



The University of North Carolina at
Chapel Hill

Strategic Energy & Water Plan – FY22/23

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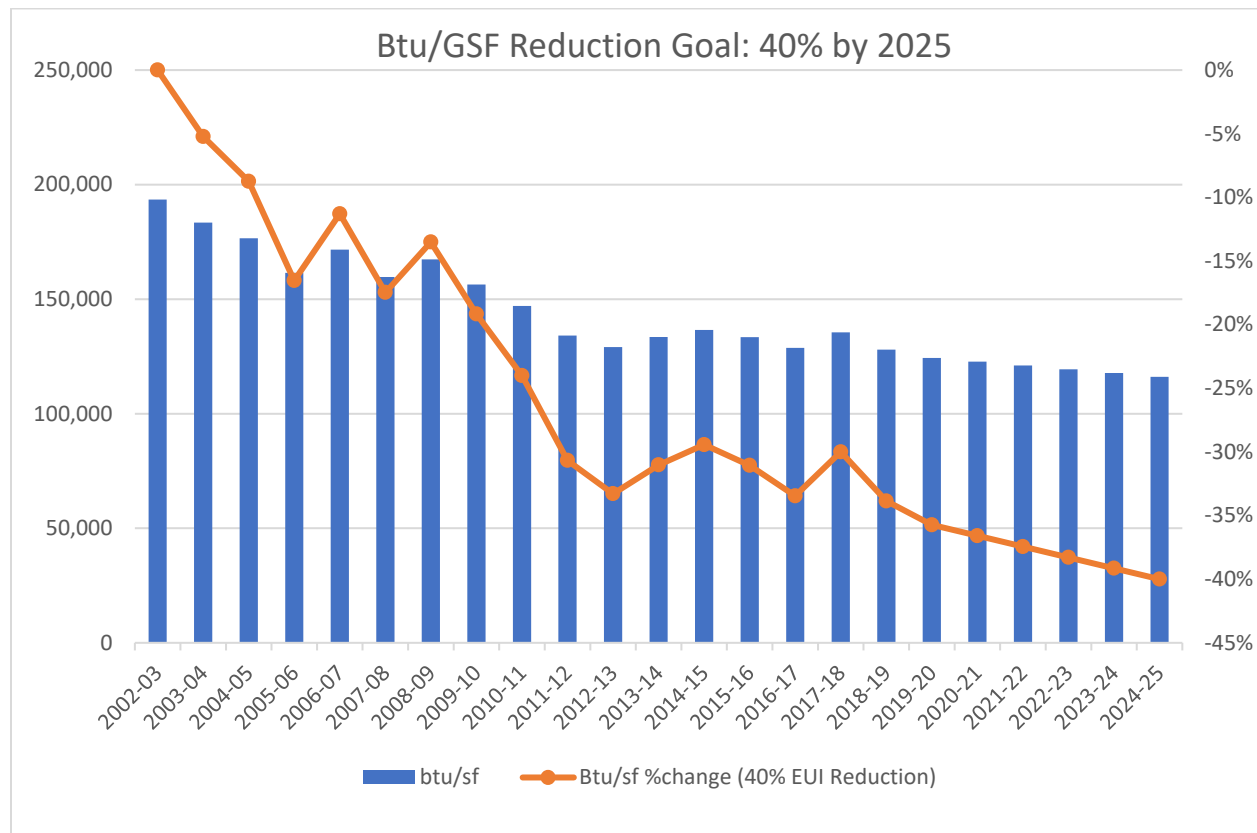
THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

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 37%. These efforts have resulted in an impressive \$524M 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.

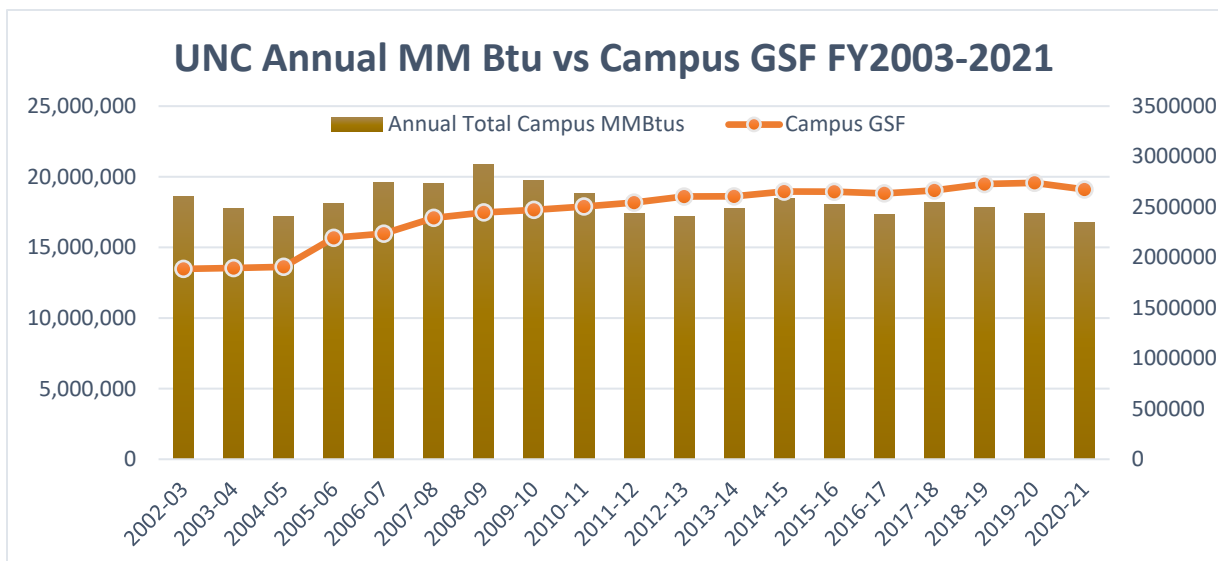
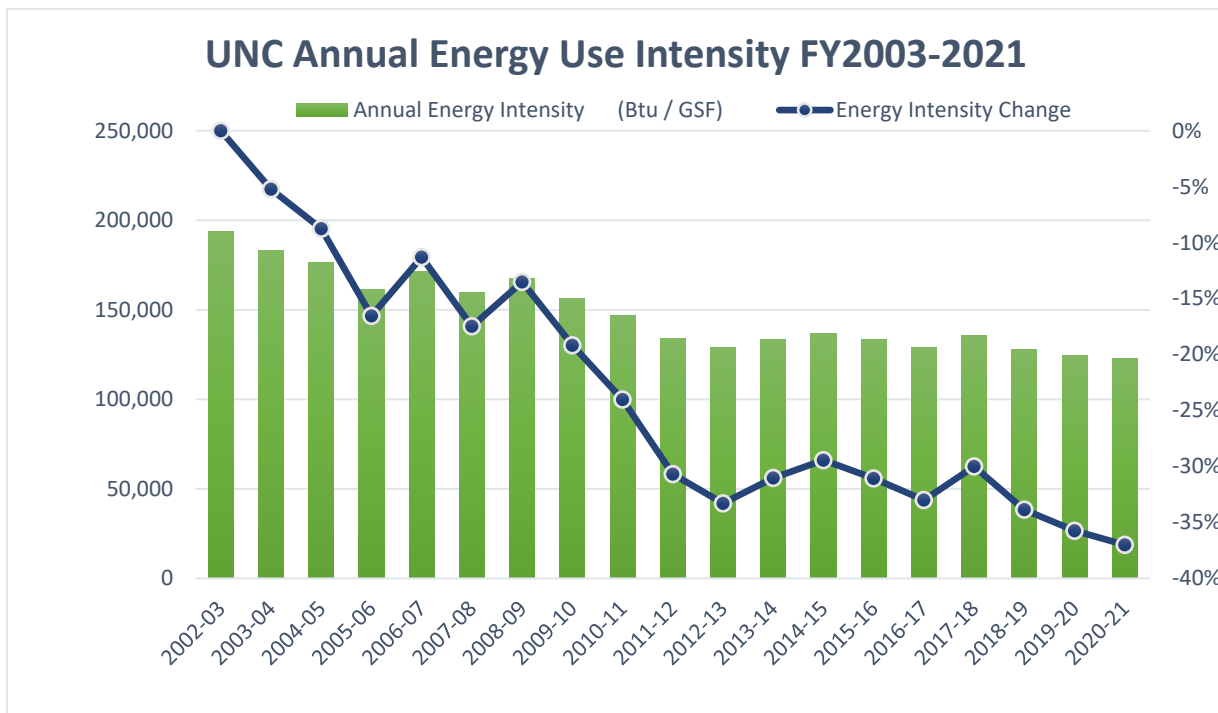
The graph below demonstrates the campus btu/gsf to achieve the 40% reduction goal.



FY21 Energy and Water Report Metrics and Trends

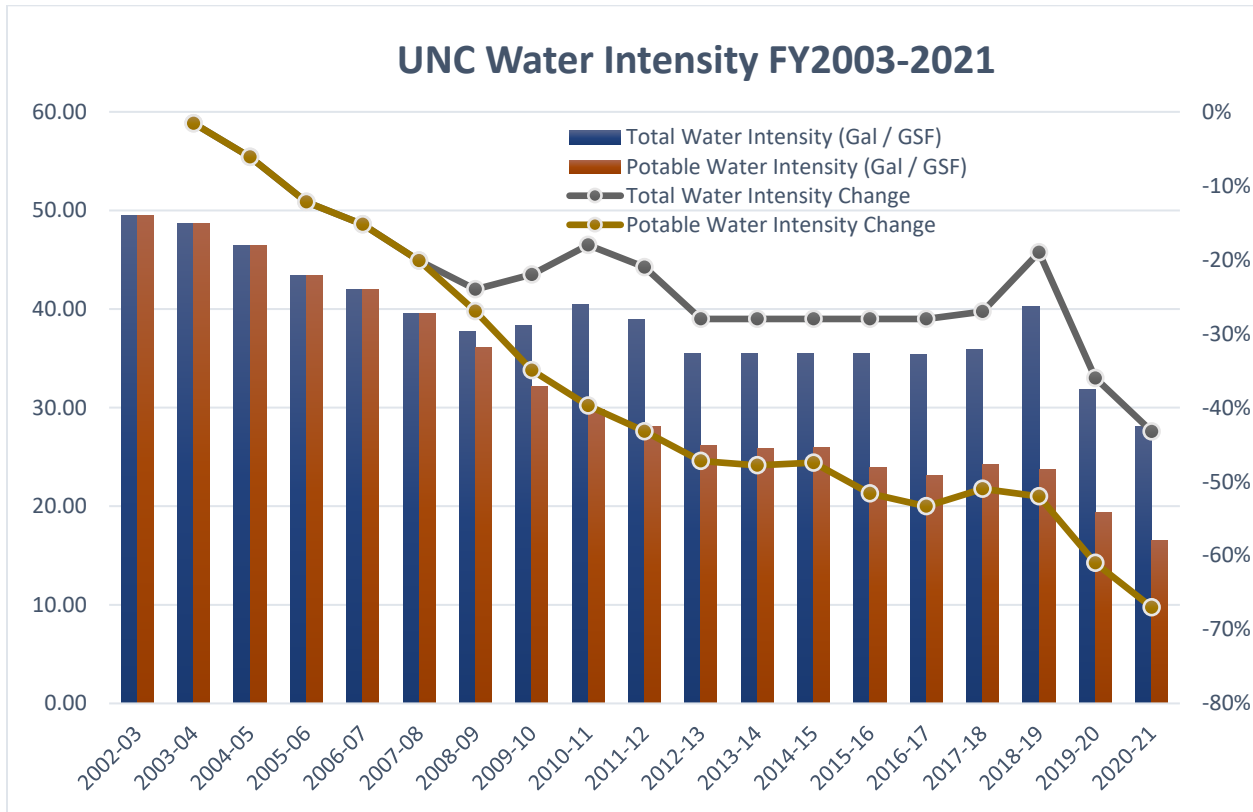
Energy Usage

For FY21 Energy and Water Reporting, the University of North Carolina at Chapel Hill campus consisted of 408 buildings with a combined building area of 19,099,722 gross square feet. For FY21, the total campus energy consumption is 2,346,170,847,602 Btu. Energy consumption per gross square foot is 122,838 Btu/GSF; a 37% 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 42% since FY03, the overall campus energy consumption has decreased by 10%



Water Usage

Potable water use for FY21 is 316,123,000 gallons. Potable water consumption per gross square foot is 16.55 gallons/GSF; a 67% 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 220,442 in FY21. The Covid Pandemic has also impacted water consumption on campus contributing to reductions in overall water use, both potable and non-potable due to reduced campus occupancy.



FY21 Strategies/Impacts

Pandemic Impact

The COVID-19 pandemic continues to have varying impacts on energy consumption related to on-campus occupancy and heightened awareness of importance of good building ventilation. Although the campus has a full re-opening in July 2021, a portion of campus staff continued to work in a hybrid arrangement of on-site and off-site. Facilities is continuing to address ventilation concerns and has implemented outside air damper replacements and repairs in about 20 buildings. Building operation practices continuing from FY21 are relaxed building schedules to allow for increased flushing of air prior to and following occupancy each day; and for areas with higher risk activities, outside air ventilation has been increased or supplemented with portable HEPA filtration units. UNCCH also increased filtration

level to MERV13 or higher for main air handling equipment that have box filters. Energy Management has not attempted to calculate any energy consumption changes related to these changes.

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 FY21, this initiative contributed to an avoided energy cost of \$2.2M and avoided energy usage of 61,484,291 kBtus.

Winter Break. The University conducted its annual Winter Break Saving Initiative that focuses on aggressive scheduling of buildings during the 9-day campus closure (Dec 23 – Dec 31).

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. Energy Management is planning to make greater use of this analysis during FY22.

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. The Medical Education Building is still under construction (Target Completion in late fall 2022) with a designed EUI target of 104. This target EUI falls within our campus target EUI of 116 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, 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.

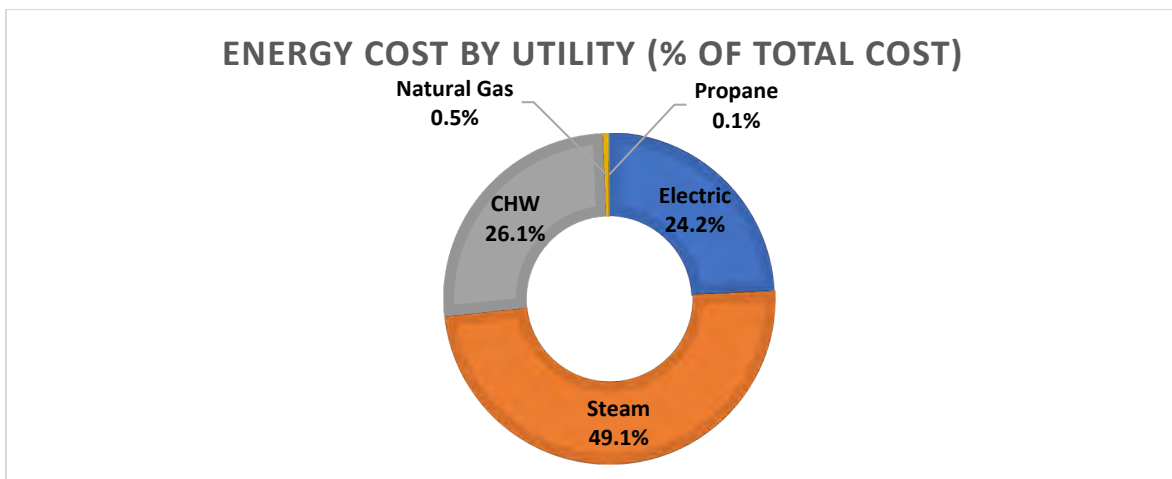
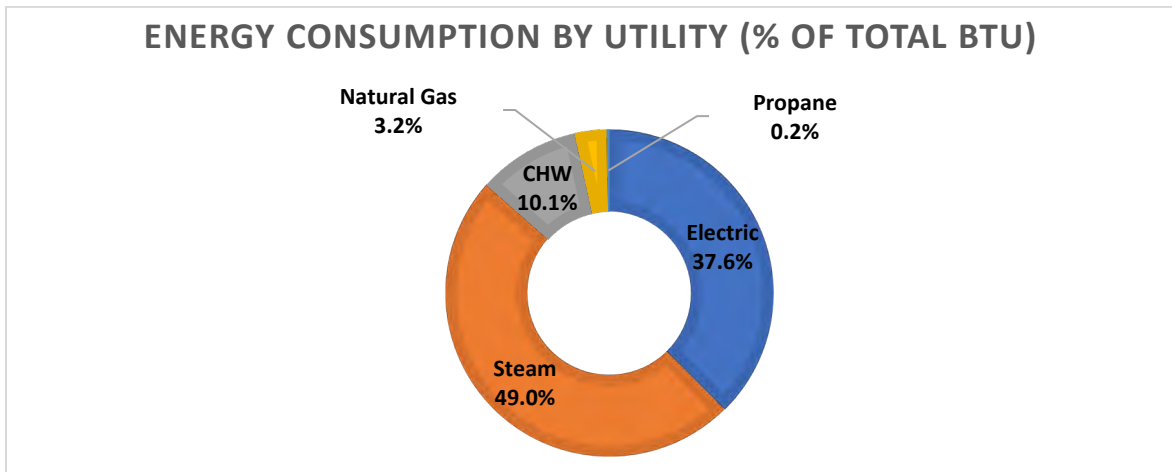
Energy Projects

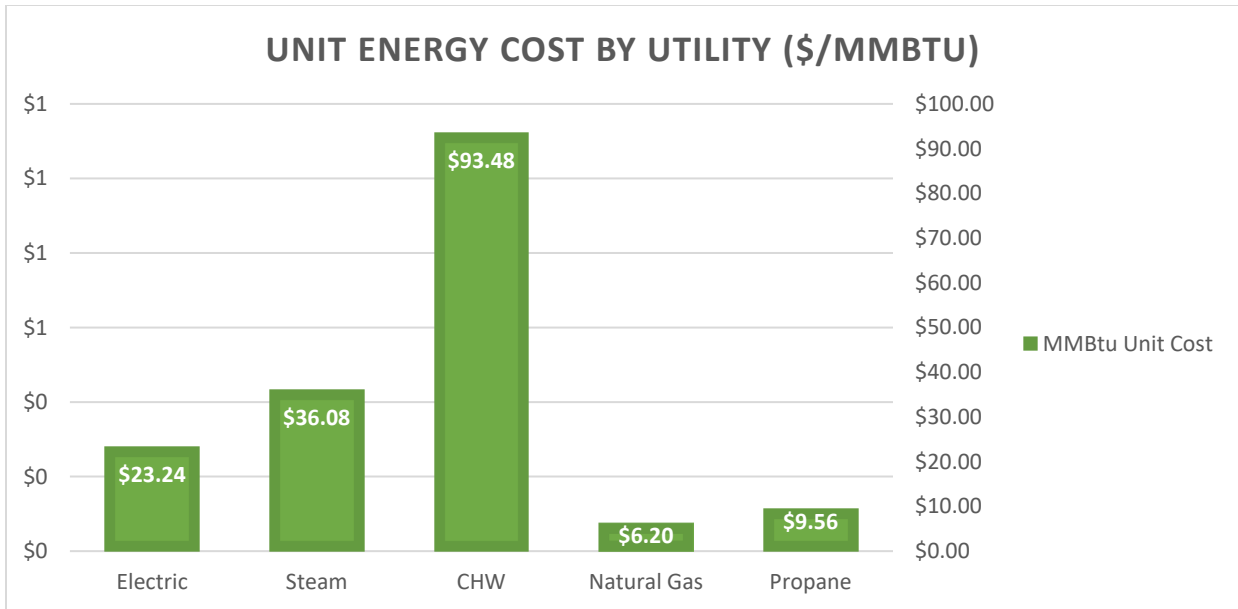
For FY22, UNCCH is utilizing 1292 funds to implement two energy projects: Thurston Bowles Air Flow Reduction and Taylor Air Flow Reduction. As part of a revised budget model, Energy Management is hoping to have access to annual 1292 funds to target energy projects.

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 FY21 energy consumption by category, cost, and unit cost are demonstrated in the following graphs.





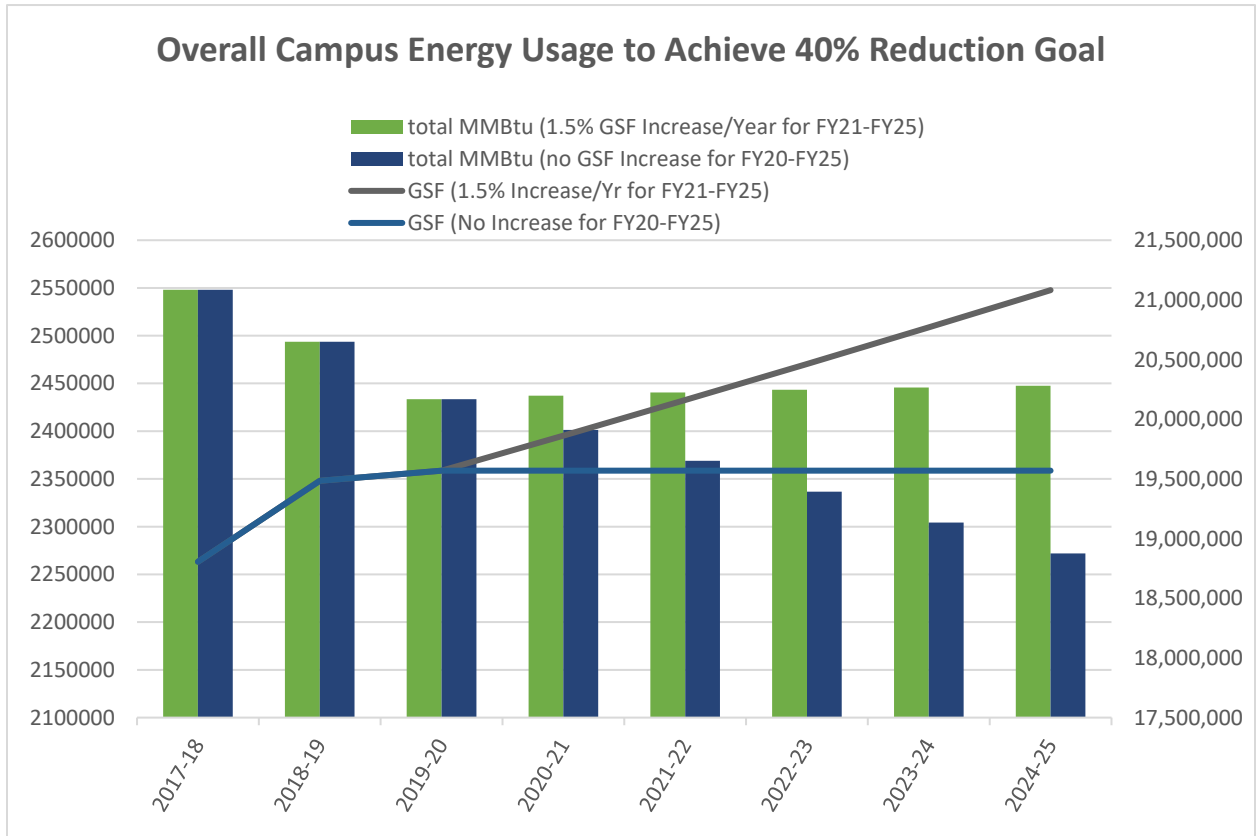
Renewable Energy Projects. Energy Services has several active renewable energy projects. The largest of these active projects is the installation a ground mounted solar array, 376kWac. The planned battery storage component of the project has been removed from the current scope due to budget constraints. 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. 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 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 use of rooftop solar, an estimated 484kW combined.

Water

Water, reclaim water, and sanitary sewer utilities are provided 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, Auqa 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 have partnered with student interns over the past three 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. 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 on a Campus LED Master Plan has been deferred because of limited staff resources although specific projects are still being pursued. 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. Energy Management estimates these efforts will result in 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 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. For FY22, UNCCH is pursuing 1292 funds for implementing two airflow reduction projects: Thurston Bowles and Taylor Hall. The Covid Pandemic has greatly impacted manufacturing and supply chains resulting in significant project cost escalations creating continued holds on some projects, including Chapman Air Flow Reduction and three future projects planned for Lineberger, Glaxo, and Fordham. The two current projects represent an estimated energy reduction of 24,532,462 kBtu and the four planned projects an estimated reduction of 29,339,481 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 years 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 funding to implement this upgrade and although design work started in FY21, progress has been slow due to several bidding challenges, including impacts of Covid pandemic. 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 years project list.

FY21 Project Status

FY21	Reduction in Usage - Calc from Metered Consumption			Btu Reduction	Project Cost	Status
	Steam (klbs)	CW (ton-hrs)	Electric (kWh)			
Steam Reduction Initiative						
10% Steam Usage Reduction - 22 Target Buildings	18,264			23,769,865,440	NA	on going
HVAC Projects						
Marsico RetroCx	-1,211	614,251	1,053,034	3,379,169,816	Note 3	complete
LED Lighting Projects					\$974,000	
Business School			335,892	1,146,063,504		complete
Cobb Parking Deck			232,512	793,330,944		complete
Rams Head Parking Deck			492,348	1,679,891,376		complete
Berryhill Demolition	20,315	2,313,095	2,927,200	41,556,748,391	Note 2	complete
				72,325,069,471	\$974,000	
Notes						
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	Status
	Steam (klbs)	CW (ton-hrs)	Electric (kWh)			
HVAC Projects						
Thurston Bowles - Air Flow Reduction	5160	1272413	3009847	19,789,723,223	\$2,477,000	Funding Approved - FY22 1292
Taylor - Airflow Reduction	1378	339677	644967	4,742,739,023	\$1,658,000	Funding Approved - FY22 1292
LED Lighting Projects						
Jackson Parking Deck			241516.8	824,055,322	\$500,000	Funded by Parking & Transportation
Steam Reduction						
Autoclave Scheduling	2,309	103,402	312,065	4,297,750,645	\$77,000	Pending Approval - Possible Student
				29,339,481,647	\$4,712,000	

FY23 Projects

FY23	Reduction in Usage					
HVAC Projects	Steam (klbs)	CW (ton-hrs)	Electric (kWh)	Btu Reduction	Project Cost	Status
Lineberger - Airflow Reduction	8229	439168	487405	13,340,733,226	\$2,420,750	Targeting FY23 1292 Funds
MBRL/Glaxo - Glaxo Airflow Reduction	3128	198196	294237	5,511,757,634	\$1,208,600	Targeting FY23 1292 Funds
Chapman Air Flow Reduction	6,798	688,383	1,042,670	13,922,215,886	\$400,000	Targeting FY23 1292 Funds
LED Lighting Projects						
Genetic Medicine: T5 Fluorescent to LED			839020	2,862,736,240	\$190,000	Targeting FY23 1292 Funds
				35,637,442,986	\$4,219,350	
Notes						
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					
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	\$1,458,340	Targeting FY24 1292 Funds
Carroll Hall - VAV Zone Control Upgrades	535	182365	128773	1,537,614,755	\$670,000	Targeting FY24 1292 Funds
Tate-Turner-Kuralt - Add VFDs to HW System			17141	58,485,092	\$18,000	Targeting FY24 1292 Funds
Tarrson - Controls Upgrade	147	50027	110851	679,805,344	\$78,000	Targeting FY24 1292 Funds
LED Lighting Projects						
House Undergrad Library			596951	2,036,796,812	\$62,300	Targeting FY24 1292 Funds
Health Sciences Library			563890	1,923,992,680	\$78,400	Targeting FY24 1292 Funds
Sitterson			1566960	5,346,467,520	\$410,000	Targeting FY24 1292 Funds
				16,542,009,185	\$2,775,040	
Notes						
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				Project Cost	Status
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	\$492,000	Targeting FY25 1292 Funds
Genome Science RetroCx	1536.2	287542.1	689685.4	4,986,295,932	TBD	Targeting FY25 1292 Funds
Kenan Labs - Airflow Reduction (Lower Floor)	3364	335491	223506	5,880,187,071	TBD	Targeting FY25 1292 Funds
Chapman - Auditorium Systems Energy Reduction	167	24653	27540	365,649,259	TBD	Targeting FY25 1292 Funds
Koury Oral Health RetroCx	972.1	166608.3	8330.415	1,660,802,660	TBD	Targeting FY25 1292 Funds
LED Lighting Projects						
Admin Office Bldg			845559	2,885,047,308	\$200,000	Targeting FY25 1292 Funds
EHS			156366	533,520,792	\$19,600	Targeting FY25 1292 Funds
MBRB			728791	2,486,634,892	\$102,200	Targeting FY25 1292 Funds
New East			189314	<u>645,939,368</u>	<u>\$26,500</u>	Targeting FY25 1292 Funds
				21,887,187,373	\$840,300	
Notes						
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.						
2. Project scope and cost estimates to be further developed during FY22.						

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 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 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.

Impact of Planned Projects vs Targets

