Building Typology

Exploring the Possibilities Workshop 2

CAROLINA NORTH

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

A Living Campus

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

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Develop Performance Type Goals For:

- Responding to climate, culture and place
- A building type based design approach
- Going beyond baseline design standards
- Synergistic building types
- A living building
- Collaboration spaces
- Carbon footprint
- Pedagogical opportunities
- Human health and productivity
- Commissioning
- Adaptability
- Operation & maintenance
  - Measurement & verification
  - Post occupancy evaluation and implementation

Case Study

Responding to climate, culture and place

Jefferson City, Missouri
120,000 sf., $17.5 million
LEED Platinum

Appropriate orientation

Native landscaping

Harvests daylight

Harvests all rainwater from roof

Optimized envelope and skin treatment

External shading integrated

Photovoltaics supply 2.5% of electricity

Lewis and Clark State Office Building

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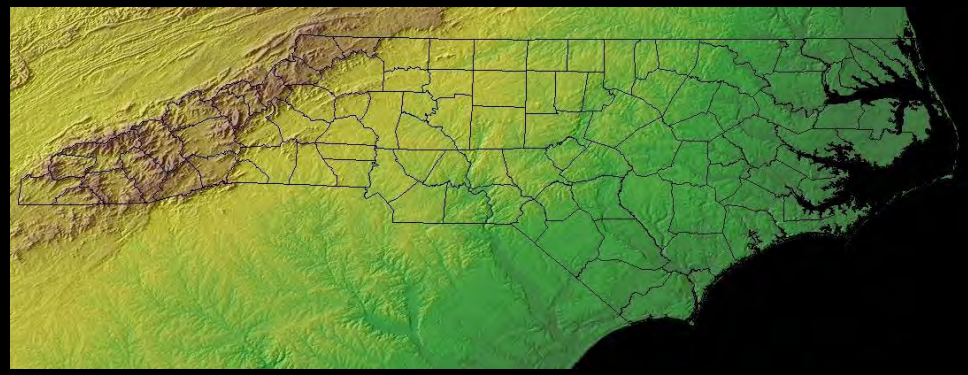
Responding to climate, culture and place

- Respect local aesthetic vernacular
- Respect local resources for materiality
- Solar orientation will be optimized
- Free resources will be utilized first
  - Sun for light and heat
  - Wind for cooling and ventilation
  - Rainwater for drinking, washing, flushing and irrigation
- 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



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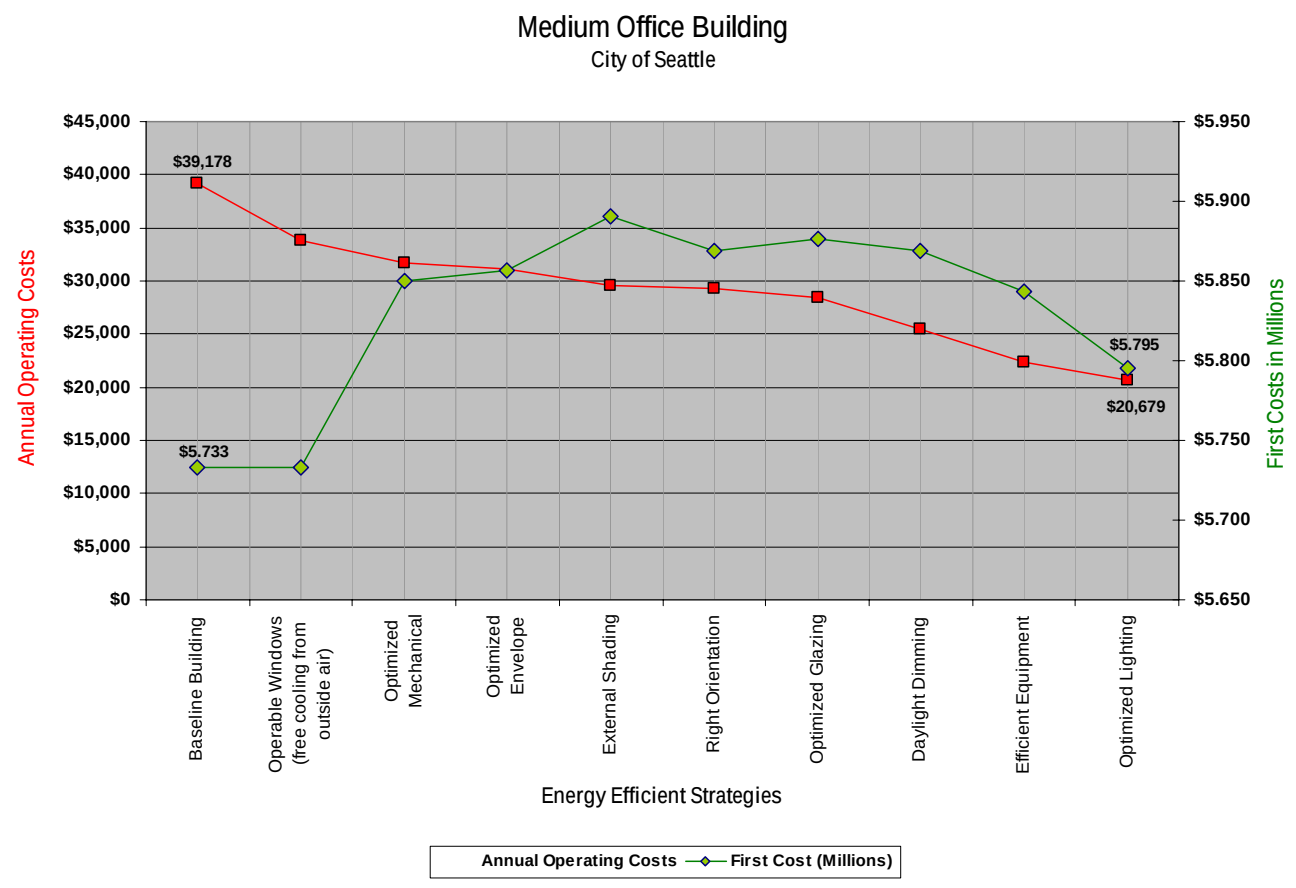
Case Study

Building Type Based Design Approach



Seattle, Washington

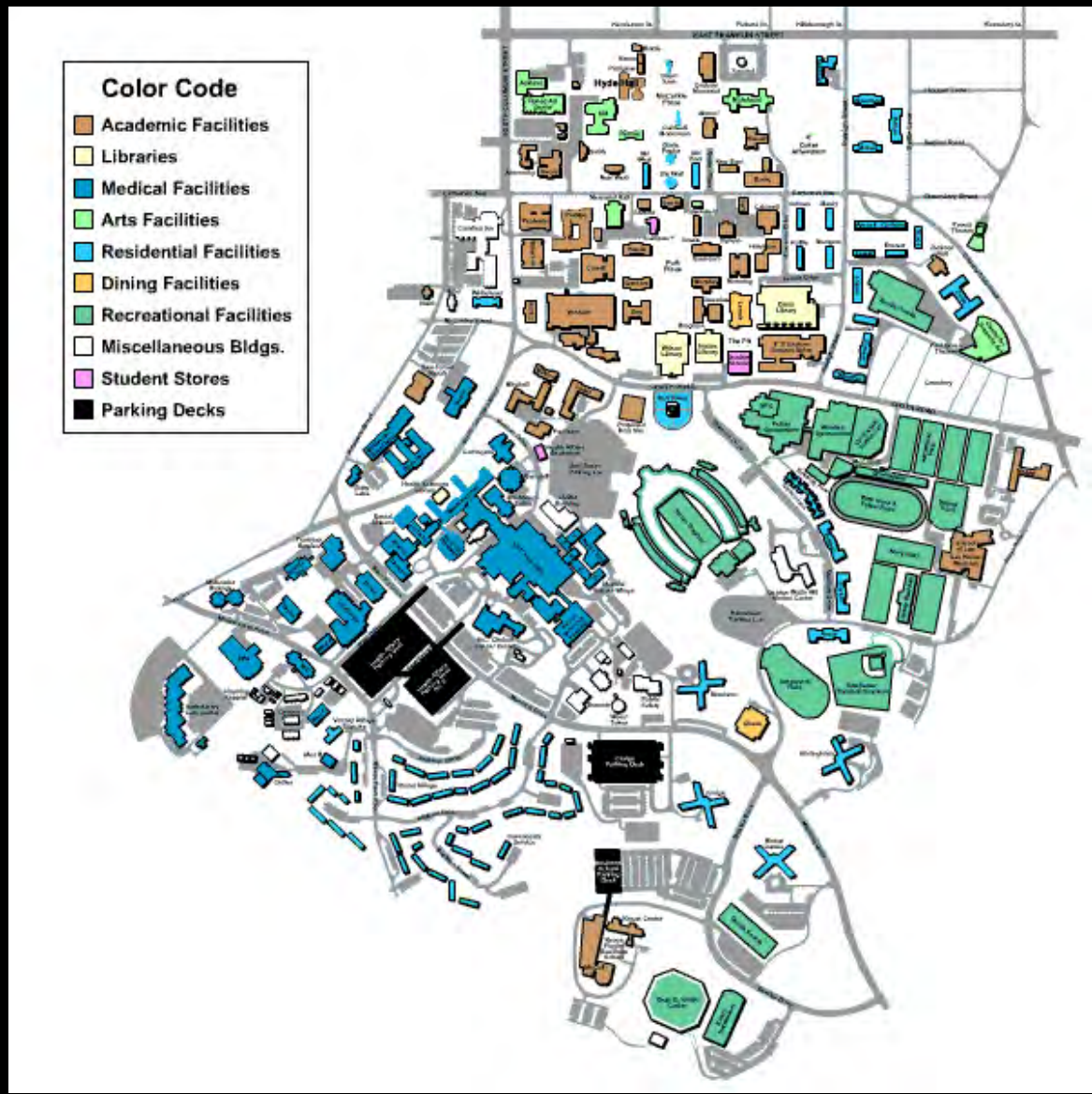
Publicly available data to educate owners, developers, design and construction teams on how to make appropriate design decisions at the schematic level

Simple study for less than 1% of the cost of the building cuts annual energy costs by 50%

Implement: Seattle's Sustainable Building Tool

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



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Case Study

Going beyond baseline design standards

Little Rock, Arkansas

96,000 sf., $18.2 Million

LEED Gold (anticipated)

Design optimized for building type and climate

Waterless and low-flow fixtures

All native vegetation

50% more efficient than ASHRAE 90.1

Only water that leaves the site is the black-water. 2nd phase incorporates living machine to treat black-water on site.

Heifer International Headquarters

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Case Study

Going beyond baseline design standards

Santa Barbara, California
84,672 sf., $26 Million
LEED Platinum

Premium-efficiency motors

VAV laboratory fumehoods

Daylight controls

PV system providing 7-10% of total consumption

Energy Performance beats Title 24 baseline by 50%

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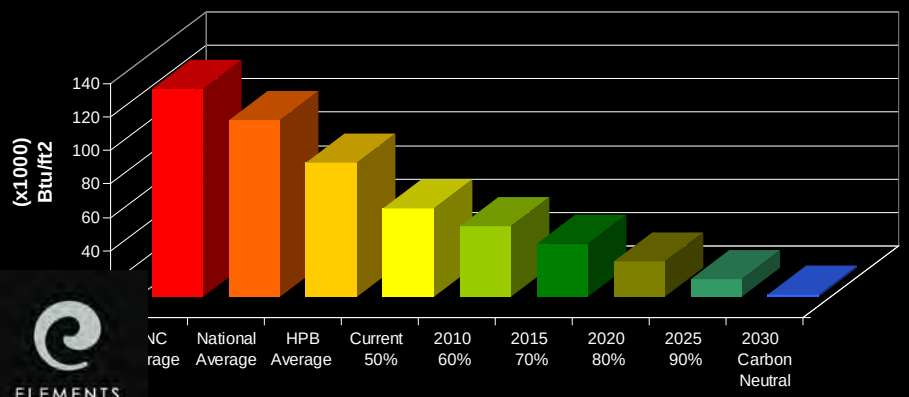
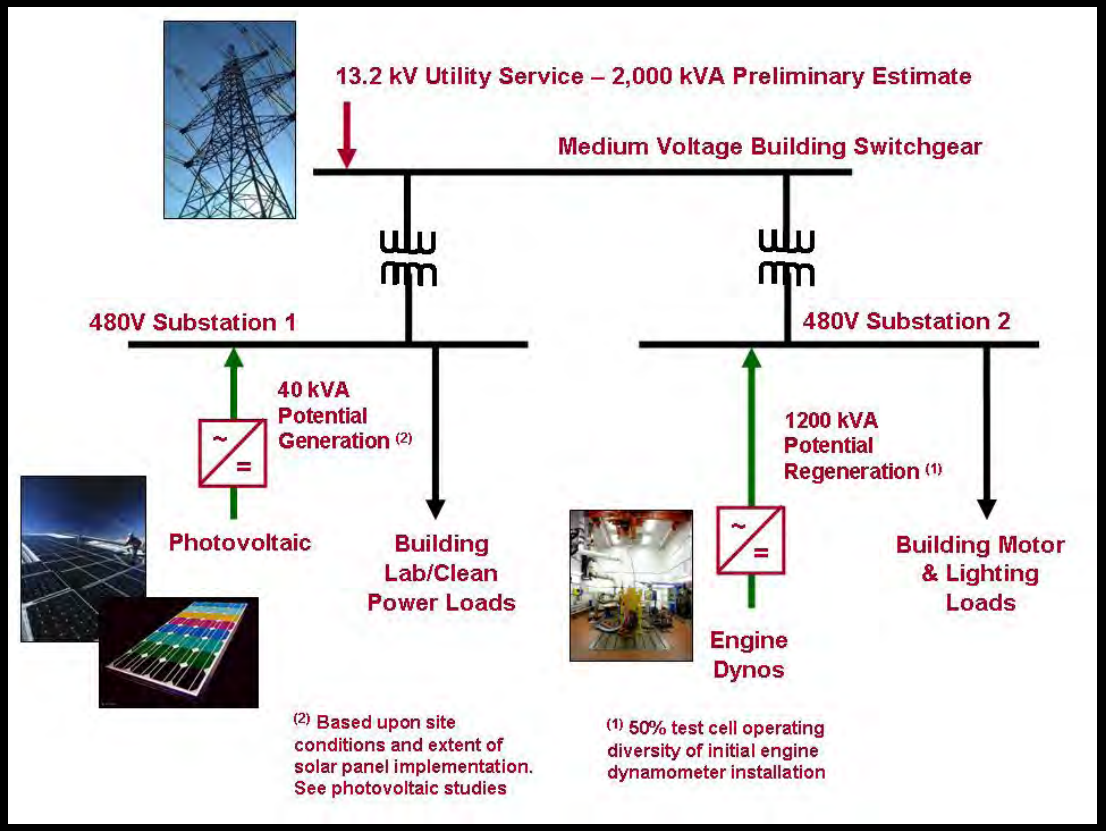
Going beyond baseline design standards

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



Synergistic Building Types

- Electrical System integrates utility distribution system, solar panel generation system, and engine dynomometer energy recovery system.
- AC Dynomometers were selected specifically for the ability to recapture waste energy
- Solar panels represent the sustainable “face” of the building but engine dynos actually produce (recovery) far more energy that the solar cells do!



New York State – Alternative Fuel Vehicle Research Laboratory

Case Study

Synergistic Building Types

Research Triangle Park, NC

101,000 sf., $21.2 million

LEED V 2 Silver

15,000 sf of photovoltaic panels on roof provide 5% of electricity requirement

Purchase agreement for 100 million kWh of green power through renewable energy certificates

U.S. EPA National Computer

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Synergistic Building Types

- Group similar building types together to take advantage of shared flexible space needs
- Group similar building functions into the same HVAC control zone so those areas can be scheduled separately (e.g. separate around-the-clock areas from classrooms and offices)
- Synergistic building types will be grouped together providing for the excesses of one building type to provide for needs of another building type
  - Waste heat from a building could be diverted to a nearby building in need of heat
  - Water collected on the roof on one building could be used for the needs of an adjacent building

Waste

=

Food

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Case Study

A Living Building

Oberlin, Ohio

13,600 sf., $21.2 million

7,500 gallon cistern for storm water retention

Living Machine collects and treats waste water from bathrooms and kitchen

4,000 SF of photovoltaic panels

Closed loop geothermal wells meet cooling demands

Occupancy Sensors, Daylight Sensors and CO2 Sensors

Oberlin College Adam Joseph Lewis Center

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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

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Cascadia Living Building Challenge

living building challenge

It's time to move beyond 'Platinum' to a true level of Sustainability – The Living Building.

Imagine buildings as elegant and efficient as a flower. Imagine a building that is informed by the eco-regions characteristics and

- that generates all its own energy with renewable resources
- that captures and treats all of its water on site
- that uses resources efficiently, but for maximum beauty

The Cascadia Region Green Building Council (Cascadia) is issuing a challenge to all building owners, architects, engineers and design professionals to build in a way that will provide all of us and our children with a sustainable future. The Living Building Challenge is attempting to raise the bar and define a true measure of sustainability in the built environment, at least as far as what is currently possible and given the best knowledge available to-date. Projects that achieve this level of performance can claim to be the most sustainable in North America and not merely less bad.

LBC LINKS + RESOURCES

- LIVING BUILDING CHALLENGE 1.0
- LIVING BUILDING USER GUIDE COMING SOON!
- LIVING BUILDING ARTICLES
- LIVING BUILDING SUMMARY

http://www.cascadiagbc.org/resources/living-buildings

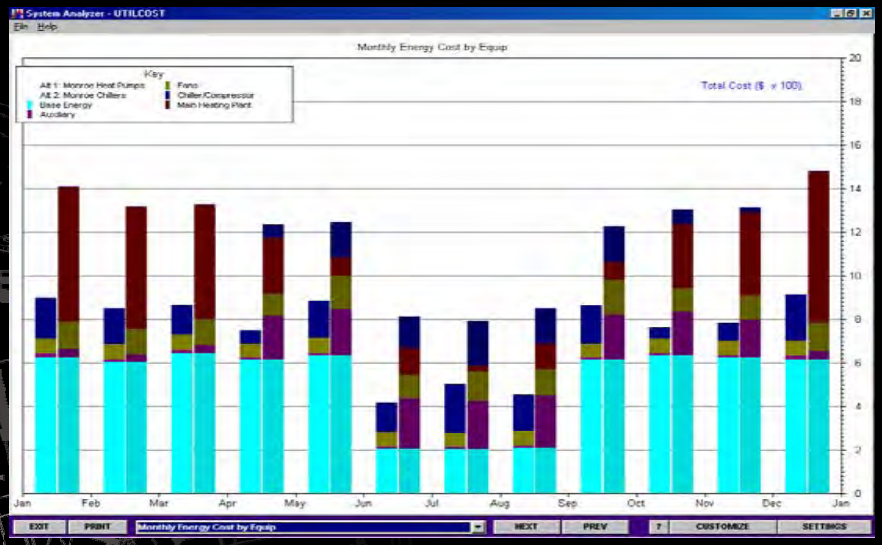
Collaboration Space

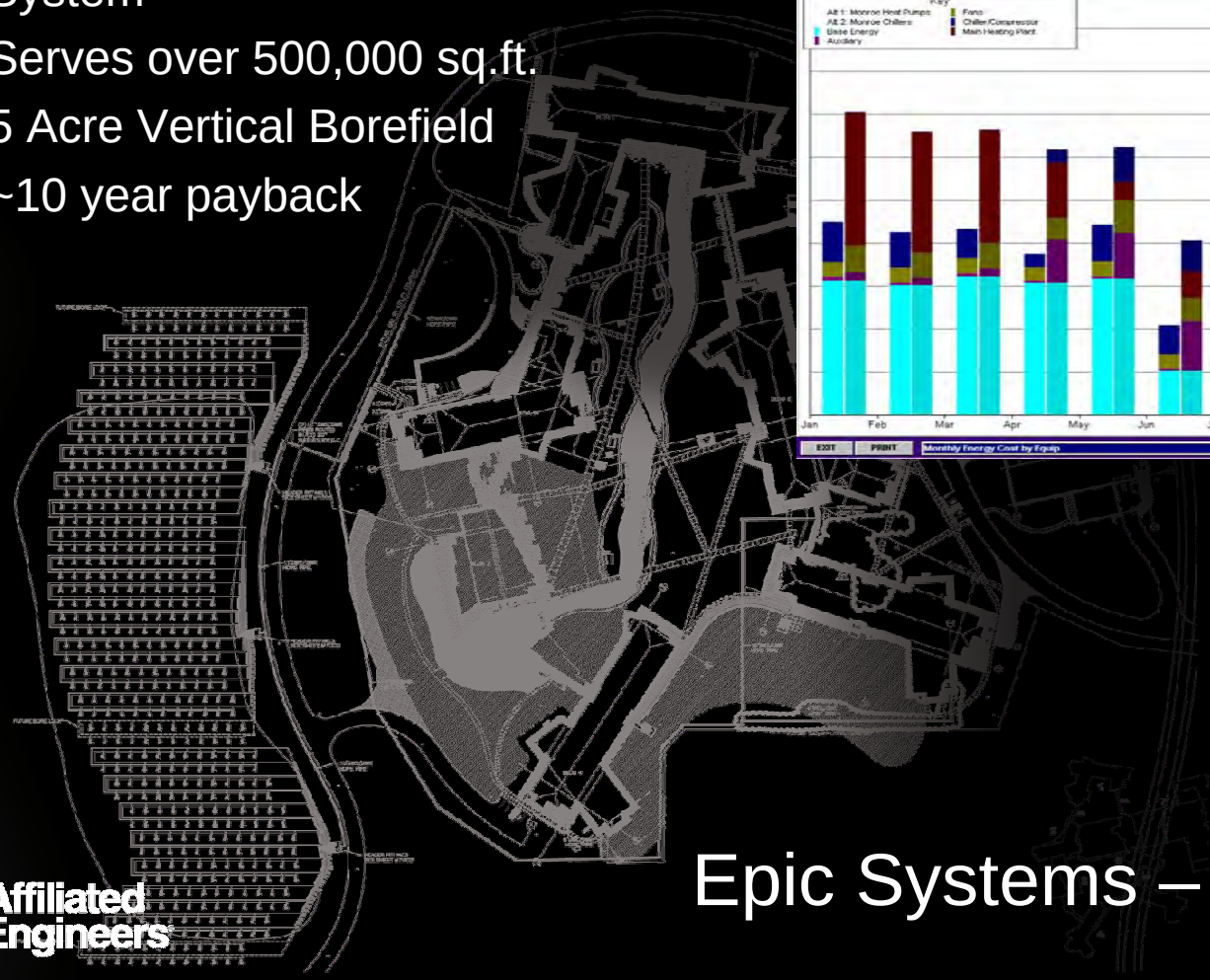
- Spaces for collaboration will be included into building programs
- Capture the potential functional uses for indoor and outdoor spaces

Carbon Footprint

Epic Systems – Verona, WI

- Ground Source Geothermal System
- Serves over 500,000 sq.ft.
- 5 Acre Vertical Borefield
- ~10 year payback





Epic Systems – Verona, WI

Affiliated Engineers

Case Study

Carbon Footprint

Houston, Texas

194,000 sf., $41.2 million

$40,000 annual savings over ASHRAE 90.1 (2004 prices) $77,000 annual savings over the building that it replaced

Uses 80% less energy/sq ft than the adjacent UT School of Public Health, built in 1977

48% cement replaced by fly-ash, saving approx. 1,800 tons of CO2 from release into the atmosphere

Baseline Green methodology

Ready for Photovoltaic Panels

University of Texas School of Nursing

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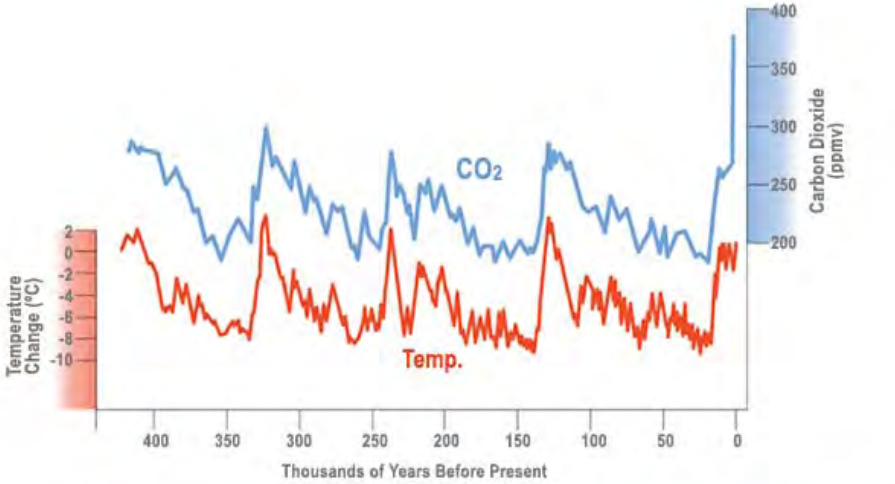
Carbon Footprint

- Minimize campus contribution towards global warming with a plan to keep carbon in check at the start of programming
- Minimize energy consumption, slow depletion of fossil fuel reserves
- Use building integrated 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
- Adhere to 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

Case Study

Pedagogical Opportunities

Santa Barbara, California

84,672 sf., $26 Million

LEED Platinum

Interpretive Display on land, air, water and energy

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Case Study

Pedagogical Opportunities

Oberlin, Ohio

13,600 sf., $21.2 million

Living Machine maintained by students and faculty

Oberlin College Adam Joseph Lewis Center

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Pedagogical Opportunities

- Use sustainable systems and technologies as learning labs integrated into the curriculum
- 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

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Case Study

Human Health and Productivity

Gainesville, Florida

47,300 sf., $6.5 million

LEED V 2.0 Gold

Integrated daylighting control system on the building's east and west facades including large exterior windows with spectrally selective glazing

A central, skylight-covered atrium provides the open public stairways with natural daylight including a dynamic beam marking solar noon each day.

Rinker Hall at the University of Florida

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Human Health and Productivity

- Indoor Environmental Quality (IEQ)
  - Harvest natural daylight to offset artificial lighting where possible
  - Provide views to the outside / exterior
  - Comply with current AHSRAE 55 for thermal comfort
  - Provide and maintain acceptable ventilation (indoor air quality - IAQ), in compliance with or exceed, where possible, current ASHRAE 62 Standards and current ANSI/AHIA Z9.5, American National Standard for Laboratory Ventilation
  - Minimize off-gassing & VOC's
  - Implement a "Building Air Quality Action Plan" as defined by the U.S. Environmental Protection Agency
  - Implement the "Best Practices for Maintaining IEQ" measures listed in the Indoor Environmental Quality appendix to the latest Version of the International Performance Measurement and Verification Protocol (IPMVP)

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Human Health and Productivity

- Provide personal controls for
  - Temperature
  - Ventilation
  - Lighting
- Provide appropriate acoustical conditions
  - Use design features and strategies to control sources of noise from mechanical and electrical equipment and from sources exterior to the building
- Provide appropriate vibration conditions
  - Use design features and strategies to control sources of externally and internally induced vibrations from wind loads, passing traffic, interior foot traffic, building HVAC systems, and interior machinery

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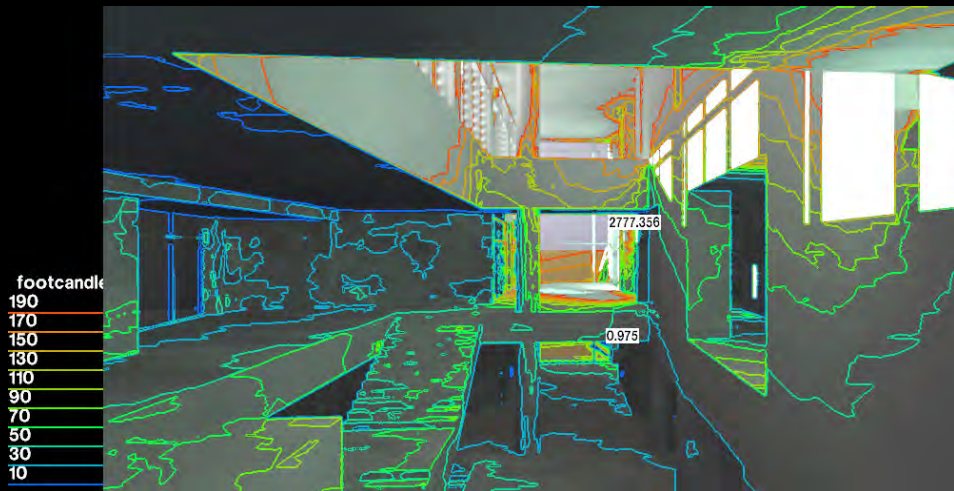
Commissioning

- Develop a commissioning plan and include a commissioning agent in the design process
- Verify that the building's energy 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 operations staff especially when someone different takes over a building



Adaptability

Envelope / Structure / Utilities

- Flexibility – enable shifts in space planning
- 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

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Case Study

Operation & Maintenance

Kansas City, Kansas

All chemical storage and mixing areas for housekeeping products allow for adequate and secure product storage.

All locations have ample room for mixing concentrated chemicals.

Drains are plumbed for the appropriate disposal of liquid waste. Each location is operated under 10% negative pressure and equipped with separate outside venting to keep chemical fumes from spreading to adjacent areas.

All cleaning and mechanical chemicals used for the building operations are environmentally preferable products, and were competitively priced.

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US EPA Region 7 Headquarters

Case Study

Operation & Maintenance

Santa Barbara, California
84,672 sf., $26 Million
LEED Platinum

Actual Energy Performance found to be 25% better than simulation prediction

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ELEMENTS
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Case Study

Operation & Maintenance

Oberlin, Ohio

13,600 sf., $21.2 million

Performance of Building is improved based on Measurement & Verification

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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

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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
- Desire for flexibility not adaptability
- The state insurance department acting as the code authority

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