CLIMATE ACTION STRATEGIES

The CAP working groups developed strategies for climate action across the Institute. **Community, Equity, and Accessibility** strategies are presented as an initial framework and integrated throughout the other focus areas to ensure equitable access and impact. The remaining strategies were organized into **eight focus areas:**

COMMUNITY, EQUITY & ACCESSIBILITY

MITIGATION & ADAPTATION

BUILDING ENERGY Strategies that reduce Scopes 1 and 2 emissions, increase energy efficiency, and reduce energy consumption in buildings.	**RENEWABLE ENERGY & OFFSETS** Strategies for implementing renewable energy sources and offsets.
MOBILITY Strategies that support fossil fuel-free mobility within campus and to and from campus.	**MATERIALS MANAGEMENT** Strategies that address how materials are bought, used, recovered, and disposed.
WATER MANAGEMENT Strategies that increase the efficiency and conservation of water management, including potable water, greywater, blackwater, and stormwater.	**CARBON SEQUESTRATION** Strategies that increase the amount of carbon dioxide sequestered through natural resources on campus.

INNOVATION

RESEARCH Strategies that support and expand current climate-related research and solutions.	**EDUCATION** Strategies that advance Georgia Tech's academic programs to prepare staff and students for climate action.

Each focus area provides an overview of the climate action strategies and details how each strategy aligns with:

- United Nations Sustainable Development Goals (UN SDGs): A full overview of how the CAP strategies align with the UN SDGs can be found in Appendix E.
- Institute's strategic plan.
- Georgia Tech's Sustainability Next plan.

How to Read These Pages

PRIORITY

It is important to assess the priority of each strategy for reaching 50% reduction in carbon emissions by 2030 and 100% by 2050. While all strategies are viewed as a priority, some are more urgent than others. Priorities for each strategy are based on emissions reduction potential, broader goals of the Institute, and stakeholder feedback. Stakeholder feedback was collected from students, staff, and faculty during engagement events through polls and comment periods. Priority is indicated by low, medium, and high.

- **HIGH**
- **MEDIUM**
- **LOW**

COST OF IMPLEMENTATION

A cost analysis was developed to estimate expected implementation costs through 2050. Estimated costs are based on assumptions in the GHG model.* Strategies that were not modeled are estimated for cost based on time and resources necessary for successful implementation. The estimated cost for each strategy is indicated by dollar symbols.

- **$$$:** High Cost
- **$$:** Medium Cost
- **$:** Low Cost

TIME FRAME

Strategies will be implemented at varying start dates and require different timelines between 2024 and 2050. Some can be implemented quickly while others require ongoing implementation. Time frames are based on expected implementation dates.

- **Short-term:** by 2030
- **Medium-term:** by 2040
- **Long-term:** by 2050

STRATEGY

Icons indicate if certain criteria were met:

- Strategy modeled for emissions reduction potential.
- Strategy met the criteria for "low-hanging fruit" based on low-cost, high-priority, and high-emission reduction potential.
- Strategy had significant contributions from students or was developed by the student working group.

CUMULATIVE GHG REDUCTION POTENTIAL

Modeled strategies were noted as low, medium, or high for potential emissions reductions by 2050.

- Strategy that resulted in an emissions reduction > 100,000 mt CO_2e.
- Strategy that resulted in emissions reductions between 50,000 and 100,000 mt CO_2e.
- Strategy that resulted in emissions reductions between 0 and 50,000 mt CO_2e.

N/A: Strategy was not modeled since potential GHG reduction is unknown


CLIMATE ACTION STRATEGIES | BUILDING ENERGY

1.1 Transition to electrification of combustion-based heating systems

Priority: HIGH
Estimated Cost: $$$
Time Frame: *Long-term, ongoing*
GHG Reduction Potential:

Building electrification is the process of replacing equipment that relies on the combustion of fossil fuels with technologies that use electricity.

The largest contributor to Georgia Tech's Scope 1 emissions is the burning of natural gas to generate steam and hot water for the purpose of heating buildings and domestic water.

With few exceptions, most of Georgia Tech's campus heat is dependent on the combustion of natural gas.

Approximately half of Georgia Tech's campus heating load is served by steam that is generated at a district or "centralized" heating plant, while the other half is served by local boilers or other gas-fired equipment. While steam is used to transfer heat from the central plant to the buildings, most buildings connected to the central plant shift this to hot water once inside the building — meaning the buildings do not *need* steam, only hot water.

At the same time, building cooling for the main campus is predominantly served by two district chilled water plants that produce and distribute piped chilled water. The process of making chilled water requires the rejection of waste heat via cooling towers. For every ton (12,000Btu/hour) of cooling, the system rejects 15,000Btu/hour of heat into the atmosphere.

By electrifying campus heat generation in the form of large industrial heat pumps, Georgia Tech can recover rejected waste heat from the cooling process and transform it to usable energy to serve the campus heating needs.

Heat pumps will simultaneously produce chilled and hot water, taking full advantage of both sides of the refrigeration cycle, and will be distributed to the campus to serve both the cooling and heating requirements.

This transition can replace over 80% of Georgia Tech's heating load and will operate at an efficiency of about five times greater than that of the current heating systems.

Additionally, minimizing the use of cooling towers to reject heat will save millions of gallons of water annually,

Page 46 Georgia Tech

BUILDING ENERGY

GUIDING PRINCIPLE
We are committed to reaching net-zero emissions by 2050.

ALIGNMENTS

SDGs: 7 Affordable and Clean Energy; 11 Sustainable Cities and Communities; 13 Climate Action

Institute's Strategic Plan:
Lead by Example, Champion Innovation

Sustainability Next:
Lead by Example in the Practice and Culture of Sustainability

Georgia Tech's mission demands a significant amount of energy to power student housing and activities, laboratories, classrooms, maintenance facilities, and other campus buildings. With the student population and campus space expected to increase, Georgia Tech will face higher energy service demands.

The increased demand does not have to result in greater energy consumption. Existing energy-efficient technologies continue to improve and become financially competitive. To take advantage of energy-efficient technologies and optimize campus efficiency, buildings require comprehensive energy management policies that inform capital investment, maintenance upgrades, and operations to maximize efficiency.

The Building Energy focus area combined strategies from the Building Utilities, Resilient Infrastructure, and Student working groups. Strategies were developed and modeled for emissions. The Building Energy focus area included stationary energy, fugitive emissions, and refrigerants that contributed to approximately 78% (158,202 mt CO_2e) of Georgia Tech's total emissions (201,682) in FY 2022.

Building Energy represents the largest source of emissions at Georgia Tech.

The strategies in this section provide pathways for reducing emissions in Scopes 1 and 2.

Notably, Building Energy accounts for 96% of Georgia Tech's Scope 1 emissions, primarily from natural gas used for heating, and 100% of Georgia Tech's current Scope 2 emissions since all purchased electricity is utilized in the built environment.

Picture Credit: Kendeda Building for Innovative Sustainable Design

> **"The Georgia Tech Climate Action Plan transforms the campus infrastructure with more sustainable systems, including electrification of the utilities. The question is not just whether we should invest in the CAP for infrastructure upgrades, but whether we rethink the needed capital improvement we must do anyway and ensure we support our sustainable goals.**
>
> **— Jim Stephens,**
> *Interim Vice President, Infrastructure and Sustainability*

ElectrifyGT

Georgia Tech students are moving the needle on electrification at Georgia Tech.

A team from ElectrifyGT, a student-led club focused on the "economical electrification of Georgia Tech's campus," won first place in the Carbon Reduction Challenge competition during Summer 2023.

Their project was focused on electrifying Georgia Tech's district energy system. The team found that electrifying Georgia Tech's Holland Plant (one of two on-site district energy plants at Georgia Tech) would save 15,000 mt CO_2e each year and result in significant cost savings for the Institute. Since the club's founding in 2022, ElectrifyGT has worked on other projects that led to the implementation of electric landscaping equipment on campus and a pilot program for electric vehicles with the Georgia Tech Police Department.

1.1 Transition to electrification of combustion-based heating systems

Priority: **HIGH**
Estimated Cost: **$$$**
Time Frame: *Long-term, ongoing*

GHG Reduction Potential:

Building electrification is the process of replacing equipment that relies on the combustion of fossil fuels with technologies that use electricity.

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Heat pumps will simultaneously produce chilled and hot water, taking full advantage of both sides of the refrigeration cycle, and will be distributed to the campus to serve both the cooling and heating requirements.

This transition can replace over 80% of Georgia Tech's heating load and will operate at an efficiency of about five times greater than that of the current heating systems.

Additionally, minimizing the use of cooling towers to reject heat will save millions of gallons of water annually, as cooling towers currently account for approximately 100 million gallons of water use each year, making it the largest use of potable water on campus.

Further, mitigation of Scope 1 emissions related to campus heating can be achieved through ground source heat pumps, air source heat pumps, sewage heat exchange, and/or renewable natural gas. Electrification can eliminate Scope 1 emissions from campus heating systems related to combustion.

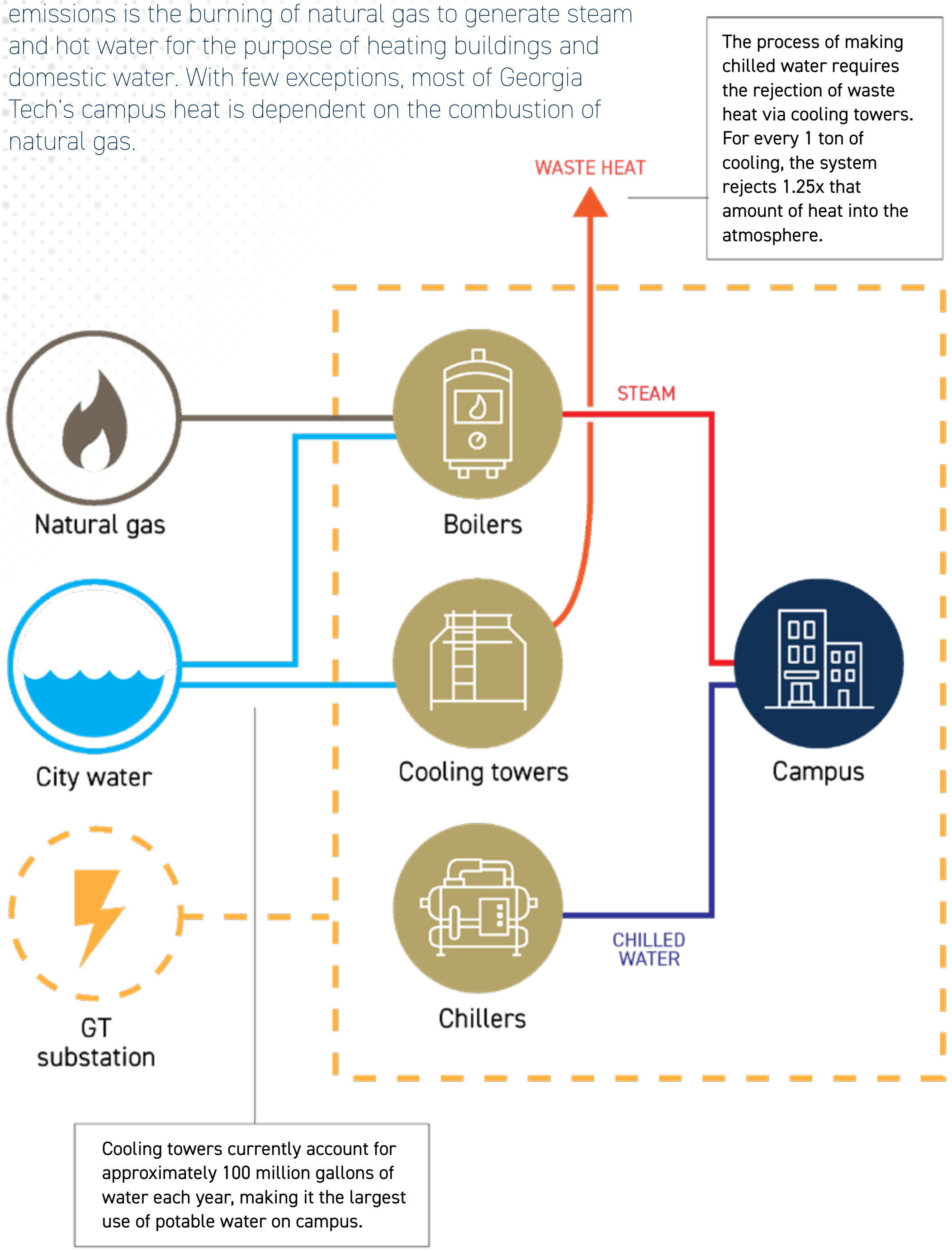
In doing so, this strategy prioritizes emissions that Georgia Tech most directly controls (Scope 1) and leverages the decarbonization of the grid (Scope 2) so that carbon savings increase over the life of the systems. In addition, electrification allows for the renewal of both the campus heating and cooling systems that need upgrades. Since refrigerants are a substantial portion of the campus reported stationary emissions, system upgrades also provide an opportunity to transition to refrigerants with lower global warming potential.

> **"Climate Action Plan modeling demonstrates that electrification of campus heating systems is the single most effective strategy that Georgia Tech can employ to reach its goal of zero emissions. When considering the cost savings inherent in the use of waste heat and the need for infrastructure renewal, I believe this can be accomplished in a cost-neutral manner over a 20-year period while providing safer, more resilient, and more maintainable systems that serve as an example to our peers and our region.**
>
> **— Greg Spiro,**
> *Interim Executive Director, Infrastructure and Sustainability*

FIGURE 8: ELECTRIFICATION OF COMBUSTION-BASED HEATING SYSTEMS

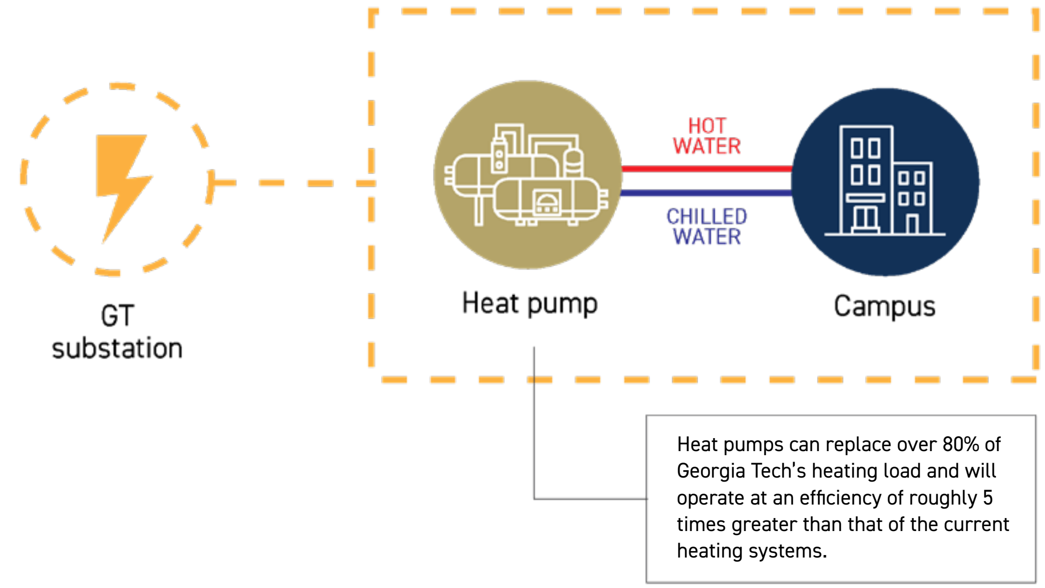
Current State

The largest contributor to Georgia Tech's Scope 1 emissions is the burning of natural gas to generate steam and hot water for the purpose of heating buildings and domestic water. With few exceptions, most of Georgia Tech's campus heat is dependent on the combustion of natural gas.



Future State

By electrifying campus heat generation in the form of large industrial heat pumps, Georgia Tech can recover rejected waste heat from the cooling process and transform it to usable energy to serve the campus heating needs. Heat pumps will simultaniously produce chilled and hot water, taking full advantage of both sides of the refrigeration cycle and distributed to the campus to serve both the cooling and heating requirements.



1.2 Increase operational energy efficiency and conservation

Priority: HIGH
Estimated Cost: $
Time Frame: *Medium-term, ongoing*
GHG Reduction Potential:

This strategy includes benchmarking, evaluating, prioritizing, and implementing Energy Conservation Measures (ECM) to decrease Energy Use Intensity (EUI) and increase operational efficiencies in existing infrastructure.

It also entails establishing an ongoing commissioning program, which is a process for using real-time or near real-time data to continuously monitor both the physical components of an energy system and the human behavior needed to optimize energy use.

Energy Use Intensity (EUI)

Energy Use Intensity (EUI) is the national recommended benchmark for building performance. EUI = Energy Use (kbtu)/Square Footage.

U.S. EPA and U.S. DOE. (2023). U.S. energy use intensity by property type. Energy STAR Portfolio Manager. portfoliomanager.energystar.gov/pdf/reference/US%20National%20Median%20Table.pdf

Such monitoring enables quicker diagnostics and fault detection so that problems can be solved quickly, saving money, and improving the comfort and well-being of the campus community. Implementing this strategy will enhance current energy systems, increase cost savings, and reduce GHG emissions.

As an urban campus, space efficiency is essential to Georgia Tech's growth in education and research. Currently, Georgia Tech is working toward modifying workspaces to support more remote and hybrid work, which has shifted the operational needs within buildings. This strategy will also help optimize space to reduce emissions, energy, and water use.

The International Organization for Standardization (ISO) 50001 Energy Management Standard, a globally recognized guide for increasing energy efficiency, will be used to help advance energy efficiency.[1] This includes developing an energy policy and implementing an Energy Management System (EMS) to ensure efficient use of resources, space, and infrastructure.

An energy policy will help increase Georgia Tech's building resiliency and support efforts to design, construct, operate, and maintain infrastructure and operating systems to achieve cost savings.

In addition, it will help reduce demand for potable water by reducing the amount of water needed to create steam for heating.

An EMS will help define governance structure based on a plan/do/check/act cycle for the entire building portfolio independent of operational ownership. The system creates a reporting structure with clearly defined roles and responsibilities in which performance is evaluated and reported to leadership, and resources are committed to ensure success.

1 Georgia Tech's Enterprise Innovation Institute/Georgia Manufacturing Extension Partnership is home to subject matter experts who helped develop the ISO 50001 standard and implemented it throughout the state of Georgia.

1.3 Develop standards for decarbonizing new buildings and renovations on campus

Priority: HIGH
Estimated Cost: $
Time Frame: *Short-term*

GHG Reduction Potential:

Prioritizing energy efficiency in the design of new buildings and renovations of existing buildings is important for ensuring the optimal use of resources, saving money over the lifetime of the building, and increasing the environmental health of buildings.

This strategy proposes standards that meet or exceed Leadership in Energy and Environmental Design (LEED) certification requirements. Key actions include evaluating industry best practice frameworks, such as Passive House, LEED, and the Living Building Challenge, to develop or adopt standards best suited to Georgia Tech. This strategy would also include developing standards specific to laboratories informed by Georgia Tech's current participation in the Guaranteed Energy Savings Performance Contract Smartlab program.

The best time to plan for energy efficiency is prior to construction.

Prioritizing energy efficiency standards and certifications during planning and design prevents difficult and costly retrofits down the road, while enabling operational energy savings to begin early in a building's life cycle. While Georgia Tech is already committed to achieving LEED Gold certification for new construction and major renovation projects, this strategy builds a stronger foundation for ensuring elevated levels of energy and water efficiency that will also reduce operating costs in the long term.

Energy Efficiency in The Kendeda Building for Innovative Sustainable Design

The Kendeda outdoor air handler (with heat recovery, demand-controlled ventilation, and overhead fans) was designed to rigorous building standards through the International Living Future Institute's Living Building Challenge. Some of the building's energy efficiency measures include a high performing envelope consistent with passive house principles including triple pane glass, a water source heat pump connected to the campus chilled water system, a dedicated range of comfort control, and a radiant floor system.

These measures have resulted in an 18 kBTU/square foot/year energy use intensity (EUI) without including the building's on-site solar, which makes the building **80% more efficient than a comparable new, conventionally built higher education building in Atlanta.** When including the on-site solar, the building produced more power than it consumed by a factor of 200% in 2022.

1.4 Invest in targeted renewal for existing buildings

Priority: HIGH
Estimated Cost: $$*
Time Frame: *Long-term, ongoing*

GHG Reduction Potential:

*Accounted for through regular annual maintenance upgrades.

Targeted deferred renewal in buildings addresses buildings that have deferred maintenance over time. It refers to the replacement or refurbishment of assets that have exceeded their useful life.

The importance of targeted renewal cannot be underestimated. This strategy is a high priority because it not only contributes to reaching net-zero emissions, but it is also critical to ensuring that Georgia Tech has state-of-the-art buildings to support its research and education priorities and needs across the Institute.

This strategy highlights the important connection between deferred renewal and climate action. It links Strategies 1.1 and 1.3 to ensure responsible use of the Institute's resources and ensures that Georgia Tech is providing safe and healthy buildings to stakeholders.

Implementation of this strategy includes developing a systemwide plan to guide the order in which infrastructure needs to be improved and identifies the funding and capital needs to execute renewal for deferred maintenance. While it requires significant upfront funding, the long-term savings and return on investment are positive.

1.5 Engage students in GHG reduction and climate action efforts in campus operations

Priority: **HIGH**

GHG Reduction Potential: N/A

Estimated Cost: $

Time Frame: *Short-term, ongoing*

Students at Georgia Tech support and want to be engaged in actions that reduce GHG emissions from campus operations.

Part of strengthening student-administration relationships includes communicating progress on emissions reductions and modeling for future projects that promote and improve energy sovereignty. This strategy involves engaging students as a key stakeholder in conversations around energy usage and sourcing on campus. It includes working with students to guide campus behavioral changes around energy and engaging students to provide suggestions for energy efficiency improvements.

It also supports the Living Campus initiative in increasing opportunities for students to use campus as a living laboratory for academic and research projects.

> **"As a student, I see climate action at Georgia Tech as vital for securing our future. It is an opportunity to engage, advocate, and equip students with knowledge and skills relevant to our careers. Georgia Tech's commitment to sustainability aligns with our sense of social responsibility, encourages innovation, and offers a platform for collaboration, fostering a more engaged and empowered student community.**
>
> **— Athena Verghis,**
> *Graduate Student, Student Government Association*

BUILDING ENERGY: Measures of Success

TABLE 2: BUILDING ENERGY MEASURES OF SUCCESS

MEASURE	2030	2040	2050
Percentage of electrified buildings not connected to the centralized campus heating and cooling system	10% of non-district buildings	60% of non-district buildings	100% of buildings
Percentage of heating and chilling equipment in district energy systems electrified	10% of chillers and coolers	60% of chillers and coolers	100% of chillers and coolers
Implement an energy policy and EMS	✓		
Develop and implement standards that promote low energy buildings	✓		
Reduce EUI in buildings	Reduce campus EUI 10%	Reduce campus EUI 15%	Reduce campus EUI 20%