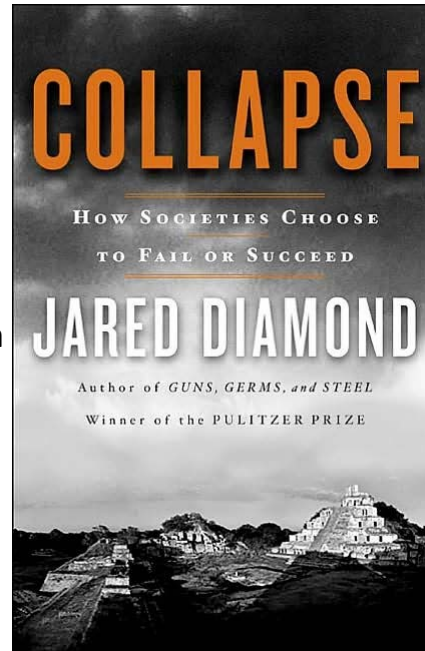




Agenda

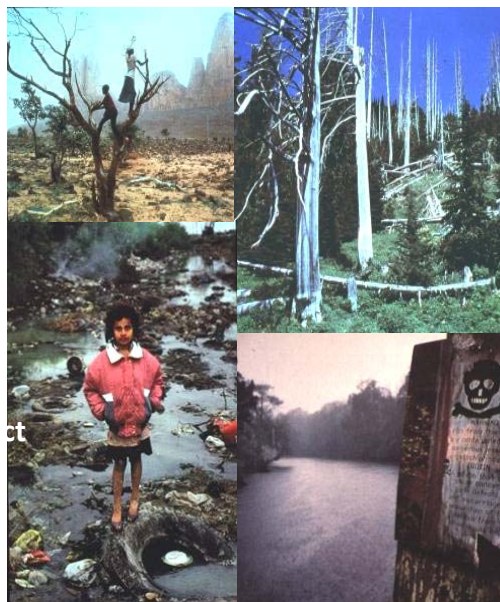
1. Background
2. Ratings Building
3. Design Process

1. To anticipate the problem
2. To recognize the problem
3. To try and solve the problem
5. To respond in time



World Environmental Challenges

1. Deforestation
2. Depletion of "wild foods"
3. Loss of genetic diversity
4. Loss of top soil
5. Fossil fuels
6. Depletion of potable water
7. Solar energy capacity
8. Toxins
9. Alien species
10. Greenhouse gases
11. Population
12. Population per person



Beijing



Beijing



Air Pollution from China to the World

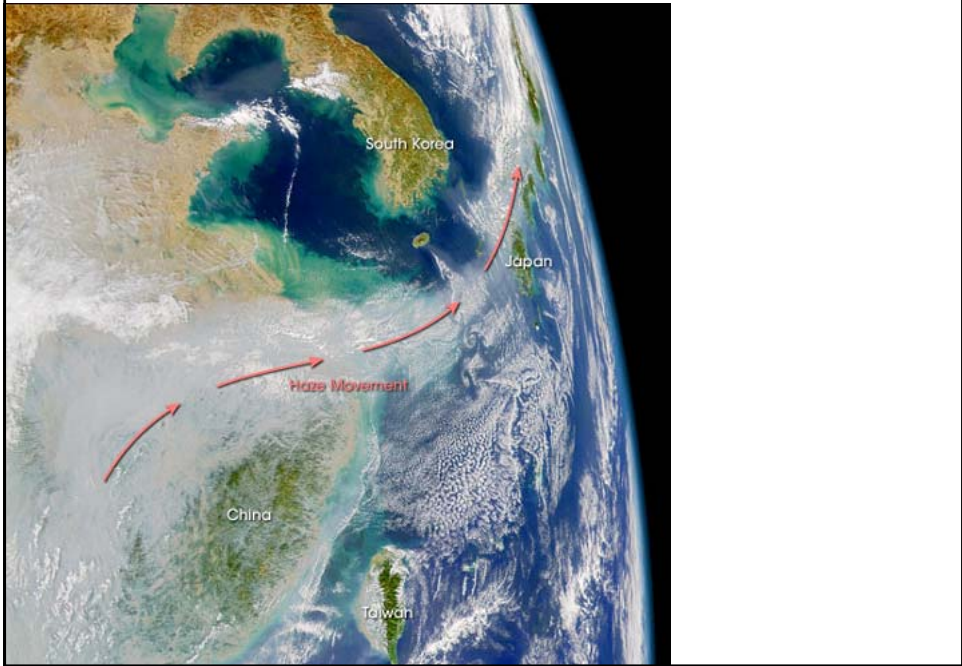
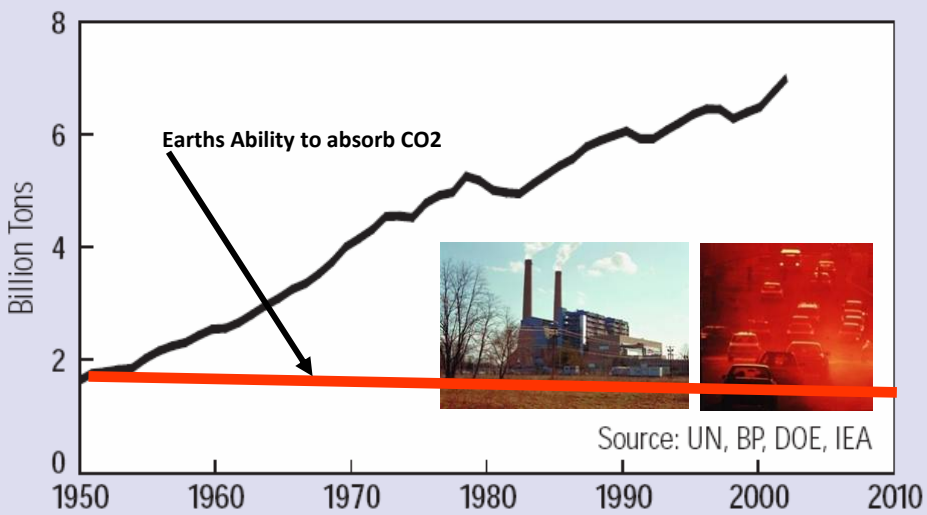
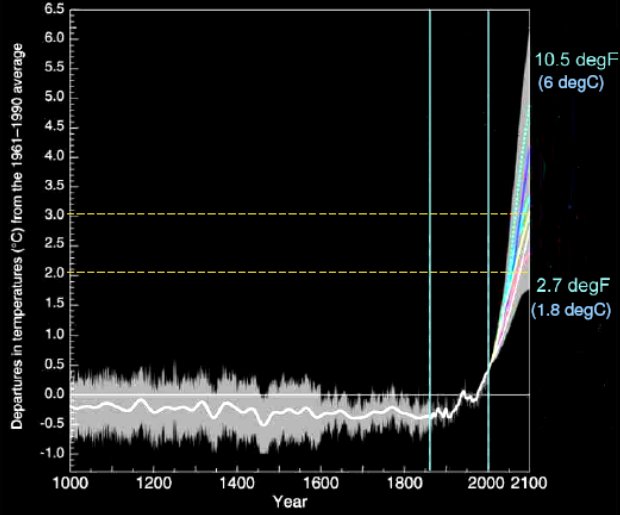


Figure 3. Carbon Emissions from Fossil Fuel Burning, 1950–2003

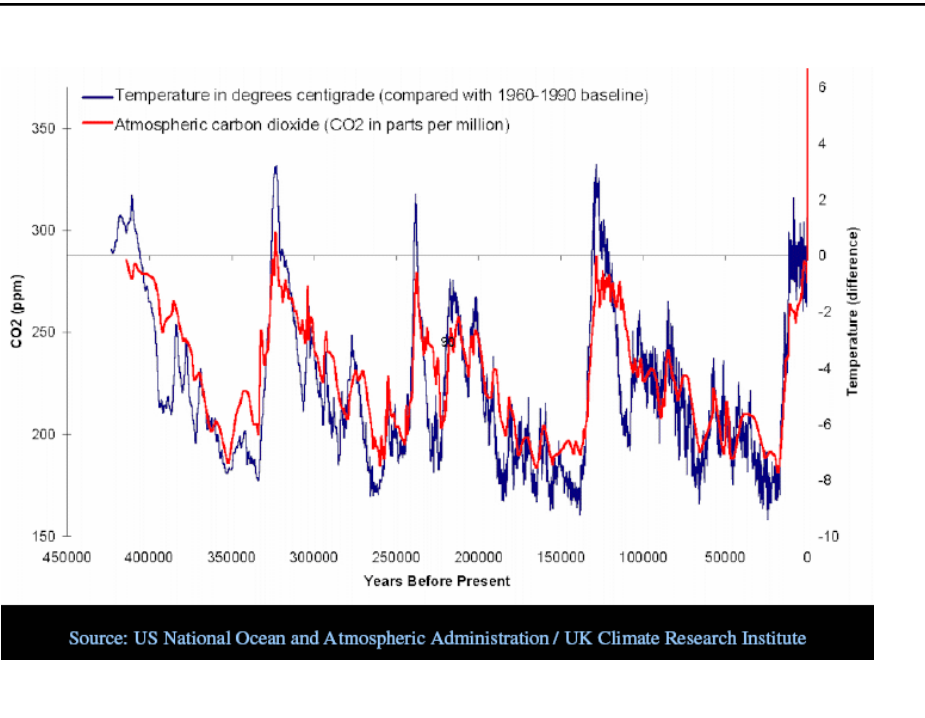


Future Scenarios for Average Earth Temperature

Earths Surface Temperature

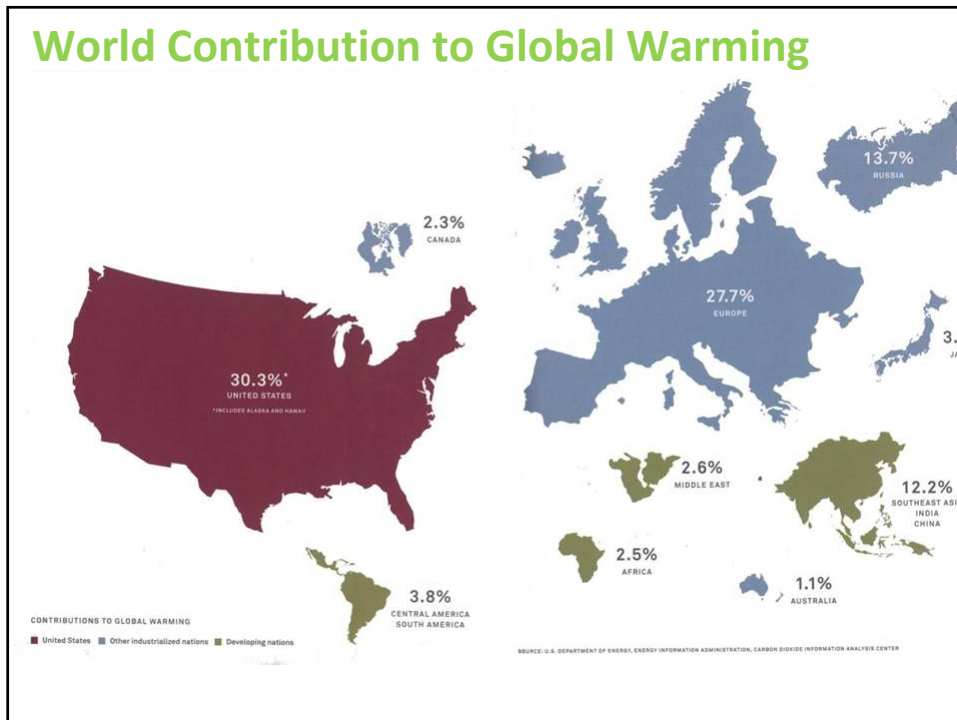


Source: UN Intergovernmental Panel on Climate Change (IPCC)

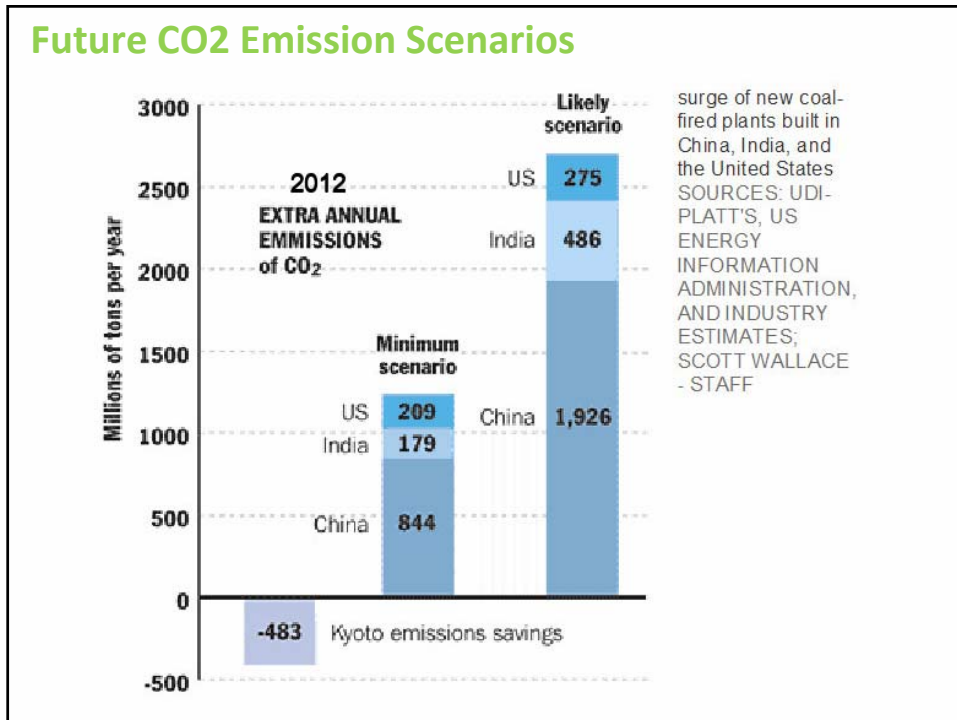


Source: US National Ocean and Atmospheric Administration / UK Climate Research Institute

World Contribution to Global Warming



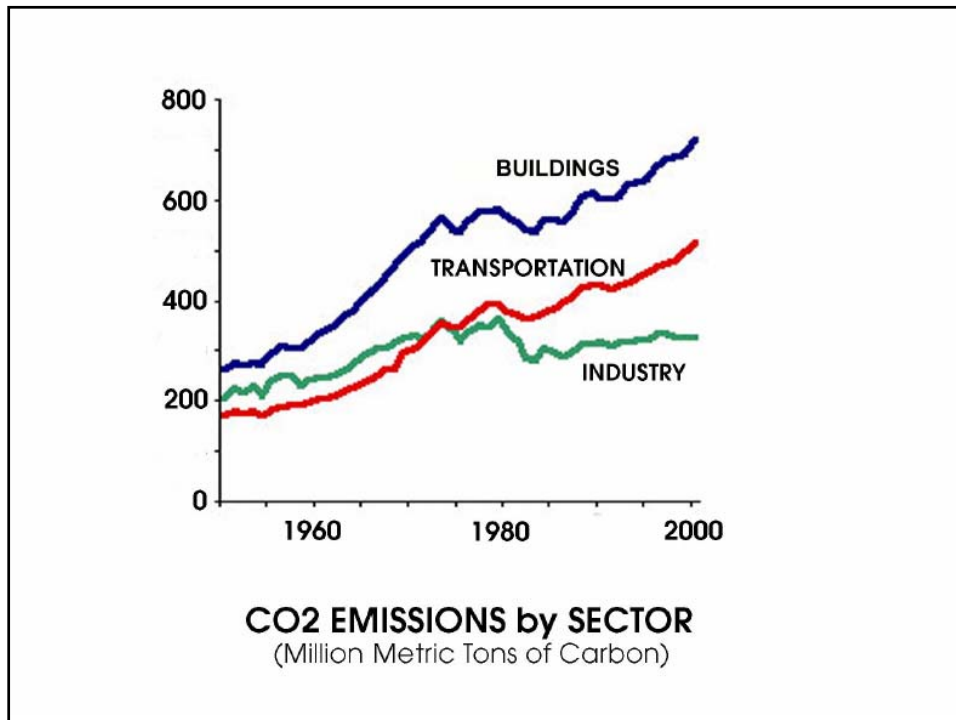
Future CO2 Emission Scenarios





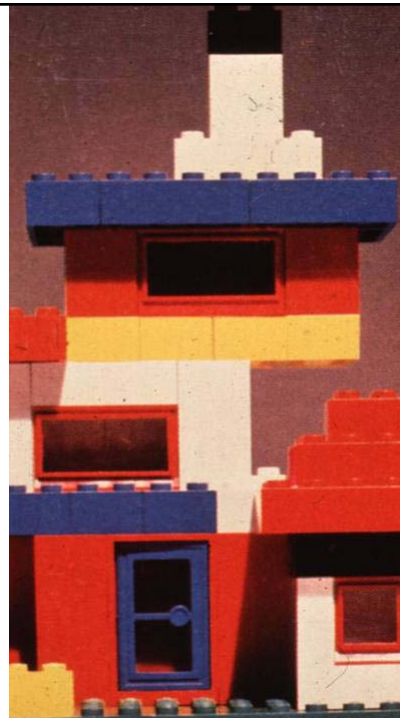
Frogs

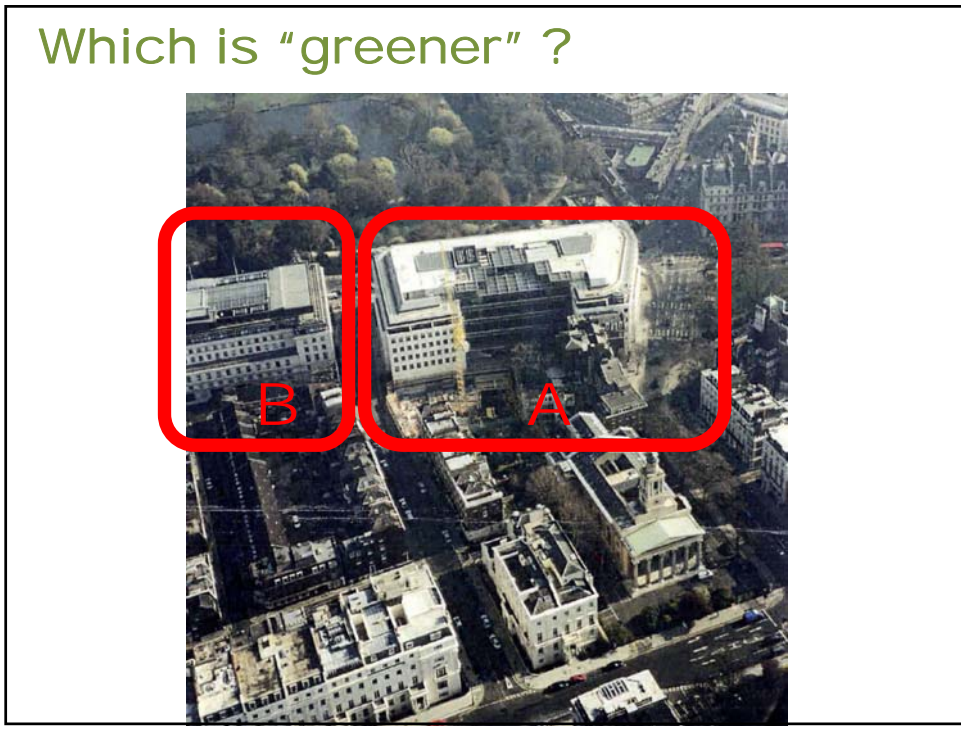
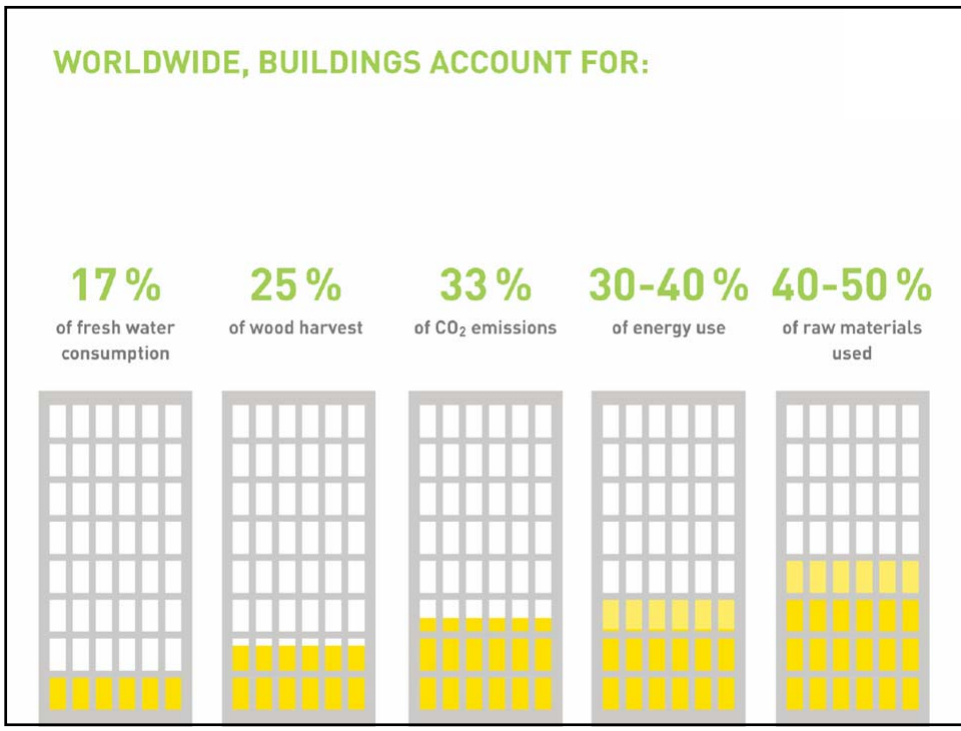




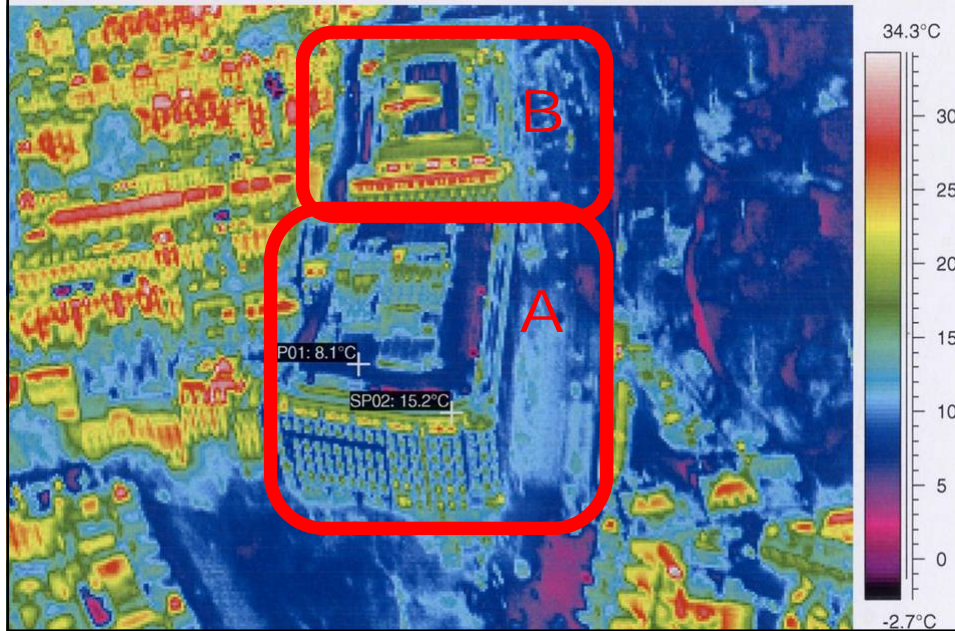
US Contribution of Buildings

- 17% of fresh water flow
- 25% of wood harvested
- 50% of CFC production
- 40% of energy flow
- 33% of total carbon dioxide emissions
- 40% of landfill material
- 30% of building suffer from “sick building syndrome”
- 95% of total energy use in a building is used in its construction





Which is "greener" ?



Food

Nutrition Facts

Serving Size 1 cup (228g)
Serving Per Container 2

Amount Per Serving

Calories 250 Calories from Fat 110

% Daily Value*

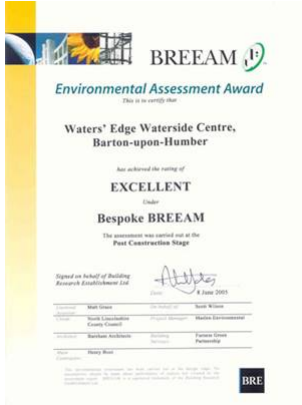
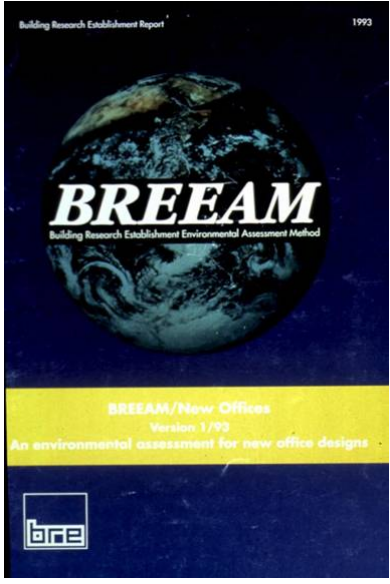
Total Fat 12g	18%
Saturated Fat 3g	15%
<i>Trans</i> Fat 1.5g	
Cholesterol 30mg	10%
Sodium 470mg	20%
Total Carbohydrate 31g	10%
Dietary Fiber 0g	0%
Sugars 5g	
Protein 5g	
Vitamin A	4%
Vitamin C	2%
Calcium	20%
Iron	4%

<h2 style="margin: 0;">Buildings</h2>	<h3 style="margin: 0;">Building Facts</h3> <p style="margin: 0;">Size: Use: Date Constructed</p>
	<h4 style="margin: 0;">CO2 Emissions</h4>
	<h4 style="margin: 0;">Total Energy Consumption</h4> <p style="margin: 0;">Fossil fuels Renewables</p>
	<h4 style="margin: 0;">Total Water Consumption</h4> <p style="margin: 0;">Potable water used Water harvested Water recycled on site</p>
	<h4 style="margin: 0;">Waste</h4> <p style="margin: 0;">Black water waste generated Black water waste recycled Solid waste generated Construction waste</p>
	<h4 style="margin: 0;">Materials</h4> <p style="margin: 0;">VOCs generated % recycled materials % recyclable Embodied energy</p>

Ideal Rating Systems

- that allows us to compare buildings one to another
- that uses recognized metrics
- that is transparent
- that is inclusive
- that is responsive to regional differences
- that is verified by an independent third party
- that allows for constant and **aggressive** improvement of standards
- that is consumer oriented – public support
- that can shape design decisions from the beginning

Building Rating Systems



BEPAC

Building Rating Systems



LEED™

LEADERSHIP IN ENERGY & ENVIRONMENTAL DESIGN

- 1. Sustainable Sites
- 2. Water Efficiency
- 3. Energy and Atmosphere
- 4. Materials and Resources
- 5. Indoor Environmental Quality

Design Tool

- Four levels of LEED-NC® certification:
 - Certified Level 26 - 32 points
 - Silver Level 33 - 38 points
 - Gold Level 39 - 51 points
 - Platinum Level 52+ points (69 possible)

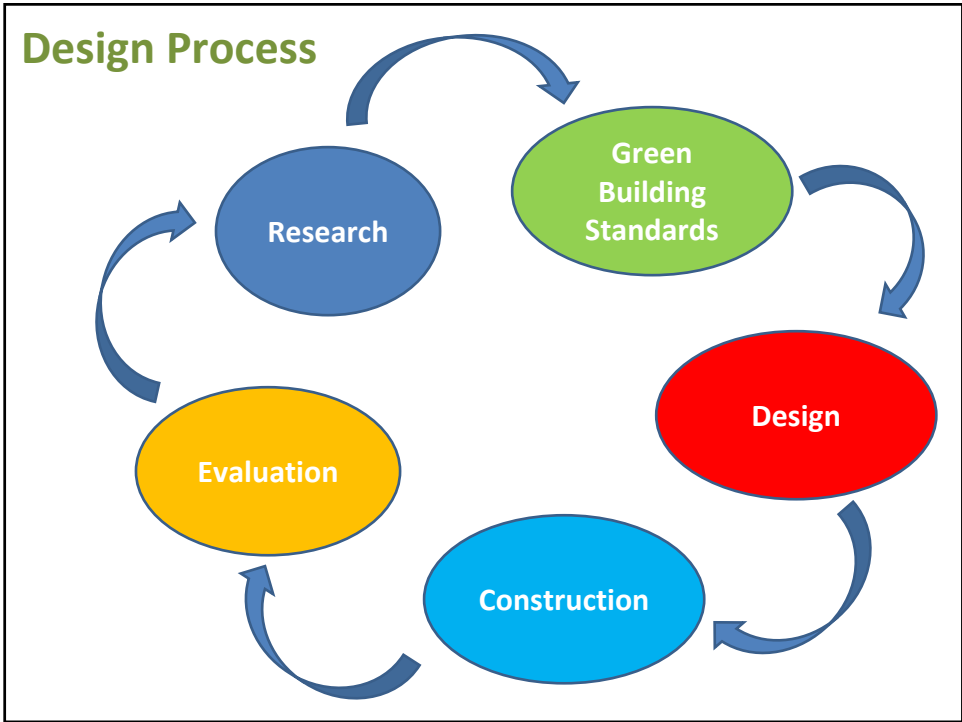
LEED NC for On Campus Building Projects
ACADEMIC BUILDINGS

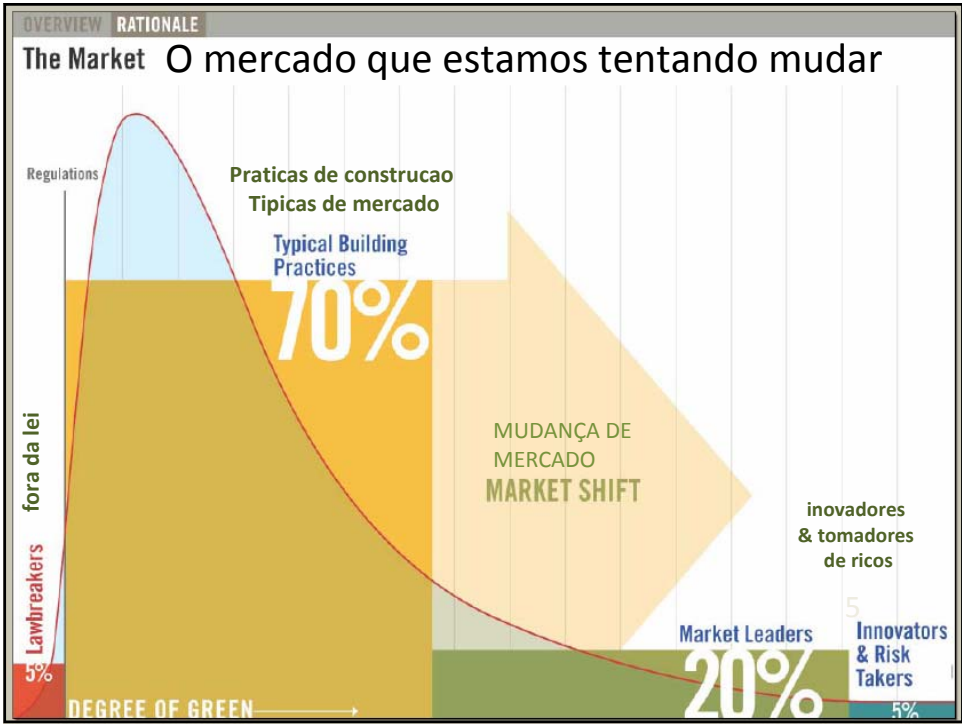
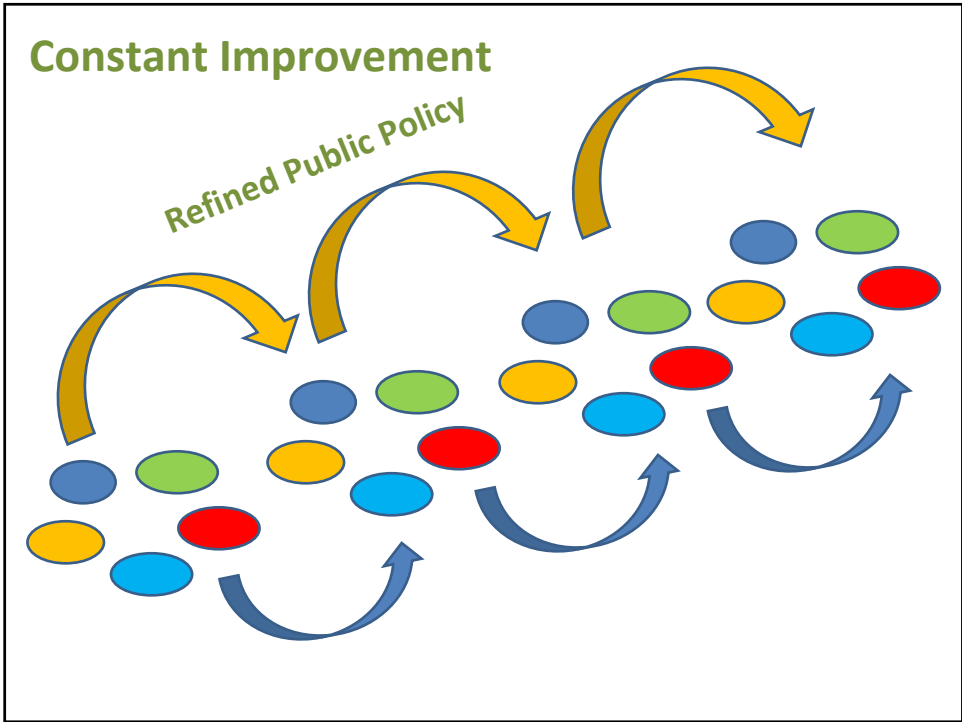
Category	Sub-Category	Points Available	Points Earned
Sustainable Sites	SS1: Location	4	4
	SS2: Access to Public Transportation	4	4
	SS3: Bicycle Facilities	2	2
	SS4: Stormwater Management	4	4
	SS5: Heat Island Reduction	4	4
	SS6: Construction Pollution Prevention	4	4
	SS7: Open Space	2	2
	SS8: Light Pollution Reduction	2	2
	SS9: Parking	2	2
	SS10: Construction Erosion Control	2	2
Water Efficiency	WE1: Water Use Reduction	4	4
	WE2: Water Fixtures	4	4
	WE3: Cooling Tower Water Management	2	2
	WE4: Water Metering	2	2
	WE5: Irrigation Water Management	2	2
	WE6: Water Recycling	2	2
	WE7: Water Efficient Landscaping	2	2
	WE8: Water Efficient Use of Land	2	2
	WE9: Water Efficient Use of Land	2	2
	WE10: Water Efficient Use of Land	2	2
Energy & Atmosphere	EA1: Fundamental Refrigerant Management	2	2
	EA2: Commissioning	4	4
	EA3: Energy Star	4	4
	EA4: Green Power	2	2
	EA5: Energy Star	2	2
	EA6: Energy Star	2	2
	EA7: Energy Star	2	2
	EA8: Energy Star	2	2
	EA9: Energy Star	2	2
	EA10: Energy Star	2	2
Materials & Resources	MR1: Building Reuse	2	2
	MR2: Construction Waste Management	4	4
	MR3: Recycled Content	4	4
	MR4: Recycled Content	2	2
	MR5: Recycled Content	2	2
	MR6: Recycled Content	2	2
	MR7: Recycled Content	2	2
	MR8: Recycled Content	2	2
	MR9: Recycled Content	2	2
	MR10: Recycled Content	2	2
Indoor Environmental Quality	IEQ1: Indoor Air Quality	4	4
	IEQ2: Indoor Air Quality	4	4
	IEQ3: Indoor Air Quality	2	2
	IEQ4: Indoor Air Quality	2	2
	IEQ5: Indoor Air Quality	2	2
	IEQ6: Indoor Air Quality	2	2
	IEQ7: Indoor Air Quality	2	2
	IEQ8: Indoor Air Quality	2	2
	IEQ9: Indoor Air Quality	2	2
	IEQ10: Indoor Air Quality	2	2
Quality of Construction	Q1: Construction Quality Management	4	4
	Q2: Construction Quality Management	4	4
	Q3: Construction Quality Management	2	2
	Q4: Construction Quality Management	2	2
	Q5: Construction Quality Management	2	2
	Q6: Construction Quality Management	2	2
	Q7: Construction Quality Management	2	2
	Q8: Construction Quality Management	2	2
	Q9: Construction Quality Management	2	2
	Q10: Construction Quality Management	2	2

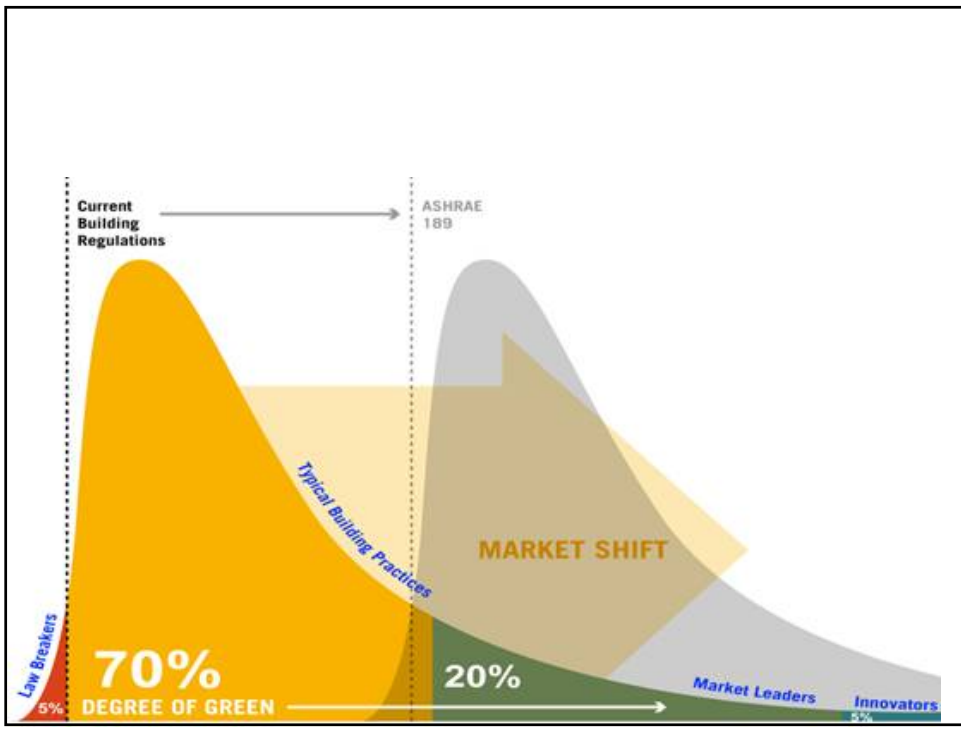


Saudi Arabian Chapter of the Green Building Council

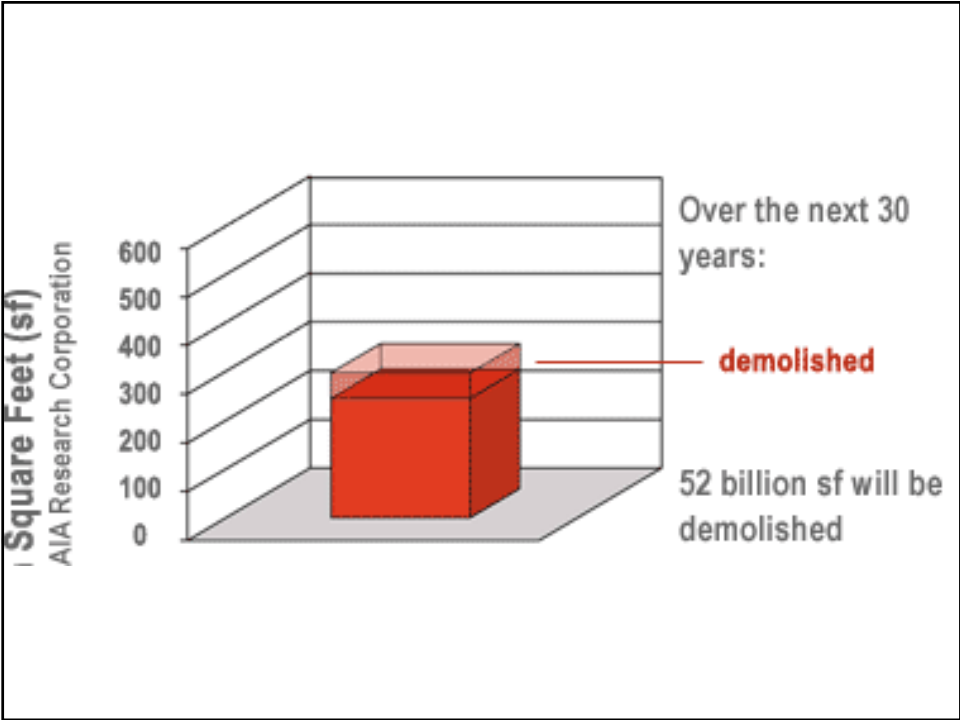
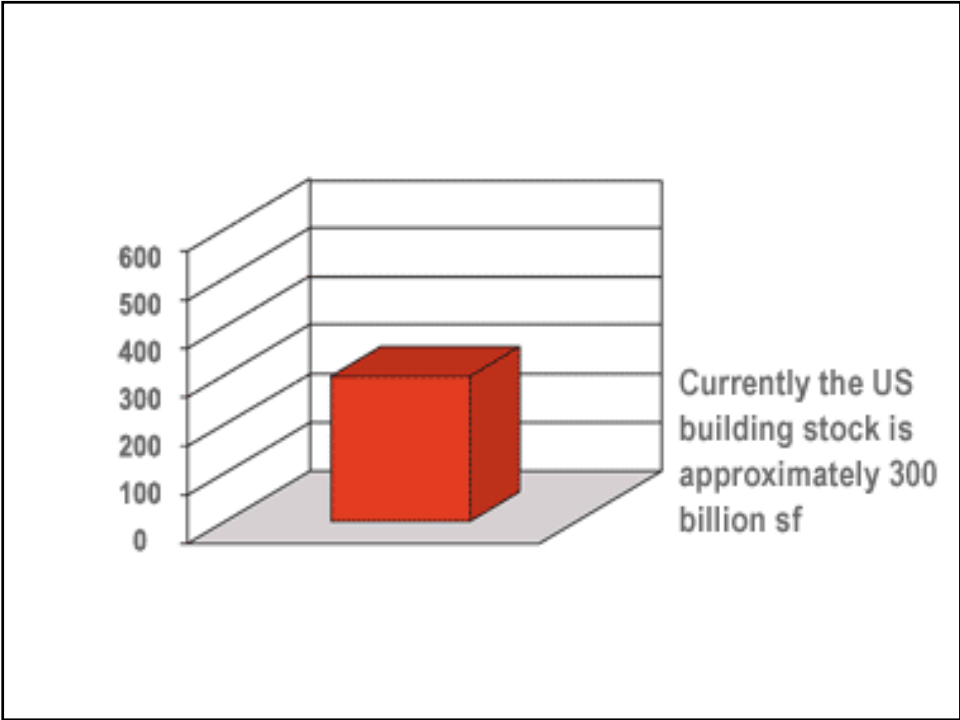


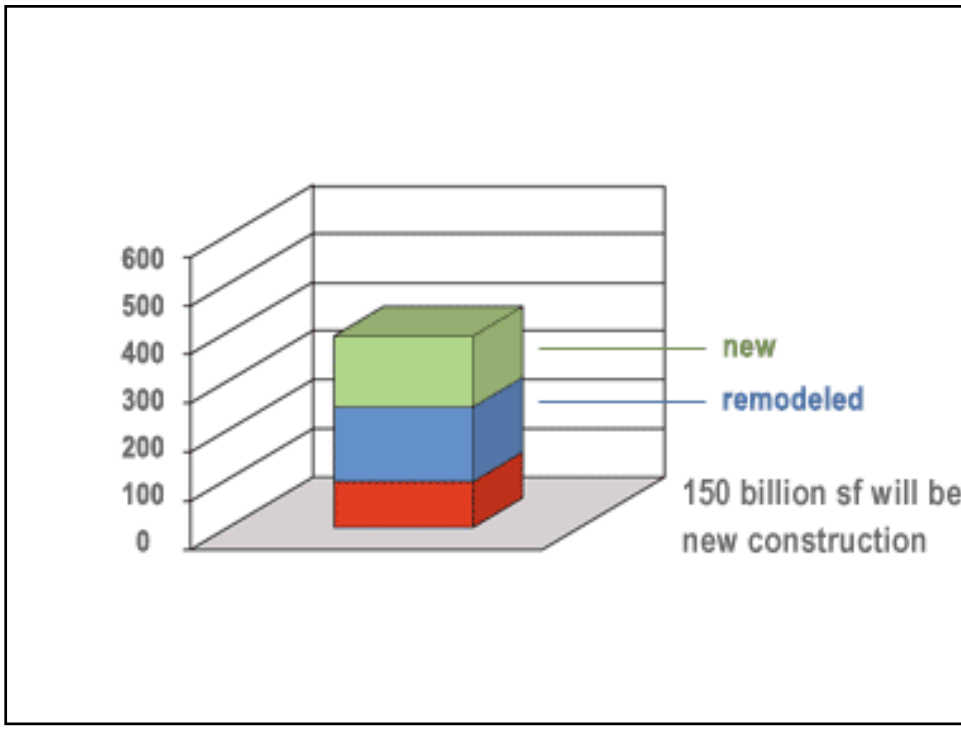
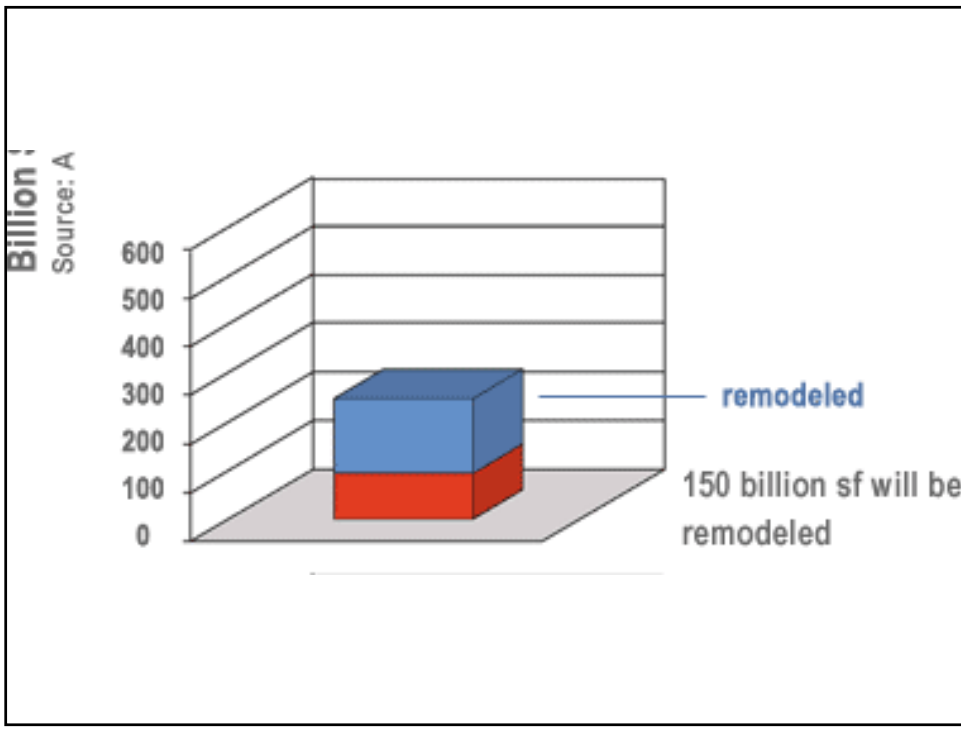






2030 °C Challenge





Changing Definition of Design

Limited daylight
No operable windows
Materials contaminate indoor air
Simultaneous heating and cooling
People overly hot, overly cold
No individual control over comfort
Simultaneous water disposal / use
\$\$\$ spent for disposal
Reliance on the automobile
Built-in obsolescence



Daylight
Operable windows
Healthy materials
Energy efficient design
Improved comfort
Individual controls
Water reuse
\$\$\$ earned from recycling
Transit options
Flexible, adaptable design

Fire and Life Safety Example



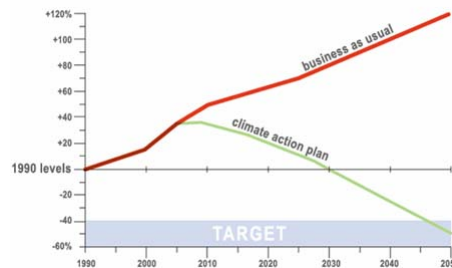
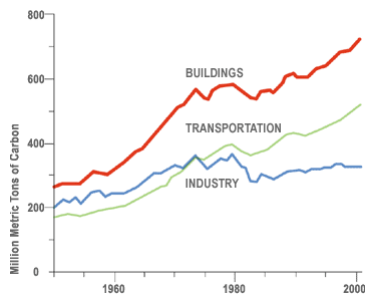
“The definition of insanity is doing the same things in the same way and expecting different results”

-Benjamin Franklin



A New Approach

Different impacts of buildings requires
A new approach to the Design Process

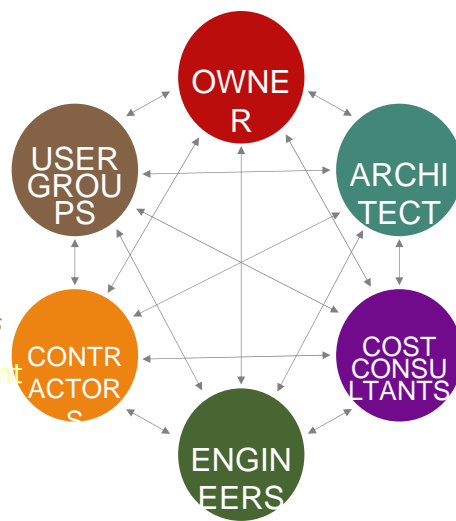


Integrated Design Overview

- **Mental Model** – an awareness of how things are connected and interrelate –
- **Process** – integrated, all parties engaged
- **Tools** – metrics, benchmarks, modeling programs
- **Techniques / Products / Solutions**

Integrated Design Teams

- New
- Holistic Thinking
- Team Based
- Organic Design Process
- Larger Team
Users, Operators, Constructors
- Innovation Encouraged by Client



Ten Key Steps to Integrated Design

- Getting Started
- Moving Forward
- Refinement
- Construction and Beyond!!!



Land / Water



Energy / Carbon

Step 1 Project Definition

40

1. Decide on use of LEED or other
2. Include visioning & goal setting
3. Include early design charrette
4. Identify feasibility studies
5. Clarify scope for site evaluations
6. Consider energy & water audits
7. Clarify scope energy & daylighting analysis
8. Include life cycle costing
9. Define commissioning scope
10. Recommend M&V plan
11. Encourage post occupancy evaluation
12. Encourage site master plan



Step 2 Team Building

Seek design team members who are experienced and committed to sustainable design and working collaboratively. Assemble the full design team and identify sustainable champions for the owner and design team.

- Team Formation
- Budgeting
- Scheduling

Steps One and Two

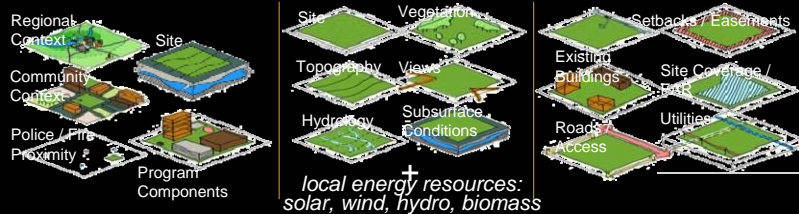
Step 3 Education and Goal Setting

1. Education
2. Goal Setting
3. Design Criteria
 - Identify design standards
 - Review and challenge design criteria assumptions
 - Identify program/space requirements
 - Seek out re-use opportunities
 - Define flexibility needs
 - Document all IAQ-related programming information



STEP 4 Site Evaluation

1. Collect climate data
2. Identify on-site energy resources
3. Identify transit networks
4. Analyze development regional impacts
5. Study best zones for development
6. Survey plant/animal species and habitats
7. Check for prior contamination
8. Identify cultural/historical elements



Contextual Influences

Natural Influences


Man-Made Influences

STEP 5 Baseline Analysis

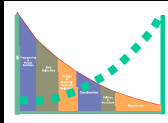
Develop baseline energy and water analysis; establish budgets and compare with benchmarks and project sustainable design goals. **Explore potential for renewable energy and financial incentives** and/or utility rebates for energy efficiency, **water**, and renewables.

Steps One and Two

Project Action Focus	Metrics
<ul style="list-style-type: none"> • <i>\$\$ per SF</i> • <i>Net to gross ratio</i> • <i>Floor area ratio</i> 	
<p data-bbox="395 1615 1029 1653">Metrics we need to be familiar with:</p> <ul style="list-style-type: none"> • <i>BTU / SF / Year</i> • <i>Watts / SF</i> • <i>Tons of Cooling / SF</i> <p data-bbox="967 1809 1182 1877"><i>understand rules of thumb...</i></p>	

Project Action Focus	Metrics
Performance Metrics	
LAND USE LAND USE RATIO: % SITE BLDG FTPRINT: % SITE PKG FTPRINT:	ENERGY SECURITY KW/NET SF PEAK ELEC: % PEAK LOAD REDUCTION: % ON-SITE RENEWABLE ENERGY GENERATION AND SOURCES: % GRID-SUPPLIED RENEWABLE:
SITE ECOLOGY % SITE ONSITE ECOSYSTEM: % PRECIP MANAGED ON SITE:	GREEN MATERIALS % OF TOTAL BY COST %: RECYCLED CONTENT: RAPIDLY RENEWABLE: CERT WOOD: LOW VOC MATLS: SALVAGED/REUSED: LOCAL (500 MI):
TRANSPORTATION % BLDG POP USING TRANSIT OPTIONS VS SOV: # PKG SPACES/PERSON:	
WATER POTABLE WATER INDOORS: GAL/YR: POTABLE WATER OUTDOORS: GAL/YR: POTABLE WATER/PERSON: GAL/YR/PERSON: POTABLE WATER/SF/YR: % WASTEWATER REUSED ON SITE: % REDUCTION	
ENERGY COOLING BTUS/SF/YR: HEATING BTUS/SF/YR: LIGHTING W/SF: PLUG LOADS W/SF: COOL'G CAPACITY SF/TON: TOTAL BTUS/SF/YR: % TOTAL ENERGY SAVINGS (INDICATE MODEL DESIGN):	WASTE REDUCTION % OF C+D DIVERTED FROM DISPOSAL: AMT OF WASTE MATL REUSED ON SITE: AMT WASTE MATL RECYCLED OFF-SITE: WASTE MATL TO LANDFILL/INCIN:
	LIGHTING AND DAYLIGHTING % TOT BLDG DAYLIT: LIGHTING POWER DENSITY/SF DESIGN:
	NATURAL VENTILATION % VENT/COOLED WITH OPERABLE WINDOWS: % YEAR BLDG FULLY VENTILATED/COOLED WITH OA:
<i>understand and compare performance...</i>	

STEP 6 Design Concept



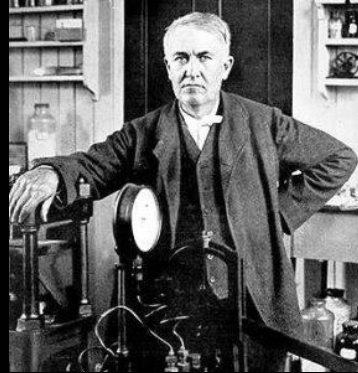
Bring aspirations & strategies to the table!

Opportunities decrease as project progresses...

STEP 7 Design Optimization

“Genius is 1 % inspiration and 99% perspiration”

- Thomas Alva Edison



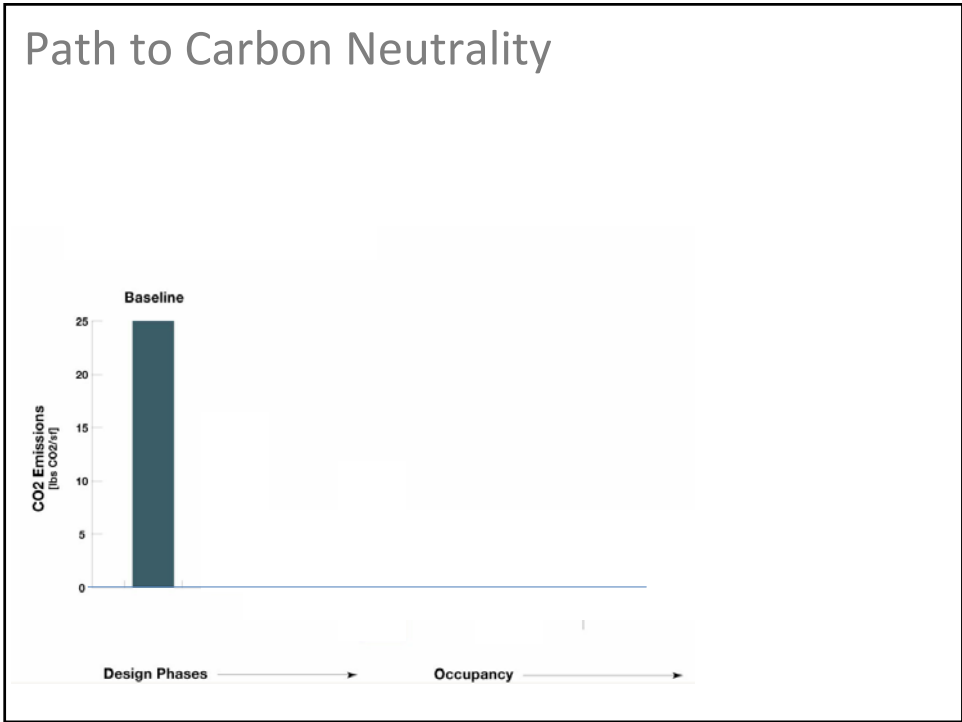
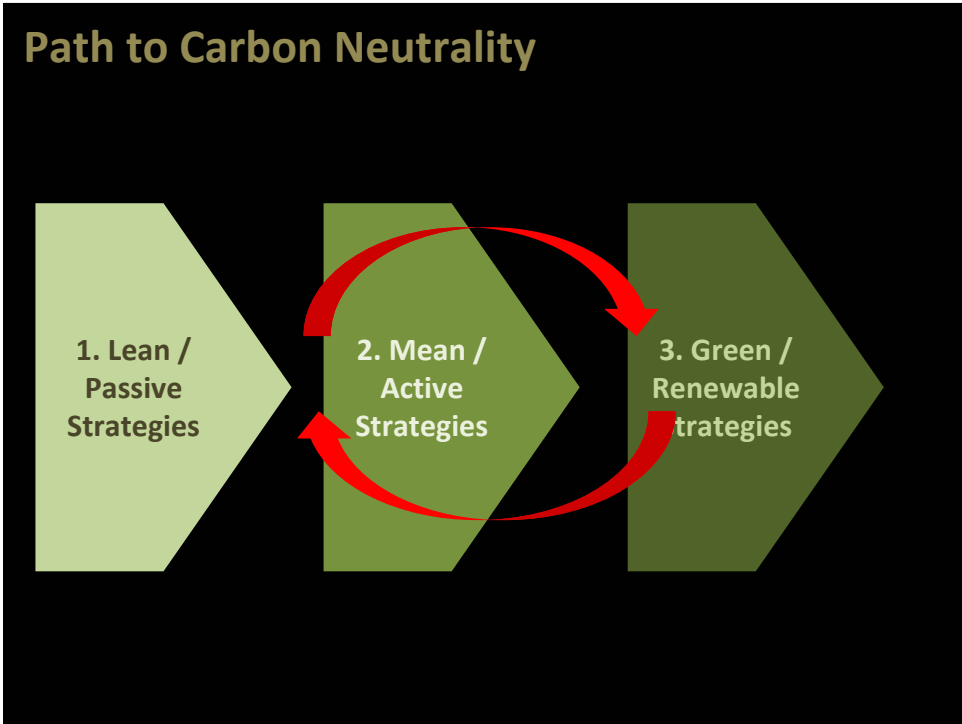
Project Action Focus

Energy Optimization

A Systematic Approach to Energy Optimization 97

- 1: Gather Information
- 2: Create Base Case Energy Model
- 3: Characterization of Energy Use and Energy Cost
- 4: Develop Alternative Design Solutions
- 5: Daylighting Design and Analysis
- 6: Energy and Economic Analysis
- 7: Repeat the Process
- 8: Follow Up

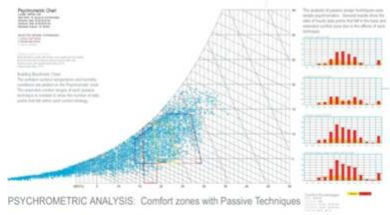




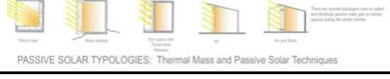
Orientation & Shading



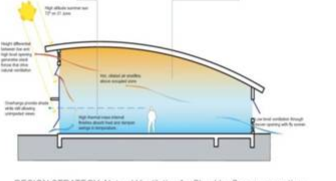
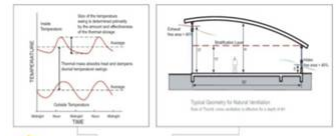
DESIGN STRATEGY: Locations for Natural Ventilation, Solar Collection and Thermal Mass



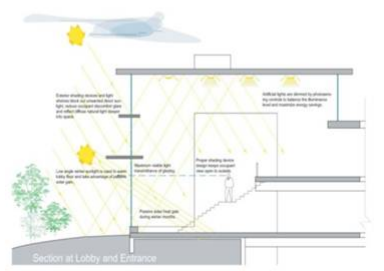
PSYCHROMETRIC ANALYSIS: Comfort zones with Passive Techniques



PASSIVE SOLAR TYPOLOGIES: Thermal Mass and Passive Solar Techniques

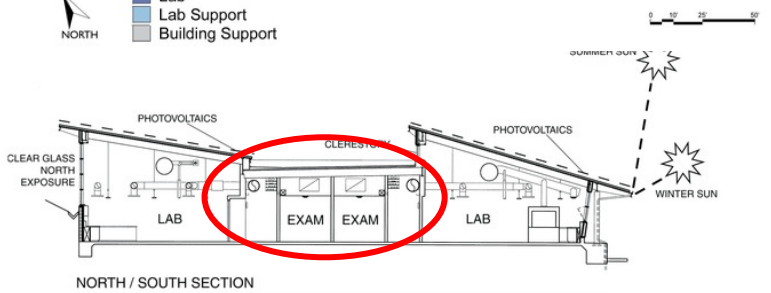
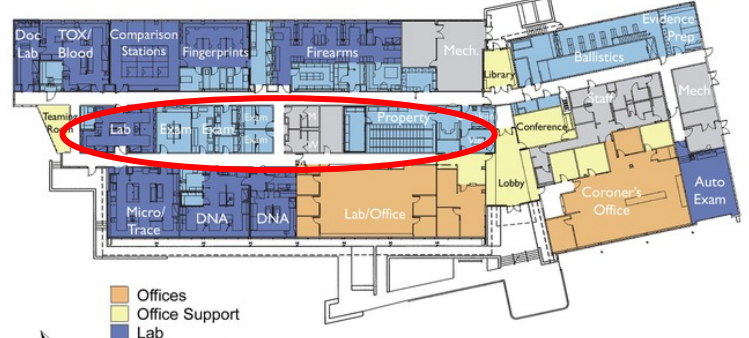


DESIGN STRATEGY: Natural Ventilation for Shoulder Season operation



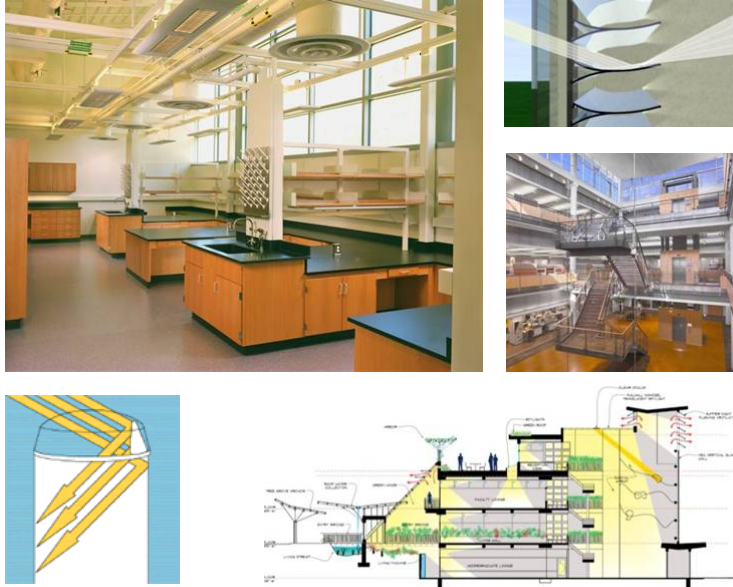
DESIGN STRATEGY: Daylight Harvesting

Isolate Internal Loads



NORTH / SOUTH SECTION

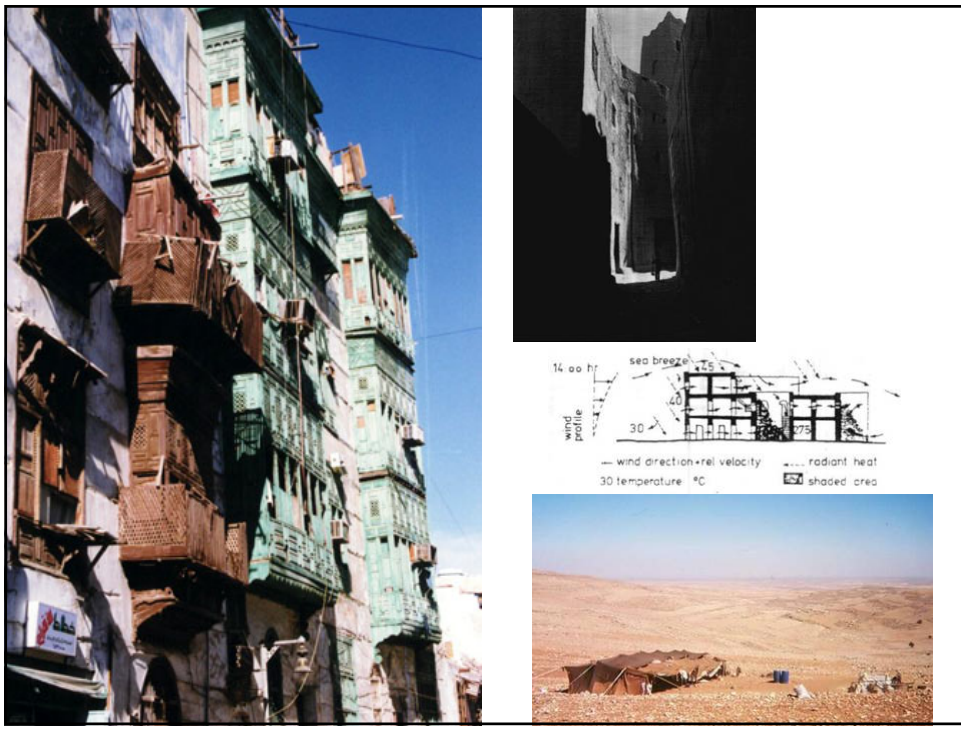
Daylight as Primary Ambient Lighting

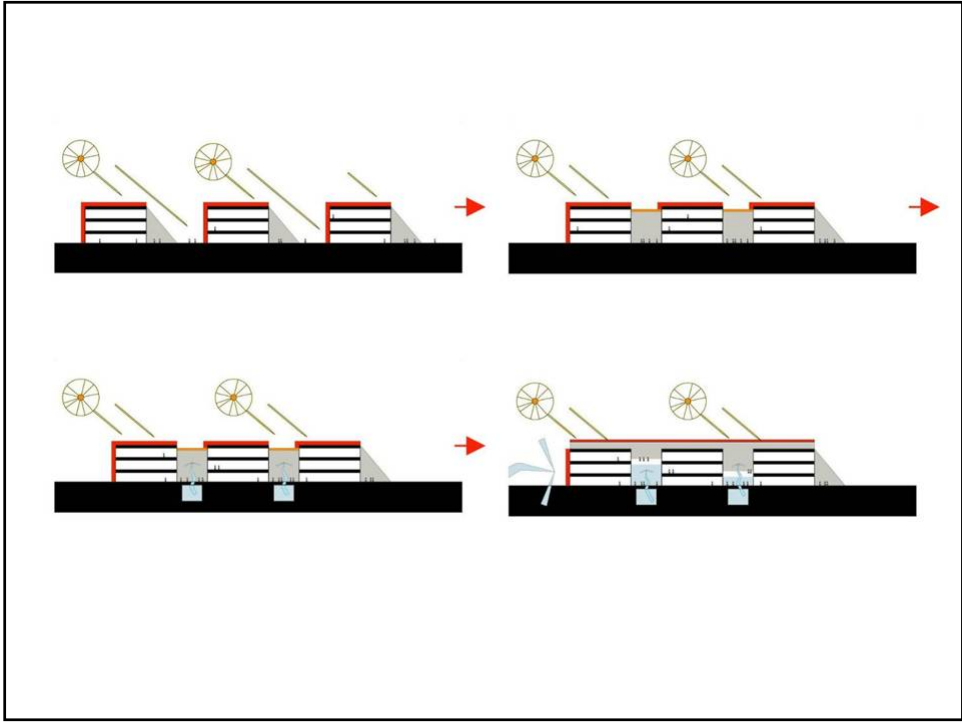


Control Exterior Loads

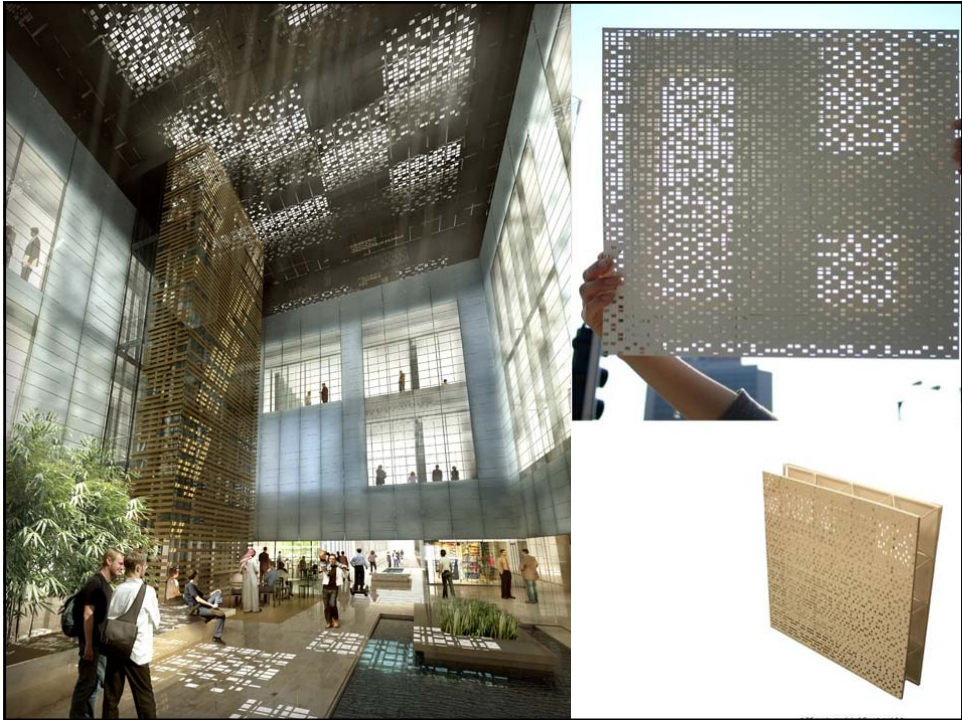
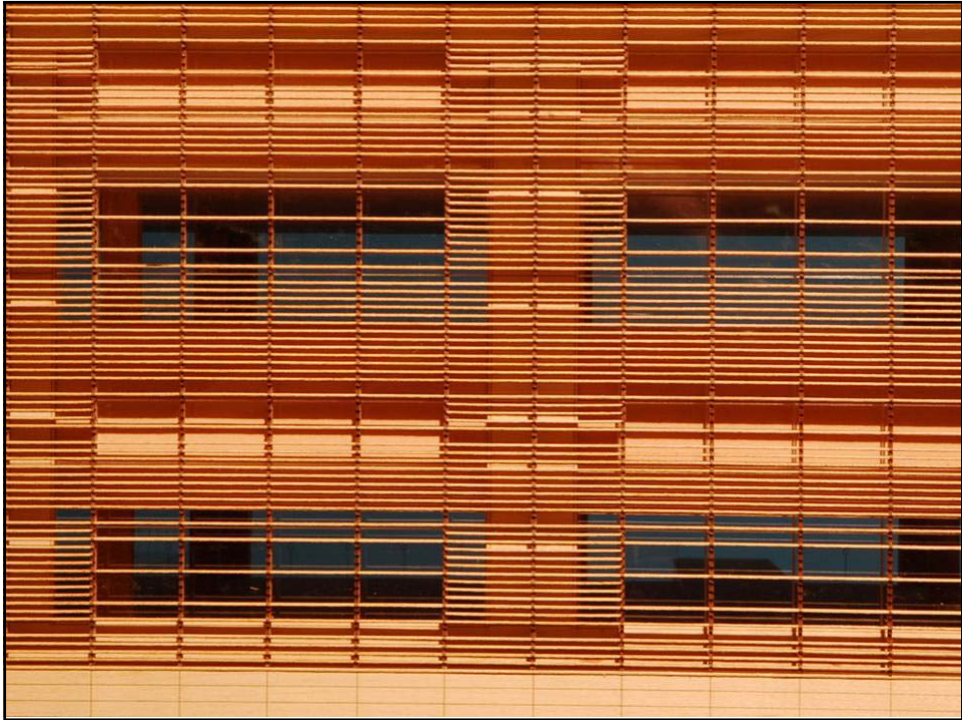


KAUST











SOLAR TOWER

COMFORT INCREASED 65%

- SHADE
- WIND
- EVAPORATIVE COOLING

Draws Air Through and Out Through Wind Tower (with Solar Stack Effect)

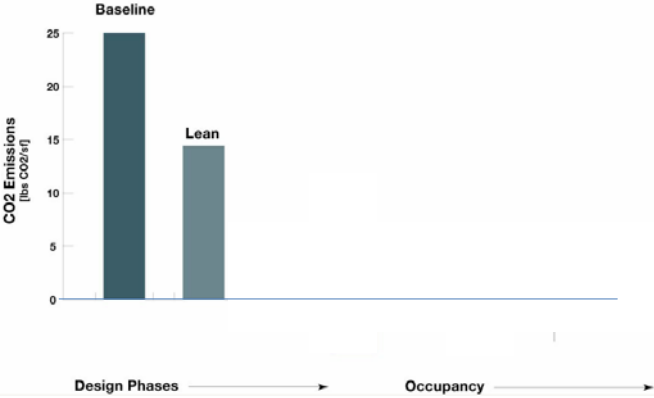
Passive Ventilation

FORMAL RESPONSE

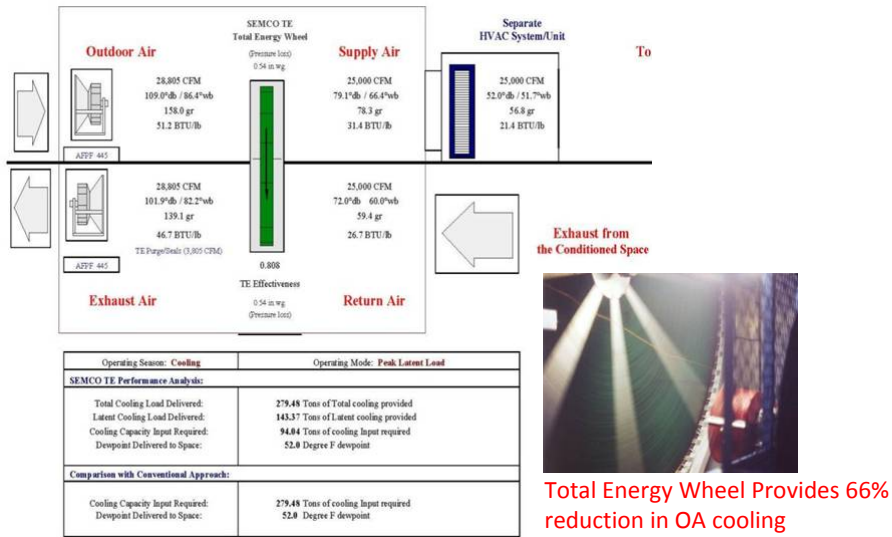
1. VERTICAL TOWER



Path to Carbon Neutrality



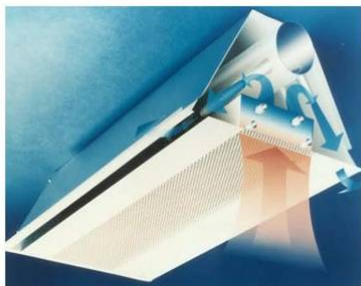
Energy recovery



Total Energy Wheel Provides 66% reduction in OA cooling

ENERGY – HEAT WHEELS

Chilled Beams



- Mechanical costs ↑
- Architectural costs ↓
- Increased usable floor area creating added value
- Reduced ongoing costs

- Cooling with water, not air
- 100% Fresh Air Supply

- Demand Controlled Ventilation
- Variable Air Volume exhaust
- Direct Drive Fans

Mini-Cogen System

125 PSIG TO AUTOCLAVE

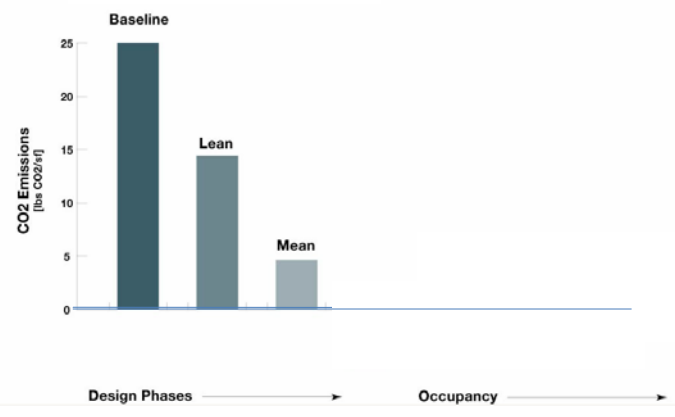
125 PSIG TO HEATING

125 PSIG GENERATOR ELECTRICTY

STEAM BOILER

BP50 Series

Path to Carbon Neutrality



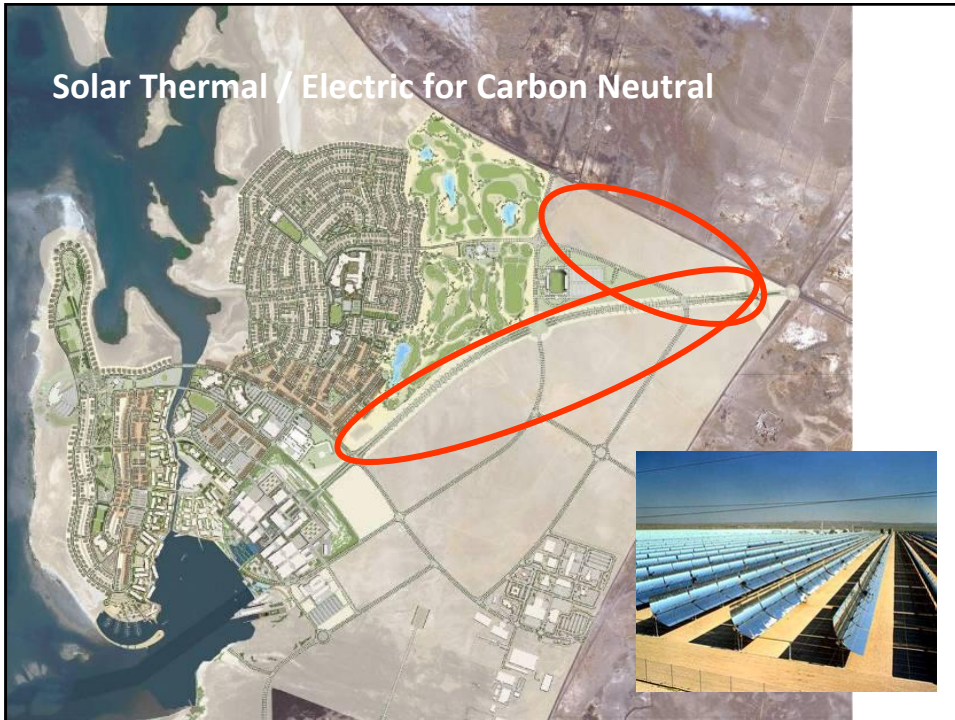
Solar Electric



Energy Efficiency



Solar Thermal / Electric for Carbon Neutral



SUSTAINABLE SITES

LEED NC for On Campus Building Projects
ACADEMIC BUILDINGS

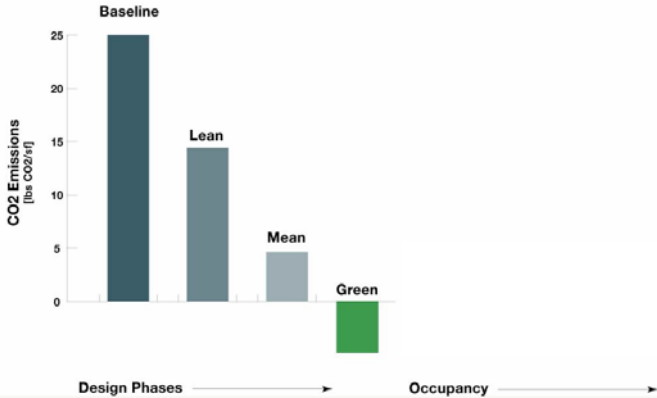
LEED Rating	Prerequisite	Optional	Points	Sustainable Site	Contribution
LEED Gold	SS-1	SS-2, SS-3, SS-4, SS-5, SS-6, SS-7, SS-8, SS-9, SS-10, SS-11, SS-12, SS-13, SS-14, SS-15, SS-16, SS-17, SS-18, SS-19, SS-20, SS-21, SS-22, SS-23, SS-24, SS-25, SS-26, SS-27, SS-28, SS-29, SS-30, SS-31, SS-32, SS-33, SS-34, SS-35, SS-36, SS-37, SS-38, SS-39, SS-40, SS-41, SS-42, SS-43, SS-44, SS-45, SS-46, SS-47, SS-48, SS-49, SS-50, SS-51, SS-52, SS-53, SS-54, SS-55, SS-56, SS-57, SS-58, SS-59, SS-60, SS-61, SS-62, SS-63, SS-64, SS-65, SS-66, SS-67, SS-68, SS-69, SS-70, SS-71, SS-72, SS-73, SS-74, SS-75, SS-76, SS-77, SS-78, SS-79, SS-80, SS-81, SS-82, SS-83, SS-84, SS-85, SS-86, SS-87, SS-88, SS-89, SS-90, SS-91, SS-92, SS-93, SS-94, SS-95, SS-96, SS-97, SS-98, SS-99, SS-100	6	SS-1, SS-2, SS-3, SS-4, SS-5, SS-6, SS-7, SS-8, SS-9, SS-10, SS-11, SS-12, SS-13, SS-14, SS-15, SS-16, SS-17, SS-18, SS-19, SS-20, SS-21, SS-22, SS-23, SS-24, SS-25, SS-26, SS-27, SS-28, SS-29, SS-30, SS-31, SS-32, SS-33, SS-34, SS-35, SS-36, SS-37, SS-38, SS-39, SS-40, SS-41, SS-42, SS-43, SS-44, SS-45, SS-46, SS-47, SS-48, SS-49, SS-50, SS-51, SS-52, SS-53, SS-54, SS-55, SS-56, SS-57, SS-58, SS-59, SS-60, SS-61, SS-62, SS-63, SS-64, SS-65, SS-66, SS-67, SS-68, SS-69, SS-70, SS-71, SS-72, SS-73, SS-74, SS-75, SS-76, SS-77, SS-78, SS-79, SS-80, SS-81, SS-82, SS-83, SS-84, SS-85, SS-86, SS-87, SS-88, SS-89, SS-90, SS-91, SS-92, SS-93, SS-94, SS-95, SS-96, SS-97, SS-98, SS-99, SS-100	SS-1: Construction Activity Pollution Prevention SS-2: Site Selection SS-3: Sustainable Sites & Community Connectivity SS-4: Stormwater Management SS-5: Alternative Transportation: Public Transportation Access SS-6: Alternative Transportation: Bicycles and Shared Bicycles SS-7: Alternative Transportation: Carpooling and Vanpools SS-8: Alternative Transportation: Low Volatility & Low-Greenhouse Gases SS-9: Alternative Transportation: Electric Bicycles SS-10: Alternative Transportation: Electric Bicycles SS-11: Alternative Transportation: Electric Bicycles SS-12: Alternative Transportation: Electric Bicycles SS-13: Alternative Transportation: Electric Bicycles SS-14: Alternative Transportation: Electric Bicycles SS-15: Alternative Transportation: Electric Bicycles SS-16: Alternative Transportation: Electric Bicycles SS-17: Alternative Transportation: Electric Bicycles SS-18: Alternative Transportation: Electric Bicycles SS-19: Alternative Transportation: Electric Bicycles SS-20: Alternative Transportation: Electric Bicycles SS-21: Alternative Transportation: Electric Bicycles SS-22: Alternative Transportation: Electric Bicycles SS-23: Alternative Transportation: Electric Bicycles SS-24: Alternative Transportation: Electric Bicycles SS-25: Alternative Transportation: Electric Bicycles SS-26: Alternative Transportation: Electric Bicycles SS-27: Alternative Transportation: Electric Bicycles SS-28: Alternative Transportation: Electric Bicycles SS-29: Alternative Transportation: Electric Bicycles SS-30: Alternative Transportation: Electric Bicycles SS-31: Alternative Transportation: 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ALTERNATIVE TRANSPORTATION

Multiple methods of transportation are being discussed to reduce the overall carbon footprint of the project.



Path to Carbon Neutrality - GREEN

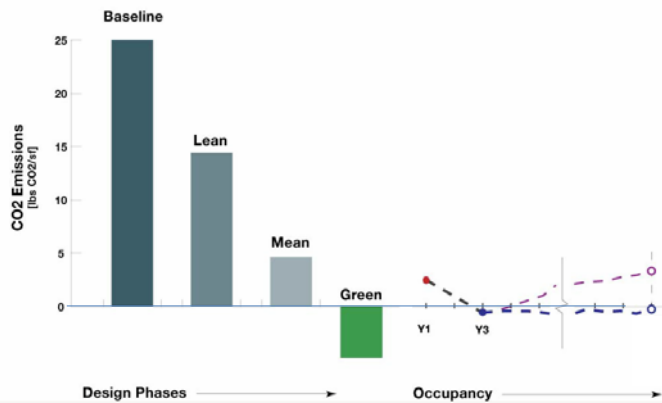


Calculating Carbon

- 1. Direct
 - Heating combustion
- 2. Indirect
 - Electric
- 3. Indirect Other
 - Water systems
 - Faculty travel
 - Departmental Vehicles
 - Waste removal
- 4. Opportunities for Sequestering

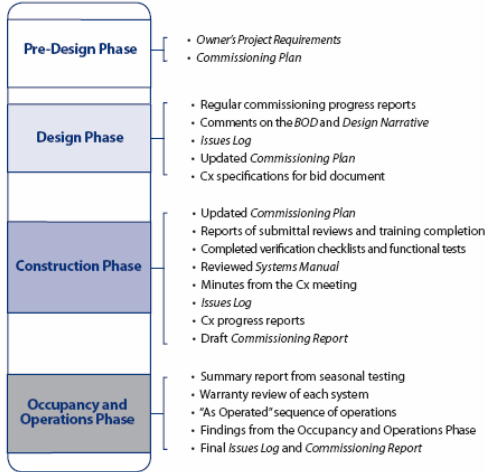


Path to Carbon Neutrality – POST OCCUPANCY MONITORING



Full Building Commissioning

Summary of Recommended Deliverables by Commissioning Phase



STEP 8 Documents and Specification

Metadata:
 Number: A219-7026
 Level: 2
 Date: APPD Loc
 Type: Interiors
 Issued: Apr 25, 2006
 CSI: 49 49
 DIMS: Imperial
 Origin: RFPD

Notes:
 Description: Access Floor Underfloor Air Delivery Perimeter Detail, interesting adjoining One-Bit Partition Type.
 Instructions: This system is based on Take Access Floors, Inc. system utilizing 24"x24"x1/8" concrete core steel panels, bolted steel stringer substructure, and adjustable steel support pedestals. This detail includes 5'-11" to 24" perimeter access panels. Refer to alternate RPD detail for perimeter access panels less than 5'-11". Make that the access floor system is self supporting, and does not transfer lateral load to the adjoining structure. Coordinate this detail with air distribution layout and supplemental details included in the Project HVAC Documents. Coordinate with the access floor details with the project specifications to cover requirements for sealing the

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SECTION 13110 - SUSTAINABLE DESIGN REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other divisions of Specifications, Division, apply to this Section.

1.2 SUMMARY

A. The Section includes general requirements and procedures for compliance with various U.S. Green Building Council's (USGBC) LEED prerequisites and credits needed for the Project to attain LEED [Certificate] [Silver] [Gold] [Platinum] certification.

1. Other LEED prerequisites and credits needed to attain LEED certification are dependent on schematic selection and may not be specifically identified as LEED requirements. Compliance with requirements needed to obtain LEED prerequisites and credits may be done in one or more of the following ways:

1. Additional LEED prerequisites and credits needed to attain the indicated LEED certification are dependent on the Architect's design and other aspects of the Project that are not part of the Work of the Contract.
2. **Elaboration and documentation in a Submittal Log.**

B. Related Sections include the following:

1. Division 01 through 49 Sections for LEED requirements specific to the Work of each of these Sections. These requirements may or may not include reference to LEED.

1.3 DEFINITIONS

A. Certificates of Class of Custody: Certificates signed by manufacturers certifying that wood used in mill products was obtained from forests certified by an FSC accredited certification body in compliance with FSC's 12 Principles and Criteria. Certificates shall include evidence that mill is certified for chain-of-custody by an FSC-accredited certification body.

B. LEED: Leadership in Energy & Environmental Design.

C. Rapidly Renewable Materials: Materials made from agricultural products that are typically harvested within a one-year or shorter cycle. Rapidly renewable synthetic materials products made from bamboo, cotton, flax, jute, straw, and other natural, vegetable, or wood.

STEP 9 Bidding and Construction



Pre-bid conferences



Bid Evaluations



Site protection

STEP 10 Post Occupancy Evaluation

HOK POE PROCESS:

1. CBE Occupant Satisfaction Survey
2. Energy Analysis
3. Interview



What can you do?

- Educate yourself and others about this issue
- Aggressively respond in your work
- Be a model in your own office
- Support renewable energy and other solutions
- Pressure government at all levels
- Speak up

What can you do on your projects?

- Select for the most experienced team
- Reach out if you need help
- Be absolutely consistent and systematic if following LEED (or other system)
- Go beyond LEED wherever possible
- Develop systems concepts for energy and water very early

Most Important

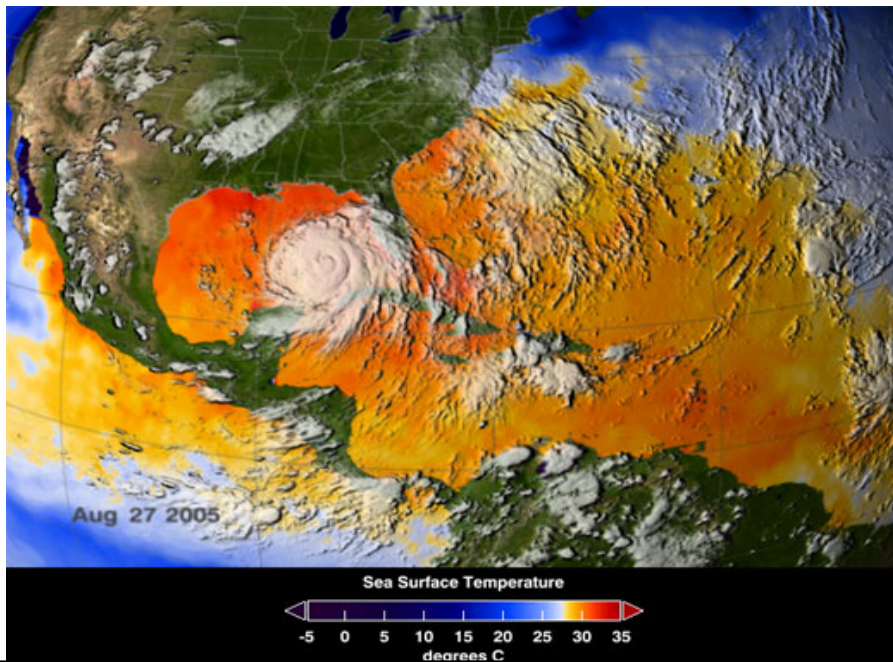
- **Be ORGANIZED**
- **Be SYSTEMATIC**
- **Be PERSISTENT**
- **Have the right**

Attitude

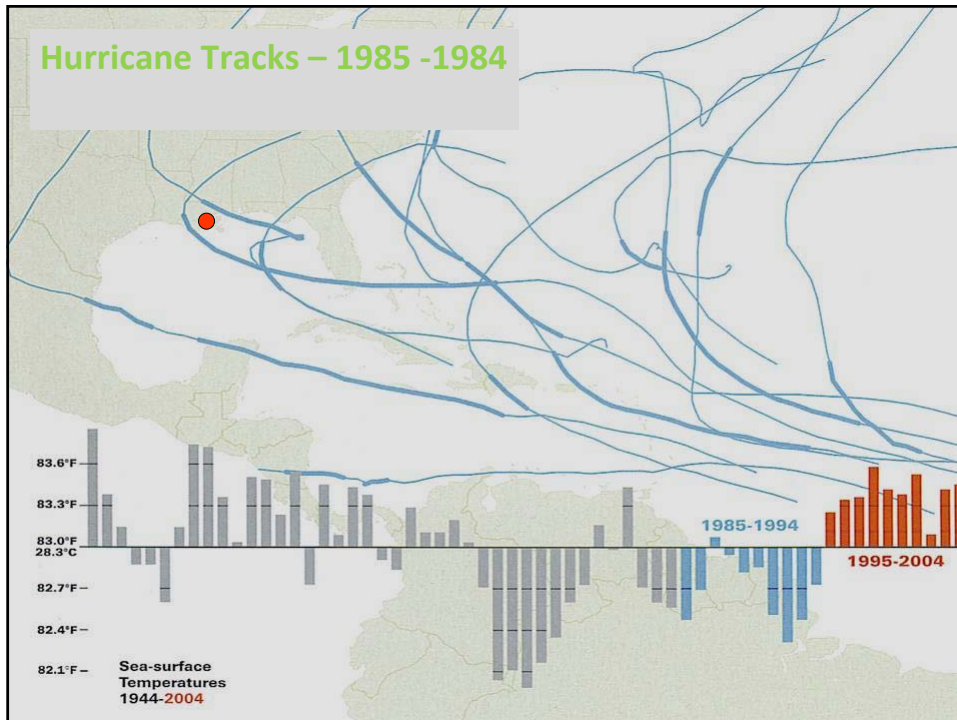
• **Don't ever give up**

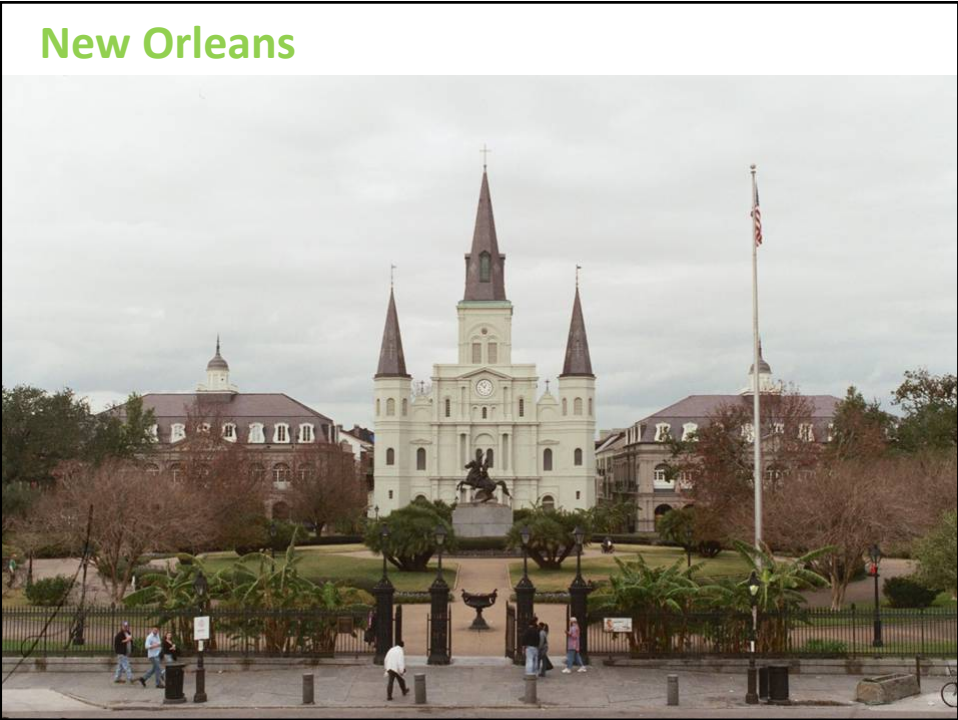
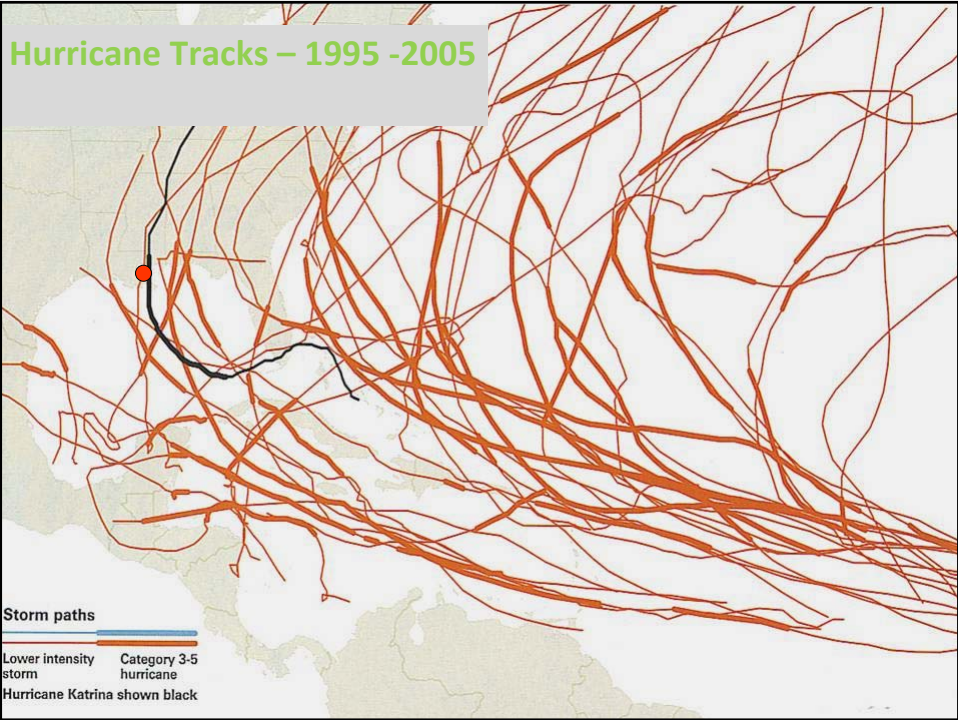


Hurricane Katrina 2005



Hurricane Tracks – 1985 -1984





New Orleans – post Katrina



New Orleans – post Katrina



Warming of the Atlantic

