implement a net-zero pathway as soon as possible with little financial downside.

Table 6. Summary of financial results, undiscounted, 2024–2050.
A negative number represents dollars saved (returns are greater than cost), while a positive number represents cost (costs are greater than returns).

Financial Estimate	Low-Carbon Scenario (undiscounted)	Low-Carbon Scenario (3% discount rate)
Total incremental capital investment, 2024–2050	$14,300 million	$9,850 million
Savings from investments made between 2024 and 2050	-$31,800 million	-$15,800 million
Total revenue made between 2024 and 2050	-$804 million	- $480 million
Net benefit, 2024–2050	**-$18,300 million**	**-$6,400 million**
Capital cost to reduce each metric ton of GHG	$144	$100
Annual household savings on energy, 2050 over 2020	-$3,490	
Investment $/person-year of employment	$162,000	

[66] *To manage the complexity of the analysis, a blanket amortization of 25 years was applied across all actions in order to demonstrate the impact of financing the actions.*

Implementing Charleston County's CAP requires a community-wide investment totaling $9.9 billion from 2024 and 2050, averaging $380 million annually (at 3% discount rate). To put this into perspective, the CAP investments represent less than 1% of Charleston County's annual GDP of $34.5 billion per year.[67]

These investments generate savings from avoided energy costs and reduced operations and maintenance costs, as well as revenue from local energy production and transit expansion. These benefits apply to the community as a whole, including households, businesses, and the County.

With selected IRA investments included, the net present value of the benefit to Charleston County is $7.4 billion, with the prospective IRA investment totalling $1 billion over a 10-year period (discounted at 3%).

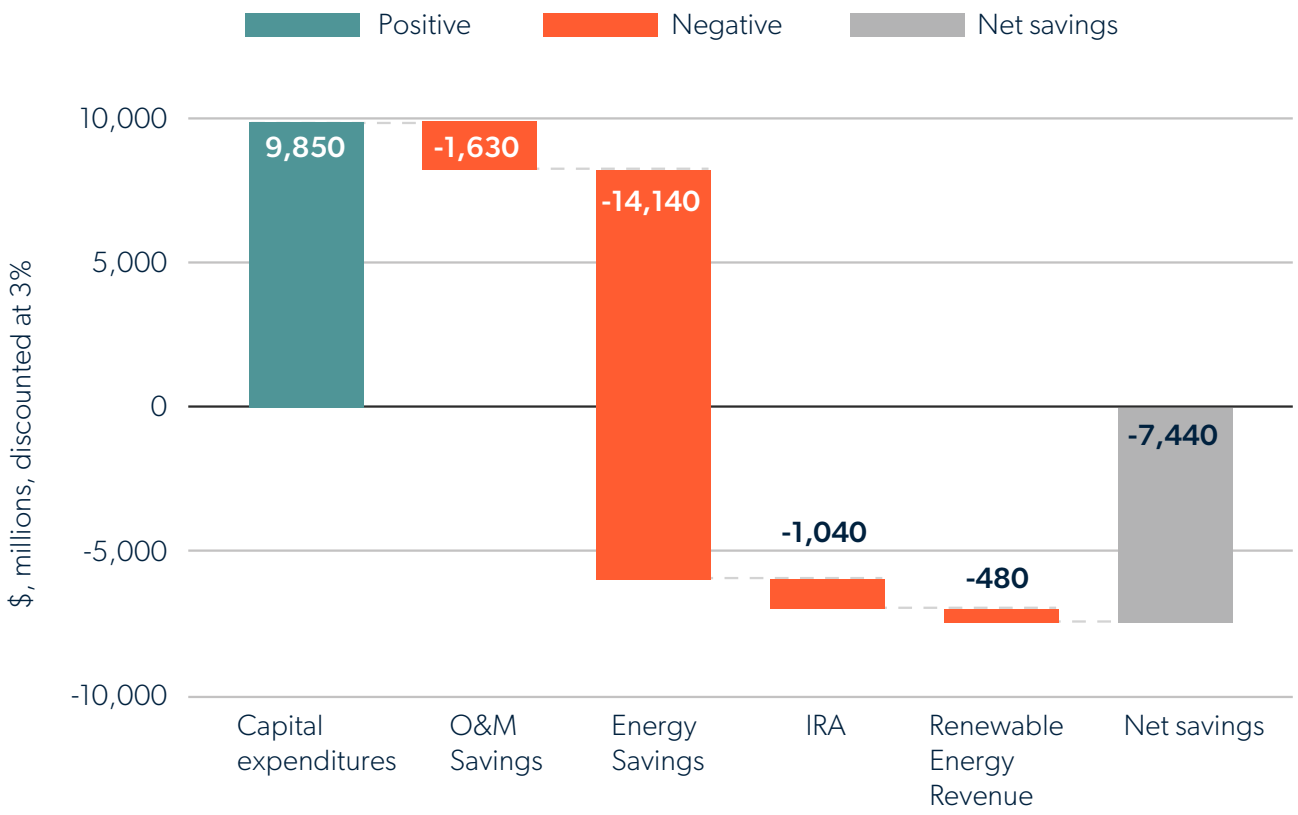


Figure 29. Present value of investments and returns, discounted at 3% for the Low-Carbon Scenario (costs are positive and revenue and savings are negative) in million $, 2024–2050.

[67] *Charleston County Economic Development. Retrieved from: https://www.charlestonCountydevelopment.org/data-center/economic-data/*

The Inflation Reduction Act

The Inflation Reduction Act (IRA) is the most extensive and ambitious piece of climate legislation in US history and is designed to transform the US economy. The IRA reinforces many aspects of Charleston County' CAP, by providing opportunities for the County to raise funds and by providing grants and incentives to individuals and businesses to support low-carbon investments.

Municipalities can apply directly to federal agencies for funding for a range of programs, including:[68]

- **A Greenhouse Gas Reduction Fund**, which will provide grants, loans, and financial and technical assistance "to enable low-income and disadvantaged communities to deploy or benefit from zero-emission technologies," including rooftop solar and other GHG reduction activities, and provide direct and indirect investment in projects, activities, or technologies;
- **Climate Pollution Reduction Grants** which provide grants to implement GHG pollution reductions;
- **Clean Heavy-Duty Vehicles**, which funds a program to cover incremental costs associated with replacing non-zero-emissions heavy-duty vehicles with zero-emissions heavy-duty vehicles, fueling and charging infrastructure, and facilitating workforce development and technical activities.
- **A Low-Emissions Electricity Program**, which will provide funding for technical assistance for domestic electricity generation and use;
- **The Reconnecting Communities and Neighborhoods Grant Program**, which will provide funding for reconnecting communities that were previously cut-off from economic opportunities by transportation infrastructure through planning grants, capital construction grants and technical assistance, to restore community connectivity through the removal, retrofit, mitigation, or replacement of eligible transportation infrastructure facilities;
- **The Environmental and Climate Justice Block Grants**, which will providing funding for community-led air and other pollution monitoring, prevention, and remediation, and investments in low- and zero-emission and resilient technologies; mitigation of urban heat islands, extreme heat, wood heater emissions, and wildfires; reducing indoor air pollution; climate resilience and adaptation; and facilitating engagement of disadvantaged communities; and
- **The State and Private Forestry Conservation Programs**, which will support tree planting activities.

[68] *Sabin Center for Climate Change Law (2022). Cities & the Inflation Reduction Act. https://blogs.law.columbia.edu/climatechange/2022/08/22/cities-the-inflation-reduction-act*

The IRA also includes the following tax credits and grants that go directly to consumers for vehicle and building electrification and distributed energy generation:

- Rebates covering 50-100% of the cost of installing new electric appliances, including super-efficient heat pumps, water heaters, clothes dryers, stoves, and ovens.
- Rebates for households to make repairs and improvements in single-family and multi-family homes to increase energy efficiency.
- Tax credits covering 30% of the costs to install solar panels and battery storage systems, make home improvements that reduce energy leakage, or upgrade heating and cooling equipment. No income limits apply.
- Tax credits covering 30% of the costs of community solar projects—owned by local businesses that sign up families to save on their electric bills—with additional bonus credits of 20% for projects at affordable housing properties and 10% for projects in low-income communities.
- Upfront discounts up to $7,500 for new EVs and $4,000 for used EVs, helping middle-class Americans skip the gas pump and save on fuel costs.

6.3 Investment Unlocks Opportunities

Figure 30 illustrates the level of investment that would be required by residents, businesses, and government to decarbonize Charleston County. Similar to other low-carbon transitions, costs are higher in the earlier years to rapidly implement the infrastructure and systems necessary to achieve GHG emissions reductions. However, financing the majority of these investments can be amortized to spread out the cost over time. By the year 2034, savings outweigh the costs, excluding the IRA investments.

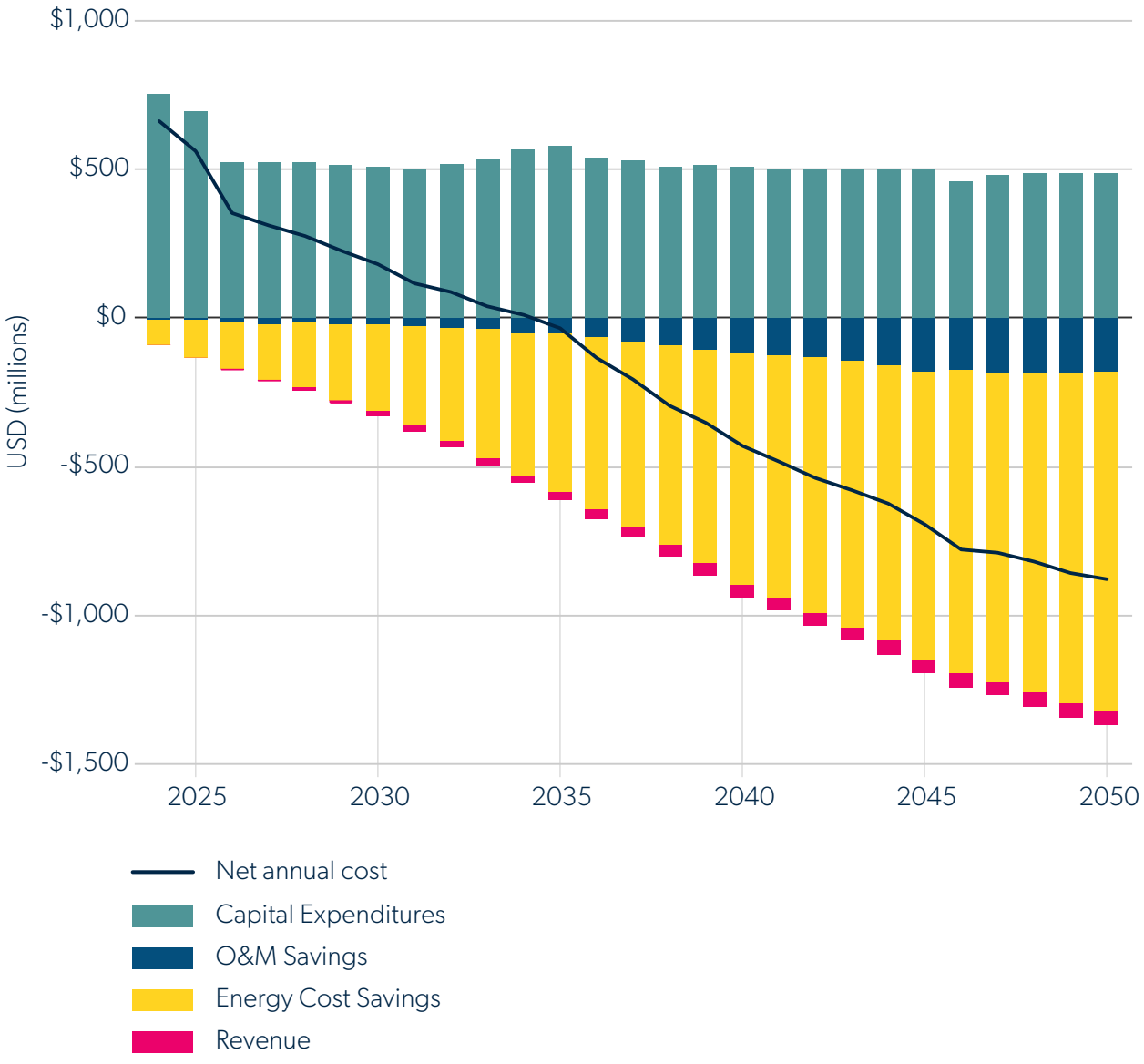


Figure 30. Year-on-year investments and returns, undiscounted, 2024–2050.

The majority of investments are for residential and commercial building retrofits, which provide long-term energy savings but entail high upfront costs. The incremental investment in transportation is negligible because the costs of light-duty electric vehicles are projected to reach parity with gas- and diesel-powered vehicles as early as 2026.[69] The reduced operational costs represent a major opportunity for cost savings going forward.

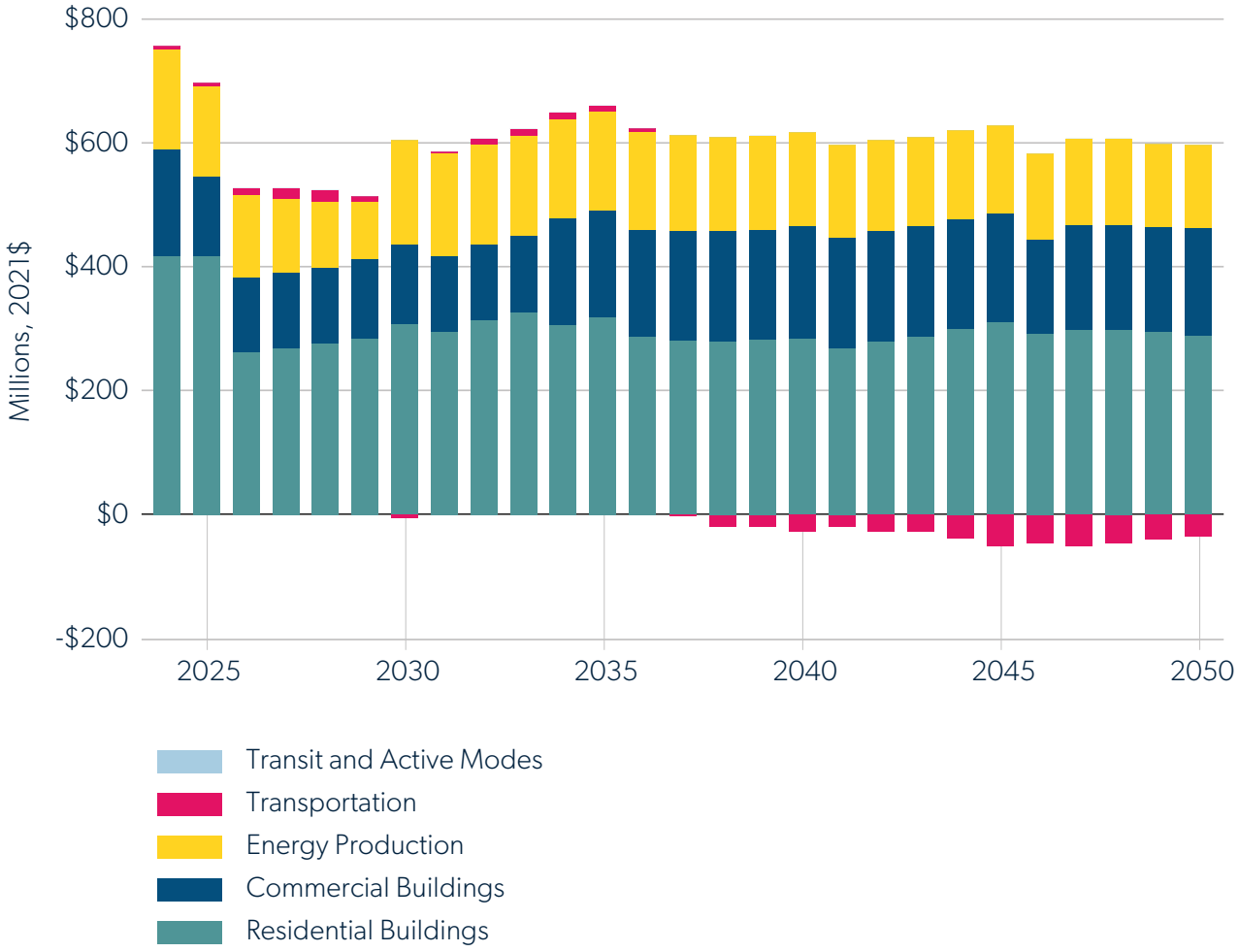


Figure 31. Incremental capital expenditures by sector, 2024–2050.

[69] *Slowik, Peter et.al. (2022). Assessment of light-duty vehicle costs and consumer benefits in the United States in the 2022–2035 time frame. The International Council on Clean Transportation. White Paper. October 18, 2022. Retrieved from https://theicct.org/publication/ev-cost-benefits-2035-oct22/*

6.4 Energy Savings for Households

Household energy expenditures (Figure 32)—natural gas, electricity, gasoline, and diesel—are projected to decline by 25% in the BAP from $5,140 in 2020 to $3,850 by 2050. These savings result from more efficient vehicles due to national fuel efficiency standards and decreased heating requirements as the climate becomes milder due to climate change. In the LC Scenario, the savings are much greater, and household energy expenditures fall by 68% to $1,640 by 2050. Depending on the business, policy, and financing strategies used in the implementation of the actions, these savings will be partly offset by the incremental capital expenditures required. Investments in building energy retrofits, faster vehicle electrification, increased transit and active trips, high-performance buildings, and renewable energy generation all contribute to significantly reducing average household energy expenditures.

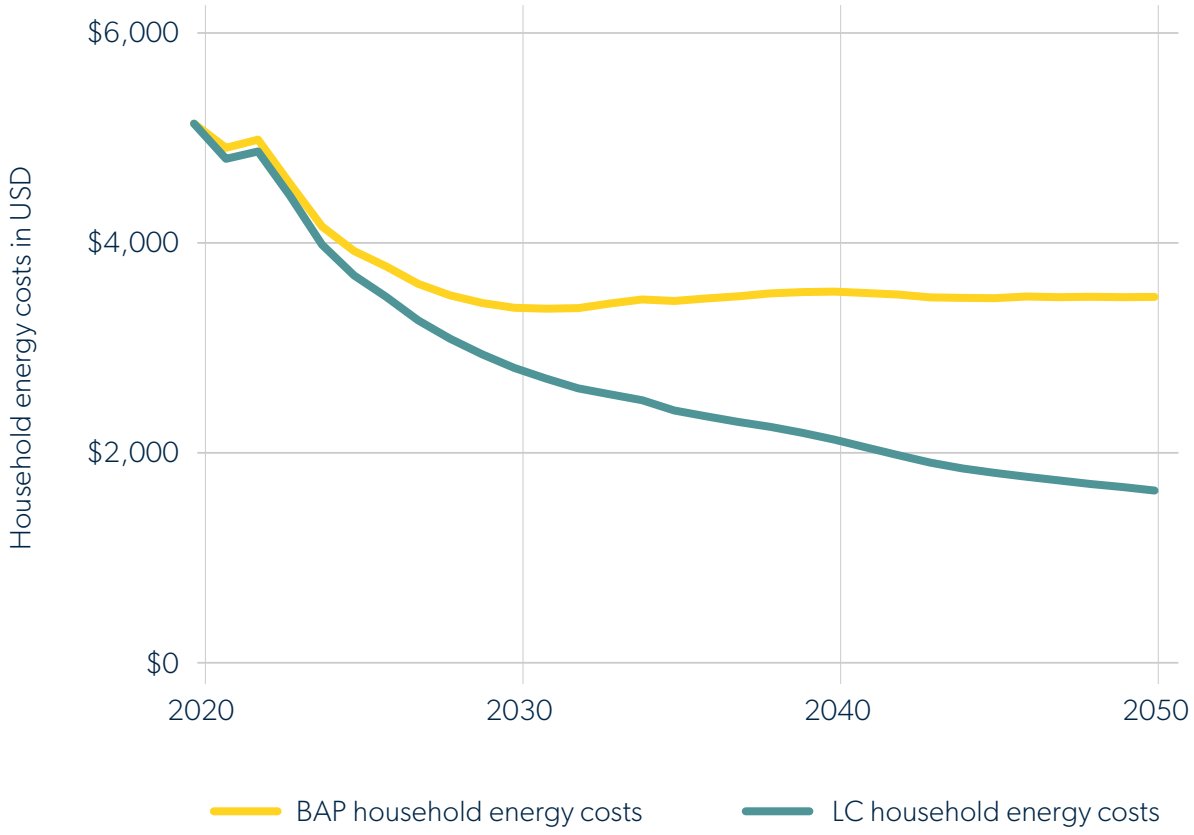


Figure 32. Household annual energy expenditures by scenario, 2024–2050.

6.5 Employment Opportunities

Transitioning to a zero-carbon economy is expected to have four types of impacts on the job market: additional jobs will be created in emerging sectors, some employment will be shifted (for example, from the fossil fuels industry to clean technology), certain jobs will be reduced or eliminated (for example, mechanics for gasoline or diesel cars), and many existing jobs will be transformed or redefined. For Charleston County, implementing the CAP is expected to add 87,900 person-years of employment between 2024 and 2050.

Building retrofits present the largest opportunity for new employment, including opportunities to partner with local education centers. This could include developing programs that teach the skills required to complete deep energy retrofits and install high-efficiency equipment. Developing partnerships to expand on local knowledge will help jumpstart this activity. In addition to building retrofits, improvements can simultaneously be made to accessibility features of public buildings, commercial buildings, and common areas.

The transportation maintenance sector shows small losses in total person-years of employment, since electric vehicles require less maintenance than gas- and diesel-powered vehicles.

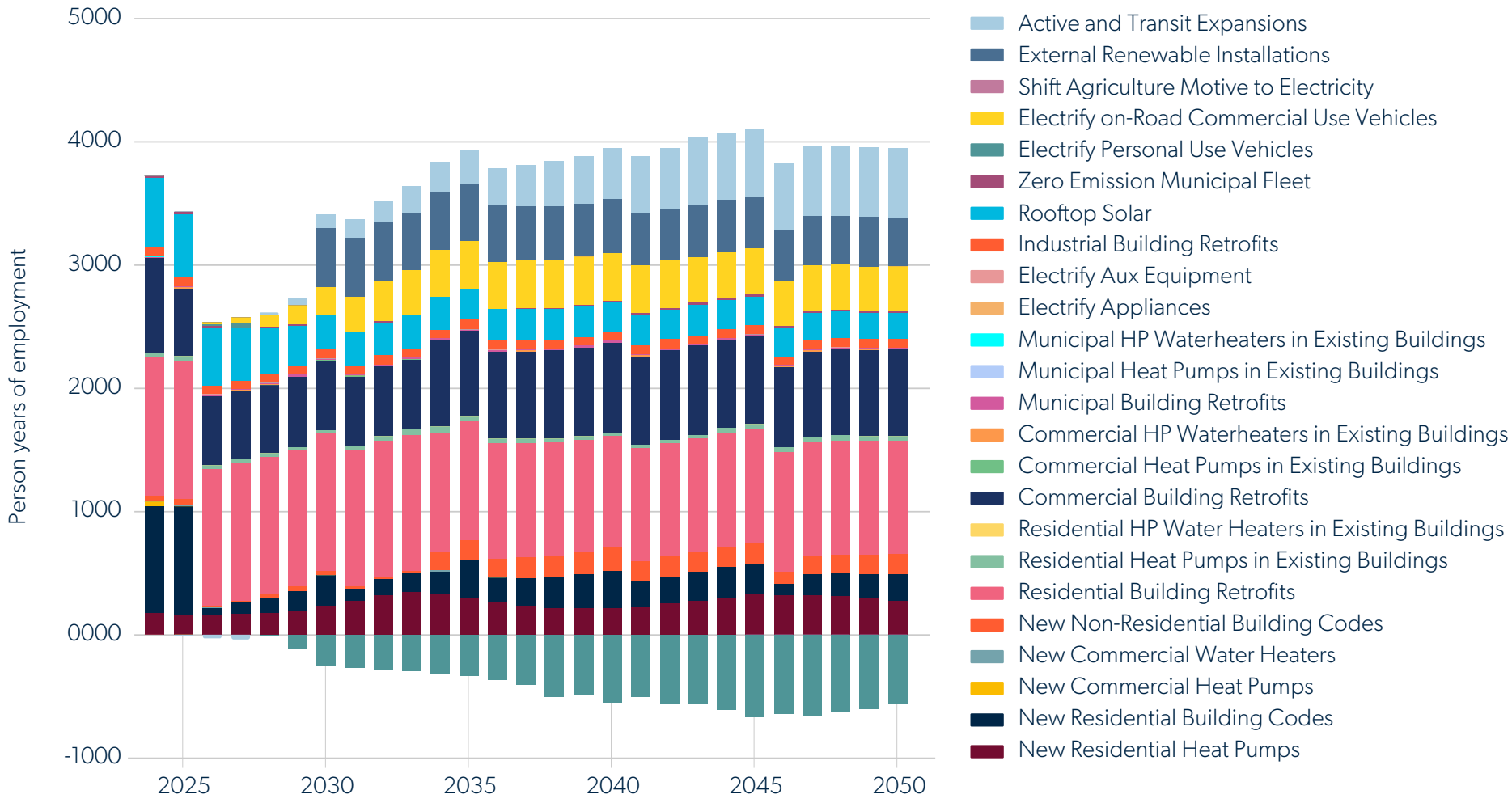


Figure 33. Annual person-years of employment generated in the Low-Carbon Scenario, 2024–2050.

6.6 Business Opportunities

Investments in the Low-Carbon Scenario represent opportunities for existing and new businesses in Charleston County. These include contractors, HVAC suppliers, renewable energy companies, auto groups, construction companies, and secondary businesses such as banks, engineering and architecture firms, and insurance companies. Figure 34 illustrates the numbers of heat pumps required to decarbonize Charleston County. These totals essentially constitute sales targets for the HVAC industry in Charleston County.

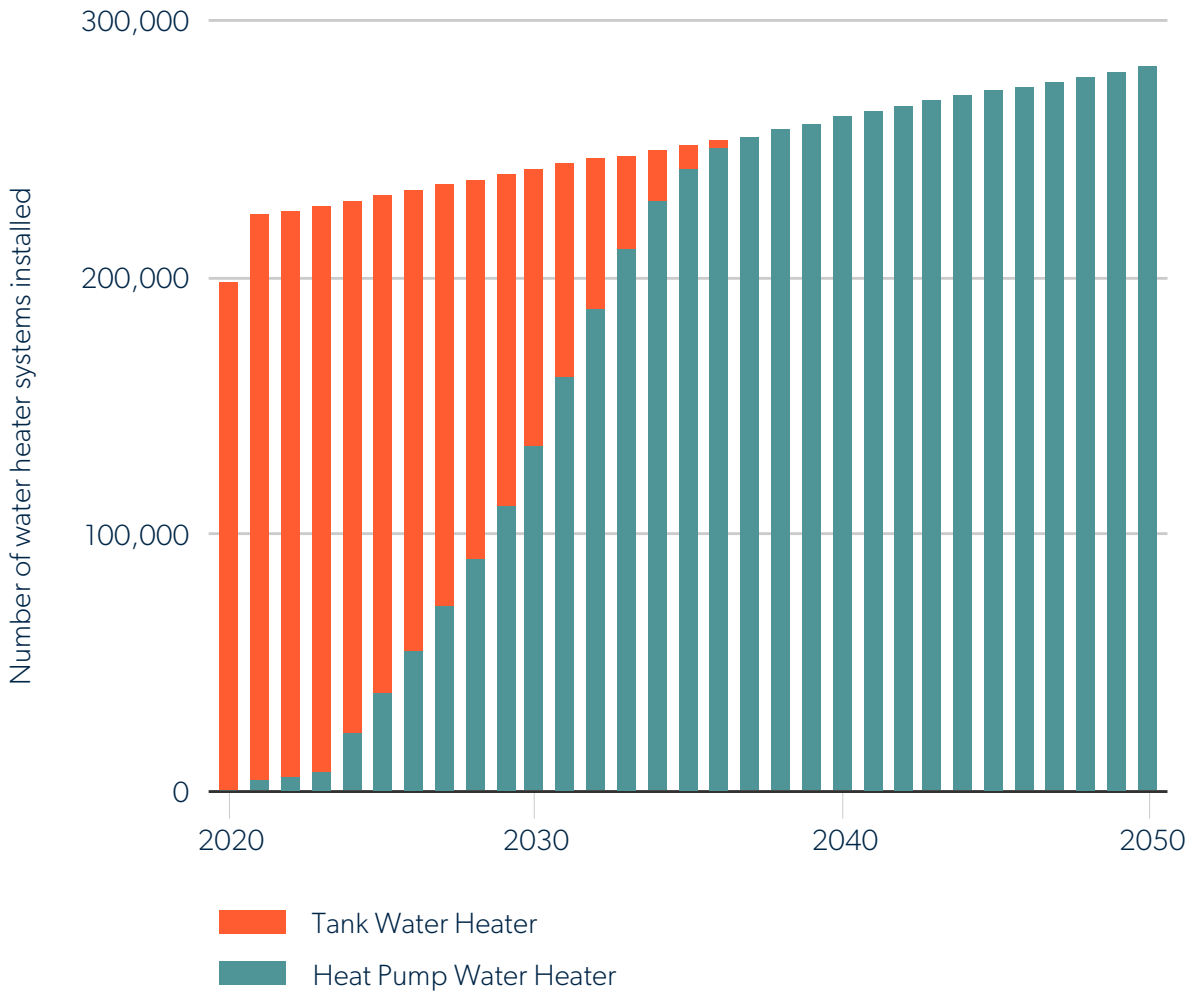


Figure 34. Annual demand for heat pumps in the Low-Carbon Scenario, 2024–2050.

The next figure shows the number of residential buildings to be retrofitted in Charleston County. The sheer amount of retrofits to be done means that there is a huge business opportunity for building contractors who are willing to work on retrofit projects.

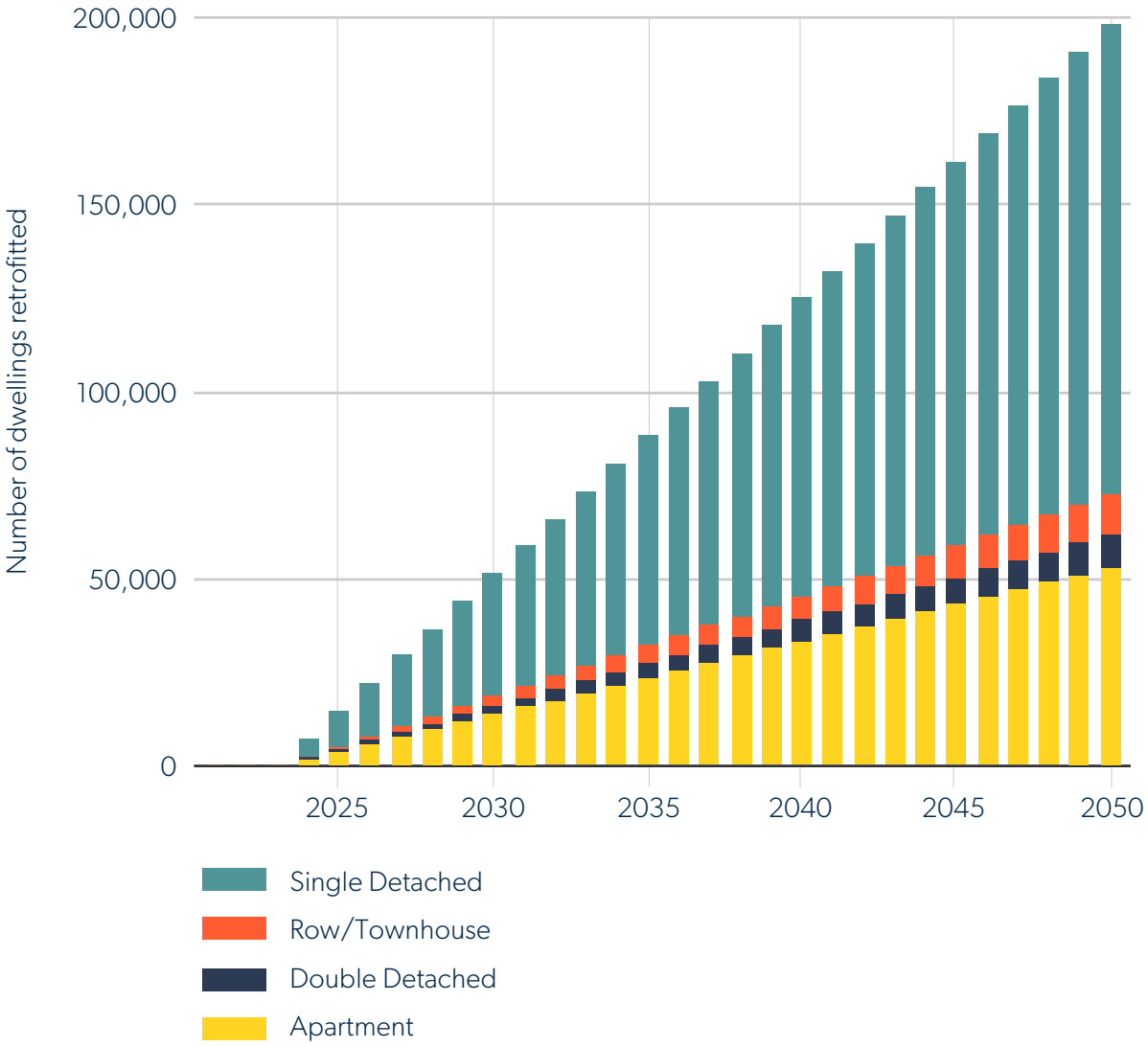


Figure 35. Number of dwellings to be retrofitted in the Low-Carbon Scenario from 2020 to 2050.

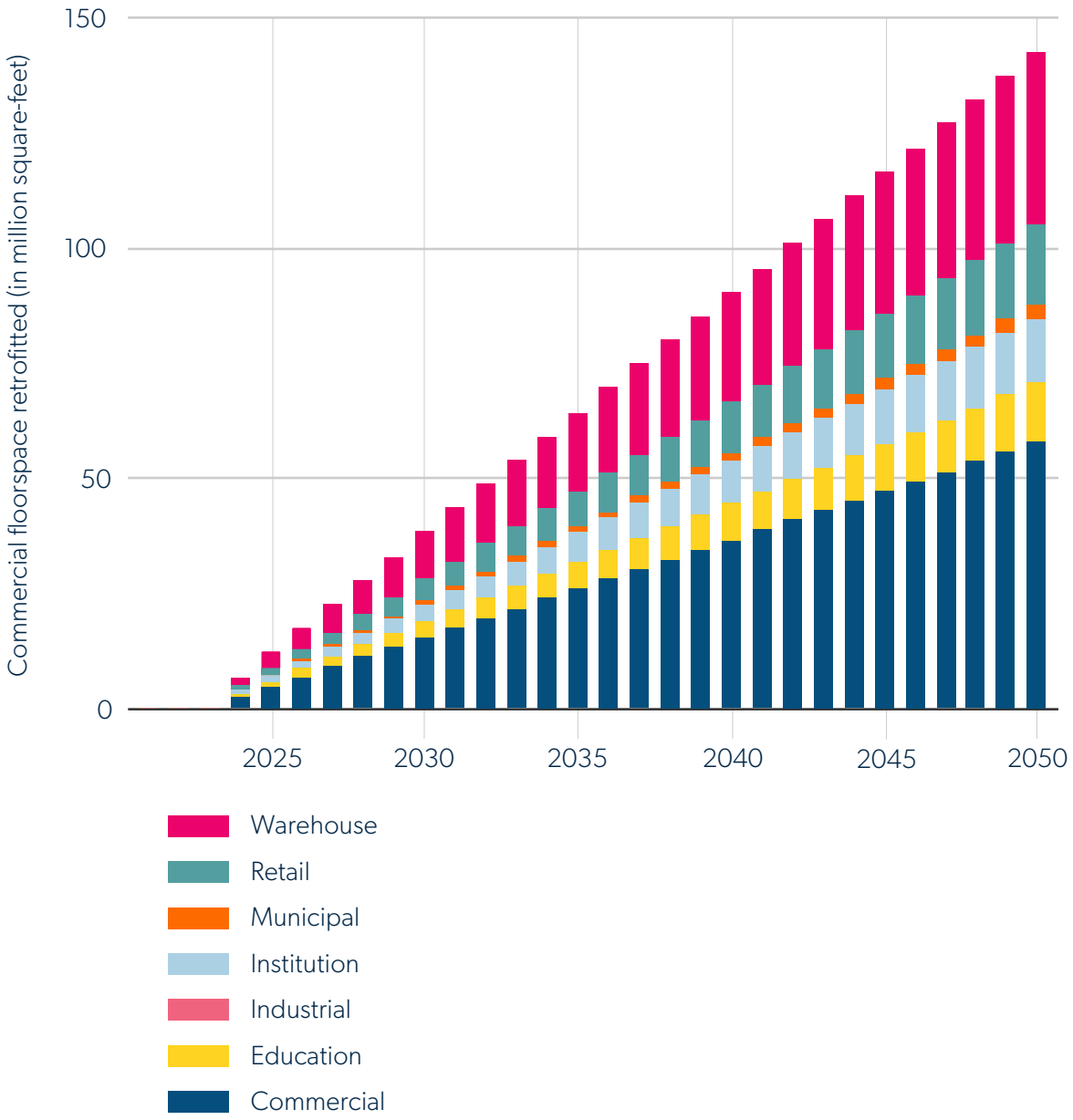


Figure 36. Commercial floor space to be retrofitted in the Low-Carbon Scenario from 2020 to 2050.

6.7 Marginal Abatement Costs

The marginal abatement cost (MAC) is the incremental cost of preventing one metric ton of GHG emissions. The lower the cost, the more affordable the action, and in some cases, the action can be profitable. The abatement cost is calculated by summing the net present value of capital costs and operating costs over the lifetime of the investments divided by the tons of GHGs reduced. Note that the IRA incentives and grants are not included in the calculation of the abatement costs; their inclusion would decrease the cost or increase the savings of many actions.

By providing individual costs for actions, MACs can imply that the actions are a menu from which individual actions can be selected. In fact, many of the actions are dependent on each other. For example, energy costs increase without retrofits. To be successful, Charleston County's CAP must be implemented in full. Additionally, in order to achieve the net-zero-emissions-by-2050 target, all the actions need to be undertaken as soon as possible.

Table 7 summarizes the marginal abatement costs for modeled measures for Charleston County. The actions with negative abatement costs generate financial returns over their lifetimes. A positive abatement cost signifies a net cost over the span of the project. This comparison provides one way to view the costs and benefits of the implementation of emissions-reducing actions but should not be the only metric used to evaluate an action.

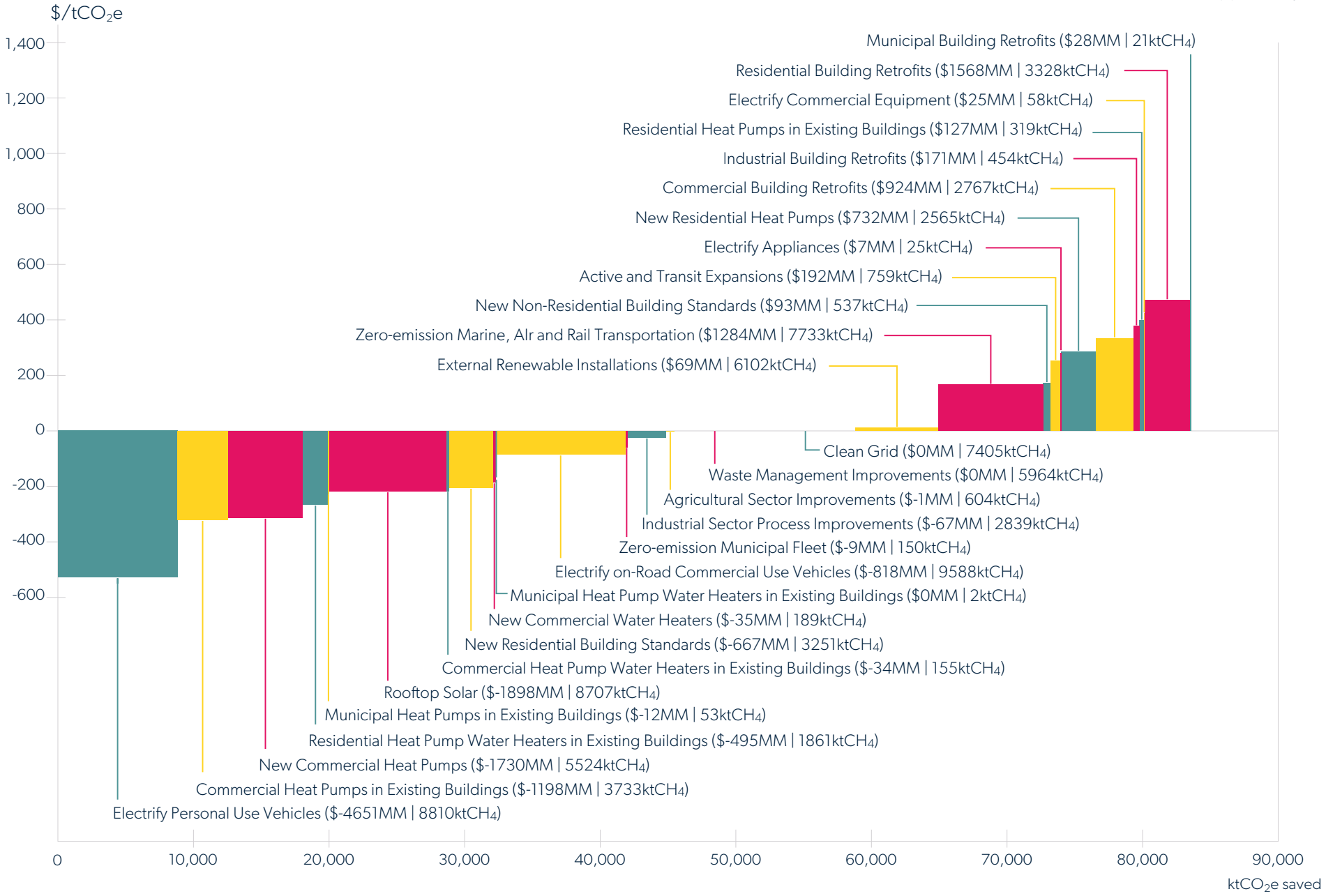


Figure 37. Marginal abatement costs for modeled measures.

Table 7. Abatement costs for modeled measures.

Low-Carbon Action	Cumulative Emissions Reduction (kt CO_2e)	Proportion of Total Reduction	Net Present Value	Marginal Abatement Cost ($/Mt$CO_2e$)
New Residential Heat Pumps	2,565	3.1%	$731,928,579	$285
New Residential Building Standards	3,251	3.9%	-$667,025,184	-$205
New Commercial Heat Pumps	5,524	6.6%	-$1,729,567,988	-$313
New Commercial Water Heaters	189	0.2%	-$35,127,181	-$185
New Non-Residential Building Standards	537	0.6%	$92,621,201	$173
Residential Building Retrofits	3,328	4.0%	$1,567,819,804	$471
Residential Heat Pumps in Existing Buildings	319	0.4%	$126,778,410	$397
Residential Heat Pump Water Heaters in Existing Buildings	1,861	2.2%	-$494,765,237	-$266
Commercial Building Retrofits	2,767	3.3%	$923,539,762	$334
Commercial Heat Pumps in Existing Buildings	3,733	4.5%	-$1,198,344,493	-$321
Commercial Heat Pump Water Heaters in Existing Buildings	155	0.2%	-$33,558,453	-$216
Municipal Building Retrofits	21	0.0%	$28,477,064	$1,348
Municipal Heat Pumps in Existing Buildings	53	0.1%	-$12,008,653	-$227

Low-Carbon Action	Cumulative Emissions Reduction (kt CO_2e)	Proportion of Total Reduction	Net Present Value	Marginal Abatement Cost ($/Mt$CO_2e$)
Municipal Heat Pump Water Heaters in Existing Buildings	2	0.0%	-$334,929	-$152
Electrify Appliances	25	0.0%	$6,991,104	$280
Electrify Commercial Equipment	58	0.1%	$24,578,081	$421
Industrial Building Retrofits	454	0.5%	$171,347,412	$378
Industrial Sector Process Improvements	2,839	3.4%	-$67,075,703	-$24
Rooftop Solar	8,707	10.4%	-$1,898,310,009	-$218
Zero-Emission Municipal Fleet	150	0.2%	-$8,733,978	-$58
Electrify Personal-Use Vehicles	8,810	10.6%	-$4,650,747,306	-$528
Electrify On-Road Commercial-Use Vehicles	9,588	11.5%	-$817,935,779	-$85
Active and Transit Expansions	759	0.9%	$191,558,847	$252
Zero-Emission Marine, Air, and Rail Transportation	7,733	9.3%	$1,283,892,912	$166
Agricultural Sector Improvements	604	0.7%	-$763,526	-$229
Waste Management Improvements	5,964	7.1%	$0	$0
Clean Grid	7,405	8.9%	$0	$0
External Renewable Installations	6,102	7.3%	$69,469,885	$11

7 Implementing Change

Implementation of solar roofs
Photo by NVB Stocker. Adobe Stock under SSG's license.

7 Implementing Change

This implementation strategy recommends 53 actions that the County should take to meet its GHG reduction targets. It serves as a guide on where to direct efforts in the next five years to align with the overall strategy of the CAP, recognizing that the speed at which these measures are accomplished will be a determining factor in reaching the County's target. After five years, the County should evaluate what it has accomplished to determine if it is on the right track with emissions reduction and make any necessary adjustments.

It should be noted that the programs, initiatives, and policies recommended here are meant to support one another and are sequenced in a timeline to maximize community co-benefits, GHG reductions, and financial return. Although adaptive management will be important as technologies and conditions change, the Plan will not generate the same outcome if only some actions are completed or if they are taken out of order. For example, building retrofits increase the impact of solar photovoltaic installations in terms of cost and GHG reductions, and adding solar photovoltaic can ensure there is clean electricity available for electric vehicles at homes and workplaces.

Table 8. Description of implementation indicators.

Measure	**Describes the measure that helps to achieve the Big Move.**
Modeled low-carbon target	Describes the modeled low-carbon targets that support the measure.
GHG impact	Describes the cumulative GHG emissions reduction impact for each measure compared to the Business-as-Planned Scenario. • Enabler: Enables the reduction of GHG emissions. • Low: <5,000 $kMtCO_2e$ • Medium: 5,000–10,000 $kMtCO_2e$ • High: 10,000–20,000 $kMtCO_2eq$ • Very High: >20,000 $kMtCO_2eq$
Community investment	Community investments are based on the upfront community-wide capital expenditure required for each modeled target beyond the BAP Scenario. • $: <$1,000,000,000 • $$: $1,000,000,000– $2,000,000,000 • $$$: $2,000,000,000–$3,000,000,000 • $$$$: >$3,000,000,000

Measure	Describes the measure that helps to achieve the Big Move.
Return on investment	Return on investment represents the community-wide savings on operating and maintenance costs and energy expenditures realized in the Low-Carbon Scenario versus the BAP Scenario. • $: <$1,000,000,000 • $$: $1,000,000,000– $2,500,000,000 • $$$: $2,500,000,000–$5,000,000,000 • $$$$: >$5,000,000,000
Metrics	The method and measurement unit for monitoring the impact of the action taken. All metrics should be analyzed regularly for actions that are being actively implemented.
Implementation mechanism	Mechanisms for delivering actions in the county fall broadly into these categories: • Policy: Instruments like regulations, policy, and bylaws developed by the County and approved by the Council. • Program: An ongoing effort by the County, with staff and financing to support the effort. • Initiative: A study or project undertaken by the County, private sector, not-for-profit sector, or other sectors, individually or collaboratively, with a specific focus and implemented for a set time period. • Infrastructure: Investment in physical infrastructure by the County or private sector, not-for-profit sector, or other sectors, individually or collaboratively. • Advocacy: Any action in favor of or recommending that another body (e.g., level of government, other governments, community partners) undertake an action/policy/program that influences emissions reductions within its jurisdictional control. • Education: A defined opportunity to target educational communications and materials to the public, community partners, and other governments related to the specific rationale and benefits of implementing climate actions.
Action	Describes the implementation action supporting the strategy.
County role	Indicates whether the County is leading, supporting, or advocating for the implementation action.

Measure	Describes the measure that helps to achieve the Big Move.
Potential partner	Indicates potential collaborative partners for action implementation.
Timing	Indicates when the County and its partners should start planning and/or implementing the recommended action.
Strategy and design considerations	Highlights Charleston County characteristics that need to be considered when implementing actions in order to maximize efficiency and efficacy.
Co-benefits, co-harms, and equity impacts	Describes community impacts that are not directly related to climate change mitigation. Planning for actions that also deliver co-benefits and mitigate co-harms increases the likelihood of success.

7.1 Big Move 1: Affordable and Resilient Buildings

Building emissions come from all types of buildings, including homes, schools, offices, stores, and industrial spaces. Buildings and the systems within them, such as water heating and space cooling systems, are long-lasting assets. Depending on how efficient they are, the types of energy that they use, and how they are operated, buildings can become a significant source of GHG emissions.

In 2020, buildings in the commercial, residential, municipal, industrial, and agricultural sectors generated 3,030 $kMtCO_2e$ of GHG emissions, about 47% of Charleston County's overall GHG emissions in the same year. Industrial processes are the largest source of building GHG emissions at 27%, followed by space cooling at 25%, and space heating at 14%. Electricity accounts for about 70% of the building sector's GHG emissions, but only about 40% of the energy consumed—this indicates that decarbonizing electricity rapidly will be transformative for the building sector GHG emissions.

Almost half of single-family homes and more than half of multi-family homes in South Carolina are uninsulated, indicating a major opportunity to reduce costs, energy consumption, and GHG emissions and increase comfort. One analysis found that a whole-home high-efficiency and electrification retrofit would result in GHG emissions reductions of 30—63%, energy bill savings of 24—57%, and energy savings of 29—67%.[70] The emissions reductions would be higher if the emissions factor of electricity goes down or if solar PV capacity is added to the home.

In the Low-Carbon Scenario, building sector GHG emissions drop off by one-third in 2024 with the closure of the WestRock paper mill in North Charleston,[71] and they continue to rapidly reduce as industry and agricultural sectors improve their processes, water heating is switched from tanks to heat pumps, space cooling and heating are switched to heat exchangers, lights are converted to LED lighting, building retrofits ramp up, and more local solar systems are installed.

---

[70] *NREL (2023). State Level Residential Building Stock and Energy Efficiency & Electrification Packages Analysis. Retrieved from: https://public.tableau.com/app/profile/nrel.buildingstock/viz/StateLevelResidentialBuildingStockandEnergyEfficiencyElectrificationPackagesAnalysis/Introduction*

[71] *McDermott, John. North Charleston paper mill shuts down. The Post and Courier. December 20, 2023. https://www.postandcourier.com/news-stories-2023/north-charleston-paper-mill-shuts-down/article_a52da22a-945e-11ee-864c-3333ee016955.html*

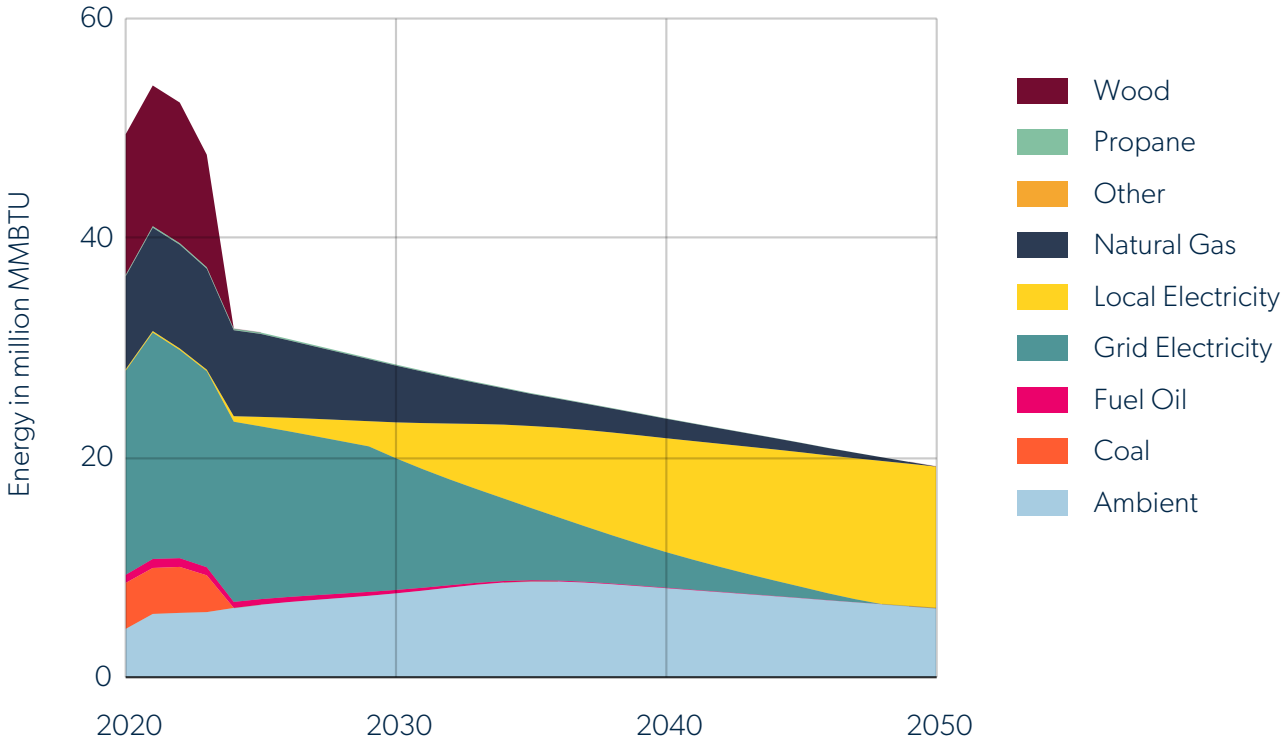


Figure 38. Building energy use by fuel type, Low-Carbon Scenario, 2020–2050.

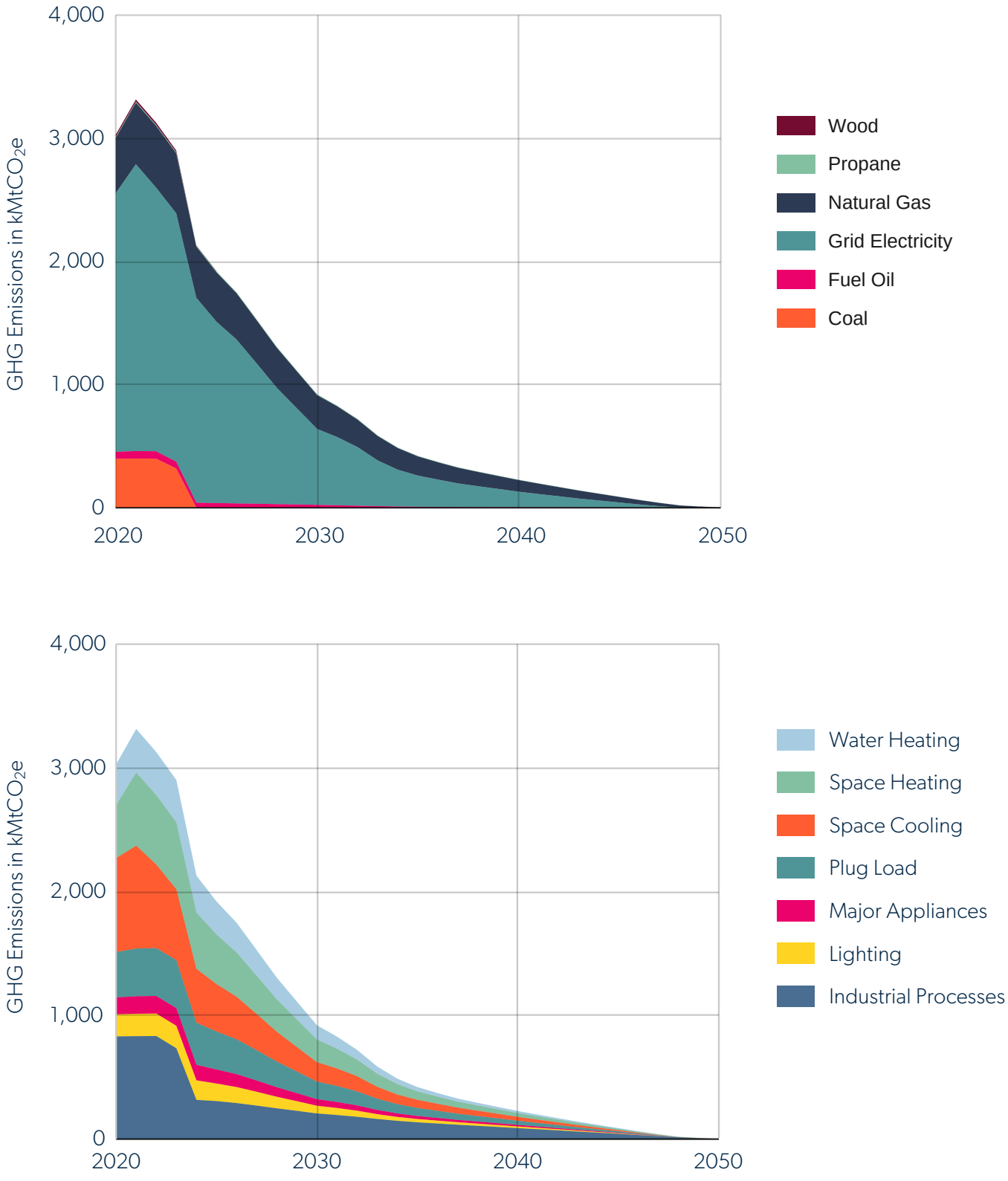


Figure 39. Building GHG emissions by energy source and end use, Low-Carbon Scenario, 2020–2050.

While the objectives overlap (e.g. getting maximum emissions reductions), the specific requirements and approaches are different for new or newly renovated buildings compared to occupied existing buildings. Programs and policies are often tailored differently to address the unique characteristics and challenges associated with each category of buildings. In this CAP, actions for this Big Move are categorized according to whether the buildings will be new construction or existing buildings.

Co-Benefits, Co-Harms, and Equity Impacts:

- High-performance buildings are more affordable to operate than conventional construction.[72]
- Energy-efficient buildings with low-carbon heating and cooling systems have fewer drafts, less condensation, and less temperature variation, resulting in greater comfort and better health.
- A traditional home, even with grid-tied PV, will not keep you warm or cool at night during an extended blackout, whereas a high- performance home will hold heat or keep the heat at bay long after a utility disruption.
- Occupants are less vulnerable to increasing energy costs.
- Improved insulation in buildings reduces residents' exposure to exterior noise.
- New higher standards and retrofit requirements will create a significant number of direct and indirect jobs annually.

[72] *CBC News (2023). Many of Canada's greenest apartments are ultra-affordable. Here's why. Retrieved from: https://www.cbc.ca/news/science/green-affordable-housing-1.6876487*

7.1.1 Net-Zero New Buildings

The first steps for designing a net-zero emissions building are (1) to aim for very low levels of energy consumption without compromising building functionality and comfort and (2) to provide a clean electricity source either as on-site PV or procured off-site renewable energy. Because procuring off-site renewable energy is an option, a net-zero-emissions building is easier to achieve than a net-zero-energy building, which typically generates all of its energy needs on site with a solar PV system. Strategies that can achieve this objective include:

- Ensuring the building envelope is well-insulated to minimize transfer of cooling, heating, and air leakage;
- Maximizing natural light and ventilation by optimizing building orientation and windows and doors placement;
- Using high-efficiency systems, equipment, fixtures, and appliances;
- Implementing water-efficient fixtures such as low-flow faucets and showerheads in concert with water-saving practices like rainwater harvesting and greywater recycling systems for non-potable water use;
- Integrating smart building technologies like occupancy sensors, programmable thermostats, and building automation systems to enhance overall building performance;
- Incorporating climate-positive design features such as high-albedo surfaces, low-embodied-carbon materials, and multifunctional,[73] native vegetation; and
- Providing the energy required for operating the building from on-site solar installations or other non-emitting sources of energy.

Reducing building electrical load as much as possible through these strategies sets the building up for success, as the required demand is much lower and can be met by smaller and cheaper renewable energy systems.

Strategy and Design Considerations:

- Charleston County does not have the authority to impose energy codes and will need to explore other policy instruments, such as a Building Performance Standard, to incentivize construction of high-performance buildings.
- High-performance buildings have a lower peak electricity demand and can reduce or minimize investments in upgrading the electricity system. Utilities can be a key partner in advancing a program for high-performance new buildings.

73Multifunctional *native vegetation comprises indigenous plants serving ecological and environmental functions while enhancing quality of life by providing shade and aesthetic appeal.*

What is a Building Performance Standard (BPS)?

A BPS policy establishes a definition for high-performance buildings and drives all buildings to achieve it, making the Country's priorities clear. From a building owner perspective, a BPS provides flexibility: Owners can use whatever technologies and operational strategies they decide are most effective and economical to meet the target. Buildings cannot all be made high-performance buildings immediately. A BPS is a forward-thinking policy commitment in which the County establishes the long-term, high-performance standard, with interim targets that ratchet up over time. The combination of short- and long-term goals assures that building performance improves consistently over time, and also sends appropriate market signals to discourage investments in long-lived, inefficiency, and environmentally damaging technology. Throughout these performance improvement cycles, the County collects data and works with the private sector, utilities, and others to create incentives and programs and provide technical assistance.[74]

BPS policies should support: (1) reducing energy use, (2) electrifying as much as possible, and (3) increasing renewable energy to reduce

fossil fuel consumption. BPS can also support equity objectives and resilience and enable federal funding opportunities.

[74] *USDN (2021). Building Performance Standards. Retrieved from: https://www.usdn.org/uploads/cms/documents/bps-framework_july-2021_final.pdf*

Table 9. Net-zero new buildings implementation strategies.

Strategy	**Net-Zero New Buildings**
Measure	**High-performance standards for new and newly renovated buildings**
Modeled low- carbon targets	100% of new residential, municipal, commercial, and industrial buildings are net-zero ready by 2035.
GHG impact	High
Investment required	$$$
Return on investment	$$$
Performance metric	% of net-zero buildings built annually

Strategy		**Net-Zero New Buildings**				
Measure		**High-performance standards for new and newly renovated buildings**				
Implementation Mechanism		**Action**	**County Role**	**Potential Partner(s)**	**Timing**	**Potential Funding**
Policy	1	Consider a net-zero design for all new municipal buildings and assess its financial value over the lifetime of the building.	County leads	-	Ongoing	• County budget, on the basis of return on investment.

Strategy	Net-Zero New Buildings				
Measure	**High-performance standards for new and newly renovated buildings**				
Implementation Mechanism	**Action**	**County Role**	**Potential Partner(s)**	**Timing**	**Potential Funding**
Initiative 2	Undertake a process to develop a high-performance building performance standard for new residential and commercial buildings for developers and owners to consider. Set appropriate targets for different segments of the building stock, guided by engagement with the building and development community in Charleston County. The BPS can include incremental targets for operational energy, operational GHG emissions, and embodied carbon and energy efficiency standards.	County leads	—	2025	• Sec. 45L Homebuilder Tax Credit- $2,500 for meeting ENERGY STAR and $5,000 for US Department of Environment (DOE) zero-energy ready. • Sec. 25C Home Efficiency Improvement Tax Credit- 30% of eligible expenses up to $1,200 per year for most projects, with a higher cap of $2,000 per year for heat pumps, heat pump water heaters and wood stoves. • $1B in grants and loans through HUD for sustainability improvements to affordable housing, authorized to seed up to $4B in loans. • Sec. 25D Residential Clean Energy Tax Credit- 30 percent credit for eligible expenditures for on-site residential solar electric, solar water heating, fuel cell, small wind energy, and geothermal heat pumps through 2032. • Sec. 179D Tax Deduction for Energy Efficient Commercial Buildings- Sliding scale of $2.50 -$5.00 per square foot. New construction must achieve 25%-50% > evolving ASHRAE 90.1 reference standard.

Strategy		Net-Zero New Buildings				
Measure		**High-performance standards for new and newly renovated buildings**				
Implementation Mechanism		**Action**	**County Role**	**Potential Partner(s)**	**Timing**	**Potential Funding**
Policy [Equity Focus]	3	Explore the potential of applying the same incentives for Affordable and Workforce Housing—fees waived, priority review, and density bonuses—for any housing type that is net- zero emissions. Provide additional bonuses for projects that provide affordable housing and are net-zero emissions.	County leads	-	2025	• As above
Policy	4	Consider incorporating low-carbon considerations into planning approvals, including orientation, glazing, building shape, and shading.	County leads		2025–2026	• None required

Strategy	Net-Zero New Buildings				
Measure	**High-performance standards for new and newly renovated buildings**				
Implementation Mechanism	**Action**	**County Role**	**Potential Partner(s)**	**Timing**	**Potential Funding**
Initiative 5	Encourage developers with incentives and other measures to prioritize heat pumps, heat pump hot water tanks, and induction cooking for new developments to ensure affordability.	County leads	Electric utilities	2025	• Sec. 25C Home Efficiency Improvement Tax Credit- 30% of eligible expenses up to $1,200 per year for most projects, with a higher cap of $2,000 per year for heat pumps, heat pump water heaters and biomass stoves.
Advocacy 6	Advocate for the State to update its building code to enhance energy performance and ensure safe homes.	County advocates	Other municipalities in South Carolina	2025	• No funding required
Education 7	Support educational sessions for builders on net-zero design principles and funding opportunities.	County supports	SC Energy Office, Homebuilders' Association	2025	• Energy Auditor Training Grant Program (DOE) • Career Skills Training Program (DOE) • State-Based Home Energy Efficiency Contractor Training Grant Program (DOE)

7.1.2 Resilient Homes and Buildings

Retrofits of homes and buildings decrease emissions as well as the amount of renewable energy required to cool or heat them. The work required varies depending on the building type and even building to building or home to home. Retrofits represent the foremost opportunity to reduce the emissions associated with energy use in buildings, while also improving the quality of homes for their occupants.

Introducing a reporting and disclosure mechanism is a key first step to identifying the energy performance of existing buildings. This information would also be very useful in fine-tuning assistance or supporting programs, such as providing financing for low-income populations, training programs for trades, and information packaging for property owners or managers. For prospective buyers or renters, building performance reports provide upfront information on operating costs. Additionally, energy reporting and disclosure programs could become valuable tools for property owners for guiding investments, optimizing energy performance, reducing costs, complying with local regulations, and enhancing the marketability and value of their buildings.

The primary tool to retrofit buildings in Charleston County is to leverage incentives in a building retrofit program, with streams for residential and commercial buildings. Within the residential stream, there could be a specific focus on LIDC neighborhoods.[75] The County could also apply the Building Performance Standard to existing buildings to accelerate the rate of retrofits. A comprehensive program may include education, coordination of financing (possibly using a Property Assessed Clean Energy [PACE] program if it is enabled) and federal and state grants, building permit approval, energy audits, contractor training and pre-approval, and workforce development. The program could take a whole-building perspective, targeting deep retrofits (savings exceeding 50%), incorporate heat pumps for heating and cooling and other high-efficiency technologies, and integrate solar photovoltaics, energy storage, and electric vehicle chargers where appropriate.

Retrofitting the building stock in Charleston County will require a skilled labor force that is trained to assess the needs of a building and to complete the retrofit work. Many homes and buildings in Charleston County are older and prone to flooding, and retrofits should consider upgrades from older electrical systems and to accommodate the installation of heat pumps (for heating and cooling), electric vehicle chargers, heat pump hot water heaters, and other electric appliances. Charleston County can develop partnerships with local colleges and trade schools, the construction industry, and the County and State to support the development of the retrofit workforce.

[75] *As an example, see: Philadelphia Energy Authority.(2023). Built to Last. Retrieved from: https://philaenergy.org/programs-initiatives/built-to-last/#:~:text=Built%20to%20Last%20seeks%20to,and%20stay%20in%20their%20homes.*

What is a Deep Retrofit?

A deep retrofit is a set of actions to improve building quality and energy efficiency.

Minor retrofits include weatherstripping, improving insulation, and relamping to LEDs. Major retrofits can include replacing windows and doors, updating heating and cooling systems, and reducing water consumption through low-flow faucets. These approaches, especially if undertaken in a piecemeal manner, are considered "light" and tend to overlook potential savings achievable from more comprehensive measures such as roof replacement or switching HVAC systems to heat pumps.

Deep retrofits go a step further by taking a whole-building approach, considering all major capital needed in the building over the next several years, and strategizing interventions that aim for higher efficiencies and other advantages. Upgrades can be implemented simultaneously or gradually phased in over several years, depending on available budget.

A deep retrofit can reduce a building's energy demand by up to 60%.

Strategy and Design Considerations:

- The SC Energy Office recently became a partner of the US DOE Better Buildings Solution Center that administers the Home Energy Score program. There is potential for Charleston to be one of the first to pilot the program in South Carolina. The Home Energy Score report estimates home energy use and associated costs and provides energy solutions to cost-effectively improve the home's efficiency based on an assessment by a certified assessor. Cities like Portland, Oregon, and Gainesville, Florida, have adopted ordinances requiring a Home Energy Score assessment before a dwelling can be sold or rented.
- There is legislative uncertainty with respect to PACE programs. A bill to introduce C-PACE is currently being considered in the state legislature.[76] PACE programs allow properties to obtain low-cost, long-term financing for qualifying energy efficiency, renewable energy, water efficiency, resilience, and public health improvements to new and existing buildings. PACE financing is secured through a voluntary assessment on the property, which automatically transfers upon sale.
- The Sustainability Institute, a non-profit organization based in North Charleston, implements various programs that merge climate and equity objectives, including the Environmental Conservation Corps program that trains youth to take part in community conservation activities. One of the key service activities is providing home energy audit and retrofits for low-income households in the Greater Charleston metro area.
- Workforce capabilities and availability will be key considerations.

[76] *As of February 4, 2024, the S0542: A Bill to Amend the South Carolina Code of Laws by Enacting the 'South Carolina Commercial Property Assessed Clean Energy and Resilience Act" has been accepted by the Senate and was introduced to the House for first reading in May 2023.*

Table 10. Resilient homes and buildings implementation strategies.

Strategy	**Resilient Homes and Buildings**
Measure	**Deep retrofit existing buildings**
Modeled low-carbon targets	• The program aims to retrofit existing residential, commercial, and industrial buildings to achieve thermal standards of net-zero-ready and 30% electrical by 2050. • Switch space heating, space cooling, and water heating equipment to heat pumps. • Electrify appliances and auxiliary equipment. • Increase solar rooftop PV installations for residential and commercial buildings.
GHG impact	High
Investment required	$$$$
Return on investment	$$$$
Performance metric	• Number of residential buildings retrofitted annually • Average annual energy savings per household • Number of non-residential buildings retrofitted annually • Number of municipal buildings retrofitted annually • Number of heat pumps sold or installed annually

Strategy		Resilient Homes and Buildings				
Measure		**Deep retrofit existing buildings**				
Implementation Mechanism		**Action**	**County Role**	**Potential Partner(s)**	**Timing**	**Potential Funding**
Initiative	8	Undertake energy audits for existing municipal buildings and implement deep retrofits where there is a lifecycle business case.	County leads	ESCO[77]	Initiating Energy Performance Contracting Project	• Clean Electricity Investment Tax Credit (Treasury) • Energy-Efficient Commercial Buildings Deduction (Treasury)
Policy	9	Initiate voluntary energy use disclosure and benchmarking for large non-residential and multi-family buildings.[78]	County leads	SC Energy Office, EPA Energy Star Portfolio Manager, US EPA Benchmarking and Building Performance Standards Policy Toolkit	2025	• Green and Resilient Retrofit Program Grants and Loans (Department of Housing and Urban Development [HUD])

[77] *US DOE defines ESCOs as energy service companies that develop, design, build, and arrange financing for projects that save energy, reduce costs, and decrease operations and maintenance costs at their customer's facilities.*

[78] *The specification of large buildings can be determined based on the types and sizes of buildings in Charleston County. Some jurisdictions like Atlanta set this 50,000 square-feet while Washington State started with buildings exceeding 50,000 square-feet for the first year of implementation and will expand to include buildings between 20,000 to 50,000 square-feet from 2027.*

Strategy		Resilient Homes and Buildings				
Measure		**Deep retrofit existing buildings**				
Implementation Mechanism		**Action**	**County Role**	**Potential Partner(s)**	**Timing**	**Potential Funding**
Policy	10	Initiate a Home Energy Score program with appropriate partners, including utilities.	County leads	SC Energy Office, US DOE Better Buildings Solution Center, utilities.	2026	—
Initiative [Equity Focus]	11	Refer homeowners to, and support the expansion of the Sustainability Institute's weatherization project for low-income households. The expanded scope could include more energy efficiency measures for deeper retrofits, solar PV installations, and increasing program coverage to reach more LIDC homes. Consider how to integrate IRA tax credits and funding into the program. Focus on neighborhoods identified as LIDC.	County supports	Sustainability Institute	2025	• South Carolina's Weatherization Assistance Program and State Energy Program • Residential Clean Energy Credit (Treasury) • Energy-Efficient Home Improvement Credit (Treasury) • $1B in grants and loans through HUD for sustainability improvements to affordable housing, with the possibility of $4 billion in additional loans

Strategy		Resilient Homes and Buildings				
Measure		**Deep retrofit existing buildings**				
Implementation Mechanism		**Action**	**County Role**	**Potential Partner(s)**	**Timing**	**Potential Funding**
Program [Equity Focus]	12	Share information on incentives and technical resources to encourage residents, especially low-income households, to purchase and install heat pumps and highly efficient appliances.	County leads	Utilities	2025	• Home Energy Rebates (DOE) • High-Efficiency Electric Home Rebate Program (DOE) • Energy Efficient Home Improvement Tax Credit (Treasury) • $The Green and Resilient Retrofit Program (GRRP) • Green and Resilient Retrofit Program provides funding for direct loans and grants of eligible HUD-assisted multi-family properties.

Strategy		Resilient Homes and Buildings				
Measure		**Deep retrofit existing buildings**				
Implementation Mechanism		**Action**	**County Role**	**Potential Partner(s)**	**Timing**	**Potential Funding**
Policy	13	Identify systemic barriers and opportunities to scale up rooftop solar photovoltaic installations in Charleston County with appropriate partners.	County leads	Power utilities, solar power companies	2025	• Sec. 25D Residential Clean Energy Tax Credit- 30% credit for eligible expenditures for on-site residential solar electric, solar water heating, fuel cell, small wind energy, and geothermal heat pumps through 2032.
Advocacy	14	Advocate for the State to enable and activate residential and commercial PACE programs in South Carolina.	County advocates	Other municipalities in South Carolina, SC Energy Office, trade associations	2025	

Strategy		Resilient Homes and Buildings				
Measure		**Deep retrofit existing buildings**				
Implementation Mechanism		**Action**	**County Role**	**Potential Partner(s)**	**Timing**	**Potential Funding**
Initiative	15	Initiate a pre-approved contractors program. The contractors should have expertise and experience in delivering deep energy retrofit solutions. The program could include training and a public registry.	County leads	Homebuilders' Association, trades associations, renewable energy installers.	2026	• Energy Auditor Training Grant Program (DOE) • Career Skills Training Program (DOE) • State-Based Home Energy Efficiency Contractor Training Grant Program (DOE)
Initiative	16	Support new or existing programs for business owners to retrofit older commercial buildings.	County supports	Chamber of Commerce, trade associations, energy service companies.	2026	• Sec. 179D Tax Deduction for Energy Efficient Commercial Buildings—Sliding scale of $2.50–$5.00 per square foot. New construction must achieve 25–50% > evolving ASHRAE 90.1 reference standard • Clean Electricity Investment Tax Credit (Treasury)

Strategy	Resilient Homes and Buildings				
Measure	**Deep retrofit existing buildings**				
Implementation Mechanism	**Action**	**County Role**	**Potential Partner(s)**	**Timing**	**Potential Funding**
Education 17 [Equity Focus]	Facilitate a concierge service[79] for IRA funding with the objective to maximize IRA investments in Charleston County.	County leads		2025	
Education 18 [Equity Focus]	Partner with organizations to offer energy savings workshops for residents and businesses. These can be tailored to specific groups in the community like low-income households, renters, newcomers, seniors, and young parents.	County supports	Climate justice groups, SC Energy Office	2025	• Environmental and Climate Justice Block Grants (EPA) • Neighborhood Access and Equity Grant Program (Department of Transportation [DOT])

[79] *The concierge service could offer one-on-one assistance to residents and businesses to help guide them to the right IRA program and services that will best meet their needs.*

7.2 Big Move 2: Sustainable and Inclusive Transportation

The transportation sector accounted for approximately 44% of Charleston County's GHG emissions in 2020, totaling 2,860 $kMtCO_2e$. Gasoline dominates as an energy source and as a source of GHG emissions. In the Low-Carbon Scenario, rapid transformation of the vehicle fleet to electric, fuel shifting to low-emissions fuel in the marine and aviation sub-sectors, and increased active transportation combined with rapidly increasing local renewable electricity generation led to the near elimination of GHG emissions from the transportation sector by 2050. The market share for gasoline and diesel is reduced by 50% by 2035 relative to 2020 levels, as increasing numbers of electric vehicles are added to the vehicle stock.

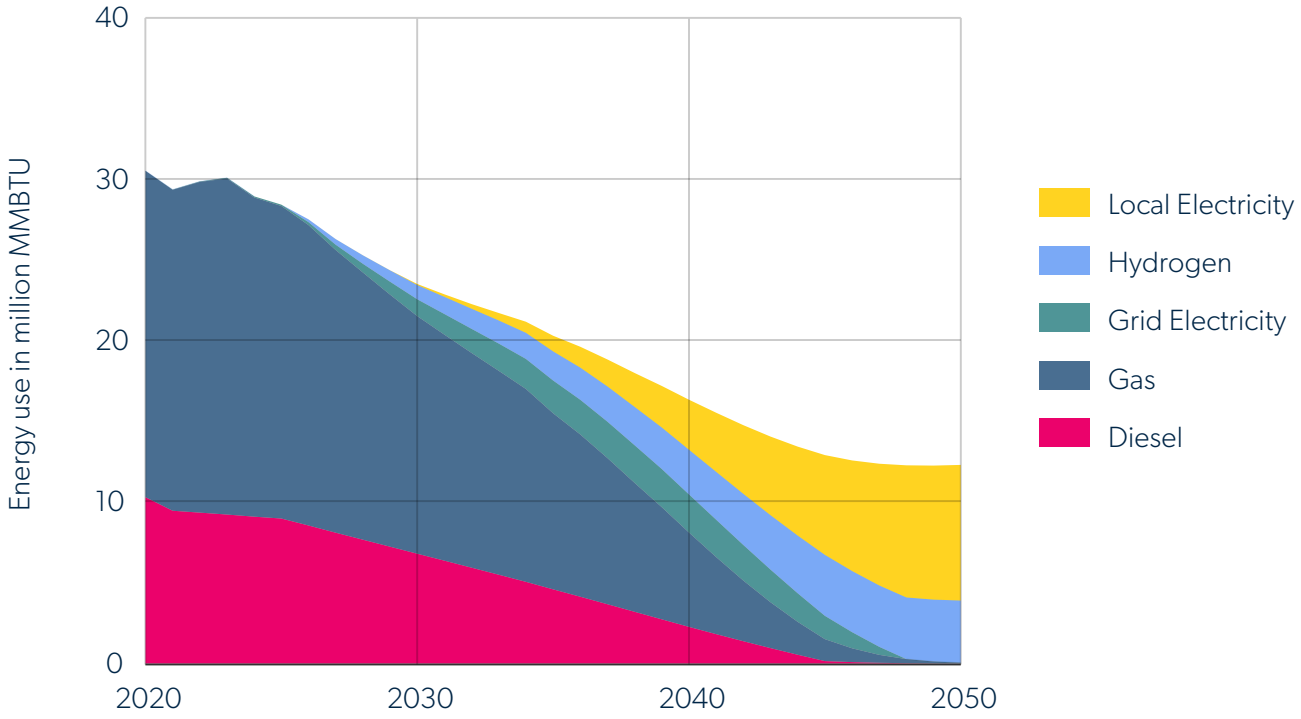


Figure 40. Declining natural gas and gasoline consumption in the Low-Carbon Scenario, Charleston County, 2020–2050.

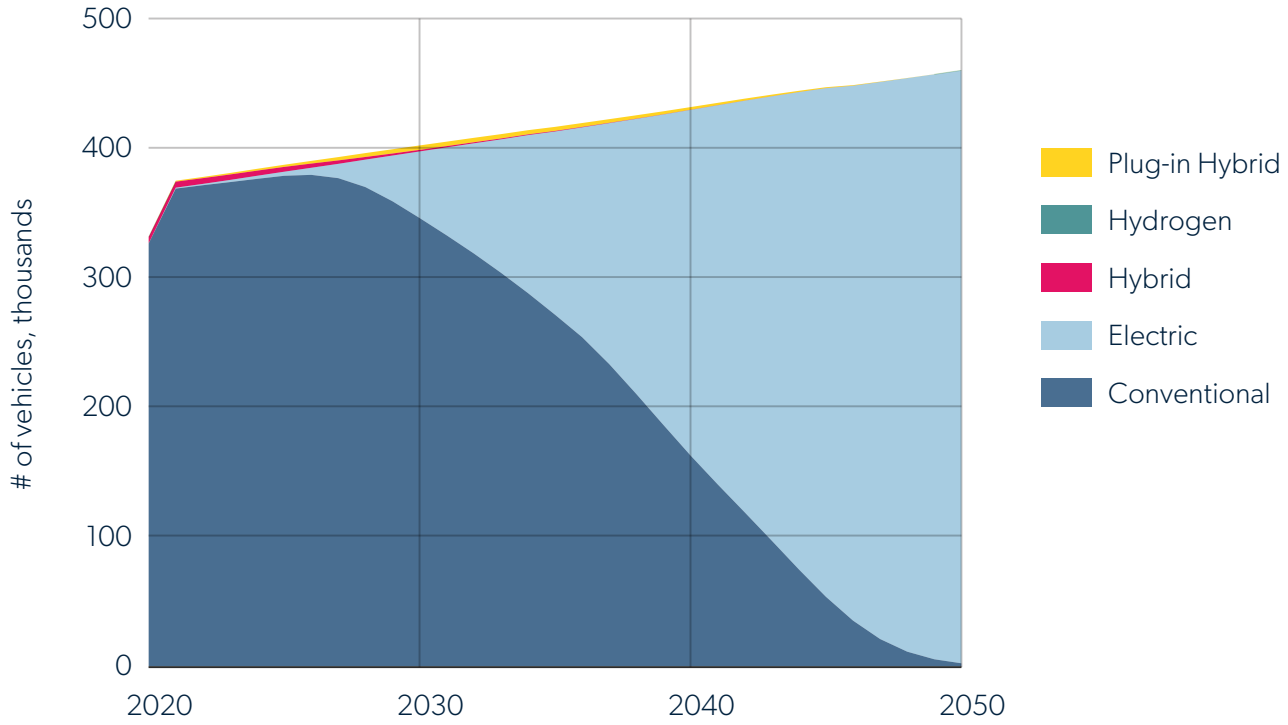


Figure 41. Growth in the share of electric vehicles in the vehicle stock in the Low-Carbon Scenario, 2020–2050.

Reducing emissions in the transportation sector requires considerations across four dimensions:

- Developing complete communities where amenities are within a short walking or bicycling distance to reduce the need for vehicle travel.
- Developing an active transportation network that encourages walking, cycling, and other micro -mobility options like scooters, skateboards, skates, rollerblades, tricycles, and wheelchairs.[80]
- Expanding public transportation networks that are safe, affordable, and accessible to encourage ridership.
- Encourage switching to electric or low-emission vehicles with a robust charging network.

[80] *E-bikes and e-scooters are included in this category despite having a motor, due to the small motor size and low top speed.*

Strategy and Design Considerations:

- Transportation planning in Charleston occurs through the combined efforts of the County, local municipalities, adjacent counties and municipalities, the South Carolina Department of Transportation (SCDOT), and the Berkeley-Charleston-Dorchester Council of Governments (BCDCOG). The County is primarily responsible for roads and drainage infrastructure.
- The Charleston Area Regional Transportation Authority (CARTA) provides local, express, and neighborhood bus services within the Berkeley-Charleston-Dorchester region. In Charleston County, CARTA's services include the Downtown Area Shuttle (DASH), the Tel-A-Ride paratransit program, and the CARTA OnDemand service[81] for seniors. CARTA has a Battery Electric Bus Master Plan and Roadmap to achieve 100% electric buses by 2040.
- BCDCOG is developing a Lowcountry Rapid Transit (LCRT), a 21.3-mile mass bus rapid transit system with dedicated lanes linking Ladson, North Charleston, and the city of Charleston.
- Charleston County has, within its geographic boundaries, three airports, freight rail services, an Amtrak passenger rail service, and marine terminals.
- Opportunities for partnering and expanding existing programs:
- Charleston Moves and Second Chance Bikes currently work on advocacy, education and outreach programs related to walking, bicycling, and public transit.
- Lime e-bike share program is already operating in the city of Charleston, and Rebellion Roads provides e-bike rental services in the City of Charleston, the Town of Mount Pleasant, the Town of Sullivan's Island, and the City of Isle of Palms.
- The Center of Resilience Excellence South Carolina (CORE SC) is currently leading a working group focused on drone delivery.
- Lowcountry Go Vanpool program provides eligible commuter groups with seven- or 15-passenger vans to commute to and from work in the Tri-County area.

[81] *CARTA OnDemand Service provides vouchers for seniors 55+ and for Tel-A-Ride customers to use Uber and Lyft throughout CARTA fixed route service areas.*

7.2.1 Enhanced Accessibility

Vehicular travel results in environmental and social impacts, including traffic congestion, air pollution, segregated communities, loss of forest and agricultural lands, etc. The idea of complete communities is a planning strategy that aims to provide a diversity of housing to meet identified community needs and accommodate people at all stages of life while also providing a wider range of employment, amenities, and services within a walkable distance.

Complementing the concept of complete communities are encouraging active transportation, which has a range of health and social benefits, and encouraging the use of public transit, which is an efficient way for people to move around.

Co-Benefits, Co-Harms, and Equity Impacts:

- Improved accessibility: A land-use policy designed to encourage diverse land uses in proximity to housing is fundamental to enabling active transportation and public transit.
- Increased affordability: Public transit, walking, and cycling are low- or zero-cost modes of travel, and the infrastructure required to support these modes is also relatively low cost, reducing the fiscal burden on governments.
- Improved health: Comprehensive, well-maintained, and safe cycling and walking infrastructure results in increased activity, better mental and physical health, lower obesity rates, and lower rates of absenteeism from work.
- Environmental benefits: GHG reductions and air pollution are reduced, as is the area of land used for transportation.

Table 11. Implementation strategies to reduce the need to travel.

Strategy	**Enhanced Accessibility**
Measure	• **Create complete communities** • **Expand transit and active infrastructures**
Modeled low -carbon targets	By 2050, 20% of trips below one mile are completed by walking, and10% of trips between 1 and 6 miles are completed by biking.
GHG impact	Low
Investment required	$$
Return on investment	$$
Performance metric	• Biking and walking mode shares in the county • Transit mode share in the county • Average vehicle-miles traveled (VMT) per household per year

Strategy		Enhanced Accessibility				
Measure		• **Create complete communities** • **Expand transit and active infrastructure**				
Implementation Mechanism		**Action**	**County Role**	**Potential Partner(s)**	**Timing**	**Potential Funding**
Policy	19	In accordance with established procedures, assess options for revising existing and new zoning codes to advance mixed-use, pedestrian-friendly, transit-oriented development.	County leads	BCDCOG	2025	—
Policy	20	Establish an objective that new developments outside Urban Growth Boundary to affordable housing and net-zero emissions projects	County leads	Local municipalities	2026	• None required

Strategy		Enhanced Accessibility			
Measure		• **Create complete communities** • **Expand transit and active infrastructure**			
Implementation Mechanism		**Action**	**County Role**	**Potential Partner(s)**	**Timing**	**Potential Funding**
Initiative [Equity Focus]	21	Apply Complete Communities policies[82] for priority LIDC neighborhoods with incentives such as reducing parking minimums (already enabled for affordable housing projects), where feasible and applicable.	County advocates	Local municipalities with urban core areas, local businesses and community organizations, residents.	2026	• Carbon Reduction Program (Federal Highway Administration [FHWA]) • Neighborhood Access and Equity Grant Program (DOT) • Safe Streets and Roads for All (DOT) • Transportation Alternatives Set-Aside (FHWA)
Infrastructure [Equity Focus]	22	Expand and improve active transportation infrastructure. Focus investments in LIDC neighborhoods and major activity centers.	County leads	SCDOT, BCDCOG, local municipalities, local businesses and community organizations, residents.	2025	• Carbon Reduction Program (FHWA) • Neighborhood Access and Equity Grant Program (DOT) • Safe Streets and Roads for All (DOT) • Transportation Alternatives Set-Aside (FHWA)

[82] *See: City of San Diego. Complete Communities: We're All In. Retrieved from: https://www.sandiego.gov/complete-communities*

Strategy	Enhanced Accessibility				
Measure	• **Create complete communities** • **Expand transit and active infrastructure**				
Implementation Mechanism	**Action**	**County Role**	**Potential Partner(s)**	**Timing**	**Potential Funding**
Infrastructure 23	Collaborate with BCDCOG and local municipalities to expand service to the regional public transit networks, including the Low Country Rapid Transit, CARTA's DASH, and theTriCounty LINK.	County supports	BCDCOG, CARTA, and local municipalities.	Ongoing	• Carbon Reduction Program (FHWA) • Environmental and Climate Justice Block Grants (EPA) • Environmental Review Implementation Funds (FHWA) • Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation (PROTECT) Formula Program

Strategy		Enhanced Accessibility				
Measure		• **Create complete communities** • **Expand transit and active infrastructure**				
Implementation Mechanism		**Action**	**County Role**	**Potential Partner(s)**	**Timing**	**Potential Funding**
Initiative [Equity Focus]	24	Support BCDCOG in developing a Multi-Modal, Safe Streets for All Transportation Plan including identifying policies and investments for LIDC neighborhoods.	County supports	BCDCOG leads. Potential partners include FHWA, SCDOT, and local municipalities.	2026	• Carbon Reduction Program (FHWA) • Environmental and Climate Justice Block Grants (EPA) • Neighborhood Access and Equity Grant Program (DOT) • Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation (PROTECT) Formula Program • Safe Streets and Roads for All (DOT) • Transportation Alternatives Set-Aside (FHWA)

Strategy		Enhanced Accessibility			
Measure		• **Create complete communities** • **Expand transit and active infrastructure**			
Implementation Mechanism		**Action**	**County Role**	**Potential Partner(s)**	**Timing**	**Potential Funding**
Education [Equity Focus]	25	Support outreach and education campaigns to encourage walking, bicycling, and riding transit.	County supports	BCDCOG, local municipalities, Charleston Moves, Second Chance Bikes	2027	• Carbon Reduction Program (FHWA); Environmental and Climate Justice Block Grants (EPA); Neighborhood Access and Equity Grant Program (DOT); Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation (PROTECT) Formula Program; Safe Streets and Roads for All (DOT); Transportation Alternatives Set-Aside (FHWA)
Initiative	26	Support the development of a last-mile delivery task force to identify innovative transportation solutions for businesses, including considering drone pilot projects.	County supports	Courier companies, delivery companies, businesses	2026	• Carbon Reduction Program (FHWA) • Environmental and Climate Justice Block Grants (EPA) • Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation (PROTECT) Formula Program

Strategy		Enhanced Accessibility				
Measure		• **Create complete communities** • **Expand transit and active infrastructure**				
Implementation Mechanism		**Action**	**County Role**	**Potential Partner(s)**	**Timing**	**Potential Funding**
Program [Equity Focus]	27	Expand e-bike/bike share programs in LIDC neighborhoods, as financially feasible.	County leads	Local municipalities, local businesses and organizations, residents.	2025	• Carbon Reduction Program (FHWA) • Neighborhood Access and Equity Grant Program (DOT) • Safe Streets and Roads for All (DOT) • Bicycle and Pedestrian Program (FHWA)

7.2.2 Zero-Emissions Vehicles for All

Despite the rapidly decreasing prices, increasing availability, and the presence of major electric vehicle manufacturing facilities in the state, uptake for electric vehicles in terms of ownership and charging networks is comparatively low. A combination of interventions and collaboration across the entire county will enable decarbonization of residential, municipal, and commercial vehicle fleets.

Co-benefits, Co-harms, and Equity Considerations:

- Reduced gasoline and diesel combustion in vehicles decreases air pollutants, which is particularly beneficial for youths and the elderly.
- EVs are quieter than gasoline and diesel vehicles, providing additional health and social benefits.
- EVs are more affordable to operate than other vehicle types, reducing energy costs for households and businesses.
- EVs can also provide vehicle-to-grid services, generating additional income and providing benefits to the electricity grid.

Table 12. Implementation strategies for decarbonizing vehicles.

Strategy	**Zero-Emissions Vehicles for All**
Measure	• **Electrify County fleet** • **Electrify light-duty vehicles** • **Switch mid-to-heavy duty vehicles to ZEV**
Modeled low-carbon targets	Personal-use vehicles: By 2035, all new personal, light-duty vehicles sold are electric. Shift mid-to-heavy-duty vehicles to ZEVs. Commercial vehicles: By 2035, all new commercial, light-duty vehicles sold are electric. By 2045, for all new mid-to-heavy-duty vehicles, 50% will be electric, 50% will be ZEVs. Marine, rail, and aviation sub-sectors: Vehicles in these sub-sectors switch to zero-emissions fuel.
GHG impact	Very High
Investment required	$$$
Return on investment	$$$$
Performance metric	• Number of electric vehicles sold • Number of DC Fast Charging stations installed at public and commercial buildings • Share of aviation and marine fuel sold that is zero-emissions • kWh of shore power consumption

Strategy		Zero-Emissions Vehicles for All				
Measure		• **Electrify County fleet** • **Electrify light-duty vehicles** • **Switch mid-to-heavy-duty vehicles to ZEVs**				
Implementation Mechanism		**Action**	**County Role**	**Potential Partner(s)**	**Timing**	**Potential Funding**
Initiative	28	Right-size and decarbonize the municipal fleet and equipment at the point of vehicle replacement, considering vehicle use, available technologies and business case.	County leads	-	Ongoing	• Clean Heavy-Duty Vehicles Grants and Rebates (EPA) • Clean Vehicle Tax Credit (Treasury) • Commercial Clean Vehicles Tax Credit (Treasury) • Environmental and Climate Justice Block Grants (EPA) • Neighborhood Access and Equity Grant Program (DOT) • Tax Credit For Alternative Refueling Property (Treasury) • Tax Credit for Previously Owned Clean Vehicles (Treasury)

Strategy		Zero-Emissions Vehicles for All				
Measure		• **Electrify County fleet** • **Electrify light-duty vehicles** • **Switch mid-to-heavy-duty vehicles to ZEVs**				
Implementation Mechanism		**Action**	**County Role**	**Potential Partner(s)**	**Timing**	**Potential Funding**
Program [Equity Focus]	29	Provide Cars 4 All incentives to help lower-income consumers living in priority populations to replace their old higher-polluting vehicles with newer and cleaner transportation, subject to grant funding. Participants have the option to purchase or lease new or used hybrid, plug-in hybrid electric vehicles (PHEV), battery electric vehicles (BEV) or zero-emission vehicles (ZEV) or an alternative mobility option such as an e-bike, voucher for public transit, or a combination of clean transportation options. Additionally, buyers of PHEVs and BEVs are also eligible for home charger incentives or prepaid charge cards if home charger installation is not an option.	County leads	South Carolina Energy Office	2025	• Clean Vehicle Tax Credit (Treasury) • Environmental and Climate Justice Block Grants (EPA) • Neighborhood Access and Equity Grant Program (DOT) • Tax Credit For Alternative Refueling Property (Treasury) • Tax Credit for Previously Owned Clean Vehicles (Treasury)

Strategy		Zero-Emissions Vehicles for All				
Measure		• **Electrify County fleet** • **Electrify light-duty vehicles** • **Switch mid-to-heavy-duty vehicles to ZEVs**				
Implementation Mechanism		**Action**	**County Role**	**Potential Partner(s)**	**Timing**	**Potential Funding**
Infrastructure [Equity Focus]	30	Support installations of DC Fast Charging stations in LIDC neighborhoods, subject to grant funding.	County supports	SC Energy Office, power utilities, business sector, developers, building owners	2025	• Environmental and Climate Justice Block Grants (EPA) • Neighborhood Access and Equity Grant Program (DOT) • Tax Credit For Alternative Refueling Property (Treasury)
Policy	31	Review land development regulations and consider incorporation of charging stations, solar canopies, permeable surfaces, and other Climate- Positive Design solutions for parking lots and major developments.	County leads	Support of local municipalities	2025	• No funding required

Strategy		Zero-Emissions Vehicles for All				
Measure		• **Electrify County fleet** • **Electrify light-duty vehicles** • **Switch mid-to-heavy-duty vehicles to ZEVs**				
Implementation Mechanism		**Action**	**County Role**	**Potential Partner(s)**	**Timing**	**Potential Funding**
Education	32	Support partner organizations in expanding existing smart commute programs like Trident Rideshare and Lowcountry Go. Coordinate with major employers to support zero-emissions transportation.	County supports	Major employers, BCDCOG, CARTA	Ongoing	• Carbon Reduction Program (FHWA) • Environmental and Climate Justice Block Grants (EPA) • Neighborhood Access and Equity Grant Program (DOT) • Safe Streets and Roads for All (DOT)
Advocacy [Equity Focus]	33	Coordinate with BCDCOG on strategies to electrify the transit fleet, including charging infrastructure and enabling land-use policies.	County supports	BCDCOG, local governments	Ongoing	• Carbon Reduction Program (FHWA) • Bus and Bus Facilities Formula Grants (FTA) • Diesel Emissions Reduction Act (DERA) Funding (EPA) • Tax Credit For Alternative Refueling Property (Treasury) • Charging and Fueling Infrastructure Discretionary Grant Program (FHWA)

Strategy		Zero-Emissions Vehicles for All				
Measure		• **Electrify County fleet** • **Electrify light-duty vehicles** • **Switch mid-to-heavy-duty vehicles to ZEVs**				
Implementation Mechanism		**Action**	**County Role**	**Potential Partner(s)**	**Timing**	**Potential Funding**
Initiative	34	Support businesses in developing collaborative green fleet strategies such as procurement coordination, leasing strategies, charging station deployment, and pilot projects for new technologies (like zero-emission trucks) and EV- sharing models.	County supports	Green business coalition, organizations with large fleets	2025	• Clean Heavy-Duty Vehicles Grants and Rebates (EPA) • Clean Vehicle Tax Credit (Treasury) • Commercial Clean Vehicles Tax Credit (Treasury) • Environmental and Climate Justice Block Grants (EPA) • Neighborhood Access and Equity Grant Program (DOT) • Tax Credit For Alternative Refueling Property (Treasury) • Tax Credit for Previously Owned Clean Vehicles (Treasury)

Strategy		Zero-Emissions Vehicles for All				
Measure		• **Electrify County fleet** • **Electrify light-duty vehicles** • **Switch mid-to-heavy-duty vehicles to ZEVs**				
Implementation Mechanism		**Action**	**County Role**	**Potential Partner(s)**	**Timing**	**Potential Funding**
Infrastructure	35	Advocate for BCDCOG to investigate the inclusion of electric ferries along major waterways as part of their public transit system to reduce congestion and increase accessibility.	County supports	BCDCOG, water transport authorities, ferry and water taxi companies	2026	• Electric or Low-Emitting Ferry Pilot Program (FTA) • Passenger Ferry Grant Program (FTA)
Infrastructure	36	Advocate for Port of Charleston to provide renewable shore power services.	County advocates	SC Ports Authority	2025	• Clean Ports Program (EPA) • Diesel Emissions Reduction Act (DERA) Funding (EPA) • Port Infrastructure Development Program (USDOT) • Charging and Fueling Infrastructure Discretionary Grant Program (FHWA)

Strategy		Zero-Emissions Vehicles for All				
Measure		• **Electrify County fleet** • **Electrify light-duty vehicles** • **Switch mid-to-heavy-duty vehicles to ZEVs**				
Implementation Mechanism		**Action**	**County Role**	**Potential Partner(s)**	**Timing**	**Potential Funding**
Infrastructure	37	Support the airport in supplying electric and low-carbon fuel options for clean aviation.	County supports	Charleston County Aviation Authority	2025	• Airport Improvement Program (FAA) • Airport Terminals Program (FAA) • Contract Tower Competitive Grant Program (FAA)
Infrastructure	38	Support rail companies in switching to battery-electric or other clean-fuel-powered locomotives.	County supports	SC Ports Authority, Amtrak, Rail companies	2026	• Interstate Rail Compacts Grant Program (FRA) • Corridor Identification and Development Grant Program (FRA) • Consolidated Rail Infrastructure and Safety Improvements (CRISI) Program (FRA)

Equity and the Cost of Transportation

EVs are not accessible to everyone, and even though they are very efficient vehicles, other transportation modes like walking, bicycling, and transit are more efficient and lower cost. Prioritizing investments in these modes over private vehicles is the priority from an equity perspective.

A car co-operative is a strategy to provide access to vehicles at a lower cost. Some cities require new developments to provide allocated parking spots for car co-operatives to ensure their availability.

Electric Ferries

The current water transportation services operating within the geographic boundaries of Charleston County are designed to cater to tourists rather than commuters. In many coastal cities like Sydney and Hong Kong, ferry services are an integral part of the public transportation network, providing an alternative mode of transportation to road travel. The King County Water Taxi in Seattle, operated by the King County Metro Transit Department, operates passenger ferries between downtown Seattle and destinations in the Puget Sound region.

Since ferries can transport a large number of passengers and vehicles in a single trip, they are much more space efficient compared to individual cars and can alleviate congested road networks, especially for coastal or island communities connected by bridges. When powered by electricity, or even directly by renewable energy sources like solar or wind, water ferries would emit far fewer GHG emissions than diesel- or gasoline-powered ferries. E-ferries also maximize rider comfort by removing noise, fumes, and vibrations, which would also benefit local marine life.

7.3 Big Move 3: Clean Energy for All

Fuel switching is an important part of the net-zero energy transition in which many activities move from fossil fuels to low-carbon sources, with an emphasis on electricity. Charleston County's CAP envisions more electric space heating, electric vehicles, and electrical processes in industry. A supply of net-zero-emissions electricity is essential for that vision, now and in the future. Electricity could either be supplied directly through the power grid or through local renewable energy generation from sources like wind and solar.

Strategy and Design Considerations:

- The State Energy Plan does not include a plan to decarbonize the electricity system; however, the declining cost of renewable energy technologies combined with federal tax credits is likely to result in a lower carbon footprint of the electricity from the grid in the future. The current electricity generation mix includes nuclear, coal, natural gas, hydro, and some renewables in the form of solar and biomass.[83] Two of the power utilities operating in the Charleston County region, Dominion Energy and Santee Cooper, have submitted Integrated Resources Plans that aim to retire existing coal plants and replace these plants with high-efficiency natural-gas-fired plants, citing reliability and affordability as their rationale.[84,85]
- The SC Energy Office hosts an online information portal on solar power (solar.sc.gov) with resources and tools for individuals, businesses and organizations in South Carolina. Some of the tools provided include a solar siting tool (Figure 42) and annual reports on solar photovoltaic installations in the state.

[83] *SC Energy Office. South Carolina Energy Landscape. Retrieved from https://south-carolina-energy-office-1-1-scors-eo.hub.arcgis.com/pages/electricity-data*

[84] *Dominion Energy South Carolina, Inc. (2023). Integrated Resource Plan. January 30, 2023. Retrieved from https://dms.psc.sc.gov/Attachments/Matter/ee0417c1-e32f-47f4-a9ee-fd3dc0725186*

[85] *Santee Cooper. (2023). Integrated Resource Plan. May 15, 2023. Retrieved from https://energy.sc.gov/sites/energy/files/Documents/2023%20Santee%20Cooper%20IRP.pdf*

Figure 42. Suitable sites for solar installations in Charleston County.[86]

[86] *Image retrieved from the South Carolina Department of Natural Resources Solar Siting Tool on February 20, 2024. The tool is available at https://scdnr.maps.arcgis.com/apps/webappviewer/index.html?id=c6cd786bb8674743aa877f36cc1af36c*

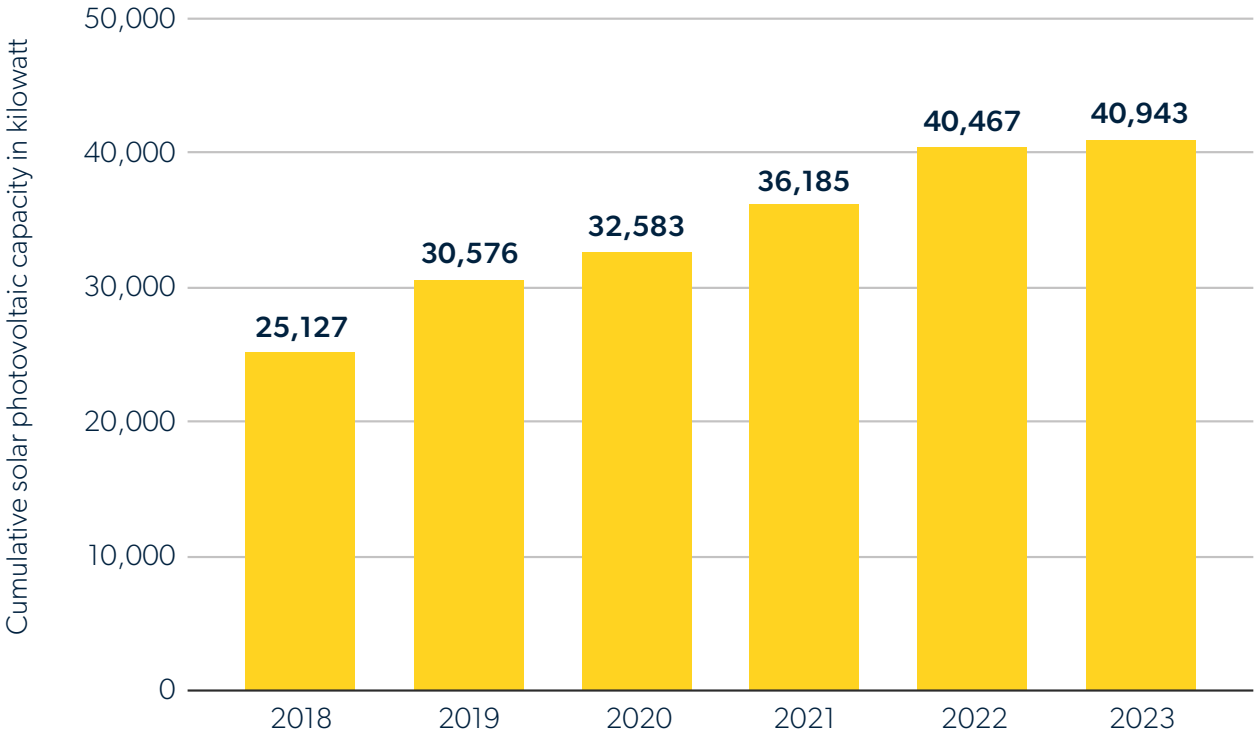


Figure 43. Solar photovoltaic installations are increasing each year in Charleston County.[87]

- Charleston County has 985 battery storage installations with a combined capacity of 6,604 kilowatts—the highest number of all counties in South Carolina.
- Charleston County has good onshore and offshore wind resources (Figures 44 and 45), and one of its local municipalities—the City of Charleston—passed an ordinance establishing support for offshore wind.[88]
- South Carolina has an established wind manufacturing industry with several companies producing components for wind power projects around the world; however, there is no offshore wind installation in the state. The Bureau of Ocean Energy Management (BOEM) oversees the approval process for offshore wind development and has recently issued a commercial lease for an offshore wind project in Carolina Long Bay spanning both North Carolina and South Carolina. This project will likely see the start of more wind power projects in the near future providing clean renewable energy to the power grid and expanding economic development in the region.

[87] *Data retrieved from the SC Energy Office Data Hub on February 20, 2024. The information is available at https://south-carolina-energy-office-1-1-scors-eo.hub.arcgis.com/pages/renewables*

[88] *City of Charleston (2013). A Resolution in Support of Offshore Wind Energy Development. Retrieved from https://www.charleston-sc.gov/DocumentCenter/View/2205/Offshore-Wind-Energy-Resolution-Signed?bidId=*

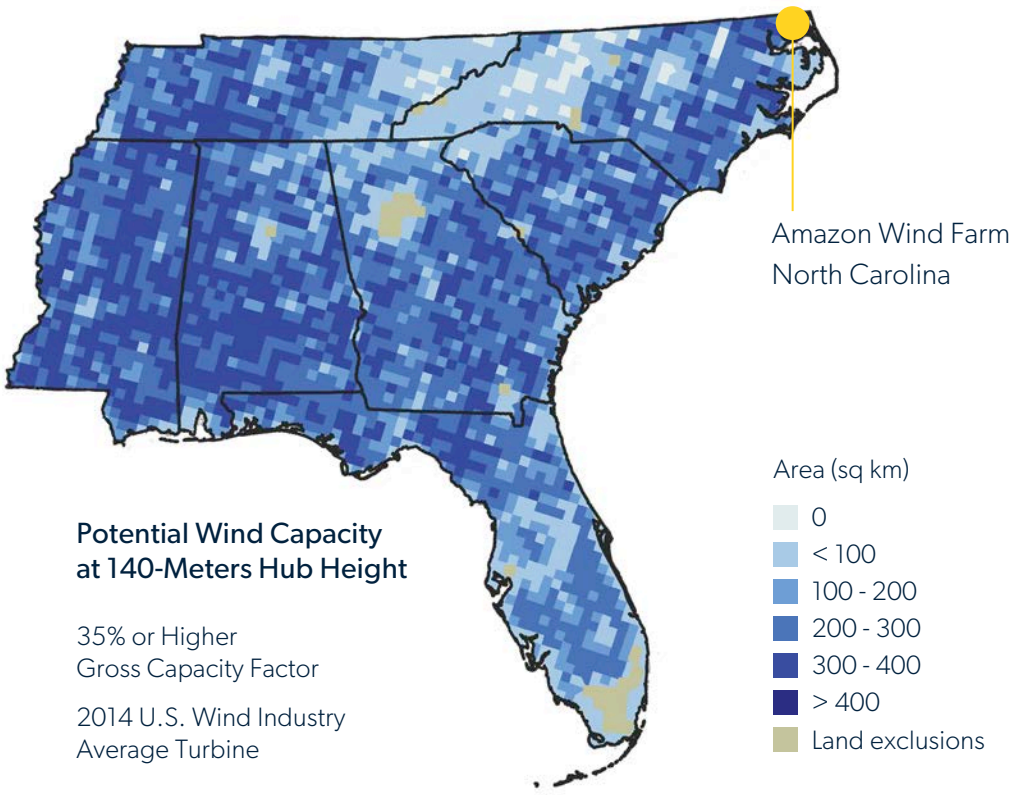


Figure 44. Onshore wind power potential in the United States Southeast region.[89]

[89] *Southern Alliance for Clean Energy. Amazon Wind Farm North Carolina-Desert Wind Fact Sheet. Retrieved from https://cleanenergy.org/wp-content/uploads/F-Amazon-Wind-Farm-Fact-Sheet-SACE.pdf*

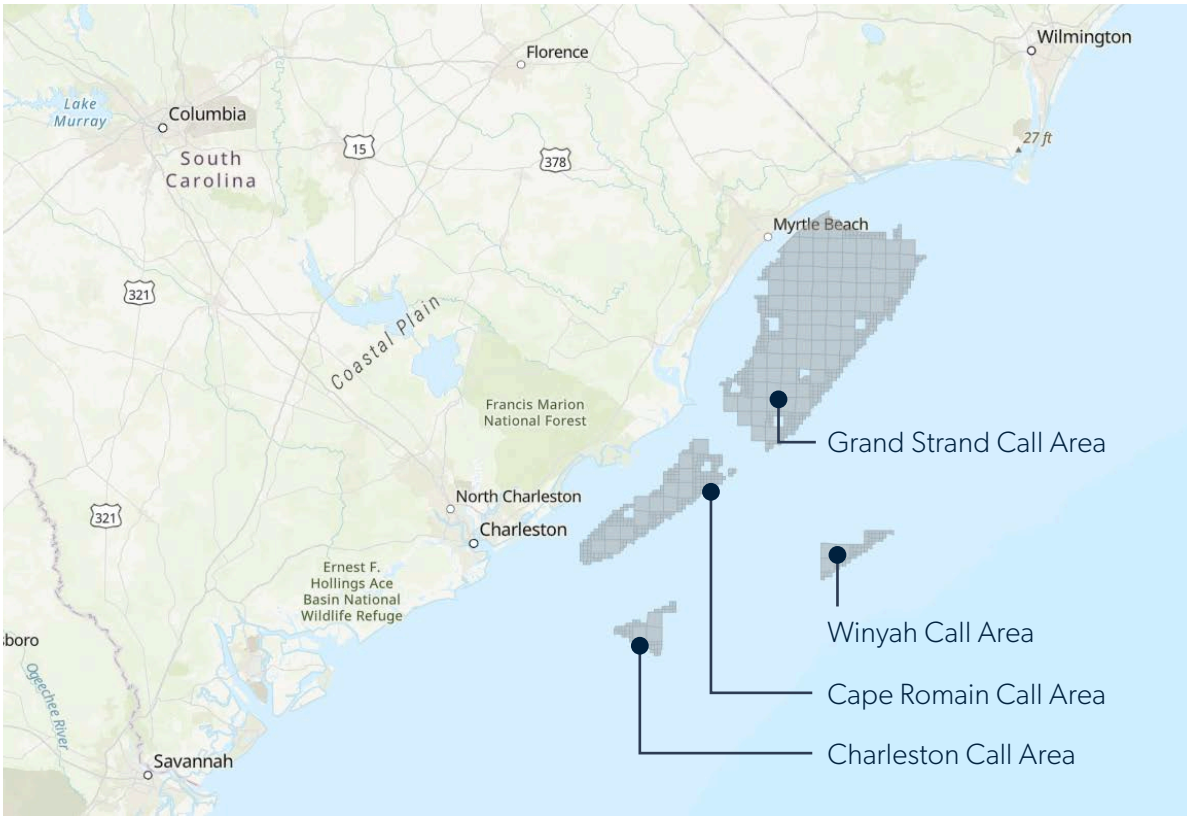


Figure 45. South Carolina Call Areas—continental shelf with wind power potential—designated by the Bureau of Ocean Energy Management. [90]

[90] *South Carolina Sea Grant Consortium. Prevailing Winds: Building Momentum Offshore. Coastal Heritage Magazine Volume 35- Number 1. Spring 2022. Retrieved from https://www.scseagrant.org/prevailing-winds/*

Table 13. Implementation strategies for clean energy generation.

Strategy	**Clean Energy for All**
Measure	**Increase local, renewable energy generation capacity**
Modeled low -carbon targets	Install 390 MW of wind generating capacity and 780 MW of ground-mount solar farms by 2040 to provide clean electricity for Charleston County[91]
GHG impact	Very High
Investment required	$$$$
Return on investment	$$$$
Performance metric	• Annual grid emissions factor • Number and capacity of solar rooftops installed annually • Number and capacity of ground-mount solar farms installed annually • Number and capacity of wind turbines installed annually • Number and capacity of energy storage systems installed annually • kWh of renewable electricity generated annually • kWh of energy stored annually

[91] *The modeled low-carbon target for solar installations is directionally aligned with Dominion Energy's 2024 Reference Build Plan proposed in the Updated 2024 Integrated Resource Plan, released on March 28, 2024.*

Strategy		Clean Energy for All				
Measure		**Increase local, renewable energy generation capacity**				
Implementation Mechanism		**Action**	**County Role**	**Potential Partner(s)**	**Timing**	**Potential Funding**
Infrastructure	39	Continue to deploy solar PV projects for municipal facilities, where there is a business case.	County leads	-	Ongoing	• Clean Electricity Investment Tax Credit (Treasury) • Environmental and Climate Justice Block Grants (EPA) • Low-Income Communities Bonus Credit (Treasury) • Green and Resilient Retrofit Program Grants and Loans (HUD) • Solar for All Grant Program (EPA)
Initiative	40	Explore affordable, green energy options for the community and businesses with utilities serving the Charleston County area.[92]	County leads		2025	• No funding required

[92] *Duke Energy and the City of Charlotte, NC signed an agreement that laid out the ways they could partner on clean energy work.and subsequently signed a large-scale deal through Duke Energy's new Green Source Advantage green tariff program.*

Strategy		Clean Energy for All			
Measure		**Increase local, renewable energy generation capacity**			
Implementation Mechanism		**Action**	**County Role**	**Potential Partner(s)**	**Timing**	**Potential Funding**
Advocacy	41	Emphasize the importance of clean electricity for the County's Climate Action plan to the Public Service Commission.	County leads	-	2025	• No funding required initially
Program	42	Partner with appropriate organizations to develop a group buy programs[93] for residential and commercial building owners to purchase and install solar and energy storage systems.	County supports	Renewable power companies, homeowners, building owners, local businesses	2026	• Clean Electricity Investment Tax Credit (Treasury) • Environmental and Climate Justice Block Grants (EPA) • Low-Income Communities Bonus Credit (Treasury) • Green and Resilient Retrofit Program Grants and Loans (HUD) • Solar for All Grant Program (EPA)

[93] *Solar group buy programs use the power of bulk purchasing to lower the base rate for solar panels, making it more accessible and affordable for customers. Example programs are the Solar Switch program in Chicago, MadiSUN program by City of Madison in Wisconsin, and Legacy Solar Co-op in Iowa.*

Strategy		Clean Energy for All				
Measure		**Increase local, renewable energy generation capacity**				
Implementation Mechanism		**Action**	**County Role**	**Potential Partner(s)**	**Timing**	**Potential Funding**
Program [Equity Focus]	43	Partner with appropriate organizations to develop a community solar garden program[94] for LIDC neighborhoods.	County supports	Renewable power companies, electric cooperatives, climate justice groups	2026	• Solar for All Grant Program (EPA); Environmental and Climate Justice Block Grants (EPA) • Low-Income Communities Bonus Credit (Treasury) • Clean Electricity Investment Tax Credit (Treasury) • Clean Electricity Production Tax Credit (Treasury)
Initiative	44	Participate in the effort to develop a business hub for offshore wind as part of the economic development strategy in Charleston County.	County supports	Charleston, Regional Development Alliance, DOE Wind Energy Technologies Office, SC Energy Office	2025	• No funding required

[94] *Community solar garden is a subscription program where community members can invest in solar energy without having to install their own solar panels. Boulder, CO has solar garden programs dedicated to income-qualified participants since 2021.*

Strategy		Clean Energy for All				
Measure		**Increase local, renewable energy generation capacity**				
Implementation Mechanism		**Action**	**County Role**	**Potential Partner(s)**	**Timing**	**Potential Funding**
Advocacy	45	Support partner organizations in developing an energy storage program including vehicle to grid for residential and commercial vehicles.	County supports	Utilities, SC Energy Office	2027	• Environmental and Climate Justice Block Grants (EPA) • Rural Energy for America Program Renewable Energy Systems & Energy Efficiency Improvement Guaranteed Loans & Grants (USDA) • Low-Income Communities Bonus Credit Program (Treasury)
Program [Equity Focus]	46	Support partner organization in establishing a workforce development program[95] to build local capacity and expertise for installing, operating, and maintaining renewable energy installations catering to LIDC populations.	County supports	SC Energy Office, trade unions, training centers, renewable energy companies	2025	• Brownfields Job Training Grants (EPA) • Industrial Assessment Centers Implementation Grant (DOE) • Energy Auditor Training Grant Program (DOE) • Career Skills Training Program (DOE)

[95] *See American Council for Energy-Efficient Economy (ACEEE) briefing on "Cities and Clean Energy Workforce Development" for examples and case studies from other municipalities. Available at https://www.aceee.org/topic-brief/cities-and-clean*

7.4 Big Move 4: Innovative Industrial and Agricultural Sectors

Shift industrial and agricultural machinery to electricity where possible and to low- or zero-emissions fuel when not. Identify and implement agricultural practices that can improve carbon sequestration and reduce GHG emissions from fertilizers, livestock, and crop losses.

While the County has limited direct input on the operational choices of existing industry, industry energy and emissions profiles are being shaped by factors such as federal regulations and consumer demand. The County can facilitate and support engagement of businesses by convening working groups, sharing the best practices, and publicly showing support.

Table 14. Implementation strategies for innovating industry and agriculture sectors.

Strategy	**Innovative Industrial and Agricultural Sectors**
Measure	• **Improve and electrify agricultural sector processes** • **Improve industrial sector processes**
Modeled low-carbon targets	• Improved agricultural practices reduce emissions by 30%. Shift agriculture fuel use to electricity. • Industrial processes are 20% more efficient by 2030 and 30% by 2050 relative to the 2020 baseline.
GHG impact	Low
Investment required	$
Return on investment	$
Performance metrics	• Number of agricultural sector workers engaged • Number of industrial sector workers engaged

Strategy		Innovative Industrial and Agricultural Sectors				
Measure		• **Improve and electrify agricultural sector processes** • **Improve industrial sector processes**				
Implementation Mechanism		**Improve industrial sector processes**	**County Role**	**Potential Partner(s)**	**Timing**	**Potential Funding**
Education	47	Leverage existing sustainable agriculture task force and organizations to identify actions to support local farms and reduce GHG emissions.	County supports	Local farmers and distributors; Local agricultural extension office	2025	• Urban and Community Forestry Assistance Program (U.S. Forest Service) • State and Private Forestry Conservation Programs (DOA) • Investing in Coastal Communities and Climate Resilience
Program	48	Assess the inclusion of carbon sequestration in the Greenbelt Program.	County leads	Local governments	2026	• Charleston County Greenbelt Program • Urban and Community Forestry Assistance Program (U.S. Forest Service) • State and Private Forestry Conservation Programs (DOA) • Investing in Coastal Communities and Climate Resilience

Strategy		Innovative Industrial and Agricultural Sectors				
Measure		• **Improve and electrify agricultural sector processes** • **Improve industrial sector processes**				
Implementation Mechanism		**Improve industrial sector processes**	**County Role**	**Potential Partner(s)**	**Timing**	**Potential Funding**
Initiative	49	Consider incentives and technical assistance for local landowners and organizations to undertake ecological restoration projects, supporting carbon sequestration.	County leads	Local extension office	2026	• Charleston County Greenbelt Program • Urban and Community Forestry Assistance Program (U.S. Forest Service) • State and Private Forestry Conservation Programs (DOA) • Investing in Coastal Communities and Climate Resilience
Initiative	50	Advocate for industry decarbonization as one of the key strategies for regional economic development.	County supports	Charleston Regional Development Alliance	2025	• Advanced Energy Manufacturing and Recycling Grants (DOE) • Energy Infrastructure Reinvestment Financing (DOE)

7.5 Big Move 5: Circular Economy

South Carolina produced 5 million tons of waste in 2021, of which 1.2 million tons was diverted.[96] About 21% of the waste was organic food waste, which can be composted. The remaining 77% was paper, plastics, and metal. In the Low-Carbon Scenario, waste management practices are enhanced to increase recycling and diversion rates. Overall, GHG emissions from the waste sector are halved from 180 $kMtCO_2e$ in 2020 to 95 $kMtCO_2e$ by 2050.

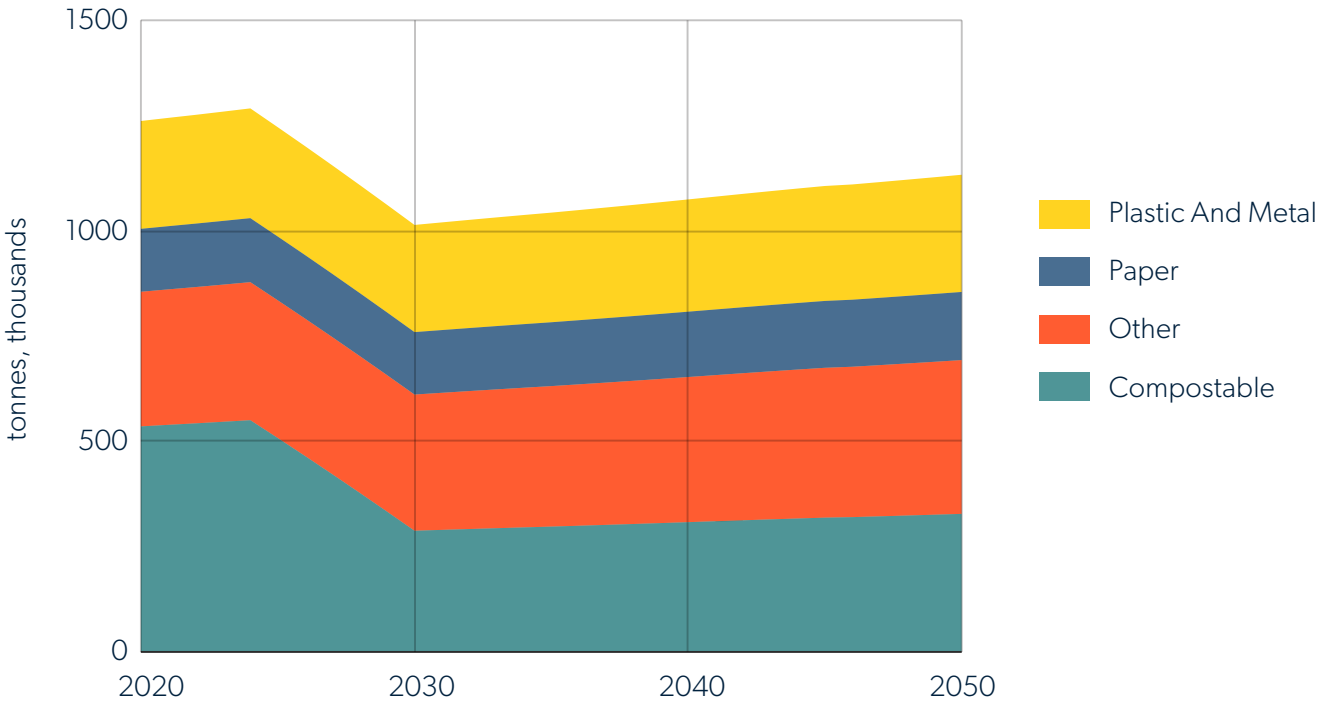


Figure 46. Waste generation by type of waste, Low-Carbon Scenario, 2020–2050.

[96] *DHEC's Office of Solid Waste Reduction and Recycling. (2021). South Carolina Solid Waste Management Annual Report. Retrieved from: https://scdhec.gov/sites/default/files/media/document/SC_SolidWasteManagementAnnualReport_FY21_OR-2302_2.pdf*

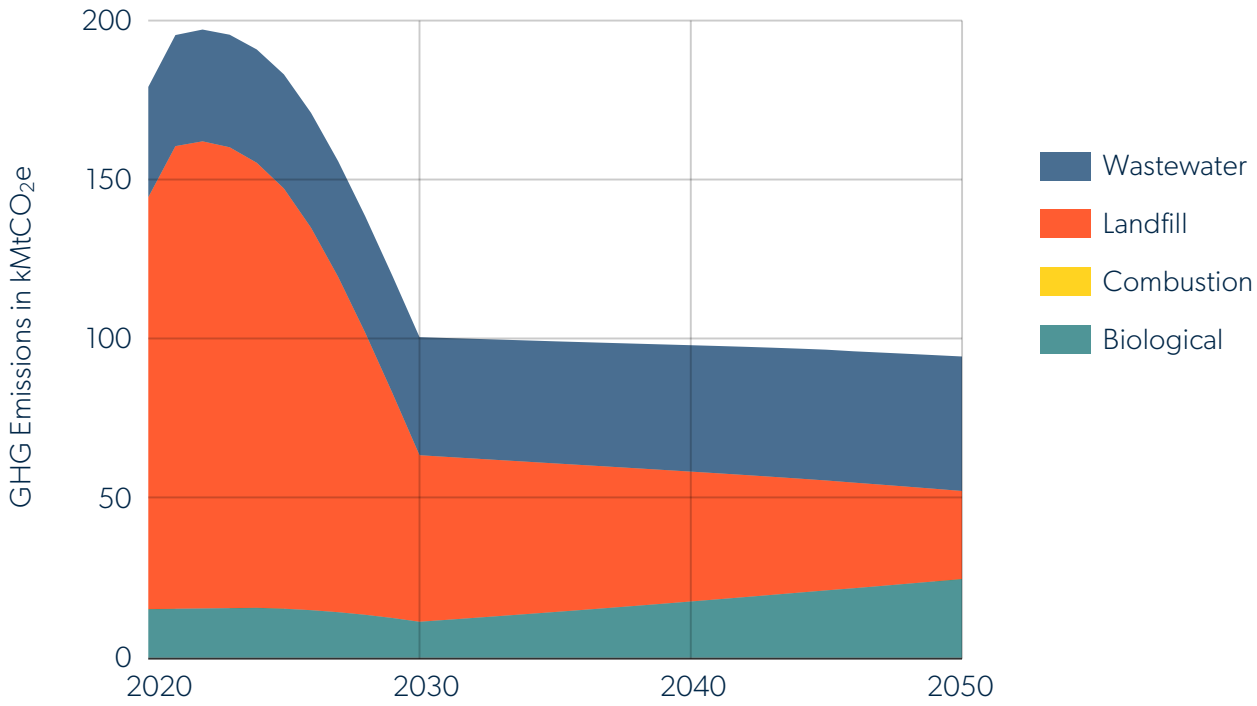


Figure 47. GHG emissions by waste treatment process, Low-Carbon Scenario, 2020–2050.

The primary source of GHG emissions from waste is the breakdown of organic matter in landfills over time. The most effective strategy to address waste emissions requires a combination of reducing the amount of waste generated while also increasing the diversion of waste from landfills, then capturing emissions from the landfill (known as biogas), and generating renewable natural gas by upgrading or cleaning the biogas.

A key strategy to divert waste from the landfill is the idea of the circular economy, where products at their end of life become new products, or feedstock for new products or services so that there is no waste.

Strategy and Design Considerations:

- South Carolina has goals to reduce municipal solid waste to 3.25 pounds per person per day and to recycle at least 40% of its waste. In 2021, the rate of disposal was 4.0 pounds per person per day and the recycling rate was 24% of waste generated.[97]
- Charleston County Environmental Management (CCEM) manages the collection or recycling and disposal of solid waste at the Bees Ferry Landfill, a 312-acre facility for local municipalities in Charleston County with sites for disposal, recycling, and composting.

Co-benefits, Co-harms and Equity Considerations:

- Less organic waste in the landfill means less odor from decaying food and yard waste, which would improve the local outdoor air quality.
- New circular economy initiatives would drive innovation and potentially create jobs.
- Municipal services will need to diversify to provide more streams of waste services, which could potentially impact municipal finances, depending on the type and frequency of services provided.

[97] *SC Department of Health and Environmental Control. South Carolina Solid Waste Management Annual Report. Fiscal Year 2021. Retrieved from https://scdhec.gov/sites/default/files/media/document/SC_SolidWasteManagementAnnualReport_FY21_OR-2302_2.pdf*

Table 15. Implementation strategies for circular economy.

Strategy	Circular Economy
Measures	• **Reduce waste generation** • **Increase waste diversion from landfill**
Modeled low -carbon targets	Divert 95% of organics and 75% of remaining waste from landfill.
GHG impact	Medium
Investment required	Not available from model
Return on investment	Not available from model
Performance metrics	• Volume of waste generated • Volume of waste diverted

Strategy	Circular Economy				
Measures	• **Reduce waste generation** • **Increase waste diversion from landfill**				
Implementation Mechanism	**Action**	**County Role**	**Potential Partner(s)**	**Timing**	**Potential Funding**
Initiative 51	Conduct a waste audit every five years to identify trends in waste generation.	County supports	SCDHEC	2026	• Solid Waste Infrastructure for Recycling Grants (EPA) • Solid Waste Management Grants (USDA)

Strategy		Circular Economy				
Measures		• **Reduce waste generation** • **Increase waste diversion from landfill**				
Program	52	Collaborate with vendors to identify and close gaps in the current composting programs for residential, institutional, and commercial users with additional drop sites, educational programs and collection strategies. Evaluate the opportunity for a biodigester as an alternative to compost, which can also receive feedstock from agricultural, forestry, and wastewater sources.	County leads	SHDEC, community climate groups, schools, businesses	2025	• Consumer Recycling Education and Outreach Grant Program (EPA) • Solid Waste Infrastructure for Recycling Grants (EPA) • Solid Waste Management Grants (USDA)
Program	53	Collaborate with industry experts to develop a circular economy strategy (including recycling) that focuses on the ideas of zero landfill waste and using waste as a resource. The strategy could include multiple actions, such as: Buy Nothing Groups, Take-it-or Leave it Center, Repair Cafes, and kitchen composter bulk buy programs.	County leads	SHDEC, community climate groups, schools, businesses	2026	• Consumer Recycling Education and Outreach Grant Program (EPA) • Solid Waste Infrastructure for Recycling Grants (EPA) • Solid Waste Management Grants (USDA)

8 Monitoring and Evaluation

Sorting and processing of garbage
Photo by Vladyslav. Adobe Stock under SSG's license.

8 Monitoring and Evaluation

Tracking the effectiveness of the actions in the CAP helps manage the risk and uncertainty associated with these efforts, as well as the external forces, such as evolving senior government policy and new technologies, which can disrupt the energy system. Key motivations for monitoring and evaluation include:

- Identifying unanticipated outcomes;
- Adjusting programs and policies based on their effectiveness;
- Managing and adapting to the uncertainty of climate change; and
- Managing and adapting to emerging technologies.

Specific activities identified to support the implementation of the CAP include an annual work plan and review, an annual indicator report, an update of the GHG inventory every four years, and an update of the CAP every five years.

Table 16. Monitoring and evaluation activities.

Activity	Purpose	Description	Frequency
1. Annual work plan and review	Review work to-date and set annual priority actions	Annual report with prioritized actions	Annual
2. Annual indicator report	Track effectiveness of actions	Annual report on set of indicators with an analysis of the results	Annual
3. Inventory	Update energy and GHG emissions profile	Recalculate the GHG emissions and energy inventory	Every 4 years
4. Update the CAP	Update the CAP to reflect changing conditions	Review each action and the progress being achieved. Identify new actions.	Every 5 years

8.1 Annual Work Plan and Review

An annual work plan will identify activities to achieve the actions and policies in the plan, as well as the responsible parties, the budget, and the schedule. The results of the previous year's work plan should be reviewed to inform the development of subsequent work plans.

Carbon Budget

A carbon budget is a governance system that offers a way for municipalities to turn climate commitments into funded and measurable actions across the municipal government. It embeds climate targets, measures, and considerations into decision-making as part of a municipality's ordinary budgeting process.[98]

The carbon budget framework brings urgency to municipal carbon management by converting long-term targets into annual emissions limits or carbon budgets. All project proposals are quantified through a climate lens, the sum of which could then be evaluated against the carbon budget.

This framework would provide Charleston County with a powerful tool for prioritizing projects and mainstreaming climate action to encompass the entire organization.

8.2 Reporting Platform

Charleston County should report annually to the Carbon Disclosure Project (CDP),[99] which will enable the County to join international networks such as the Global Covenant of Mayors,[100] the UN's Race to Zero,[101] and WWF's One Planet Cities.[102] Each of these networks is a community of cities that can provide networking and profile to the County's efforts.

8.3 GHG Inventory

Charleston County should complete a GHG inventory according to the GHG Protocol for Community-Scale GHG Inventories,[103] the standard accounting protocol for GHG emissions, on a regular basis as this will enable the County to track its progress against targets. It will also support reporting to CDP.

---

[98] *C40. Climate Budget. https://www.c40knowledgehub.org/s/topic/0TO1Q000000x2DNWAY/climate-budgets?language=en_US*

[99] *The CDP platform is available here: https://www.cdp.net/en/cities*

[100] *Global Covenant of Mayors: https://www.globalcovenantofmayors.org/how-to-join/*

[101] *Race to Zero: https://www.c40knowledgehub.org/s/cities-race-to-zero?language=en_US*

[102] *WWF's One Planet Cities: https://wwf.panda.org/projects/one_planet_cities/*

[103] *WRI. (2021). GHG Protocol for Community Scale GHG Inventories. Retrieved from: https://ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities*

8.4 Annual Indicator Report

There are two aspects involved in the application of indicators: collecting data on indicators (monitoring) and interpreting the results of those indicators (evaluation). Over time, Charleston County can also evaluate its effectiveness in embedding the knowledge and wisdom gained through this process into the organization.

From the perspective of the CAP, there are multiple purposes for which data is collected: to evaluate the effectiveness of the actions, to evaluate the impact of the actions on the community, and to evaluate the uptake of the lessons from the evaluation.

Table 17. Types of indicators.

Indicator Category	Question
1. Effectiveness indicators	Are the actions achieving their objectives?
2. Impact indicators	What is the impact of the actions on the community?

8.5 Effectiveness Indicators

These indicators will be designed to evaluate whether or not policies or actions are having an effect. They will vary from municipality to municipality according to the specifics of the community energy and emissions plan. The results of the indicators are then compared against the assumption in the modeling to monitor whether or not the community is on track with projections. Indicators should be developed for each policy or mechanism.

The effectiveness indicators for Charleston County are listed as performance metrics in the implementation section of this report.

8.6 Impact Indicators

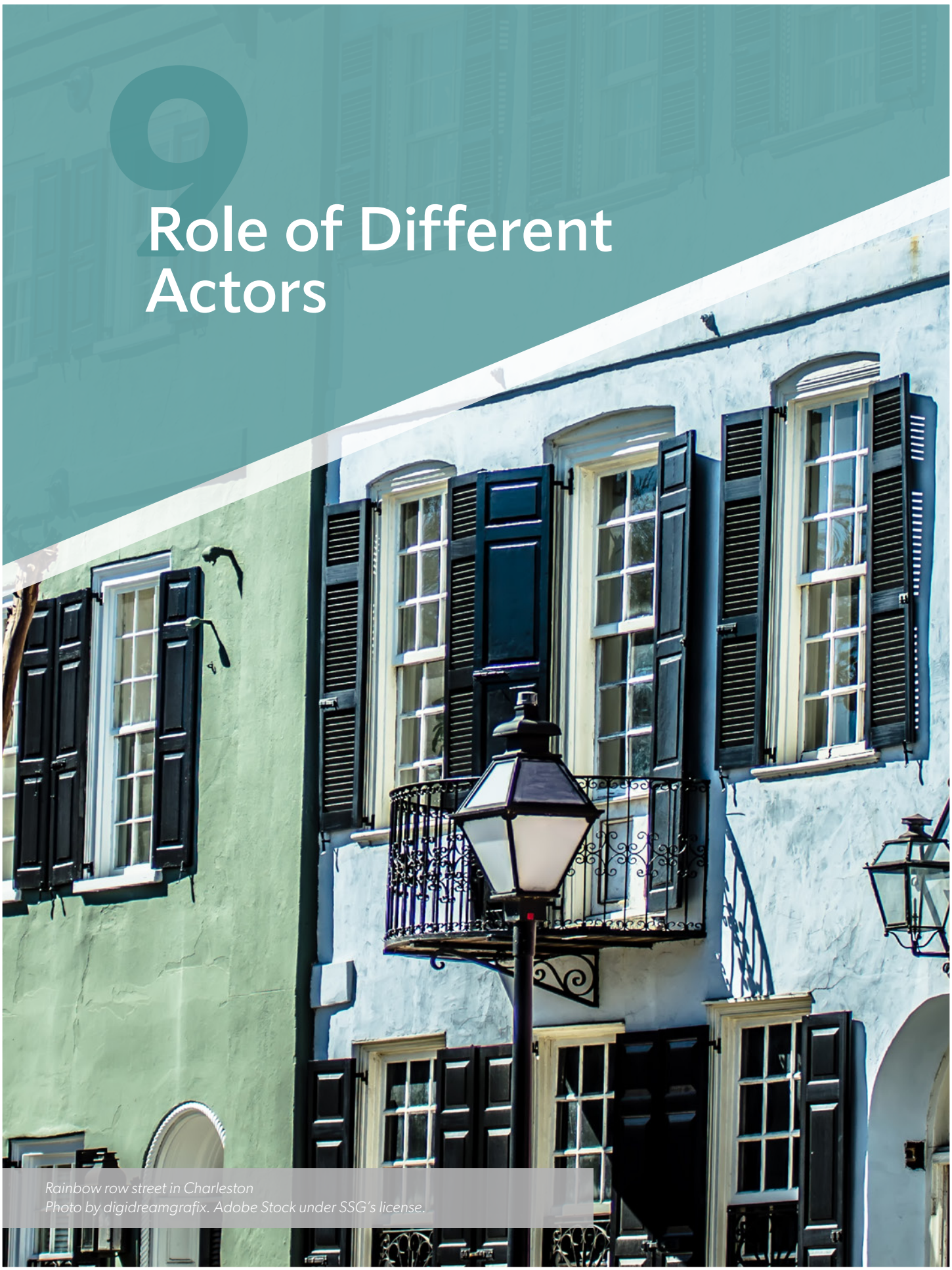
Charleston County can develop a set of indicators that track macro trends and drivers of GHG emissions. These are designed to be reported on each year.

Table 18. Indicators.

Indicator	Trend	Data sources
Total new dwellings by type	An indication of the growth of the building stock.	Buildings permits
Average total floor area of new dwellings	An indication as to whether there is more or less additional floor space to heat or cool.	Building permits

Indicator	Trend	Data sources
Diversity of dwelling types	An indication of the types of dwellings and whether or not they have shared walls.	Building permits
Total new non-residential floor space by type	An indication of the growth of the building stock.	Building permits
Total demolitions	An indication of the change in the building stock.	Demolition permits
Percentage of new dwelling units that are built within the Urban Growth Area	An indication as to whether or not residential development is occurring in areas more appropriate for walking, cycling, and transit.	Building permits and GIS analysis
Percentage of non-residential floor space that is occurring within the Urban Growth Area	An indication as to whether or not commercial development is occurring in areas more appropriate for walking, cycling, and transit.	Building permits and GIS analysis
Number of new dwellings that are within 400 m of a transit stop	Indication of transit accessibility.	GIS layers of transit and building footprint
Annual or monthly energy price by fuel (electricity, gasoline, diesel) ($/GJ)	Energy costs are an important indicator of opportunities for energy savings and renewable energy, household, municipal, and business energy costs.	Available from Dominion Energy South Carolina
Total energy consumption by sector for electricity (GJ)	An indication of trends in energy use in buildings.	Available from Dominion Energy South Carolina
Total solar PV installs (# of installations)	An indication of the extent of decentralized renewable energy.	Available from Dominion Energy South Carolina
Total gasoline sales ($)	An indication of GHG emissions from vehicles.	VMT from Replica
Total transit trips	An indication of whether or not non-vehicular trips are increasing.	Charleston County
Length of physically separated cycling lanes	An indicator of opportunity for people of all ages to cycle.	Charleston County

9 Role of Different Actors



Rainbow row street in Charleston
Photo by digidreamgrafix. Adobe Stock under SSG's license.

9 Role of Different Actors

9.1 The Role of the County

- **Implement the CAP:** The primary role of the County is to act as the steward of the CAP, using its regulatory authorities; developing policies; developing and implementing programs; convening partners, other municipalities, and other levels of government; advocating for policies or authorities that implement the CAP; making investments in infrastructure; and ensuring that its operations are in alignment with the objectives of the CAP.
- **Develop an annual carbon budget**: A carbon budget is a mechanism to align financial budgets with GHG targets in order to operationalize the CAP and ensure GHG reductions are an organization-wide responsibility.
- **Apply an equity lens for expenditures and policies**: An equity lens evaluates the impact of a policy or action on equity-seeking groups and identifies measures or changes that ensure no one is left behind.
- **Annual GHG and energy-use reporting**: The County can undertake annual reporting on energy, costs, and emissions. The annual report can also include a review of programs to determine the ones that are successful and the ones that need to be adjusted to be more effective.
- **Addressing the emissions gap**: While the Low-Carbon Scenario guides the decarbonization pathway, it is not enough to reach net-zero emissions by 2050. Therefore, during the annual reporting process, the County must take the opportunity to reassess the emissions gap and identify and implement opportunities where possible to close the gap.
- **Make sustainability someone's job**: Charleston County needs dedicated staff resources to develop pilot projects, build relationships with working groups, identify and apply for funding, and work within the County to decarbonize municipal operations.
- **Make municipal operations zero-emissions**: The County can commit to only constructing net-zero buildings and purchasing zero-emissions vehicles for its municipal fleet from 2024. The County can develop a decarbonization strategy to retrofit existing municipal buildings and improve municipal operations.
- **Create a financing strategy:** The CAP requires investments in buildings, transportation, renewable energy, and other technologies to drive down emissions. The County cannot mobilize the investments required on their own, but it can create the conditions that enable, encourage, or mandate these investments. A financing strategy would help the County differentiate between investments that apply specifically to municipal operations and investment needed to foster an enabling environment for CAP implementation, quantify the amount of investment required, and identify tools, funds, and partnerships that can be leveraged to meet the investment requirements.

- **Create a Community Climate Action Task Force:** A community task force can be a powerful mechanism for continuing to build community support for challenging climate actions. The task force can advise the County on climate actions, monitor CAP implementation progress, and serve as a forum for initiating or coordinating community-level programs.

9.2 The Role of Residents

Residents play an important role through actions related to their day-to-day lives, as well as by putting pressure on governments and businesses to institute positive change. Climate actions residents can take include, but are not limited to, those listed below:

- **Retrofit homes:** Add insulation, improve windows, and ensure tight air sealing.
- **Electrify equipment and appliances**: Switch to heat pumps for space heating and cooling and water heating, and switch to electric or induction heating for cooking. This may involve upgrading the electrical panel, modifying or replacing the ducting system, and adding new wiring.
- Walk, cycle, and take transit wherever possible.
- Purchase an electric vehicle, if possible.
- Install a solar system along with energy storage or participate in solar gardens.
- Advocate for climate action.
- Reduce household waste.

A detailed guide on how to leverage the IRA tax credits and grants is available at Rewiring Canada.[104]

[104] *Rewiring America. (2023). Your guide to the Inflation Reduction Act. Retrieved from: https://www.rewiringamerica.org/IRAguide*

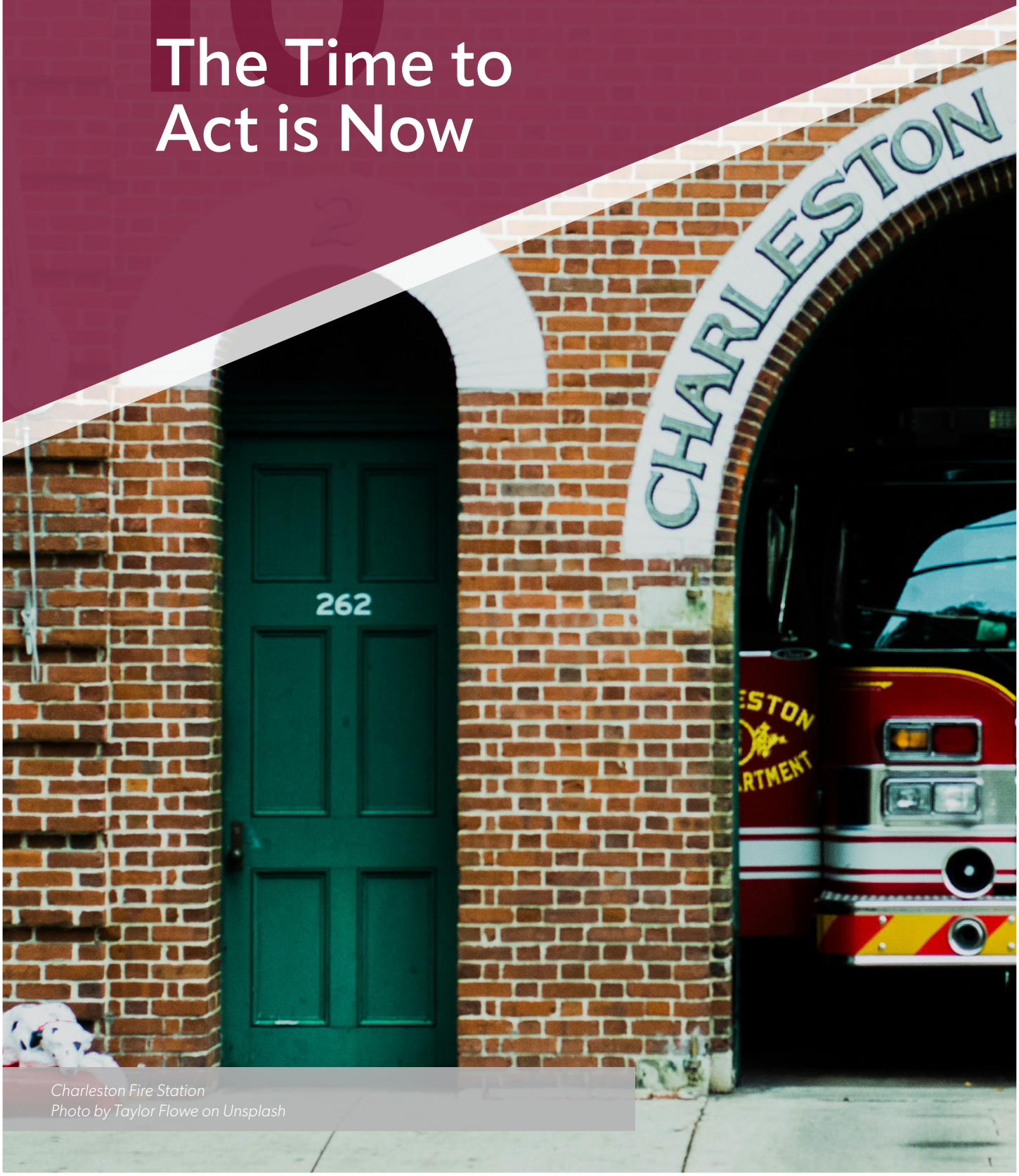
9.3 The Role of Community and Business Institutions

Community and business institutions have direct control over a significant share of local emissions. Climate actions they can take include, but are not limited to, those listed below:

- Adopt an energy and emissions target that aligns with the County target.
- Implement concrete actions to reduce emissions.
- Apply a climate lens to procurement processes.
- Undertake a deep energy building retrofit.
- Install solar PV.
- Right-size the vehicle fleet and switch to zero-emissions vehicles.
- Provide vehicle charging stations on site.
- Offer remote or hybrid work options.
- Introduce initiatives to reduce waste in the workplace, including going paperless and setting up segregated waste bins for garbage, food waste, and recyclables.

10

The Time to Act is Now



Charleston Fire Station
Photo by Taylor Flowe on Unsplash

10 The Time to Act is Now

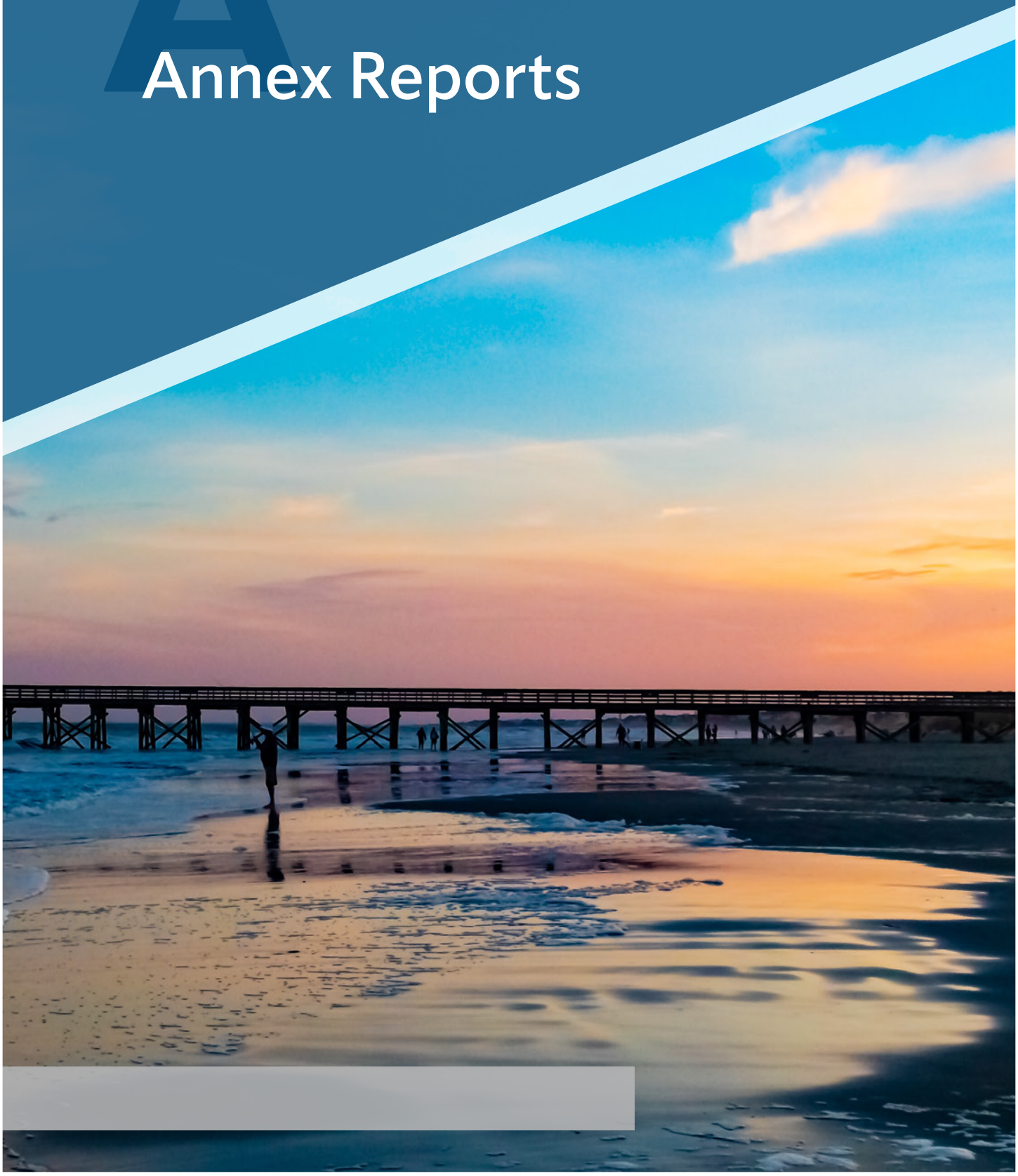
The Climate Action Plan for Charleston County represents a crucial step towards a sustainable and resilient future. By acknowledging the pressing challenges posed by climate change and outlining comprehensive strategies, Charleston County aims to safeguard the community, environment, and economy. The collaborative efforts of local governments, businesses, residents, and organizations underscore a shared commitment to mitigating the impacts of climate change.

As the community of Charleston County develops, adapts, and implements the proposed initiatives, ongoing engagement and education will be critical to build understanding, collaboratively design policies and programs, and maintain and build momentum. Charleston County has the opportunity to stimulate new economic opportunities and jobs and to reduce household energy costs for those who need it most, showcasing the potential for positive change at the regional and national levels.

Strategies that improve homes and buildings, reduce pollution from vehicles, invest in infrastructure for walking, cycling, and transit, and accelerate renewable energy can also enhance community well-being and increase resilience against increasingly severe extreme weather events.

This Climate Action Plan is not just a document. It is a roadmap for Charleston County's journey towards a more sustainable, equitable, and resilient future. By embracing these strategies, we can collectively work towards building a community that survives the challenges of climate change and thrives in the face of adversity, leaving a lasting legacy for generations to come. The time to act is now.

A Annex Reports



11 Annex Reports

Annex I: Co-benefits Analysis

External document

Annex II: Data, Methods, and Assumptions Manual

External document

Annex III: IRA Calculations

External document

Annex IV: RSAC Workbook

External document

Annex V: SECAT Workbook

External document

CHARLESTON
COUNTY
SOUTH CAROLINA