



The University of North Carolina at  
Chapel Hill

# Strategic Energy & Water Plan – FY24

Prepared by George Jacobs, PE

UNCCH Facilities, Engineering Services, Energy Management

9/1/23



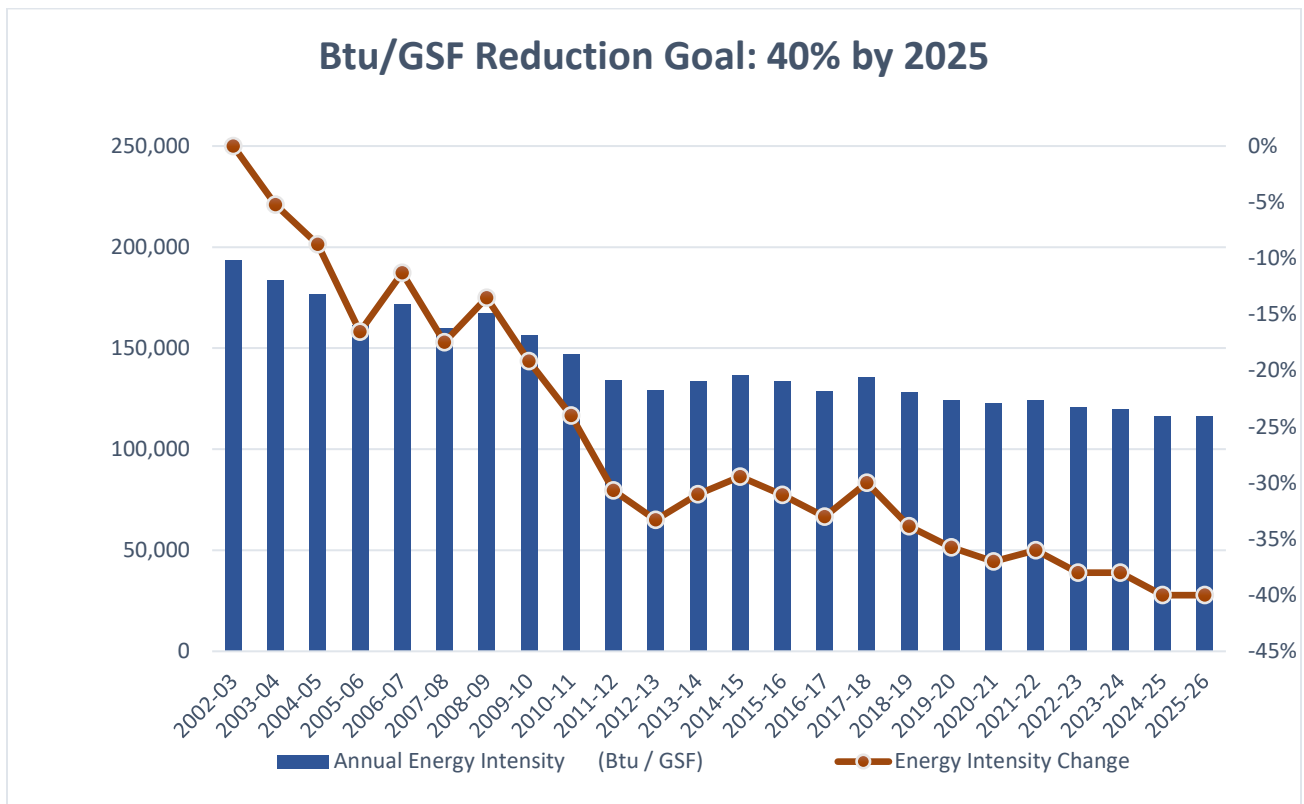
THE UNIVERSITY  
*of* NORTH CAROLINA  
*at* CHAPEL HILL

## Overview

The Strategic Energy and Water Plan is a requirement of NC GS 143-64.12. (a). This legislation includes a past goal of 30% reduction of energy consumption per gross square foot for all State buildings by 2015 based on energy consumption for FY2003. UNCCH achieved this mandated goal and has continued to show annual energy reductions ranging between 31% and 38%. These efforts have resulted in an impressive \$628,000,000 of cumulative avoided energy cost since FY2003 for UNCCH.

To encourage increased energy savings, the UNC System has established a new goal of 40% reduction of energy consumption per gross square foot by 2025 based on energy consumption for FY2003. This is a voluntary goal with no current legislative requirements. This goal aligns with the Governor’s Executive Order 80, requiring a 40% reduction of energy consumption for all Cabinet Agencies. The goal also aligns with filed HB 330 (2019-20 Session) that remains in committee review. The purpose of the Strategic Energy and Water Plan is to identify strategies for achieving the 40% reduction goal including outreach programs, energy conservation measures, design guidelines, and alternative energy sources. The plan also includes cost estimates and energy savings analysis.

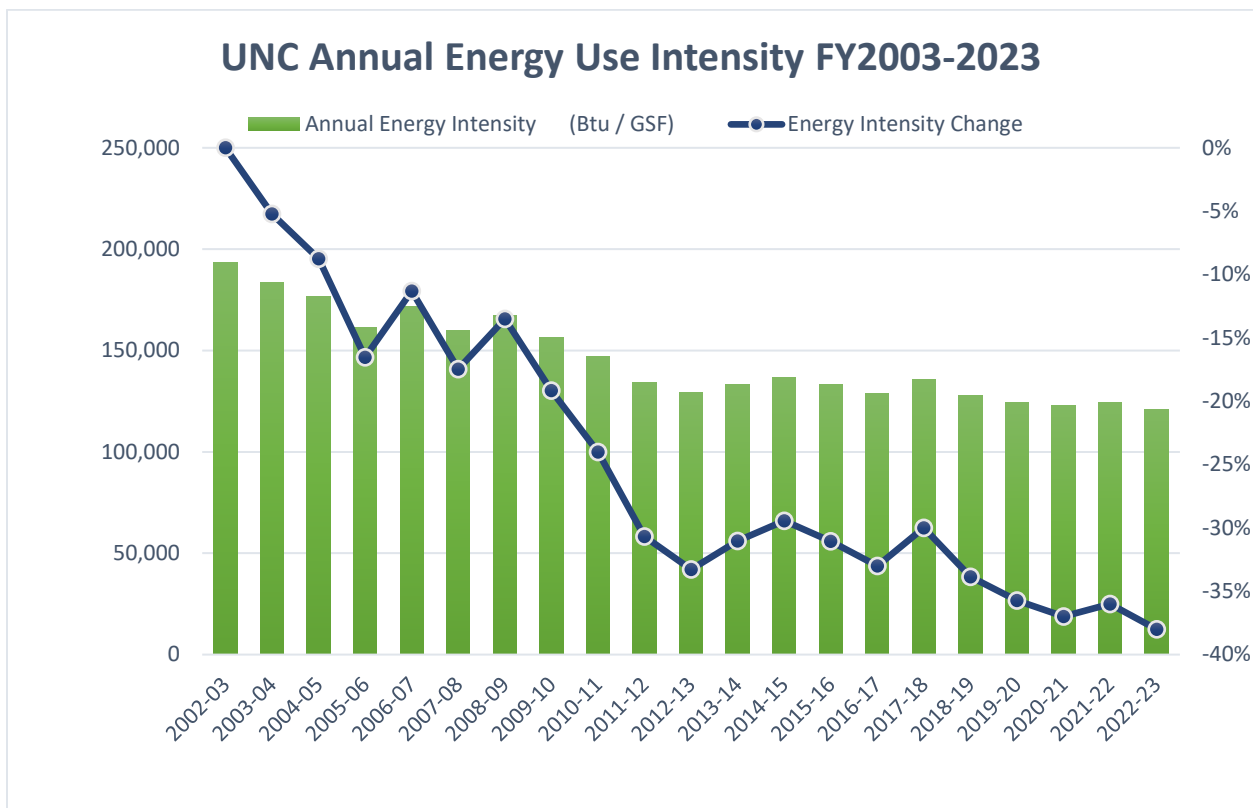
The graph below demonstrates the campus Btu/GSF to achieve the 40% reduction goal.

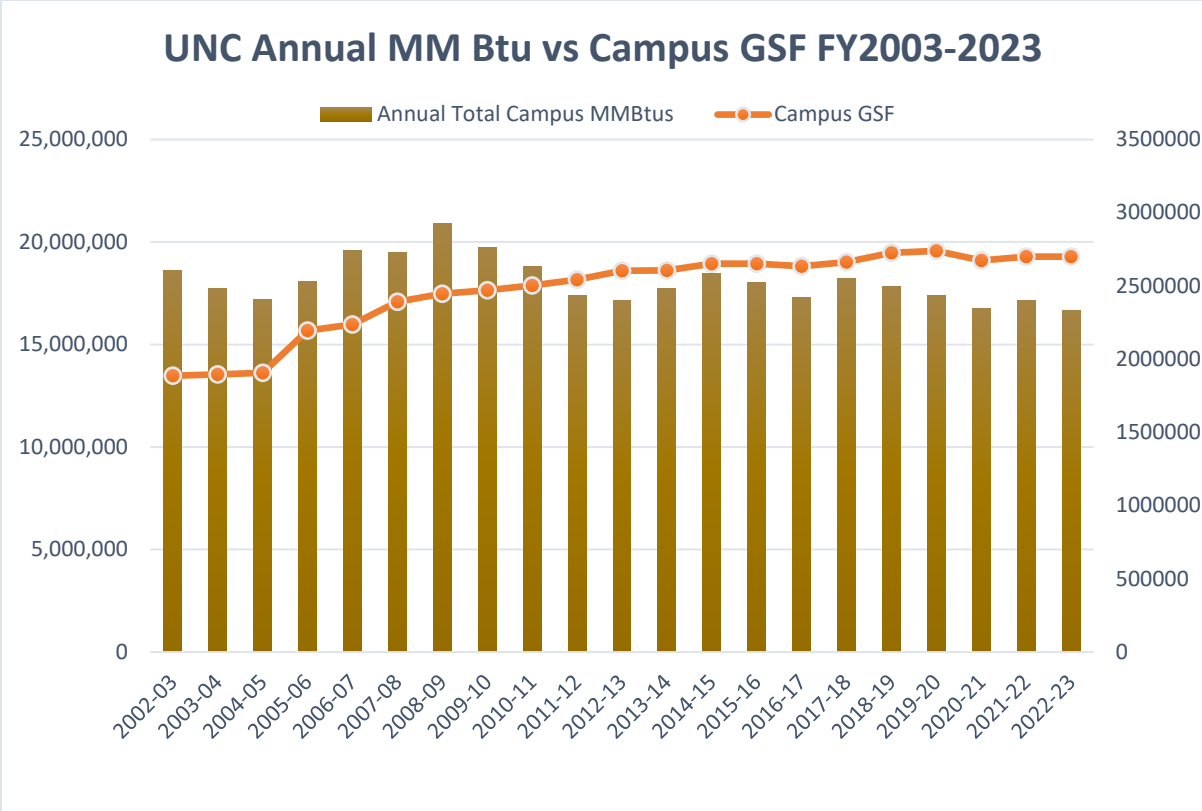


## FY23 Energy and Water Report Metrics and Trends

### Energy Usage

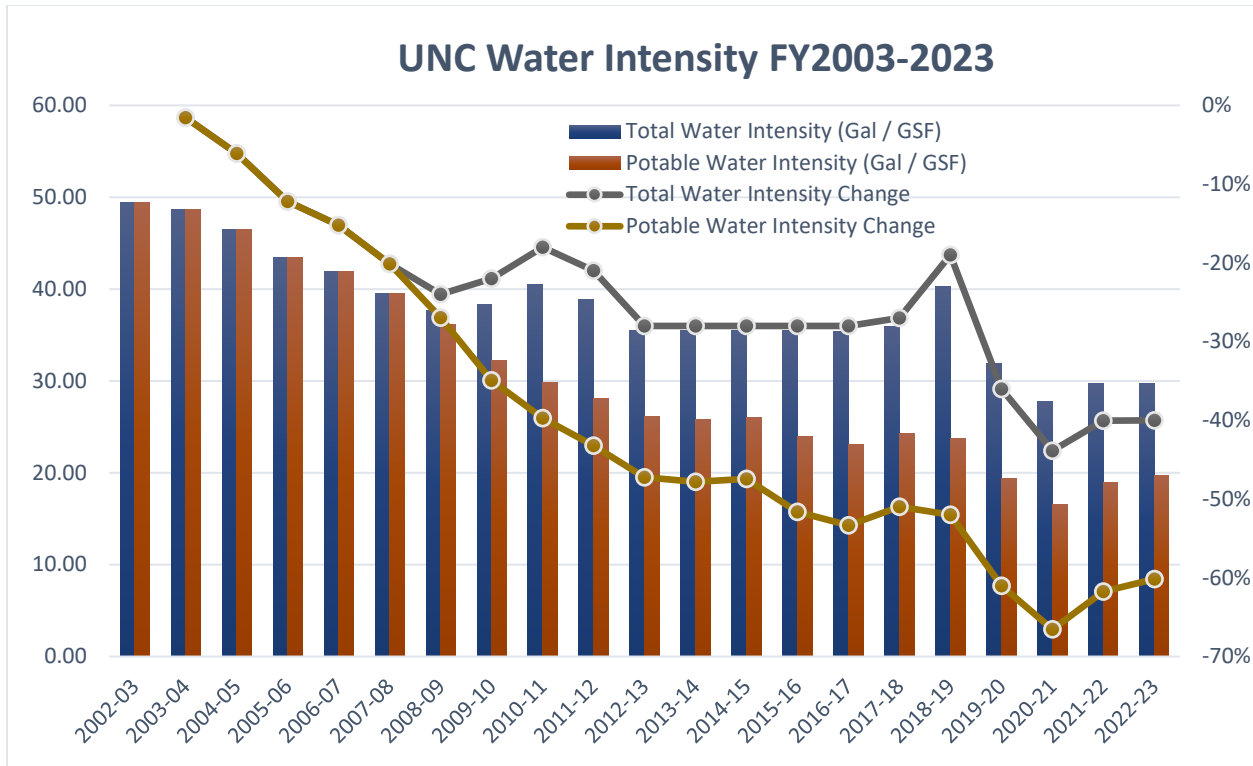
For FY23 Energy and Water Reporting, the University of North Carolina at Chapel Hill campus consisted of 417 buildings with a combined building area of 19,285,404 gross square feet. For FY23, the total campus energy consumption is 2,327,151,395,993 Btu. Energy consumption per gross square foot is 120,699 Btu/GSF; a 38% decrease from FY03 energy consumption of 193,500 Btu/GSF. For base reporting year FY03, the total energy consumption was 2,607,938,628,500 Btu for a campus size of 13,477,719 GSF. Although the campus has experienced a building GSF growth of about 43% since FY03, the overall campus energy consumption has decreased by 11%.





**Water Usage**

Potable water use for FY23 is 380,113,000 gallons. Potable water consumption per gross square foot is 19.71 gallons/GSF; a 60% decrease from FY03 potable water consumption of 49.48 gallons/GSF. The reduction in potable water use is a result of installation of low flow fixtures in restrooms, installation of domestic water cooling controls on autoclaves, replacement of domestic water cooled steam stills with RO water systems, increased use of non-potable water from the Reclaim Water utility on campus and the use of captured rainwater and condensate from cistern storage. The Reclaim Water utility became available in FY09 and use of this utility has increased from 27,054 gallons in FY09 to 191,754 in FY23. Post Covid Pandemic overall decreased occupancy in campus buildings has also impacted water consumption contributing to reductions in overall water use, both potable and non-potable.



## FY23 Strategies

### Ongoing Initiatives

**Low Cost ECMs and Monthly Monitoring of Building Energy Use.** Energy Management has implemented low cost ECMs in 150 major buildings on campus. These 150 buildings represent about 12,000,000 GSF or about 62% of the total campus GSF. Energy Management generates monthly energy forecast reports for these 150 buildings to identify higher than expected energy use by utility allowing for more timely intervention. Maintenance issues are addressed through the maintenance work order system. Other continued low performers are targeted for retro-commissioning opportunities, including improved control sequences, tuning of control loops, and calibration of sensors. Based on our forecasting model for FY23, this initiative contributed to an avoided energy cost of \$1.7M and avoided energy usage of 109,376,078,000 Btus.

**Winter Break.** The University conducted its annual Winter Break Saving Initiative that focuses on aggressive scheduling of buildings during the 10-day campus closure (Dec 23 – Jan 1).

**Target EUIs for Buildings by Type.** Energy Management participated with a UNCCH capstone project in FY20 to establish target EUIs for each of the building types on campus. This will be another energy analysis tool that will help identify low energy performers creating a more targeted and coordinated approach to defining and implementing ECMs in low performing buildings. Energy Management is also hoping this will be useful tool in selling the value of including energy improvement components in capital projects, including Repair and Renovation projects. Energy Management is planning to make greater use of this analysis during FY24.

***New Building Construction/Major Building Renovation.*** New buildings and major building renovations on campus require designs to meet the Performance Standards for Sustainable, Energy-Efficient Public Buildings (NCGS 143-135.35-40). Designers are required to model the buildings for energy performance and to evaluate life cycle costs of building/energy systems that result in energy savings over the life of the building. The UNCCH team is actively engaged with energy performance throughout the design and construction process, including comprehensive commissioning of the building envelope, building HVAC control systems, and building electrical systems. The Medical Education Building (Roper Hall) is nearing completion with a designed EUI target of 104 Btu/GSF. This target EUI falls within our campus target EUI of 116 Btu/GSF to meet the 2025 goal.

***Campus Engagement.*** Energy Management is actively engaged in many outreach programs on campus, including participation in new student orientation, Green Labs, UNCCH Housing Sustainability, UNCCH Three Zeros, RESPC Student Green Fee Organization, student Capstone projects, and student interns through the EcoStudios program and the Sustainable Triangle Field Site (STSF) programs. The programs allow UNCCH Energy Management to educate campus partners about energy savings opportunities and to assist groups with implementing changes that result in energy reduction. It would be very challenging to calculate energy savings specific to these efforts; however, UNCCH Energy Management believes engaging with campus partners is impactful and helps gain support of other initiatives.

## **Energy Projects**

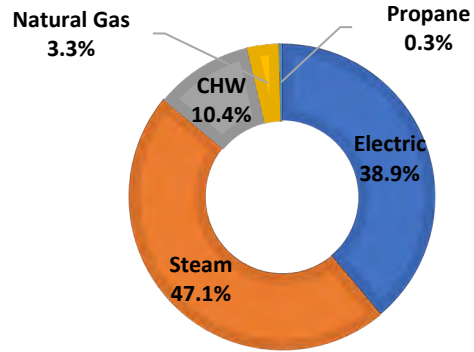
For FY24, UNCCH is utilizing 1292 funds to implement three energy projects: Thurston Bowles Building Air Flow Reduction, Taylor Hall Air Flow Reduction, and Chapman Hall Air Flow Reduction. As part of a revised budget model, Energy Management is hoping to have access to future annual 1292 funds to target energy projects.

## ***Campus Utilities***

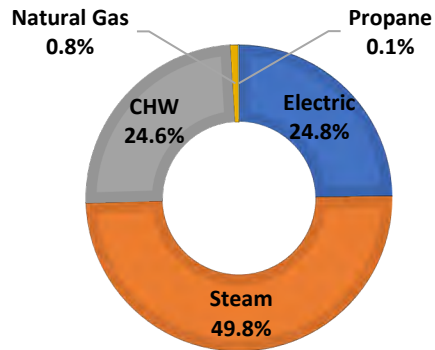
### **Energy**

***Consumption and Cost by Energy Type.*** Energy on the UNCCH campus is supplied by UNCCH Energy Services and consists of electricity, district chilled water, district steam, natural gas, and propane. The campus electricity is sourced from Duke Energy Carolinas and the UNCCH Co-Gen plant. Each utility is metered at the building level with a few exceptions for steam to hot water convertors that serve multiple buildings. UNCCH Energy Services establishes the billing rates for these utilities. For FY23 energy consumption by category, cost, and unit cost are demonstrated in the following graphs.

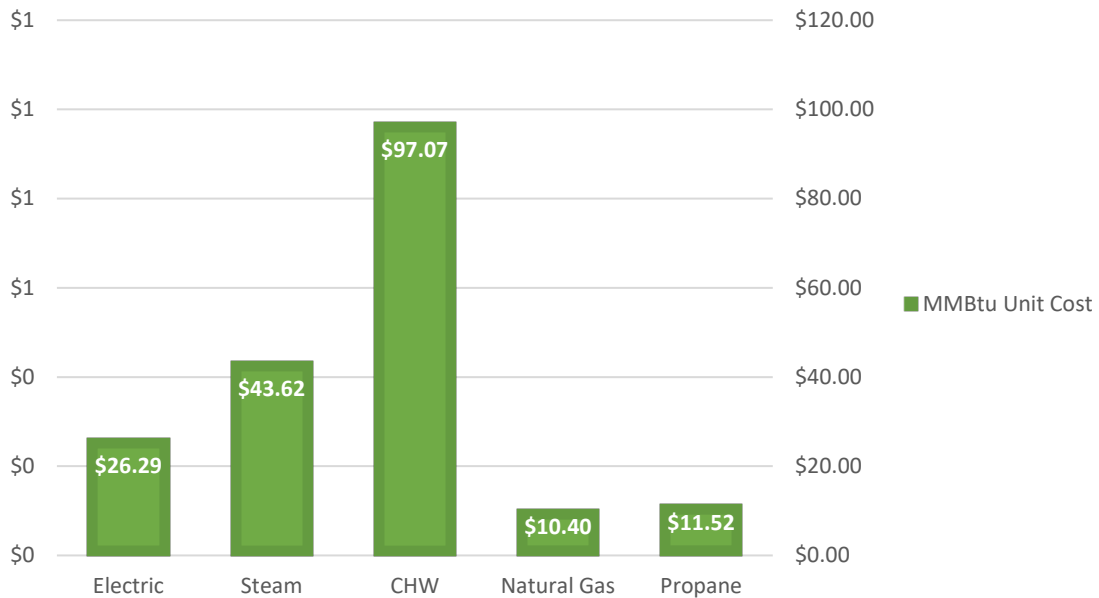
### ENERGY CONSUMPTION BY UTILITY (% OF TOTAL BTU)



### ENERGY COST BY UTILITY (% OF TOTAL COST)



### UNIT ENERGY COST BY UTILITY (\$/MMBTU)



**Renewable Energy Projects.** UNCCH Energy Services has several active renewable energy projects. The largest of these active projects is the installation of a ground mounted solar array, 376 kW. The planned battery storage component of the project has been removed from the current scope due to budget constraints. Project includes provisions for future battery storage. This project is sited on the Carolina North campus and connected to the electric grid that supplies power to the current north campus buildings. Construction of this project is scheduled to begin FY24 with completion slated for FY25. The other two renewable projects are the more traditional rooftop solar arrays planned for Friday Center (70.7 kW) and the Carroll Hall Addition (25.2 kW) projects. These two projects are being funded through RESPC, the student green fund organization. The UNCCH Kenan Flagler Business School is actively seeking renewal energy options as part of the design of the Business School Addition. The design team is pursuing an aggressive EUI target of 46.4 with expectations of further reductions from the use of rooftop solar, an estimated 484 kW combined.

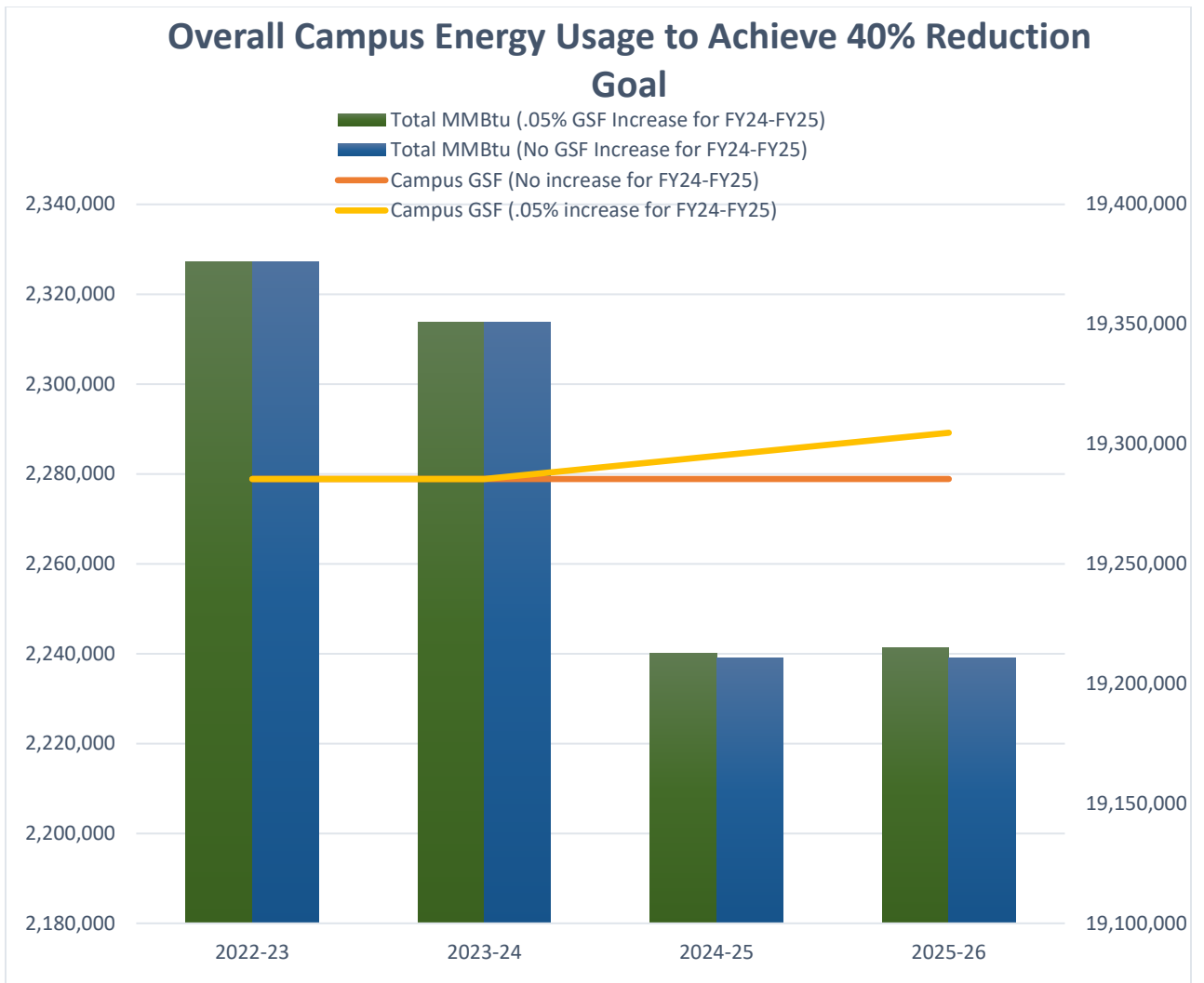
## **Water**

Water, reclaim water, and sanitary sewer utilities are provided by Orange Water and Sewer Authority (OWASA); however, these utilities are managed and billed by UNCCH Energy Services. In FY20, OWASA provided UNCCH with water analytics software, Aqua Vista, that provides interval water use data that can be trended and used for notifications, including leak detection. UNCCH Energy Services and UNCCH Energy Management have started using this analytic tool to provide earlier detection of water leaks and to identify high water consumers in different user categories. This tool appears to have high potential for providing timely information that can lead to decreased water consumption. UNCCH Energy Services and UNCCH Energy Management have partnered with student interns over the past five semesters to perform some initial analysis of the data.

## ***FY25 Goal of 40% Reduction in Energy Consumption per GSF***

The FY25 goal of 40% reduction in energy consumption per gross square foot from base year FY03 is equivalent to 116100 Btu/GSF and represents an estimated \$52.7M avoided energy cost for FY25. The new Medical Education Building (Roper Hall) is coming online in FY24 generating an increase of 176,000 to the overall campus GSF of building area. Assuming a campus growth of 0.05% per year for FY24 and FY25, the overall campus Btu in FY25 must not exceed 2,282,731 MMBtu to meet the goal of 116100 Btu/GSF. Graphs below show projections and values to meet the FY25 goal.





In identifying strategies to achieve the 40% goal, this report assumes no increased building SF as a conservative approach in establishing the required reduction in energy usage. Even though the ongoing initiatives listed earlier in the report will still be pursued, this section identifies specific efforts and projects.

### Strategies

**LED Lighting Upgrades.** UNCCH is continuing to convert campus lighting to LED. LED fixtures are standard for new construction, including small upfit projects across campus. Exterior lighting has been a prime focus with about 97% conversion to LED lamps. Work on a Campus LED Master Plan has been deferred because of limited staff resources although specific projects are still being pursued. UNCCH Transportation has a LED Master Plan for Parking Decks and Surface Lots and multiple LED lighting retrofit projects in design and construction. Three parking decks were completed in FY21 and a fourth deck retrofit was bid in FY23. The completed LED lighting projects for the parking decks have demonstrated significant energy savings of approximately 50%. Other LED lighting retrofit projects being planned are conversion of T5 fluorescent to LED and T8 fluorescent to LED. UNCCH Energy Management

has mentored several student interns that evaluated LED retrofit projects. In the current product market, their evaluation indicated the use of LED direct replacement lamps in newer fixtures provided the shortest payback period and allowed for flexibility of installation by in-house staff. Several of these types of LED retrofits appear in the project list across all years.

***Focus on Steam Use Reduction in Lab Buildings.*** Steam use on the UNCCH campus accounts for almost 50% of the campus energy consumption and about 50% of the campus energy cost by utility. Since it is also a significant contributor to GHG emissions, focusing on reducing use of this utility has good potential for energy savings and GHG emission reductions. The UNCCH campus supports significant research in energy intensive laboratories. About one-third of the campus steam usage is consumed by 20 of these laboratory buildings. Current efforts to reduce steam usage in these buildings include retrofitting steam sterilizers (autoclaves) with scheduling programs, identifying steam stills that can be replaced with more energy efficient RO/DI systems, and checking for leak by on steam valves. UNCCH also operates an in-house steam trap inspection and repair program that inspects each building once per year. UNCCH Energy Management estimates these efforts will result in a 10% reduction in steam usage for 22 targeted lab buildings, representing about 23,770 MMBtu of steam reduction. The autoclave retrofit with scheduling function is being funded by the student green fee group (RESPC). Autoclave scheduling retrofits have been completed in three lab buildings with a measurable impact.

***Airflow Reduction in Lab Buildings.*** Many of the older research labs on campus are operating with air change rates more than 9 air changes per hour (ACH). This ventilation rate requires a tremendous amount of energy to heat/cool/dehumidify the single pass outside air requirement. Current lab standards consider 6 ACH to provide for safe working environments. UNCCH Energy Management and UNCCH Environmental Health & Safety have been partnering to identify lab buildings where airflow reduction projects are feasible and impactful on energy use reductions. For FY24, UNCCH secured 1292 funds for implementing airflow reduction projects in three campus buildings: Thurston Bowles Building, Taylor Hall, and Chapman Hall. Thurston Bowles Building and Taylor Hall projects are currently under construction with completion scheduled for mid to late FY24. The Covid Pandemic has greatly impacted manufacturing and supply chains resulting in significant project cost escalations creating continued holds on some projects, including three future projects planned for Lineberger Cancer Research Center, Glaxo Research Building, and Fordham Hall. The three current projects represent an estimated energy reduction of 38,726,385 kBtu and the three planned projects an estimated reduction of 23,811,338 kBtu. One of these buildings, Lineberger Cancer Research Center, has been funded with FY23 1292 funds and is presently entering the design phase.

***Expanded HVAC Scheduling in Athletic Buildings.*** Athletic buildings have sporadic occupancy scheduling based on the nature of the activities occurring in these buildings. As such, it is very challenging to establish fixed occupancy scheduling for HVAC equipment setbacks and shutdowns. UNCCH Energy Management is investigating opportunities to use interactive occupant scheduling tool that provides scheduling information to the BAS to establish unoccupied hours for these buildings. Events to HVAC is one brand of this type of occupant scheduling tool and it is being successfully used at the Student Activity Center on campus. For Fall Semester 2023, Energy Management is hosting an EcoStudio Student Intern that will be investigating impact of HVAC scheduling in the Athletic Buildings as their study project. As UNCCH Energy Management develops more detailed scope, these projects/initiatives will be added to each year's project list.

**HVAC Building Controls Upgrades.** A significant number of buildings on campus have outdated HVAC control systems. The oldest of these are pneumatic control systems with no remote visibility. There is also older direct digital control (DDC) based systems that are obsolete and no longer supported by the vendor. These older software systems are also not compatible with newer Windows operating systems and are presenting numerous IT challenges. UNCCH has partial funding to implement this upgrade. Design work began in FY21, and the first phase of the project will be controls upgrades for Lineberger Cancer Research Center, McGavran-Greenberg Hall, and Aycock Family Medical Center. Construction is scheduled to begin in FY24. Installation of updated controllers, gateways, and software provides expanded opportunities for energy savings through programming of the building automation system, enhanced trending, and enhanced remote graphics. As UNCCH Energy Management develops more detailed scope, these projects/initiatives will be added to each year’s project list.

**Building Controls Optimization.** Utilizing in-house resources and expertise UNCCH Energy Management can assess building controls operation and strategies then implement modifications to optimize operation of building HVAC systems with respect to energy consumption.

**FY23 Project Status**

<b>FY23</b>	<b>Reduction in Usage</b>					
<b>HVAC Projects</b>	<b>Steam (klbs)</b>	<b>CW (ton-hrs)</b>	<b>Electric (kWh)</b>	<b>Btu Reduction</b>	<b>Project Cost</b>	<b>Status</b>
<b>Energy Management Programs</b>						
Building Optimization	18724	3187859	22746541	109,376,077,869	NA	on going
<b>Steam Reduction</b>						
10% Steam Usage Reduction - 22 Target Buildings	21,942			<u>28,556,635,320</u>	NA	on going
				137,932,713,189	NA	
<b>Notes</b>						
1. Steam reduction will focus on repairs and calibrations many to be accomplished through maintenance budget						

## FY24 Projects

FY24	Reduction in Usage				Project Cost	Status
HVAC Projects	Steam (klbs)	CW (ton-hrs)	Electric (kWh)	Btu Reduction	Project Cost	Status
Thurston Bowles - Air Flow Reduction	5160	1272413	3009847	19,937,333,310	\$2,477,000	Funding Approved - FY22 1292
Taylor - Airflow Reduction	1378	339677	644967	4,782,144,272	\$1,658,000	Funding Approved - FY22 1292
Chapman - Air Flow Reduction	6965	713036	1042677	14,276,640,430	\$616,700	Funding Approved - FY22 1292
<b>Energy Management Programs</b>						
Building Optimization	18724	3187859	22746541	109,376,077,869	NA	on going
<b>Steam Reduction</b>						
Autoclave Scheduling	3,848	172,336	520108	7,182,733,743	\$70,000	Pending Approval - Possible Student Green Fee
10% Steam Usage Reduction - 22 Target Buildings	18,264			23,769,865,440	NA	on going
<b>LED Lighting Projects</b>						
Genetic Medicine: T5 Fluorescent to LED			839020	2,862,736,240	\$190,000	Funded by Sustainable Carolina
Jackson Parking Deck			241516.8	<u>824,055,322</u>	<u>\$500,000</u>	Funded by Parking & Transportation
				183,011,586,627	\$5,511,700	
<b>Notes</b>						
1. Steam reduction will focus on repairs and calibrations many to be accomplished through maintenance budget						

## FY25 Projects

FY25	Reduction in Usage				Project Cost	Status
HVAC Projects	Steam (klbs)	CW (ton-hrs)	Electric (kWh)	Btu Reduction	Project Cost	Status
Lineberger - Airflow Reduction	8229	439168	487405	13,391,680,227	\$2,700,000	Funding Approved - FY23 1292
<b>Energy Management Programs</b>						
Building Optimization	18724	3187859	22746541	109,376,077,869	NA	on going
<b>LED Lighting Projects</b>						
Caudill Labs: T5 Fluorescent to LED			328320	<u>1,120,227,840</u>	<u>\$54,300</u>	Targeting Sustainable Carolina Fund
				123,887,985,936	\$2,754,300	

## FY26 Projects

FY26	Reduction in Usage					
HVAC Projects	Steam (klbs)	CW (ton-hrs)	Electric (kWh)	Btu Reduction	Project Cost	Status
Fordham Hall - Controls Upgrade & Airflow Reduction	875	215694	980260	4,958,846,981	\$1,619,000	Targeting FY25 1292 Funds
Carroll Hall - VAV Zone Control Upgrades	535	182365	128773	1,537,614,755	\$1,040,000	Targeting FY25 1292 Funds
Tate-Turner-Kuralt - Add VFDs to HW System			17141	58,485,092	\$27,000	Targeting FY25 1292 Funds
MBRL/Glaxo - Glaxo Airflow Reduction	3128	198196	294237	5,534,749,955	\$1,208,600	Targeting FY25 1292 Funds
<b>Energy Management Programs</b>						
Building Optimization	18724	3187859	22746541	109,376,077,869	NA	on going
<b>LED Lighting Projects</b>						
House Undergrad Library			596951	2,036,796,812	\$62,300	Targeting FY25 1292 Funds
Health Sciences Library			563890	1,923,992,680	\$78,400	Targeting FY25 1292 Funds
Sitterson			1566960	5,346,467,520	\$410,000	Targeting FY25 1292 Funds
				130,773,031,666	\$4,445,300	

## FY27 Projects

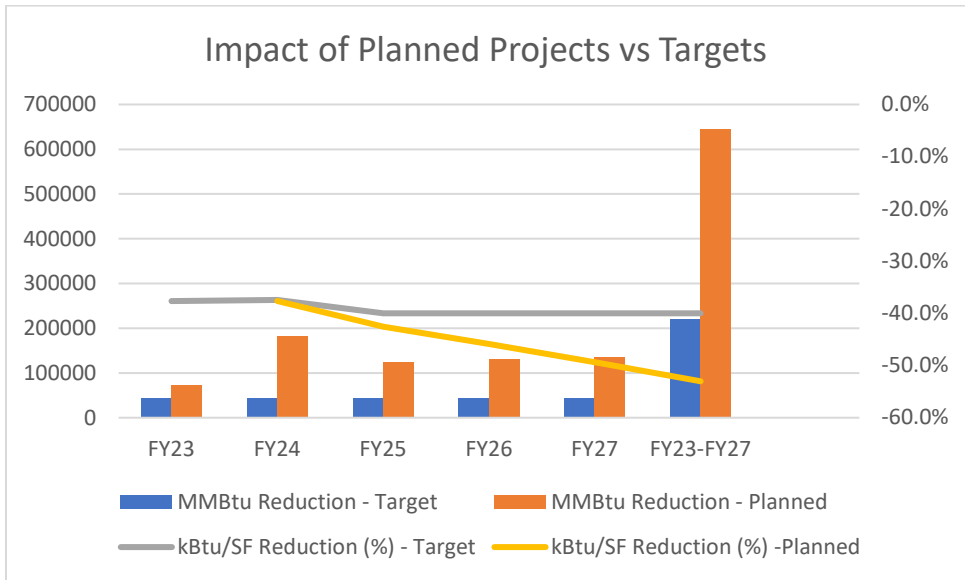
FY27	Reduction in Usage						
HVAC Projects	Steam (klbs)	CW (ton-hrs)	Electric (kWh)	Btu Reduction	Project Cost	Status	
McGavran Greenburg - Heat Recovery Replacement	1972	26261	-53122	2,443,110,092	\$703,600	Targeting FY26 1292 Funds	
Genome Science RetroCx	1536.2	287542.1	689685.4	4,986,295,932	TBD	Targeting FY26 1292 Funds	
Kenan Labs - Airflow Reduction (Lower Floor)	3364	335491	223506	5,880,187,071	TBD	Targeting FY26 1292 Funds	
Koury Oral Health RetroCx	972.1	166608.3	8330.415	1,660,802,660	TBD	Targeting FY26 1292 Funds	
Tarrson - Controls Upgrade	147	50027	110851	685,608,876	\$1,170,000	Targeting FY26 1292 Funds	
Jackson Hall Controls Upgrade	1344	137614	87098	2,365,627,114	\$364,000	Targeting FY26 1292 Funds	
Ackland Art Museum Controls Upgrade	469	80084	262287	1,691,115,677	\$199,600	Targeting FY26 1292 Funds	
Burnett-Womack Duct Sealing	228	12816	79638	598,192,907	\$62,357	Targeting FY26 1292 Funds	
<b>Energy Management Programs</b>							
Building Optimization	18724	3187859	22746541	109,376,077,869	NA	on going	
<b>LED Lighting Projects</b>							
Admin Office Bldg			845559	2,885,047,308	\$200,000	Targeting FY26 1292 Funds	
EHS			156366	533,520,792	\$19,600	Targeting FY26 1292 Funds	
MBRB			728791	2,486,634,892	\$102,200	Targeting FY26 1292 Funds	
New East			189314	645,939,368	\$26,500	Targeting FY26 1292 Funds	
				136,238,160,558	\$2,847,857		
<b>Notes</b>							
1. Project scope and cost estimates to be further developed during FY25.							

## Conclusions

The Strategic Energy & Water Plan is a working document designed to provide guidance in reaching the University's goals for reduced energy use intensity and water use intensity. The plan is designed to be easily updated and flexible so that initiatives can be modified in response to changes in the University's capital program and in response to changes to operations on the University campus.

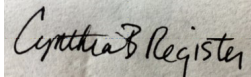
With the current and future planned projects/initiatives identified in this plan, UNCCH will be close to achieving the 40% goal for FY25. UNCCH Energy Management is continuing to develop projects/initiatives and to seek funding approval as required to implement. In addition, UNCCH Energy Management is continuing its on-going monitoring and retro-commissioning efforts in-house to maximize low-cost opportunities for energy and water savings. The savings results of these efforts will

be captured in each annual update of the Plan. The graph below illustrates the impact of planned projects identified in the previous tables.




# Energy Mandate

I have read the Strategic Energy and Water Plan for the organization. The plan, as presented, supports the reductions required in Session Law 546.

A rectangular box containing a handwritten signature in cursive script that reads "Cynthia Register".

Cynthia Register

Executive Director of Engineering Services

A handwritten signature in cursive script that reads "Wendy Halsey".

Wendy Halsey

Associate Vice Chancellor of Facilities Services