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The Role of a Green Bank in South Carolina: A Market & Feasibility Assessment

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THE ROLE OF A GREEN BANK IN SOUTH CAROLINA

A MARKET & FEASIBILITY ASSESSMENT

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Keywords: green bank; South Carolina
Abstract/description: A market and feasibility report that explores the role of a green bank in South Carolina. This report is the culmination of a multi-year process that included a comprehensive market assessment and interviews with over 60 organizations across South Carolina. It demonstrates that a green bank could play a vital role in South Carolina by creating a dedicated institution working to accelerate the flow of capital to projects that seek to reduce carbon pollution and increase resilience to climate impacts.

Executive Summary

Fleming, J. & Windsor, C. (2022). The Role of a Green Bank in South Carolina: A Market & Feasibility Assessment. *University of South Carolina*. https://scholarcommons.sc.edu/geog_facpub/231/

What is a Green Bank?

Green banks are institutions that identify and address financial barriers while driving carbon pollution reduction, economic development, job creation, and climate resilience. Common green bank strategies include direct loans, co-investment, risk mitigation, credit enhancement, on-bill financing, aggregation, technical assistance, and information coordination. Stakeholders across South Carolina see an opportunity for a green bank. South Carolina can leverage the green bank model currently deployed in 18 states and internationally through an institution designed to accelerate economic activity and investment in projects at the scale and speed necessary to mitigate damages from climate change and boost resilience.

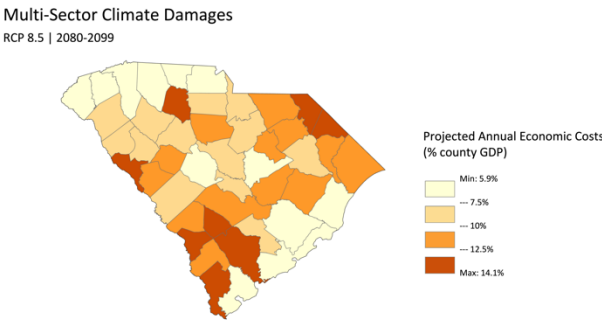
A SC Green Bank Would Address Serious Problems

Climate Costs

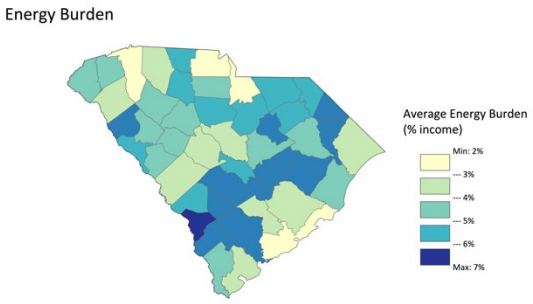
Losses and damages from climate change are ongoing and increasing, particularly from extremes in temperature, flooding, and sea level rise. Future damages are projected to directly affect important economic sectors including manufacturing, tourism, agriculture, infrastructure, and services. Non-economic climate impacts are also growing and include public health, biodiversity, and quality of life.

Economic & Energy Inequities

South Carolina struggles along several economic measures, with 1 in 7 people living in poverty and a typical household earning ~$10,000 less than the national average. Disadvantaged communities currently spend more on energy, are more likely to face higher climate costs, and need additional help recovering and achieving resilience.



A map of economic damages from climate change. The average SC county (9.62% GDP damage) is slightly more than double the national average damage. See Market Background – Climate Conditions.



A map of energy burden for households across South Carolina, averaged for all households in a county. The statewide average is 3%, but the lowest income households spend up to 27% of their income on energy bills. See Market Background – Economic Conditions.

South Carolinians Face Financial Barriers in Climate Mitigation and Resilience

Based on the input and expertise of over 60 organizations across South Carolina that were interviewed for this report, barriers were identified that slow the speed, scale, and equity of investment in a market environment and policy landscape that is currently failing to address them adequately.

South Carolina Market Conditions Overview

- The clean energy and energy efficiency sectors have solvable barriers like up-front costs or payback time that constrain growth. Residents, businesses, non-profits, and government all have potential long-term cost savings that could be achieved through energy projects if these barriers are addressed.
- South Carolina is home to leading national and international firms that are encountering challenges in meeting carbon emissions reduction commitments to stakeholders. Firms, especially in the manufacturing and energy sectors, could realize benefits from a clean energy transition.
- Agribusinesses are early adopters of clean energy in South Carolina, but also face some of the highest costs from climate change and can have limited access to finance and investment.
- Existing infrastructure, especially the utility grid, faces rising demand and costs from climate change. Resilience investment has begun in South Carolina but has not achieved the scale needed, especially in specific areas like green infrastructure.
- A challenging policy landscape has cost the state hundreds of millions of dollars in private investment in offshore wind and electric vehicle manufacturing in 2022 alone.
- Existing sources of funding have specific barriers that make them difficult to access or are simply not large enough to meet current community needs. For example, 90% of South Carolina's eligible low-income households do not receive federal energy bill assistance.

The full report identifies additional gaps and unmet needs across these market sectors. Green bank funding accelerates capital flows to these markets by designing programs that address them through direct investment or indirectly leveraging funds to accelerate sector activity.

A SC Green Bank Provides Feasible Solutions to Urgent Issues

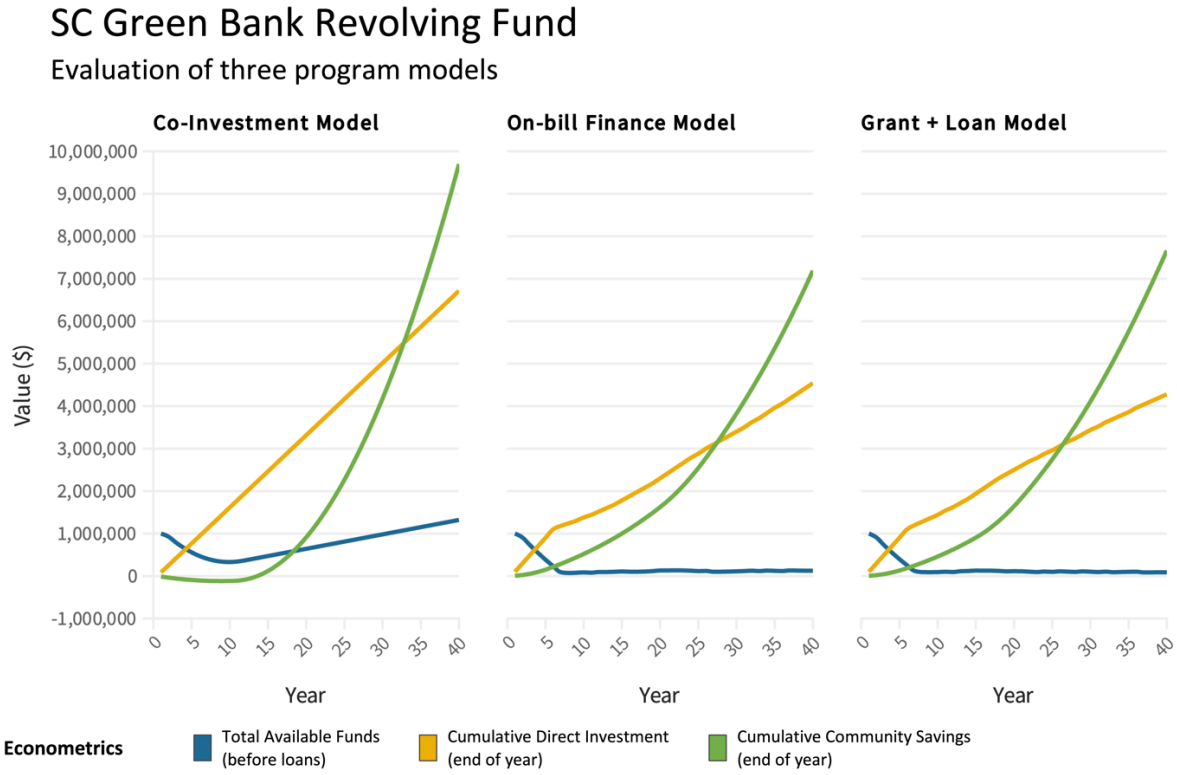
With growing public and private interest, including the state's largest firms and two investor-owned utilities pledging to decarbonize, South Carolina is poised to embark on a major market transition. However, investment is not occurring at a speed or scale fast enough to make the transition and achieve needed results. A green bank, organized as a 501c3, can establish lasting partnerships, leverage additional investment, and align with existing and emerging utility and government funding streams.

The report presents organizational logistics alongside initial strategy considerations and potential pilot programs. A green bank would initially pursue a proof-of-concept project while working towards creating programs and developing partnerships that leverage other sources of capital. Initial potential pilot programs identified in this report include starting a revolving fund for clean energy or energy efficiency projects, partnering with utilities and local financial institutions to craft innovative financing, and addressing gaps in underserved communities and sectors.

Initial Funding Proposal

To achieve the above, the plan is to establish a 501c3 that will be managed by an executive director and an experienced board of directors. We intend to attract at least $500,000 to fund the initial operation of the 501c3 and pursue a proof-of-concept project. A strategic initial pilot program would use a green bank's funds directly because it would be simpler to execute and could respond directly to a market barrier that has already been identified. One possibility is a revolving fund for community centers, businesses, or homeowners to implement energy efficiency or clean energy projects. Options for a solar project revolving fund are shown below.

Alongside this report, early work could be leveraged in applying for larger funding streams such as the Inflation Reduction Act of 2022, which includes funding (~ $7 billion) for green banks at the state level. Based on existing green banks, initial capitalization between $1 million to $5 million offers the ability to scale a proof-of-concept into an initial pilot program. After a green bank is capitalized, it creates more programs, forms partnerships, and leverages funding to change wider economic systems.



Based on the current market, a solar system size of 6 – 8 kW would be typical. This would cost between $18,000 - $30,000 and generate $1,500 - $3,000 yearly in energy savings. Co-investment model: a green bank pays for a % of project costs and receives the same % of monthly savings generated. On-bill finance model: a green bank pays for project costs and is reimbursed on a 20-year loan collected through utility bill payments. Grant + loan model: a green bank pays for project costs and is reimbursed on a 15-year loan (10% of the project cost is given as a grant). For details and assumptions of the models, see Feasibility Assessment – Green Bank Strategy & Initial Programs.

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Document Purpose & Structure

This report represents a first step to establishing a green bank in South Carolina: a market and feasibility assessment. The purpose of this document is to introduce readers to a green bank and showcase why one could be successful and impactful in South Carolina. It is composed of three sections:
1) An **introduction** designed to demystify the concept of a green bank, illustrate how green banks operate in the United States and in the Southeast, and explain the process that led to this report.
2) A **market assessment** highlighting relevant background context in South Carolina and synthesizing the key findings from an in-depth market research and stakeholder engagement process.
3) A **feasibility assessment** that illustrates what a South Carolina green bank could look like and showcases the positive impact it could have.

The authors utilized a variety of inputs in this market assessment. Inputs to this market assessment were evaluated up until August 1st, 2022. Analysis includes scientific research and models, industry and non-profit reports, major news reports, datasets from a variety of sources, strategic discussions with the Coalition for Green Capital and existing green banks, and a comprehensive stakeholder interview process where over 60 organizations shared their expertise across a variety of sectors in South Carolina. Specific sources are referenced using endnotes; other information is derived from stakeholder interviews. All stakeholders who contributed to this market assessment are listed in the Appendix.

Introduction

What is a Green Bank?

Green Bank 101

Green banks are financial institutions designed to accelerate the transition to clean energy and boost resiliency in the face of environmental change.[1] Green banks are not deposit-holding institutions and do not offer traditional banking services. They provide financial support and investment for projects across a range of sectors that are important to the communities and economies where they operate (see Figure 1). They focus on accelerating the flows of capital in these sectors by identifying and alleviating financial barriers, helping to drive economic development and job creation while benefiting disadvantaged communities and increasing resilience. Green banks are one instrument to address a fundamental market failure: existing capital providers are not investing at the scale or speed needed to avoid large future losses and damages from climate change.

Figure 1: Green banks invest in a range of sectors based on the needs in their area. Figure adapted from the Coalition for Green Capital.

The Green Bank Model

Green banks are market-based solutions that work to adopt clean energy and resilience projects. Green banks operate by seeking to identify a specific financial barrier affecting the market and designing a financial solution that reduces or removes it.[2] When this occurs, green banks can accelerate the activity of local businesses, create new markets, or drive job creation. Green bank funding is most often deployed as loans or other programs to accelerate capital flows; subsidies or grants are used occasionally for targeted purposes.[3] Commonly used tools include direct loans, co-investment, risk mitigation, credit enhancement, on-bill financing, aggregation & warehousing, technical assistance, and information coordination.[4] Shown below are two example green bank programs (see Table 1).

	Program 1	**Program 2**
Topic	Renewable Energy	Energy Efficiency
Stakeholder	Small Business	Homeowner / Renter
Market Barrier	Up-front cost, lengthy payback time, not cash flow positive, transferability	Up-front cost, high cost of financing
Financial solution	Direct loan, on-bill financing	Risk mitigation (reducing risk for lenders)
Brief Description	A green bank helps a small business install solar panels via a direct loan and ensures the energy savings exceed the financing costs each month on their utility bill.	Existing financing for home energy efficiency improvements is too costly. A green bank provides a loan loss reserve to a local bank, resulting in them offering loans with no-money down and below-market interest rates to individuals.
Existing Example	Hawaii Green Infrastructure Authority[5]	Connecticut Green Bank[6]

Table 1: Two types of green bank programs broken down to see how they function and which market barriers they address, plus an existing green bank program that is a close match to the sample programs.

Almost all green banks have formed within the past 15 years.[7] The oldest green bank in the U.S. formed in 2011, and green banks have since expanded across the country including the Southeast.[8] Currently, 18 states, the District of Columbia, and Puerto Rico have green banks, and 16 additional states took action to develop one in 2021/2022 (see Figure 2).[9] The institutional type of a green bank can be customized for the area it operates in. These existing green banks largely fall into two categories:

1. public or quasi-public institutions
2. non-profits or CDFIs (Community Development Financial Institution).[10]

Regardless of its institution type, green banks share a common vision and program offerings can look similar. Institutional design considerations for a SC green bank are explored in the Feasibility Assessment.

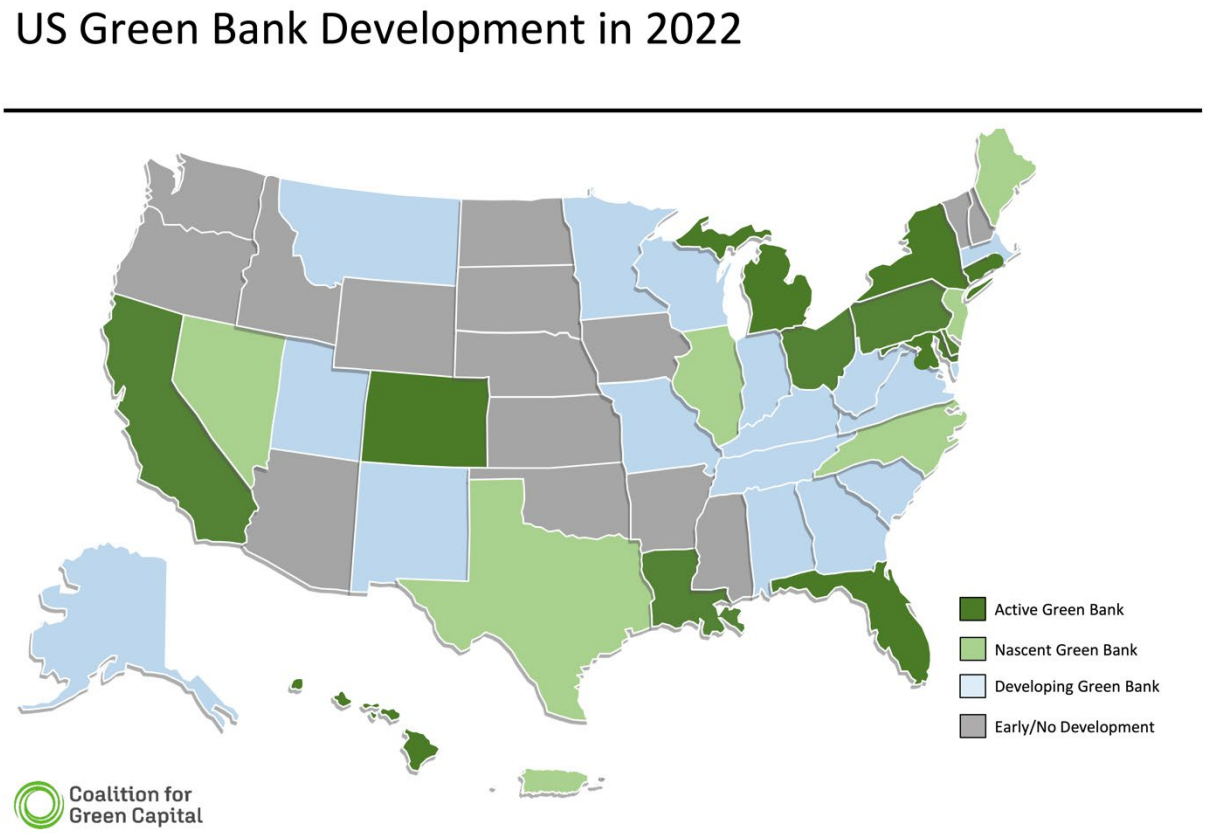

Figure 2: Existing and emerging green banks in the United States. This market assessment represents the current developing green bank in South Carolina. Figure provided by the Coalition for Green Capital.

After a green bank forms, it acquires initial capital, invests in projects, and tracks the environmental, economic, and social benefits over time. A green bank can acquire capital from a variety of sources including government funding, fees, grants, or private investment.[11] It then uses this capital for programs, either directly or in combination with other capital providers. Existing green banks do not compete with traditional capital providers and are highly collaborative, attracting $3.70 in co-investment for every green bank dollar.[12] Green banks seek to grow their programs and offer new ones as the amount of capital increases over time. In 2020, green banks across the country mobilized a record $1.7 billion in investments using $442 million in green bank funds.[13] Initial strategic analysis of potential program activities and capitalization pathways for a SC green bank are explored in the Feasibility Assessment.

Green banks are increasingly expanding into the Southeast region. Florida's green bank, the Solar and Energy Loan Fund (SELF), is a Southeast regional example of

green bank benefits and impacts since it began operating in 2011.[14] SELF is a non-profit and certified CDFI. SELF has provided $11 million in total loans for clean energy and energy efficiency home improvements. SELF has benefited over 4,000 people, 70% of whom are low to moderate income clients. Besides energy efficiency retrofits, SELF has also provided loans for solar water heaters, solar panels, and wind hazard mitigation. SELF loan recipients have saved 25% in energy costs on average and reduced their combined carbon footprint by 1,100 metric tons of CO_2. SELF has created 30,000 job hours and promoted financial education and energy contractor training. Other Southeastern regional examples include Finance New Orleans[15], focused on building energy equity and resiliency into affordable housing, and newly emerging green banks in North Carolina[16] and Virginia.[17]

Pros and Cons of Green Banks

States are increasingly recognizing the benefits of green banks. Green bank economic activities benefit states in the short-term[18] through economic multiplier effects like job growth and addressing inequities; and in the long-term[19] through decarbonization, economic benefits from accelerated investment, and avoiding large damages from climate change impacts. Existing green banks have been evaluated as low-risk, stable economic interventions that have successfully accelerated private sector investment and benefited disadvantaged communities.[20] Based on the initial performance of the green bank model, Congress is implementing it at the federal level.[21]

Benefits of green banks include the ability to encourage investment across the public and private sectors, reduce or remove market barriers, and drive market activity by reducing risk and generating demand. By resolving market failures, green banks can close investment gaps that currently hinder existing capital sources.[22] Increasing investment in a community stimulates local economies and spurs job creation. Green banks can respond directly to the economic impacts of climate change and aid disadvantaged communities within a defined area.[23] Green banks focus on growing their funds and ability to invest in a community over time.[24]

Commonly cited drawbacks of green banks include not addressing the underlying systemic cause of environmental losses and damages. Green bank programs often respond directly to or try to reduce pollution from carbon dioxide and methane. They do not necessarily address the political, social or ethical drivers that led to pollution. These drivers can prevent systemic actions even when overall economic benefits exceed costs.[25] Green banks cannot replace public policy. State level policies, such as clean energy portfolio standards, provide businesses a level of certainty and market incentive that can drive private investments at a scale beyond even a well-funded green bank. Federal direct financing, such as the recent investment of $5 billion into a

national electric vehicle charging network[26], is also beyond the scale of a state level green bank. Green banks are sometimes difficult to start due to the challenges of acquiring and scaling capital, and technical considerations in design and implementation.[27]

The Green Bank Roadmap in South Carolina

Observing the innovative examples in energy policy and markets across the Southeast region, the Energy Office of the SC Office of Regulatory Staff (SC Energy Office) began assessing financing tools that could benefit the state. The South Carolina Energy Efficiency Roadmap, an initiative that evolved out of the State Energy Plan, laid out a recommendation in the report to "Assess the feasibility, costs, and benefits of establishing a South Carolina Green Bank" as part of its accessible financing focus area.[28] The report identified key potential benefits including reductions in greenhouse gas emissions, spurring economic growth, and ensuring a just energy transition that would benefit stakeholders across the state.[29]

The SC Energy Office led an informational webinar in December 2020, leading to a working group that convened and met over the course of 2021 (see Figure 3). Beginning in August 2021, a small team of third-party experts from the University of South Carolina partnered with the SC Energy Office and the Green Bank Working Group to conduct a market assessment and prepare a report to assess the feasibility and benefits of a SC green bank.

Figure 3: Key dates that led to this market assessment.

This roadmap aligns with the established process for implementing a green bank that is shared by the Green Bank Design Platform[30] and the Coalition for Green Capital.[31] The North Carolina Clean Energy Fund offers a sister-state example. Their market assessment was completed in 2020, followed by institutional design and establishing the green bank as a non-profit in 2021. The institution has established their structure and list of future projects as it is seeking initial capitalization. The SC Energy Office met the first step of generating initial interest and gathering stakeholders. The remainder of this report completes the second step (market assessment) and gives strategic guidance on the third step (institutional design and program implementation). This report could be utilized to follow this pathway in South Carolina.

Market Assessment

Market Background

Climate Conditions

Climate change is broadly acknowledged and readily observed in current conditions[32], and will continue with increasing pollution from greenhouse gases.[33] South Carolina is projected to experience large losses and damages from climate change by the end of the century (2080-2099), where it is expected to have the 8th highest economic costs among states.[34] Every SC county exceeds the national average for annual average damages to its GDP (gross domestic product)[35], many by double or more (see Figure 4). In 2020 dollars, the minimum and maximum proportional expected costs would range from ~$1.99 billion (5.92% GDP) in Greenville County to ~$33.8 million (14.08% GDP) in McCormick County.[36] Sectors in South Carolina known to be vulnerable to expected climate change impacts include tourism, manufacturing, agriculture, construction, infrastructure (including utilities, trade, and transport), and services.[37] The combination of cross-sector impacts, current inaction, and uncertainties is leading to ongoing discussions of systemic risk within the financial sector.[38] The economic costs described here indicate how changing climate conditions will affect South Carolina. It is critical to note that these costs can be reduced by minimizing pollution from carbon dioxide, methane, and other greenhouse gases.

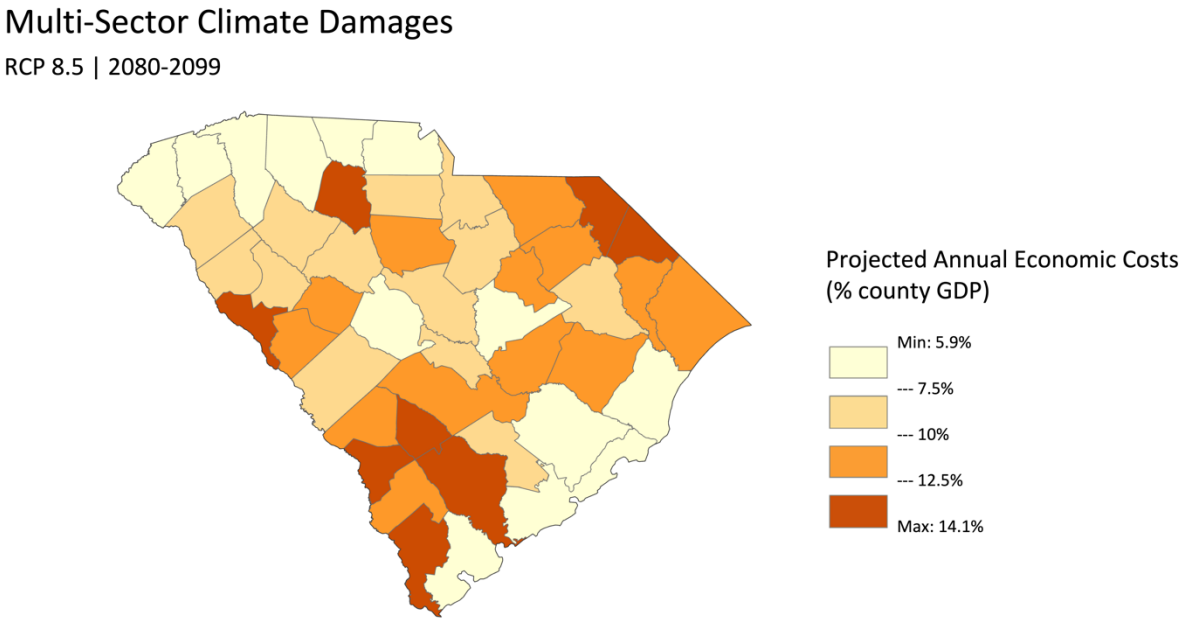

Figure 4: An analysis was conducted using data from Hsiang et al. (2017) [39], losses are expressed as annual economic damages as a % of county GDP. This represents the yearly economic costs by the end of the century under a high carbon emissions scenario. The national average is 4.57%. The least damaged county in SC is still 29% higher than the national average (5.92%), while the most damaged county is more than triple the national average (14.08%). The average SC county (9.62%) is slightly more than double the national average in terms of damages.

An increase in average temperature and changes in seasonal and daily temperature patterns continue to be observed in South Carolina.[40] Temperature is projected to continue rising – by the end of the century, summer days are expected to have a normal high temperature of 95 °F [41], with days over 100 °F [42] becoming commonplace.[43] Heatwaves are climate change effects already observed in South Carolina[44] and these will become more common and dangerous.[45] By mid-century, most counties in South Carolina will experience several weeks with hazardous heat.[46]

These temperature changes will have severe economic costs in South Carolina.[47] For example:

- By 2070, 28.9% of SC's GDP growth is expected to be lost every year due to the rise in temperature without adaptation.[48]
- 6 or more days above 90 °F decreases production in an average auto-manufacturing plant by 8% that week.[49] The number of days per year over 90 °F is projected to double by 2099 at the sites of the Volvo and BMW plants in South Carolina.[50]
- Temperature strongly impacts outdoor workers in sectors like agriculture and tourism, resulting in declines in labor productivity and lost wages.[51] Nearly half of South Carolina counties have >25% of adults working outdoors,

representing 22% of the state's workforce.[52] These workers are expected to lose $1.1 billion in lost wages every year from extreme heat by 2065 (see Figure 5).

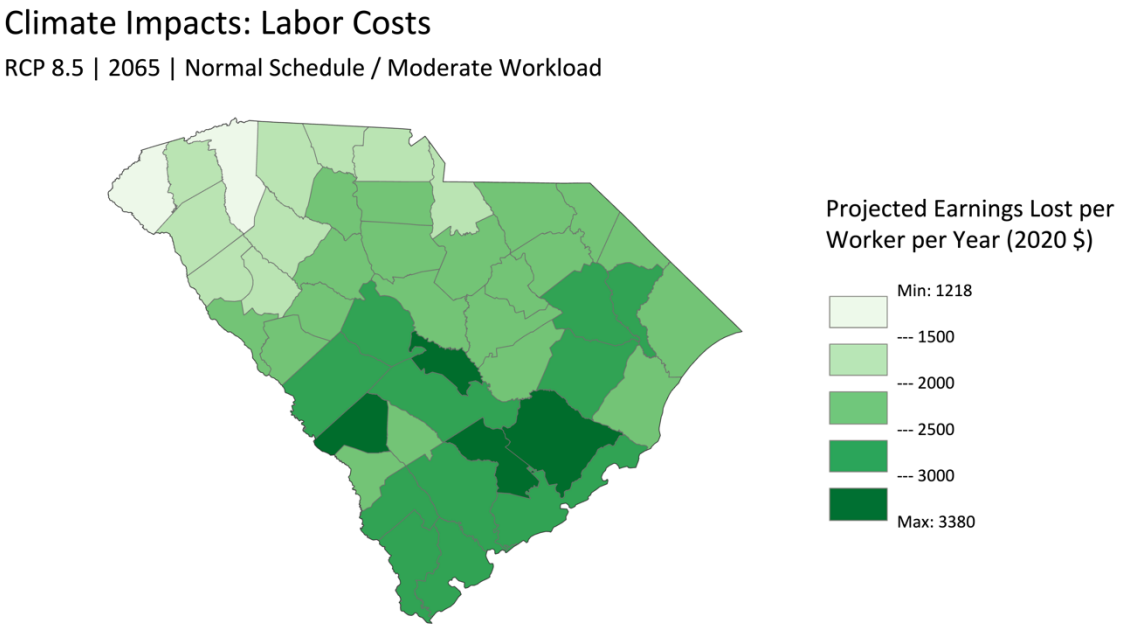

Figure 5: An analysis was conducted using data from Dahl & Licker (2021).[53] The scenario used is midcentury, business-as-usual climate scenario (RCP 8.5), annual earnings at risk with normal schedule and moderate workload, by county. This shows the yearly projected economic effects by 2065 of a high carbon emissions scenario combined with assumptions that labor conditions will not alter substantially from what they are today.

An increase in average rainfall continues to be observed; by 2100 heavy rainfall events are expected to become more severe and double in frequency.[54] This increase is already apparent in South Carolina, with major rainfall events across the state observed in 2015[55], 2016[56], & 2018[57] South Carolina has large numbers of disadvantaged communities at risk from changes in flood risk.[58] These rainfall changes will have severe economic costs in South Carolina.[59] For example:

- The extreme rainfall events listed above cost South Carolina ~$10 billion and resulted in deaths.[60]
- Future events like these are projected to cost South Carolina $750 million[61], on average, every year by 2050 (see Figure 6). The statewide county average is $16.3 million, and the coastal county average is $95 million.[62]
- South Carolina is projected to be one of the states most impacted by business closures and damage to critical infrastructure from changes in flood risk. Today, South Carolina has over 12,000 businesses, 200,000 homes, and 1,400 critical facilities at risk from flooding.[63] Over the next 30 years, businesses are

expected to face a 48.2% increase in costs and 51.3% increase in closure days due to flooding over the next 30 years.[64]

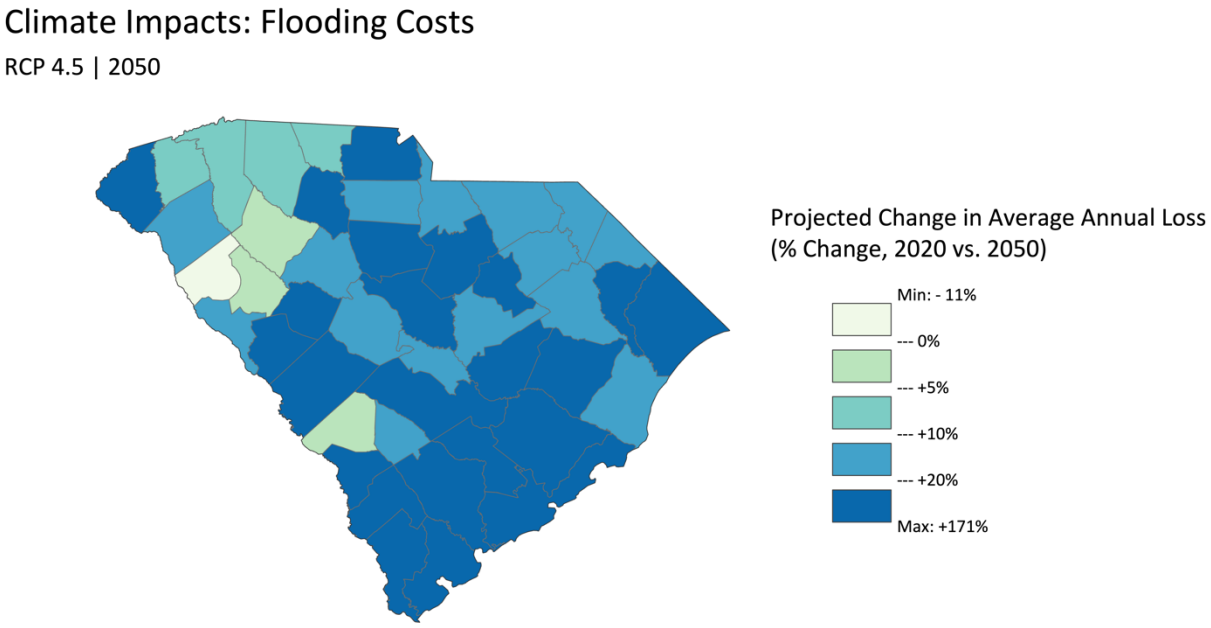

Figure 6: An analysis was conducted using data from Wing et al. (2022).[65] The percent change is calculated by comparing current flood costs (2020) to projected flood costs accounting for climate change (2050). This shows the projected increase (or decrease) in flooding costs for different areas by 2050 under a moderate emissions scenario (RCP 4.5).

In South Carolina, sea levels continue to rise. At the Charleston tidal gauge station (which has recorded data since September 13, 1899), sea level has risen 1.1 feet and the rate of increase has accelerated since 2000.[66] Comprehensive sea level rise forecasts are available for South Carolina's coastline. Based on greenhouse gases already emitted, sea levels in South Carolina will rise an additional 10 - 14 inches by 2050.[67] This means that extreme sea level events, those that cause damage to homes & businesses, will occur 20 times as often by 2050.[68] Sea levels will continue rising beyond 2050, and could reach an additional 16 feet if ice sheets in Greenland and Antarctica collapse.[69] Sea level rise will have severe economic costs in South Carolina and the state is among the most severely economically impacted.[70] For example:

- As of 2019, there are 5,648 businesses in South Carolina employing over 22,000 people at risk from coastal inundation today, a number expected to increase as sea levels rise and as climate change makes floods more severe.[71]
- Communities on the coast are at flood risk today. For example, Seabrook Island currently has 100% of its businesses and infrastructure and 98% of its homes at risk from coastal floods.[72] Today, most communities on the coast have at least a moderate risk from coastal floods to critical infrastructure, businesses, or homes.[73]

- Risk will continue to increase as sea levels rise. For example, property damages in South Carolina's coastal counties are projected to exceed $250 million per year by 2050[74] (see Figure 7). These property risks are already being priced today. For example, coastal flood risk has reduced the current value of some homes in Hilton Head by over 15%.[75] Recent analysis of property market dynamics suggests an emerging real estate bubble as sea level rise impacts worsen.[76]
- Sea level rise will create traffic delays and damage roadways along the coast. South Carolina is projected to experience hundreds of millions of hours of vehicle delays per year by 2050, resulting in large economic costs.[77] For example, a 0.1 mile stretch of Route 21N near Hilton Head, SC is projected to be inundated for ~300 hours per year by 2050, causing $15,000 in repair costs and $1.2 million per year in traffic delay costs.[78] South Carolina is projected to have over $500 million per year in combined costs of traffic delays for coastal roads by 2050.[79]

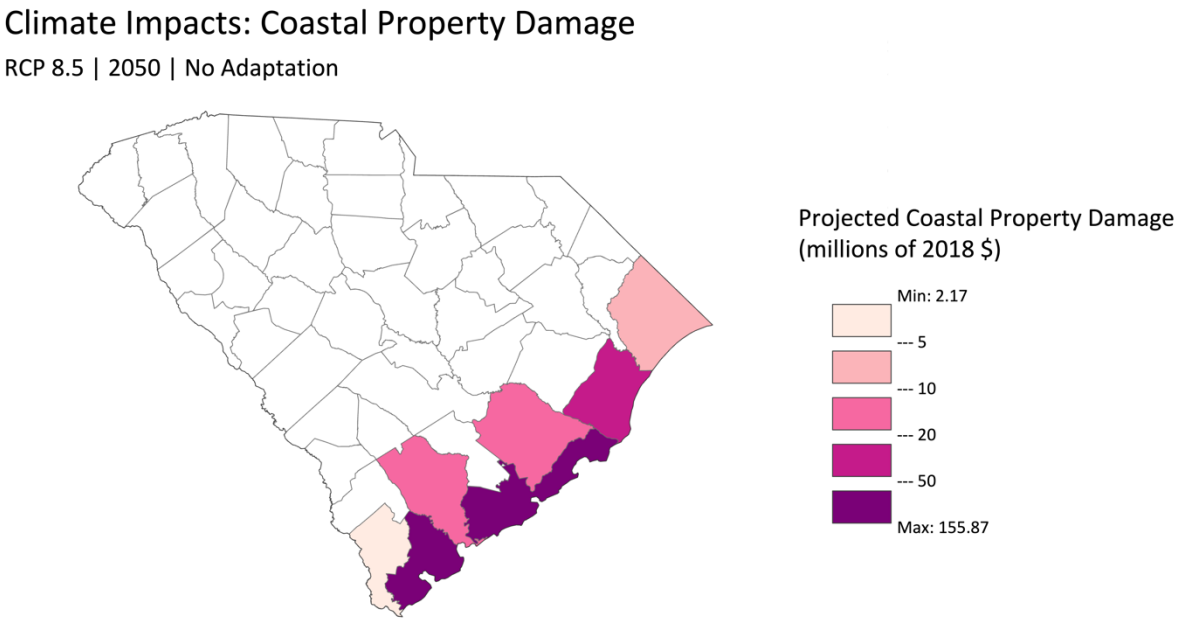

Figure 7: An analysis was conducted using data from Neumann et al. (2021).[80] Data are from the business-as-usual climate (RCP 8.5) and no adaptation scenario for 2050. This shows the yearly projected economic effects by 2050 of a high carbon emissions scenario combined with assumptions that ignore potential adaptation actions that could reduce these costs if significant investment occurs prior to the property damage. Damages are defined as structure damage from periodic storm surge (expected annual repairs costs), and losses of property and structure from permanent sea level inundation. It's important to note that a great deal of the variability between areas comes from the number of properties affected and their monetary value. Custom data provided courtesy of the authors.

The costs explored here are not exhaustive. There will be further economic costs that are more difficult to project, further economic costs in other sectors, as well as losses that are not economic. For example:

- In 2021 there were two tropical systems affecting South Carolina with costs exceeding $1 billion.[81] The intensity of Atlantic hurricanes is increasing, making them more physically and financially damaging to homes and businesses.[82] Economic projections are not yet available for future hurricane damages in South Carolina, although financial impacts from hurricanes have been examined.[83] As economists continue improving their methods and incorporate additional climate impacts (wildfire risk[84], etc.), projected economic costs will rise.
- Economic costs linked to these climate impacts will be felt across a wide range of sectors, including smaller industries or services that are not typically associated with prior conceptions of the state's economy at first glance. For instance, recreational fishers will encounter degraded fisheries.[85] The $8.9 billion yearly statewide savings in ecosystem services that marshes provide will be reduced by sea level rise[86], and healthcare costs will rise.[87]
- Many climate impacts harm communities but are not usually evaluated in economic terms. For instance, pollen counts are projected to increase by 150% and occur over a longer period[88], mosquitos are projected to become more prevalent and increase disease transmission[89], 15 bird species could disappear from South Carolina[90], 38 tree species will have reduced capability to cope or persist,[91] and the cultural heritage of the Gullah Geechee community is affected by sea level rise.[92] Heatwaves in the past 20 years are associated with higher adult death rates in counties across South Carolina,[93] and warmer nighttime temperatures in the Southeast[94] reduce sleep quality.[95]

Economic Conditions

Demographics & Underserved Communities

South Carolina has the 23rd highest state population with a little over 5 million people. The state's population has grown 10.7% over the last decade.[96] South Carolina is ranked near the bottom in terms of household income, with a typical household earning ~$10,000 less than the national average.[97] The state struggles in other economic measures, with 1 in 7 people living in poverty and with 26 counties classified as persistent childhood poverty counties. [98] Inequality is unevenly distributed across the state. The federal government identifies many communities in South Carolina as disadvantaged (see Figure 8).

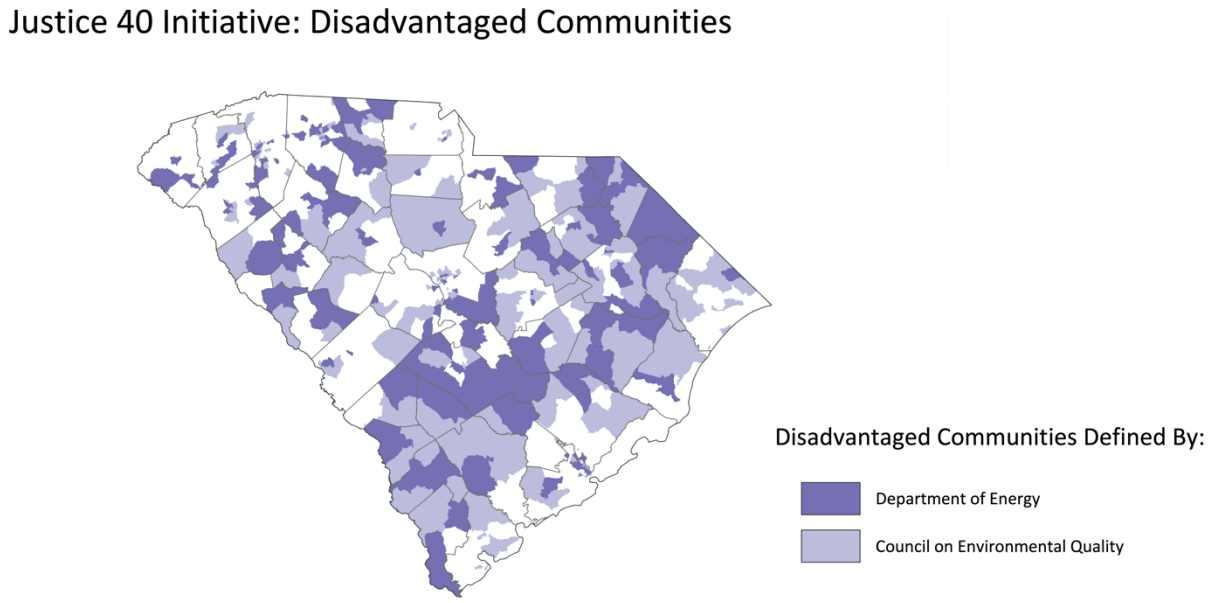

Figure 8: Disadvantaged communities identified by the Department of Energy and Council on Environmental Quality under the Justice 40 Initiative.[99] Both definitions are composite metrics of multiple socio-economic, public health, and environmental variables and are used to direct federal funds. Other federal agencies may identify disadvantaged communities using a different metric.

These metrics may not fully capture underserved communities or their economic needs. However, as part of the Justice 40 Initiative, they will be used to direct 40% of federal investment in climate change, clean energy and energy efficiency, clean transit, affordable and sustainable housing, training and workforce development, the remediation and reduction of legacy pollution, and the development of critical clean water infrastructure.[100] However, these funds may not fully address the needs of financially underserved communities, the challenges faced by Black and Brown communities and/or rural communities, or other concerns that are important to assessing community needs specific to South Carolina. Since the economic impacts of climate change are not felt equally by all communities[101], it is important that green bank programs and activities use a variety of metrics and grounded expertise to work with vulnerable communities facing both economic and environmental challenges.

Poverty status or other types of precise income thresholds are often used when qualifying for benefits programs. The use of such thresholds may create a "benefits cliff" problem where economic needs are not being addressed.[102] For example, nearly a third of South Carolina households spend a high percentage of their income on housing and there is no county in the state where a full-time, minimum wage worker working 40 hours a week can afford a two-bedroom rental (the state also faces some of the fastest rising rents in the country, with some areas rising ~20%).[103] This affects both low-income and middle-income households, where energy expenditures

can be a significant burden (see Market Background – Energy Burden). A green bank could work to address these economic conditions and work to ensure its programs and activities respond to those left behind by benefits cliffs.

Energy Burden

South Carolina ranks 26th in yearly total energy expenditures per capita ($3,796), with the 19th most expensive retail residential electricity price (13.91 cents / kWh) and the 6th most expensive residential natural gas price (17.32 $ / thousand cu ft).[104] The average energy burden (the percentage of gross household income spent on energy costs) is 3%. [105] Energy burden is not equally distributed within the state (see Figure 9), and households with incomes below the median spend disproportionately more on energy costs, with energy burdens as high as 27% for the lowest income households.[106]

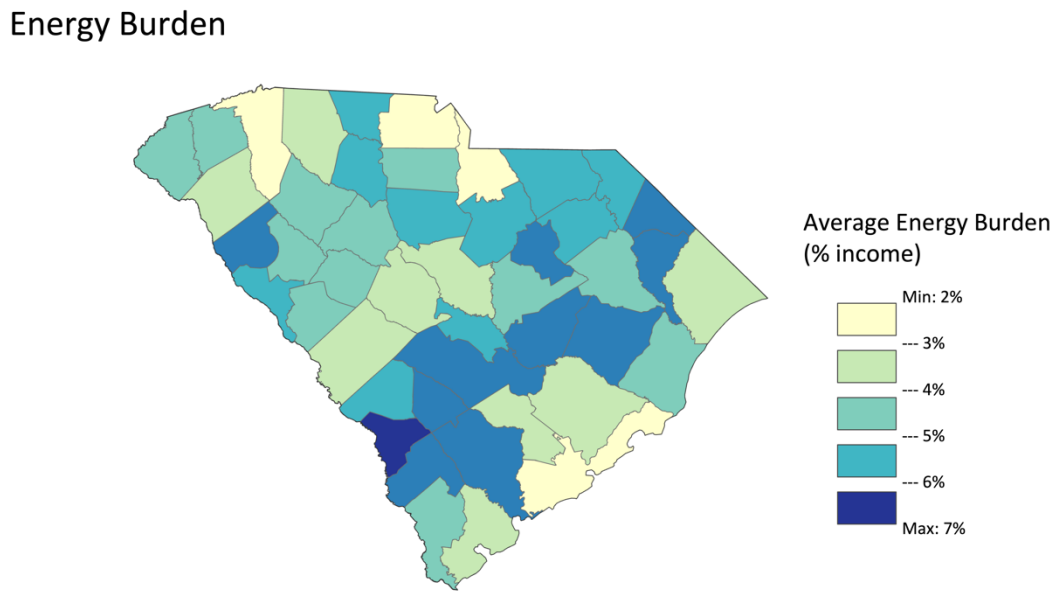

Figure 9: An analysis was conducted using data from the Department of Energy (2022).[107] Energy burden is averaged across all households in the county, using 2016 values (most recent data available).

High energy bills disproportionately affect disadvantaged communities and decrease economic activity as more community wealth is spent on energy expenses.[108] High energy prices also do not account for externalities and limit the ability of communities and businesses to make investments (such as energy efficiency or electrification projects).[109] Climate change has already driven an increase in energy use, especially during the summer as air conditioning becomes increasingly necessary for residences amid rising temperatures.[110] Climate change is projected to further increase energy demand by 7 – 8%[111], resulting in energy expenditures rising by an average of 10.5% in South Carolina.[112] A core outcome of green bank programs and

activities in South Carolina would be responding to energy burden by seeking to reduce the expenditures of households, businesses, and utilities.

Fossil Fuels & Public Health

Climate impacts, especially extreme heat, are harmful to human health and increase morbidity and mortality.[113] Achieving 100% clean electricity by 2050 would save an estimated 42.2 thousand lives and $19.3 billion in South Carolina.[114] Eliminating all carbon pollution by 2050 would save an estimated 99.8 thousand lives and $46.7 billion in South Carolina.[115]

While the primary harm to public health in South Carolina comes from the effects of climate change, other pollutants emitted while using fossil fuels are also harmful. Common sources of harmful exposure include cars using gasoline or diesel fuels, home appliances that use oil or gas (stoves, water heaters, and indoor air heating), and point sources (industrial facilities, power plants, etc.).[116] Exposure is harmful to the respiratory and circulatory systems (especially in children), and the recommended level of exposure is zero.[117] The following table summarizes the health effects of the pollutants $PM_{2.5}$, SO_2, NO_x, NH_3, & VOC in sectors that also emit greenhouse gases using two epidemiological models from the EPA (see Table 2). The table lists only the health impacts of the pollutants and does not include further environmental harm caused by CO_2 or other greenhouse gases emitted at the same time.

Sector	**Asthma Exacerbations**	**Heart Attacks**	**Hospital Admissions (respiratory + cardiovascular)**	**Deaths**	**Work Loss Days**	**Monetary Value (all health impacts)**
Utility (fossil fuel generation plants)	273.1 | 273.1	1.1 | 10.5	5.3 | 5.3	12.6 | 28.6	1316.7 | 1316.7	$140.6 million | $317.2 million
Highway Vehicles (fossil fuels)	578.8 | 578.8	2.6 | 24.5	12.5 | 12.5	26.8 | 60.8	2785.4 | 2785.4	$298.5 million | $673.2 million
Residential (fossil fuel use)	20.7 | 20.7	0.1 | 0.8	0.5 | 0.5	0.9 | 2.1	98.6 | 98.6	$10.4 million | $23.5 million
Industrial (fossil fuel use)	1767.6 | 1767.6	8.3 | 77.0	39.5 | 39.5	80.3 | 181.4	8313.9 | 8313.9	$892.6 million | $2.01 billion

Table 2: Environmental Protection Agency, CO-Benefits Risk Assessment Health Impacts Screening and Mapping Tool (COBRA).[118] Ranges, represented by a vertical line, show a low and high estimate for South Carolina using two different epidemiological models of how harmful the exposure is. The

same number means the two models return the same result for that health impact. The COBRA model was analyzed for various sectors as listed in the table. Pollutants were reduced by 100% to simulate total health impacts. Resulting values are annual, starting in 2023 and averaged over a 20-year period for the entire state. The discount rate used for monetary valuation is 3%.

Public Views

Most South Carolinians support policies that address climate change mitigation and adaptation (see Figure 10). For example, 76% of South Carolinians support tax rebates for solar panels and electric vehicles, 76% support funding research in renewable energy, 69% support regulating CO_2 as a pollutant, and 62% support requiring utilities to produce 20% of their electricity from renewable sources.[119] Other residents of the Southeast and the average American have similar public views.[120] Existing green banks in other states are usually popular because their programs and activities involve funding projects or advancing markets in these areas with broad public support.

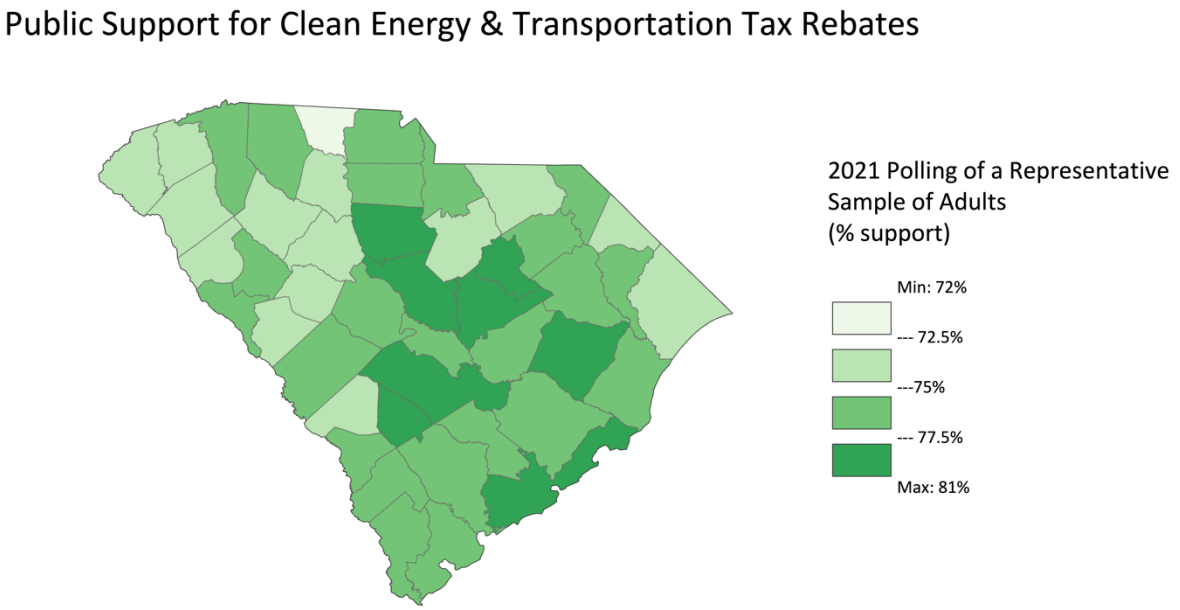

Figure 10: An analysis was conducted using data Howe et al. (2015).[121] Representative polling of adults in each county was conducted in 2021, showing the percentage who "support tax rebates for people who purchase solar panels or energy-efficient vehicles". The national average is 77%, and the South Carolina statewide average is 76%. Note that lighter colors denote only small changes in public support, even in the least supportive county there is 72% support. This suggests that programs that also help communities access energy savings would be viewed favorably.

Clean Energy Transition

The economy is undergoing a clean energy transition across a variety of sectors, responding to a mix of market forces, government regulation, stakeholder demands, and rapidly rising costs from climate impacts.[122] Clean energy often has lower capital

expenditure (CAPEX) and operating costs than fossil fuel alternatives.[123] Costs for clean energy projects have continually decreased over time.[124] Wind project costs fell 15% and solar project costs fell 13% in 2021.[125] Clean energy is also not subject to swings in the price of inputs (unlike fossil fuel plants, no fuel is required), and social and environmental costs are lower.[126] An electric vehicle is usually cheaper to own and operate than a traditional vehicle.[127] Firms are reducing greenhouse gas emissions to create value and respond to stakeholders (see Market Sectors – Carbon Markets).

These changes affect multiple sectors in the economy but are primarily driven by the energy sector.[128] For example, decarbonizing the transportation sector or manufacturing firms relies on the ability of utilities to increase electricity generation overall and provide a growing percentage of it as clean energy. An increase in the price of electricity as utilities decarbonize would slow investment in other sectors.[129] South Carolina's two largest investor-owned utilities have ambitious and comprehensive goals to meet this transition in the market[130], but are currently not moving at a speed or scale fast enough to meet their goals.[131] Fully transitioning the market carries large net benefits to the economy.[132] Despite positive net benefit, market transitions in South Carolina are either not occurring or not occurring rapidly enough to avoid the largest economic losses and damages noted in other sections of this market assessment. This is due to a variety of factors; market & financial barriers are examined in detail by sector while policy barriers are examined for some (but not all) sectors. A successful market transition requires a large increase to the current volume and growth rate of investment in the state.

Policy Conditions

South Carolina Policies

Solar Power

Senate Bill 1189 in 2014 (Act 236) created South Carolina's Distributed Energy Resource Program, set a solar power target of 2% aggregate generation capacity, and directed the Public Service Commission to make renewable energy access easier for residents, non-profits, and commercial customers.[133] The South Carolina Energy Freedom Act (House Bill 3659) was passed in 2019.[134] The bill was important, paving the way for solar advancements such as solar choice metering tariffs, community solar, a voluntary renewable energy program, and power purchase agreements.[135] It also required utilities to submit detailed plans to the utility regulator (integrated resource plans) every three years and provide annual updates. After the Energy Freedom Act passed, the solar market has nearly tripled if measured by total solar net generation (see Market Sectors – Solar). Each of these laws increased transparency and supported solar expansion for all South Carolinians.

South Carolina has a state solar energy tax credit for both businesses and residences. Businesses that have purchased a solar energy system receive a tax credit of up to

25% of the costs from the purchase and installation of a solar energy system.[136] This tax credit also applies to hydropower or geothermal equipment that can be used for heating, energy efficient demand response, and heating water and space. Residents can apply for tax credits at both the state and federal level. The South Carolina Department of Revenue offers the Solar Energy, Small Hydropower, and Geothermal Tax Credit to cover up to 25% of the costs from purchasing and installation (up to $3,500 or 50% state tax liability).[137] The federal Residential Renewable Energy Tax Credit helps cover purchase and installation costs (26% in 2022) for renewable energy units.[138]

Wind Power

In 2022, House Bill 4831 was passed to direct the Department of Commerce to study the effects and advantages of the offshore wind industry.[139] This research includes investigating South Carolina's supply chain advantages for manufacturing, assembly, and ancillary services related to offshore wind. The department is also directed to research the benefits to the local tax base and other co-benefits. In the process of conducting this study, the Department of Commerce will begin to identify the supply chain needs necessary to support future offshore wind developments.[140]

Energy Efficiency

The South Carolina Energy Efficiency Act was passed in 1992.[141] This created the South Carolina Energy Office and directed the office to establish a state energy plan with initiatives focused on energy conservation within the public sector. As a result, all utility, state energy, and public building conservation plans include energy efficiency measures. In 2008, SC Code Section 48-52-620 established energy conservation plans for all state agencies, school districts, and public universities.[142] This required public institutions to reduce their energy consumption by 1% annually from 2009-2013 and 20% in total by 2020. The state met this goal, and the Energy Efficiency Roadmap is considering setting new energy efficiency goals.[143] Rebates and other incentives may be available for some energy efficiency upgrades, but these come from either utilities or the federal government.

Resilience

The Disaster Relief and Resilience Act, or state bill 259, was passed in 2020 to expand the state's resilience to flooding and natural disasters.[144] This bill created the state's Office of Resilience led by the Chief Resilience Officer. The office oversees the coordination of disaster recovery tasks and related resilience efforts throughout the state, conducts resilience planning statewide, and has some funding mechanisms for resilience projects.[145]

Policy Gaps

There are significant policy gaps surrounding decarbonization, clean energy, and emerging carbon industries. There are no statewide mandates to require clean

energy, energy efficiency, or electric vehicle goals in South Carolina. The state's lack of a renewable portfolio standard and electric vehicle goals has resulted in lost investment and growth in the emerging wind and electric vehicle manufacturing industries (this market assessment identified hundreds of millions of dollars in private investment lost in 2022 alone, see Market Sectors – Wind & Transportation). The state has limited funding across residential, commercial, and industrial sectors for large scale decarbonization efforts. The state does not currently aid existing firms in accessing carbon markets or in supporting startups in the growing decarbonization sector. Other areas have successful startups focused on technology or engineering for carbon removal or monitoring.

Financial Landscape

Financial Resources

There are currently untapped opportunities for financial institutions that operate in South Carolina to invest in clean energy and resilience. There is a large opportunity for a green bank to accelerate investment flows, especially in partnerships that leverage funds from in-state financial institutions, investors, philanthropists, government, and other partners. Existing funding streams are overviewed here and further detailed by market sector below. Market barriers vary by sector, but commonalities include:

- Limited flows of money for projects, across multiple market segments, compared to identified needs
- Financial products that do not meet specific needs around return-on-investment time, length of financing, financing cost, etc.
- Complexity in accessing funds from grants, revolving funds or other sources with no guarantee of investment (competitive investment)
- A lack of in-state investors and philanthropic funds[146]
- Problems related to policy and/or market demand

Financial Regulation

Banks, investors, and other financial actors in South Carolina are growing more aware of climate change and seeking information. Climate change presents a financial risk to their portfolios[147] and there is concern among clients.[148] The clean energy transition also presents opportunities for investment. Financial regulators, including the Federal Reserve and the Office of the Comptroller of the Currency, are actively considering responses including climate stress testing and changes to the Community Reinvestment Act to help the financial system respond.[149] The Community Reinvestment Act incentivizes financial institutions to re-invest in communities, requiring a performance evaluation with the regulator to expand into new markets or acquire new firms.[150] Financial institutions can be rewarded under the Community Reinvestment Act for investing in the clean energy transition[151], especially in areas designated financially distressed or underserved (see Figure 11). Investors can re-invest capital gains into designated opportunity zones, although there is not a

defined pathway for investing in the clean energy transition in South Carolina.[152] Green banks can assist financial actors in meeting their regulatory requirements and goals by leveraging or amplifying community investments.

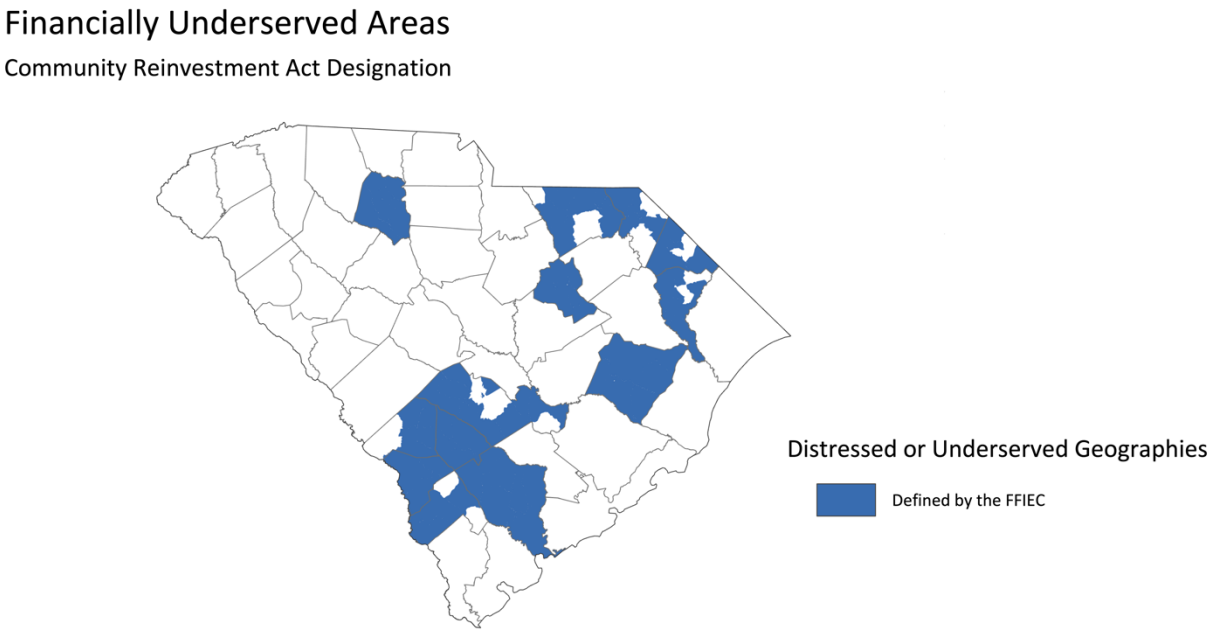

Figure 11: An analysis was conducted using data from the Federal Financial Institutions Examination Council (FFIEC).[153] Financial institutions are incentivized to increase the volume of financial activity in these areas under the Community Reinvestment Act. Census tracts that were designated as distressed or underserved in either 2020, 2021, or 2022 are shown. Note that not all areas were designated in each of the three years; the merging is meant to show which areas of the state have recently been included.

In response to rising concerns of investors and other stakeholders (see Market Sectors – Carbon Markets), the Securities and Exchange Commission has proposed a rule that would require all registrants to report climate-related risks and greenhouse gas emissions.[154] This change would affect public companies in South Carolina and add climate risk and carbon pollution to their existing disclosures of traditional financial and risk metrics.[155] Climate risk is already being priced into financial markets and investor behavior[156], and communities and firms in South Carolina may be left unprepared.

Existing Funding Streams

Utility Funding

Utilities are an important source of funding, especially in the energy efficiency sector. In 2020, South Carolina utilities spent $49.2 million (0.6% statewide electricity revenues) on energy efficiency programs and supplemented federal low-income energy assistance programs with an additional $2,219,427, or $1.49 per qualified

resident.[157] Around 80% of utilities provided some sort of funding or have other related programs, although most of the funding comes from the state's largest utilities.[158] These activities included providing financial incentives to reduce energy consumption and for energy efficient construction, weatherization programs, and peak load or demand control. These reduced rates and financial incentives helped utilities reduce electricity during high demand periods while also lowering customers' monthly electric bills. For further details, see (Market Sectors – Energy Efficiency).

Examples of utility activities include:

- Santee Cooper, a state-owned utility, offers rebates for energy efficient equipment, including HVAC and water heating systems.[159] The utility also offers residential customers on-bill financing for up to $40,000 for the installation of solar panels, wind energy, micro-hydropower, biomass, or solar water systems through their Renewable Energy Resource Loans.[160]
- Dominion Energy, an investor-owned utility, helps customers reduce their energy usage through a portfolio of 10 energy efficiency programs, including free home energy checkups, discounts and rebates on energy efficient technology, and free appliance recycling.[161] Dominion is exploring ways for its customers to increase their access to affordable energy efficiency improvements.
- Duke Energy, an investor-owned utility, utilizes their Smart Saver home improvement rebate program to invest in energy efficiency.[162] Duke is conducting a North Carolina on-bill financing pilot for energy efficiency that could later expand into South Carolina to fund energy efficiency improvements or distributed solar.
- The Electric Cooperatives of South Carolina use the Help My House financing program to help provide financial assistance to customers for efficiency upgrades, with 5 cooperatives participating currently. Funding for this program comes from the U.S. Department of Agriculture's Rural Energy Savings Program with $15.5 million in loans for weatherization and home upgrades.[163] Customers have realized about 30% in energy savings on average, which equates to about $288 in yearly energy savings per household.[164]
- Lockhart Power, an investor-owned utility, supplies its customers with clean power by working to ensure the portion that they generate is nearly all renewable energy.[165] The utility also works with industrial customers to incentivize demand-side management initiatives.

State Funding

There are a variety of existing funding streams from (or administered by) state government. While not meant to be exhaustive, this section overviews major

programs. These programs are further evaluated in context in the Market Sectors section of this report.

Weatherization

The state receives money from the U.S. Department of Energy for weatherization projects in low-income households. Weatherization seeks to reduce energy bills through energy efficiency measures such as appliances, insulation, and building envelope repairs. A typical project saves $283 a year in energy savings at a ~$4,000-$5,000 average cost.[166] Residents access weatherization funding through their local Community Action Agency, with information on the program available through the S.C. Office of Economic Opportunity.[167] Since 2010, South Carolina has received $20.6 million in weatherization funding for 5,242 projects.[168] Around 300 homes are weatherized in a typical year, and many homes are deferred due to issues that would prevent a project from beginning.[169] In fiscal year 2022 the state will receive $42,582,236, an increase due to the Bipartisan Infrastructure Bill.[170] Weatherization projects can also be funded through charities or utilities, although the volume of these funding streams is harder to gauge. For further details, see (Market Sectors – Energy Efficiency).

Low-Income Home Energy Assistance Program (LIHEAP)

The state receives money from the U.S. Department of Health and Human Services for direct monetary assistance for low-income households struggling to afford home heating or cooling under the LIHEAP program. Residents access LIHEAP funding through their local Community Action Agency, with information on the program available through the S.C. Office of Economic Opportunity.[171] In fiscal year 2020, the program served 43,957 households (out of 447,749 population eligible).[172] Households receive between $300 - $1,000 yearly through the program.[173] In fiscal year 2022 the state will receive $45,084,877.[174] Energy bill assistance can also be funded through charities or utilities, although the volume of these funding streams is harder to gauge. For further details, see (Market Sectors – Energy Efficiency).

South Carolina Energy Office

The South Carolina Energy Office is housed within the South Carolina Office of Regulatory Staff and receives funding from the U.S. Department of Energy via the State Energy Program.[175] The office promotes energy efficiency, renewable energy, and clean transportation and conducts research, facilitates stakeholder groups, and is involved in other market development activities. It also operates several revolving funds and grants. The ConserFund Program offers financing to public institutions and charities (100% loan in ConserFund or 70% loan / 30% grant in ConserFund Plus) for energy efficiency and clean energy projects.[176] The program averages 4 loans per year, and from 2009 – 2020 funded 85 projects that generated ~$40 million in savings from ~$30 million invested.[177] Most of the projects are building energy efficiency upgrades such as lighting, building envelope or HVAC systems. The Energy

Efficiency Revolving Loan is offered to private firms via the Business Development Corporation and has made 6 loans in total towards energy efficiency projects.[178] The SC Energy Office also runs a Mini-Grant Program, awarding several small grants annually (up to $10,000 each) for energy efficiency, renewable energy, and clean transportation projects by public institutions and charities.[179] For further details, see (Market Sectors – Energy Efficiency).

South Carolina Office of Resilience

The South Carolina Office of Resilience receives funding from the state to support disaster recovery and resilience planning statewide. The office has begun a variety of funding programs to enhance resilience efforts from municipalities and charities. The South Carolina Resilience Revolving Fund has ~$6 million to loan to municipalities for flood buyouts and floodplain restoration.[180] The Disaster Relief and Resilience Recovery Fund is a first source of money for communities to use following a federally declared disaster before money from the Federal Emergency Management Agency or other federal agencies arrives.[181] The office also has $5 million available to assist communities in meeting cost share requirements for federal grants used to fund resilience projects, and helps communities seeking to access federal resilience grants and disaster recovery funds.[182] For further details, see (Market Sectors – Infrastructure & Resilience).

South Carolina Conservation Bank

The South Carolina Conservation Bank receives funding from the state to support conservation through land management, which has ancillary resilience benefits (see Market Sectors – Infrastructure & Resilience). Over the past two decades, the bank has awarded around $330 million to conserve about 350,000 acres (1.5% of the state's area). The bank receives regular funding each year and uses it for grants that assist landowners, non-profits, and municipalities in accomplishing their land management goals that align with the bank's priority areas for conservation.

South Carolina Department of Health and Environmental Control

The South Carolina Department of Health and Environmental Control receives funding from the state and federal governments to support environmental health and regulate economic activities that harm communities and businesses. The department provides regular grants for planning and implementation to watershed projects and other activities that have ancillary resilience benefits (see Market Sectors – Infrastructure & Resilience). The department also assists communities in applying for funding to pursue resilience projects, advises and educates communities on environmental justice, and coordinates stakeholder groups to share knowledge and build capacity.

Federal Funding

Inflation Reduction Act of 2022

At the time this report was being completed, the U.S. Congress passed the Inflation Reduction Act of 2022.[183] This bill comprehensively changes policy incentives for each of the market sectors analyzed in this report. After its passage, large market shifts are expected. One example is the regulatory action announced by the state of California (and expected to expand to 17 states) to ban the sale of gas-powered cars after 2035.[184] It is important to note that this market assessment does not fully evaluate the changes to federal funding and expected market shifts from the Inflation Reduction Act. This report represents the market landscape as of July 2022.

Federal Investment

Even with increased federal funding, some barriers may still apply. For example, an increased tax rebate or other policy incentive may further reduce but not entirely eliminate an up-front cost barrier that a household or business faces for an energy efficiency or clean energy project. This report found that existing federal funding is often insufficient, not well targeted, or not flowing to communities due to specific issues (e.g., matching requirements or other issues in applying). Some of these issues may still apply to new federal funding streams.

It is important to note that a green bank cannot approach levels of federal funding in many sectors. Several state agencies and local non-profits are currently working to aid communities and citizens in taking advantage of federal programs, and a green bank could potentially contribute to these efforts. Federal programs prior to passage of the Inflation Reduction Act that are detailed in other sections of this market assessment include:

- *Department of Energy*: The Department of Energy funds energy-related programs in South Carolina, including the South Carolina Energy Office and its revolving funds, and opens additional funding opportunities to utilities and communities. The department also collects data and conducts research that helps communities understand the energy sector and its economics.
- *Department of Agriculture*: The Department of Agriculture invests in agribusinesses through a variety of programs. The Rural Energy for America Program is a major source of funds for renewable energy and energy efficiency projects on farms. The department also funds rural development and utility programs in rural areas, such as the Electric Cooperatives of South Carolina's Help My House program.
- *Department of Transportation*: The Department of Transportation helps communities in funding public transportation and electric vehicle infrastructure. For example, the department is set to fund the development of fast charging networks across the state by deploying ~$70 million from the Bipartisan Infrastructure Bill through the National EV Infrastructure Program.[185]

- *Department of Health and Human Services*: The Department of Health and Human Services funds programs that help low-income households afford their energy bills and conducts research into how climate change affects public health.
- *Department of Labor*: The Department of Labor is currently researching how climate risk affects occupational safety and the wider labor market.
- *Department of Homeland Security*: The Department of Homeland Security, via the Federal Emergency Management Agency, helps communities recover from climate extremes and funds resilience projects that aim to reduce future damages. One example, is the Building Resilient Infrastructure and Communities program, which invested $122,286,709 in 33 projects in South Carolina in fiscal year 2020.[186]
- *Department of Commerce*: The Department of Commerce, via the National Oceanic and Atmospheric Administration, provides data, resources, and funding to help communities and businesses understand climate risk and pursue resilience projects.
- *Environmental Protection Agency*: The Environmental Protection Agency provides data, resources, and funding to help communities and businesses reduce greenhouse gas emissions and pursue resilience projects. The agency also collects data and conducts research that establishes the effects of pollutants, including greenhouse gases, and devises and enforces regulations.
- *Department of Treasury / Federal Reserve / Securities and Exchange Commission*: These agencies are responsible for maintaining market stability and integrity. They are currently advising financial institutions and beginning to act in areas like carbon reporting and climate risk.

Market Sectors

Energy Efficiency

Current Market Conditions

Energy efficiency saves residents or businesses money and benefits utilities. It can refer to any number of activities that reduce the total amount of energy consumed, or that changes the timing of energy demanded (reducing spikes in energy demand on the grid lowers costs for utilities). Collectively, these energy efficiency activities are sometimes referred to as demand side management to reflect their role and position in economic decision making and policy. South Carolina has a high energy burden (see Market Background – Energy Burden) and currently fares poorly in achieving energy efficiency, saving only ~0.35% in energy savings from retail electricity sales.[187] This is among the best regionally, but only half the national average.[188] According to a national assessment South Carolina ranks 40th nationally in energy efficiency policy, but ahead of some Southeastern neighbors.[189]

Commercial buildings in South Carolina use outdated minimum energy efficiency codes from 2009 and many businesses are not required to participate in utility energy

efficiency programs.[190] Businesses, especially industrial firms with high energy usage, make independent investments in energy efficiency and some have an energy manager or energy team. Many homes in South Carolina are older or are manufactured homes with poor energy efficiency. Even new construction imposes some costs by not implementing energy efficiency beyond minimum requirements. Addressing the building envelope for homes that are energy inefficient can save hundreds or even thousands of dollars a year.[191] Energy savings increase with building size and energy use, with the potential for large savings for commercial and public users.[192]

For example, 99% of all households in South Carolina would save on their energy bills by switching to modern energy efficient appliances (heat pumps for indoor air heating/cooling and water heating, and induction stoves).[193] The average household would save $414 annually; those switching from fossil fuels save proportionately more but even customers already on electric would save ~$300 annually from upgrading to a higher efficiency system.[194] In every county in South Carolina, low- to middle-income households would save more than the average household in that county (see Figure 11). Full implementation of energy efficient electrification would generate 3,700 installation jobs (with more economic development potential if the state successfully competes for manufacturing jobs) and save 70 premature deaths per year by removing harmful air pollution caused by fossil fuel appliances (gas stoves indoors, and outdoor air pollution from natural gas, propane, and fuel oil energy systems).[195]

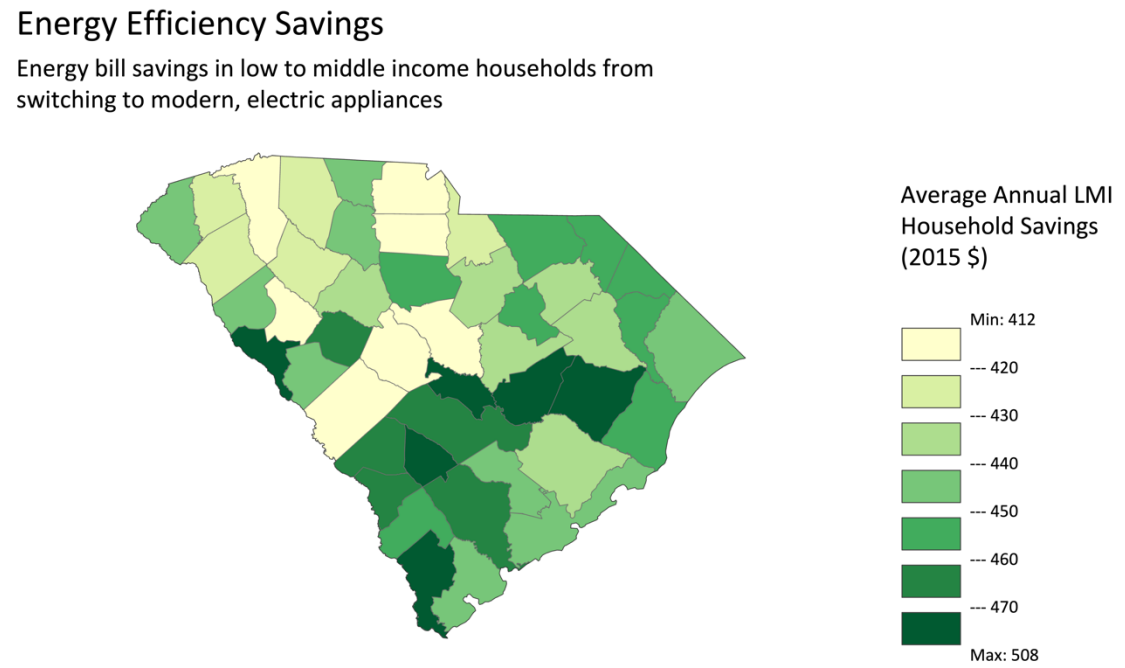

Figure 12: An analysis was conducted using data from Rewiring America (2022).[196] The report does not give a reason for why LMI households save more but is likely due to a combination of older

appliances and less efficient buildings (which would save proportionately more from receiving an upgrade). In South Carolina, households in rural areas generally save more than urban areas, likely for similar reasons.

Residents and businesses could save money through implementation of energy efficiency measures, and there are existing resources available (see Market Background – Financial Landscape). Energy efficiency is easy to ignore or de-prioritize, and both sectors face market barriers. A green bank could accelerate the market for energy efficiency in South Carolina by addressing these barriers and gaps in existing resources, following the recommendation set out in the State Energy Plan.[197]

Market Barriers & Issues

Residential

Homeowners often have a variety of improvements they could make, from upgrading appliances, home-energy systems (indoor air heating/cooling and water heating), and the building envelope (the exterior of the building including doors, windows, roofing and insulation). Common barriers identified in South Carolina include:

- *Information*: Residents often face difficulty evaluating the volume of information on available programs and supports and may not take advantage of government or utility programs they are eligible for. Residents can also find it difficult to identify energy efficiency needs in their home if they are less obvious.
- *Up-front cost*: These improvements often cost thousands of dollars and save hundreds of dollars per year. Even if an upgrade would save more or pay for itself in only a few years, many households cannot make the up-front investment.
- *Sunk cost*: For many homeowners, identifying which improvements are possible often requires an initial payment to a contractor or business to conduct an energy audit. This also affects contractors' ability to expand their business.
- *Timing*: A common moment to make an energy efficiency improvement is when something breaks or is damaged, but in this case some residents may seek the fastest or cheapest repair or replacement.

Renters and landlords face a complex set of decisions because they may not always be able to make energy efficiency improvements without multiple parties. Renters may not reside in the unit long enough to recoup capital investment costs if the burden of the improvement is left solely to the occupant. Landlords may not see the benefit for such improvements if there is high turnover for the units or they do not pay the utility charges. Owners of larger residential buildings can often make significant energy efficiency improvements that affect multiple households but may not pursue this if the costs of finance are too high or they are not sufficiently incentivized to do so.

Low- to middle-income households face disproportionately higher energy costs (as high as 27% of total income)[198], often due to poorly insulated buildings and less efficient appliances. Existing state programs such as the Weatherization Assistance Program and Low-Income Home Energy Assistance Program are not adequate to address the need of these households – currently only 10% of the eligible population is served.[199] Charities and other types of emergency or community support are also working to assist households with energy needs but do not fully close the gap. The Weatherization Assistance Program faces the barrier of not being able to fund energy improvements in certain cases, such as roof damage or mold, severely slowing the pace of home energy improvements.[200] Even if funding is available for a household energy improvement, some contractors are insufficiently rewarded for participating in weatherization programs or are harder to access in rural or disadvantaged areas. Other key barriers include those who are not eligible for assistance but still struggle to afford energy bills (e.g., program cutoffs are often arbitrary) and those whose income rises above the cutoff and are now ineligible for support that was previously relied on. The up-front cost barrier is exacerbated for low- to middle-income households. These households are also more likely to not have the capital to invest in a replacement or upgrade if an appliance breaks or the building envelope of a residence is damaged, leading to increasing energy consumption over time.

Business, Commercial & Public Sector

Although energy efficiency is often thought of in terms of residential buildings, owners or occupants of non-residential buildings (including businesses & non-profits, commercial building owners, or public sector entities) can be interested in energy efficiency as well. A key reason for pursuing projects is long-term cost savings, which are important for organizations with small profit margins or where energy is a large percentage of operating expenses (e.g., manufacturing). Energy efficiency projects free up additional capital to deploy for other uses and can help an entity meet its energy savings targets or commitments to stakeholders (e.g., corporate net zero plans). Common barriers identified in South Carolina include:

- *Up-front cost*: Some organizations do not make an investment in energy efficiency, or will delay making energy efficiency improvements, due to initial costs. Efficiency projects can be much more expensive than in residential buildings (up to tens or hundreds of thousands of dollars) due to a variety of factors, including building size and project complexity.
- *Least cost alternative*: If a lower cost but less efficient option is available it is sometimes pursued instead of a more efficient alternative, resulting in some short-term savings but higher long-term expenses. Some organizations may be encouraged or required to pursue the least cost alternative depending on their organization's strategy and/or policies.

- *Return on investment time*: Organizations with large energy expenditures often routinely deploy capital on efficiency projects. Even in these cases, projects with a payback time more than 5 years are typically not pursued because the capital could be used in other areas.
- *Misaligned incentives*: Building owners' incentives may not align with those of their tenants, depending on how utility payments are arranged in a leasing structure.
- *Knowledge and expertise*: For organizations entering a building lease, it can be difficult to know what typical energy expenses are. For smaller organizations or those without an energy manager or energy team, it can be difficult to identify potential energy efficiency improvements. Hiring a contractor or conducting an energy audit usually carries direct costs, and exploring projects independently has indirect costs. This barrier extends to identifying available funding or utility incentives that may be available. For new construction, LEED or other sustainable building programs may be available but difficult or costly to access.
- *Accessing innovative financing*: Many organizations already have sufficient access to capital through traditional forms of finance (such as a loan with their regular lender) and use it for energy efficiency projects if it meets their needs. In some cases, different types of finance can be hard to access because specialized knowledge is required, such as energy savings performance contracting.[201] In other cases, it may not be currently available in South Carolina, such as commercial property assessed clean energy (C-PACE)[202], or available in only limited cases, such as on-bill financing.
- *Policy barriers*: Building codes and energy efficiency targets are out of date, market disclosures are not always required, and participation in energy efficiency programs is not always required.[203]

There is a large potential market for energy efficiency programs, because every organization has a level of interest in saving on energy expenses. Although the potential market is large, current activity in the sector is disproportionately low. In addition, cheaper or easier projects like LED lighting improvements are overrepresented. While these improvements are important and save organizations money, investing in more significant improvements can save 20-30% or more on energy bills. Large facilities in the state that have taken on specialized staff and invested heavily in more complex energy efficiency projects have saved large sums ($1 million or more) for their organizations.

Although the policy landscape shapes the overall market forces, economic barriers are also present. Return on investment time slows the pipeline of energy efficiency improvements, and in a surprisingly large number of cases up-front cost is leading organizations to lose money in the long run as they invest in less efficient alternatives at a marginally lower price point. Two state revolving funds – ConserFund and the

Energy Efficiency Revolving Loan – are available but may not meet the needs of target organizations. Despite attractive interest rates (1.5 – 2%), both programs struggle with volume and have unspent money available in the funds. The ConserFund Plus program, which offers 70% financing and 30% grant, is currently spent out. ConserFund averages four loans per year, and the Energy Efficiency Revolving Loan has had 6 loans total and none in the past two years.[204] Current funding through these programs is not geographically well distributed (the three largest counties have received 29% of all program funding[205]), with better resourced entities able to dedicate more staff and resources towards navigating complex requirements. Revolving loan activity in South Carolina lags other states.[206] The most common barriers with existing revolving loans are awareness, loan requirements, time investment prior to receiving funds, and repayment terms limited to 10 years (which in some cases excludes otherwise viable projects).

Innovative financing mechanisms could be expanded in the market. A large opportunity exists for on-bill financing (especially in connecting utilities with local lenders to make finance more accessible), and there is some market potential for more specialized finance like energy savings performance contracting and commercial property assessed clean energy (C-PACE). In other states, capital deployed through innovative financing mechanisms like these typically exceeds the volume deployed through government and utility programs.[207]

Utilities

Utilities are interested in energy efficiency for a variety of reasons including lower operating costs (less energy demanded means less needs to be produced), decreased stress on the grid at times of peak demand, expanding into new markets (for example, electric vehicles), community engagement opportunities, and commitments to regulators, investors, or other stakeholders. Utilities offer a variety of energy efficiency programs for both residential and commercial customers (see Market Background – Financial Landscape). Most utilities have a greater volume of programmatic activity directed to residential customers. The number of programs doesn't necessarily correspond to its impact on the market, and utilities that offer residential programs typically offer programs for commercial and industrial market segments as well. Many utilities are looking to expand their energy efficiency programs. For example, both Duke and Dominion have conducted market potential studies and indicate plans for expansion in this market.[208]

The energy savings achieved by existing programs are above average regionally but below average nationally[209], and the money spent annually on them is significant (0.6% statewide electricity revenues) but also below most other states.[210] Common barriers identified in South Carolina include:

- *Education & awareness*: Customers may not be aware of programs or incentives they are eligible for and how to apply.

- *Insufficient or mis-aligned incentives*: Incentives can be overly concentrated in limited areas (e.g., light bulbs), incentives may not be high enough to cover the cost differential compared to a least-cost alternative, there may not be enough incentives compared to needs, or in some cases may direct customers to natural gas despite climate and health costs (see Market Background).
- *Need to accelerate effective programs*: Effective programs, such as weatherization and on-bill financing, could be expanded with a greater volume of funding and/or pipeline of projects (in some cases more funding exists than is spent).

Gap Analysis

The following gaps were identified specific to the energy efficiency market in South Carolina:

Financing

- *Increase the volume and accessibility of funding:* Grant-based programs are either depleted or insufficient to address the scale of need. Other forms or funding may not be easily accessible. A green bank could play a role in directly or indirectly making additional funds available, especially as mixed offerings of grants & traditional forms of financing:
    - *Fix barriers to existing funding*: Existing funding in the state is available but currently unspent, including the two revolving funds operated by the SC Energy Office and weatherization programs (from the SC Office of Economic Opportunity and/or utility programs). A green bank could work to address the reasons why the money is unspent, such as fixing building issues that prevent a home from being weatherized.
    - *Expand revolving funds:* Existing state revolving funds exclude the residential sector, despite high needs. A green bank could directly or indirectly contribute to a similar offering for this sector. Some non-residential institutions, especially those with large building footprints, need a program that addresses specific barriers like up-front cost differentials between an efficient product and a least-cost alternative. An internal revolving fund set up with green bank support or backing could potentially accomplish this.
    - *Accelerate traditional financial sector offerings*: Existing lending from banks and credit unions is available but may not meet the needs of the consumer. In many cases, a targeted financial product can be developed. A green bank could offer a loan loss reserve, credit enhancement, or other mechanism to decrease interest rates and/or extend repayment time (10+ years optimal, depending on project). For example, a green bank could jointly invest but defer its payment to increase the repayment time. A green bank can also advertise existing financial products.

    - *Utility partnerships*: Utilities are interested in financial mechanisms but do not want to take on a lending function internally or devote staff to a program. A green bank could partner with utilities and South Carolina lenders to utilize on-bill finance or other mechanisms to enable cash-flow positive projects for consumers and decreased financial risk for lenders. A green bank could also attempt to work to make existing utility incentives more attractive.
    - *Commercial Property Assessed Clean Energy (C-PACE):* Commercial buildings could benefit from the ability to use this as an alternative to loans or other currently available financing. In other states, green banks either aid or are tasked with implementing property assessed clean energy within an area. A green bank should not provide funds for residential property assessed clean energy (R-PACE) in South Carolina because of the reputational risk involved with placing a lien on a home.
- *Develop pipeline of energy efficiency projects*: The residential sector faces two more specific barriers: lack of access to information and sunk cost.
    - *Connect residents to information*: A green bank could use its knowledge and expertise in economics to provide useful information to residents, such as the trade-off between up-front cost and long-term savings. A green bank could also connect them to existing groups that provide useful general financial information[211], guidance on connecting with contractors, or existing products offered by in-state financial institutions. These activities will increase the size of the market as more people understand energy costs and benefits.
    - *Sunk cost*: A small initial cost to conduct an energy audit or site visit from a contractor can prevent a project from starting, decreasing residential savings. A green bank could work to decrease this barrier by covering a portion or the entirety of an energy audit. For example, a green bank could make a local lender's financial offering more attractive by re-imbursing a household for the energy audit expense if the project is pursued. This could also benefit contractors, who face a growing market where demand is rising but job stability and hiring are both difficult.[212]

Education & Communication

- *Enhance existing work*: Utility programs can be underutilized by target consumers, and a green bank could work directly or indirectly (pointing people to groups that already assist with this work) to increase the existing successes of these programs. A green bank could also help with existing efforts to share specialized knowledge on how to implement energy efficiency projects.[213]
- *Enhance future work*: Utilities are planning for the clean energy transition and increasing demand side management initiatives. A green bank could support

creation of new programs or avenues for benefitting both consumers and utilities, such as utilizing on-bill finance for energy efficiency programs.

- *Policy barriers*: In many cases policy can drive market forces or result in sub-optimal conditions. Examples include outdated building codes, inability for residents or businesses to determine energy costs prior to purchasing, etc.[214] A green bank could use its expertise at the intersection of climate and finance to advise others or support existing initiatives.

Clean Energy

Solar

Current Market Conditions

The Southeast is the 2nd most economical region for solar power after the desert Southwest. South Carolina ranks 15th in mean global horizontal irradiance (a measure of how much energy a flat surface receives from the sun) at 4.76 kWh / m^2 / day (see Figure 13). Solar panels are an economically sound investment for many areas across the region, and the Southeast is developing its solar markets.[215]

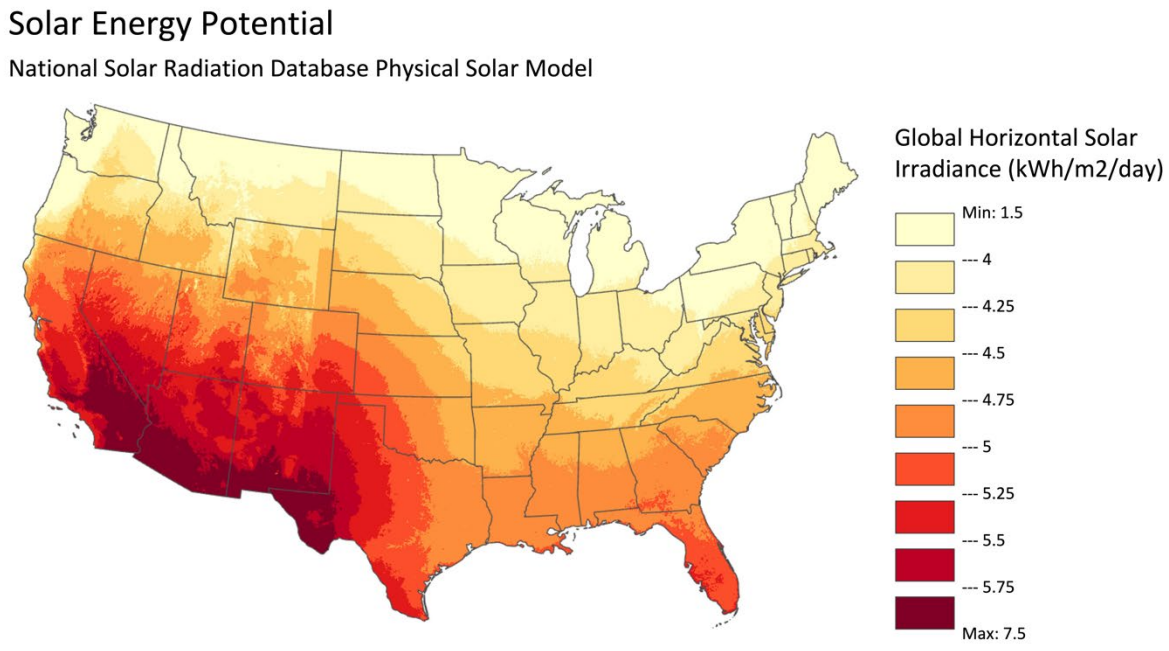

Figure 13: An analysis was conducted using solar supply curve data from the National Renewable Energy Laboratory (2018).[216] The southern and coastal regions of the state have slightly higher global horizontal irradiance, although all areas of the state are above the national average. Note that the data is spatially averaged, meaning that not all sites within each cell have the same value. For example, individual sites can be shaded by trees or obstructed by buildings at a very small scale.

South Carolina has a functioning solar market but falls behind other states regionally in the total capacity of currently installed solar panels and has a very low percentage

(~2%)[217] of its total electricity generation provided by solar power (see Figure 14). However, when generation is scaled to the number of people, South Carolina's current market size is among the highest in the region.[218] South Carolina is below the Southeast average in total market investment in solar, with $2.4 billion compared to a regional average of $7.4 billion.[219] The regional average is pulled upwards by significant investments in Florida, which has the strongest solar energy potential, and North Carolina, which has strong policy support (see Figure 14).

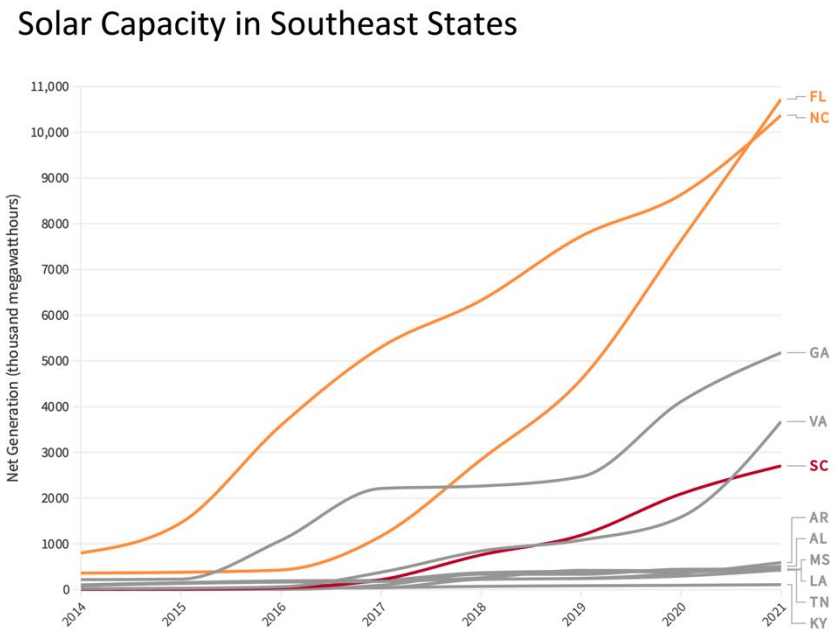

Figure 14: An analysis was conducted using data from the U.S. Energy Information Administration (2022).[220] South Carolina is highlighted alongside two states with strong solar market growth.

After the passage of the SC Energy Freedom Act in 2019, total solar net generation in the state more than tripled.[221] As a result, South Carolina currently has the highest compound annual growth rate regionally (see Figure 15), but industry forecasts expect investment to slow.[222] South Carolina's projected market growth in the next 5 years ranks 21st nationally and below average regionally in numeric terms, but above average regionally when scaled to population.[223]

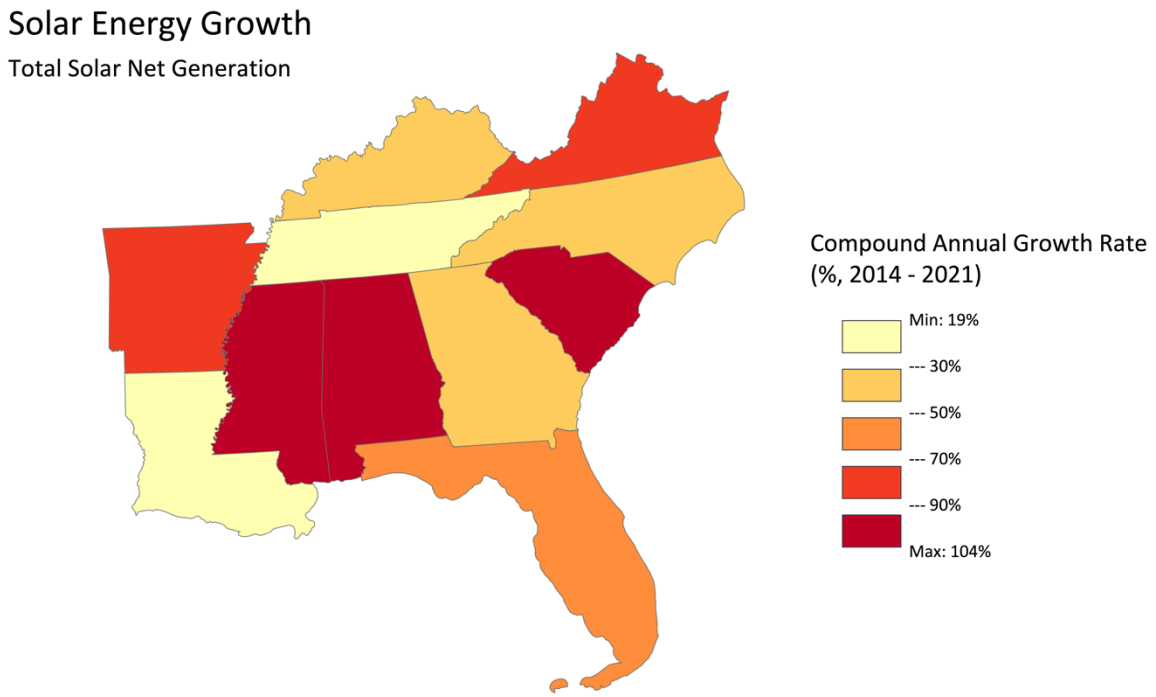

Figure 15: An analysis was conducted using data from the U.S. Energy Information Administration (2022).[224] The compound annual growth rate was calculated between 2014 – 2021, when all Southeast states had net generation above zero.

South Carolina has 73 solar companies (18 manufacturers, 31 installers/developers, 24 others) employing 3,086 people (see Figure 16). This is below average regionally, although the states with more companies and jobs generally have larger economies overall. Some SC solar companies operate regionally, or in a few cases nationally (e.g., Palmetto recently raised $375 million in capital[225]).

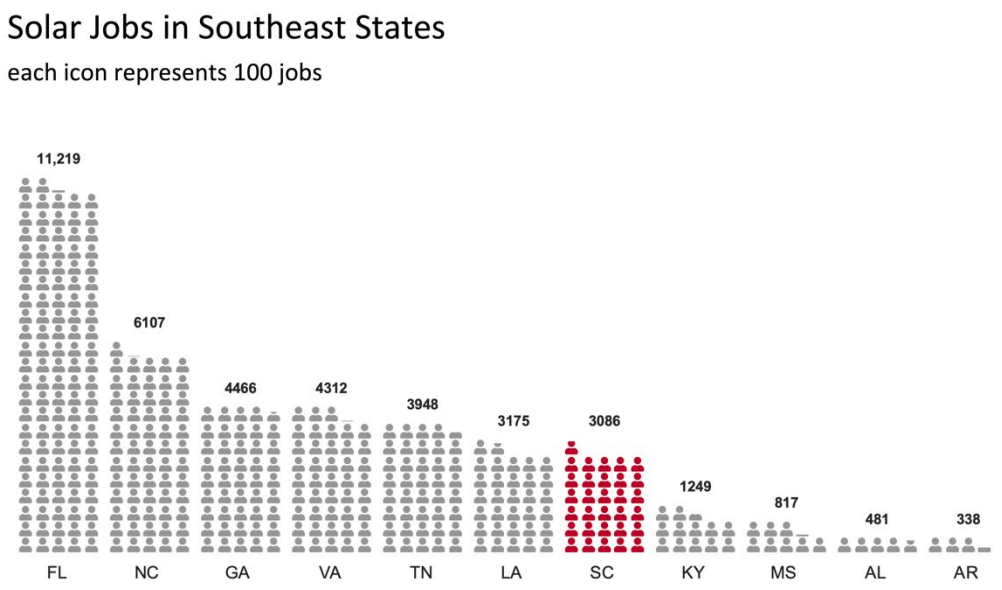

Figure 16: An analysis was conducted using data from Wood Mackenzie & Solar Energy Industries Association (2022).[226] The number above each set of icons represents the total number of jobs. Market data collates jobs across all types of work related to the solar industry (manufacturing, installation, etc.) in the year 2021. South Carolina is highlighted.

Market Segment Overview (The barriers and issues faced by each segment are further described below):

- *Residential/Commercial*: This sector constitutes 17.6% of the SC market, in terms of solar capacity, although it is the largest segment by total number of installations.[227] The vast majority (~ 72%) are owned by households / businesses and the remainder are leases.[228] The average size of these installations is 8 KW.[229] Small scale systems typically cost between $15,000 - $30,000 and save the household / business thousands of dollars per year on energy costs (or about 80 – 100% of an average household's electricity bill).[230] The payback time ranges between 7 – 15 years.[231] The distribution of solar installations in this market segment is not correlated to solar potential, indicating that local market factors are important and some areas of the state have higher access to solar and households / businesses in those areas are reaping greater economic benefits than others (see Figure 17).
- *Industrial*: This sector constitutes 5.2% of the SC market in terms of solar capacity.[232] Industry & manufacturing firms within the state face high energy costs, and business considerations differ when compared to small and medium sized firms (which resemble the residential market). Some firms have installed on-site solar; for example, Boeing has a large 2 MW installation at its plant in North Charleston.[233] Many firms are seeking 100% clean energy to power their facilities as part of net zero goals or other corporate commitments to investors

and other stakeholders. SC firms such as Nucor Steel[234] are directly involved in solar manufacturing at a national scale, and Rolls Royce uses Aiken, SC for integrated solar power technology developments.[235]

- *Utility*: This sector constitutes 77.2% of the SC market in terms of solar capacity.[236] In addition to being the largest market segment, utilities also significantly affect other market segments due to the current policy and regulatory landscape. The average utility scale solar installation is ~ 12 MW. South Carolina utilities, except for Santee Cooper, rank above average regionally for solar on-grid.[237] Solar is currently cost-competitive at this scale, readily observed in the fact that all of South Carolina's new utility scale electricity generation added in 2020-2021 was solar.[238] Utility scale solar is significantly cheaper than other market segments due to economies of scale and the low cost of land in much of the state.[239] Utility-scale solar is key to achieving a clean energy transition, although the savings are typically not passed through to residents or businesses. Utilities with portions of their operations in South Carolina are projected to invest billions of dollars in solar in the coming decades to achieve their net zero carbon goals, although the speed of their clean energy transition plans do not always match stakeholder needs or the lowest cost option for ratepayers.[240]

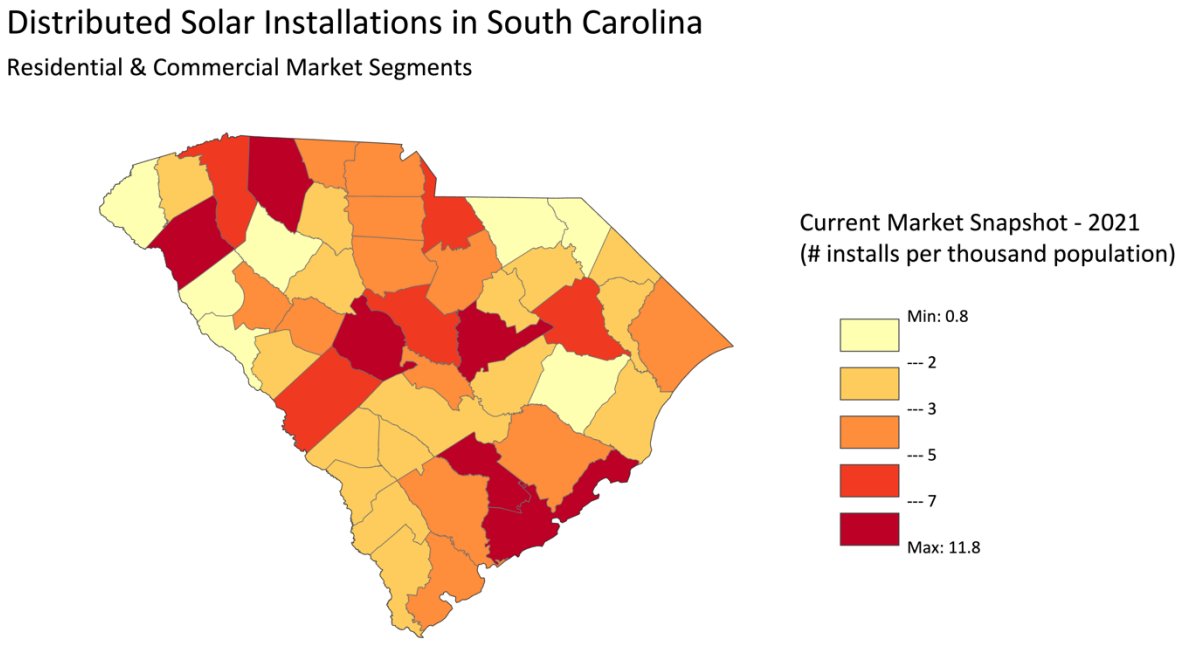

Figure 17: An analysis was conducted using data from the SC Energy Office (2022) and U.S. Census Bureau (2022).[241] Dividing the solar market data by the number of people living there allows for comparisons between more and less populous areas.

Solar is often viewed as a mechanism to avoid climate damages or achieve environmental goals, but other primary benefits are health benefits (for communities),

energy cost savings (for communities) and economic development (for both communities and markets). Costs have fallen exponentially over the past decade across all market segments, and solar is now among the cheapest forms of energy.[242] Many homes and businesses in the state face high energy costs, and access to a solar installation could collectively save them hundreds to thousands of dollars per year. Access to clean energy is important for economic development in several sectors, especially manufacturing, aerospace, technology, and life sciences. Counties in South Carolina are adding between a few dozen and a few hundred installations per year across all market segments, with significantly more installations in counties with major urban centers or larger populations.[243] However, solar is still currently only ~2% of South Carolina's electricity mix[244] and must scale significantly in the coming years to meet market needs, capture economic development opportunities, and avoid large climate damages.[245]

Market Barriers & Issues

Residential

Residential customers often have limited understanding on how to reap solar savings. Likewise, customers may not understand how to work with their utility to install solar and how utility rates with solar savings work. Low- to middle-income residents not only have difficulty affording solar installations but are also asked to navigate complex rules and long-term planning to evaluate their cost savings from solar. Customers face the burden of the up-front costs and cannot readily access the profitability in the future. For all residential customers, the up-front cost barrier is intimidating and requires trust in the solar company. Community-level awareness is low in South Carolina because not many residences can afford solar and serve as a hub of experience for their neighborhood.

Low- to middle-income communities stand to gain the most from solar energy savings but they are the least likely to be able to afford the up-front cost or have access to good financing options. There are complex and difficult barriers regarding credit and ownership. Solar purchases with loans could require a high credit score (>665). Traditionally, debt-based financing does not work well for low- to middle-income residents since they have less capacity (and/or face higher interest rates) to take out a loan for residential solar. If these low- to middle-income residents are renters, solar financing is less attractive since landlords will be parties to any solar installations and may have different incentives. Community solar[246] has environmental justice benefits and enables households to directly save on their energy bills. Community solar has additional co-benefits for low- to middle-income communities such as enhancing resilience by increasing the capacity to respond to natural disasters and grid disturbances (especially for critical community infrastructure). The ability for multiple groups to benefit simultaneously increases awareness about energy and renewables.

For all residential customers, there are few incentives to finance solar energy. Many customers want monthly energy savings to exceed monthly finance payments. The current tax incentives and net metering regimes are not designed to meet this need and may not benefit all residential customers equally (or at all). The rates for money paid back into the grid are artificially low and encourage small system size, which inflates marginal costs for homeowners. The federal and state tax credits do not equally impact residential customers. Customers need to be wealthier with higher taxes for this incentive to be helpful, and it reduces but does not eliminate the up-front cost barrier. Utilities do not typically offer meaningful incentives. While homeowners are concerned with payback time, they are less concerned than other market segments, although the ability to transfer ownership and financing of a solar installation alongside the home itself would remove an additional barrier.

Small & Medium Sized Businesses

Small scale solar projects are increasingly being pursued by small- and medium-sized businesses in South Carolina, especially those with high energy bills. In addition to traditional rooftop solar, there is a wider variety of project types such as solar powered lighting. Solar projects are typically evaluated by businesses similarly to other projects that are fixed cost investments generating a predictable monthly return.

Many businesses may change location frequently or not have ownership of the property or land where the business is located. If the business moves before 20 years, they may not receive the full benefit of their solar panels if they purchased them up-front (unless they re-install the panels at a new location at added expense). Some businesses can readily afford the up-front capital costs of a solar installation, although this is a barrier for many others. Most small- and medium-sized businesses are likely to evaluate solar panels on either a cash flow basis (where monthly savings exceeding cost is the primary decision metric) or on a return-on-investment basis (where a payback time of 5 to 8 years with a positive net present value is the primary decision metric).

While they may be interested in the investment, small- to medium-sized businesses face similar barriers to residences in evaluating the economics of an investment in solar, especially with understanding net metering rates and available finance options. Businesses may have fewer financing options available from their local lender, and existing incentives may not match their needs. Current funding mechanisms designed for these businesses, such as the EERL program, do not adequately address issues of payback.

Large Firms & Industry

For South Carolina's large firms and industry, energy can be among their largest operating expenses. Reducing these costs is a core business priority, with many

manufacturers having a dedicated energy manager or energy team. Solar projects are evaluated as a potential cost savings measure. About 10% of SC manufacturers are currently exploring on-site solar. For large firms, the return-on-investment time is often the key decision metric. All projects with a positive net present value will be pursued, but the investment with the shortest return time will be prioritized. Payback times of less than 5 years are preferred.

The current policy and market outlook in South Carolina does not generally support the corporate clean energy and net zero targets of many of these firms. Firms are looking for solar (either on-site or through their electricity provider) to align with this corporate strategy and to ensure Environmental Social and Governance (ESG) commitments to investors and other stakeholders are met. However, the state's utility transition speed is limiting the ability to meet their goals. Further lack of policy support from the state drives down the financial investment from industry. Large power purchase agreements are favorable for this market sector, but without political commitment and expertise for clean energy developments, the state may see unfulfilled economic development from this sector in the state.

Some firms in the state are also facing an unusual financial barrier, where they may have projects between about $1 – 10 million that are unattractive for large investment banks, which are mainly interested in projects at a scale of $100 million or above. This mainly affects firms that have limited internal funding capacity and high weighted cost of debt.

Public & Non-Profit Sectors

A few South Carolina cities, government agencies, school systems, and non-profits are pledging for 100% clean energy and net zero emissions, but the public sector faces challenges in fulfilling these goals. Cities are also interested in investing in solar energy to lower electricity costs and increase resilience. During extreme weather events, cities are exploring battery storage for first response centers and grid resilience. Despite the growing number of public entities interested in solar, the constraints of municipal or non-profit budgets make it challenging to afford the up-front cost.

The public sector faces barriers surrounding ownership, payback time, and lack of incentives. For municipalities, leasing solar or accomplishing a power purchase agreement is confusing since any solar not directly owned can end up benefiting other actors involved in the agreement. Existing incentive programs, especially tax credits, specifically exclude public and non-profit actors (since they do not pay taxes). Solar leases for municipalities or non-profits are often more complex since these owners cannot take tax credits, and so the cost of a solar installation is higher than for other segments of the market. This also results in a longer payback period of 10-15 years from their initial investment, although the public sector is often slightly less

interested in payback time than other market segments. Overall, this sector has interest but few funding mechanisms available to them.

Utilities

Utility scale solar projects are the most cost-efficient because of proportionally lower fixed costs and the utility's weighted cost of debt is extremely low. These projects' capital investments are expensed over time to ratepayers. Utilities in South Carolina are driving large investments in these projects and will continue to drive the market overall in terms of solar capacity. Even though other market segments are investing in their own solar projects, these investments are small compared to the utilities' role in increasing the amount of solar deployed on-grid and in reducing emissions in the state.

Utility scale solar projects typically do not pass-through savings to the communities or businesses it powers. The existing regulatory structure, especially in distributed solar, drives down economic development and investment in South Carolina by other market segments. Existing utility incentive programs, even successful ones, can be complex and do not always align with residential or business customers' needs. This can artificially limit the utilities' own goals in community partnerships. Because of the immediate and long-term cost savings, solar power presents a large opportunity for local partnerships and for increasing the spread of successful models like on-bill financing.

Gap Analysis

The following gaps were identified specific to the solar market in South Carolina. Some have other entities working on them, particularly in communication and education, but all could be accelerated. There is a specific need for knowledge and applied programs / funding at the intersection of climate and finance.

Communication & Education

- *Workforce development*: work to support training, community education, and fostering market stability for local contractors through developing pipelines of projects.
- *Turn interest into demand*: interest among people and businesses in energy savings does not turn into demand due to market barriers, driving down economic investment and development. Reduce or eliminate market barriers to drive demand and accelerate financial investment by referring to in-state financial institutions with established programs or tools to de-mystify available incentives.[247]
- *Economic expertise*: solar economics can be complex and/or intimidating to some market segments. Connect and amplify existing education efforts.

Generate Demand & Broaden the Market

- *Address primary market barriers*: up-front cost, day 1 positive cash flow, payback time (return on investment time). Reduce or eliminate one or more barriers with programs or funds targeted to specific market segments, directly or in coordination with local financial institutions. Accelerate funding both within the state and from outside the state.
- *Broaden market access*: Some actors are arbitrarily disadvantaged in the current market, especially renters, some businesses (underserved business community, leased buildings, etc.), public sector (municipalities & non-profits), and low to moderate income communities. Develop green bank programs or funds specific to these customers, directly or in coordination with local financial institutions.

Coordination & Partnerships

- *Work towards greater quantity and variety of finance options*: Benefit the market and local financial institutions. Drive greater investment by assisting with generating demand, risk mitigation or helping lenders move away from risk assessments that involve credit scores, connecting local solar companies and local financial institutions, co-investment products and programs, innovative financing that tackles specific finance needs (e.g., finance that extends beyond 10-year terms).
- *Address specific needs of businesses, industry, and utilities*: accelerate clean electricity and carbon markets in South Carolina, aiding grid stability and resilience by coordinating technologies or policies in the distributed energy space, accelerate successful utility programs and models like on-bill financing.
- *Deploy finance and climate expertise*: assist in coordinating projects, advise on policy, and drive both in-state investment and flows of investment from outside the state.

Wind

South Carolina currently has no wind energy on the grid, either onshore or offshore.[248] Onshore wind increases local property values, income, and GDP.[249] Wind energy potential in South Carolina is limited onshore according to standardized data collected from the National Renewable Energy Laboratory[250], although recent pilot tests at a greater elevation indicate that there is potential for economical onshore wind energy in some areas of the state. Offshore, South Carolina has very high potential, especially further offshore near the Gulf Stream.[251]

North Carolina recently leased an offshore wind project near the South Carolina border for ~$315 million between two companies: TotalEnergies Renewables USA, LLC and Duke Energy Renewables Wind, LLC.[252] This project will also result in $42 million in local workforce and supply chain development initiatives[253] and an economic benefit of over $4 billion.[254] A preliminary economic assessment of an

offshore wind farm off South Carolina's coast in 2030 would result in a net economic benefit of $7 billion.[255] South Carolina has an offshore wind energy task force but is not currently participating in the market, in priority planning with the Bureau of Ocean Energy Management,[256] or in federal-state economic development partnerships.[257]

While it is not directly engaged in the market, South Carolina has 48 companies participating in the offshore wind supply chain.[258] 15 of these companies are wind manufacturing facilities, including some that supply critical components nationally.[259] The combined economic impact of these firms was ~$500 million annually in 2012.[260] South Carolina is currently seeking to update these numbers and attract additional offshore wind energy firms to the state.[261] Existing firms plan to invest millions of dollars in South Carolina in the coming business cycle, and small/medium sized firms (especially components, carbon fiber, & engineering services / logistics firms) and the Port of Charleston are investigating the sector as an additional source of revenue. In addition to these firms, South Carolina educational institutions have attracted over $50 million in federal investment towards wind energy research.[262] Clemson University has a nationally significant wind turbine & electrical testing facility in Charleston.[263] The SC Energy Office hosted a SC Wind Workshop in August, 2021 which attracted over 125 attendees. Attendees discussed actions that the state could take to develop the sector, including an office or initiative within state government, an updated economic impact and supply chain study, and reaching out to North Carolina and Virginia to form a joint supply chain initiative.

Lack of strong clean energy policies is currently damaging the state's ability to attract firms, with South Carolina losing out to states with robust clean energy policies and active wind projects. For example, Siemens Gamesa recently passed over South Carolina despite the state's existing wind manufacturers and wind turbine testing facility in Charleston, instead selecting Portsmouth, Virginia for a $200 million wind turbine facility.[264] Because of this expansion, the U.S. Department of Transportation recently awarded an additional $20 million to the port there.[265]

Long term, an offshore wind farm is unlikely if the state does not enact comprehensive policies that would create market stability, which are key for offshore wind projects which require large capital expenditures and nearly a decade to bring to market. A SC green bank is unlikely to have the capital needed to directly co-invest in offshore wind, although it can be supportive via analysis, communication, or other market building activities in coordination with the state that provide market stability, attract additional firms, or help coordinate outside investment. A green bank co-funded pilot project or small-scale onshore wind project in coordination with utilities could help create a market which attracts additional firms or investors.

Transportation

Electric Vehicles

South Carolina has a strong auto-manufacturing sector and has several companies directly involved in the electric vehicle industry, including BMW, Volvo, Proterra, Arrival, Bosch, and Freightliner. There is also an office of ChargePoint, a national electric vehicle charging network, located in South Carolina. Known in-state investments of $742 million for electric vehicle manufacturing and battery assembly among some of these firms in FY20 - FY22 have provided thousands of new jobs.[266] However, the policy landscape in South Carolina poses a barrier to economic development in this industry. For example, the Town of Camden recently lost out on $150 million in electric vehicle manufacturing investment.[267] South Carolina could further expand its role in this market through intentional economic development and by leveraging existing firms and assets like the Port of Charleston.

The electric vehicle market is expanding exponentially and sales of internal combustion engine vehicles have been declining as a share of the market since 2017.[268] Consumer demand for electric vehicles in South Carolina is growing because they are cheaper to own and operate, but ownership rates per capita are about three times lower than the U.S. average and also below average for the Southeast.[269] The 2014-2020 compound annual growth rate for electric vehicle registrations in South Carolina is 51.9%, but electric vehicles currently represent less than 1% of all registered vehicles.[270] According to the Department of Motor Vehicles, as of 2021 there are 9,419 electric vehicles registered in South Carolina.[271] The spatial distribution of these electric vehicles is strongly correlated with high-income areas and/or major urban areas (see Figure 18). A market analysis in 2022 found that, currently in South Carolina, purchasing an electric vehicle saves a consumer money over the lifetime of the vehicle compared to its gas equivalent for every vehicle evaluated.[272] Several electric vehicles are also cheaper right away on a monthly basis with typical financing.[273] Electric vehicles generally have lower repair costs (fewer parts are required)[274], operating costs are lower as fully charging a typical battery at home costs as much as 10 times less than filling a typical gas tank[275], and they also improve local air quality and public health (no tailpipe emissions).[276]

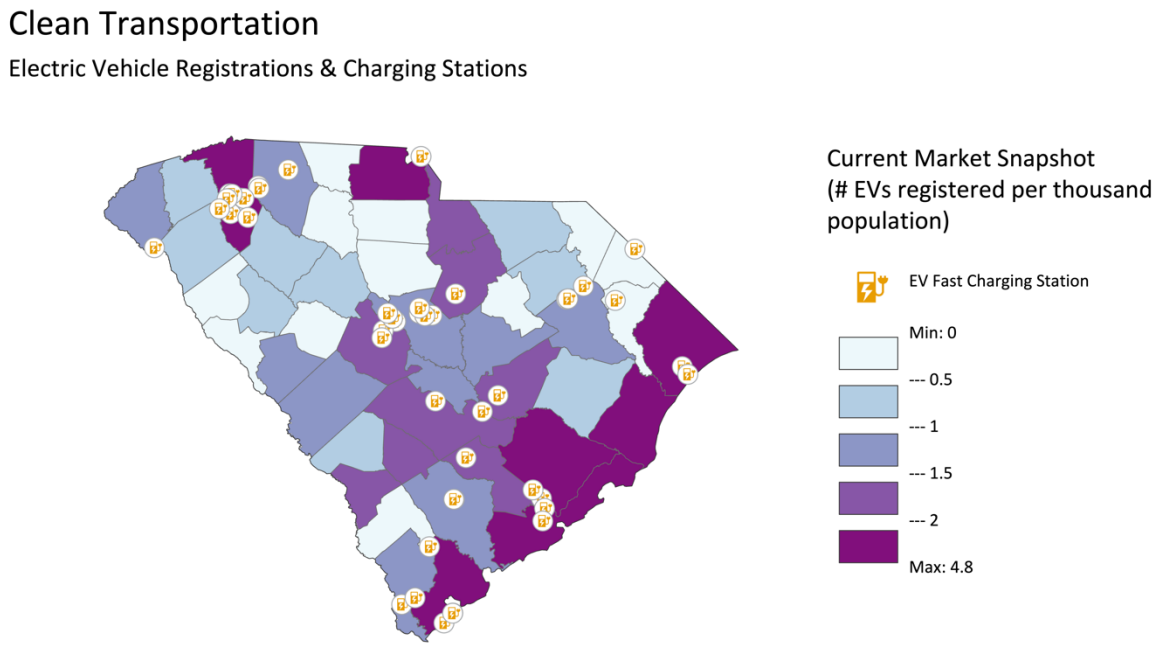

Figure 18: An analysis was conducted using electric vehicle registration data from the SC DMV (2021), charging station data from the U.S. Department of Energy Alternative Fuels Data Center (2022), and population data from the U.S. Census Bureau (2022).[277]

A current barrier for accessing electric vehicles is up-front cost. Even if it is significantly cheaper in the long term, an electric version is currently a few thousand dollars more up-front than its gas equivalent. A federal tax credit of up to $7,500 is available[278], but this benefits only those who can utilize it and who have existing access to auto financing.[279] The used car market for electric vehicles is under-developed in the short term, because many models have only recently entered the market (although a few have been on the market for several years). This presents a barrier to many people who cannot afford to buy new cars, and thus currently have limited access to electric vehicles that would save them money on fuel costs.

Auto manufacturers are shifting assembly lines and global supply chains, with many large firms switching entirely to electric.[280] In addition to meeting rising consumer demand, electric vehicles are also typically more profitable to manufacture than internal combustion engine vehicles.[281] In the long term, this will lead to falling up-front cost and more used electric vehicles. There is no role for a green bank in this case, because electric vehicles will be significantly cheaper in both the short- and long-term. However, there could be a role in the next ~10 years (while up-front cost remains higher) in preventing an unequitable outcome where only wealthy households can access the fuel savings from electric vehicles. Apart from the larger consumer market, a green bank could also assist in niche markets looking to access savings from electric transportation, including school districts (South Carolina has a central statewide purchaser which could amplify school bus electrification) and local

businesses and farms with small delivery fleets who could stand to benefit most from marginal savings on operating expenses. Effective green bank programs would operate in a changing landscape of federal funding and could aid these groups via technical assistance and specialized financing targeted to gaps in emerging grant programs. In the longer term, utilities are interested in the potential for electric vehicles to provide distributed energy storage and some have begun offering incentives for purchasing electric vehicles[282]; a green bank could assist in developing or implementing distributed energy policy.

Charging Infrastructure

Many electric vehicle owners install level 2 charging stations at their residences, and access to level 2 charging stations can incentivize vehicle owners to go to local shopping and recreation areas. However, a network of fast chargers is important for those without access to home or public charging and those traveling longer distances. South Carolina currently has 48 fast charging stations, an average number of fast chargers for its population size compared to the Southeast regional average (see Figure 18).[283] There are currently about 10 times as many gas stations as there are electric vehicle fast chargers in the state, and the average electric charging station only accommodates 5 vehicles.[284] The current geographic distribution is poor, tightly clustered around larger urban areas and interstate highways (see Figure 18). This matches current demand but poses a problem for the state's future economic development. Communities in South Carolina that do not have nearby fast chargers are currently losing out on revenue, especially in travel dependent fields like tourism, a problem that will rise as electric vehicle adoption accelerates.

Level 2 chargers are often installed at a vehicle owner's residence and can cost ~$500 - $2000 total depending on the amount of electrical work required. Local financial institutions have begun offering innovative financing packages which bundle these costs into the auto loan for a new electric vehicle, and some utilities provide grants or other incentives. Demand is growing because consumers save the most money if they can charge at home. Overcoming information barriers and connecting supply and demand are currently common market barriers. Those who rent and/or live in apartment complexes must negotiate with additional parties and have reduced incentives in some cases. Businesses can install level 2 charges to attract customers and earn additional revenue but face up-front cost barriers of ~$12,000 for the charger plus additional costs for installation. Fast chargers are significantly more expensive, and a growing number of private firms are entering this market and establishing networks of charging stations. Through the Federal Highway Administration's National EV Infrastructure (NEVI) program, the federal government is set to provide ~$70 million for South Carolina to expand the quantity and geographic distribution of fast chargers within the state.[285]

Existing efforts to plan for charging infrastructure are ongoing, such as the SC Department of Transportation's NEVI Plan, the Southeast Regional Electric Vehicle

Information Exchange, and other initiatives.[286] A green bank could play a variety of roles for supporting charging infrastructure in South Carolina. For level 2 chargers, a green bank could provide direct or on-bill finance for small businesses, community business zones, multi-family apartment complexes, and other smaller investors that are hindered by the up-front cost barrier and accelerate other innovative finance in this space from local financial institutions. A green bank could also play a role in education and policy for local charging around distributed energy and demand side management alongside utilities and other partners. Due to large federal funding streams, a green bank should not directly invest in fast chargers but could play a supportive role in advising on equitable distribution and geographic coverage. A green bank could also support local communities with technical assistance for obtaining federal funding, especially for communities that lack access or connections to regional transportation planners and electric mobility hubs, or with targeted assistance if a matching requirement poses a challenge for rural or low-income communities.

Public Transportation

Most communities in South Carolina are heavily dependent on automobiles, lowering direct economic development (markets are lower density and more difficult to access for those without a vehicle), imposing indirect costs (such as time lost to traffic delays), and increasing impacts on the environment. The federal government combined with regional municipalities are the core funders of public transit, including emerging programs for fleet electrification. A green bank could serve a role in advising communities without access to mobility hubs and accelerating economic growth in communities that seek to make public and business spaces more accessible to pedestrians, bikes, & public transit.

Agriculture

There are approximately 25,000 farms in South Carolina[287], and about 14 - 20% of the state's residents live in rural areas.[288] The market value of agricultural crops in South Carolina exceeds $3 billion[289], with an estimated economic impact exceeding $16 billion.[290]

Agriculture is among the market sectors in South Carolina facing the highest costs from the impacts of climate change. Although crops can benefit from increased concentrations of CO_2 in the atmosphere, they can also suffer from regional shifts in average temperature and precipitation, greater variability in groundwater and soil moisture, and changes in the timing of seasons (e.g., first/last frosts) resulting from climate change.[291] People who work on farms are also impacted by extreme heat, with costs imposed on the agricultural labor market.[292]

Most counties in South Carolina are expected to see a decline in agricultural yields of common crops when these effects are considered together, with 60% of counties

exceeding the national average (see Figure 19). While impacts vary by crop, over 90% (by sales volume)[293] of the state's agricultural crops have some level of vulnerability to changes in climate, including: poultry[294], livestock[295], corn[296], wheat[297], cotton[298], rice[299], soybeans[300], peanuts[301], sweet potato[302], and fruits[303]. Climate change has already impacted the sector. Over the past four decades, years with above normal high temperatures resulted in South Carolina farmers losing 12.3% of cotton crops, 14.4% of soybean crops, and 23.5% of corn crops.[304]

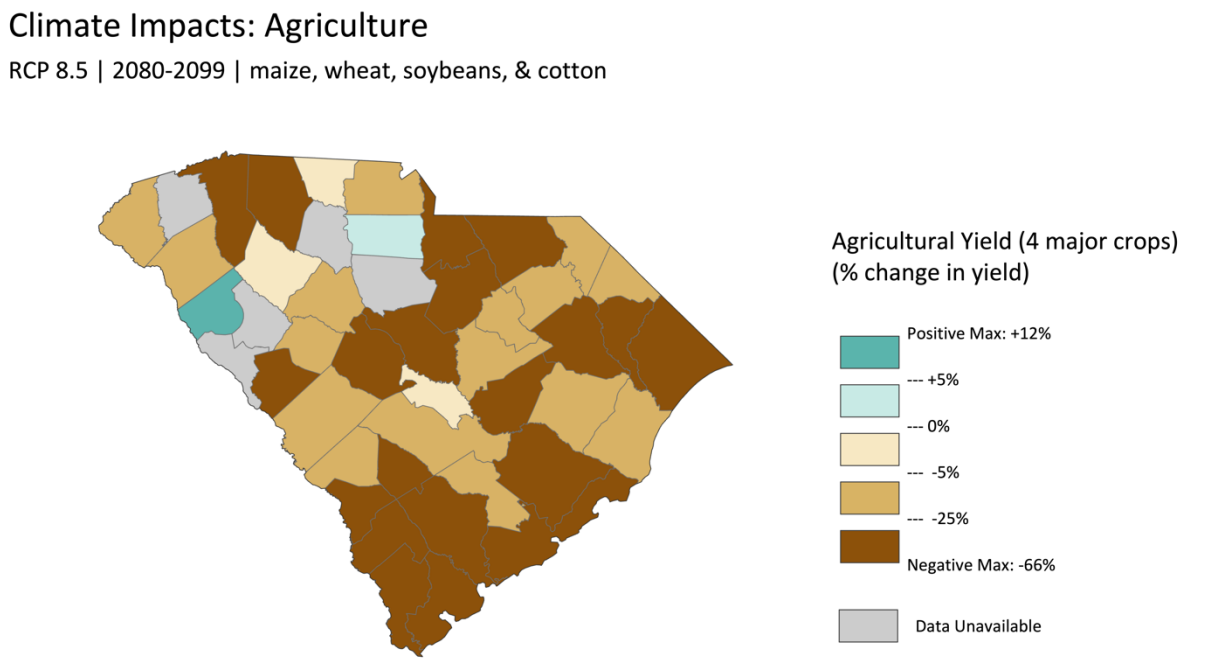

Figure 19: An analysis was conducted using data from Hsiang et al (2017).[305] These damage estimates are for years 2080-2099 under a business-as-usual climate scenario (RCP 8.5) and are percent change in yields, area-weighted average for maize, wheat, soybeans, and cotton. These 4 crops represent ~16% of the state's agriculture economy.

A growing number of agribusinesses are interested in sustainable farming practices due to resilience benefits, the potential to lower operating expenses, and increasing market demand.[306] Energy expenses on an average farm are 2.8% of operating expenses[307], but specialized energy intensive agribusinesses can face significant monthly energy bills ($1,000 - $5,000+).

The agriculture sector has utilized solar power for the longest period in South Carolina compared to most other sectors to reduce business costs, especially for irrigation and via land leases for solar farms. Over 600 farms have solar panels in South Carolina, with an additional ~200 farms having other types of renewable energy systems.[308] Farms in some cases have partnered with utilities or energy firms for renewable energy projects.

There is growing interest in leveraging renewable energy for additional revenue. Rural communities benefit more from renewable energy investment than other areas due to positive regional effects on property values, income and GDP growth.[309] The agricultural sector has access to valuable land that has high potential for solar energy in South Carolina and could leverage techniques like agrivoltaics to grow crops or livestock underneath solar panels, doubling the revenue streams for a given unit of land.[310] Carbon markets (e.g., selling offsets or carbon credits) represent a third potential revenue stream, but this market is still nascent and many farms in South Carolina find it difficult to access or participate in it.

About $1.4 billion of capital investment was recruited in rural areas in 2021.[311] However, rural residents and business owners can face limited access to capital overall. The state receives a significant amount of yearly funding from the U.S. Department of Agriculture Rural Energy for America Program[312], but in most years some of South Carolina's funds remain unspent due to a variety of barriers. Technical assistance and specific finance gaps (especially farms shouldering up-front costs and long waiting periods before expenses are reimbursed) limit capital flows with federal funds.

Rural poverty rates are generally higher than the state average and the agricultural sector has fewer financial resources to put towards their capital investment needs, including renewable energy. While some large operations have sufficient access to capital, overall, the sector needs increased financial resources. A green bank could accelerate the agricultural sector's transition towards clean energy through direct financing and grant application guidance. Access to cheaper electric vehicles for transporting crops to local markets (and associated charging infrastructure) is needed. Green banks could also help farmers earn revenue from carbon markets via technical assistance or aggregating projects. Green banks could partner with existing financial institutions in serving rural communities across the state.

Carbon Markets

Current Market Conditions

In response to regulatory change, stakeholders, and market conditions a growing number of companies are setting net zero policies[313] or greenhouse gas emissions reduction targets as part of their corporate strategies. Globally, ~35% of Forbes Global 2000 firms have a target of some kind.[314] Companies in South Carolina that have integrated these policies into their corporate strategy or made commitments to investors or other stakeholders include: Sonoco[315], Volvo[316], BMW/Rolls-Royce[317], Mercedes-Benz/Daimler[318], Boeing[319], Michelin[320], Schaeffler[321], Continental[322], Nucor[323], Blackbaud[324], Duke Energy[325], and Dominion Energy[326]. Several large banks serving South Carolinians have also made commitments, including Truist[327], Bank of America[328], and Wells Fargo[329]. In many cases, these policies include Scope 3 emissions (all pollution arising from the firm's value chain). This means that smaller

suppliers also must set emissions reduction targets or risk losing contracts with the larger firm that has a net zero policy, especially in the manufacturing sector.

These firms represent a significant percentage of the state's manufacturing and energy sectors and are all major employers and drivers of economic activity in the state. While the commitments can vary in quality, having one indicates that a firm is seeking to get ahead of the market and regulatory requirements and grow the value of the firm by engaging with investors and other stakeholders.

Market Barriers & Issues

The growing number of firms seeking to interact with carbon markets and net zero policies face difficulties in South Carolina. Lack of carbon expertise in-state harms the ability of firms to develop or improve net zero policies, participate in or co-develop new carbon markets, and understand changing market conditions and business risks.[330] Some firms are actively seeking to invest in carbon markets in South Carolina, such as by purchasing carbon credits to offset some of the firm's emissions, but are currently unable to do so because the South Carolina market is either non-existent or low capacity. For some firms, investing in the community where the firm operates and released the pollution carries additional benefits for marketing and corporate social responsibility.

South Carolina is also not actively seeking funding from firms with operations outside the state that are currently investing large amounts (capital flows exceeding hundreds of millions of dollars) in carbon markets and especially carbon removal firms.[331] In addition to corporate offsets or climate investments, the federal government[332] and venture capital funds[333] are actively funding new firms in the fields of decarbonization engineering and technology (capital flows exceeding tens of billions of dollars). Investment into carbon markets in South Carolina is currently limited, and firms in the rapidly growing sectors of carbon removal (engineering/technology) or carbon services (monitoring & accounting, policy, etc.) are critically under-represented in the state's economic development strategies. There are few startups or major firms in these sectors headquartered in South Carolina (this market assessment did not identify any) to capitalize on this funding and high-value labor.[334]

Gap Analysis

The following gaps were identified specific to carbon markets in South Carolina:

Carbon Credits

- *Assist firms in identifying opportunities for funding*: Many organizations are unaware of this market and potential opportunities to fund different types of projects that may already be occurring due to resilience or other co-benefits.[335] A green bank could track the development of carbon markets and broaden awareness within the state.

- *Increase accessibility of carbon markets:* Capital flows in carbon markets are increasing, but there is a lot of room for error. Firms are wary of issues with carbon credits[336] that can damage the firm's reputation and are increasingly turning to standards[337] or rating agencies[338] to verify carbon credits. This often poses a significant hurdle to entering the market because the process may be lengthy or technical, especially for an organization or project that is smaller in scale. A green bank could play a role in assisting organizations in navigating this process, or in decreasing barriers of entry to the market by centrally warehousing carbon credits from across South Carolina and accessing markets on behalf of these organizations.

Supporting Firms

- *Advance value chains*: Firms with ambitious net zero policies include Scope 3 emissions, which includes all inputs into its value chain. Large firms must then engage with their suppliers to reduce their emissions. A green bank could assist smaller firms needing to set or achieve science-based targets[339] to keep contracts and assist larger firms in developing supplier incentives, carbon contracting, or other market structures to support the development of carbon mitigation in their sector.
- *Aid firms seeking to meet stakeholder commitments*: The policy landscape and speed of utility clean energy transitions threatens some South Carolina firms' ability to maintain its commitments to investors or other stakeholders. For example, a firm can make a commitment to purchase 100% clean energy, but this may not be currently available from utilities. A green bank could aid these firms by accelerating the clean energy transition in-state and supporting robust climate policies to undergird the market.
- *Fund or provide expertise to startups*: Where feasible, a green bank could support the development of new firms seeking to target funding or develop technologies in the carbon marketplace by seeking to establish an in-state innovation prize or by providing expertise and connections to researchers or other educational resources.
- *Develop new markets*: A green bank could support existing firms seeking to enter new markets in carbon capture or other related fields in carbon engineering or technology.
- *Enhance public-private partnerships*: A green bank could support economic development strategies that seek to build partnerships between firms and local or regional municipalities seeking to attract investment or build a carbon sector in their area.

Education

- *Build carbon expertise*: A green bank could work to increase the availability of in-state expertise in carbon tracking, policy, or other skillsets with the goal of giving more options to firms that currently hire out of state consultants.

Infrastructure & Resilience

Grey Infrastructure

South Carolina's current infrastructure is rated as "poor" with strong risk of failure in all categories except bridges ("mediocre") and ports ("good"), requiring billions of dollars in investment.[340] For infrastructure in poor condition, the focus of funding is often repairing it to a serviceable state.[341] Climate change increases the vulnerability of existing infrastructure due to shifts in gradual environmental variables and damages associated with extreme events.[342] For example, the 2015 flooding in the midlands region of the state damaged a large number of dams in poor condition, and as of 2022 some are not yet fully repaired.[343] Some climate costs are difficult to project. For example, the Port of Charleston and associated economic activity (estimated at over $63 billion)[344] is known to be partially vulnerable to sea level rise by ~2050 as flooding limits access to road networks.[345] Other infrastructure costs have been modeled for South Carolina. The state can expect to face the following changes in costs by the end of the century due to climate change (assuming the current trend of limited investment in adaptation continues); these costs increase rapidly over time (see Figure 20):

- Roads: direct damages exceeding $20 billion and indirect costs exceeding $400 billion[346]
- Rail: combined costs exceeding $40 billion[347]
- Bridges: increases in the number of vulnerable bridges of ~40-50%[348]
- Watersheds: welfare loss to municipal water supply systems of ~$10,000 and decrease in water quality index of ~15-20%[349]

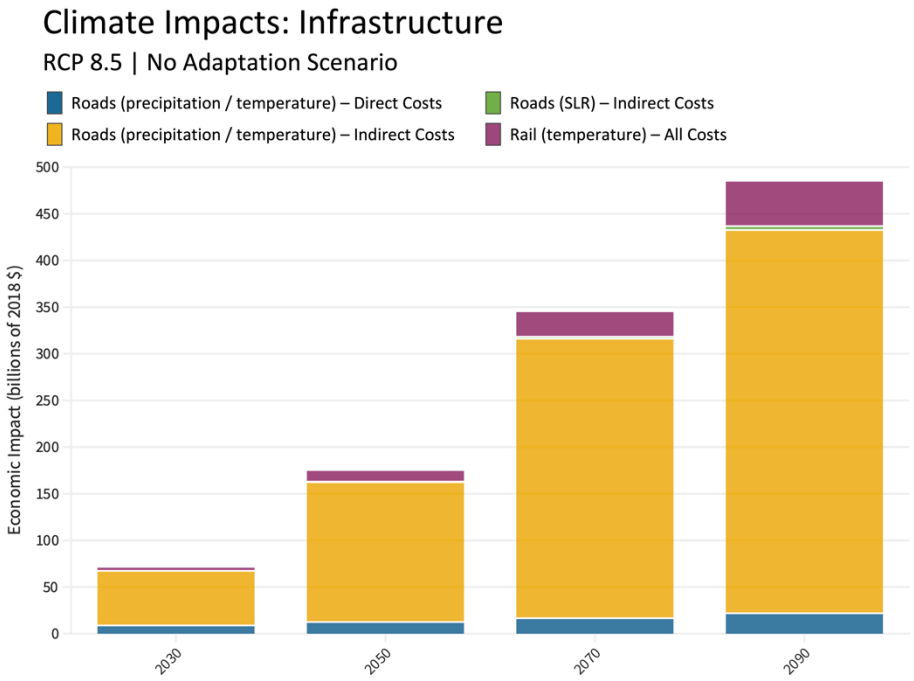

Figure 20: An analysis was conducted using data from Neumann et al. (2021) and Fant et al. (2021).[350] These data are for the business-as-usual climate (RCP 8.5) and no adaptation scenario. This represents the yearly economic costs by the end of the century under a high carbon emissions scenario and assumes no adaptation projects would be implemented prior to the infrastructure damage occurring. Economic impact totals represent a statewide annual economic impact projection for each category.

The electric grid will also face costs associated with climate change, especially with increased frequency of extreme events. There have been two recent examples: winter storms in Texas (2021)[351] and heatwaves in the Carolinas (2022).[352] South Carolina's grid is vulnerable to climate impacts including storms, extreme heat, and flooding.[353] The Southeast is one of the two most vulnerable regions in the country for physical risk to the electric grid from climate change.[354] These risks are expected to cost grid operators in South Carolina a combined $288 million annually by 2050 and $643 million annually by 2090.[355] Larger utilities, particularly ones with more infrastructure assets, are aware of these costs and are already beginning to plan for them. Smaller utilities face additional challenges, with fewer resources (either financially or in staff capacity) to increase the resilience of their systems.[356] It is unknown whether these costs will be passed on to ratepayers or how utility regulators in the state will respond to these challenges.

Green Infrastructure

Adaptation projects that utilize nature-based solutions are also a viable pathway towards resilience. These are sometimes referred to collectively as green infrastructure (as opposed to traditional "grey" infrastructure). The resilience benefits can be quantified (e.g., the $8.9 billion yearly in ecosystem services that marshes provide for South Carolina[357]). Many types of green infrastructure projects have other

co-benefits, such as public health benefits for watersheds impacted by flooding[358] or urban centers impacted by extreme heat.[359] For example, Charleston conducted a spatial analysis of the benefits that the city's trees provide for relief from heat and flood prevention.[360] Investments in green infrastructure can provide local jobs and decrease the damages from climate impacts. [361]

There are a wide variety of green infrastructure projects successfully implemented across the country, and some can be cheaper up-front (compared to grey infrastructure) and/or have lower maintenance costs over time.[362] A key barrier is funding. Existing grants such as Federal Emergency Management Agency's Building Resilient Infrastructure and Communities Funds (see Market Background – Financial Landscape) are often competitive and insufficient compared to the scale of the need and may be inaccessible to communities in the application process or the cost match. Funding is not readily available from municipal and regional governments, because budgets for relevant agencies such as stormwater management are often already underfunded. Philanthropy is increasingly interested in this space, but often face a knowledge gap where green infrastructure investments can be difficult to implement without a local partner with both climate and biological expertise. Businesses often benefit directly from green infrastructure investments in their area but lack incentives to participate directly and find it difficult to know how to accelerate investment locally. There are a few exceptions to this, such as coastal mariculture and aquaculture where green infrastructure is a component of the business itself.

South Carolina also invests in conservation and biodiversity, which is often closely related (e.g., a green infrastructure project which uses native plants or improves local habitats also has conservation value). These investments lower damages from certain climate impacts and have recreational and tourism benefits. There are efforts from landowners, land trusts, and organizations like the SC Conservation Bank (see Market Background – Financial Landscape) to protect areas that provide these services, but the resilience and carbon benefits are not typically valued. A green bank could work to expand the ability of landowners to access and benefit from work that has resilience benefits through carbon markets or other structures.

Resilience

Like any other pollution problem, the easiest and cheapest solution to respond to various climate impacts is to simply stop polluting further, which usually prevents the associated costs from increasing. In the absence of this, communities can take steps to prepare for these costs by attempting to reduce them or recover faster when they occur. This is often termed adaptation or resilience. Investing in resilience can save communities a large amount of money and delaying investment in resilience can lead to sub-optimal investments.[363] Investments in resilience can also work to benefit disadvantaged communities if funds are equitably allocated.

Resilience projects are often expensive, take time to implement, and can take a long time to recover the initial investment. For example, coastal resilience projects like Charleston's proposed seawall cost over $1 billion and building more seawalls across the state could cost over $20 billion by 2040.[364] In other cases, resilience investments can be smaller, "hidden" investments that save money by changing an underlying aspect of a system. For example, South Carolina received a score of 91.9% for adoption of building codes that increase resilience to floods and hurricanes.[365] This saves an estimated $18 million per year in avoided flood losses and $67.6 million per year in avoided wind losses from hurricanes.[366] Effective enforcement and contractor licensing requirements further improves savings.[367]

The main barrier to increasing investment in resilience is availability of funding. Because adaptation projects usually protect a large geographic area, local and regional governments (sometimes in partnership with or alongside non-profit efforts) are often the main actors designing and implementing them. Adaptation projects that would avoid costs in the future can be expensive up-front and may not demonstrate any benefits until the next event occurs. This can be challenging for smaller governments that operate on tight budgets and do not have large reserves of unassigned capital that they can use for resilience investments (or even staff time to pursue external funds). In many cases, state or federal funding is more readily available after an extreme event or disaster instead of before it. Many grants are competitive, meaning a community may expend effort in applying with no guarantee of reward. Even for available funding sources, there are many hoops and requirements that municipalities or other applicants must pass through for the work to be funded or over the course of a project. This can be especially problematic for under-resourced communities: 54% of rural communities in South Carolina are beneath the national median in their governmental capacity, with many lacking a government staff person in charge of planning.[368]

A growing number of communities and organizations in South Carolina are beginning to consider resilience in their planning, although it remains uneven and sporadic.[369] The state is currently conducting a Strategic Statewide Resilience and Risk Reduction Plan.[370] The South Carolina Office of Resilience has varying funding sources that have recently become available (see Market Background – Financial Landscape). Federal funding is also important. One example, the Federal Emergency Management Agency runs the Building Resilient Infrastructure and Communities program to fund pre-disaster mitigation projects. The program invested $122,286,709 in 33 projects in South Carolina in fiscal year 2020.[371] These funds improve resilience efforts, but additional funding is needed in the sector because existing funds can only support a limited number of projects at a time. These funding needs include a greater volume of financing in general and increased funding for unmet resilience needs.

Gap Analysis

The following gaps were identified specific to infrastructure and resilience in South Carolina:

Financing

- *Expand existing programs*: Support early efforts in resilience revolving funds, grant matching, and other programs.
- *Leverage grants*: Develop finance that can accelerate size-limited grant projects, and/or fund the post-implementation maintenance of grant projects
- *Develop new programs*: grants or revolving funds, especially if they are competitive, are problematic for many stakeholders seeking to implement adaptation projects. Work to develop other ideas and opportunities to finance resilience projects.

Expand Markets

- *Increase equitable programs*: Support and develop programs that actively reduce or eliminate requirements and other inequitable financial barriers to increase the capacity of disadvantaged communities to invest in resilience.
- *Fix missing valuation*: Avoided climate damages and co-benefits are not currently being valued correctly in the market. Coordinate partnerships and/or develop incentives.
- *Develop incentives*: Actors such as businesses and property developers are not always well incentivized to engage in local resilience. Work to develop or support emerging ideas to create additional incentives.
- *Accelerate flow of private capital*: Foster ideas, programs, and/or partnerships to increase the number of philanthropists, financial institutions, and businesses involved in funding resilience projects.
- *Foster market stability*: Resilience investment can be sporadic and unstable. Work to increase the stability and predictability of funding sources.

Education and Expertise

- *Provide information*: Direct businesses and other actors to reliable information on how to engage in resilience projects.
- *Coordinate credit schemes*: If it would accelerate deployed funding, provide relevant expertise or centralization to facilitate access to carbon markets, carbon credits, and/or resilience credits.
- *Methodological funding barriers*: Some economic methods like cost-benefit analysis can become a barrier to resilience investment by de-prioritizing disadvantaged communities. Use expertise and partnerships with existing organizations to advise these communities on alternative methods when seeking funding.

Feasibility Assessment

Market Synthesis

South Carolina has challenges along several economic metrics and has many underserved areas and people with limited financial resources. Many residents and businesses struggle with energy costs. The state is expected to face large losses and damages from climate impacts (both gradual changes and changes in weather extremes) and public health costs from existing fossil fuel use. These will exacerbate existing economic inequality, further increase energy burden, and pose risks to businesses and communities. These conditions also exist amidst a backdrop of market transitions, investor demands, and shifts in policy and regulatory structures. Across market sectors, South Carolina faces a gap between the current environment and what is possible for the market to achieve:

- *Energy Efficiency*: The state's energy burden is high and will continue growing without additional investment. The energy efficiency market has large potential because residents, businesses and government all have potential long-term cost savings that could be achieved through energy efficiency projects. Energy efficiency represents a low hanging goal for the state to reduce its energy demand and build a more resilient electricity grid. Principal issues include information gaps and up-front cost. There are more existing funding streams in this sector in South Carolina compared to other sectors, but overall levels of investment in energy efficiency remain lower than other geographic areas.
- *Clean Energy*: The state's solar market is growing exponentially (especially in utility scale solar) but currently market investment remains below its potential. There are key market barriers like up-front cost, day one positive cash flow and return on investment time that slow investment from residences and businesses, which existing incentives do not fully address. There is growing interest and potential for the state's offshore wind industry. The state has already missed opportunities for economic development and growth in the offshore wind industry due to lack of policy support. Levels of investment in clean energy in South Carolina are below other areas.
- *Transportation*: Because of the state's strong auto-manufacturing sector, South Carolina could reap the benefits of the automotive industry's transition to electric vehicles. The state lags in electric vehicle ownership rates and only a limited subset of consumers is currently benefitting from reduced fuel costs and long-term costs from electric vehicles. There are barriers to accessing level 2 chargers for some market segments, and a limited network of fast chargers poses a risk to economic development in sectors like tourism reliant on transportation. This sector has higher levels of investment due to expanding electric vehicle manufacturing in-state and federal investment in fast charging infrastructure, but there are still funding needs in specific market segments.
- *Agriculture*: Agriculture faces some of the highest costs from climate change but can have limited access to finance and investment. Rural areas can have

lower capacity for resilience planning and face barriers in accessing existing funding streams. Agribusinesses have some of the most existing experience with solar power, with high growth potential and opportunities for additional revenue streams.

- *Carbon Markets*: South Carolina is home to major firms, especially in the manufacturing and energy sectors, that have carbon emission reductions goals and are interested in carbon markets. They are challenged by lacking expertise and investment into carbon credit markets. Carbon markets are underdeveloped in South Carolina compared to other areas of the country. Firms with carbon emission reduction goals or net zero policies face challenges in keeping their commitments to investors and other stakeholders due to the current policy and market landscape in the state. The growing sectors of carbon removal and carbon services are critically under-represented in the state's economic development strategies, and South Carolina is not currently attracting new startups despite large volume of investment occurring in other areas.
- *Infrastructure & Resilience:* Existing infrastructure, including the utility grid, faces rising demand and costs from climate change. Resilience investment has begun but does not meet the scale of need, especially in certain areas like green infrastructure projects. Additional investment is needed to avoid future damages and increase resilience. This sector has higher levels of investment, as utilities have begun addressing physical asset risk and state funding for resilience has recently increased. However, this funding does not meet the current need for resilience projects.

Capitalizing on changes in the market can save people and businesses money. Underinvestment will slow economic development in the long term and increase losses and damages from climate change. The current market conditions indicate that an institution focused on increasing investment in these sectors can address these challenges (see Figure 21). A green bank will help to reduce the state's greenhouse gas emissions while also building resilience and economic development.

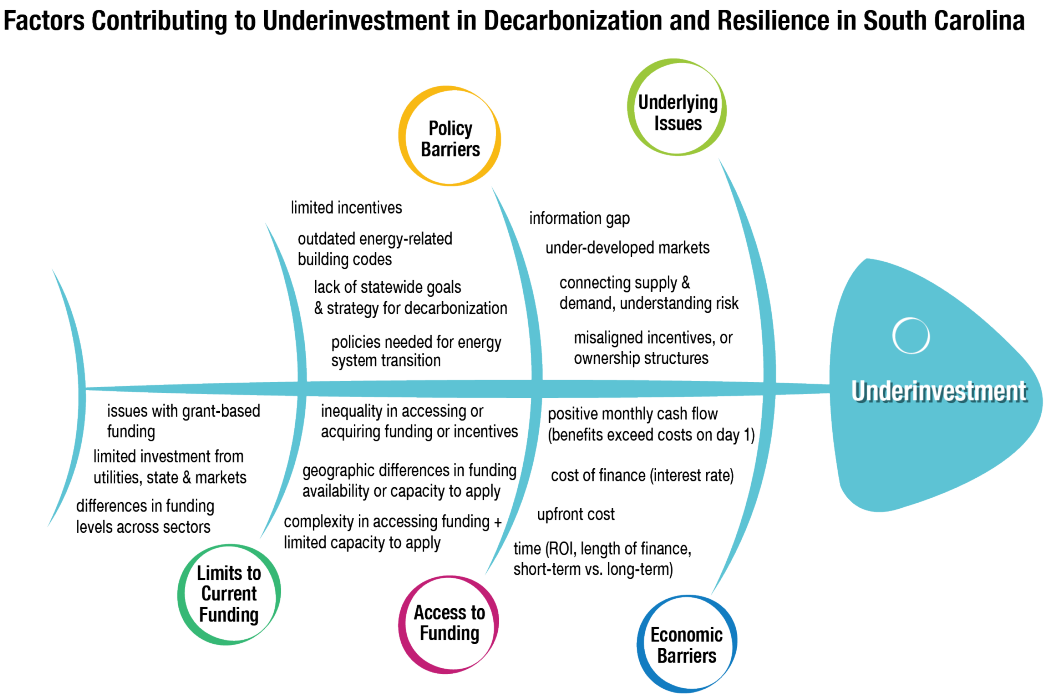

Figure 21: A root cause analysis was performed based on the market conditions and barriers identified in this assessment. These factors affect each market sector differently and are fully detailed in the market assessment section of this report.

Green Bank Logistics

Mission & Vision

A strong mission & vision statement guide a nascent institution in identifying priorities and developing a role within the existing market landscape. The green bank working group held a workshop to co-create a draft mission & vision statement. The working group favored brief statements that used clear and specific wording that would guide the organization while making its purpose clear to all.

Mission Statement: The SC Green Bank seeks to accelerate a sustainable and resilient future for South Carolina using finance, creating an economy that is equitable and decarbonized.

Vision Statement: We envision a landscape in South Carolina where lack of money never impedes a person or group from decreasing carbon pollution or increasing resilience.

Name

The green bank working group held a workshop to discuss potential names for a green bank in South Carolina. The name "green bank" was highlighted as being potentially confusing since green banks do not provide traditional banking services, while the words "clean energy" and "resilience" were highlighted as providing a good description of activities a green bank typically does. The working group favored wording that indicates the purpose of a green bank, such as "investment", "fund", "accelerate", "transform", etc. The following candidates emerged as potential names to pursue:

- *SC Clean Energy and Resilience Accelerator (SC Clear)*
- *SC Green Bank*
- *SC Green Accelerator*
- *SC Clean Energy Fund*
- *Palmetto Clean Energy and Resilience Fund*

Organization Types & Funding Pathways

The two main models for existing green banks are public (or quasi-public) institutions or non-profits. Some non-profits also pursue designation as a CDFI (Community Development Financial Institution). In rare cases, green banks are organized as a B-Corp or other private institution. All existing green banks in the Southeast are currently organized as non-profits. Regardless of organization type, a green bank would pursue similar programs and the mission and vision of the organization would not change.[372] The main difference is in funding pathways.

Green banks organized as public institutions typically operate as an independent office or agency empowered to undertake financial transactions and fund projects.[373] Potential sources of funding are recurring funds from a state or municipal budget, a fee levied on utility bills, or one-time sources of funding like raising a bond.[374] This type of model benefits from funding sources that are more stable or allow a green bank to capitalize quickly and with operating expenses accounted for immediately. In some instances, highly predictable and long-term funding can enable certain kinds of financial deals or partnerships. On other occasions, acting as a government entity can enable different types of market development activities. Drawbacks include programmatic challenges from starting with high levels of funding, limited flexibility, decreased ability to accept certain kinds of funding, and possible mission drift.

Green banks organized as non-profits typically receive initial funding from philanthropy or a federal grant.[375] They leverage initial funding into a pilot project, and then pursue additional funding to establish a single program. As the green bank's operating expenses become more stable, additional partnerships and co-investment are possible and further programs are added over time. The non-profit model is highly adaptable and able to respond directly to community needs, while a CDFI designation offers unique partnership possibilities with financial institutions.

Drawbacks include not having operating expenses guaranteed in the first few years, and the green bank is usually only able to pursue one or two programs until it is fully capitalized. A non-profit model does not preclude accepting state funding and using it for a designated program while simultaneously pursuing other programs or entering strategic partnerships with the state.

At the time this report was being completed, the Inflation Reduction Act of 2022 passed the U.S. Congress and includes significant funding ($27 billion) for green banks at both the national and state levels.[376] Funding would be available to green banks organized under either a public or non-profit model and flow through existing recognized structures such as the Coalition for Green Capital and American Consortium of Green Banks. The extensive market research in this report can be used to pursue this funding and could be further supported by a proof-of-concept project implemented as this funding comes online. Other sources of capitalization and leveraged funds from partnering financial institutions would remain important components of an SC green bank.

When asked, stakeholders interviewed for the market assessment typically preferred a non-profit model. Concerns about a public institution included control of funding, the potential for political influence and misuse of funds, the difficulty and burden of working with existing public institutions, and core accountability to other actors and not underserved communities. Stakeholders broadly encouraged collaboration with state agencies and public/private partnerships. Stakeholders discouraged extractive private models of investment or accepting funding that required a return on investment, especially before a green bank becomes established and has stable operating expenses.

Implementing a Green Bank in South Carolina

Green Bank Solutions

Existing investment in several sectors in South Carolina is below the regional and/or national average. Existing funding streams examined in the market assessment are often not large enough to meet current needs or have barriers to access and implementation. A South Carolina green bank could kickstart decarbonization, foster resilience, and contribute to economic development in the state by developing programs that target specific market barriers or seek to accelerate current rates of investment.

The market assessment indicated that a green bank could fulfill multiple roles within South Carolina's existing financial landscape. Financial roles include acting indirectly to accelerate flows of capital, such as by removing risk for existing financial institutions, or by directly investing in projects that are underserved or not well suited to existing financial products. Informational roles include facilitating the flow of information and connections between market actors, bundling projects, growing new

markets, and technical assistance that utilizes a green bank's unique combination of experience in finance and climate change. There are several well-scoped pathways for how green bank solutions could accelerate investment (see Figure 22); the gap analyses in the market assessment provide specific examples by sector.

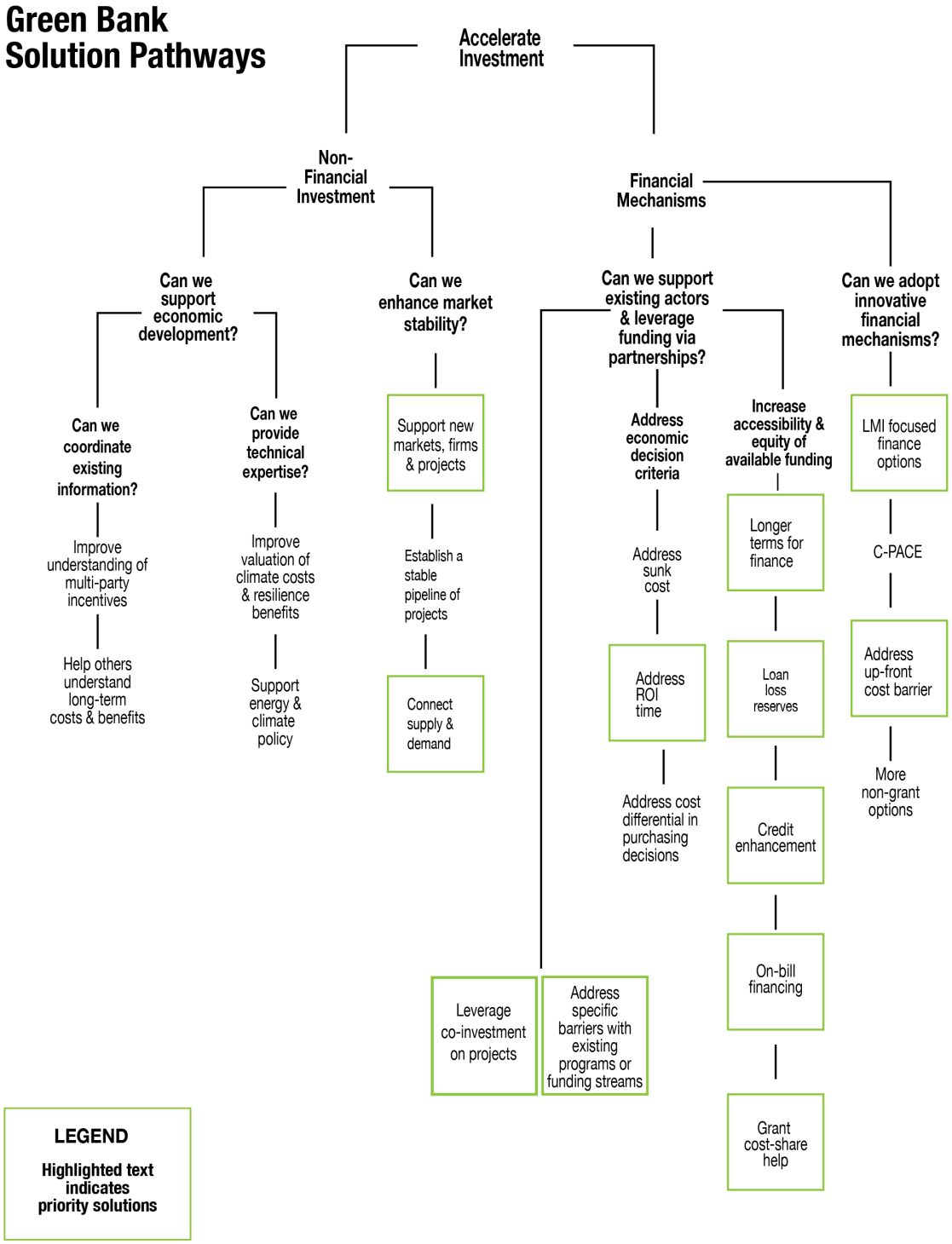

Figure 22: Green bank solution pathways were mapped using problem disaggregation and a deductive logic model. Solutions are linked to relevant sectors and prioritized according to whether existing efforts were identified and the likelihood that a fully capitalized green bank could make significant progress.

Green Bank Strategy & Initial Programs

A green bank could serve a unique role in South Carolina by ensuring just and equitable access to resources for communities unable to afford decarbonization or resilience projects. A green bank will need to be community-centered to form relationships and respond to community needs. A strong mission will help a green bank establish its role and build an initial strategy. South Carolina is poised to start a green bank due to changing market conditions, environmental and economic needs, and an increasing number of potential partners. An emerging green bank can establish lasting partnerships, leverage additional investment, and align with existing and emerging utility and government funding streams.

A green bank's initial strategic priorities would include institutional design and implementation of a pilot program that responds to community needs (see Figure 23). The initial goals over the first several years would be to scale the pilot program and work towards becoming self-sustaining and implementing additional programs. North Carolina's market assessment provides a useful sister state model for initial strategy. Using the lower end of their ranges to scale for South Carolina's smaller economy, a green bank could be initially capitalized at $1 million plus operating expenses to establish a pilot program or fully capitalized at $10 million plus operating expenses to implement a small number of programs.[377] A proof-of-concept project would likely cost an initial $200,000 to $400,000 plus operating expenses and would be used to pursue additional funding to capitalize the green bank and grow the capacity to target additional partnerships and systemic changes.

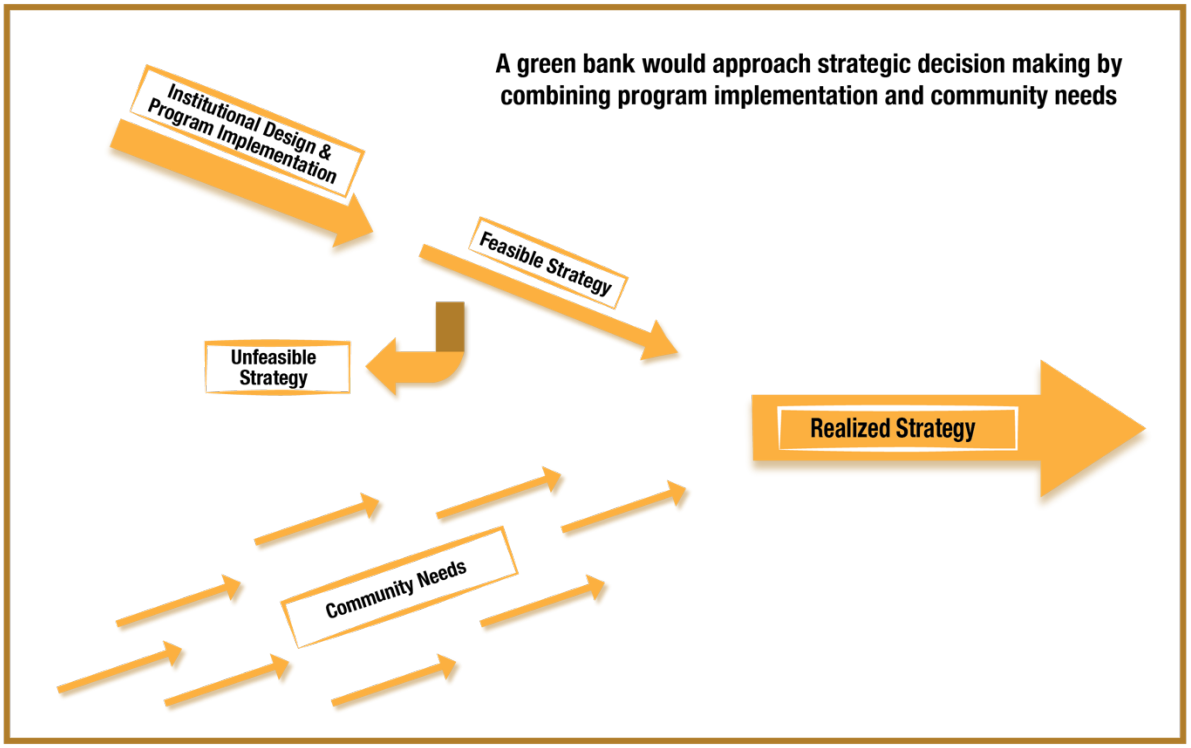

Figure 23: Strategic decision making would be guided by informed analysis and problem design but responsive to emerging community needs. Figure adapted from Geels, Berkhout & van Vuuren (2016).[378]

An initial pilot program is likely to be one that uses a green bank's direct funds. An ideal proof-of-concept project would be simpler to execute and could respond directly to a market barrier that has already been identified. One possibility is a revolving fund for community centers, businesses, or homeowners to implement energy efficiency or clean energy projects. These groups face an up-front cost barrier or are sometimes (as in the case of community centers) ineligible for existing incentives such as tax-credits, increasing the cost of a project. They can face high energy bills, and cost savings would likely be re-directed into the community or used to grow the business.

An example revolving fund for rooftop solar installations is shown below with three potential structures (see Figure 24). Based on the current market, a system size of 5 – 8 kW would be typical. This would cost between $18,000 - $30,000 and generate $1,500 - $3,000 yearly in energy savings.[379] In a co-investment model, a green bank pays for a percentage of project costs and receives the same percentage of the monthly energy savings generated. In an on-bill finance model, a green bank pays for project costs and is reimbursed through utility bill payments. In a grant + loan model, a green bank pays for project costs and is partially reimbursed through loan payments (a portion of the project cost is given as a grant). The graph below

illustrates the available green bank funds over time (blue), the cumulative amount of money the green bank would invest into the community over time (yellow), and the accumulation of organizations' energy savings (green).

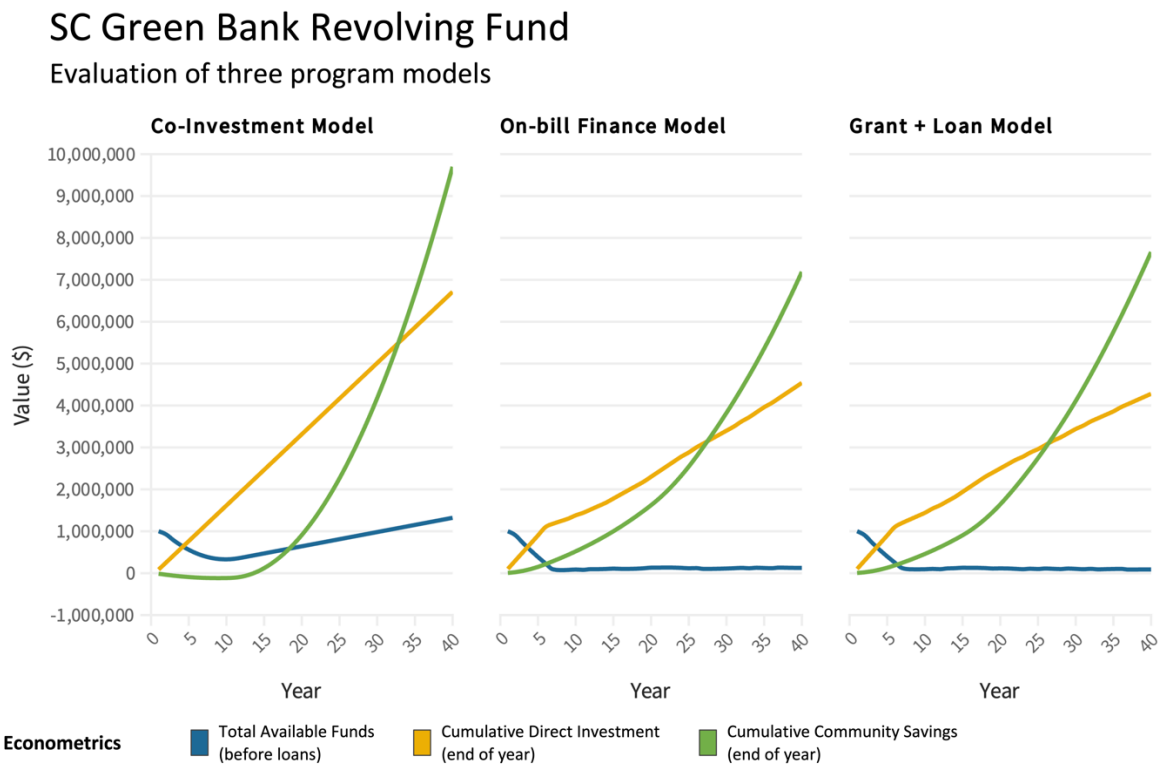

Figure 24: The cumulative direct investment is simply the sum of every dollar the green bank has spent to fund solar projects. The cumulative community savings is the total amount of money the community's organizations will have saved on their energy bills because of the solar project, minus their contributions to the project's up-front cost (if any) and their payments to the green bank. In the co-investment model, cumulative community savings are higher over time because payments to the green bank stop after ~10 years (compared to 15 or 20 years in the grant + loan and on-bill finance models, respectively). However, initially community savings are negative because they also invest in a percentage of the project's up-front costs. The yearly payments for both the on-bill finance and grant + loan models are ~50% of the estimated yearly energy savings. These models cumulative community savings, but also ensure no up-front cost. All models are stable over time, but a green bank cannot invest in as many projects yearly in the on-bill finance or grant + loan models because the green bank does not recoup its investment as quickly.

Model assumptions - In each model, the revolving fund has an initial endowment of $1 million. To simplify the models, they assume that solar panels operate for 40 years and there are no yearly additions or administrative costs to the revolving fund. At the beginning of each year, the green bank takes on as many new projects as it can fund with the funds currently available to it, with a maximum of 10 new projects per year. All models assume an average project cost of $20,000 and an average yearly energy savings of $2,250. The co-investment model assumes that the green bank will pay 85% of the project costs on average and receive 85% of energy savings generated until 120% of the amount invested is returned. The on-bill finance model assumes a 5.5% interest rate over a 20-year term. This is comparable to existing green bank funds. The grant + loan model assumes a 10% grant and a 1.5%

interest rate over a 15-year term. This is comparable to the ConserFund Plus program, but with a lower percentage grant and longer term.

After setting up its initial operations and starting a pilot program, a second program offers opportunities for longer term partnerships in which a green bank co-invests or indirectly leverages additional funding, which targets a wider economic system or market segment. These could include credit enhancement, loan loss reserves or other innovative financing mechanisms identified as impactful in the clean energy and energy efficiency sectors. Small-scale energy efficiency improvements often cost around $2,500 (labor + materials) and generate ~$300 to ~$1,000 a year in energy savings.[380] A green bank program that works to make the monthly cost of finance below the monthly savings could increase the flow of capital from SC financial institutions or utilities, especially with additional partnerships like on-bill financing. A green bank could work to develop innovative partnerships, such as helping local firms install level 2 electric vehicle chargers to attract high-paying customers to their businesses. The cost of an installation is ~$12,000 and would generate ~$1,000 yearly in charging revenue.[381] The green bank would receive a portion of the charging revenue comparable to the amount invested and could lower the project cost through co-investment and advertising on the charger. Finally, a green bank could accelerate existing programs, such as helping the South Carolina Office of Resilience help more communities meet the cost-match requirement on federal grants or the South Carolina Energy Office replenish successful programs like ConserFund Plus.

Appendix

Green Bank Working Group Meetings

The green bank working group met for the following discussions:

- *February 26th, 2021*: Introduction to Green Bank Creation
- *March 25th, 2021*: Discussion with Solar Energy Loan Fund
- *May 6th, 2021*: Discussion with Colorado Clean Energy Fund
- *August 13th, 2021*: Discussion with Electric Cooperatives of South Carolina
- *October 11th, 2021*: Mission & Vision Workshop
- *October 18th, 2021*: Discussion with Virginia Department of Mines, Minerals and Energy
- *February 2nd, 2022*: Name Workshop
- *February 4th, 2022*: Discussion with National Energy Improvement Fund

Green Bank Strategic Consultations

The following existing green banks or emerging green banks provided strategic consultation and guidance for this market assessment:

- Coalition for Green Capital
- North Carolina Clean Energy Fund
- Solar Energy Loan Fund (Florida)
- Colorado Clean Energy Fund
- Hawaii Green Infrastructure Authority
- Rhode Island Infrastructure Bank
- Virginia Department of Mines, Minerals and Energy

Stakeholder Interviews

The following organizations contributed their expertise and insights to this market assessment:

- Alder Energy
  - Don Zimmerman – President & CEO
  - Jeep Ford – Director of Commercial Sales
- Amplified Ag, Inc.
  - Donald Taylor – CEO
  - Kindall Brantley – Sustainability Specialist
- Bank of America
  - Ben Taube – Senior Vice President for Energy Services
- Boeing
  - Gary Londo – Global Utilities Manager
  - Aaron Johnson – Environmental Leader for the Eastern U.S.
  - Matthew J. Taylor – Charleston, SC Facilities Deputy Director
  - Brian Corley – Energy Conservation Coordinator for South Carolina

- Business Development Corporation
    - Nat Green - Senior Vice President & SSBCI Lending Officer
- Central Midlands Council of Governments
    - Guillermo Espinosa – Principal Environmental Planner
- City of Columbia Climate Protection Action Committee
    - Robert Anderson
    - Mary Pat Baldauf
    - Penny Cothran
    - John Epting
    - Robert Gudea
    - Jennifer Heinmiller
    - Kappy Hubbard
    - Gretchen Lambert
    - Zach Laprise
    - Bob Petrulis
    - Priscilla Preston
    - Clint Shealy
    - Peggy Smedley
    - Dr. Dameria Warren
    - Dr. Lori Ziolkowski
- City of Greenville
    - Michael Frixen – Sustainability Coordinator & Assistant to the City Manager
- ChargePoint
    - Ben Kessler – Public Policy Manager for the Eastern U.S.
- Charleston County
    - Kevin Limehouse – Innovation Officer for Public Services
- Clemson University
    - Snowil Lopes – Campus Energy Manager
- Coastal Carolina University
    - Dr. Paul Gayes – Professor & Executive Director, Burroughs & Chapin Center for Marine and Wetland Studies
- Coastal Conservation League
    - Eddy Moore – Senior Energy Program Director
- Coldwell Banker Richard Ellis (CBRE) Group
    - Bran Van Meter – Associate, CBRE Greenville
- Colite Technologies
    - Matt Winter – Vice President for Sales
    - Mandy Green – Marketing Manager
- Conservation Voters of South Carolina
    - Jalen Brooks-Knepfle – Energy Project Manager
    - John Brooker – Energy Project Manager
- Dominion Energy

    - Daniel Kassis – Vice President for Customer Relations and Renewables
    - Therese Griffin – Manager for Energy Efficiency and Demand Side Management
    - Mark Furtick – Manager for Renewables
- Duke Energy
    - Lynda Powers – Strategy & Collaborations Manager (Carolinas)
- E4 Carolinas
    - Bonnie Loomis – Managing Director
- Environmental and Energy Study Institute
    - Miguel Yanez – Program Associate for On-Bill Financing
- Federal Reserve Bank of Richmond
    - Erika Bell – Community Development Regional manager for North Carolina & South Carolina
- First Citizens Bank
    - Ken Cox – Senior Vice President & South Carolina Regional Mortgage Sales Manager
- Gullah Geechee Nation
    - Queen Quet – Chieftess
- Heron Farms
    - Sam Norton – Owner
- Lockhart Power
    - Bryan Stone – President
- Medical Technology Enterprise Consortium
    - Jill Sorenson – Chief Operating Officer
- New Alpha Community Development Corporation
    - Reverend Leo Woodberry – Executive Director
- Nexans High Voltage USA, Inc.
    - Emmanuel Martin-Lauzer – Director of Business Development
- Nucor Building Systems
    - Jon Tomlinson – National Accounts Sales Manager
- Nuveen
    - Jessica Bailey – President
- Proterra
    - Dale Hill – Founder (retired)
- Richland County
    - Synithia Williams – Richland County Stormwater Manager
- Rolls-Royce
    - Arunachalam Lakshminarayanan – Project Manager & Development Engineer
- South Carolina Bankers Association
    - Fred Green – President & CEO
- South Carolina Association of Community Action Partnerships

    - Natasha Pauling – Director of Resource Development & Public Information Officer
- South Carolina Conservation Bank
    - J. Raleigh West III – Executive Director
- South Carolina Department of Agriculture
    - Kyle Player – Executive Director, Agribusiness Center for Research & Entrepreneurship (ACRE)
- South Carolina Department of Commerce
    - Anna DeLage – Recycling Market Development Manager
- South Carolina Department of Health & Environmental Control (DHEC)
    - Keisha Long – Environmental Justice Coordinator
- South Carolina Electric Cooperatives
    - John Frick – Vice President for Government Relations
    - Mike Smith – Vice President for Technology and Business Strategy
- South Carolina Energy Office
    - Stacey Washington – Senior Program Manager
    - Rick Campana - Technical Program Manager
- South Carolina Launch
    - Matt Bell – Director
    - Austin Saggus – Investment Associate
- South Carolina Office of Economic Opportunity
    - Matthew Melton – Senior Manager for Weatherization
- South Carolina Office of Resilience
    - Alex Butler – Resilience Planning Director
- South Carolina Research Authority (SCRA)
    - Catherine Hayes – Industry Manager, SC Industry Solutions
- South Carolina Sea Grant
    - Brita Jessen – Interdisciplinary Research & Partnerships Lead
    - Matthew Gorstein – Assistant Director for Development & Extension
- South Carolina Small Business Chamber of Commerce
    - Frank Knapp – President & CEO
- South Carolina State Climate Office
    - Dr. Hope Mizzell – South Carolina State Climatologist
- South Carolina State Federal Credit Union
    - Jonathon Kozar – Vice President for Lending
    - Matt Tischler – Chief Lending Officer
- Southeast Climate and Energy Network (SCEN)
    - Alex Easdale – Executive Director
    - Sophie Pessagno – Programs & Communications Coordinator
- Southeastern Wind Coalition
    - Diana Godlevskaya – Program Manager
- Southern Alliance for Clean Energy (SACE)
    - Chris Carnevale – Climate Advocacy Director

    - Stan Cross – Electric Transport Policy Director
- Southern Environmental Law Center
    - Jenny Brennan – Science & Policy Associate
- The Sustainability Institute
    - Bryan Cordell – Executive Director
- United Way of the Midlands
    - Sara S. Fawcett – President & CEO
- University of South Carolina Department of Geography
    - Dr. Connor Harrison – Associate Professor of Geography (Economic Geography)
- University of South Carolina Moore School of Business
    - Dr. Tamara Sheldon – Associate Professor of Economics (Environmental Economics)
- University of South Carolina Office of Sustainability
    - Larry Cook – Director
- Upstate Forever
    - Megan Chase – State Policy Director
- Vote Solar
    - Lindsey Hallock – Southeast Senior Regional Director
- Warren Forensic Engineers
    - Matthew Warren – Business Development Manager
- Whitney M Slater Foundation
    - Loretta Slater – Executive Director

Events & Conferences

The following events & conferences provided insights to this market assessment:

- SC Wind Energy Workshop, August 18th 2021, virtual
- National Oceanic & Atmospheric Administration & Liberty Mutual Workshop on Climate and Resilience Risk, October 5th 2021, virtual
- Southeast Energy Insecurity Stakeholder Initiative: Final Recommendation Workshop, December 7th 2021, virtual
- The Economist Climate Risk North America Conference, February 15-17th 2022, virtual
- Clemson Energy Analytics & Visualization Center (workshop), March 24th 2022, Clemson, SC
- Climate Ready Columbia Conference, April 1-2nd 2022, Columbia, SC
- Carbon Markets Summit, June 30th 2022, virtual

Endnotes

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[32] For example, see how climate change can be observed in today's temperature data here: https://www.climatecentral.org/tools/climate-shift-index

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[34] An analysis was conducted using data from Hsiang et al (2017). These damage estimates are for years 2080-2099 under a business-as-usual climate scenario (RCP 8.5) and are expressed in the data as a % of county GDP. Numbers used are the median damage estimate. SC rank's 8th out of all U.S. states for average annual economic damage to GDP (averaged across counties for each state). The state's average damage is more than triple the average of other states.

Hsiang, S., Kopp, R., Jina, A., Rising, J., Delgado, M., Mohan, S., Rasmussen, D. J., Muir-Wood, R., Wilson, P., Oppenheimer, M., Larsen, K., & Houser, T. (2017). Estimating economic damage from climate change in the United States. Science, 356(6345), 1362–1369. https://doi.org/10.1126/SCIENCE.AAL4369

[35] A commonly used economic measure for an area, representing the value of goods and services produced there.

[36] The least and most heavily damaged counties in SC, respectively. The numbers represent the median estimate from Hsiang et al. (2017) applied to county GDP numbers for 2020 from the U.S. Bureau of Economic Analysis. Note that Hsiang's estimates are not scale dependent and can be applied to current figures (p. 2). These damage estimates are for years 2080-2099 under a business-as-usual climate scenario (RCP 8.5). A combination of inflation and economic growth would change the dollar value based on the county GDP in the future (but not the relative % of county GDP). The numbers in text are rounded and should be used as a way to envision damages in the far future to numbers that make sense today.

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NOAA National Centers for Environmental Information, State of the Climate: National Climate Report for October 2015, published online November 2015, retrieved on April 26, 2022 from https://www.ncdc.noaa.gov/sotc/national/201510

[56] Large swaths of the state experienced a 1-in-50 year rainfall event (~15 counties) , and some areas experienced 1-in-100 (~13 counties), 1-in-500 (~4 counties), or 1-in-1000 (~2 counties) year rainfall event.

NOAA National Centers for Environmental Information, State of the Climate: National Climate Report for October 2016, published online November 2016, retrieved on April 26, 2022 from https://www.ncdc.noaa.gov/sotc/national/201610

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NOAA National Centers for Environmental Information, State of the Climate: National Climate Report for September 2018, published online October 2018, retrieved on April 26, 2022 from https://www.ncdc.noaa.gov/sotc/national/201809

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[61] An analysis was conducted using data from Wing et al. (2022). The data represent the average annual loss, in millions of dollars, by 2050 under RCP 4.5.

Wing, O.E.J., Lehman, W., Bates, P.D. et al. Inequitable patterns of US flood risk in the Anthropocene. Nat. Clim. Chang. 12, 156–162 (2022). https://doi.org/10.1038/s41558-021-01265-6

[62] An analysis was conducted using data from Wing et al. (2022). Counties considered coastal are Beaufort, Berkeley, Charleston, Colleton, Georgetown, Horry & Jasper. In South Carolina, coastal counties face significantly higher flooding costs because of sea level rise, which exacerbates flood risk & damages. At the high end, Charleston County is projected to face costs of ~$300 million per year, which equates to approximately half of the entire county budget.

Wing, O.E.J., Lehman, W., Bates, P.D. et al. Inequitable patterns of US flood risk in the Anthropocene. Nat. Clim. Chang. 12, 156–162 (2022). https://doi.org/10.1038/s41558-021-01265-6

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South Carolina (out of 46 counties) has 44 counties with over 10% in poverty, 34 counties with over 15% in poverty, 13 counties with over 20% in poverty, and 5 counties with over 25% in poverty (Allendale, Barnwell, Dillon, Lee & Marlboro). 26 counties are classified as persistent childhood poverty counties, meaning that over 20% of that county's children under age 18 were in poverty in the 1980, 1990, 2000 censuses and the 2007-2011 American Community Survey.

By one metric of income inequality, the Gini Index, South Carolina ranks 37th among states. State ranking excludes the District of Columbia, although including it does not change the ranking. South Carolina's Gini Index is 0.477. The index ranges from 0 (perfect equality in income) to 1 (perfect inequality in income).

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[202] Commercial property assessed clean energy is when a lender pays the up-front costs associated with an energy efficiency project and receives payment over time with a line item added to the property tax bill. This usually adds an additional lien on the property. There are a variety of reasons why this arrangement could be pursued in commercial properties, but the main ones include: payments extend over a longer time-horizon (usually 20+ years) because it is tied to the property value of a valuable building, the payments stop if a tenant leaves the property (because the financing is tied to the property, not the borrower), and can help align the incentives of building owners and tenants. For more, see this overview from PACE Nation: https://www.pacenation.org/what-is-pace/

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[230] This report relies heavily on inputs from experts and SC companies, but cost & savings estimates are available from a variety of sources online for households / businesses across the state.
Example 1: Energy Sage, using Department of Energy Data. https://www.energysage.com/
Example 2: Google, using Google, NREL, and Department of Energy Data. https://sunroof.withgoogle.com/

[231] Payback time can vary according to several factors, including system size (which affects up-front costs), whether the system is purchased outright or financed, etc. This report relies heavily on inputs from experts and SC companies, but payback time estimates are available from a variety of sources online for households / businesses across the state.
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Example 2: Google, using Google, NREL, and Department of Energy Data. https://sunroof.withgoogle.com/

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Electric vehicle charging station numbers are accurate as of June 2022. The dataset may not include all chargers because the dataset updates on a rolling basis and new charging stations are being installed regularly. Note that the map shows the location of an individual station, which may have more than one charging outlet at that station (similar to how a gas station has multiple re-fueling points). The map does not differentiate between which fast charging cables are available at which station (at the moment there are three main cables: Tesla, CCS, and CHAdeMO).

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U.S. Census Bureau (2022). 2020 Decennial Census [Data set]. https://www.census.gov/data.html

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Climate Action Reserve: https://www.climateactionreserve.org/
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Neumann, J.E., Chinowsky, P., Helman, J. *et al.* Climate effects on US infrastructure: the economics of adaptation for rail, roads, and coastal development. *Climatic Change* **167,** 44 (2021). https://doi.org/10.1007/s10584-021-03179-w

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Example 1: Energy Sage, using Department of Energy Data. https://www.energysage.com/
Example 2: Google, using Google, NREL, and Department of Energy Data. https://sunroof.withgoogle.com/

[380] These numbers are specific to South Carolina and rely on inputs from experts and SC companies. General sources at a national level are comparable and can be referenced using sources cited in the Energy Efficiency Sectoral Analysis.

[381] The charger cost relies on inputs from experts and SC companies. Revenue estimate assumes the charger is used for 15% of the time, an average vehicle charge time of ~2 hours, and a charge price of 20 cents per kWh (the cost of electricity is 12-13 cents per kWh).