I. OVERVIEW

The University of North Carolina at Greensboro (UNCG) is continuing to reduce its energy footprint by using all available resources for more energy efficiency on campus while supporting the University’s missions. Through the implementation of the UNC System’s first performance contract, installation of several new technologies, improvements to the steam and chilled water infrastructures, and education and outreach efforts, UNCG energy, and water consumption have decreased significantly since the baseline year FY2002-2003 designated by the State. This report provides a top-level description of the campus utility infrastructure and an update on campus progress towards utility reduction goals with projects already implemented and those planned for next year.

UNCG continues to reduce utilities consumption and expenditures despite the changes in student counts and campus building square footage. UNCG is currently at 95,179 EUI BTU/GSF, achieving a 24% EUI reduction from 125,963 EUI in the baseline year of 2003. Full-Time Equivalent (FTE) student enrollment has declined during and post-pandemic. The fall of 2021 showed 17,025 FTE, a 5% enrollment decline from the prior fall and a 38% increase from 12,000 FTE in the 2003 baseline year. For 2022, the campus footprint on the other hand stayed flat to the prior year, holding a 58% area increase of 2.5 million GSF of additional indoor spaces over the 2003 baseline area.

II. SUMMARY OF THE FISCAL YEAR 2021-22:

Utility expenditures for the University were $8.87 million (Electricity: $4.70 million for 78.54 million kWh; Natural Gas: $2.71 million for 3.61 million therms; Water: $1.23 million for 116.6 million gallons of water; and $240 thousand for 88.7 kgal of #2 fuel oil. FY2022 utility costs showed a 16% higher expenditures or $1.21 million dollars difference to the prior 2021 fiscal year.

In FY2022, the University used approximately $981,000 of Utility Savings Carry Forward HB 1292 (USCF) funds for different projects on campus to improve efficiency and to back up Repairs & Renovation (R&R) funds when needed. To cut costs and time, Facilities Operations managed all the projects in-house:

Steam Plant Activities:
• Boiler #4 Economizer $145,717: a new more efficient airside economizer replaced the original 2005 one that was leaking for a couple of years causing plug one of the 6-passes were leaks the most.
• Boiler #1 Feedwater Pump $51,246: the project upgraded an obsolete horizontal 75 horsepower (HP) pump with a new vertical Grundfos 30 horsepower HP and installed a variable frequency drive VFD. This project was left on from the previous project for Boiler #2 & #3 Feedwater pumps due to insufficient funds.
• Steam System infrastructure $197,740: inspected steam and condensate piping conditions for the area between MH #11 to MH #12 and added ventilation.

HVAC Shop Activities
• Cooling Tower Fan Motors $12,994: replaced (2) two old failing 100 HP motors each with new NEMA Premium Efficient ones in McIver Chiller Plant with a 6,000-cooling ton capacity.
• New mini-split cooling units $27,477: for ITS Information Technology rooms to maintain equipment requirements at lower down to 68-72 F cooling temperature. This approach would not only help maintain ITS pieces of equipment but also reduces the additional cooling loads at the related air handler unit throughout the day and when set on unoccupied mode. HVAC personnel installed in-house all the (4) four purchased mini-split units each in the assigned building.
• New Temperature and Humidity sensors for Weatherspoon Cone Art Building $42,381: replaced and relocated the existing temperature and humidity sensors for the galleries for more thermal enhancement to the museum facility.
• Repair various air handling units on campus for $65,883: replaced faulty return and or outdoor dampers, actuators, and linkages.
• Outdated HVAC systems’ Air Compressor Replacements:
  - Sullivan Science Building $61,025: upgrade an old scroll open system compressor (6-motors 5 HP each) with a NEMA 30 HP oil-free rotary screw air compressor. The compressor serves teaching labs & nuclear magnetic resonance room.
  - Eberhart Building $10,812: replaced an old obsolete 4 HP compressor with a new Duplex Mounted & Dryer NEMA 1 Control & magnetic motor starters.
• Outdated Boiler Replacements:
  - Becher-Weaver Building heating boiler $74,477: replaced with a new more efficient one. The new boiler was downsized to 1.8 million BTU/hr two-thirds of the original design of 2.52 million BTU/hr to serve the entire building. The new boiler serves only the warehouse portion, leaving (9) heating/cooling rooftop units taking care of the office area.
  - Chemical Safety Building heating boiler $19,788: replaced with a new more efficient one matching the original outdated 23-year-old heating boiler.

- Electric Shop and Buildings and Trades LED Upgrade on campus: on top of continuous efforts to upgrade T12, metal halide, and incandescent lamps on campus to LED, USCF funds used for larger-scale LED upgrade projects on campus:
  • Curry Building (everywhere except for the Auditorium) $20,009: over 2,300 lamps of T12 and incandescent were converted into LED in an in-house upgrade project.
  • Moran Commons Fountain Steps $26,759: in-house project converted fluorescent into LED.
  • School of Education stairwell fixtures $31,955: converted wall-mounted compact fluorescent with battery pack ballast into line-voltage LED fixtures in an in-house project.
  • Jackson Library Chiller Plant $1,417: in-house project converted high-bay 400-watt high-pressure sodium fixtures into LED.
  • Campus-wide outdoor LED $49,003: UNCG contracted out LED installation work for 368 outdoor lighting poles. The work converted high-pressure sodium lamps to line-voltage bypassing LED. The project finished Phase 5 through 10 of the original 10-phase in-house Campus Outdoor Poles Green Fund plan. The student-supported Green Fund paid for Phases 1 through 4.
  • UNCG contracted out an LED upgrade using a leftover from the previous year’s USCF capital project to upgrade the lighting in two buildings for $98,900: An auditorium room in Curry Building, and two gymnasium rooms in the 1510 Walker Ave Building houses Guilford County Schools’ Middle College at UNCG.

III. UTILITY USAGE

UNC Greensboro currently stands at 95,179 BTU/GSF overall campus Energy Use Intensity (EUI), achieving over 24% EUI reduction to the FY2003 baseline year. Although UNCG has not met the 30% State-mandated EUI reduction goal from FY2015, the University dropped below the 107,939 BTU/GSF/year UNC System FY2021 level after starting at a lower baseline at 125,992 BTU/GSF/year in 2003.
FY2022 electricity, natural gas, and water total utility cost per campus square foot were 1.3 $/GSF, a flat change to the baseline year and a 16% increase from $1.1 in the prior year. Mentioning the prior year, FY2021 was the lowest key performance indicator (KPI) cost per unit area UNCG has registered since 2003.

The University electricity costs over the prior year have not changed much. Similarly, campus water usage has less than a half percent consumption increase, and only 8% expenditures increase over the prior year including a 4%-unit rate increase from the vendor. On the other energy side, however, the ongoing global natural gas crisis has directly affected Steam Plant therms usage and expenditures (over 85% of total campus natural gas consumption). The supply shortage crisis not only curtailed natural gas to the steam plant a couple of times through wintertime, but also significantly higher natural gas therm costs. In FY2022, UNCG Steam Plant had a 9% drop in consumption, yet still, natural gas and #2 fuel oil expenditures had 66% costs increase over FY2021.
FY2022 Energy Usage Narrative:
- the newly constructed Nursing and Instructional Building (NIB), 186,004 GSF, came online in December 2020 served by campus utility loops (steam, chilled water, electricity, and domestic water) folded its full operational year with 1.67 million kWh for only at the building level.
- The newly constructed South Chiller Plant’s 3,000-ton cooling capacity came online in September 2020. The new more efficient chiller plant is running at a full capacity as a baseload for campus cooling load supporting McIver Chiller Plant 6,000-ton capacity.
- UNCG Steam Plant had a significant natural gas reduction after fixing substantial condensate leaks in the campus steam and condensate underground distribution system in FY2021.
- National Weather Service showed Greensboro observed 3,122 Heating Degree Days (HDD) to 3,453 degrees in the prior year, 331 fewer degrees for a milder winter. On the cooling side and summertime, Greensboro and the campus observed 1,618 Cooling Degree Days as compared to 1,506 in the prior year with 112 additional degrees developing a warmer summer.

Despite the NIB’s additional load, the University recorded the lowest ever EUI, 95,197 EUI BTU/GSF, a 5.6% reduction over FY2021, and a 24% reduction over the 2003 baseline year level.

**Decreased EUI (BTU per GSF) by 24% compared to baseline year FY2003.**
This fiscal year detailed the following utility consumption over the prior year: Electricity had 78,540,579 kWh; less than 1% increase = 764,347 kWh additional over the prior year’s consumption. The University used 3,610,286 therms of over 10% reduction = 433,157 therms fewer than what have been used in the prior year (not including #2 fuel oil therms). UNCG Steam Plant under 405N - Natural Gas (Pipeline, Firm & Interruptible) mandatory statewide term contract had a couple of natural gas curtailments resulting in using $239,641 for purchasing 88,740 gallons #2 fuel oil.

On the water side, the campus used 116,586 kGal of water, a 0.5% increase = 599 additional kGal to the prior fiscal year. The campus water KPI is 17.3 Gallons/GSF showing a 78% reduction from the 2003 level, surpassing the UNCG System goal.

Since the baseline level in 2003, FY2022 showed the University has expanded by a 58% increase in campus buildings footprint with only a 19% increase in million BTU used for the operation to make it up to the 24% EUI reduction.

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- 16%
- 17%
- 17%
- -5%
- 23%

% Change to 2003 Baseline
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- 60%
- 2%
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- 28%
### Key Performance Indicators (KPI).

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- % Change from 2021: 0% -4% -5% 17% -5% 0% 1% 1% 5%
- % Change to 2003 Baseline: 58% 38% 19% 53% -24% -13% -65% -78% -75%

![Campus Energy MMBTU & Campus GSF Since 2003 Baseline](image_url)
IV. BASELINE & UTILITY OVERVIEW

- WATER
UNCG receives water and sewer service from the City of Greensboro. The University owns and maintains a distribution system that receives water through three (3) City master meters and distributes it to over 60 buildings. UNCG also has water service for several outlying properties as well. Most buildings on campus have UNCG-owned water meters that are read, and data is subsequently entered into a database. Where water is used for irrigation or cooling towers, submeters have been installed so that the University can take monthly meter readings of water that does not enter the sanitary sewer system in order to receive appropriate credits from the City of Greensboro Water Resources Department.

UNC Greensboro has made tremendous progress in reducing water consumption. UNCG’s Facilities organization places special emphasis on leak investigation and underground steam repairs, as well as on identifying and eliminating any wasteful operational practices. Installation of water-conserving fixtures during new construction and renovations has also been implemented. These practices have led to a 78% reduction in water consumption (per GSF) since the baseline year, FY2003, and a half percent 0.52% increase when compared to the prior fiscal year 2021.

Decreased water consumption (Gal per GSF) by 78% compared to the baseline year FY2003.
ENERGY (ELECTRICITY, NATURAL GAS, AND #2 FUEL OIL)

ELECTRICITY

Duke Energy provides electric power to UNCG facilities through over a hundred accounts. By far the largest account is the main campus substation that feeds an underground medium voltage electrical distribution system connected to more than 60 buildings. The campus substation is on a time-of-use electricity rate schedule that is reviewed annually to evaluate the best rate options and the incentive programs for which UNCG qualifies. In addition to reviewing the main substation account, all other UNCG accounts with Duke Energy are evaluated for best rate options on an annual basis. All buildings served by the substation have electricity submeters that are read monthly, and the values are entered into a database. UNCG has taken steps toward automating the UNCG-owned meter reading process by giving the UNCG meter readers a comprehensive electronic form using an iPad with Google Sheet. The new approach is more efficient because it replaces using the cumbersome Logbook where the meter readers had to write down each meter reading which was subsequently manually entered by others into a spreadsheet.

In FY2022, the University’s total electricity bill was $4.7 million for 78.54 million kWhs, reflecting 11.66 kWh per GSF in electricity KPI, and 4,613 kWhs per FTE student. FY2022 showed less than a 1% increase to 11.54 kWh/GSF in FY2021 and a 25% reduction to 15.45 kWh/GSF baseline year KPI.
Natural Gas: The Steam Plant’s Natural Gas is purchased through State Term Contract 405N, which is currently held by Texican Natural Gas Company, LLC. Piedmont Natural Gas (PNG) provides service to the campus and outlying properties. Complying with N.C. Gen. Stat. § 105-164.13(52) which provides tax exemption to State agency accounts, all University natural gas accounts are tax-free.

In FY2022, the total natural gas expenditures were $2.71 million for 3.61 million therms reflecting over a 10% decrease of approximately 433,000 fewer therms compared to FY2021, and a 21% actual therms increase over the baseline year. FY2022 Natural gas’s KPI (BTU/GSF) recorded 53,581, showing a 10% decrease over the last year and a 24% decrease to 70,145 BTU/GSF in FY2003. Natural gas energy per student is 21.21 MMBTU/FTE, which shows a 7% decrease compared to FY2021 and a 13% decrease from the baseline KPI.
No. 2 Fuel Oil: The UNCG Steam Plant is capable of using No. 2 fuel oil as a backup fuel to natural gas. This provides the University with an emergency fuel source and allows Piedmont Natural Gas (PNG) to interrupt natural gas service to the campus during times of peak gas demand. In FY2022, UNCG used over 88,740 gallons of No. 2 fuel oil at the Steam Plant for a couple of curtailments in winter 2021-22.

- STEAM AND CHILLED WATER

The University uses purchased power and natural gas to create chilled water and steam that are distributed to the campus. Most buildings connected to the Steam Plant and Chiller Plants do not have a steam meter or chilled water meter; however, the University has developed a comprehensive Campus Metering Plan to install steam meters and chilled water meters in all buildings. Facilities Operations uses an assigned building’s gross square footage to allocate the total steam and chilled water cost for each entity.

Steam: Steam is piped to 63 buildings on the main campus. The UNCG Steam Plant has four boilers with 190,000 pounds per hour (PPH) total capacity. Steam distribution capacity covers the campus steam peak load including the newly constructed Nursing and Instructional Building NIB. UNCG used 1292 carry forward funds to maintain and improve the steam plant performance. In FY2020, new boiler controls were installed to replace outdated ones with a new burner management system and master controller. In FY2022, Boiler #4 Economizer was replaced with a new, and Boiler #1 feedwater pump was downsized and added a new variable frequency drive VFD to optimize performance.

Much of the campus steam infrastructure and piping system is 50 years old. The system has been periodically serviced in response to failures or normal wear and tear. Using renovation and repair funds, the University replaced three different sections over the years so far. In the Summer of 2019, the Phase-4 section of manholes #73 to #74 EUC to Bryan Building Service Drive at Theta Street project was completed. The project replaced steam and condensate pipes, manhole refurbishment, and site work in Part-A between the Elliott University Center and Sterling St. Funds however were not available to complete Part-B between Sterling St. and the Bryan Building. UNCG plans to continue on Phase-4 Part B section as funds are available.

In the current Campus Master Plan recently updated by Affiliated Engineers and Sasaki, UNCG has included five (5) high-priority steam projects of a $3.9 million estimated cost to replace and renew critical portions of the steam distribution system.

In Summer 2020, a couple of condensate leaks were identified. After a large 5.1 magnitude earthquake hit North Carolina in August 2020, those leaks got worse affected by ground movement and a total of five leaks were identified. FY2021 carry forward funds were used to fix 5 of the leaks (1) Steam Plant-backside, (2&3) Theta Street leaks, (4) manhole MH55 Steam Tunnel, and (5) MH 85 by the EUC. Another suspected leak was exposed in FY 2022 from Manhole 11 to 12 South College Ave. The underground piping work showed no leaks to be concerned about in this section.

UNCG Steam Plant, including the NIB building, serves over 2.2 million assigned GSF (Assigned GSF =~60% of total GSF). In FY2022 the Plant produced 273.75 million pounds of steam. The steam mount shows an 8% decrease = 23 million fewer pounds for a 10% milder winter = 331 fewer HDDs over FY2021. Steam makeup water was 4.77 million gallons, a 39% decrease = 3.1 million fewer gallons of water used subsequent to fixing the various condensate leaks. The steam production energy and water consumption and costs can be furtherly controlled if UNCG has the funds to move forward with replacing the critical portions of the steam and condensate distribution system.
Chilled Water: UNCG McIver Chiller Plant (4 chillers 6,000-ton total capacity) and South Chiller Plant (2 chillers 3,000-ton current capacity) produce chilled water to serve HVAC needs in 43 buildings including the newly constructed NIB facility. The two chiller plants both serve over 1.5 million assigned GSF including NIB and Ragsdale Mendenhall Residence Hall which were recently (2019) connected to the campus chilled water loop.

- ENERGY DATA MANAGEMENT & BAS
UNCG collects energy consumption and billing information on a monthly basis for all buildings and facilities not served directly by utility companies. Currently, meters are still read manually, and the data is analyzed via MS Excel. These data are used to discover trends in energy consumption and identify facilities that warrant more detailed evaluations. UNCG Facilities Operations staff also examine the monthly data to find and correct billing errors and to identify any anomalies in the energy and water consumption of specific facilities. Currently, UNCG has 65 buildings on the Tridium Niagara AX JACEs Building Automation System (BAS). In FY2021, when Tridium alert stop supporting Niagara AX Supervisor licenses, UNCG contracted with Schneider Electric to migrate Niagara AX to Niagara 4 licensing model to maintain Tridium BAS on campus.

V. SUSTAINABILITY & ENERGY
UNCG received a STARS Silver rating in recognition of its sustainability achievements from the Association for the Advancement of Sustainability in Higher Education (AASHE). STARS, the Sustainability Tracking, Assessment & Rating System measures and encourages sustainability in all aspects of higher education.

- In FY21, UNCG’s carbon footprint declined by 25% since 2009. Overall, the largest declines can be attributed to reductions in fossil fuel energy production by our utility provider, Duke Energy; the reduced occupancy of campus, and the related declines in business travel and student commuting due to the COVID-19 pandemic; and Facilities energy efficiency initiatives. Facilities has achieved a 33% reduction in emissions from purchased electricity since 2009, which accounts for 50% of total reductions in tons of CO2 since 2009 or 13% of UNCG’s overall 25% reduction in emissions.

- UNCG earned Tree Campus Higher Education® recognition for the 13th year in a row. To obtain this distinction, UNCG met the five core standards for sustainable campus forestry required by Tree Campus USA, an Arbor Day Foundation program, including the establishment of a tree advisory committee, evidence of a campus tree-care plan, dedicated annual expenditures for its campus tree program, an Earth Day observance, and the sponsorship of student service-learning projects.

- The UNCG Green Fund has awarded $463,800 to 76 projects during its 7 years of existence to support sustainability initiatives on campus. In FY22, the Green Fund awarded a one-year record of 16 grants, totaling $77,557 for an average of $4,847 per grant. Facilities-related projects in FY22 included:
  - $3,032 to purchase 288 LED bulbs to upgrade the emergency lighting in Moore Strong, Winfield, and Ragsdale Mendenhall residence halls.
  - $5,760 to convert approximately fifty-three exterior lighting fixtures to LEDs.
  - $3,327 to purchase 550 LED bulbs to upgrade the emergency lighting in Reynolds, Grogan, and Cone residence halls.
  - $1,866 to purchase a new water bottle refill station in the Curry Building.
  - $2,104 to purchase a new water bottle refill station in the Moran Commons.
  - $5,544 to purchase 550 LED bulbs to upgrade the emergency lighting in McCormick and Lexington residence halls.
  - $3,752 to pay student labor to conduct a pilot study on the impact glass buildings on campus have on the local bird population.
VI. PROJECTS AND ENERGY SAVINGS

To achieve energy consumption and utilities cost reduction goals, UNC Greensboro focuses first on low- and no-cost energy conservation measures (ECMs). The HB 1292 Utility Savings Carry Forward (USCF) program is used as the main resource to support energy-saving projects.

UNCG had only one energy savings contract (ESCO), a $7.2 million performance contract in 2008. UNCG started reporting/requesting the USCF credits in FY2011. The funds in 2012 were around $232,000 since the guaranteed energy savings contract pre-dated the HB 1292 legislation. All the way to FY2018, the approved/executed funds stayed below half a million dollars. Starting in FY2019, the funds continued to increase at a faster pace to be $981,009 in FY2022, and $1,065,902 requested to carry forward to FY2023. In this regard and to best use this program, UNCG plans ahead in a responsible stewardship manner to spend the entire USCF amount before it disappears by the end of the fiscal year.

Utility Savings Carry Forward funds (HB1292 / General Statute 143-64.12(a)) will continue to be invested in energy conservation measures to achieve the University and State energy reduction and decarbonization goals. In addition, the fund will back up the Repair and Renovation (R&R) funds in replacing failed and outdated HVAC equipment with more energy-efficient equipment in State-supported facilities.

VII. UNCG ENERGY MANAGEMENT

UNC Greensboro’s energy management group consists of an Energy Team and an Energy Committee working together to closely monitor campus energy performance, identify anomalies, implement energy-related projects, and recognize gaps for improvements to achieve the University’s energy and sustainability goals while supporting education and research requirements.

The Energy Committee is led by the Vice Chancellor for Facilities, the Director of Facilities Operations, the Sustainability Office, and the Energy Team. The Energy Team includes the Campus Mechanical Engineer, the Energy Analyst, the Utilities Manager, and Electric and HVAC Shop Supervisors. The Energy Team is the working group that operates and maintains campus facilities, implements projects, tracks performance, identifies anomalies and areas of improvement, and provides recommendations to the committee. The group meets on a monthly basis to review and monitor campus energy performance and establish plans to improve campus infrastructure and progress toward goals.
The University as part of the UNC System supports Executive Order 80 (EO80) and participates in the Utility Savings Carry Forward program G.S. §143-64.12 (USCF). For UNC Greensboro, USCF funds are the main source to improve campus energy and implement conservation measures. In this regard, the Energy group responsibly manages the funds to best serve the energy goals and maintain systems on campus.

On an annual basis, members of the Energy group attend State Energy Conference, Appalachian Energy Summit, and NC APPA conference. Both the Campus Mechanical Engineer and the Energy Analyst have completed Energy Management Diploma and obtained a certificate. Training is recommended for Controls Shop personnel to obtain Niagara 4 certification to enhance capabilities to manage buildings connected and controlled by UNCG’s Tridium Building Automation System.

**VIII. GOALS**

UNC Greensboro continues to grow including increase in the campus indoor footprint. Since the baseline year, FY2003, the campus GSF has increased by 58%. However, during that same time period, UNCG has decreased its Energy Use Intensity by 24%. As of FY 2022, the University’s carbon footprint has achieved a 78% reduction in water gallons/GSF surpassing the State water reduction mandate.

UNCG supports the State greenhouse gas emissions goal of a 40% reduction below 2005 levels. An official 2021 UNCG Greenhouse Gases footprint report showed 54,956 MTeCO2 which is a 25% reduction from our baseline FY09 footprint of 73,052 MTeCO2 (as far back as the inventory goes). Since 2009, the University achieved a 41% MTeCO2 reduction per 1000 gross square feet and a 29% MTeCO2 reduction per weighted campus in FY21.

Despite budgetary constraints, and not reaching the 2015 energy reduction mandate, UNCG will continue embracing Executive Order 80 and UNC System energy goals. Utility Savings Carry Forward funds (HB1292 / General Statute 143-64.12(a)) will continue to be invested in energy conservation measures throughout State-supported campus facilities. Efforts to reduce UNCG’s per square foot energy consumption will continue, guided by the UNCG Climate Action Plan and the responsible stewardship approach of the Facilities Operations Energy Management Team.
We have read the Strategic Energy & Water Plan for our University. The plan, as presented, supports the reductions required in Executive Order 80 (EO80) and G.S. 143-64.12(a).

Implemented August 2022.

Energy Analyst  
Director of Facilities Operations  
Associate Vice Chancellor for Facilities