Energy Design and Management Guidelines

Wake County Public School System

Wake County Government

Wake Technical Community College

October 2022

Energy Design and Management Guidelines

Energy Guidelines for the Design and Operation of Buildings

Prepared by:
Wake County Government
Wake County Public School System
Wake Technical Community College

in consultation with:
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Energy Design and Management Guidelines

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Preface

Introduction

The Energy Conservation and Management Policy was adopted by the Wake County Board of Commissioners in 1992 to encourage energy efficiency and improve environmental quality in Wake County's public facilities. The policy formed the basis for the development of the energy guidelines - first published in 1992, revised in 2004 and 2018 - and authorizes future guideline updates.

This 2022 energy guideline update seeks to support the Board of Commissioners policy and endorsement by redefining the energy design and management process primarily through the following key actions:

1. Validate and Improve Building Performance Targets
3. Update Sustainable, Efficient Design Elements and Requirements
4. Update Renewable Energy Implementation

This update compliments and connects the Board of Commissioners initiatives in the areas of Clean Water and Green Infrastructure. It also helps to achieve the goal endorsed by the Board of Commissioners in 2018 to reach 100% Clean Energy by 2050. Three organizations within Wake County are partnering on this guideline: Wake County Government, Wake County Public Schools (partnered in version 2), and Wake Technical Community College (Wake Tech). These organizations are collectively responsible for over 34 million square feet of complex building inventory and while governed and managed separately, all receive funding from the Wake County Citizen.

Purpose and Scope

The purpose of this document is to provide facility design and construction guidelines as well as energy management guidelines for public facilities in Wake County in order to:

- Transform the energy performance of the Wake County facility inventory
- Require greater energy efficiency and water conservation measures
- Demonstrate a strong return on investment
- Deploy emerging technologies wherever feasible
- Balance building performance with occupant comfort, health, safety and productivity

In an environment of diminishing resources, this document provides the minimum requirements for planning, designing, constructing, renovating, and maintaining, high performance and sustainable facilities that will augment the County's capabilities by:

- Reducing total ownership costs of facilities
- Enhancing facility performance and sustainability
- Promoting sustainable resource and environmental stewardship

- Considering and implementing renewable energy, district and campus energy, and green technology in a baseline
- Verifying thorough standard energy metrics

Guideline Chapter Definitions

This document, the Energy Design and Management Guidelines, or Energy Guideline for short is divided into two main chapters: Chapter 1: Energy Design Guidelines focus on the design process for new buildings and major renovations including performance and design requirements for projects. Chapter 2: Energy Management Guidelines focus on the operation of the existing building portfolio, performance metrics reporting by partners, expansion of energy efficient and emerging technologies to improve overall system efficiency, and conservation.

Wake^3 Partnership

The three partners in this guideline are Wake County Government, Wake County Public Schools, and Wake Technical Community College (Wake Tech), nicknamed Wake^3 (Wake-cubed). These organizations have partnered on these guidelines at the request of the Wake County Energy Commission for the following reasons: 1) each organization competes for the same public capital funds, and 2) each partner has a large public facility inventory that consumes natural resources and has professional staff to manage these inventories. A collective guideline increases transparency in government by publishing how tax dollars are used relative to energy design and management and strengthens public accountability and efficiency by reporting and sharing energy metrics and experiences among Partners. Each organization, in addition to publishing their design guideline has committed to:

1. Assemble annually
2. Review annual projects and related metrics
3. Share and leverage research and development experiences

While each organization shares similar goals, the governing bodies of each are separate, therefore this guideline includes specific sections which apply to each organization. While framed differently to suit each organization's unique facility types and customers, the guidelines share many of the same subjects and sections. The commonalities are identified in the following tables.

Table 1: Wake³ Guideline Commonalities

Design Commonalities	WAKE COUNTY NORTH CAROLINA		WAKE TECH COMMUNITY COLLEGE
Custom Building Performance Target	●	●	●
NC State Statues – Building Requirement			●
Sustainable Strategies	●	●	●
Presentations to an advisory/review Committee	●	●	
Energy Model Required in Design	●	●	●
Life Cycle Cost Analysis	●	●	●
Submetering	●		●
Solar Ready or Designed with Solar	●		●
Building Management Systems	●	●	●
Emerging Technology Evaluation Process	●		●
Commissioning Required for New Construction	●	●	●
Design Reporting Forms	●	●	●
Management Commonalities			
Annual Meeting	●	●	●
Annual Energy Performance Metric	●	●	●
Utility Data Storage and Analysis	●	●	●
Energy Conservation Plan/Policy	●		●
Energy Conservation Measure – Capital Projects	●	●	●
Energy Service Performance Contracting		●	
Building Management Systems	●	●	●

● ● ● *Commonalities will be identified in this document with color coded bullets next to the sections which share common subjects. Each organization is represented with a color the same as above. The common sections are not identical.*

Acknowledgements

The revision of this guideline could not have been completed without the expertise, contributions, guidance and leadership of many throughout the partnering organizations. A special acknowledgment goes out to the following:

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  * Growth & Sustainability Committee Members

Wake County Energy Advisory Commission

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- Robert Leker, Vice Chair
- Stephen Hepler
- Marty Clayton
- Paul Davis
- Peter Egan
- William Jensen
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Chapter 1: Energy Design Guidelines

This chapter seeks to inform designers of the energy related design preferences and define the review and decision-making process and documentation during design.

The Wake[3] partners have each provided a section for designers to incorporate specific requirements of each organization. The requirements share some common elements and goals, however, they each have specifics that best suit the individual organization.

The design team must create an energy efficient design that meets or exceeds the efficiency targets while meeting the project budget. The proposed design should incorporate the best possible building based on life cycle cost, maintainability for existing maintenance staff, and environmental sustainability. The proposed design should also provide a healthy and comfortable environment for employees, customers, students and visitors.

Energy and water consumption should be considered throughout project development from programming and concept design through construction and commissioning. Status forms and/or design review sessions are intended to communicate the design status throughout development.

This guideline speaks to the methods for performing life cycle cost, as well as, the types of building systems and sustainable features for consideration. Each of the Wake[3] partners in this guideline have specific design targets and requirements separated into the following sections:

Wake County Government

The County owns or manages over 5.0 million square feet of buildings. Building types include Court, Detention, Library, Human Services, Animal Control, Museum, EMS and Fire, Parks and Stadium facilities. Designing and targeting the energy performance of these buildings requires a flexible method which has been modeled after the US Green Building Council - LEED certification program. In addition, providing a productive and healthy environment for County staff and citizens by incorporating sustainable design elements is required.

This guideline applies to all new construction buildings and to major renovations where building finishes, mechanical and electrical systems are replaced concurrently.

WCG 1.1 Sustainable Design and Certification

Sustainable design elements should be incorporated into each project concentrating on those which provide value and cost savings. LEED certification will be considered on a case by case basis. While LEED certification will not be a requirement for all projects, certification will be pursued for selected projects where certification can be obtained for minimum additional cost.

WCG 1.2 Building Performance Target

The design team must create an efficient design that meets or exceeds energy efficiency targets referenced below.

TABLE 2: WAKE COUNTY BUILDING PERFORMANCE TARGET

Energy	Comply with the most recently published version of ASHRAE 90.1 in effect at the start of the schematic design phase.
Water	Demonstrate a 25% reduction in water consumption compared with the baseline building according to current North Carolina State Building Code.

For large buildings (≥20,000 ft^2), the ASHRAE 90.1 performance rating method shall be used. For small buildings (<20,000 ft^2) the prescriptive is acceptable but an energy model must be performed to show the estimated performance. Energy forms shall be completed for all projects. The designer should establish and identify the version of ASHRAE 90.1 to be used during schematic design. Designs should also meet Wake County Design Standards for buildings.

WCG 1.3 Designer Requirements

The designer should keep the County informed of energy saving design alternatives and associated life-cycle cost to help in the decision-making process. The County requires certain items to be incorporated into the building such as sustainable design elements, submetering, and being designed with solar. In addition, the designer shall perform certain tasks such as presentations to the Wake County Citizens Energy Advisory Commission, perform life cycle cost analysis for design alternatives and complete energy models and reporting forms. The reporting forms are intended to communicate the design status throughout the design process. The following checklist provides an overview of specific designer requirements and deliverables.

Wake County Energy Design Guidelines - Designer Checklist

Project Phase	***Task and Deliverables***
Programming and Concept Design Determine building program, operating hours and occupancy based on the programming. Consider site orientation paying attention to solar gains, building efficiency and the potential for renewable energy resources. Energy conservation measures should be discussed with the County and an overview of the project should be presented to the Energy Advisory Commission.	☐ Consider Site, Building Orientation and Renewables Review solar gain and shading to building and consider where solar could be located and oriented, during construction or in the future. Identify and consider campus energy strategies with adjacent County buildings.
	☐ Identify Energy Conserving Design Alternatives (Design Alternatives) Work with the County and Energy Advisory Commission to identify efficient design alternatives and technologies to analyze during schematic design.
	☐ Present to Energy Advisory Commission Present on the building including sustainable and energy efficient features planned, and the design alternatives planned for analysis
	☐ Reporting Form Outline ECMs identified after being reviewed by the County
Schematic Design Document the baseline and proposed buildings to be used as a benchmark. Life cycle cost analysis should be performed on the design alternatives selected as well as renewable energy systems. The design alternatives should then be selected based on the analysis.	☐ Perform LCCA on selected Design Alternatives Life Cycle Cost Analysis on the identified alternatives above and beyond the proposed building.
	☐ Confirm Design Alternatives based on LCCA Discuss with the County which design alternatives will be incorporated into the building design based on budget.
	☐ Reporting Form Define and Summarize Baseline and Proposed Building Systems outlining construction type and building systems in the baseline and proposed building.
Design Development An energy model of the proposed and baseline buildings will be completed during this process including acceptable design alternatives selected by the County. The LCCA results and building performance should be presented to the Commission.	☐ Energy Model Complete an energy model of the building including the baseline and proposed buildings. Confirm that the energy performance meets the target. Include the ECMs if selected.
	☐ Reporting Form Complete the design development form which details the energy model results, energy cost, and energy use intensity (EUI).
	☐ Present to Energy Advisory Commission Compile a presentation on the building including energy conservation measure LCCA results, the energy performance summary, and renewable energy considerations, annual savings and payback.

Construction Documents If changes in scope must occur to accommodate the project budget, life cycle cost should be considered while reducing scope. While the construction drawings are completed for the project, an energy model should be run incorporating any design changes and conveying the monthly utility estimates.	☐ Energy Model Update the energy model based on any changes which have occurred during design development. ☐ Reporting Form Use the form to submit the results of the energy model including monthly consumption figures.
Pre-construction Upon the project being bid, changes in building components may be needed to stay within the project budget. During this budget reconciliation, life cycle cost should also be considered when making decisions. An energy model will be required if any Value Engineering or Alternates that are incorporated into the construction contract during the bidding period would affect the building energy projections.	☐ Energy Model (if required) If budget reconciliation affects building energy performance, the energy model should be updated to reflect these changes. ☐ Reporting Form (if required) Use the form to submit an updated energy model of the building including monthly consumption figures.
Commissioning Functional testing and verification of system performance of all energy technologies operating alone and as part of the total building operation shall be conducted by an independent commissioning agency.	☐ Functional Performance Testing Commissioning agent should provide proof of system functionality.
Monitoring and Verification During the first year of occupancy, the design team should check on a quarterly basis to see if the building energy consumption is close to projections. This will give an opportunity to correct any controls or operational issues. After one year of occupancy, the design team will conduct a post-occupancy review of the energy consumption and determine how the performance differs from the design. If the actual building energy performance is significantly differently than the performance projected, the design team will compile information to explain these discrepancies.	☐ 1-Year Post-Occupancy Reporting Form The designer should complete the reporting form using County utility or submeter data. ☐ Present to Energy Advisory Commission For all buildings, a presentation to the Energy Advisory Commission will be required to explain any discrepancies and provide recommended corrective actions.

WCG 1.3.1 Sustainable Design

For all projects, sustainable design elements should always be considered and included. Examples of these elements include:

- Sensitive Land Protection
- Heat Island Reduction
- Rainwater Management
  - Rain Gardens
  - Bio swales
  - Other BMPs
- Indoor air quality
  - Tobacco/Smoke Control
  - Construction air quality management
- Low Emitting Materials
- Renovation of abandoned or blighted buildings

WCG 1.3.2 Energy Advisory Commission Presentations

The design team will provide in-person presentations to the Wake County Citizens Energy Advisory Commission (Energy Advisory Commission) outlining the building design, building component selection, and energy and water consumption predictions two times during project development.

The second presentation is help to provide feedback after considering the suggestions and comments from the Energy Advisory Commission.

a) Format and Timing

The first of two formal presentations will be scheduled for the later part of programming and concept design. The second presentation will be scheduled to coincide with design development. The presentations are intended to cover the energy efficiency and water conserving features as well as the sustainable design elements planned for the building.

b) Presentation Contents

i. **First Presentation: Programming and Concept Design**

The architect and mechanical and electrical designers should provide an overview of the project to the Energy Advisory Commission. The Commission members can pose questions to the designer and provide suggestions and comments for consideration. The presentation should include:

- Introduction of design team
- Site Layout and orientation
- Renewable Energy Considerations
- Building Program Overview
- Building component selection and baseline for comparison
- Proposed design alternatives for further investigation

ii. **Second Presentation: Design Development**
The architect and mechanical and electrical designers shall return to provide an update on the building design, energy conservation measures analyzed, energy performance predictions and responses to questions posed in the first presentation. The presentation should include:
- Building Overview
- Renewable Energy review
- LCCA Review
- DD Form and Energy Model Results

iii. **Third Presentation: 12 Month Review**
The architect and mechanical and electrical designers shall return to give a final presentation to the Energy Advisory Commission to explain first year performance and any recommendations for improvements.

WCG 1.3.3 Energy Modeling

Energy Modeling helps to inform the overall design process and shall be completed for each new building or renovation. Modeling provides data to support design decisions and helps provide the County with appropriate information to make the best long-term decisions.

The energy model will be used as a comparative and predictive tool: comparative for design decisions and predictive for utility budgeting. Early energy models should be used to compare design alternatives. The energy model submitted at design development should demonstrate compliance with the performance target.

The baseline building is defined in the ASHRAE standard and represents the minimum code building which will share the same shape, gross square footage, floor layout, building orientation and perform the same program functions. Program functions will drive building schedule, population, and plug loads.

a) Energy Model Submissions

i. **Design Development Phase Energy Model**
The baseline building and proposed building will be modeled and compared. The model should reflect building components as designed and provide the basis for performing energy saving calculations on specific components selected during design. The model should use all occupancy and set points desired by the County.

ii. **Construction Documents Phase Energy Model**
The proposed building will be modeled incorporating all changes from DD and using all occupancy and set points desired by the County.

iii. **Pre-Construction Energy Model**

If any Value Management or Alternates that are incorporated into the construction contract during the bidding period would affect the building energy projections a pre-construction energy model should be performed to incorporate these changes.

b) Energy Model Inputs

Due to the variability in energy modeling software inputs, guidance is given on model inputs to keep certain items consistent across all projects. These items include:

- Occupancy
- Schedules
- Space temperature set points
- Ventilation assumptions
- Infiltration
- Receptacle and auxiliary loads
- Energy rates
- HVAC Setpoints and Unmet Hours
- Energy Modeling Software

Actual building geometry and properties should be modeled as designed. Baseline buildings modeled should follow ASHRAE 90.1 Appendix G. The energy models should follow these guidelines:

i. **Occupancy**

Occupancy for each building should be modeled by space type with default occupant density specified in the ASHRAE 62.1 or as provided by the County The building occupancy at full capacity should be included in the building status report.

ii. **Schedules**

Buildings should be modeled using operating schedules approved by the County. These schedules should be included as backup material in each status report. The same lighting, equipment, occupancy and hot water schedules should be used in all proposed and baseline building models.

As a starting point, default schedules can be based on the operating hours of the proposed facility with the following schedule details:

- Operating Hours:
  - 80% occupancy
  - 100% Receptacle Loads
  - 100% Interior Lighting

- Non-Operating Hours: 3-hour linear reduction in density to
    - 0% occupancy
    - 50% Receptacle Loads
    - 5% Interior Lighting
- HVAC setpoints should be set for occupied during operating hours plus 3 hours before and after

iii. Ventilation

Minimum ventilation rates should be used as specified in the applicable code. These rates should remain the same for baseline and proposed buildings unless demand control ventilation is proposed. The minimum outdoor air required as designed and modeled should be reported on the status form.

iv. Infiltration

Modeling of infiltration should account for air infiltration through the building envelope and for air changes due to door openings. Both air through the building envelope and door openings can be modeled by a constant airflow rate as described in the study: Energy Savings Impact of ASHRAE 90.1 Vestibule Requirements.

v. Receptacle Loads

Receptacle loads can be modeled by using actual panel loads determined in design or by using power density as defined by receptacle power densities in the included table or ASHRAE 90.1 User's Manual, Table G-C. Examples of receptacle loads include personal computers, copy machines, appliances in kitchens, printers, fax machines, and any type of specialized equipment for specific building types. Receptacle loads and schedules should be the same for the baseline and proposed buildings modeled.

The following table indicates the peak loads and will vary based on the schedules applied. Total annual receptacle energy consumption (kWh) should be divided by 8760 hours and building footprint (ft^2) and then provided in the energy status report as the average plug load.

TABLE 3: RECEPTACLE POWER DENSITY

Building Type	Receptacle Power Density (W/ft^2)
Assembly	0.25
Health/Institutional	1.00
Lodging/Hotel/Motel	0.25
Office	0.75
Restaurant	0.10
Retail	0.25
School	0.50
Warehouse	0.10

All other auxiliary loads such as elevators, garage ventilation, refrigeration systems and other process loads should be included in the model separate from receptacle loads if possible and if no energy conservation alternative is available, these systems should remain the same for the baseline and proposed system.

vi. Energy Rates

The buildings should be modeled using the appropriate rate schedule from the utility. The energy model should take into account demand and time-of-use to determine the monthly cost. The energy costs are important in meeting the building performance target.

vii. HVAC Set points and Unmet Hours

Energy models performed should use the setpoints requested by the County. This could include space temperature set points, night setbacks and deadbands. Systems shall be modeled such that total annual unmet hours do not exceed 300 hours per year with a throttling range appropriate to the system selected but not more than +/- 5 degrees F.

viii. Weather Data

The most current Typical Meteorological Year (TMY) weather data file available should be used for simulation.

ix. Energy Modeling Software

The designer can use any commercially available computer-based program for the energy modeling provided the software is able to model all components of common building systems on an hourly basis including variations in occupancy, lighting power, auxiliary equipment, receptacle loads, and HVAC operation and setpoints, thermal mass effects, multiple zones, equipment-specific performance characteristics such as chiller and boiler efficiency and part-load efficiency, shading and surface radiation absorption and reflectance properties.

The designer should convey all building energy model files electronically to the County at pre-construction in original program format and the simulation output in PDF.

WCG 1.3.4 Life Cycle Cost Analysis

Life Cycle Cost Analysis (LCCA) is a critical part of the decision-making process. Alternative design elements that have different first costs or impact operating and maintenance costs can be compared effectively using a LCCA.

Due to the various methods which can be used calculate Life Cycle Cost (LCC), a standardized method is required in order to make the analysis useful as a primary tool in the decision-making process. The LCCA method for North Carolina State Facilities was used as the basis of development. Refer to the Life Cycle Cost Analysis for State Facilities manual for details on performing the analysis except for those requirements listed in this guideline.

For each system under consideration, a summary table of options along with the appropriate Life Cycle Cost spreadsheets should be provided to the County for review. The spreadsheet template for North Carolina State Facilities should be used.

a) *Life Cycle Cost Analysis Method*

The LCCA method for design alternatives considered includes all installation and operating costs and includes inflation and energy escalation.

Factors to be included in the LCCA include:

- Initial Cost
- Energy Cost
- Maintenance Cost
- Economic Life
- Energy Escalation
- Replacement Cost

Initial cost for the life cycle replacement should consider current construction market conditions, site restrictions, and any other project-specific costs. Estimates from contractors or adjusted unit costs can be used.

Energy costs should be modeled in the energy software to consider both demand and energy charges. Use the appropriate utility rate schedule in the energy model. Energy unit costs assumptions must be cited.

Maintenance costs should include all recurring and preventative maintenance costs and should be determined based on each technology selected and the current County maintenance capabilities. If contract maintenance is required, this may increase the cost of maintenance of a particular technology. If the NC State Construction manual does not include an appropriate maintenance cost, other maintenance engineering handbooks can be used to estimate maintenance hours. The County will provide hourly rates for maintenance when needed.

Economic life of each component should be considered in the LCCA. The economic life, or service life, is the time frame where the component costs less to operate and maintain than it would to replace it. See Appendix for the economic life table.

Annual Energy escalation should be considered in the LCCA and the inflation rates should be taken from the most recent version of the US Energy Information Administration Annual Energy Outlook.

Replacement or repair costs, if they are anticipated to be significant, should be annualized in the analysis for comparison.

WCG 1.3.5 Building Component Consideration

The building components selected should meet the current County building design guidelines and standards as well as pass technical, organizational and economic criteria to ensure the systems selected can be incorporated into the County's existing building inventory and be effectively operated and maintained.

The County has drafted building design guidelines which include comprehensive preferences for building design, materials and standards for building management systems and commissioning on projects.

While not a comprehensive list, the following table includes several technologies which could be considered during design.

TABLE 4: BUILDING COMPONENT CONSIDERATION

Envelope and Fenestration	• Additional Roof Insulation • High Reflectance Roof Membrane • Mass Wall • Additional Wall Insulation • Slab Insulation • Reduced Glazing Area • Advanced and Alternative Glazing Design • External Shading (Vertical and Horizontal) • Building Orientation • High Performance Windows • Air Barrier Technologies
Mechanical	• Demand Control Ventilation • Energy Recovery Ventilation • Condensing Boiler • Cooling System Comparison (DX vs. ACC vs. WCC) • Economizer (air, water) • Hot Water Recovery (condenser, blowdown) • Ground Source Heat Pump • Combined Resources (Campus heating/cooling)
Electrical	• High Performance Lighting (LED, Induction) • Lighting Controls • Daylighting Systems (Shades, Diffusers, Fixtures, Controls) • Energy Star Appliances
Plumbing	• High Efficiency Water Heater • Low Flow Fixtures
Water Conservation	• Rainwater Harvesting • Condensate Reclaim
Renewable Energy	• Solar PV • Solar Thermal

a) *Renewables*

Renewable energy technologies shall be considered in a similar manner to other building components or energy conservation measures by completing a life cycle analysis for decision making. Reducing energy consumption and carbon footprint through renewable energy utilization is preferred if the lifecycle cost and payback are advantageous, and the renewable energy technology is not inconsistent with other building systems and their life cycle replacement.

Designed with Solar

Where site conditions allow, new construction projects shall be designed with solar to offset buildings energy consumption. Both roof-mounted, parking-lot canopy, and ground-mounted solar PV should be considered to support the building's electrical loads.

The designer should incorporate a solar energy system throughout the design, including consideration of building orientation, site shading, roof structure, electrical infrastructure, and material selections. Sizing of the solar system should maximize available roof/site area while also meeting the net-metering requirements. The solar system can be listed as a bid alternate to ensure the project budget can be met, however the minimum building standard should be kept to "solar-ready" to allow a solar system to be installed without major infrastructure changes.

Guidance for "designed with solar" is as follows:

- Building Orientation, roof angles and site shading should support the installation of solar
- Identify ordinances which may affect the installation of solar
- Ensure structure is capable of carrying additional load, including wind load
- Minimize rooftop equipment and keep the south-facing section obstruction-free
- Design and select a compatible roofing system and confirm compliance with roof warranties. Identify and specify roof slip-sheet material.
- Design the electrical system for a net-metered solar PV system complying with the interconnection requirements of the utility including AC disconnects.
- Select an appropriate location for the inverters – interior is preferred.
- Where a phased approach is needed the full build out should still be designed.

b) *BMS*

Building management systems (BMS), also known as Building Automation Systems (BAS), shall be incorporated on buildings with sufficient complexity and in buildings over 7,000 ft^2. A meeting shall be held to determine the County's expectations regarding the complexity of the BMS design for the proposed project prior to the Design Development submittal. The BMS system should incorporate control of lighting, electrical and mechanical systems, and should provide useful measurement and trending of building energy use.

During design and construction, the designer should specify and confirm that the BMS sequence of operations programmed, properly takes advantage of energy efficiency features available from the BMS system and building components. The BMS system should incorporate:

- Scheduling – turning equipment on or off depending on the time of day, week, etc.
- Lockouts – Ensure that equipment does not come on unless necessary to protect against glitches
- Resets – adjust operating parameters based on external measurements such as outdoor air temperature or building load
- Ventilation Control – Economizer and Demand Control Ventilation sequences should maximize efficiency

For example, where condensing boilers are selected, the BMS system should control the boiler supply temperature to take advantage of the efficiency of the condensing operating range and raise the temperature only when necessary.

During construction the designer should confirm that the controls vendor has correctly interpreted the design sequence. Building commissioning should also confirm the programming functions according to the designer's intentions.

The designer should also confirm that appropriate trends are setup during construction so the long-term performance can be analyzed.

c) Submetering

Consumption from building utility meters provides a reliable means to determine monthly energy input into one or more building. They do not, however, offer insight into individual systems, system groups, parts of buildings, or provide a means to measure energy supplied to and from chiller and boiler plants which may serve large or multiple buildings.

The design team should make accommodations to allow the measurement of individual systems and plants on new construction and major renovation projects. Metering to be considered includes:

- Building Level
    - Electric Service
    - Natural Gas Service
- System Level
    - Chiller Plants
    - Boiler Plants
    - Building Systems
        - Mechanical
        - Lighting
        - Receptacles

Electric panel layout should allow for separate measurement of lighting, mechanical, and receptacle loads by grouping circuits in dedicated panels according to usage. Chiller and boiler plants should be equipped with monitoring of plant efficiency calculated from electrical, thermal and fuel flow measurements as necessary.

Submeters should be integrated with existing building management systems and allow for long term trending on database warehouse locations external from the BMS server or cloud. The County shall establish normalized data by type of submeter for relative reporting from disparate systems.

Accuracy

Electric meters installed for tracking building energy use should have revenue grade accuracy and meet Class 0.5 or better of ANSI C12.20. Meters within the building monitoring multiple circuits should have an accuracy of ANSI C12.1 or better.

Liquid flow meters used for the calculation of energy in water systems should have an accuracy of better than +/- 1%. If a separate BTU totalizer with flow and temperature inputs is not used, the BMS system shall be programmed to calculate energy on the field panel.

Liquid temperature sensors used in the calculation of energy flows should have an accuracy of less than 0.5 degrees C over the normal operating range.

Other sensors such as air temperature and relative humidity sensors that are not used to calculate energy can have industry standard accuracy.

● ● ● WCG 1.3.6 Commissioning

New buildings and major renovations will have commissioning agents working directly for the County through the design process. Division 24 of the County's design guideline speaks to the commissioning requirements and contains requirement for both design review and functional testing.

http://www.wakegov.com/projects/guidelines/Pages/DesignGuidelinesAndStandards.aspx

WCG 1.3.7 Post-Occupancy Review

One year after a new building has reached substantial completion and the building is occupied, the designer should perform a post-occupancy review. The goal of this review is to ensure the building is operating as intended and establish an accepted energy performance benchmark for the building. This is achieved by reviewing utility bills, and offering suggestions for improvement when needed.

The designer should provide the County with recommendations to improve operations as needed. The designer will give a final presentation to the Energy Advisory Commission to explain any discrepancies and provide the recommended corrective actions.

WCG 1.3.8 Reporting Forms

The design team should provide updates on the projects by using the Wake County reporting forms during each phase of the project.

WCG 1.4 Evaluation Process

Evaluation of building design alternatives, fleet vehicles, and other emerging technologies, will occur to determine feasibility within 3 categories and include recommendations by county staff to answer 3 basic questions 1) Will it Work? 2) Can we Support it? 3) Can we afford it? When technologies are being compared, greenhouse gas will be considered within technical and economic feasibility of relevant systems. The 3 evaluation categories are:

1. Technical – This review determines the soundness of energy design implementation with emphasis on integration into current building systems or fleet. When considering environmental benefits of technology, the value of reduced or offset greenhouse gas should be determined.

2. Organizational – Review of maintainability and integration of energy strategies and technologies into current building or fleet operations including staff capabilities, faculty and student requirements/impacts, parts and service availability, or other effects on normal business operations.

3. Economic – Determine energy design implementation cost, payback, lifecycle cost and evaluate possible sources of project funds if necessary. Greenhouse gas reductions will be considered on relevant systems within economic feasibility, provided that the technology meets both technical and organizational feasibility.

Staff Recommendation – A staff recommendation shall be based on feasibility of technical, organizational and economic characteristics.

This evaluation process will occur before any type of demonstration or pilot project/installations are performed.

Energy Status: Programming Reporting Form

Project Description

Project	
Submitted By	
Date	

Building Description Design Team

Building Type		Architect	
Gross Square Footage		Mechanical Engineer	
Comments		Electrical Engineer	

Description of Design Alternatives

The designer should provide a description of any design alternatives to perform a life cycle cost analysis on during schematic design. These design alternatives are intended to be above and beyond systems selected in the proposed design. This list should be reviewed and confirmed by County before submitting.

Energy Conserving Measure	Description

Renewable Energy System	Description
PV or Solar Thermal	

Energy Status: Schematic Design Reporting Form

Project Description

Project	
Submitted By	
Date	

Building Description Design Team

Building Type		Architect	
Gross Square Footage		Mechanical Engineer	
Comments		Electrical Engineer	

Version of ASHRAE standard used ____

Results of LCCA

The designer should provide a summary of the life cycle cost analysis and provide results including capital cost, annual savings, simple payback, and life cycle cost at an identified economic life.

Energy Conserving Measure	Description

Renewable Energy System	Description
PV or Solar Thermal	

Description of Proposed Design

The designer is to provide an overview of the proposed building components and the baseline building components for comparison. The baseline building should be code compliant and will serve as the baseline to compare against.

	Baseline Building System Description	Proposed Building System Description
Envelope		
Roof		
Walls, above ground *Description and overall U-Value for both*		
Walls, below ground		
Floors, below grade		
Fenestration		
Glazing Area		
Glazing *Description and overall U-Value and SHGC*		
Lighting		
Interior		
Exterior		
Mechanical		
Ventilation		
Heating System		
Cooling System		
Plumbing		
Water Heater		
Toilet Fixtures		
Lavatory Fixtures		

Energy Status: Design Development Reporting Form

Project Description

Project	
Submitted By	
Date	

Building Description Design Team

Building Type		Architect	
Gross Square Footage		Mechanical Engineer	
Comments		Electrical Engineer	

Energy Model Setpoints

	Occupied	Unoccupied
Cooling Setpoint		
Heating Setpoint		

Energy Model Results

	ASHRAE 90.1 Version:			
	Baseline		Proposed	
	% Consumption	kBTU/year	% Consumption	kBTU/year
Heating				
Cooling				
Pumps/Aux				
Ventilation				
Interior Lighting				
Plug Loads				
Hot Water				
Total Energy, kBTU				
Energy Cost, $				
Percent Energy Cost Below Baseline				
EUI				
Percent EUI Below Baseline				
EUI (*with on-site renewable generation if applicable)*				
Average Plug Load (w/ft2)				
Max Occupants (# people)				
Building Min OA (cfm)				

Water Consumption Results

	Baseline	Proposed
Water Consumption (kgal)		
Percent Below Baseline		

Energy Status: Construction Documents Reporting Form

Project Description

Project	
Submitted By	
Date	

Building Description Design Team

Building Type		Architect	
Gross Square Footage		Mechanical Engineer	
Comments		Electrical Engineer	

Monthly Energy Model Results

Monthly energy consumption should be provided by utility and equipment type. The following tables should be completed, or alternatively an energy model output can be attached provided that the output provides similar information.

Electric	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh
Heating												
Cooling												
Pumps/Aux												
Ventilation												
Interior Lighting												
Plug Loads												
Hot Water												

Fuel	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
	kBTU	kBTU	kBTU	kBTU	kBTU	kBTU	kBTU	kBTU	kBTU	kBTU	kBTU	kBTU
Heating												
Cooling												
Pumps/Aux												
Ventilation												
Interior Lighting												
Plug Loads												
Hot Water												

Energy Status: 1-Year Post Occupancy Reporting Form

Project Description

Project	
Submitted By	
Date	

Building Description Design Team

Building Type		Architect	
Gross Square Footage		Mechanical Engineer	
Comments		Electrical Engineer	

Monthly Comparison

The design should provide a comparison by month of the energy model versus the actual consumption of the building. The following tables should be completed, or alternatively a spreadsheet can be attached provided that the output provides similar information.

Electric	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh
Energy Model												
Utility Consumption												
% Difference												

Fuel	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
	kBTU	kBTU	kBTU	kBTU	kBTU	kBTU	kBTU	kBTU	kBTU	kBTU	kBTU	kBTU
Energy Model												
Utility Consumption												
% Difference												

	Proposed Consumption	Actual Utility Consumption
	kBTU	kBTU
Electric Consumption, kBTU		
Fuel Consumption, kBTU		
% Difference		

Is the percent difference less than 20%? Yes / No

Wake County Public School System

Wake County Public Schools consists of 27.2 million square feet of building area on over 5192 acres including 119 elementary, 41 middle, and 34 high schools. The district is committed to the design and construction of high-performing facilities to meet the needs of it rapidly growing student population. Building efficiency into school designs reduces the economic impacts associated with excessive energy use and reflects the priority of environmental stewardship in our community.

WCPSS 1.1 Target Building Performance

A high-performance building is defined as a facility that optimizes all major building attributes, including energy efficiency, durability, life-cycle performance and occupant productivity. A key energy programming criteria is performance. The following Energy Consumption Budgets and Goals were established as benchmarks upon which to judge a project's performance success. These parameters were derived by analyzing standards applicable to our immediate climatic area as well as project data for local projects of similar type, and are based upon 10 hours per day 12 months per year for typical annual operation.

TABLE 5: WCPSS BUILDING PERFORMANCE TARGETS

Building Type	Energy Consumption Budget (kBTU/sqft-yr)	Energy Consumption Goal (kBTU/sqft-yr)
Elementary School	39.6	32.4
Middle and High Schools	50.6	41.4
Other Buildings	(see note *)	(see note *)

The Energy Consumption Budget performance reflects a high-performing building with an anticipated performance at least 14% higher than the "baseline" prerequisite standard as defined by ASHRAE 90.1-2010. Building-specific energy models are created to compare various strategies to achieve higher efficiency, using criteria such as life- cycle cost benefit analyses to determine feasibility in design. These strategies may include alternative HVAC equipment, building controls, building envelope, and sustainable energy options. Achievement of the Energy Goal is considered to be excellent.

* If the building to be designed is not representative of any of the above categories, specific Energy Consumption Budget and Goal parameters shall be developed during the conceptual stage in collaboration with Wake County Government and the Design Team.

WCPSS 1.2 Designer Requirements

WCPSS 1.2.1 Sustainable Design Review Meeting

For all new construction and renovation projects over 20,000 ft2 the school system will require a sustainable design review meeting to evaluate the potential for sustainable design strategies based on the current LEED scorecard as well as the scope of the project. If during this meeting, LEED certification is found to have minimum cost impact on the project, certification may be pursued.

In addition, during this meeting, sustainable design elements will be identified for further consideration if LEED certification is not pursued. These elements include:

- Sensitive Land Protection
- Heat Island Reduction
- Rainwater Management
    - Rain Gardens
    - Bio swales
    - Other BMPs
- Indoor air quality
    - Tobacco/Smoke Control
    - Construction air quality management
- Low Emitting Materials

Renovation of abandoned or blighted buildings

WCPSS 1.2.2 Priorities for Energy Conservation Strategies

In addition to evaluating quantifiable energy models to optimize building systems, there are other key components with a significant impact on overall energy design. In general, it is desirable to incorporate natural energy solutions over mechanical solutions. Daylighting is a high priority in learning environments due to demonstrated health and increase in productivity, in addition to reduced energy consumption associated with lighting. According to the US Department of Energy, next-generation windows and advancing building envelope technologies have substantial technical potential to reduce energy consumption in buildings. Solutions should be used which have minimal environmental impact and result in better indoor air quality. Low maintenance solutions should be implemented to ensure a sustained level of performance over the life of the systems.

WCPSS 1.2.3 Building Component Consideration

On the following page, the table identifies most of the components that should be considered and analyzed by the designers in preparing life-cycle cost analysis for a project.

Envelope and Fenestration	• Additional Roof Insulation • High Reflectance Roof Membrane • Mass Wall • Additional Wall Insulation • Slab Insulation • Optimum Glazing Area • Window Performance (high R-value) • External Shading (Vertical and Horizontal) • Building Orientation • Air Barrier Technology
Mechanical	• Demand Control Ventilation • Energy Recovery Ventilation • Condensing Boiler • Cooling System Comparison (DX vs. ACC vs. WCC) • Economizer (air, water) • Ground Source Heat Pump • Combined Resources (Campus heating/cooling)
Electrical	• High Performance Lighting (LED) • Lighting Controls • Daylighting Systems (Shades, Diffusers, Fixtures) • Energy Star Appliances
Plumbing	• High Efficiency Water Heaters • Low Flow Fixtures
Water Conservation	• Rainwater Harvesting

a) BMS

Building management systems (BMS), also known as Building Automation Systems (BAS), shall be incorporated on buildings with sufficient complexity. A meeting shall be held to determine the County's expectations regarding the complexity of the BMS design for the proposed project prior to the Design Development submittal. The BMS system should incorporate control of lighting, electrical and mechanical systems, and should provide useful measurement and trending of building energy use.

During design and construction, the designer should specify and confirm that the BMS sequence of operations programmed properly takes advantage of energy efficiency features available from the BMS system and building components. The BMS system should incorporate:

- Scheduling – turning equipment on or off depending on the time of day, week, etc.
- Lockouts – Ensure that equipment does not come on unless necessary to protect against glitches
- Resets – adjust operating parameters based on external measurements such as outdoor air temperature or building load
- Ventilation Control – Economizer and Demand Control Ventilation sequences should maximize efficiency

For example, where condensing boilers are selected, the BMS system should control the boiler supply temperature to take advantage of the efficiency of the condensing operating range and raise the temperature only when necessary.

During construction the designer should confirm that the controls vendor has correctly interpreted the design sequence. Building commissioning should also confirm the programming functions according to the designer's intentions.

The designer should also confirm that appropriate trends are setup during construction so the long-term performance can be analyzed.

WCPSS 1.2.4 Life-Cycle Analysis

The purpose of a life-cycle analysis is to compare alternative design options available to select the most cost-effective design option. The life-cycle cost analysis shall be certified by a registered professional engineer or bear the seal of a North Carolina registered architect, or both as required by the respective licensing board.

1. Components studied by a life-cycle cost analyses include (but not limited to) the following:
   - The amount and type of fenestration employed in the facility;
   - Mechanical and electrical systems;
   - Thermal characteristics of materials incorporated into the facility design.

2. Calculation of the cost of each system being compared shall consider the following elements:
   - Initial cost
   - The estimated annual operating cost of all associated utilities;
   - The estimated annual cost of maintaining each system; and
   - The estimated replacement cost for each system expressed in annual terms

- Useful life of systems
- Energy annual inflation rate
- Equipment replacement annual inflation rate

3. The Designer shall use the life-cycle cost analysis over the life expectancy of the facility in selecting the optimum system or combination of systems to be incorporated in the design of the facility. The energy consumption analysis of systems in a facility shall simulate each system over the entire range of operation of the facility for a year's operating period, considering the **expected** load (based on weather and other data) rather than full or rated outputs.

a) Criteria for Life-Cycle Cost Analysis

A life-cycle cost analysis shall be used to evaluate the cost effectiveness of various design options to be implemented in building design. Incorporating life-cycle cost approaches throughout design ensures that all reasonable energy options are considered.

A comprehensive LifeCycle Cost Analysis (LCCA) method is available for reference by the North Carolina State Construction Office at the following link:

https://ncadmin.nc.gov/document/lccalcca-manual

Energy inflation price indices are available on the National Institute of Standards and Technology (NIST) website in its most recent annual supplement to Handbook 135. These energy price indices shall be used in preparing life cycle cost analyses.

Additional financial information for use in preparing LCC analyses such as inflation rates or bond financing in North Carolina are available on the State Construction Office website.

b) Timeframe for Life-Cycle Cost Analysis

The "estimated life" of the measure determines the period over which the life-cycle cost analysis is to be run. If the project involves a new building, the estimated life would be longer than that of a renovated structure. Likewise, building shell component decisions should be viewed in a larger context than equipment which is often replaced by new technologies. To provide a guide for the design team, the following timeframes are to be used in the modified life-cycle analysis. This modified approach (which multiplies the projected life of the facility time a factor or percentage) reflects a balance between what is best for the life of the facility and the importance of keeping initial cost low.

Type Of Measure	Projected Life Of Facility	Timeframe For LCC Analysis (% And Years)
New Construction		
Building Shell (Thermal Envelope)	50 years	50%, 25 years
Maintenance Facilities	30 years	50%, 15 years
Mechanical Equipment, Electrical, Lighting and Controls		
Renovation		
Building Shell (Thermal Envelope)	*	50% *
Maintenance Facilities		
Mechanical Equipment, Electrical, Lighting and Controls	30 years	50%, 15 years

* On renovation projects, the design team will recommend the projected remaining useful life of the facility or equipment. This projected life figure should be multiplied by the percentages listed above in order to determine the actual number of years to use in the modified life-cycle cost analysis.

WCPSS 1.2.5 Commissioning

New buildings and major renovations will have commissioning agents working directly for the County through the design process. Division 1 of the Wake County Public School System's design guideline speaks to the commissioning requirements and contains requirement for both design review and functional testing.

https://www.wcpss.net/Page/251

WCPSS 1.2.6 Reporting Forms

The Designer must prepare and submit an Energy Status Report at each phase of the design. The reporting form, which is included at the end of the section, is intended to aid the designer in monitoring the energy efficiency targets established in this Guideline. The following reporting forms should be completed at each stage in project design.

Energy Status: Schematic Development Reporting Form

Project Description

Project	
Submitted By	
Date	

Building Description Design Team

Building Type		Architect	
Gross Square Footage		Mechanical Engineer	
Comments		Electrical Engineer	

Energy Consumption

Energy Budget (kBTU/sqft-yr)	
Energy Target (kBTU/sqft-yr)	
Energy Projection (kBTU/sqft-yr)	

Energy Model Results

	% Consumption	kBTU/year
Heating		
Cooling		
Pumps/Aux		
Ventilation		
Interior Lighting		
Plug Loads		
Hot Water		

Average Plug Load (w/ft2)	
Max Occupants (# people)	
Building Min OA (cfm)	

Anticipated Energy Sources and Systems to be Used

	Fuel/Energy Source	Description
Heating		
Cooling		
Hot Water		
Lighting		
Fire Pump		
Generator		

Energy Status: Design Development Reporting Form

Project Description

Project	
Submitted By	
Date	

Building Description Design Team

Building Type		Architect	
Gross Square Footage		Mechanical Engineer	
Comments		Electrical Engineer	

Energy Consumption

Energy Budget (kBTU/sqft-yr)	
Energy Target (kBTU/sqft-yr)	
D.D. Energy Projection (kBTU/sqft-yr)	
S.D. Energy Projection (kBTU/sqft-yr)	

Energy Model Results

	% Consumption	kBTU/year
Heating		
Cooling		
Pumps/Aux		
Ventilation		
Interior Lighting		
Plug Loads		
Hot Water		

Average Plug Load (w/ft2)	
Max Occupants (# people)	
Building Min OA (cfm)	

Anticipated Energy Sources and Systems to be Used

	Fuel/Energy Source	Description
Heating		
Cooling		
Hot Water		
Lighting		
Fire Pump		
Generator		

Energy Status: Construction Documents Reporting Form

This form will be used for the 60% CD phase as well as and 100% CD Phase

Project Description

Project	
Submitted By	
Date	

Building Description Design Team

Building Type		Architect	
Gross Square Footage		Mechanical Engineer	
Comments		Electrical Engineer	

Energy Consumption

Energy Budget (kBTU/sqft-yr)	
Energy Target (kBTU/sqft-yr)	
C.D. Energy Projection (kBTU/sqft-yr)	
D.D. Energy Projection (kBTU/sqft-yr)	
S.D. Energy Projection (kBTU/sqft-yr)	

Energy Model Results

	% Consumption	kBTU/year
Heating		
Cooling		
Pumps/Aux		
Ventilation		
Interior Lighting		
Plug Loads		
Hot Water		

Average Plug Load (w/ft2)	
Max Occupants (# people)	
Building Min OA (cfm)	

Energy Status: Bidding Phase Reporting Form

Project Description

Project	
Submitted By	
Date	

Building Description Design Team

Building Type		Architect	
Gross Square Footage		Mechanical Engineer	
Comments		Electrical Engineer	

Energy Consumption

Energy Budget (kBTU/sqft-yr)	
Energy Target (kBTU/sqft-yr)	
Bidding Phase Energy Projection (kBTU/sqft-yr)	
C.D. Energy Projection (kBTU/sqft-yr)	

Energy Model Results

	% Consumption	kBTU/year
Heating		
Cooling		
Pumps/Aux		
Ventilation		
Interior Lighting		
Plug Loads		
Hot Water		

Average Plug Load (w/ft2)	
Max Occupants (# people)	
Building Min OA (cfm)	

Wake Technical Community College

Wake Technical Community College (Wake Tech) consists of 2.76million square feet of building area located at 7 campuses and 2 centers, including classrooms, offices, auditoriums, meeting spaces, shop areas, labs, and gymnasiums, among others. Designing and targeting the energy performance of these buildings follows the US Green Building Council (USGBC) - LEED program and/or the Green Building Initiative (GBI) – Green Globes Program, as well as the State of North Carolina Legislative requirements. In addition, Wake Tech wishes to incorporate sustainable design elements into each building to provide a productive, energy efficient, and healthy environment for students, faculty, staff and citizens.

WTCC 1.1 Sustainable Design and Certification

Wake Technical Community College adheres to NC General Statute 143-64.10 Conservation of Energy, Water, and Other Utilities in Government Facilities; NC General Assembly Session Law 2007-546, Senate Bill 668 An Act to Promote The Conservation of Energy and Water Use in State, University, and Community College Buildings; and NC Governor Roy Cooper's Executive Orders, EO80 & EO246. The main objectives of sustainable, energy efficient design is to avoid resource depletion of energy, water, and raw materials; prevent environmental degradation caused by facilities and infrastructure throughout their life cycle; and create buildings that are livable, comfortable, safe, and productive. Please refer to the following links to obtain these documents:

https://www.ncleg.net/enactedlegislation/statutes/html/byarticle/chapter_143/article_3b.html

https://www.ncleg.net/sessions/2007/bills/senate/html/s668v6.html

https://governor.nc.gov/documents/executive-order-no-80-north-carolinas-commitment-address-climate-change-and-transition

https://governor.nc.gov/executive-order-no-246

All applicable new construction and major renovation projects of 5,000 gross ft2 or greater commencing design after January 1, 2010 shall be designed and constructed in accordance with the current version of either: LEED for New Construction Green Building Rating System, as published by the US Green Building Council, or Green Globes Certification, as published by the Green Building Initiative. Sustainable design elements should be incorporated into each project concentrating on those which provide value and cost savings. While LEED and/or Green Globes certification may not be a requirement for all projects, certification will be pursued for projects which can attain certification for little additional cost.

WTCC 1.2 Building Performance Target

The design team must create an efficient design that should meet or exceed energy efficiency targets referenced below.

TABLE 6: WAKE TECHNICAL COMMUNITY COLLEGE BUILDING PERFORMANCE TARGET

Energy	Demonstrate a 15% reduction in energy compared with the baseline building according to the current North Carolina State Building Code or meet the objectives of the most recently published version of ASHRAE 90.1.
Water	Demonstrate a 25% reduction in water consumption compared with the baseline building according to current North Carolina State Building Code.

The targets were developed by referencing the Optimize Energy Performance and Indoor Water Use Reduction credits in LEED and/or Green Globes. Except for the specific requirements in this guideline, the LEED / Green Globes methodology should be referenced.

WTCC 1.3 Designer Requirements

The designer should keep the College informed of energy saving design alternatives and associated life-cycle cost to help in the decision-making process. The College requires certain items to be incorporated into the building, such as submetering and solar-ready design, and may require the designer to perform certain tasks such as presentations to the Wake Technical Community College Board of Trustees, Life Cycle Cost Analysis for design alternatives, energy modeling specifics and completion of energy status reporting forms, and provide assistance for the College's Energy Efficiency Programs (Rebates, Incentives, and Allocations).

Wake Technical Community College adheres to the North Carolina State Construction Manual, latest edition, which obligates designers to follow specific requirements throughout the project's development. Please refer to the following link to obtain the latest edition of this manual:

https://ncadmin.nc.gov/construction-manual-0

WTCC 1.3.1 Sustainable Design Review Meeting

The College has instituted a number of strategies to support the development of a sustainable campus. Designers working on a Wake Tech campus are requested to partner in these efforts by striving to identify sustainable design opportunities. Design teams are expected to conduct a charrette early in the design process to involve stakeholders in planning for energy efficiency, water efficiency, solid waste reduction, land preservation and other aspects of sustainable development. Ideas will be evaluated by the project team for feasibility within the constraints of project program, budget and schedule. Each project shall include and has been budgeted to include, but not limited to; building envelope commissioning, energy modeling, commissioning of HVAC systems, tie-ins to the campus energy management system, metering and submetering to facilitate the collection of energy data, stormwater management, and construction waste recycling.

The college recognizes the USGBC's LEED / GBI's Green Globes rating system as the most widely accepted standard for evaluating sustainability of the built environment. Each project is expected to incorporate measures that would enable an acceptable and documented return on investment, as well as adherence to the Campus Design Guidelines. A LEED / Green Globes checklist is to be included with each design submittal indicating current performance objectives. Supporting documentation outlining the strategies that will be employed to achieve energy and water efficiency should also be included. The College will elect to seek LEED / Green Globes Certification on a project-by-project basis. The exception is the conditional development of our RTP Campus per the Wake Technical Community College Rezoning Petition dated January 27, 2015 where the Town of Morrisville requires WTCC to obtain certification from the US Green Building Council, the Green Building Initiative or comparable certification that provides an equivalent level of sustainability practices for all buildings on the site whose primary purpose is for educational services.

WTCC 1.3.2 Building Management Systems

Building management systems (BMS), also known as Building Automation Systems (BAS), shall at a minimum be incorporated on larger buildings with sufficient complexity in new construction and major building renovations where applicable. The College maintains a separate Building Automation System Guideline (BAS Guideline) that is intended to provide design professionals, contractors, vendors, service personnel, operators and others involved in building operations at Wake Tech with an understanding of the fundamental requirements of the Building Automation Systems (BAS). The latest version of the BAS Guideline shall be provided to the designer or contractor and shall take precedent over this document, if contradictions exist. A meeting shall be held to determine the expectations regarding the complexity of the BMS design for the proposed project prior to the Design Development submittal. . The BMS system may incorporate control of lighting, electrical systems, mechanical systems, and other connected systems to provide useful measurement and trending of building energy use.

- During design and construction, the designer should specify and confirm that the BMS sequence of operations programmed properly takes advantage of energy efficient features available from the BMS system and building components. The BMS system should include, but is not limited to the following:
- Scheduling – Turning equipment on or off depending on the time of day, week, etc.
- Trending – Recording historic point data.
- Alarms – Generate notifications when operating parameters are not satisfied.
- Lockouts – Ensure that equipment does not come on unless necessary to protect against glitches.
- Resets – Adjust operating parameters based on external measurements such as outdoor air temperature or building load.
- Ventilation Control – Economizer and Demand Control Ventilation sequences should maximize efficiency.

During construction the designer should confirm that the controls vendor has correctly interpreted the design sequence. Building commissioning should also confirm the programming functions according to the designer's intentions.

The designer should also confirm that appropriate trends are setup during construction so the long term performance can be analyzed.

The College utilizes analytics software that is integrated into the BAS. Both the designer & commissioning agent shall confirm that appropriate trends are setup in this software during construction so that building performance can be analyzed.

● ● WTCC 1.3.3 Submetering

Consumption from building utility meters provides a reliable means to determine monthly energy input into one or more buildings. They do not, however, offer insight into individual systems, system groups, parts of buildings, or provide a means to measure energy supplied to and from chiller and boiler plants, which may serve large or multiple buildings. The College maintains a separate Metering Guideline that is intended to provide design professionals with a detailed understanding of a building's submetering requirements. The latest version of the Metering Guideline will be provided to the designer and shall take precedent over this document, if contradictions exist.

The design team should make accommodations to allow the measurement of individual systems and plants. Metering to be considered includes:

- Building Level
  - Electric Service
  - Natural Gas Service
  - Domestic Water
  - Reclaimed Water
  - Sewer (Energy Plants only)
- Building Systems
  - Chiller Plants
  - Boiler Plants
  - Mechanical
  - Lighting
  - Plumbing
  - Receptacles
  - Connected Building Systems (i.e. PV Arrays)

Electric panel layout should allow for separate measurement of lighting, mechanical, and receptacle loads by grouping circuits according to usage. Chiller and boiler plants should be equipped with monitoring of plant efficiency calculated from electrical, thermal and fuel flow measurements, as necessary.

Submeters should be integrated with existing building management systems and allow for long-term trending.

Meter Accuracy

Electric meters installed for tracking building energy use should have revenue/utility grade accuracy and meet Class 0.5 or better of ANSI C12.20. Meters within the building monitoring multiple circuits should have an accuracy of ANSI C12.1 or better.

Liquid flow meters used for the calculation of energy in water systems should have an accuracy of better than +/- 1%. If a separate BTU totalizer with flow and temperature inputs is not used, the BMS system shall be programmed to calculate energy on the field panel.

Liquid temperature sensors used in the calculation of energy flows should have an accuracy of less than 0.5 degrees C over the normal operating range.

Other sensors such as air temperature and relative humidity sensors that are not used to calculate energy can have industry standard accuracy.

● ● WTCC 1.3.4 Renewables

Renewable energy technologies should be considered in a manner similar to other building components or energy conservation measures by completing a life cycle analysis for decision making.

Solar Ready Buildings

New construction projects should be built to a "solar-ready" standard. The standard, defined in this section, applies to roof-mounted and ground-mounted solar PV that would feed into the building's electrical systems.

The designer should identify adequate, maintainable, and unshaded roof area for solar and identify the standard output capacity based on this area. The drawing should be provided to the College in an architectural and electrical drawing, for future use. The conduit sizing should be based on this maximum size build out.

Guidance for solar-ready is as follows:

- Buildings should not incorporate elements which could preclude the installation of solar thermal or solar PV during or after construction.
- Avoid shading from trees, buildings, etc.
- Check zoning in the area to ensure future construction will not cast a shadow on the array.
- Identify ordinances which may affect the installation of solar.
- Keep the south-facing section obstruction-free.
- Minimize rooftop equipment.
- Select a compatible roofing system and consider roof warranties.

- Identify areas for future PV array and estimate full build-out capacity and provide an outline drawing.
- Ensure structure is capable of carrying additional load, including wind load.
- Specify electric panel capacity sufficient to accommodate total power coming into the building (PV plus breaker protecting main).
- Identify electric panel location and spare breaker location for PV interconnection.
- Install conduit pathways sized to full build out including roof penetrations and external disconnects per the utility requirements for AC disconnects. Adequate interior space within an electrical room should be provided for future inverter & related equipment location.

WTCC 1.3.5 Emerging Technologies

When emerging technologies are presented as alternatives to traditional building systems, the College will take a systematic approach to evaluate the appropriateness of investment. The design team should help the College through this process, including reviewing the technical and economic aspects of the technology. The College will determine if the technology meets design guidelines and standards as well as pass technical, organizational and economic criteria to ensure the systems selected can be incorporated into the College's existing building inventory and be effectively operated and maintained.

For example, if a new chiller technology is considered for design, this chiller must be technically sound, have an economic payback, and be easily and cost effectively maintained by the College, meaning good parts and service availability for the particular chiller technology.

Evaluation Process

Evaluation of design alternatives and or emerging technologies, will occur to determine feasibility within 3 categories and include recommendations by staff to answer 3 basic questions 1) Will it work? 2) Can we support it? and 3) Can we afford it? When technologies are being compared, greenhouse gas will be considered within technical and economic feasibility of relevant systems. The 3 evaluation categories are:

1. Technical – This review determines the soundness of energy design implementation with emphasis on integration into current building systems. When considering environmental benefits of technology, the value of reduced or offset greenhouse gas should be determined.

2. Organizational – Review of maintainability and integration of energy strategies and technologies into current operations including staff capabilities, faculty and student requirements/impacts, parts and service availability, or other effects on normal business operations.

3. Economic – Determine energy design implementation cost, payback, lifecycle cost and evaluate possible sources of project funds, if necessary. Greenhouse gas reductions will be

considered on relevant systems within economic feasibility, provided that the technology meets both technical and organizational feasibility.

Staff Recommendation – A staff recommendation shall be based on feasibility of technical, organizational and economic characteristics.

This evaluation process will occur before any type of demonstration or pilot project/installations are performed.

● ● ● WTCC 1.3.6 Commissioning

New buildings will have commissioning agents working directly for the College from design through project closeout. Refer to commissioning guidelines listed in the State Construction Manual, LEED and/or Green Globes, and SB668, as noted earlier in this document.

WTCC 1.3.7 Measurement and Verification

Measurement and verification (M&V) should be performed on new buildings and Energy Conservation Measure (ECM) projects. The goal of measurement and verification is to establish an accepted energy performance benchmark for the building or verify the real actualized savings of an ECM.

● ● ● WTCC 1.3.8 Post-Occupancy review

After a new building has reached substantial completion and the building is occupied, the designer shall request to receive from the College the building's energy and water consumption, BMS trends, and data analytics from the College's SkySpark program. The intent is for the designer to receive this on a monthly basis for one year after project completion to ensure that the building is operating as expected and to give the designer an opportunity to suggest changes to the building sequence and settings to make the building run efficiently, as designed and modeled.

After this one-year period the designer will provide the College with a post occupancy review of the building's Energy Use Intensity (EUI, in kBTU/sf) and water use (in gallons/year). This review to verify performance shall include measurements from submeters or utility meters , and measurements from building operational performance to include HVAC and lighting schedules, BMS trends, and data analytics. If the average building energy or water consumption over the one-year period following the date of beneficial occupancy is greater than 10% of the EUI performance goals established by the building model, the designer, College, electrical contractor, mechancial contractor, controls contractor, Contract Manager at Risk, and commissioning agent shall investigate, determine the cause of the shortfall, recommend and implement corrections or modifications to meet performance goals, as required in SB 668.

WTCC 1.3.9 Reporting Forms

The design team should provide updates on the projects by using the reporting forms found on the NC State Construction Office website, forms & documents page, as referenced by the following link: https://files.nc.gov/ncdoa/documents/files/EEREPORT.pdf

Chapter 2: Energy Management Guidelines

Energy management includes ongoing efforts to measure, maintain, control and minimize the energy consumption of the existing building portfolio. This Chapter describes and references both methods and policies which allow for continuing improvements in system energy performance.

Wake³ Partnership

The three partners in this guideline Wake County Government, Wake County Public Schools, and Wake Technical Community College (Wake Tech) have each provided a section which references individual policies. As with Chapter 1 (energy design), Chapter 2 (energy management) contains both common and specific activities for the individual organizations.

Wake3 2.1 Annual Meeting

Each organization partnered in this guideline have staff responsible for maintenance, utility billing, building automation and management systems, and implementing energy conservation measures. The staff responsible for such activities will assemble annually to share lessons learned from recent construction projects, energy conservation projects, and ongoing maintenance as well as review the energy consumption metrics. Annual meetings will be held at the beginning of each fiscal year.

Wake3 2.2 Annual Energy Metrics

The Wake³ partners will share annual energy data and combine in a common format. This data will be reviewed annually at the Wake³ meeting. The data includes portfolio totals for energy and water consumption as well as energy rate and weather information for comparisons. The following is an example format for the shared metrics.

Fiscal Year Annual Energy Metrics

Fiscal Year:

Annual Energy and Water		
Wake3 Partners		
Energy Use Intensity		kBTU/sqft-yr
Water Consumption		kgal/sqft-yr
Building Footprint		Sqft

	Wake County Government	Wake Technical Community College	Wake County Public Schools
Energy Use Intensity			
Water Consumption			
Building Footprint			

Energy Rate Changes[1]

Weather Data Comparison[2]

[1] Average rate changes for electric and natural gas
[2] Percent difference in the current year vs the typical meteorological year

Wake County Government

All Wake County employees shall share in the responsibility of energy conservation and shall be diligent in their efforts to conserve resources and use energy efficiently. Because of the complex environmental, economic and social consequences of the use of finite energy resources, appropriate procedures operation and maintenance of buildings.

The Energy Conservation and Management Policy was adopted by the Wake County Board of Commissioners in 1992 in order to encourage energy efficiency and improve environmental quality in Wake County's public facilities. The policy formed the basis for the development of the energy design guidelines as well as ongoing activities related to energy management.

Key staff in the Wake County General Services Administration have the primary responsibility for energy billing, budgeting, measurement, building management controls and implementation of energy conservation and renewable energy projects. These activities are part of the larger responsibility shared by all County staff.

WCG 2.1 Utility Data Management and Analysis

To manage and minimize energy consumption, energy must be measured and analyzed. This data can then be used to identify and understand where energy is being used and how it is trending long term. Wake County stores utility and building management data and uses the data to update the utility forecast and budget, to conduct utility rate analysis and/or bill audits, to check for anomalies or upward consumption trends and for measurement and verifications of energy conserving projects. This data is key to identifying service needs and where energy conservation projects can have the most impact.

WCG 2.2 Building Management System

Most buildings with sufficient complexity over 7,000 ft2 are equipped with Building Management Systems and assist with energy efficiency.

WCG 2.2.1 Building Occupancy

Building occupancy is scheduled through the building automation system according to the program schedule with time for support activities such as security and housekeeping. When staff must use the building outside of normal operating hours local override buttons can be used to extend HVAC and lighting schedules.

WCG 2.2.2 Temperature Control

Building thermostats can be controlled locally within the building to within +/- 2 degrees of set point. Building thermostat will have default settings through the building automation system to the following setpoints:

Heating Setpoint: 70 °F
Cooling Setpoint: 74 °F

WCG 2.2.3 Lighting Control

Many larger buildings have lighting relay panels which are controlled through the building management system. Lights are turned off during unoccupied periods, but can be overridden on with an override button.

WCG 2.3 Energy Conservation Projects

Projects with the sole purpose of reducing energy or water consumption are identified as energy conservation measures and are implemented based on life cycle analysis and elevated when cost savings and reasonable system payback are expected and ongoing maintenance issues are eliminated. ECMs are funded by operating or capital dollars but must demonstrate real, tangible energy savings.

Measurement and verification (M&V) should be performed on Energy Conservation Measure (ECM) projects. The goal of measurement and verification is to verify the real actualized savings of an ECM and ensure that the savings justified the intent of the project. The M&V approach used will vary based on the type of project. For instance, a whole building using the utility meters could be used where projects affect a large area of the building while an isolated approach could be used where a single building system is affected.

WCG 2.4 Emerging Technologies

When emerging technologies are presented as alternatives to traditional building systems, the County will take a systematic approach to evaluate the appropriateness of investment. The design team should help the County through this process, including reviewing the technical, organizational and economic aspects of the technology. If outside of the design process, the county may elect to assign a design consultant or determine feasibility in house. The County will determine if the technology meets design guidelines and standards as well as pass technical, organizational and economic criteria to ensure the systems selected can be incorporated into the County's existing building inventory and be effectively operated and maintained.

For example, if a new chiller technology is considered, this chiller must be technically sound and integrate within design, must fit within the service skill set and have cost effective and available parts and service, and must possess an economic payback.

WCG 2.4.1 Research and Development

Emerging technologies which do not meet the economic feasibility requirement could still be considered as a research and development project. Those technologies which provide tangible and long term technical and organizational benefits can be considered a research and development project given that the market is proven to be developing to provide economic feasibility in the future.

The County may elect to pilot a new technology, however the pilot project must not affect or interrupt current County operations and cannot adversely affect or harm the existing buildings systems. Vendors of approved Pilot Projects introducing technologies with the potential to effect broader building systems must have sufficient insurance to protect County assets or the Pilot Project shall be canceled. Vendors shall abide by all County rules and sign a license agreement binding them to such requirements.

WCG 2.4.2 Evaluation Process

Evaluation of emerging technologies will occur as defined in WCG 1.4 Evaluation Process.

Wake County Public School System

Wake County Public School System takes pride in their ongoing efforts to support the learning experience of over 150,000 students. The Energy and Physical Plant (EPP) within the Maintenance & Operations department maintains and provides quality service to students, faculty, and staff to enhance learning and teaching in a safe and comfortable environment. EPP maintains the systems that are contained in nearly 20 million square feet of buildings. EPP keeps the lights on, the rooms cool in the summer and warm in the winter and the facilities running efficiently through Utility Data Management, Building Management System Control, and Preventative Maintenance.

WCPSS 2.1 Utility Data Management and Analysis

Utility data is monitored and audited by the Energy & Physical Plant department on a continual basis. Excessive usage is identified, investigated for cause, and addressed by maintenance. Annual rate analysis is conducted on all accounts to ensure that the most advantageous rate structures are applied. Utility management software is utilized for charting, trending, and historical analysis.

WCPSS 2.2 Building Management System

WCPSS 2.2.1 Building Occupancy

Building occupancy is scheduled through the building automation system according to the published school calendar and bell schedule. Occupied hours begin one hour before the opening bell for the school day and continue until one hour after the dismissal bell. In unoccupied mode the building temperatures will be set back for energy savings. Administrative areas are scheduled for occupancy from 7am to 5pm, Monday through Friday (excluding holidays) all year, regardless of the school calendar. Media centers are also scheduled to be occupied during this time in an effort to control humidity in the space.

WCPSS 2.2.2 Temperature Set Points

When the building is scheduled to be occupied the temperature set points are 75F for cooling and 68F for heating. In an effort to save energy, the set points are relaxed when the building is unoccupied. During the unoccupied times the temperature set points are 82F in cooling season and 55F in heating season. All sensors are accurate to within +/- 2 degrees of set point.

WCPSS 2.2.3 Timed Override

School facilities have timed override buttons installed to allow school personnel to override the Building Automation System and turn on the HVAC systems for specific zones in the school for one hour at a time. This is a supplement to the scheduling feature in the Building Automation System that is designed to allow users to control specific areas of the building in the event there is unplanned usage required.

WCPSS 2.2.4 After Hours Use

When staff must use the building outside of normal operating hours local override buttons should be used to maintain occupied set points for a period of one hour. Should a planned gathering of staff, students, or parents after hours require HVAC, a schedule request must be submitted to the energy management department via the work order system prior to the event.

WCPSS 2.2.5 Overnight Exterior Lighting

Exterior lighting at most campuses is provided by a combination of area lights leased from the utility and exterior lights attached to the building. The Building Automation System has been programmed to reduce the hours that the building-mounted exterior lights operate. The lights are now turned on at sundown and de-energized 10 minutes after the school's security system is armed (indicating that the site is unoccupied). The lights are then re-energized at 5:30 AM, and turned off again at sunrise. If there are night events at the school, the lights will be turned on whenever an area of the building is scheduled to be occupied by the BAS between sundown and 11:00 PM. Parking lot and pole mounted area lights are not affected by these measures, and continue to operate from dusk to dawn via photocell control.

WCPSS 2.3 Preventative Maintenance

Preventive maintenance is performed at manufacturer recommended frequencies on all major mechanical equipment, ie. Chillers, boilers, cooling towers, air handlers, and fans, to ensure that they are functioning at optimal efficiency.

Wake Technical Community College

Wake Technical Community College (Wake Tech) staff, faculty, students, and contracted service providers share in the responsibility of energy conservation and are diligent in their efforts to conserve resources and use energy efficiently. Wake Tech utilizes appropriate procedures in the operation and maintenance of buildings to ensure that facilities function at peak energy performance.

Wake Technical Community College adheres to SB668, the General Assembly of North Carolina, Session Law 2007-546, Senate Bill 668, An Act to Promote the Conservation of Energy and Water Use in State, University, and Community College Buildings. The main objective of sustainable, energy efficient design is to avoid resource depletion of energy, water, and raw materials; prevent environmental degradation caused by facilities and infrastructure throughout their life cycle; and create buildings that are livable, comfortable, safe, and productive. Each community college is required to submit to the State Energy Office an annual written report of utility consumption and costs. Wake Tech strives to exceed the State goal to reduce energy consumption per gross square foot goal for all buildings in total by thirty percent (30%) based on energy consumption for the 2003-2004 fiscal year. Please refer to the following link to obtain this document:

https://www.ncleg.net/sessions/2007/bills/senate/html/s668v6.html

Key staff in Facilities Operations at Wake Tech have the primary responsibility for energy bill monitoring, budgeting, measurement, Building Automation System (BAS) controls, and implementation of energy conservation and renewable energy projects. These activities are part of the larger responsibility shared by all Wake Tech staff, faculty & students.

WTCC 2.1 Utility Data Management and Analysis

To manage and minimize energy consumption, energy must be measured and analyzed. This data can then be used to identify and understand where energy is being used and how it is trending daily, weekly, month-to-month, and long term. Wake Tech stores detailed utility billing information (usage & costs) accumulated monthly and stores BAS trend data, and uses these data sources to update the utility budget, and check for anomalies and upward consumption trends. This data is key to identifying maintenance needs and targeting where energy conservation projects can have the most impact for the College.

WTCC 2.2 Energy Conservation Projects

Projects with the sole purpose of reducing energy or water consumption are identified as Energy Conservation Measures (ECM) and are implemented based on life cycle analysis and elevated when relieving ongoing maintenance issues. ECMs are funded by the Energy Efficiency Fund, Operating or Capital Improvement Program (CIP) dollars, but must demonstrate real, tangible energy savings. A Measurement & Verification process may be completed to ensure that the savings justified the intent of the project.

WTCC 2.3 Emerging Technologies

When emerging technologies are presented as alternatives to traditional building systems, the College will take a systematic approach to evaluate the appropriateness of investment. The design team should help the College through this process, including reviewing the technical and economic aspects of the technology. The College will determine if the technology meets design guidelines and standards as well as pass technical, organizational and economic criteria to ensure the systems selected can be incorporated into the College's existing building inventory and be effectively operated and maintained.

For example, if a new chiller technology is considered for design, this chiller must be technically sound, have an acceptable economic payback, and be easily and cost effectively maintained by the College, meaning good parts and service availability for the particular chiller technology.

WTCC 2.3.1 Research and Development

Emerging technologies which do not meet the economic feasibility requirement may still be considered as a research and development project. Those technologies which provide tangible and long term technical and organizational benefits can be considered a research and development project given that the market is proven to be developing to provide economic feasibility in the future.

The College may elect to pilot a new technology, given these types of projects do not affect current College operations and do not adversely affect or harm the existing building systems. Those technologies with the potential to effect broader building systems must have sufficient insurance to protect College assets.

WTCC 2.3.2 Evaluation Process

Evaluation of emerging technologies will occur as defined in WTCC 1.3.5 Evaluation Process.

Appendix A: Energy Conservation and Management Policy (Wake County Government)

ADOPTION OF RESOLUTION

ENERGY CONSERVATION AND MANAGEMENT POLICY

FOR WAKE COUNTY BUILDINGS

The Wake County Citizens' Energy Advisory Commission has developed an Energy Conservation and Management Policy for Wake County Buildings. All Wake County employees shall share in the responsibility for implementation of this energy policy and shall be diligent in their efforts to conserve resources and use energy efficiently.
At the Administration Committee meeting held April 27, 1992, the Committee recommended to the full Board that approval be given to the Energy Conservation and Management Policy for Wake County buildings.

ENERGY CONSERVATION AND MANAGEMENT POLICY

All Wake County employees shall share in the responsibility for implementation of this energy policy and shall be diligent in their efforts to conserve resources and use energy efficiently. Because of the complex environmental, economic and social consequences of the use of finite energy resources, appropriate procedures shall be employed in the design, construction, operation and maintenance of buildings and in the purchase, operation and maintenance of equipment and vehicles.

1. The County Manager shall initially designate one staff person to serve as Energy Conservation Advisor to all employees regarding implementation of energy conservation policies and procedures.
2. Wake County shall employ appropriate staff and consultants whose assigned responsibilities include the development and implementation of energy conservation programs.
3. The Energy Conservation Advisor shall determine annually an energy consumption goal to be used in budget preparation.

   Budget requests for the operation and maintenance of existing facilities and equipment shall include adequate funds to maintain and enhance the operating efficiency of building systems and equipment.
4. Proposed capital budgets shall provide for quality, energy-efficient facilities and equipment which meet or exceed the performance criteria established in the Building Energy Design Guidelines.

5. Building Energy Design Guidelines shall be developed by the Construction Management and General Services Administration Staff during FY 92-93 and reviewed annually thereafter by the Wake County Citizens' Energy Advisory Commission. Guidelines shall include design standards, energy goals, economic assumptions for life cycle cost analysis and other criteria on building systems and technologies. Architects and engineers shall be required to demonstrate that their designs are in conformance with these guidelines to the satisfaction of the professional staff of General Services Administration and Construction Management.
6. The selection process for design teams of architects, engineers and other consultants shall assure the selection of design teams who are fully qualified to provide comprehensive design services including energy analysis services as specified in the Building Energy Design Guidelines.
7. Contracts for design services for all major new buildings and major renovations shall specify energy analysis for the whole process from site selection and programming through evaluations after occupancy as specified in the Building Energy Design Guidelines.

   Contract shall specify a review system for energy consideration during the design process, an evaluation system for designers and a design fee which is adequate to support comprehensive design services.
8. Energy analysis shall be performed by design teams at appropriate intervals after completion of new buildings and major renovations to compare actual consumption to consumption estimates projected by designers.
9. The staff shall develop and implement guidelines during FY 92-93 that specify procedures for the operation and maintenance of facilities during occupied and unoccupied times, and shall review guidelines annually.
10. Energy use, cost data, and abnormal usage for each major facility shall be monitored monthly and reported upon request to the Wake County Citizen's Energy Advisory Commission. Data shall be reviewed annually by the staff and recommended goals established for each major facility.
11. The Energy Conservation Advisor shall review consumption data and energy related maintenance and operational activity as presented in reports, facility audits and studies conducted during the previous year and shall prepare a report, in coordination with the Energy Advisory Commission, which recommends capital needs for energy retrofit for the next fiscal year.
12. General Services Administration and the Emergency Management Department shall develop specific emergency energy conservation guidelines during FY 92-93 that the County Manager may implement in the event of an energy emergency. These guidelines shall include shut-down priorities and procedures that may be implemented during periods of energy or funding crisis and be reviewed annually by staffs from General Services Administration and Emergency Management Department.

Upon motion of Commissioner Hedrick, seconded by Commissioner Nichols, the Board unanimously approved the recommendation of the Administration Committee, accordingly.

Appendix B: Energy Advisory Commission Presentations (Wake County Government)

The design team will provide in-person presentations to the Wake County Citizens Energy Advisory Commission (Energy Commission) outlining the building design, building component selection, and energy and water consumption predictions two times during project development.

Some questions to consider for the presentations include:

Programming and Concept Design Presentation:

- Leveraging Other Resources
    - Is the site near other County owned buildings which can be leveraged in a central plant concept?
- Renewables
    - What capacity of solar photovoltaics can the building support?
    - What is the feasibility of solar thermal?
    - What is the feasibility of the site to implement geothermal?
- Building
    - What is the percentage of glass anticipated?
    - What are the shading techniques?

Early Design Development:

- ECM Results – Life cycle cost
    - Capital Cost
        - What cost-per-watt was used for solar-PV analysis?
    - Maintenance Cost
        - Did you consider maintenance cost?
    - Energy Cost
        - Did you consider energy escalation in the life cycle cost?
- What technologies allowed this to meet the County's energy target?

Appendix C: Life Cycle Cost Definitions

Economic Life

The following economic life table is based on both ASHRAE and the NC State Construction LCCA Manual

Component	Economic Life (years)		Component	Economic Life (yrs)
Divisions 2-14			Division 23	
GENERAL CONSTRUCTION			HVAC - cont'd	
Foundations	30+		Air Terminals - Diffusers, grilles, and registers	25
Substructure - Masonry	30		Air Terminals - fan-coil units; fan-powered boxes	20
Substructure - Wood	20		Air Terminals - VAV boxes	20
Superstructure - Masonry	30		Air Washers	17
Superstructure - Wood	20		Duct work	30
Exterior Closure - Masonry	30		Dampers	20
Exterior Closure - Wood or Metal	20		Fans - Centrifugal	25
Roofing - Shingles	12-20		Fans - Axial	20
Roofing - Built-up	17		Fans - Propeller	15
Roofing - Single-ply (other than EPDM)	20		Fans - Ventilating roof-mounted	20
Roofing - EPDM	10-12		Coils - DX, water, or steam	20
Interior Construction	10		Coils - Electric	15
Conveying Systems	10		Heat Exchangers - Shell-and-tube	24
Equipment	10		Reciprocating compressors	20
			Packaged Chiller - Reciprocating	20
Division 23			Packaged Chiller - Centrifugal	23
HVAC			Packaged Chiller - Absorption	23
Air Conditioners - Window unit	10		Cooling Tower - Galvanized Metal	20
Air Conditioners - Residential Single or split package	15		Cooling Tower - Stainless Steel	25-30
Air Conditioners - Commercial through the-wall	15		Cooling Tower - Ceramic	34
Air Conditioners - Water-cooled package	15		Air-cooled condensers	20
Air Conditioners - Computer room	15		Evaporative condensers	20
Heat pumps - air-to-air	15		Pumps - Base-mounted	20
Heat Pumps - water-to-air	19		Pumps - Pipe-mounted	10
Roof-top air conditioners - Single zone; VAV	15		Pumps - Sump and well	10
Roof-top air conditioners - Multizone	15		Pumps - Condensate	15
Boilers, hot water - Steel water-tube	24		Controls - Pneumatic	20
Boilers, hot water - Steel firetube	25		Controls - Electric	16
Boilers, hot water - Cast iron	25		Controls - Electronic	15
Boilers, hot water - Electric	15		Piping, Ductwork, Insulation	25
Burners	21			
Furnaces - Gas or oil-fired	18		Division 26	
Unit heaters - Gas or electric	13		ELECTRICAL CONSTRUCTION	
Unit heaters - Hot water or steam	20		Electric motors	18
Radiant heaters - Electric	10		Motor starters	17
Radiant heaters - Hot water or steam	25		Electric transformers	30
			Engine/Generators	20