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

Sustainable Design and Infrastructure Workshop #2
November 29, 2006

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ELEMENTS
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Living Campus a Model for Sustainability

A Living Campus is designed to provide all of its own operating needs and not burden other systems beyond its borders

- Treat all wastewater on site
- People and Planet friendly transportation
- Treat water as a valuable resource
- Restore native habitat
- Treat buildings as species
- Design for human health and productivity
- Educate at every opportunity
- Plan based on resources
- Operate a climate neutral campus

Landscape, Natural Habitat, Water Quality

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Possible Goals

- Create a space with more biodiversity than it has today.
- Understand and educate people that the CN campus will look different than the main campus, with an emphasis on providing and celebrating natural and native ecosystems that are integrated throughout the site.
- Identify existing site features that we want to celebrate, protect, and enhance and design for better access to experience their value.

Possible Goals

- Integrate research, education, and outreach in both built and non-built conditions. Pursue these opportunities during planning, construction, and post-construction phases.

- Maintain/enhance community and ecosystem connectivity by preserving viewscapes, integrating ecological function throughout the built environment, and creating a natural and functional transition to the non-built environment. Provide for dedicated green space in the built environment.

- Restore disturbed ecological systems concurrent with development activities.

Possible Goals

- Protect sensitive natural areas by thoughtful planning, design and maintenance of access around them.
- Protect, enhance and restore native soil properties to support indigenous plant growth, native soil fauna, enhance natural hydrologic process and support overall ecosystem function.
- Minimize erosion to protect habitat and reduce stress on natural water systems by preserving steep slopes in a natural, vegetated state.
- Replicate the natural, undisturbed hydrologic function of the land.

Possible Goals

- Use native plant species for a healthy ecosystem that will conserve native wildlife, decrease the amount of water needed for landscape maintenance, reduce long-term maintenance, reduce soil erosion by production of long root systems, and protect water quality by controlling erosion and moderating floods and drought.

- Reduce the heat island effect by preserving forest patches, reforesting areas, and planting street, courtyard, and plaza trees.

Possible Goals

- Build on existing disturbed areas before considering natural landscapes and allow natural site features to influence building siting and utility location.
- Plan for and design staging and stockpile areas associated with construction activities to avoid impacts to natural areas.
- Avoid disturbance to natural areas during construction and minimize disturbance in construction areas by providing tree protection and minimizing soil compaction.

Possible Goals

- Quantify and understand the existing natural capital of the site to inform the planning process and associated conservation/development strategies.

- Plan for and design east-west access routes and paths across existing rail corridor and Seawell School Rd. Consider scenarios where rail line no longer exists or has been relocated.

- Maintenance of natural systems should be included as part of the site's operating budget. Maintenance of the natural systems should take an adaptive management approach.

Possible Goals

- Employ environmentally sound maintenance practices to support biodiversity and protect at-risk ecosystems.
- Establish and sustain an active forest management program that considers harvesting of timber for use in site construction.
- Incorporate edible landscapes throughout developed areas.
- Identify and create community garden areas that provide a food source, social gathering place, and research opportunities.

Stormwater, Water & Sewer Systems

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Water, Wastewater, Stormwater Goals

- Implement potable water conservation
- Separate potable water and reclaimed water infrastructure
- Maintain flexibility to treat wastewater on site
- Reclaim stormwater and wastewater
- Integrate research opportunities with regulatory and technology requirements

Water, Wastewater, Stormwater Goals

- Replicate natural hydrology within disturbed areas vs. undisturbed areas vs entire site
- Limit land disturbance
- Flexibility, Adaptability in Proven Innovative Systems
- Standardization of systems for each phase of development
- Develop O&M strategies for all systems

Water, Wastewater, Stormwater Goals

- Integration of design, operation & maintenance and intended use of spaces
- Consider energy efficiency of on-site systems
- Explore means to develop innovative mechanisms to fund innovative systems
- Develop redundancy / backup for innovative systems
- Explore alternate sources for potable water

Internal Transportation, Parking & Roads

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Draft Transportation Goals

- Design Carolina North as a walkable community:
  - Design the transportation system and development patterns (i.e., urban design elements such as density, building design, mix of uses, open space, etc.) to encourage self-propelled based transportation (walking, biking, etc.) as the primary means of travel and to promote a vibrant community
  - Integrate on-site bike and pedestrian routes with existing and planned local facilities
  - Design complete streets to minimize speeds, maximize peaceful coexistence of all modes, and minimize conflicts between pedestrian, bicycles and vehicles
  - Create vehicle-free zones

Draft Transportation Goals

- Maximize use of transit at every phase of development:
  - Design site to maximize opportunities to travel by transit from outset
  - Design site for efficient transit movement as a priority element
  - Focus most intensive development around transit nodes
  - Identify, preserve and retrofit corridors for future transportation needs
  - Reserve land for transit center
  - Use rail corridor for high speed transit to extent feasible

Draft Transportation Goals

- Minimize single-occupant vehicle use through policies, programs, and incentives:
  - Apply travel demand management experience from Main Campus
  - Promote greater use of strategies such as telecommuting and flexible work hours
  - Automate administrative processes to minimize travel within and between campuses
  - Provide incentives for using alternative modes
  - Provide services and amenities that minimize the need to leave site
  - Provide strong connections to Main Campus

Draft Transportation Goals

- Design each phase of Carolina North to be accessible, and to progressively reduce reliance on SOV use and on-site parking
- Provide minimum amount of needed parking
  - Maximize use of satellite parking for those who choose to drive
  - Minimize amount of impervious surface
  - Maximize opportunities for shared use of parking

Draft Transportation Goals

- Design site and individual phases to minimize impacts of construction traffic
- Design a delivery and servicing system that provides convenient access to each building while minimizing conflicts with other modes
- Design site and transportation system with the flexibility to adapt to a variety of future transportation scenarios
- Respect surrounding neighborhoods:
  - Minimize undesirable transportation impacts
  - Provide appropriate connections

Draft Transportation Goals

- Develop a plan to address capital and recurring funding needs for transportation, particularly transit
- Partner with local, regional and state transportation agencies:
  - Develop a phased transportation plan and improvements
  - Develop regional transportation initiatives to encourage use of alternatives
  - Obtain and leverage funding for transportation improvements

Building Typology

How Buildings Behave

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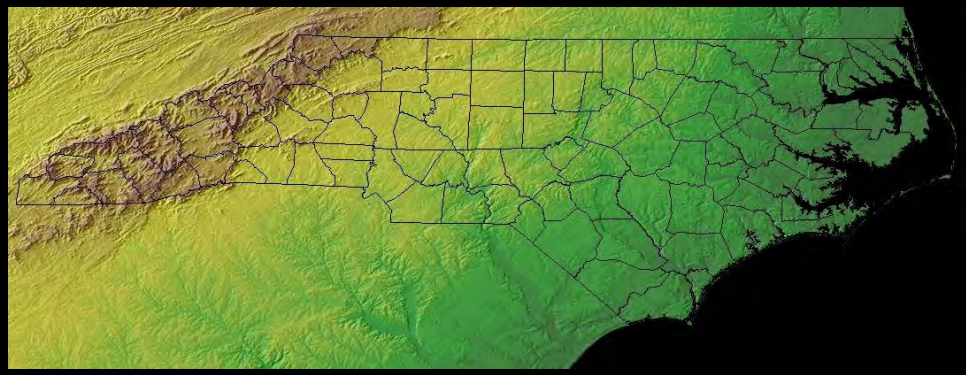
Develop Performance Type Goals For:

1. Responding to climate, culture and place
2. A building type based design approach
3. Going beyond baseline design standards
4. Synergistic building types
5. Collaboration spaces
6. Carbon footprint
7. Pedagogical opportunities
8. Human health and productivity
9. Commissioning
10. Adaptability
11. Operation & maintenance
    - Measurement & verification
    - Post occupancy evaluation and implementation

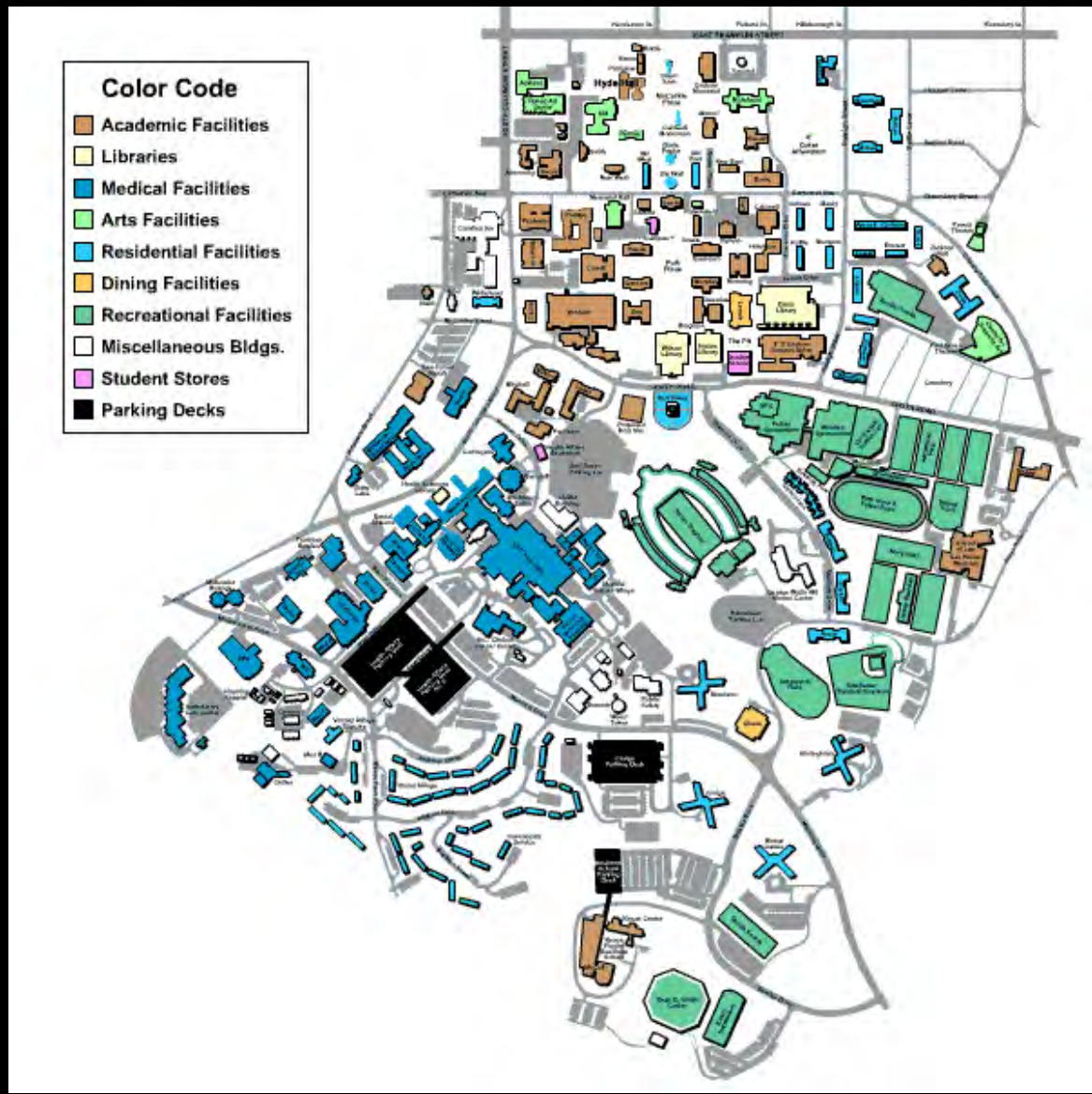
Responding to climate, culture and place

- Respect local aesthetic vernacular
- Respect local resources for materiality
- Solar orientation will be optimized
- *Respect the topography of land and natural resources*
- Free resources will be utilized first
  - Sun for light and heat
  - Wind for cooling and ventilation
  - Rainwater *Non-potable and Potable*
- Passive solar strategies will be utilized
- External shading will be integrated
- Envelope design and skin treatments will be optimized
- Allow for integration of site appropriate renewable energy sources



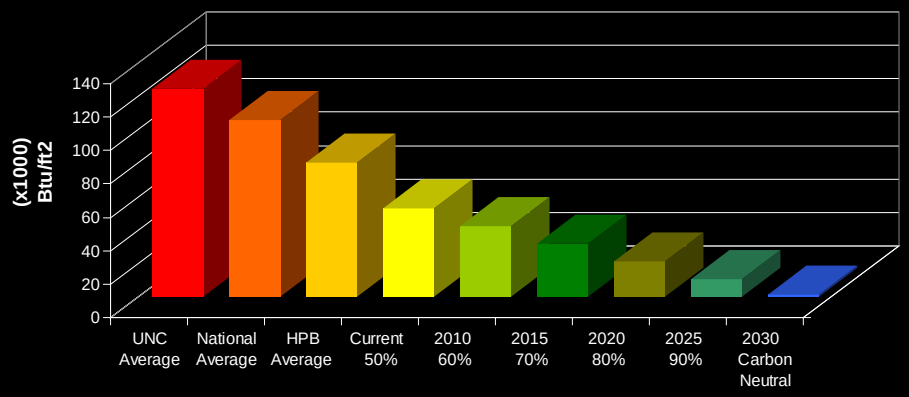
Building Type Based Design Approach

- Design strategies will be applied based on building type
- Design strategies will be considered on a life-cycle cost basis, not first cost



Going beyond baseline design standards

- Exceed local energy and water codes
- Exceed Energy Policy Act (water)
- Exceed current ASHRAE 90.1
- Exceed current International Energy Conservation Code (IECC)
- Align with Architecture 2030 goals



Synergistic Building Types

- Synergistic building types will be grouped together providing for the excesses of one building type to provide for needs of another building type
- Group similar building functions into the same HVAC control zone so those areas can be scheduled separately (e.g. separate around-the-clock areas daytime areas)

Waste

=

Food

A Living Building

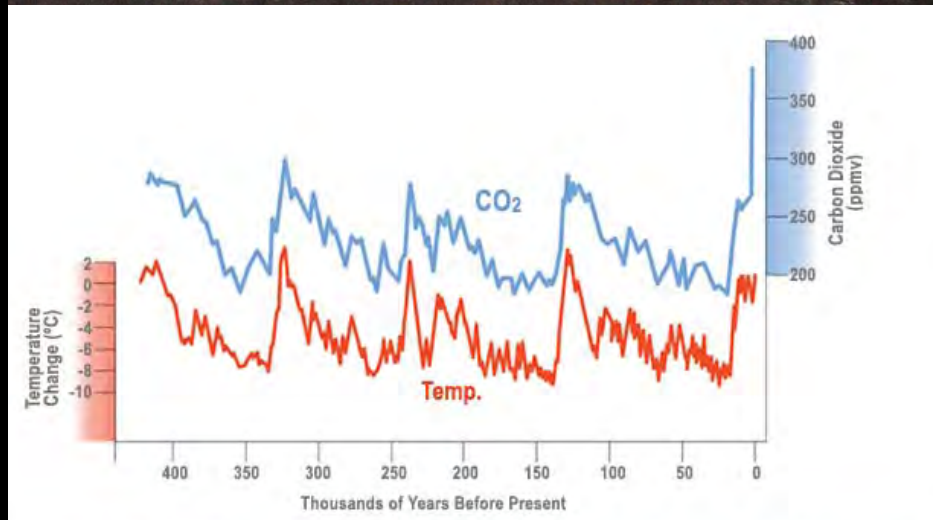
- Harvests all its own energy and water
- Adapted to climate and site
- Operates pollution free
- Promotes health and well-being
- Comprised of Integrated Systems
- Is Beautiful
- Educates and Integrates Users
- Uses Post Occupancy Evaluation to inform its behavior

Collaboration Space

- Spaces for collaboration will be included into building programs
- Capture the potential functional uses for indoor and outdoor spaces

Carbon Footprint

- Develop a plan to keep carbon in check at the start of programming
- Minimize energy consumption, slow depletion of fossil fuel reserves
- Use building integrated and campus wide renewable energy systems
- Purchase renewable energy credits or carbon offsets for non-renewable energy fuels used
- Utilize a cradle-to-cradle approach when specifying products and systems
- Align with Architecture 2030 goals when developing a building project
- Comply with CRED for lifestyle and policy decisions



GLOBAL TEMPERATURE AND CO_2 OVER THE PAST 450 THOUSAND YEARS

Source: UN Intergovernmental Panel on Climate Change (IPCC), Third Assessment Report, Climate Change 2001

Graphic: Woods Hole Research Center

Pedagogical Opportunities

- Use sustainable systems and technologies as learning labs integrated into the curriculum/ research
- Provide real time performance data to the building users on site and to the public at large via the world wide web
- Demonstrate developing technologies

Human Health and Productivity

- *Provide and maintain acceptable indoor air quality, which is defined as: "Air in which there are no known contaminants at harmful concentrations as determined by cognizant authorities and with which a substantial majority (80% or more) of the people do not express dissatisfaction." (ASHRAE 62)*

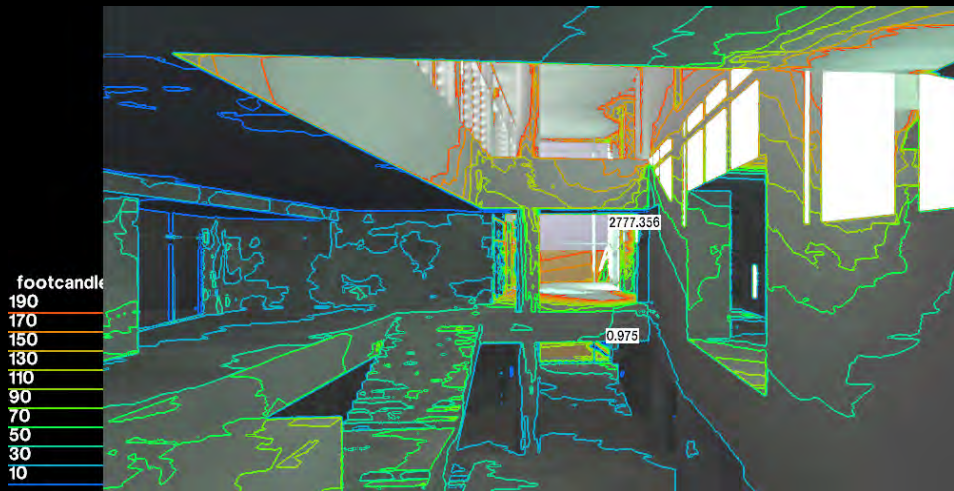
- *Monitor and avoid indoor air quality problems during renovation, demolition, and construction activities*

- *Provide occupants with operational control of lighting and HVAC systems whenever possible*

- *Produce environments that enhance human comfort, well-being, performance, and productivity by reducing sick time*

Commissioning

- Develop a commissioning plan and include a commissioning agent in the design process
- Verify that the building's energy *and water* related systems are installed, calibrated and perform according to the owner's projects requirements, basis of design, and construction documents
- Provide easy access to user's manuals and continuing education for proper operation & maintenance of building systems to *occupants* and operations staff especially when someone different takes over a building



Adaptability

Envelope / Structure / Utilities

- Flexibility – *for accommodating program and regulatory changes*
- Expandability / Shrinkability - facilitate changes to the quantity of space
- Convertibility - allow for changes in use
- Durability - select materials, assemblies and systems that require less maintenance, repair and replacement.
- Disassembly - make it easier to take products and assemblies apart so that their constituent elements can more easily be reused or recycled
- Layering - the goal should be to uncouple those layers of a building that have significantly different lifetimes:
  - Shell – structure, skin
  - Services – plumbing, electrical, circulation
  - Scenery – partitioning, ceilings, finishes
  - Set – furnishings

Operation & Maintenance

- Green/healthy housekeeping products will be preferred
- Institute purchasing & discard policies to minimize packaging and waste
- Integrate recycling programs
- Compost organic waste
- Spaces left unoccupied will have a lights out policy
- Provide for the ongoing accountability of building resource consumption over time
- *Utilize the accounting information to inform Operations & Maintenance and design decisions for future projects*
- Reconcile performance with goals
- Provide post occupancy evaluations and implement findings into future projects
- *Integrate a building user liaison to inform the facilities engineering staff*

Potential Barriers

- Most Challenging Building may happen first
- The State Legislature and the separation of capital costs and operating costs
- Design and Construction Team Selection or Availability
- Not asking why enough
- Educating end users about how their building fits into the whole University
- *Educate and dialogue with State and local Regulatory agencies about*
  - *review and approval*
  - *Procurement*
  - *Incentives*

Goal Areas that support the Living Campus

Treat all wastewater on site
- A living building

People and Planet friendly transportation

Treat water as a valuable resource
- A living building

Going beyond baseline design standards
- Responding to climate, culture and place
- Restore native habitat
- A living building

Treat buildings as species
- Responding to climate, culture and place
- A building type based design approach
- Synergistic building types
- A living building
- Carbon footprint

Design for human health and productivity
- A living building
- Human health and productivity
- Operation & maintenance

Educate at every opportunity
- A living building
- Collaboration spaces
- Pedagogical opportunities
- Commissioning
- Operation & maintenance

Plan based on resources
- Adaptability
- A living building
- Carbon footprint
- Operation & maintenance

Operate a climate neutral campus
- Responding to climate, culture and place
- A building type based design approach
- Going beyond baseline design standards
- Synergistic building types
- A living building
- Carbon footprint
- Commissioning
- Operation & maintenance

Utility Infrastructure, Energy Generation & Consumption

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Summary of Discussion

- Carbon reduction is a focus
- Optimize for “Best of Both Worlds” - advantages of Central Systems were confirmed although it was acknowledged that certain technologies can be more efficiently implemented locally
- Sharing energy amongst buildings, through central systems, represents a key opportunity (Waste = Food)

Affiliated Engineers

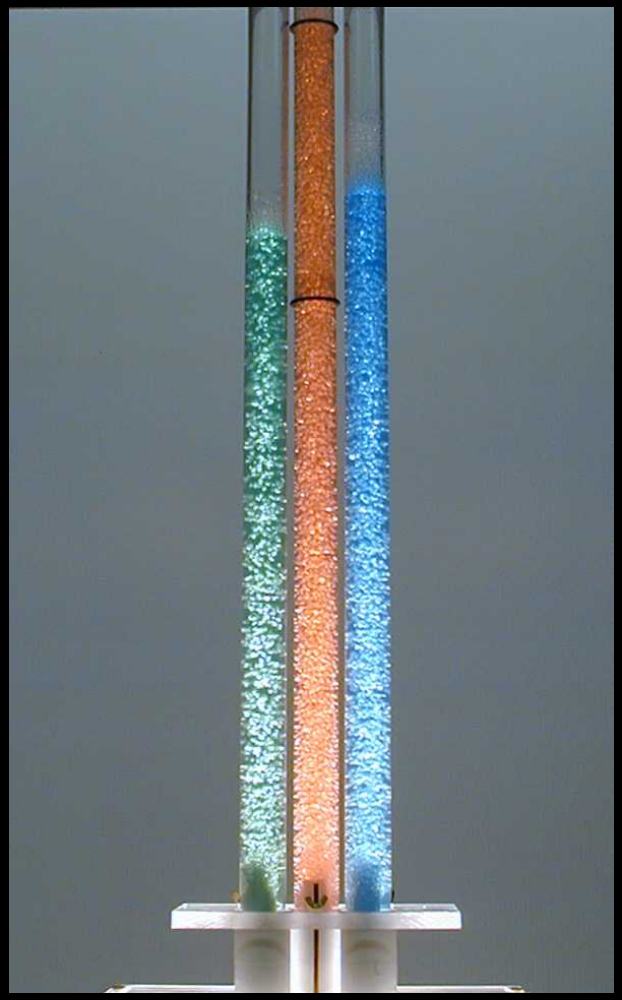
Summary of Discussion

- Appropriate levels of diversity, reliability, and redundancy need to be established (by building type / building program)
- Combined Heat and Power (CHP) offers many advantages in a single solution and is a well established approach at UNC
- Alternative fuel sources for energy systems represent a significant opportunity for the environmental goals and the economic vitality of North Carolina – offsite production will be considered

Affiliated Engineers

Summary of Discussion

- Availability of energy use information is important locally and campus wide likely from a mix of analog-type meters and digital displays – needs reference metric
- Climactic conditions of Chapel Hill suggest the most viable renewable energy technologies are solar based - Naturally occurring wind is not a viable energy source



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Summary of Discussion

- Solar hot water systems may be attractive for their economics, reliability, and ability to be implemented in a distributed nature
- Broad education program will be necessary for various stakeholder groups:
  - Building Occupants
  - O&M Staff
  - General Campus Population

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Summary of Discussion

- No technology mandates should be goals (ie 5% energy production via solar)
- More analysis is required to differentiate renewable technologies
- Specific building typology energy consumption targets should be set (ie Energy Budgets)
- Significant land use implications are evident when considering alternative central plant schemes (geothermal bore fields) or renewable energy strategies (PV arrays, biomass production and / or storage)

Challenges / Barriers

GENERAL

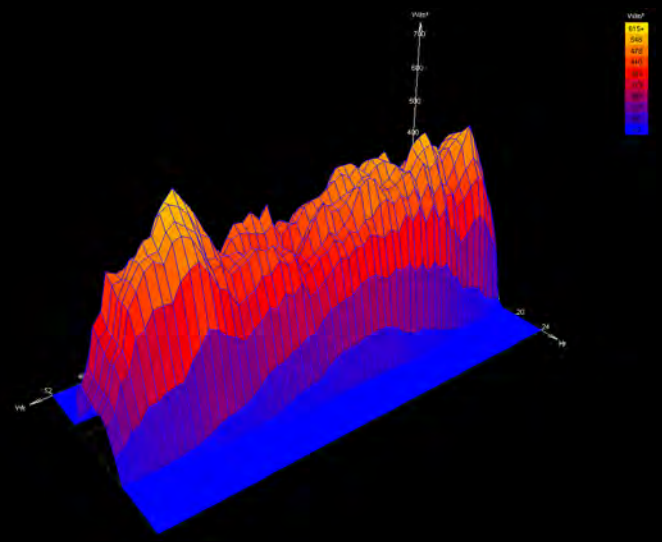
- New Ideas and Technologies
  - Acceptance
  - Reliability
  - Operation and Maintenance
- Utility Ownership and Maintenance
- Reliability Expectations
- Funding of Production and Distribution Systems
- Single Source for Procurement of New Technologies
- Shared Utility Corridors – Separation / Easements / Access
- Metering and Billing of Shared Utilities

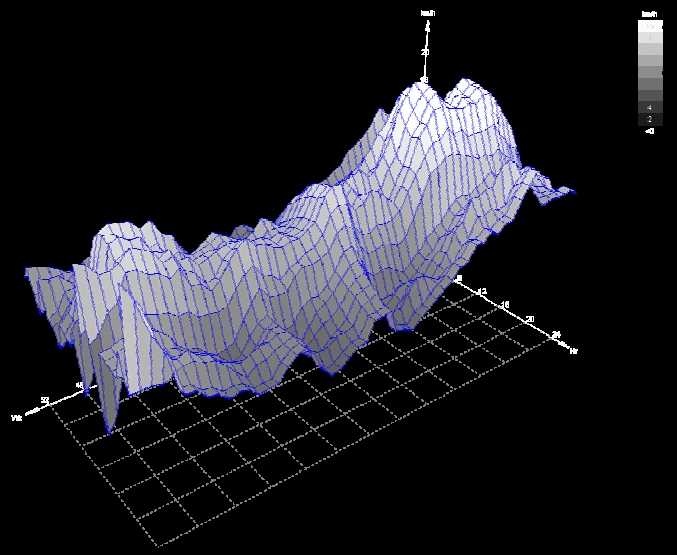
BIOMASS RELATED

- Supply issues
  - Dispersed sources
  - Long-term contracts challenging
  - “Waste” today, “valuable resource” tomorrow
  - Fuel processing & fuel quality
  - Reliability
- Fuel handling and transportation
- Space for fuel processing & storage

The Path Forward

- Develop a “Problem Diagram” describing this complex multiple solution set
- Develop a matrix comparison of alternative technologies considering factors such as:
  - Cost
  - Reliability
  - Land use
  - Aesthetics
  - Carbon
  - Operation & Maintenance
  - Resource Conservation
  - Pedagogical Opportunities
  - Health & Wellness
  - Offsite / Distribution Requirements
  - Phasing
  - Other
- Develop a mock CN Program on which to apply sensitivity models – based on load profiles from main campus historical data
- Define draft goals for Metric Workshop





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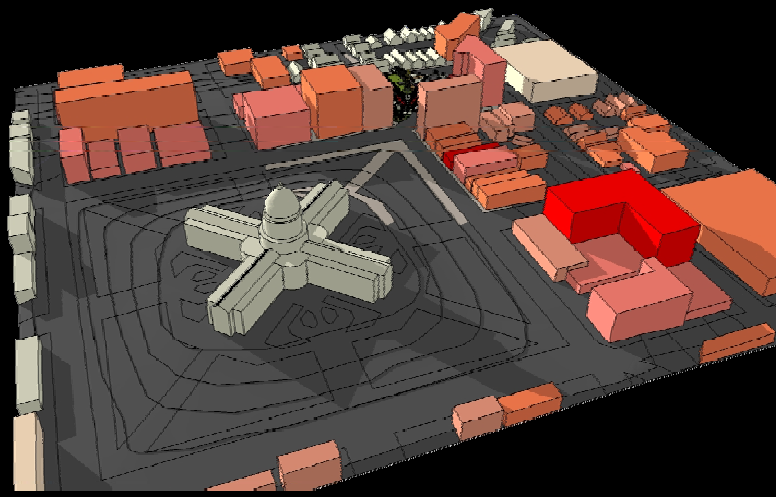
Potential Goals

- Minimize carbon emissions
  - Maximize Building Efficiency
  - Maximize use of renewable energy
- Centralize utilities where practical
- Recycle energy amongst buildings
- Plan for Combined Heat and Power
- Provide appropriate levels of redundancy and reliability
- Allow for changing technologies in system design
- Provide net energy metering
- Display building energy performance (local and central)
- Provide shared utility corridors
- Educate campus users on energy systems



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