Scaling Up Climate Action through Building Stewardship

The Carbon Savings of Existing and Historic Buildings at Agnes Scott College

2022.05.13

AGNES SCOTT COLLEGE

GOODY CLANCY
ARCHITECTURE / PLANNING / PRESERVATION

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The Zero Net Carbon Collaboration (ZNCC), the community where idea for this study was sparked.

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Executive Summary

Stewardship of historic and existing buildings is a key, yet often overlooked, strategy for climate action. Sustainable design has focused disproportionately on reducing emissions through new construction; and yet it is clear that given the urgency of mitigating climate change, it is simply not possible to build our way to net zero. This study illustrates the measurable climate benefits that can be achieved through responsible reuse of existing buildings at Agnes Scott College.

Building reuse is an impactful and immediate step toward a circular economy in the building sector and nearly always has the potential for a faster carbon payback than new construction. It is simply not possible to achieve a net zero built environment without reducing the operational emissions of existing buildings, and the global carbon budget cannot afford the continued high embodied carbon cost of new construction. However, current building performance standards and climate action plans that consider only reductions in energy use or operational carbon over time fail to capture the total environmental benefits of reuse that result from avoided embodied emissions. Additionally, there are many paths to net zero that can result in large quantities of emissions expended to achieve carbon neutrality. This study proposes a methodology that accounts for both avoided embodied emissions and reductions in operational emissions in order to quantify and illustrate the carbon benefits of stewardship at a campus scale.

The planet is now in the critical decade of action that will largely decide the future of the climate. Meeting the global temperature targets of the Paris Agreement established at the 2015 United Nations Climate Change Conference (COP21), requires limiting the total additional greenhouse gas emissions to a global carbon budget. The sooner the rate of annual emissions is reduced, the most likely it is that the budget will be met. This means that the emissions reductions made now have a greater contribution to climate action than those made over the long-term. This study estimates the near-term embodied and operational emissions benefits of maintaining and upgrading existing buildings rather than replacing them with new construction.

Higher education has been a leading sector in both recognizing the urgency of the climate crisis, and setting meaningful and ambitious targets to achieve carbon neutrality. In 2006, a dozen college and university presidents initiated the American College and University Presidents' Climate Commitment (facilitated by Second Nature) and in 2007, Agnes Scott College and over 300 other institutions became charter signatories of this commitment. To date, Second Nature member institutions have publicly reported nearly 4,000 greenhouse gas inventories and 600 Climate Action Plans. Through the support of both Second Nature and the Association for the Advancement of Sustainability in Higher Education (AASHE), higher education is a leading sector in the United States in advancing climate action and sustainable stewardship.

While institutions of higher education are positioned as early leaders in climate action, few take into account total (embodied and operational) carbon of buildings or the time value of when emissions occur throughout a building's life in their carbon accounting practices. This study illustrates the importance of evaluating total carbon and understanding the carbon return on investment of building decisions. It offers a replicable process for evaluating climate impacts of building reuse at a campus scale. The findings illustrate the avoided carbon emissions of keeping historic buildings in use at Agnes Scott College and the importance of building reuse as a strategy in meeting the college's climate goals.

REDUCTION IN TOTAL EMISSIONS (2007–2037)

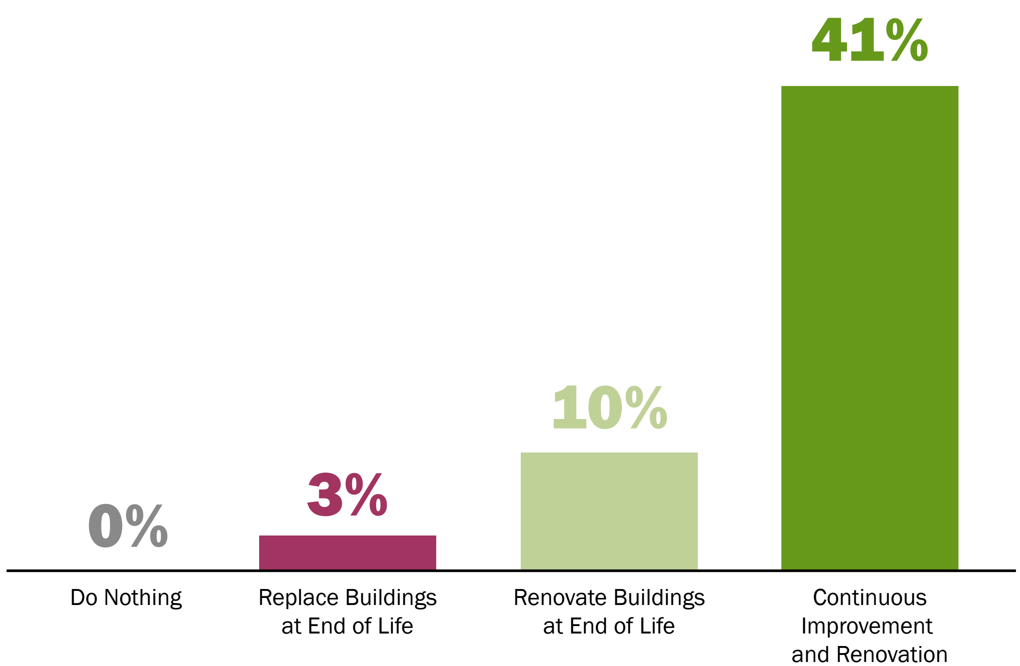

FIGURE 1 At Agnes Scott, a historic campus in Decatur, Georgia, retrofit and reuse of existing buildings offers a significant carbon reduction strategy through the carbon neutrality target year 2037. An approach of replacing old buildings in need of renovation with high performance new construction would result in a total emissions reduction of only 3% compared to taking no action at all. By contrast, a broad retrofitting campaign to reduce the operational emissions of existing buildings across campus in conjunction with major renewals at buildings at the end of their renewal cycle yields an emissions reduction of approximately 41%. This savings translates to avoided emissions that would take a forest the size of the campus roughly two centuries to sequester.

Overview

While it is common sense that the least resource intensive approach to the building process is to extend the life of structures that already exist, current practices around carbon accounting, climate action planning, and green building standards are not set up to quantitatively incorporate this principle. Embodied emissions of built facilities are frequently omitted from the scope of sustainable design targets. Additionally, life cycle emissions are typically evaluated over the full life of a building, which is standardized as 60 years; this does not accommodate the time value of carbon given the limited window available to reduce global emissions. The methodology proposed within this study aims to provide decision-making information to incorporate total carbon benefits of building stewardship into these important climate action frameworks.

This study uses retrospective modeling to illustrate the cumulative benefits of keeping existing and historic buildings in active use over time. Predictive modeling of emissions over the next several decades estimates the carbon reduction potential of building reuse and retrofit and provides active decision-making data for owners and planners to inform campus decarbonization.

In this study, total reduction in carbon emissions associated with stewardship of historic buildings at a campus scale is quantified through a life cycle assessment approach. Both the embodied carbon emissions from the materials associated with construction and renovation, as well as the operational carbon emissions of the buildings' use over time, are quantified and illustrated across the full timeline of the campus from the founding of Agnes Scott in 1889 through the present day. By comparing the approximate total carbon emissions of the campus to a scenario in which buildings are torn down and replaced rather than kept in services through retrofit and renovation, the analysis results present the carbon benefits of the college's continual reinvestment in its built heritage and physical assets.

The analysis is founded in the Carbon Avoided Retrofit Estimator (CARE) Tool, which estimates total carbon outcomes of building reuse and retrofit compared to building replacement. Two timeframes are assessed: the first retrospectively approximates the avoided embodied carbon of prioritizing historic preservation and building reuse over replacement over the history of the college. The second evaluates the impact of building reuse and retrofit as a strategy toward meeting Agnes Scott College's carbon neutrality target date of 2037. Each of these periods of study illustrate the impact building reuse and upgrade can make, both achieving net zero carbon emissions, and in minimizing the carbon debt incurred to reach that point.

Research Team

Agnes Scott College

Founded in 1889, Agnes Scott College is a women's liberal arts college located in Decatur, Georgia. Named the most innovative liberal arts college in the country by U.S. News and World Reports four years (2019-2022) in a row, Agnes Scott is a regional and national leader for achieving ambitious carbon reduction goals. The college founded the Office of Sustainability in 2008 (now the Center for Sustainability) to deliver on the college's mission to educate its students to live both honorably and engage the intellectual and social challenges of their times by ensuring the student body has a robust understanding of climate change and climate justice. Susan Kidd, while she was executive director of the Center, initiated this report with Lori Ferriss (see below) and contributed to the research and editing. Elizabeth Rowe, who served as interim director of the Center, provided research, writing, and publication assistance.

Goody Clancy

Goody Clancy is an education design firm and a recognized leader in designing places for learning and community. The firm itself strives to be continually learning—by rigorously re-evaluating the social and physical success of their work, and by engaging with and learning from the communities and schools with which they work. Goody Clancy views each of its projects as an investment in a more healthy, sustainable, and just built environment. Lori Ferriss, Goody Clancy's Director of Sustainability and Climate Action, served as the principal investigator and author of this study with support from Caroline Lippincott, research intern and Master of Architecture Candidate at the Rhode Island School of Design.

Agnes Scott Stewardship Philosophy

Given Agnes Scott's important asset of historic buildings, the college's leadership has had an unwritten "philosophy" of building stewardship for many decades. While the rationale behind decisions to preserve buildings on campus has not always been documented, it is clear that staff and trustees led efforts to continue the use of buildings in a respectful way. These decisions were made for economic as well as preservation reasons, which combined, have resulted in a stewardship approach that has served the college well.

Of the approximately 820,000 total square feet of building space at Agnes Scott, roughly two-thirds were built before 1972, meeting the National Register of Historic Places standard of 50 years or older. This collection of buildings strongly represents both a variety of architectural styles and 130 years of history of women's education. The physical campus is often cited among the deciding factors for students that choose to attend Agnes Scott, which is a very compelling argument for continued stewardship. Generations of alumnae have demanded the stewardship of the buildings on campus to preserve this cherished aesthetic. Sometimes it seems that the strength of Agnes Scott's campus—both the buildings and the landscape—has had its own survival instinct, buoyed by those who love and treasure it.

Key Findings

On Agnes Scott College's path to climate neutrality, emissions reductions depend on the journey, not just the destination. The three projected scenarios outlined here can all end at net zero when combined with the college's overarching goals for renewable energy and offsets, as outlined in the Climate Action Plan. But this report shows there is a 41% reduction in total carbon emitted into the atmosphere between the approach that focuses solely on high-performance new construction to reduce emissions compared to that which maintains, upgrades, and renovates all existing buildings.

"This is a critical finding for institutions like Agnes Scott that need to carefully balance the costs and benefits of providing safe, healthy, and beautiful spaces to live, learn, and work on campus. The college will immediately use this information as it moves forward with the renovation of the oldest building on campus, Agnes Scott "Main" Hall, built in 1891. These findings reinforce that renovating historic buildings is not just about looking at the past, it is also part of building a better future."

—LEOCADIA I. ZAK, PRESIDENT, AGNES SCOTT COLLEGE

- For more than a century, Agnes Scott has implemented a stewardship approach to growth in which reuse of existing buildings is prioritized and paired with strategic new construction to accommodate the need for evolution and expansion over time rather than simply tearing buildings down and replacing them when renovation is needed. It would take longer than 300 years for a forest the size of the Agnes Scott Campus to sequester the avoided embodied carbon dioxide emissions resulting from the retention of existing buildings over the history of the campus.
- Every existing building that can be reused is an opportunity to avoid embodied carbon emissions of new construction. At Agnes Scott, the embodied carbon associated with replacing individual buildings at the end of their life cycle is as high as 30% to 50% of the whole portfolio's annual emissions.
- Avoided carbon emissions form building stewardship can be measured at the single building scale. For example, the reinvestment in Rebekah Scott Hall through three major renovation cycles has avoided ~6,000 $mtCO_2e$ compared to new construction.
- Between 2007 and 2037, incremental improvements to energy efficiency across the Agnes Scott campus in conjunction with reuse of buildings at the end of their renewal cycles is projected to result in avoided emissions equivalent to ~115,000 metric tons of CO_2e. It would take a forest the size of the Agnes Scott campus over 1,300 years to sequester that amount of carbon dioxide.

Conclusions

- There are countless paths to carbon neutrality, many of which result in net greenhouse gas emissions that exceed the global carbon budget because they require more carbon costs than are offset by the resulting carbon savings within the critical timeframe. Reusing and upgrading existing buildings offers a path to net zero carbon with minimal upfront carbon investment, offering a solution with a quick carbon payback.
- It is imperative to substantially reduce emissions within the next decade to meet climate targets, and yet institutional buildings reach a point of renewal or replacement only every 40–50 years. It is, therefore, necessary to both reinvest in buildings at renewal points and implement energy retrofits across as many buildings s possible mid-renewal cycle to maximize total carbon reductions in the near term.
- Replacing existing buildings with high-performance new construction will typically not yield the needed near-term carbon reductions due to the high upfront expenditure of embodied carbon.
- Stewardship of historic buildings offers co-benefits that range from supporting the local economy to offering lessons about both the past and the future of design and sustainability.

Introduction

Stewardship of historic and existing buildings is a key, yet often overlooked, strategy for climate action. Sustainable design has focused disproportionately on reducing emissions through new construction; and yet it is clear that given the urgency of mitigating climate change, it is simply not possible to build our way to net zero. This study illustrates the measurable climate benefits that can be achieved through responsible reuse of existing buildings at Agnes Scott College.

Building reuse is the most impactful and immediate step towards a circular economy in the building sector and nearly always has the potential for a faster carbon payback than new construction. However, current building performance standards and climate action plans that consider only reductions in energy use or operational carbon over time fail to capture the total environmental benefits of reuse that result from avoided embodied emissions. Additionally, there are many paths to net zero that can result in large quantities of emissions expended to achieve carbon neutrality. This study proposes a methodology that accounts for both avoided embodied emissions and reductions in operational emissions to quantify and illustrate the carbon benefits of stewardship at a campus scale.

The Paris Agreement established at COP21, the 2015 United Nations Climate Change Conference, set a target of limiting global temperature rise to 1.5 to 2 degrees Celsius to avert the worst impacts of climate change. Meeting this target requires limiting total additional global greenhouse gas emissions to a certain "budget," and the sooner the annual rate of emissions is reduced, the more likely it is to stay within this budget. This concept of the time value of carbon, meaning that the emissions reductions made now have a greater contribution to climate action than those made over the long-term, is illustrated in the chart on the right, which indicates probability of staying below 1.5 °C based on several carbon reduction scenarios. 2020 to 2030 is the critical decade of climate action that will largely decide the future of the planet.

According to the Global Alliance for Buildings and Construction's 2021 Global Status Report for Buildings and Construction, the built environment is currently responsible for approximately 37% of global carbon dioxide emissions—27% from building operations (operational carbon), and 10% from building and construction (embodied carbon).[1]

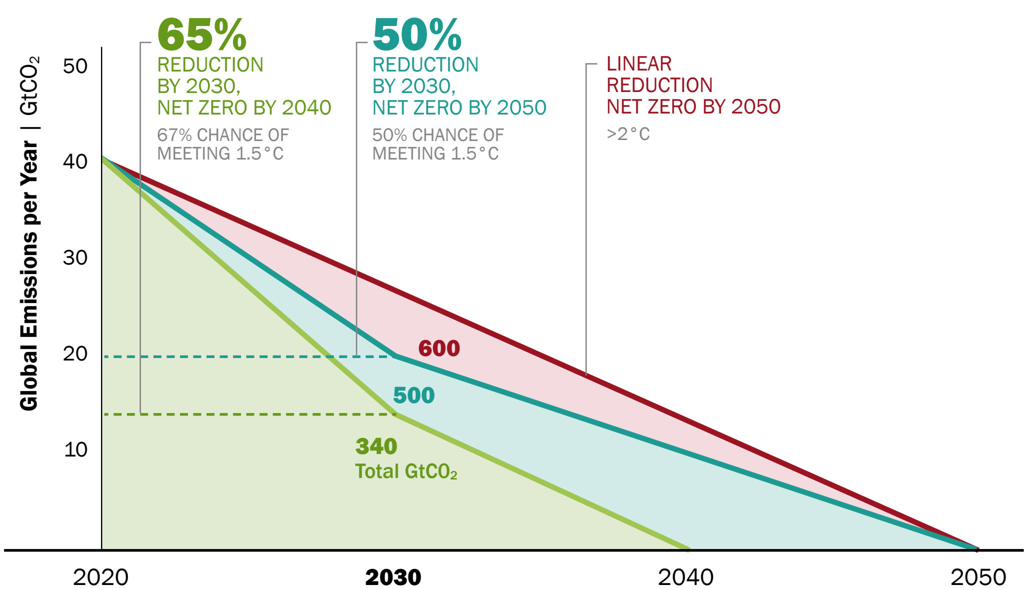

FIGURE 2 Copyright Architecture 2030

Global building stock has significantly increased over the years, and there is no sign of it slowing down. According to researchers at Architecture 2030, "by 2060, the world is projected to add 230 billion m^2 (2.5 trillion ft^2) of buildings, or an area equal to the entire current global building stock," and nearly two-thirds of the buildings that are here today will exist in 2050.[2] With that in mind, it is imperative to not only ensure that new construction is built efficiently and sustainably, but more importantly, to accelerate the retrofit of existing buildings. New construction can at best not add to our current rate of emissions; reductions must be made to operational emissions of existing buildings in order to decrease the carbon footprint of the built environment. It is simply not possible to achieve a net zero built environment without reducing the operational emissions of existing buildings, and the global carbon budget cannot afford the continued high embodied carbon cost of new construction.

While institutions of higher education are positioned as early leaders in climate action, few take into account total (embodied and operational) carbon of buildings or the time value of when emissions occur throughout a building's life in their carbon accounting practices. This study illustrates the importance of evaluating total carbon and understanding the carbon return on investment of building decisions. It offers a replicable process for evaluating climate impacts of building reuse at a campus scale and quantifies the avoided carbon emissions of keeping historic buildings in use at Agnes Scott College.

Overview

The primary goal of this study is to quantify the avoided carbon emissions resulting from Agnes Scott College's stewardship philosophy. Specifically, the carbon savings associated with building reuse and retrofitting will be assessed in comparison to building replacement over time. The second goal of this study is to present a replicable model that can be used at other colleges and universities.

The study aims to evaluate the embodied carbon avoided through reuse, the operational carbon saved through retrofit, and the holistic co-benefits of sustainable stewardship. This study will support Agnes Scott College in realizing their 2037 carbon neutrality goal while minimizing total emissions by understanding the impacts of continued investment in their historic structures.

The secondary goal is to establish a replicable process that can be implemented on other campuses or similar portfolios of buildings. The analysis methodology used in this study provides a template for other building portfolio owners to follow with information applicable to their own buildings, history, and climate targets. While Agnes Scott College has extensive records of its sustainability goals, construction timeline, and building energy use, it is assumed that not every institution has equivalent documentation, and thus this study also aims to identify key information required for the accuracy and usefulness of the analysis as well as where broader assumptions based on publicly available benchmarks and data may be adequate.

About the Research Team

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Glossary of Terms

Carbon Neutral	Achieved when anthropogenic CO_2 emissions are balanced by anthropogenic CO_2 removals over a specified period.[3]
Carbon Payback	The period of time it takes a carbon reduction action to meet or offset the amount of carbon dioxide emitted in its life cycle.
Embodied Carbon	The carbon footprint of a material resulting from the emission of greenhouse gases during extraction, processing, transportation, fabrication, and assembly of a material or product.[4] Sometimes referred to as embodied emissions.
Greenhouse Gas (GHG) Emissions	Gases that contribute to global warming when trapped in the atmosphere. Carbon dioxide is a major GHG, but many other gases are also included. The term "carbon emissions" refers to carbon dioxide equivalent, which allows the use of carbon dioxide as a proxy for GHG.
LEED	A green building certification determined by a set of rating systems based on design, construction, and operational standards.
Operational Carbon	The carbon emissions that result from using a building, including from the energy used to heat, ventilate, cool, light, and otherwise provide power.
Renewal Cycle	For this study, it is assumed that institutional buildings will require significant renovation and reconfiguration approximately every 40–50 years to replace and update building systems, reflect changing space needs, and address deferred maintenance. This time period if considered the renewal cycle at the end of which a building will likely be renovated or replaced.

Primary References

Information regarding Agnes Scott College's history came from:

- Agnes Scott's Special Collections archive
- Assessments done by the Atlanta Preservation and Planning Services
- The 1994 South Candler Street-Agnes Scott College Historic District National Register of Historic Places nomination form

Information regarding the college's sustainability planning and climate resiliency came from the school's sustainability website and its supporting documents, including:

- The Climate Action Plan
- The Climate Resilience Plan
- The college's Strategic Plan
- Agnes Scott's Association for the Advancement of Sustainability in Higher Education (AASHE) Sustainability Tracking, Assessment & Rating System (STARS) reports

Greenhouse Gas inventories and energy consumption data—including electric and natural gas monthly usage figures—were directly supplied by the college.

FIGURE 3 Agnes Scott "Main" Hall and Gazebo.
Courtesy of Agnes Scott College Special Collections

Agnes Scott College Campus Context

Campus History

Agnes Scott College, formerly the Decatur Female Seminary and then the Agnes Scott Institute, was the first institution of higher education in Georgia to receive regional accreditation after its founding in 1889. Agnes Scott is committed to educating its students to “think deeply, live honorably, and engage the intellectual and social challenges of their times.”

As a historic women’s college, Agnes Scott continues to provide women with an edge for achievement. Since the early 1920s, the college has ranked in the top ten percent of American colleges whose graduates complete Ph.D. degrees. Today, Agnes Scott is ranked #2 in the country for its commitment to teaching and #3 for creating vibrant living-learning communities. Combined with a 11:1 student to faculty ration, Agnes Scott students benefit from individualized classroom experiences.

The college’s historic residential campus, prized for its aesthetic distinction, has given generations of students a sense of place, purpose, and responsibility. The structures range in style from Victorian Gothic Revival and Italian Renaissance Revival to Mid-Century Modern and contemporary buildings. This diversity of architectural styles expresses the growth and evolution associated with an expanding student population, changes in pedagogical philosophy and technology, and expectations about the physical facilities of higher education institutions that have occurred over the college’s long life. Many of the structures on campus have gone through several renovations over time. In recent years, Agnes Scott has renovated three of their historic buildings, with a fourth underway, to renew the structure while accommodating today’s programmatic requirements. These renovations have prioritized sustainability in order to meet the goals outlined in the college’s Climate Action Plan.

The campus was listed on the National Register of Historic Places in 1994 as part of the South Candler Street–Agnes Scott College Historic District.

FIGURE 5 Students studying outside McCain Library. Courtesy of ASC Special Collections.

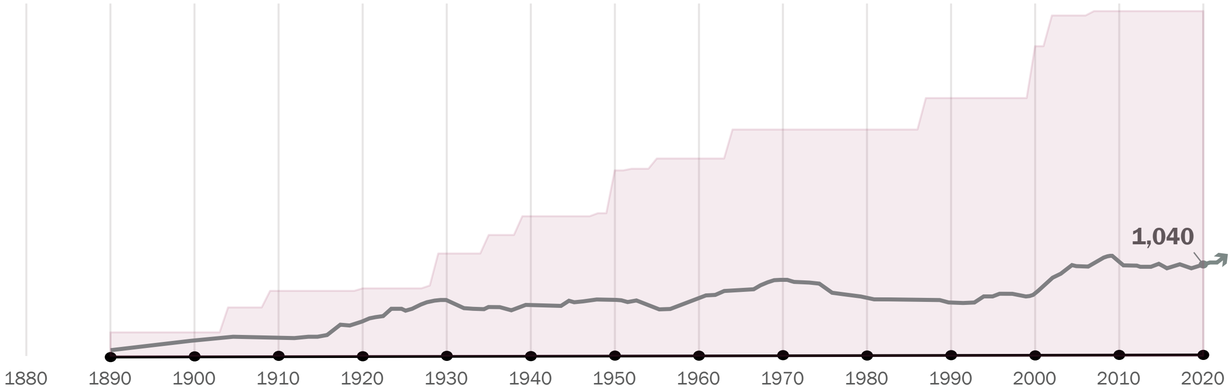


FIGURE 4 Chart illustrating total built square footage in shaded purple against student enrollment.

Timeline of Construction and Renovation

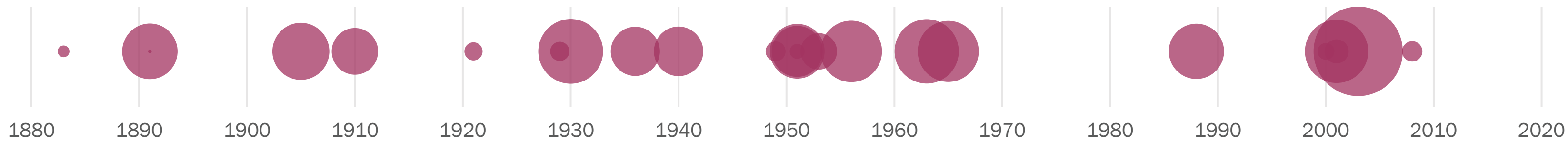


FIGURE 6 Campus growth over time where size of bubble represents relative square footage.

The college's oldest extant building is Agnes Scott "Main" Hall. Completed in 1891, Main was innovative for its time, including being the first building in Decatur with electric lights. The building has undergone two known major renovations—the first in the 1950s and the second in 1986. Main is currently undergoing a third major renovation, which is on track to receive LEED Gold certification.

The second oldest building on campus is Rebekah Scott Hall, completed in 1905. Similar to Main, Rebekah has undergone multiple renovations, with its most recent receiving LEED Platinum certification. Next came Inman Hall in 1910, and then a moderate building boom in the 1920s and 1930s, which added a steam plant, library, and additional academic facilities. A second building boom came between 1949 and 1965 when a number of buildings were added to campus, including an observatory, dining hall, arts center, and several residence halls. During these years, several major renovations took place as well.

Construction resumed when the Woodruff Physical Activities Building was erected in 1988. The 1980s also brought about more major renovations to existing buildings, Main and Rebekah included. The late 1990s and early 2000s brought about some new construction and renovation projects. The West Parking Deck was finished in 1999. In 2001, the Alston Campus Center and the Theme Houses were added to the college's building inventory. The college's most recent new construction projects—The Mary Brown Bullock Science Center and the Julia Smith Thompson Chapel—were completed in 2003 and 2008, respectively.

As expected, some of the college's buildings have undergone programmatic changes as well to reflect evolving space needs. Many of these shifts required interior retrofits to accommodate the space's new function. While these changes were primarily aesthetic and spatial, there were instances where the building's structure had to be slightly modified or reinforced. There are several buildings on campus that are multi-purpose housing student residences, administration offices, and faculty offices. The 2014 renovation of Campbell Hall, the 2018 renovation of Rebekah Scott Hall, and the upcoming renovation of Main Hall have had to accommodate a wide variety of operational needs within a single building.

Throughout the college's history, a number of buildings were also moved—as many as three times—and/or demolished. The practice of relocating buildings rather than tearing them down, which was a historically common practice, allowed the campus to expand and evolve around new modes of residential education while extending the life of existing structures. In addition to being relocated, many of the buildings changed use, balancing residential, academic, and recreational needs on campus. The demolition of existing buildings occurred in waves that correspond to the new construction previously described, often to make space physically for one of these new buildings or because a purpose-built structure was being replaced with a more state-of-the-art facility.

Today, Agnes Scott is prioritizing renovating and enhancing their historic buildings rather than rebuilding them. In doing so, the college is reducing their carbon footprint while preserving the campus's historic character. Agnes Scott already has three LEED certified buildings, and is about to complete work on a fourth.

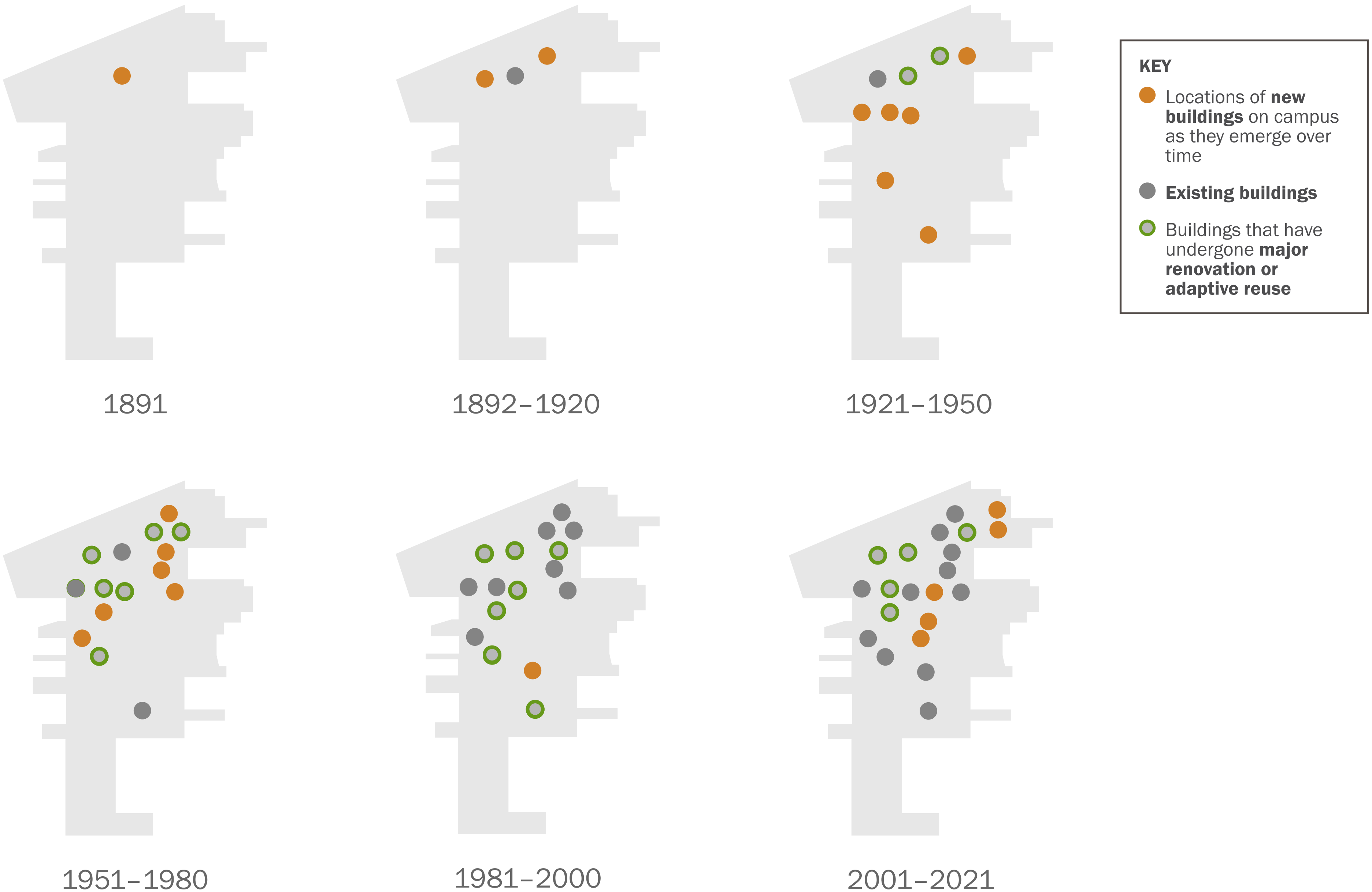


FIGURE 7 This series of maps highlights the pattern of growth on the Agnes Scott Campus, the current footprint of which is illustrated in gray. *Where dates of historical renovations were not documented, a renewal cycle of 40–50 years was assumed.*

Sustainability at Agnes Scott College

Since the establishment of their sustainability program, Agnes Scott's principal sustainability focus has been on climate change and carbon neutrality. In 2007, the college took a formal step toward carbon neutrality when it became a charter signatory of the American College and University Presidents' Climate Commitment (now known as the Presidents' Climate Commitment), setting a goal to achieve carbon neutrality by 2037. In 2008, the college launched the Office of Sustainability and appointed its first executive director. The same year, the college committed to ensuring that all new construction and renovations to existing buildings must meet LEED Silver standards or higher. The following year, Agnes Scott College published their first Climate Action Plan (CAP), which acts as a road map for how the college will reduce net carbon emissions to zero by 2037.

Agnes Scott initiated the Green Revolving Fund in 2011 to "establish a pool of financial resources dedicated to funding energy-efficient and sustainable projects that generate cost savings. The money saved through these projects is then recycled back into the fund for future ones, resulting in an efficient and sustainable funding source for climate neutrality efforts."[5]

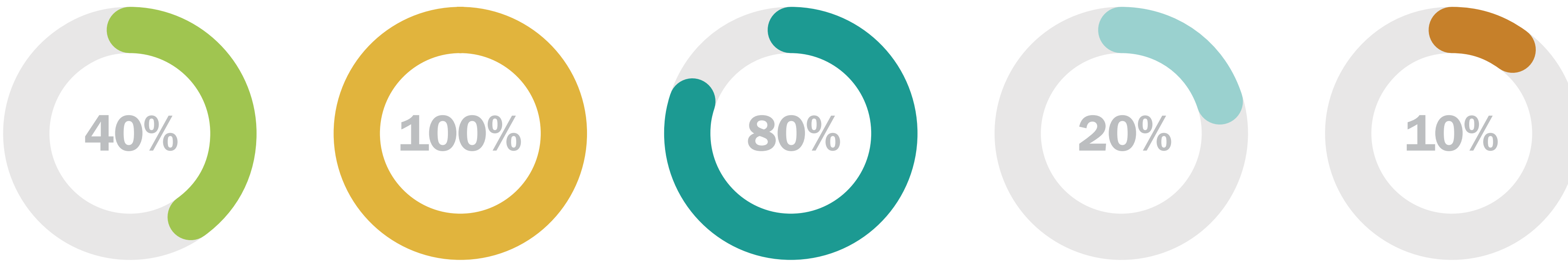
In 2015, the Office of Sustainability became the Center for Sustainability, marking a transition from sustainability planning to program implementation. As a result, the Center transitioned the original Sustainability Steering Committee into programmatic committees that provide guidance and planning on some of the college's programmatic priorities, including the Arboretum Advisory Committee, the Green Revolving Fund Committee and the Waste Diversion Committee. The Center for Sustainability is where the Agnes Scott community learns about the challenges of global climate change, including climate and environmental justice. Our mission is to seek collaborations on innovative and equitable solutions for sustainability on and off campus.[6]

As part of the college's accountability through the Presidents' Climate Commitment, Agnes Scott has created a Climate Action Plan and Climate Resilience Plan (CRP). The CAP serves as a road map to achieve carbon neutrality goals by first focusing on energy efficiency projects, such as equipment replacement and building envelope improvements, in order to reduce campus energy use. The CAP also includes aggressive goals for renewable energy generation with a priority for on-campus infrastructure. The Climate Resilience Plan was created jointly with the City of Decatur as a guide for the college and the city to combine efforts to address the impacts caused by local changes in the climate. Multiple committees made up of faculty, staff, student interns, and community partners exist to ensure these plans are properly implemented in a timely manner.

ASC CLIMATE COMMITMENT TIMELINE

- **2007** ASC signs ACUPCC and sets 2037 carbon neutrality goal
- **2008** College launches Office of Sustainability
- **2009** ASC releases the Climate Action Plan
- **2009** First LEED certified renovation completed
- **2011** Green Revolving Fund started
- **2015** Office of Sustainability becomes Center for Sustainability
- **2020** Climate Resilience Plan finished

FIGURE 8 Timeline of formalized climate action milestones at Agnes Scott College.



Carbon Reduction
Agnes Scott has reduced their carbon footprint by 40% from 2009 levels

LED Lighting
Approximately 100% of the school's lighting is LED

Water Fixtures
80% of Agnes Scott's water fixtures are high efficiency

Water Consumption
Agnes Scott has decreased potable water consupmtion by approximately 20%

Geothermal
10% of the campus square footage powered by geothermal HVAC

FIGURE 9 Since Agnes Scott College's signing of the President's Climate Commitment, measurable reductions have been made to the college's consumption of natural resources.

By prioritizing equipment replacement and building envelope improvements, and leveraging active community participation in energy and water conservation, Agnes Scott College has reduced its carbon footprint by nearly 40% from their 2009 baseline as of 2021 and is on track to achieve a 50% reduction by the end of calendar year 2022. Currently, the college has one LEED Silver building, one LEED Gold building, and one LEED Platinum building, all of which are historic structures. Agnes Scott is now a leader in geothermal energy with two of their buildings' HVAC systems running on 100% geothermal energy, meaning 10% of the college's square footage is heated and cooled with zero-emission geothermal energy. Additionally, almost 100% of the school's lighting is LED and 80% of water fixtures are low flow.

In 2019 Agnes Scott College conducted a comprehensive campus master plan. Through building assessments, interviews with students, faculty, and staff, and understanding the college's short-term and long-term goals, a 10-year vision for Agnes Scott College was crafted. Sustainability is fully integrated into the plan's recommendations, and each suggested intervention embraces the college's guiding sustainability principles and considers their 2037 carbon neutrality goal. In addition, the plan includes a set of Sustainability Guidelines, which support the implementation of the campus' Climate Action Plan. These objectives cover Buildings and Landscapes, with subtopics in Energy, Water, Materials, and Education.

As the Center for Sustainability looks ahead to the next 15 years of climate action, the Center is committed to elevating climate and environmental justice as cornerstone of its work.

Environmental and Cultural Stewardship Case Study:

Rebekah Scott Hall

Rebekah Scott Hall, one of the Agnes Scott College's most historic buildings, embodies the college's approach to stewardship. The most recent renovation in 2018 preserved the historic character of the building, while also renewing the physical condition of the facility, reducing energy use, and meeting the present space use needs of the college. Rebekah Hall is a multi-use space housing residence halls, administrative offices, and the college's Welcome Center. Prior to this renovation, only the first floor of the building was air conditioned, and a primary goal of the renovation was to modernize all building systems including bringing air conditioning to the entirety of the space. The installation of a HVAC system had the potential to create a substantial increase in the college's carbon footprint, however through the installation of a geothermal HVAC, the college has been able to reduce its overall emissions while improving occupant comfort and increasing utilization of the building.

In addition to reducing total emissions through clean energy, installation of the geothermal system also resulted in the removal of a surface parking lot, which has been transformed into a campus green space. In 2019, Rebekah Hall received both the Chairman's Award and an award for Excellence in Sustainable Rehabilitation from the Georgia Trust for Historic Preservation.

1905 — Completed Construction

Rebekah Scott Hall was completed in 1905. After Main, it is the second oldest original building on campus today.

1950 — First Major Renovation

Rebekah underwent its first major renovation in 1950. New electrical wirings, plumbing, finishes, and beam reinforcements were added.

1986 — Second Major Renovation

Rebekah underwent its second major renovation in the 1980s. Along with aesthetic enhancements, windows, plumbing, electrical, and roof were replaced and upgraded.

2015 — New Renovation Phase I

Phase I primarily included exterior brickwork repairs, cupolas repairs, and a new roof.

2017 — Second Major Renovation

Phase II consisted of renovations to student residents on second and third floors, installation of AC, and new offices and a welcome center on the first floor.

2018 — Building Reopened

Rebekah Scott Hall reopened in Fall of 2018. It was awarded LEED Platinum status

FIGURE 10 This figure highlights accomplishments made on Rebekah Scott Hall, their only LEED Platinum building.

GEOTHERMAL

Rebekah Hall's HVAC now runs on geothermal energy. 42 wells, 500 feet below ground utilize the Earth's core temperature to heat and cool the building.

LOW-FLOW

All existing plumbing fixtures were replaced with new low-flow systems. This move has greatly reduced the college's water consumption.

LED LIGHTS

All lights in Rebekah Hall were replaced with LED lighting. LEDs have a longer lifespan, higher energy efficiency and performance, and emit very little heat.

SUSTAINABLE LANDSCAPE

A new sustainable garden was planted where the former parking lot used to sit. The erasure of the parking lot has reduced the heat island effect, and the new plantings filter rain water.

FIGURE 11 To date, Agnes Scott College has renovated three of their historic buildings to meet today's green building standards. They are currently working on their fourth, Main Hall.

AGNES SCOTT CAMPUS CONTEXT

Quantifying the Carbon Impacts of Stewardship

While it is common sense that the most sustainable building is the one that already exists, current practices around carbon accounting, climate action planning, and green building standards are not structured to quantitatively incorporate this principle.

Embodied emissions are frequently omitted from carbon reduction targets and building performance metrics. Additionally, life cycle emissions are typically assessed over a standardized 60-year life; this does not accommodate the time value of carbon given the limited window to reduce global emissions. The methodology proposed within this study aims to provide decision-making information to incorporate total carbon benefits of building reuse into these important climate action frameworks.

In this campus-wide study, total reduction in carbon emissions associated with building stewardship at a campus scale is quantified through a life cycle assessment approach. Both the embodied carbon emissions from the materials associated with construction and renovation, as well as the operational carbon emissions of the buildings' use over time, are quantified and illustrated across the full timeline of the campus from the founding of Agnes Scott in 1899 through the present day. By comparing the approximate total carbon emissions of the campus to a scenario in which buildings are torn down and replaced rather than kept in service through retrofit and renovation, the analysis results present the carbon benefits of the college's continual reinvestment in its built heritage and physical assets.

Methodology

The basis of the data and calculation approach for this study is founded in the Carbon Avoided Retrofit Estimator (CARE) tool, a tool for calculating and comparing the embodied, operating and avoided carbon impacts and benefits of reusing, upgrading existing buildings versus building new ones.

TOTAL ADDED EMBODIED & OPERATIONAL EMISSIONS OVER 15 YEARS

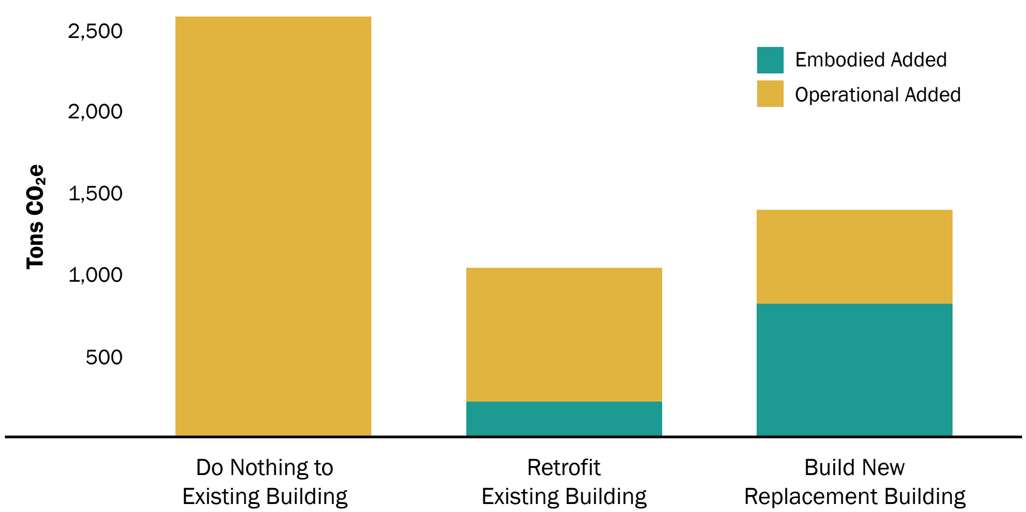


FIGURE 12 This example of a summary chart from the 2Build or not 2Build Carbon Calculator illustrate that in the near term when carbon reductions are critical, reusing and upgrading an existing building can reduce total carbon emissions compared to new construction through avoided embodied emissions and reduced operational emissions.

This tool allows users provide information in four categories from which the tool estimates both embodied carbon and operational carbon of retrofit or replacement over a specified time frame:

1. General building information, such as location and occupancy use, from which grid emissions and energy use assumptions are drawn, as well as a specified time duration for the analysis, which may align with a carbon neutrality target date;
2. Information about the renovation indicated by drop-down menus to describe scope, including extent of interior, structural, envelope, and building systems renovation to approximate embodied carbon, as well as targeted energy use to determine operational carbon;
3. New building information, which selects from one of four typical construction typologies for embodied carbon, and target energy use for operational emissions; and
4. Special conditions like poor soils or high seismic requirements that may significantly impact embodied carbon.

The calculator uses the user input information to estimate carbon emissions using built-in embodied carbon data and operational energy and emissions data from the Commercial Buildings Energy Consumption Survey (CBECS) and Portfolio Manager. The outputs show total embodied and operational emissions over the specified time frame for three scenarios: the existing building with no intervention, the renovated building, and the new construction.

To perform this analysis at the scale of an entire campus, the calculator was expanded to allow for the input and cumulative evaluation of all individual buildings at Agnes Scott. The same drop-down menu options were applied to every building to determine the embodied carbon and operational carbon emissions of each building renovation throughout the college's history compared to a hypothetical replacement. For buildings that were renovated at multiple points over their life, each point of renewal was treated with the option of renovating or replacing with new. A given building's total life cycle carbon emissions were calculated by summing the embodied carbon of original construction plus the operational emissions resulting from the period between the original construction and the first point of renovation, the embodied carbon of the first renovation plus the operational emissions from the first renovation to the second, and so on through the total number of renovations, as described in Figure 14. The total portfolio emissions were determined by summing the total emissions of each building for a given duration of time.

$$LCE = \sum_{i=0}^{n} EC_i + OC_i * t_{(i+1)-i}$$

LCE = total life cycle carbon emissions of a single buildings

EC_i = embodied carbon emissions resulting from construction of $_i$

OC_i = annual operational carbon emissions between construction period $_i$ and $_i + 1$

t = number of years between construction period $_i$ and $_i + 1$

FIGURE 13 Equations illustrating the above described approach to calculating the life cycle carbon emissions of each building within the scope of study.

Retrospective and Predictive Assessment Periods

The analysis is treated in two time-views relative to the year 2007, the year of the college's formal climate commitment. The first is retrospective, spanning from the original construction of each building through 2007; the second is from 2007 through the year 2037—the year by which the campus has committed to achieving carbon neutrality. The retrospective analysis uses contemporary operational and embodied emissions data and energy use averages and is meant to be comparative in nature rather than a calculation of the precise energy used over time and the resulting emissions. The analyses of the present era are based on energy use information calibrated to metered energy and emissions data as described below and is intended to reflect the true current and projected emissions of buildings on the Agnes Scott campus through the defined timespan. All terms are used as defined in Section 2 of this report.

Summary of Assumptions

Rate of Emissions Over Time

- Analysis assumes all embodied emissions occur upfront; in reality they are distributed across the life cycle, with the majority occurring during the material production and construction stages.
- Operational emissions are assumed to occur at a constant annual rate between years of construction or renovation.

Energy Use and Operational Emissions

- When available, metered electricity and gas consumption are used.
- Baseline energy use is derived from CBECS 2003 based on primary building energy use and climate zone.
- Operational emissions, when not provided by the college, are calculated based on EPA eGRID 2018 state emissions rates and Portfolio Manager fuel mix ratios.

Frequency of Renovation

- When gaps in recorded data exist regarding the dates of past renovations of existing buildings, it is assumed that comprehensive renewal or replacement occurs approximately every 40–50 years. This duration is referred to as the building renewal cycle throughout this report.

Historical Renovation and Replacement Assumptions

- Pre-1950 renovations:
  - No major upgrades to mechanical systems
  - No reduction in energy use
- Post-1950 renovations:
  - Major upgrades to mechanical systems, unless additional information about extent of renovation is known
  - No reduction in energy use. During this era, addition of cooling or more extensive mechanical systems may actually have yielded higher energy use; however, no change is assumed.
- Pre-1950 replacements:
  - Where historic buildings are constructed of masonry bearing walls with wood interior framing, hypothetical replacement buildings prior to the year 1950 are assumed to be replaced in kind.
  - No reduction in energy use
- Post-1950 replacements:
  - Replacements of masonry and wood framed structures occurring after 1950 are assumed to be of steel and concrete construction
  - No reduction in energy use; addition of cooling or more extensive mechanical systems may actually have yielded higher energy use; however, no change is assumed, similar to the renovation case, which allows for comparison.

Projected Future Renovations and Replacements

- Assume 80% reduction in energy use from baseline for both renovations and new construction. This reflects the college's aggressive climate targets. The impact of this assumption is discussed within the findings.
- Assume that all buildings that reach the end of their 40 year renewal cycle between the present day and 2037 will be replaced or renovated during this analysis time frame.

Carbon Reductions of Single Building Reuse

The concept of avoided emissions resulting from building reuse compared to replacement can be most clearly illustrated at a single building scale. The graph below tells this story for Rebekah Scott Hall, whose history is described in detail in the previous section. Originally built in 1905, the first documented renovation of the residence hall occurred in 1950. Since that point, it has been renovated twice more, most recently in 2018 to LEED Platinum standards.

In 1950 and at each of the points of renewal that followed, the college had the choice to renovate Rebekah Scott Hall or to replace the structure with new construction. The graph below illustrates the cumulative total carbon impacts of this choice from 1950 through the campus' carbon neutrality target year of 2037, inclusive of the embodied and operational carbon emissions.

Each point of intervention beginning with the first renovation results in a jump in emissions, which represents the embodied carbon associated with the construction, either renovation or replacement. This embodied carbon value is much lower for the renovation than it is for the replacement because of the reuse of the most carbon intensive elements of the building, the envelope and structure. This reuse avoids the emissions that would result from new construction of those systems.

At each of these renewal points, the slope can also be seen to change. This represents the improvements in operational efficiency that result from the renovation, or the improved efficiency that would occur in new construction, which result in lower annual operational emissions. As the building becomes more efficient over time, the embodied carbon plays a relatively greater role in the total emissions.

Overall, the cumulative result of reinvesting in this building again and again rather than replacing it is avoided emissions equivalent to nearly 6,000 metric tons of carbon dioxide.

REBEKAH HALL—REUSE VS. REPLACE OVER TIME

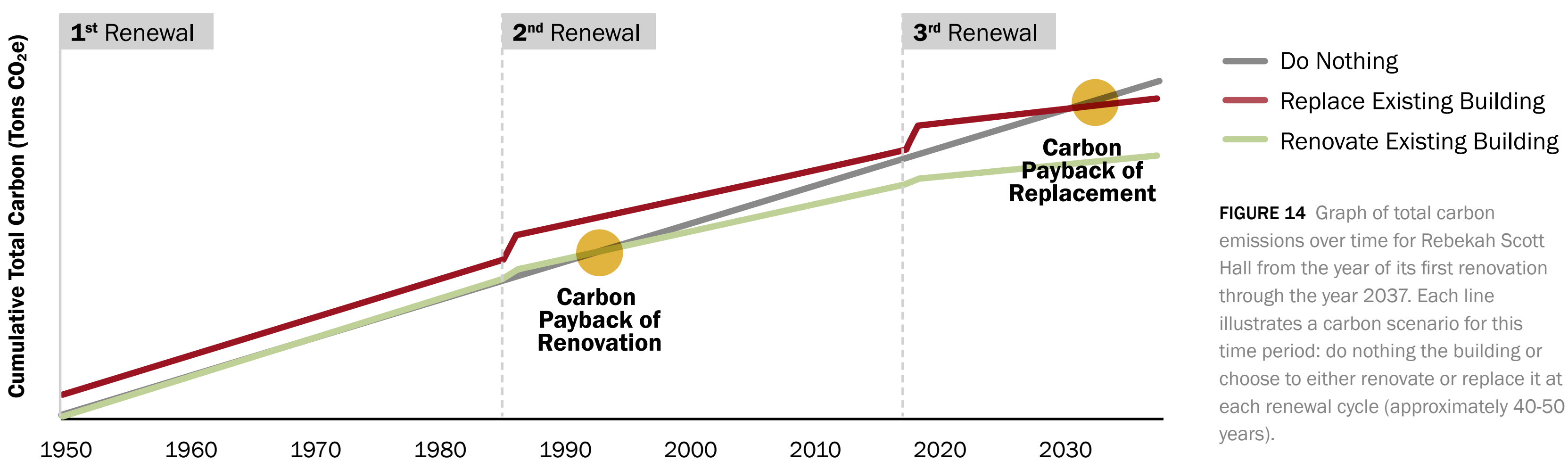


FIGURE 14 Graph of total carbon emissions over time for Rebekah Scott Hall from the year of its first renovation through the year 2037. Each line illustrates a carbon scenario for this time period: do nothing the building or choose to either renovate or replace it at each renewal cycle (approximately 40-50 years).

Emissions Before the College's Climate Commitment

From the establishment of Agnes Scott College in 1889 through the college's signing of the American College & University Presidents' Climate Commitment in 2007, the construction, renovation, and operation of physical facilities have all resulted in carbon emissions. During this more than century-long period, the physical campus developed to match the growing enrollment, pedagogical needs, programmatic expectations, and capacity of the institution. While new buildings were added over time to expand the square footage of the campus facilities, older buildings were also renovated, in some cases multiple times, to reflect changing space use needs, provide new technology, and adapt to evolving building conditioning standards.

While there is no historical inventory of carbon emissions of the campus, the carbon associated with the college's facilities can be approximated to illustrate the likely emissions profile over time. Each time a new building was constructed, embodied emissions occur from the materials and construction of the building; after a building was constructed, operational emissions occurred from the building's use each year to operate that square footage. This means that every new building resulted in both a one-time carbon expenditure, seen as steps in the lines of the embodied carbon chart (Figure 15), as well as an increase in the campus' annual operational emissions. When a building was renovated, the embodied carbon "step" is typically much lower than that associated with new construction.

CAMPUS GROWTH 1889–2021

FIGURE 15 Graph of total square footage of campus buildings plotted against the embodied carbon emissions of the campus. The stewardship approach to growth reflects the decisions that have been at Agnes Scott; new buildings have been added to accommodate changing technological needs, evolving expectations about campus facilities, and population growth, but existing buildings are also retained and renovated as an integral part of the campus' built facilities and culture. In the replacement building approach, the same square footage is added over time, however rather than renovate buildings at the end of renewal cycles, each building is replaced with a building of comparable scale and use.

Agnes Scott College's history of reinvestment in their existing buildings has resulted in cumulative avoided emissions equivalent to more than 34,000 metric tons of carbon dioxide.

That is equivalent to driving around the world more than 3,250 times.[7]

It would take longer than 300 years for a forest the size of the Agnes Scott campus to sequester this amount of carbon dioxide.

Emissions after the College's Climate Commitment

When Agnes Scott signed the ACUPCC in 2007, they gave themselves an ambitious thirty-year time frame to achieve carbon neutrality. Because building operations contribute a significant proportion of the college's greenhouse gas emissions, decarbonization of the existing building portfolio is an essential piece of the path to net zero.

There are two ways to eliminate operational emissions from buildings: retrofit existing buildings to a higher level of efficiency, or replace existing buildings with new, high-performance construction. While the second option is often perceived to be more effective in reducing carbon emissions, this strategy rarely results in lower total emissions in the critical near term if embodied and operational carbon are both calculated and taken into account. New construction is associated with a large upfront embodied carbon cost; even the most high-performance new construction takes on this carbon debt from year one. Existing building reuse, in comparison, can typically achieve near to or equal levels of performance, but with a substantially lower upfront embodied carbon cost. The result is that in the critical near-term, reuse and upgrade offers an opportunity for significant carbon reductions compared to either taking no action with existing buildings or replacing existing buildings with new construction.

To assess the benefits of reuse, this study estimates the total carbon emissions over time of three portfolio approaches:

1. **Do Nothing:** This scenario is used as a baseline case. It assumes that no changes are made the original state, resulting in no added embodied carbon and no change in operational carbon emissions.

2. **Retrofit Existing Buildings:** This scenario assumes that every building that reaches the end of a renewal cycle will be renovated for continued use.

3. **Replace Existing Buildings:** This scenario assumes that every building that reaches the end of a renewal cycle will be replaced with a building of comparable size and use type.

Cumulative Impacts of Reuse versus Replacement

Figures 16 illustrates current and projected carbon emissions of the total portfolio of buildings on Agnes Scott College's campus from 2007 through 2037 for the three scenarios outlined above. Emissions from 2007 through 2021 are approximated based on metered energy use data and are indicated in solid lines, while projected emissions beyond 2021 are illustrated as hypothetical carbon emissions in dashed lines. The hypothetical carbon reduction scenarios assume that all buildings that reach a renewal cycle during this time period (assuming 40-year cycles) will be either renovated to a high level of efficiency or replaced. Both retrofits and replacement buildings are assumed to achieve an operational efficiency improvement of 80%. For both the renovation and replacement scenarios, it is assumed that renewable energy on-site or off-site along with offsets will bridge the gap between the operational emissions that will occur by the year 2037 and net zero operations.

At the year of each renovation or replacement, the slope of the carbon profile decreases, indicating improved efficiency and lower operational emissions. At the same time, the embodied carbon of these renovation and new construction activities results in a singular increase in total emissions at each of these points. In the previous single building example, the embodied and operational impacts were clearly visible at each point of renovation. By contrast, this graph plotting total cumulative campus emissions highlights the fact that each individual building has a relatively minor impact in the context of the entirety of the campus portfolio's emissions.

Each building renovation or replacement creates only a ripple in the total emissions profile. Even so, the approach to renovate rather than replace buildings has a carbon payback point at around the year 2018, which means that the carbon investment associated with renovations and upgrades as already been paid back through improved operational performance.

PORTFOLIO APPROACH: REUSE VS. REPLACE

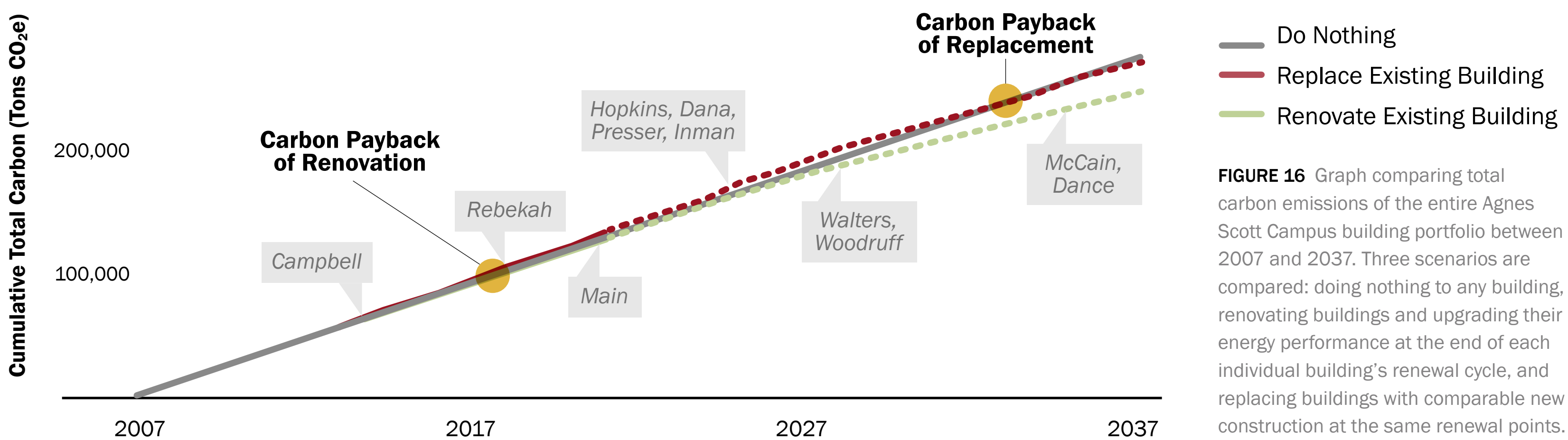


FIGURE 16 Graph comparing total carbon emissions of the entire Agnes Scott Campus building portfolio between 2007 and 2037. Three scenarios are compared: doing nothing to any building, renovating buildings and upgrading their energy performance at the end of each individual building's renewal cycle, and replacing buildings with comparable new construction at the same renewal points.

The replacement scenario is not projected to pay back until approximately the year 2034. If the hypothetical replacement buildings are only able to achieve a 60% improvement in energy performance rather than 80%, the building replacement scenario results in higher total emissions than leaving the existing buildings as is by the year 2037. However, even if the existing buildings are only renovated to a 40% reduction in emissions and new construction achieves an 80% reduction, the reuse scenario will still yield a 25% greater reduction in emissions by the year 2037 compared to new construction.

Annual Impacts of Reuse versus Replacement

Breaking out annual emissions rather than cumulative, and embodied and operational emissions in addition to total emissions, allows for additional analysis of these results. The grid of charts in Figure 17 illustrates this parsing of analysis results: each column represents one of the previously described scenarios—do nothing, replace buildings at renewal cycles, and renovate buildings at renewal cycles, and each row represents a subset of carbon emissions by phase—embodied carbon, operational carbon, and total carbon. Viewing the results in this way emphasizes the potentially significant contribution from embodied carbon on annual GHG emissions, which is shown to be as high as 30% to 50% of the whole portfolio's annual emissions in a given year. Both the replacement and renovation scenarios show a downward trend of annual operational carbon emissions associated with improved energy performance in the middle row. However, the total carbon row, summing embodied and operational emissions, puts into proportion the embodied emissions spikes in the replacement scenario as compared to the renovate scenario, which counteract the emissions reductions achieved through operational efficiency.

The embodied carbon of replacing buildings at the end of their life cycle is as high as 30% to 50% of the whole portfolio's annual emissions for any given year.

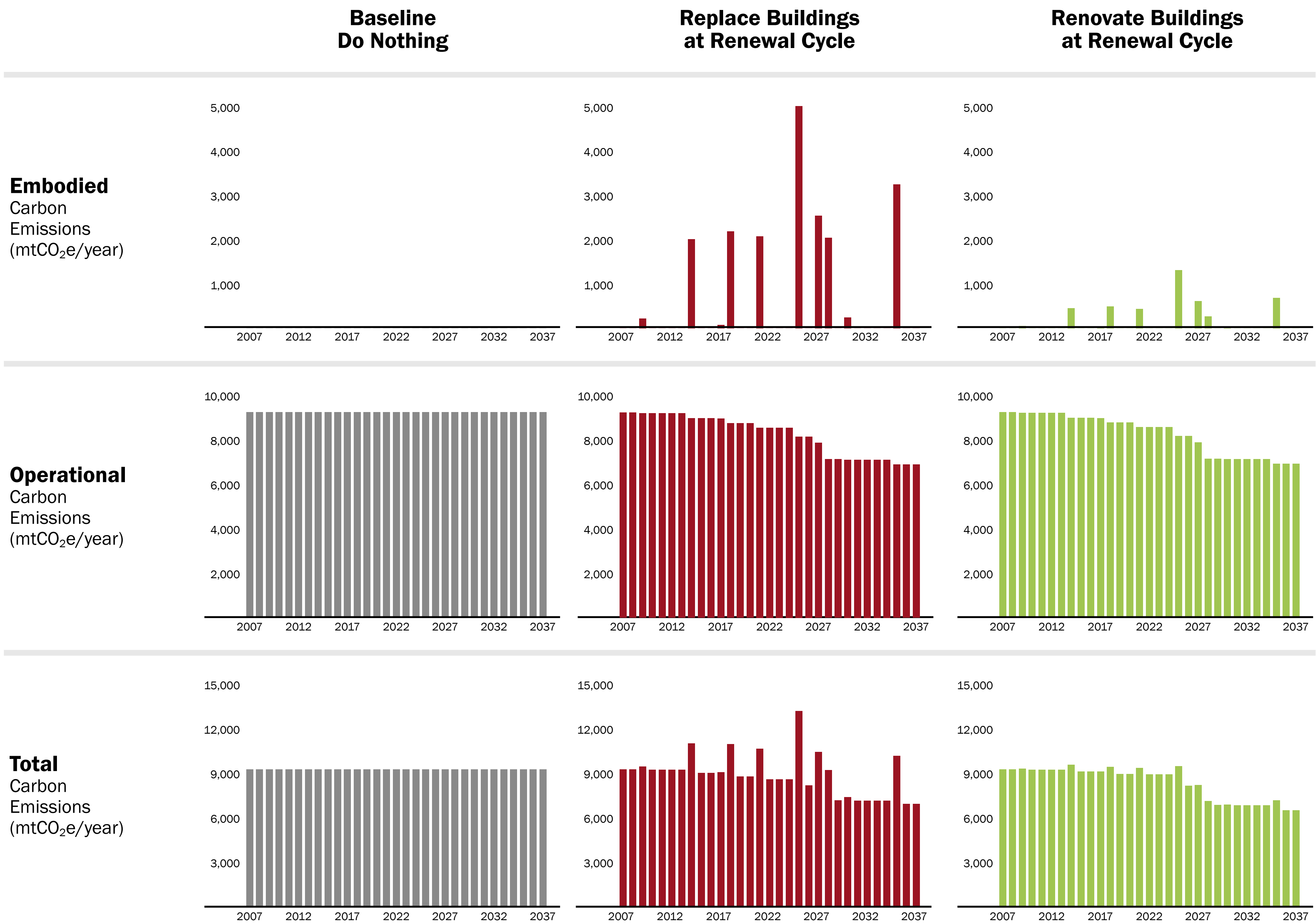


FIGURE 17 Each scenario to do nothing, replace buildings at renewal cycle, or renovate buildings at renewal cycle has unique implications on embodied and operational emissions over time.

Given that only a small proportion of existing buildings will hit the point of requiring major renovation or replacement by many carbon neutrality target dates, mid-renewal cycle retrofits are critical to reducing emissions. Between 2007 and 2037, incremental improvements to energy efficiency across Agnes Scott in conjunction with reuse of buildings at the end of renewal cycles is projected to avoid emissions equivalent to ~115,000 metric tons of CO_2e. It would take a forest the size of the Agnes Scott Campus over 1,300 years to sequester that amount of carbon dioxide.

Mid-Renewal Cycle Operational Improvements

While the previously established scenarios illustrate the carbon outcomes of choosing to renovate versus replace at points of renewal, in reality, maintenance of existing buildings is an ongoing process, and incremental improvements to building operations are implemented continuously across the entire portfolio. By leveraging the unique financing structure of the college's Green Revolving Fund (GRF), Agnes Scott College has aggressively pursued performance improvements toward their carbon neutrality goals. For example, the GRF has supported the replacement of 80% of campus lighting to LED; and larger-scale energy investments including two geothermal HVAC systems for Campbell Hall and Rebekah Scott Hall; retrocommissioning the Bullock Science Center; installing a 6 kW solar array on the roof of the Bradley Observatory; and daylight sensors in Evans Dining Hall. Between the years 2007 and 2021, Agnes Scott reported a nearly 40% reduction in GHG emissions overall. This chart clearly illustrates that implementing these continual incremental improvements across the whole campus in conjunction with performing major renovations as necessary yields the lowest annual emissions in both the near and mid-terms, resulting in significant cumulative reductions over time. Minimizing the carbon expended on the path to net zero requires both building reuse at 40-50 year renewal cycles and retrofit for operational improvements that can be implemented at any point during that renewal cycle. Given that only a small proportion of buildings will hit the point of requiring major renovation or replacement in the critical next decade, mid-renewal cycle retrofits are critical to staying within the carbon budget.

ANNUAL TOTAL CARBON EMISSIONS (ULTRA HIGH-PERFORMANCE NEW CONSTRUCTION)

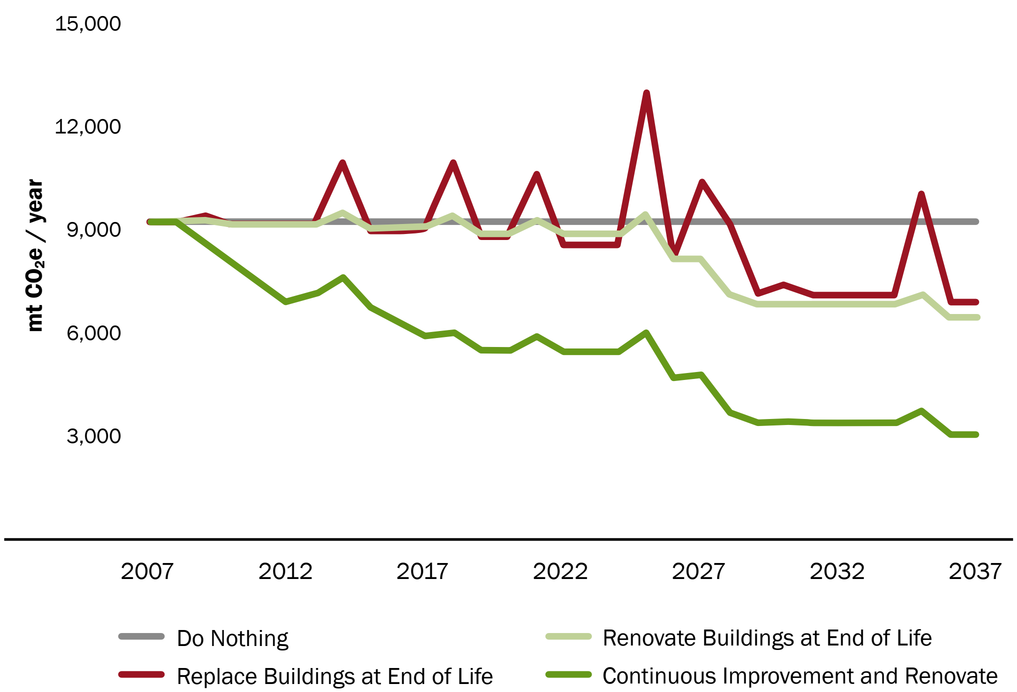


FIGURE 18 This graph illustrates the trajectory of annual total carbon (embodied + operational) for four scenarios. The upward spikes indicate the one-time embodied carbon debt associated with new construction or renovation, while the decreasing slope represents reduced operational emissions over time. The area under each of these curves represents the cumulative tonnes of carbon emitted between 2007 and 2037 for each of these scenarios.

While the three potential carbon profiles in Figure 18 could each result in “net zero” by the year 2037, they will result in the release of measurable different quantities of carbon dioxide into the atmosphere up to that point in time. This illustrates that it is not only the end goal of carbon neutrality that matters; the path to net zero can result in dramatically varying level of carbon emissions (Figure 18), which is perhaps more important to staying within our global GHG emissions budget to mitigate climate change.

On the path to net zero, environmental impacts depend on the journey, not just the destination. While the three projected scenarios here can all end at net zero with offsets and renewable energy, there is a 41% reduction in total carbon emitted into the atmosphere between the approach that focuses solely on high-performance new construction to reduce emissions compared to that which maintains, upgrades, and renovates all existing buildings.

REDUCTION IN TOTAL EMISSIONS (2007–2037)

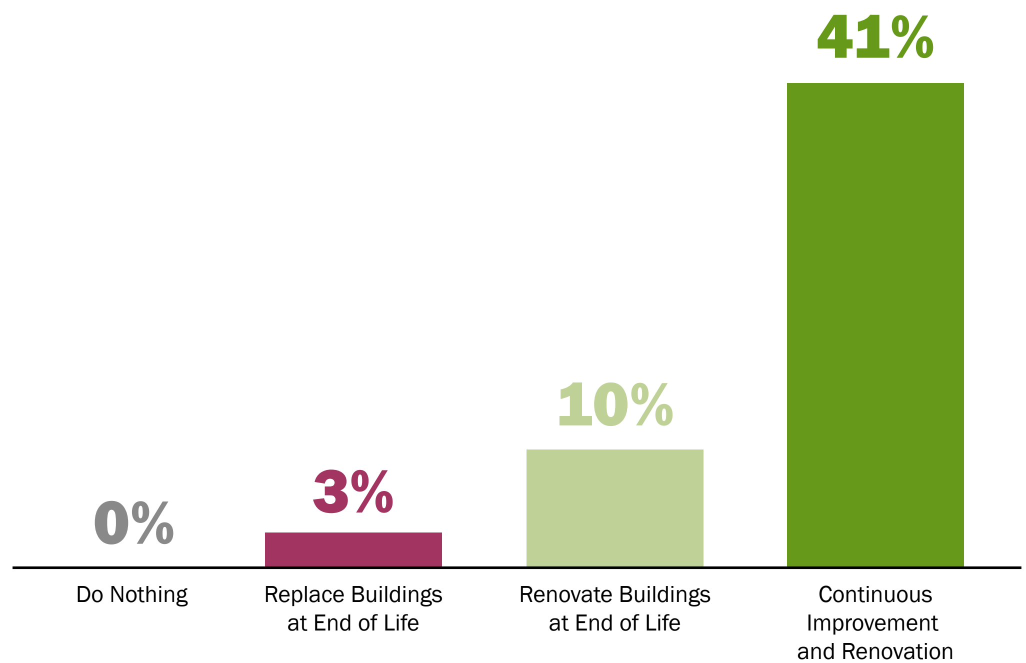


FIGURE 19 This chart looks at the information from Figure 18 a different way. Each bar here shows the total percentage reduction in carbon emissions of each portfolio scenario compared to the baseline case in which no buildings are upgraded or replaced. While each of these scenarios could lead to carbon neutrality by the year 2037, this chart shows that how net zero is achieved has a substantial impact on the environment.

Beyond GHG Emissions

Both the stewardship of historic buildings and the mitigation of GHG emissions offer co-benefits that range from supporting the local economy to preserving the college's natural landscape. While the principal focus of the college's sustainability program is climate change and carbon neutrality, the Center for Sustainability strives to create a culture of sustainability and stewardship on campus that is accessible to students, faculty, staff, and community partners.

Equity and Inclusion

Agnes Scott College is proudly committed to fostering a community that celebrates and honors the intersections of identity, extending to all campus partners, including the Center for Sustainability's commitment to the promotion of environmental and climate justice.

Agnes Scott is committed to providing a healthy learning and work environment that is safe and is characterized by mutual trust and respect for all of our community.[8] Through the Gay Johnson McDougall Center for Global Diversity and Inclusion works to uplift and honor all intersections of identity. Training and education on various topics of diversity, equity, and inclusion, is always available to all employees, students, our governing body, and community partners.

The Center for Sustainability is committed to ensuring that all members of the Agnes Scott community are aware of the intersectional challenges of global climate change, including the challenges of climate and environmental justice. Agnes Scott recognizes that the greenhouse gases associated with college's emissions will have disproportionate impacts on the health and well-being of communities globally, and specifically in the metro-Atlanta region. These impacts will be far greater than those felt on the Agnes Scott campus, and therefore the Center strives not only to mitigate greenhouse gas emissions, but also other toxic air pollutants associated with our carbon footprint.

Education

Agnes Scott strives to be a model for how both organizations and individuals can collectively work to meet ambitious climate targets, whether it is through the college's curriculum or being a resource for community learning through campus tours and mentorship.

As a higher education institution, Agnes Scott is training a new generation of sustainability professionals that have the skills and passion to not just address climate change, but to ensure women and climate justice are at the heart of all climate change policy and programs. The college has been named the No. 1 Most Innovative National Liberal Arts College by U.S. News & World Reports for the four years in a row. Agnes Scott's Environmental and Sustainability Studies (ESS) program provides students with an interdisciplinary curriculum that equips them to understand the environmental, intellectual, and social challenges of sustainability. As an ESS minor, students gain an understanding of real-world climate issues through experiential learning and engagement with on-campus initiatives. ESS graduates have successfully completed graduate programs in architecture and interior design after working directly on the renovations of Campbell Hall and Rebekah Hall. Every one of the college's sustainability achievements can be traced back to a student internship or work-study project.

Agnes Scott's sustainability efforts serve as a model not just for our campus community, but also the broader Decatur and Atlanta communities on how to achieve ambitious climate commitment targets.

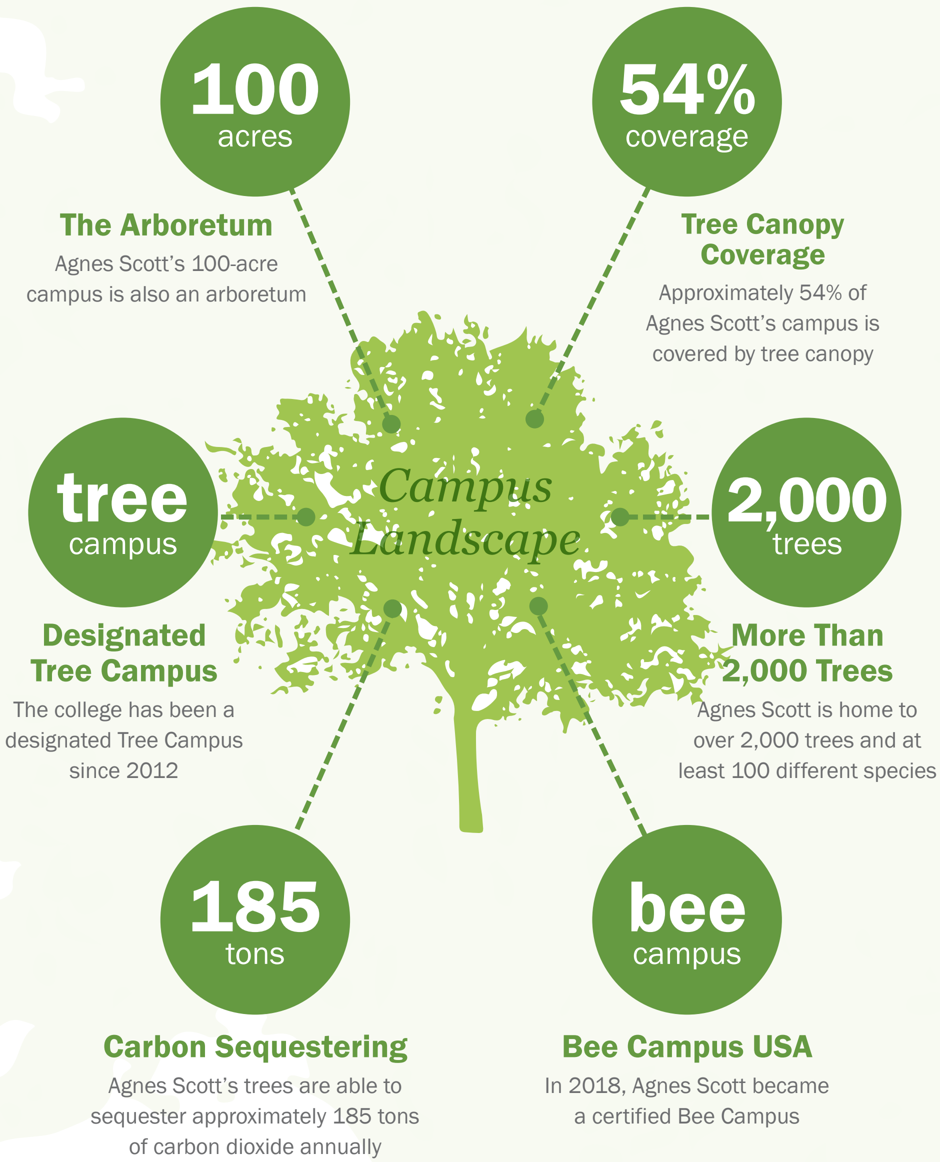


FIGURE 20 With over 2,000 trees on their 100-acre campus, Agnes Scott College has been a certified Tree Campus since 2012.

Preservation of Campus Landscape

One of the most cherished aspects of Agnes Scott College is its balance between architecture and nature. Despite its urban setting, the 100-acre campus feels removed from the surrounding cities of Decatur and Atlanta and contributes to the feeling of community that is a hallmark of Agnes Scott College.

Agnes Scott's 100-acre campus is home to over 2,000 trees and one of the largest green spaces in the City of Decatur. Agnes Scott is a ArbNet Level II accredited arboretum and a certified Tree Campus USA since 2012. Agnes Scott's Level II accreditation requires the college have 100 or more unique species of trees.

The Agnes Scott Arboretum itself reflects Agnes Scott's liberal arts curriculum. Staff and faculty from different departments—classics, art, biology, anthropology, environmental and sustainability studies, women's gender and equality studies—facilities, ITS, communications, and sustainability joined together to establish the Arboretum Advisory Committee, the arboretum website, and the arboretum interactive tour.

In addition, the Center for Sustainability manages an organic demonstration garden which gives interested students opportunities to plant, cultivate, and harvest small yields of crops. Given the garden's location, many Decatur residents pass by the garden and often gain gardening and pollinator tips. In 2018, Agnes Scott was certified as a Bee Campus USA.

Resilience

In order for Agnes Scott to deliver on its commitment to prioritize environmental stewardship, it is imperative to build community resilience to climate change at the local level. For Agnes Scott, this has meant developing a landmark Climate Resilience Plan in partnership with the City of Decatur.

In 2015, Agnes Scott joined the Presidents' Climate Leadership Commitment to expand its carbon mitigation commitment to include climate resilience. The resulting CRP was created as a joint effort between Agnes Scott College and the City of Decatur. The community of staff, students, and residents who will be impacted by climate change locally in the months and years to come are now more organized to face these challenges. Both the college and the city have a history of addressing environmental concerns and encouraging community activism. However, the limited funding and incentives for climate change in Georgia and the southeast have resulted in less ability to work together, move beyond these limits, create new solutions, and jointly find funding support when needed.

While many colleges and universities have committed to resilience planning through the Presidents' Climate Leadership Commitment, Agnes Scott is groundbreaking in its approach by partnering with the City of Decatur from the beginning of the planning process.

Waste Diversion

A cornerstone of the college's commitment to environmental sustainability is through responsible resource management and waste diversion. This includes single-stream recycling, food waste compost, and the prioritization of renovation over new construction.

Agnes Scott College strives to attain zero waste (diverting 90 percent of the waste stream away from conventional landfills) by promoting waste reduction through reuse and repair as well as waste diversion through recycling and composting. To help reach this goal the Center of Sustainability partners with the Office of Facilities and the custodial staff to ensure the campus community is educated on what materials go where and why it is important.

A part of this commitment to zero waste also includes items that cannot be placed in single-stream recycling. Agnes Scott developed a partnership with the Center for Hard to Recycle Materials, a local nonprofit that works to encourage reuse and diverts thousands of pounds of hazardous waste, bulky trash, and other hard-to-recycle items from metro-Atlanta.

Agnes Scott is also committed to recycling all building materials from building construction and renovation projects. As part of the college's LEED policy, Agnes Scott has achieved the highest levels of construction waste diversion of its renovation of Campbell Hall and Rebekah Hall. But this same commitment applies to smaller projects.

Benefits to Local Economy

Agnes Scott recognizes that its commitment to preservation and stewardship not only positively impacts its climate action goals, but also the local economy through partnerships with local businesses and nonprofits.

In addition to the environmental benefits realized from Agnes Scott's commitment to diverting and salvaging building materials from its renovation projects the local economy stands to benefit as well. Studies show that reuse/ refurbishment produces 300 jobs per 10,000 tons of waste compared to 1-6 jobs in the traditional landfilling/incineration process.[9]

In 2016, the college replaced all campus toilets with low-flow alternatives through funding from the Green Revolving Fund. Through the college's waste consultant, Agnes Scott was able to partner with a local business to recycle the porcelain from the toilets that were replaced.

In 2018 during the renovation of Rebekah Scott Hall, the Center for Sustainability partnered with Habitat for Humanity to donate all of the building's old residence hall furniture and the Life cycle Building Center to donate salvageable building materials. Most notably this included the original interior metal elevator doors.

Conclusions

Findings

The total carbon emissions avoided through stewardship of historic buildings on the Agnes Scott College campus compared to replacement with new construction illustrates the benefits of building reuse, both over the college's long history, and moving forward towards the climate neutrality target of 2037.

Well before any official commitment to environmental sustainability, Agnes Scott College applied a preservation-centered approach to their campus. New buildings were constructed over time to mirror the growth of the college's population and reach, but existing buildings were also maintained, renovated, and upgraded over time to reflect changing standards of use and programmatic needs. This reinvestment in existing facilities over time compared to replacing buildings when they need substantial renewal has resulted in avoiding carbon emissions equal to the amount of carbon dioxide a forest the size of Agnes Scott College would sequester in over three centuries of growth.

From the year 2007, when Agnes Scott signed the Presidents' Climate Leadership Commitment, the campus has focused on reducing greenhouse gas emissions. Upgrading and improving existing buildings has been a key strategy in achieving this target. This approach leads to significant reductions in operational emissions with minimum embodied carbon investment. Between the years 2007 and 2037:

- The path to net zero can result in dramatically varying level of carbon emissions. While the three projected scenarios analyzed in this study—1) retrofit buildings at points of renewal, 2) replace buildings at points or renewal, and 3) implement continuous performance upgrades to existing buildings in concert with renovating at points of renewal—can all end at net zero with offsets and renewable energy, the third scenario of leveraging existing buildings will result in more than 100,000 metric tons of avoided carbon emissions, an 38%, reduction, compared to the first scenario.
- Renovating all existing buildings at the end of renewal cycles during this time frame has a carbon payback by approximately the year 2018. This means that the upfront carbon cost of renovation is paid back by improved operational efficiency, resulting in net carbon reduction, well before 2037.
- Replacing all buildings that reach the end of a renewal cycle during this time frame emits more carbon dioxide equivalent to either retrofitting the same buildings or leaving them unrenovated if the new buildings achieve a 60% or lower reduction in operational emissions.

Lastly, while carbon is a necessary metric when evaluating climate action, it is important to acknowledge the co-benefits of stewardship on people and place. Reusing existing buildings can frequently provide opportunities support local economies, strengthen local communities, address existing inequities, and preserve cultural identity while contributing to carbon mitigation and future resilience.

Replicability

One of the goals of this study was to create a replicable process that could be used on other campuses with similar sustainability ambitions. While the findings from this study would not be applicable to every campus, the methodology developed here can be broadly adapted.

Agnes Scott College has extensive documentation of their campus' physical history, which allowed for a representative reconstruction of historical emissions profiles. While this knowledge of the detailed construction and renovation history of the campus's buildings was used when possible to refine inputs to the analytical modeling such as years and extent of past renovations, the retrospective analysis could also be completed using rules of thumb about how frequently buildings are renovated as well as knowledge about historical building approaches at different points in history. Because this analysis is most useful for comparing renovation to new construction, the details of the history are less critical than the consistent application of assumptions about how buildings are renovated and with what type of building they are replaced.

While the historical modeling is illustrative of the cumulative benefits of building reuse, the current and predictive modeling is the most significant portion of the analysis. These results provide active decision-making data for owners and planners as we move through the critical next decade in climate action. The outcomes of this study have shown that formulating this analysis with the correct scenarios and assumptions is key to obtaining useful results. It is not necessary to know the details of each building in a portfolio to do this. The factors that had the greatest impacts on the results of this study are:

- Accurate representations of square footage
- An understanding of where buildings are relative to points of renewal (e.g. when will the decision to renovate or replace occur)
- What level of energy efficiency can be achieved across the portfolio through independent retrofit measures outside of a major renovation
- How energy efficient will new buildings be (code compliant, net zero, or other)

Many educational institutions have climate action plans; few take into account total carbon, or the temporal dimension of when emissions occur over the course of a building's life. This study illustrates the importance of evaluating total carbon and understanding the carbon return on investment of decisions around building.

Next Steps

This study resulted a valuable, tangible example of the climate benefits of building stewardship at the campus scale. Through the course of the project, a number of paths emerged that would offer additional value through more in-depth evaluation. The following topics are areas of potential future study that would build on and enhance the findings of this report.

- Conduct a deeper economic study of the reuse versus the replacement of the college's buildings
- Tie in construction and renovation decisions to better help the local economy
- Research historical emissions factors, especially local buildings
- Understand how historical approaches to thermal comfort might inform future interventions. How can inherently sustainable vernacular features, such as verandas, guide design decisions?
- Research and conduct more detailed life cycle assessment of the most recently renovated buildings
- Integrate local grid projections into the analysis in order to assess how greening an electrical grid over time reuse and construction to not only achieve carbon neutrality, but to do so in a way that results in the lowest possible carbon cost to arrive at that point.

Endnotes

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