



The University of North Carolina at  
Chapel Hill

# Strategic Energy & Water Plan – FY20/21

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8/30/20



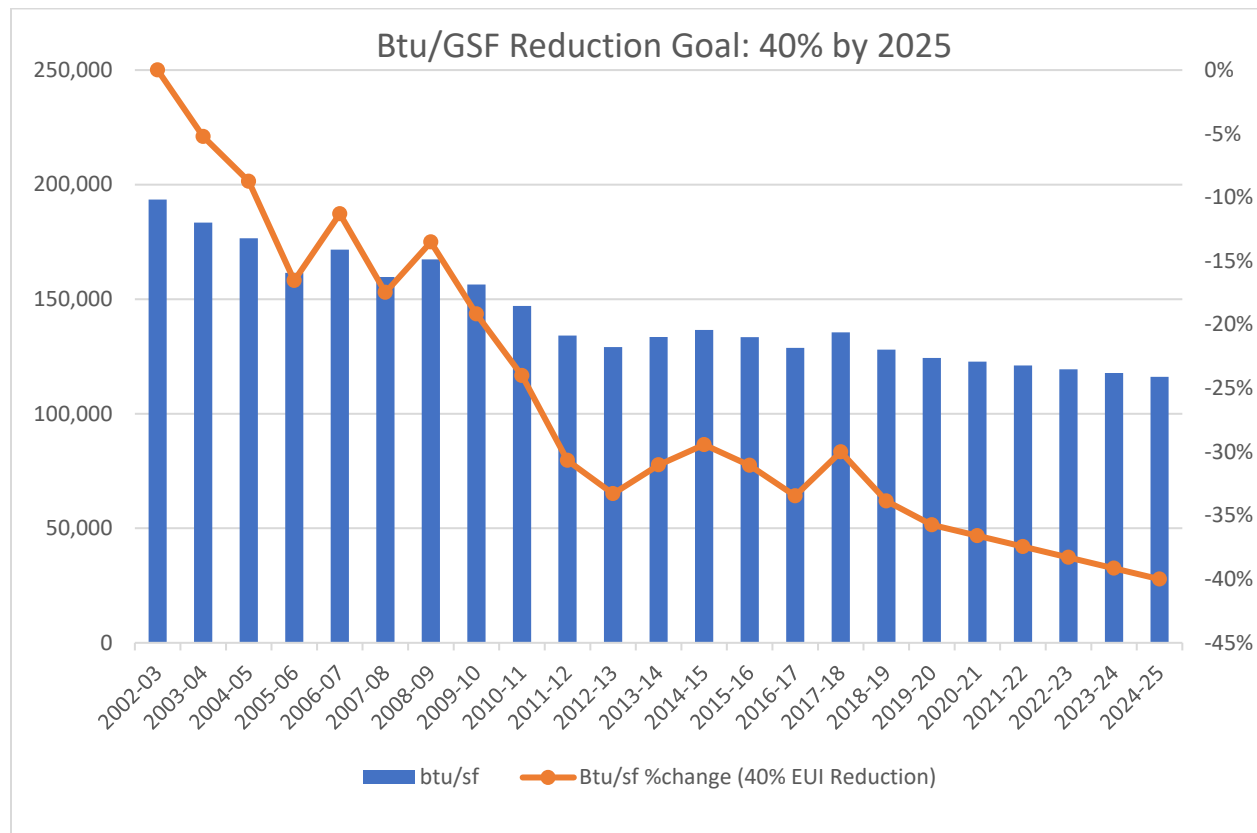
THE UNIVERSITY  
*of* NORTH CAROLINA  
*at* CHAPEL HILL

## 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. UNC-CH achieved this mandated goal and has continued to show annual energy reductions ranging between 31% and 36%. These efforts have resulted in an impressive \$474M of cumulative avoided energy cost since FY2003 for UNC-CH.

To encourage increased energy savings, the UNC University 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.

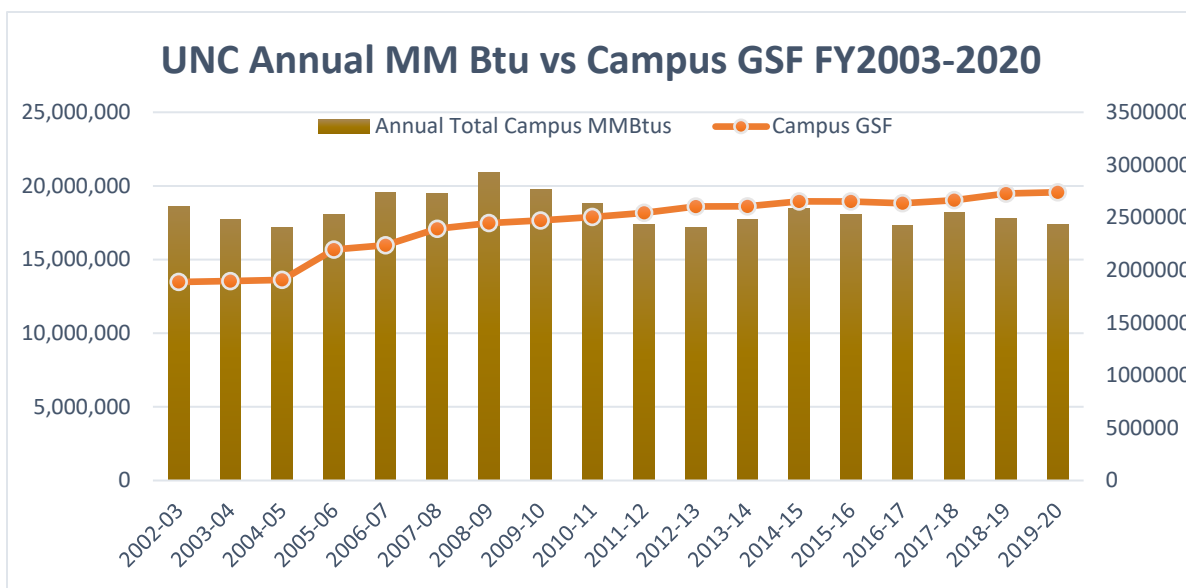
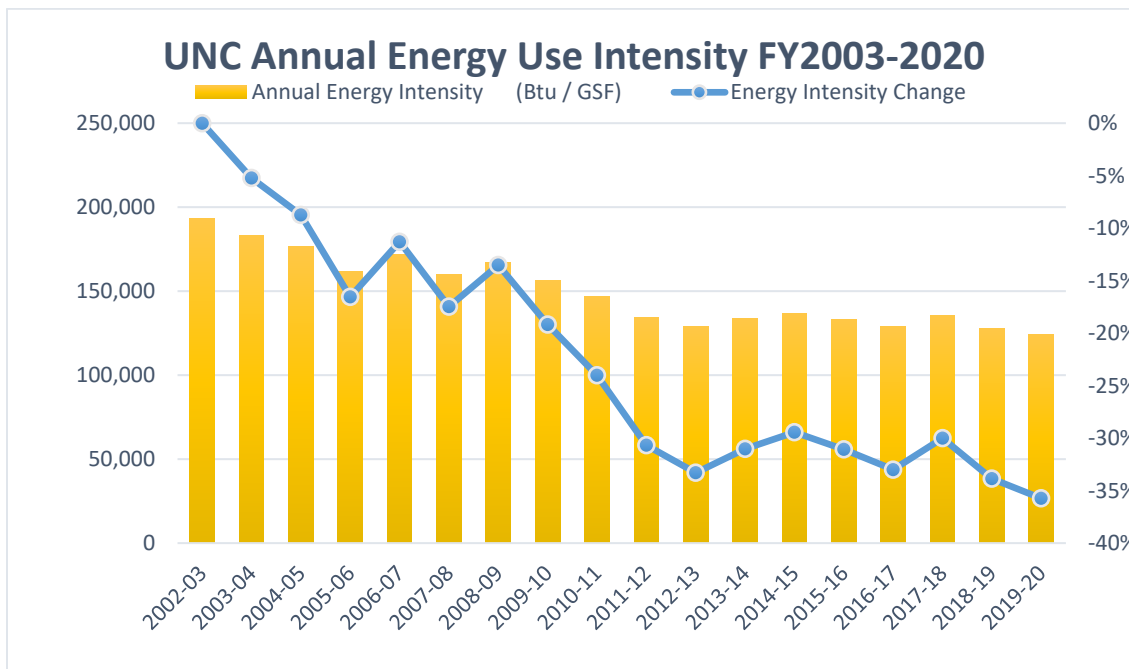
The graph below demonstrates the campus btu/gsf to achieve the 40% reduction goal.



## FY20 Energy and Water Report Metrics and Trends

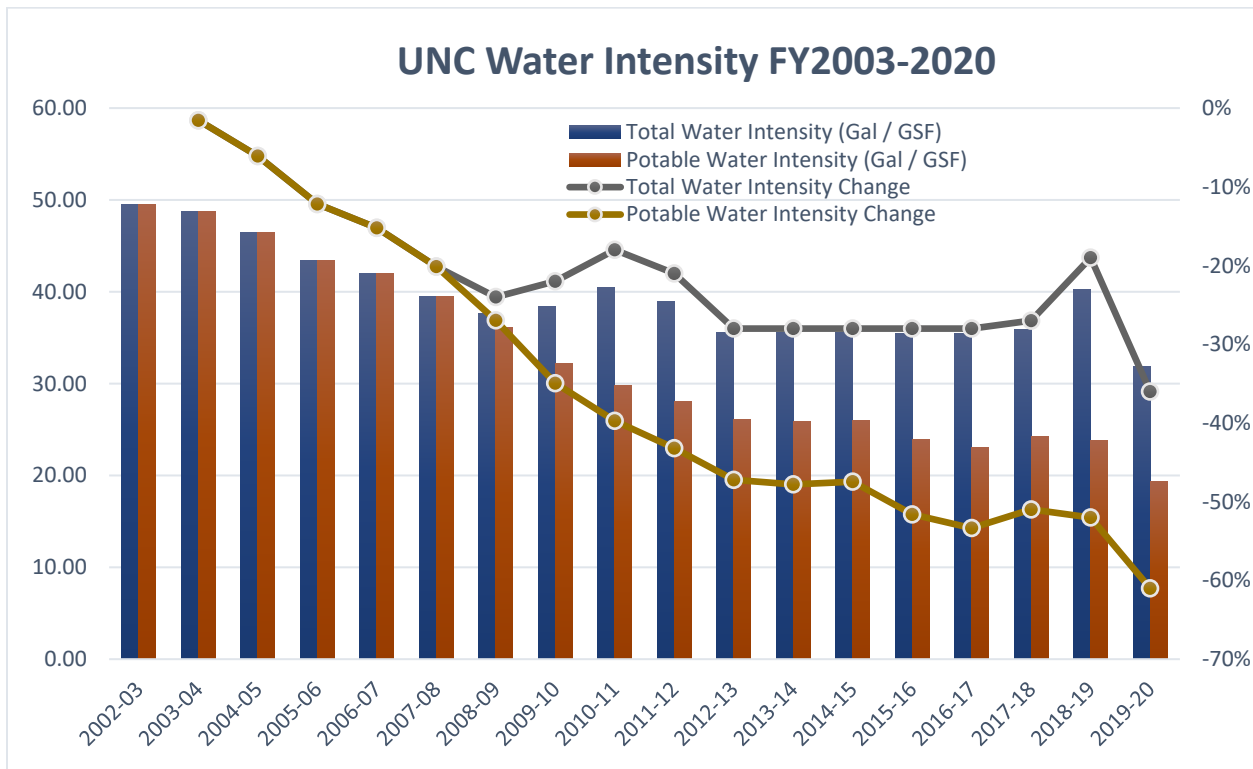
### Energy Usage

For FY20 Energy and Water Reporting, the University of North Carolina at Chapel Hill campus consisted of 420 buildings with a combined building area of 19,569,181 gross square feet. For FY20, the total campus energy consumption is 2,433,542,229,218 Btu. Energy consumption per gross square foot is 124,356 Btu/GSF; a 36% decrease from FY03 energy consumption of 193,500 Btu/GSF. For base reporting year FY03, the total energy consumption was 2,607,959,528,644 Btu for a campus size of 13,477,719 GSF. Although the campus has experienced a building GSF growth of about 45%, the overall campus energy consumption has decreased by 6.7%



## Water Usage

Potable water use for FY19 is 378,805,000 gallons. Potable water consumption per gross square foot is 19.36 gallons/GSF; a 61% decrease from FY03 potable water consumption of 49.48 gallons/GSF. The reduction in potable water use is a result of 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 244,978 in FY20.



## FY20 Strategies/Impacts

### Pandemic Impact

The COVID-19 pandemic was a contributing factor in the energy and water reductions for FY20. In response to the pandemic, the University significantly reduced on-campus operations starting in mid-March and continuing through end of FY20. To reduce energy consumption, UNC-CH implemented energy savings initiatives during the spring months (March 18 through May 15) like those operated annually over Winter Break. The minimal campus population during Spring 2020 also resulted in significantly reduced water consumption, both potable and non-potable. At this time, it is unknown the impact pandemic may have on FY21 consumption. The pandemic has increased awareness and concerns related to building ventilation and indoor air quality (IAQ). As recommended by CDC, the University did conduct water flushing and fresh air flushing of the buildings prior to re-occupancy. CDC also provides guidelines for enhanced HVAC system operations related to COVID-19. These are currently under review by UNC-CH staff and senior leadership.

## 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 FY20, this initiative contributed to an avoided energy cost of \$2.9M and avoided energy usage of 81,739,750 kBtus.

**Winter Break.** The University conducted its annual Winter Break Saving Initiative with an estimated avoided energy cost of \$86,500 and avoided energy usage of 3,720,000 kBtus.

**Target EUIs for Buildings by Type.** Energy Management participated with a UNC 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 and 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.

**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 life of the building. The UNC 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. Mary Ellen Jones (MEJ) total building renovation shows how impactful this can be on energy usage. FY20 marked a full year of occupancy in the renovated MEJ building with a building EUI of 246kBtu/year. This is a significant reduction of 42% from a previous EUI of 424 kBtu/year as measured in FY15 prior to construction starting. We are expecting a similar future reduction as Berryhill is demolished and replaced with the Medical Education Building; project is currently under construction with demolition ongoing.

**Campus Engagement.** Energy Management is actively engaged in many outreach programs on campus, including participation in new student orientation, Green Labs, UNC Housing Sustainability, UNC 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 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, Energy Management believes engaging with campus partners is impactful and helps gain support of other initiatives.

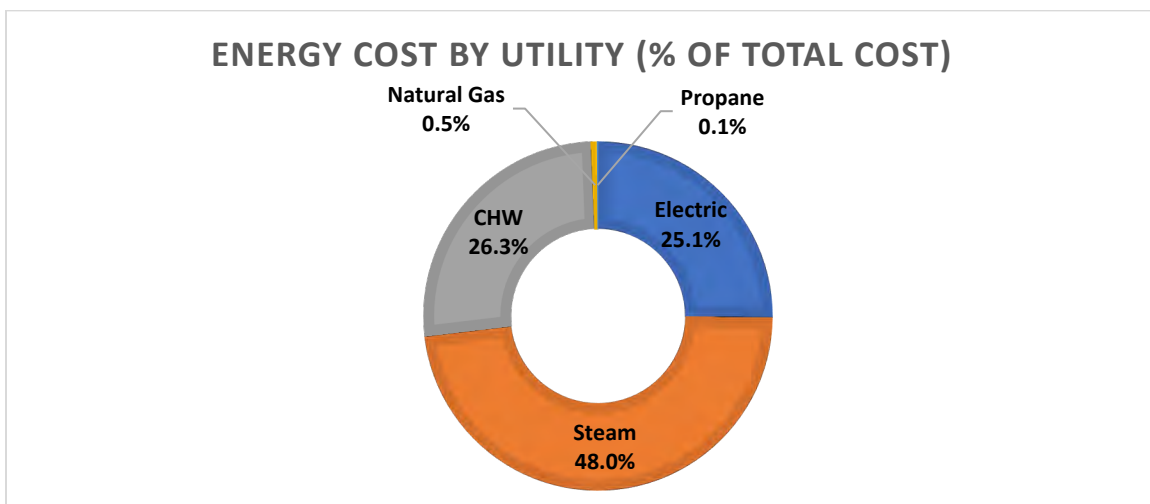
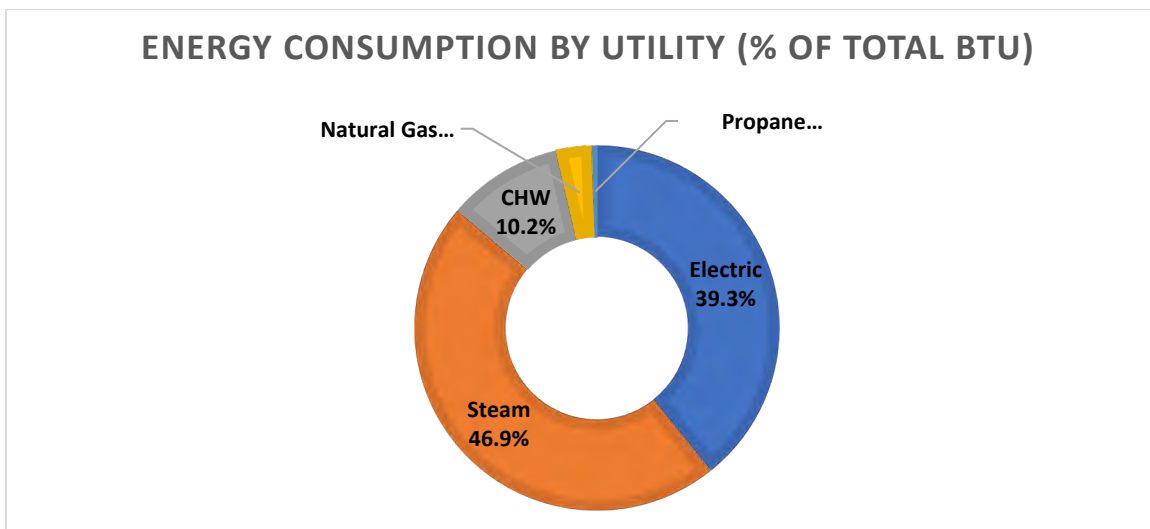
## Energy Projects

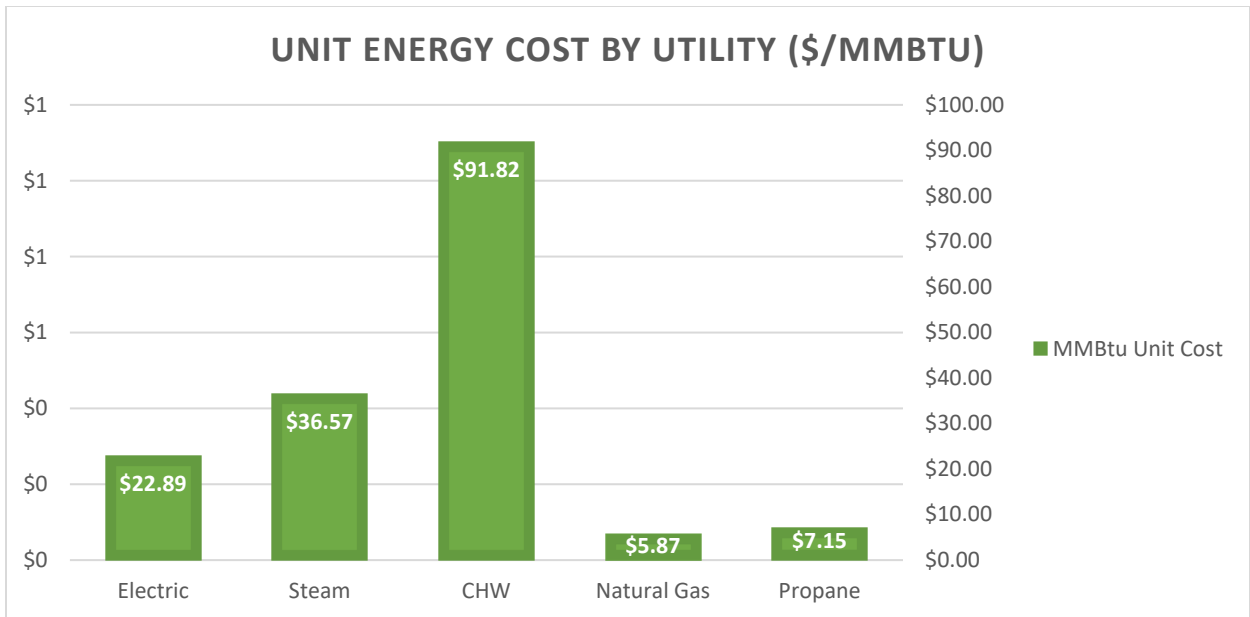
Many UNC-CH capital projects were put on hold as the COVID-19 pandemic created financial uncertainty across the country. This included two significant energy projects: Thurston Bowles Air flow Reduction and Taylor Air flow Reduction. As a result, energy specific projects were not significant contributors to the FY20 Strategy. Impact of these projects will be captured in the report section FY25 Goal of 40% Reduction in Energy Consumption per GSF.

## Campus Utilities

### Energy

**Consumption and Cost by Energy Type.** Energy on the UNC-CH campus is supplied by UNC 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 UNC 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. Energy Services establishes the billing rates for these utilities. For FY20 energy consumption by category, cost, and unit cost are demonstrated in the following graphs.





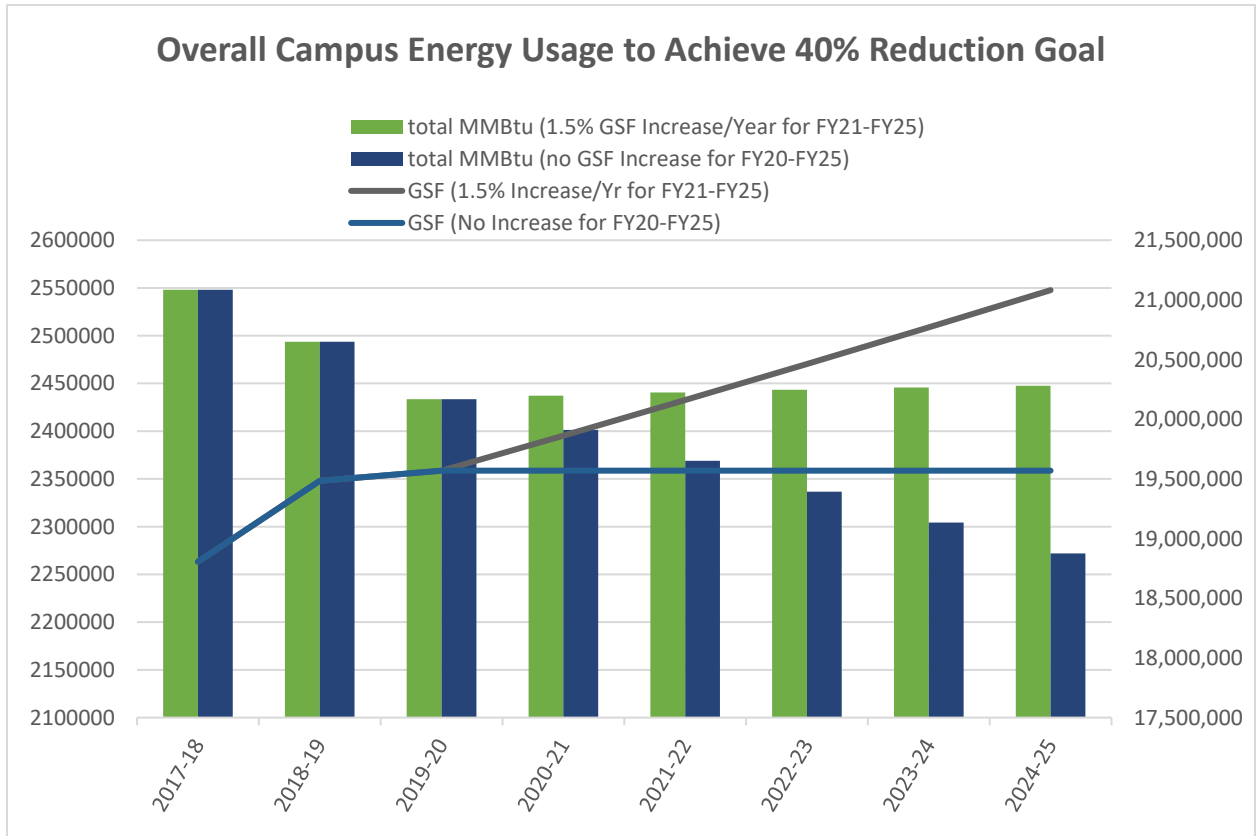
**Renewable Energy Projects.** Energy Services has several active renewable energy projects. The largest of these active projects is the installation of a ground mounted solar array, 376kWac, coupled with battery storage of 556 kWh. The project will be sited on the Carolina North campus and connected to the electric grid that supplies power to the current north campus buildings. Energy Services will be operating this system using a variety of charge and discharge strategies to gain better understanding of how this type of renewable energy system can be used to best benefit the University. The other two renewable projects are the more traditional rooftop solar arrays planned for Friday Center and the Carroll Hall Addition projects. These two projects are being funded through RESPC, the student green fund organization.

## Water

Water, reclaim water, and sanitary sewer utilities are provided by OWASA (Orange Water and Sewer Authority); however, these utilities are managed and billed by UNC Energy Services. In FY20, OWASA provided UNC-CH with water analytic software, Aqua Vista, that provides interval water use data that can be trended and used for notifications, including leak detection. Energy Services and Energy Management have started using this analytic tool to provide earlier detection of leaks and to identify high water consumers in different user categories. This tool appears to have good potential for providing timely information that can lead to decreased water consumption. Energy Services and Energy Management are planning to co-mentor a student intern who can devote a semester to enhancing our use of this software.

## **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. Considering a campus growth of 1.5% per year, the overall campus Btu in FY25 must not exceed 2,473,464 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 is underway on a LED Master Plan for the campus that will provide cost savings analysis to evaluate uses in various spaces and to establish priority of projects. UNC 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 are nearing completion and are shown in the FY21 list of projects. LED lighting is planned for a



fourth deck and that project is being shown in FY22. The completed LED lighting projects for the parking decks have demonstrated significant energy savings of about 50%. Other LED lighting retrofit projects being planned are conversion of T5 fluorescent to LED and T8 fluorescent to LED. 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 type of LED retrofits appear in the project list across all years.

**Focus on Steam Use Reduction in Lab Buildings.** Steam use on the UNC 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 GHS emissions, focus on reducing use of this utility has good potential for energy savings and GHG emission reductions. The UNC campus supports significant research in energy intensive laboratories. About one-third of the campus steam usage is consumed by 20 of these laboratories. 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. Technicians received training this year on use of steam trap testing equipment. Energy Management estimates these efforts will result in 10% reduction in steam usage for 12 targeted lab buildings, representing about 52,175 kBtu 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 in excess of 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. Energy Management and Environmental Health & Safety have been partnering to identify labs where airflow reduction projects are feasible and impactful on energy use reductions. UNCCH has three active airflow reduction projects at Taylor (funds on HOLD), Thurston Bowles (funds on HOLD), and Chapman; and has identified three additional projects at Lineberger, Glaxo, and Fordham. The three current projects represent an estimated energy reduction of 38,455,000 kBtu and the three planned projects an estimated reduction of 23,811,000 kBtu.

**Expanded HVAC Scheduling in Athletic Buildings.** Athletic buildings have sporadic occupancy scheduling based on 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. Energy Management is investigating opportunities to use interactive occupant scheduling tool that providing 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. As 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 controls systems. The oldest of these are pneumatic control systems with no remote visibility. There are also older direct digital control (DDC) based systems that are outdated 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 finding to implement this upgrade and work is starting in FY21. 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 Energy Management develops more detailed scope, these projects/initiatives will be added to each year's project list.

### FY21 Projects

FY21	Reduction in Usage			Btu Reduction	Project Cost
	Steam (klbs)	CW (ton-hrs)	Electric (kWh)		
<b>Steam Reduction Initiative</b>					
10% Steam Usage Reduction - 12 Target Buildings	23,671			52,173,821	TBD
Autoclave Scheduling	2,309	103,402	312,065	4,297,750,645	\$77,000
<b>HVAC Projects</b>					
Chapman Air Flow Reduction	6,798	688,383	1,042,670	13,922,215,886	\$400,000
Marsico RetroCx	3,452	628,061	31,403	5,983,477,118	Note 3
<b>LED Lighting Projects</b>					\$974,000
Business School			335,892	1,146,063,504	
Cobb Parking Deck			232,512	793,330,944	
Rams Head Parking Deck			492,348	1,679,891,376	
Berryhill Demolition	20,315	2,313,095	2,927,200	<u>41,525,179,270</u>	Note 3
				69,400,082,565	
<b>Notes</b>					
1. Steam reduction will focus on repairs and calibrations many to be accomplished through maintenance budget					
2. Berryhill, EUI 532, will be replaced by Medical Education Bldg, modeled EUI 104, currently under construction. The EUI of 104 falls within the 40% goal.					
3. Scope is included in larger capital project that is currently funded. Cost breakout NA at time of this report.					

## FY22 Projects

FY22	Reduction in Usage			Btu Reduction	Project Cost
	Steam (klbs)	CW (ton-hrs)	Electric (kWh)		
<b>HOLD Projects from FY20</b>					
Thurston Bowles - Air Flow Reduction	5160	1272413	3009847	19,789,723,223	\$1,650,000
Taylor - Airflow Reduction	1378	339677	644967	4,742,739,023	\$600,000
<b>LED Lighting Projects</b>					
Genetic Medicine: T5 Fluorescent to LED			839020	2,862,736,240	\$190,000
Caudill: T5 Fluorescent to LED			328320	1,120,227,840	\$54,000
Jackson Parking Deck			241516.8	<u>824,055,322</u>	\$500,000
				29,339,481,647	
<b>Notes</b>					
1. The two projects on hold from FY20 have complete designs and were previously bid for construction. Construction funds were frozen due to COVID19 pandemic. Hope funds will return by FY22.					

## FY23 Projects

FY23	Reduction in Usage			Btu Reduction	Project Cost
	Steam (klbs)	CW (ton-hrs)	Electric (kWh)		
<b>HVAC Projects</b>					
Lineberger - Airflow Reduction	8229	439168	487405	13,340,733,226	\$2,105,000
MBRL/Glaxo - Glaxo Airflow Reduction	3128	198196	294237	5,511,757,634	\$1,208,600
Fordham Hall - Controls Upgrade & Airflow Reduction	875	215694	980260	4,958,846,981	\$1,458,340
<b>LED Lighting Projects</b>					
House Undergrad Library			596951	2,036,796,812	\$62,300
Health Sciences Library			563890	1,923,992,680	\$78,400
Sitterson			1566960	<u>5,346,467,520</u>	\$410,000
				27,772,127,333	
<b>Notes</b>					
1. The lighting projects are LED direct lamp replacements for T5 and T8 florescent tubes in existing fixtures performed by in-house staff. These costs are estimated from electrical plans and a future field survey is required for more accurate scope and cost estimate prior to funding projects.					

## FY24 Projects

FY24	Reduction in Usage			Btu Reduction	Project Cost
	Steam (klbs)	CW (ton-hrs)	Electric (kWh)		
<b>HVAC Projects</b>					
Carroll Hall - VAV Zone Control Upgrades	535	182365	128773	1,537,614,755	\$670,000
Tate-Turner-Kuralt - Add VFDs to HW System			17141	58,485,092	\$18,000
Tarrson - Controls Upgrade	147	50027	110851	679,805,344	\$78,000
McGavarn Greenburg - Heat Recovery Replacement	1972	26261	-53122	2,443,110,092	\$492,000
Genome Science RetroCx	1536.2	287542.1	689685.4	4,986,295,932	TBD
<b>LED Lighting Projects</b>					
Admin Office Bldg			845559	2,885,047,308	\$200,000
EHS			156366	533,520,792	\$19,600
MBRB			728791	2,486,634,892	\$102,200
New East			189314	645,939,368	\$26,500
				13,123,879,315	
<b>Notes</b>					
1. The lighting projects are LED direct lamp replacements for T5 and T8 florescent tubes in existing fixtures performed by in-house staff. These costs are estimated from electrical plans and a future field survey is required for more accurate scope and cost estimate prior to funding projects.					

## FY25 Projects

FY25	Reduction in Usage			Btu Reduction	Project Cost
	Steam (klbs)	CW (ton-hrs)	Electric (kWh)		
<b>HVAC Projects</b>					
Kenan Labs - Airflow Reduction (Lower Floor)	3364	335491	223506	5,880,187,071	TBD
Chapman - Auditorium Systems Energy Reduction	167	24653	27540	365,649,259	TBD
Koury Oral Health RetroCx	972.1	166608.3	8330.415	1,660,802,660	TBD
				7,906,638,990	
<b>Notes</b>					
1. Project scope is under review and project costs are being updated.					

## 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 operations on the University campus.

With the current and future planned projects/initiatives identified in this plan, UNCCH will be very close to achieving the 40% goal for FY25. Energy Management is continuing to develop projects/initiatives and to seek funding approval as required to implement. In addition, Energy Management is continuing its 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 the planned projects identified in the previous tables.

