Montgomery County Planning Board
2009 Growing Smarter Speaker Series

Thursday, February 12th, 2009

Green Building:
Today's Practices
Tomorrow's Challenges

Carl Elefante, FAIA, LEED AP

Principal

Director of Sustainable Design

QUINN EVANS | ARCHITECTS

Outline

- Who I am
- Today's Green Building Marketplace
- Current Green Building Practice
- Emerging Green Technologies
- Facing the Carbon Challenge

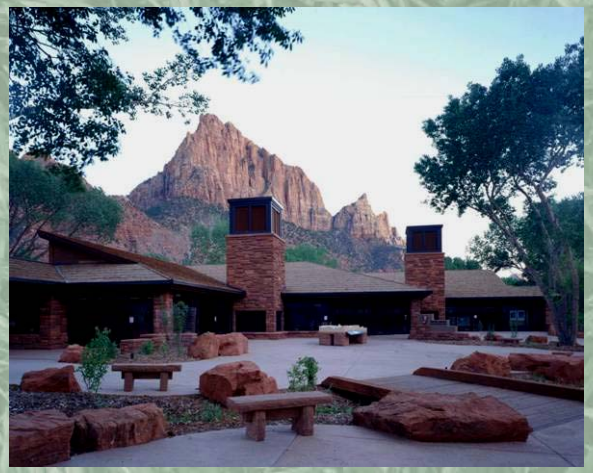
Renewing Legacy

Ocean Hall

Peabody Institute

Dana Building

The *Greenest* Building is …



… One That is *Already* Built.

Outline

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Green Building Rating Systems

LEED

USGBC

United States Green Building Council

LEED

Leadership in Energy and Environmental Design

Green Building Rating Systems

LEED

SS Sustainable Sites

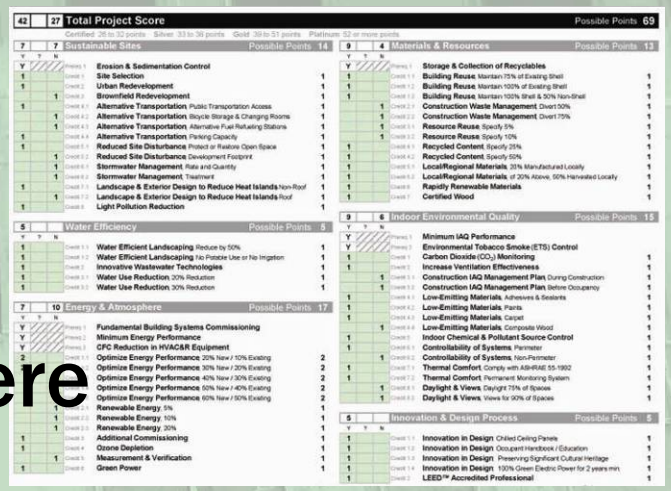
WE Water Efficiency

EA Energy & Atmosphere

MR Materials & Resources

EQ Environmental Quality

ID Innovation & Design



Green Building Rating Systems

LEED

LEED NC v2.2 Scoring

69 total points

Platinum

52 + points

Gold

39 – 51 points

Silver

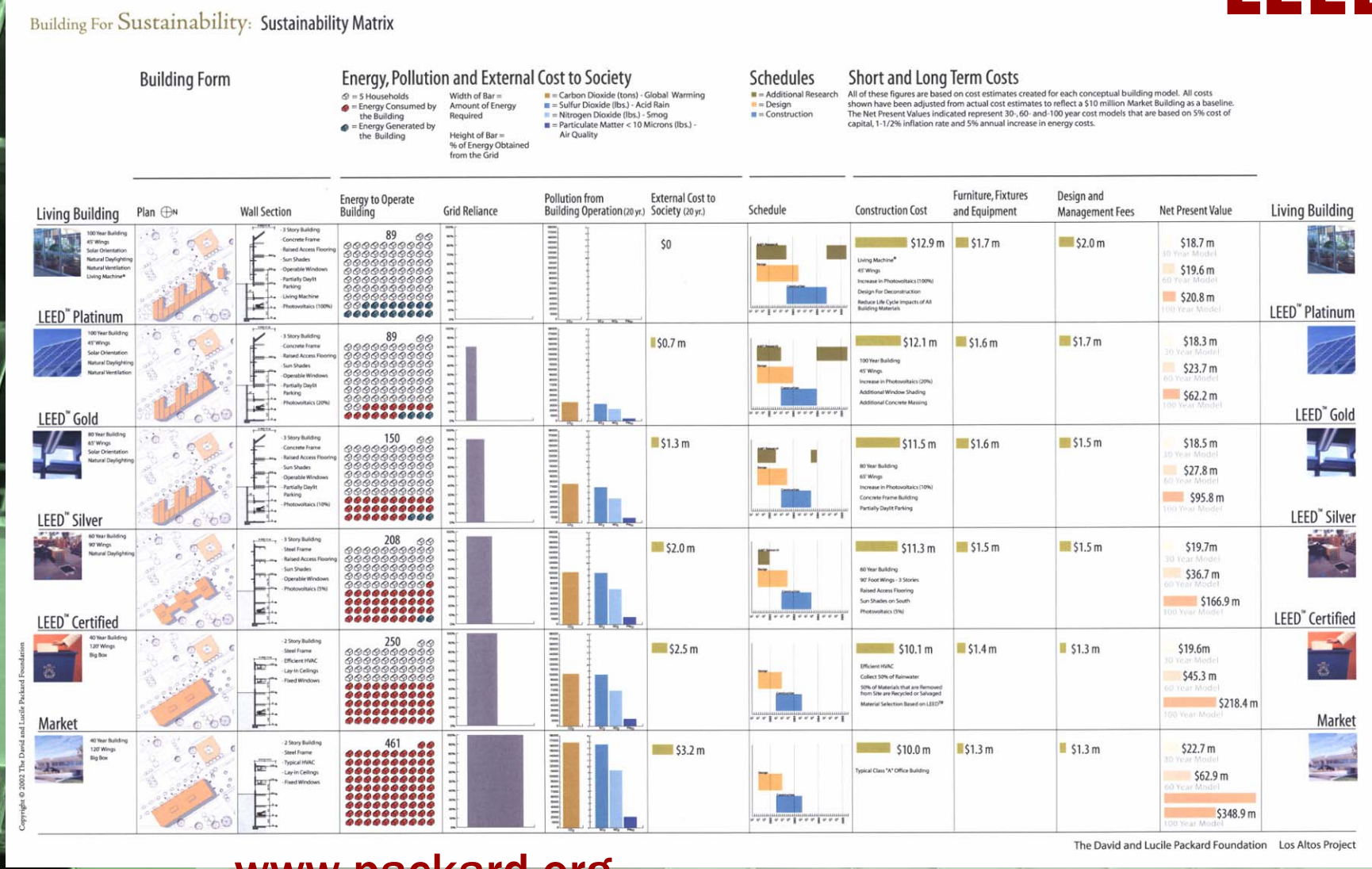
33 – 38 points

Certified

26 – 32 points

Green Building Rating Systems

LEED



www.packard.org

Green Building Regulation
Maryland

High-Performance Buildings Act

LEED Silver Rating / Green Globes 2 Globes

7,500 SF

Green Buildings Tax Credits

8% Construction, 30% Fuel Cells,

25% PV's, 20% BIPV's, 25% Wind

Energy Administration Incentives

Bio-Fuel Tax Credits, Renewable Energy Grants, Geothermal Grants, Wind Power Grants

Green Building Regulation
Montgomery County

Green Buildings Law

LEED Certification over 10,000 SF

LEED Silver Rating for Public Buildings

Clean Energy Rewards

Clean Energy Purchase Tax Credits

Solar Tax Credits

50% Tax Credits on Solar Technologies

Green Building Standards

Federal

- ASHRAE
  - Advanced Energy Design Guides
    - 90.1-2004 30% better than 90.1-1999
    - Net-Zero Goal
- US DOE
  - Energy Efficiency & Renewable Energy
    - Building Energy Codes
- US EPA
  - Energy Star

Outline

- Who I am
- Today's Green Building "Marketplace"
- **Current Green Building Practice**
- Emerging Green Technologies
- Facing the Carbon Challenge

Current Green Building Practice

No-Cost Green

Best-Practice Green

Maximum Benefit Green

No-Cost Green

Shielded Lighting Fixtures

Water-efficient Plumbing Fixtures

Occupancy & Proximity Sensors

Green Materials

Green Cleaning

No-Cost Green

Transit-oriented Development

Compact Mixed-use Development

Climate-responsive Design

Daylighting

Operable Windows

Best-Practice Green

LID Stormwater Management

Rainwater Harvesting

High-performance HVAC Systems

Energy-efficient Lighting Technologies

High-performance Building Envelopes

Commissioning

Greening Case Study

HD Cooke

Greening Case Study

HD Cooke

Greening Case Study

HD Cooke

Greening Case Study

HD Cooke

Greening Case Study
HD Cooke

Sustainable Sites

- Dense urban site
- Access to transit
- Alternative transportation
- Contamination-Free site
- Storm water quantity and quality
- New roofs limit heat-island effect
- Joint use of facilities

Greening Case Study
HD Cooke

9	3	4		Sustainable Sites	Possible Points 16
Y	?	N			
Y			Prereq 1	Construction Activity Pollution Prevention	
Y			Prereq 2	Environmental Contamination-Free Site	
1			Credit 1	Site Selection	1
1			Credit 2	Development Density & Community Connectivity	1
	1		Credit 3	Brownfield Redevelopment	1
1			Credit 4.1	Alternative Transportation: Public Transportation Access	1
1			Credit 4.2	Alternative Transportation: Bicycle Storage & Changing Rooms	1
1			Credit 4.3	Alternative Transportation: Low Emitting & Fuel Efficient Vehicles	1
1			Credit 4.4	Alternative Transportation: Parking Capacity	1
		1	Credit 5.1	Site Development: Protect or Restore Habitat	1
		1	Credit 5.2	Site Development: Maximize Open Space	1
1			Credit 6.1	Stormwater Design: Quantity Control	1
1			Credit 6.2	Stormwater Design: Quality Control	1
		1	Credit 7.1	Heat Island Effect: Non-Roof	1
1			Credit 7.2	Heat Island Effect: Roof	1
	1		Credit 8	Light Pollution Reduction	1
		1	Credit 9	Site Master Plan	1
	1		Credit 10	Joint Use of Facilities	1

Greening Case Study
HD Cooke

Water Efficiency

- Water efficient landscaping w/o irrigation
- Water use 30% below the baseline

Greening Case Study

HD Cooke

4	2	1	Water Efficiency	Possible Points	7
Y	?	N			
1			Credit 1.1	Water Efficient Landscaping: Reduce by 50%	1
1			Credit 1.2	Water Efficient Landscaping: No Potable Use or No Irrigation	1
	1		Credit 2	Innovative Wastewater Technologies	1
1			Credit 3.1	Water Use Reduction: 20% Reduction	1
1			Credit 3.2	Water Use Reduction: 30% Reduction	1
	1		Credit 3.3	Water Use Reduction: 40% Reduction	1
		1	Credit 4	Process Use Reduction: 20% Reduction	1

Greening Case Study
HD Cooke

Energy & Atmosphere

- Fundamental & enhanced commissioning
- Energy use 17.5% below baseline

Greening Case Study

HD Cooke

4	3	10	Energy & Atmosphere	Possible Points 17	
Y	?	N			
Y			Prereq 1	Fundamental Commissioning of the Building Energy Systems	
Y			Prereq 2	Minimum Energy Performance	
Y			Prereq 3	CFC Reduction in HVAC&R Equipment	
1			Credit 1.1	Optimize Energy Performance: 10.5% New / 3.5% Existing	1
1			Credit 1.1	Optimize Energy Performance: 14% New / 7% Existing	1
1			Credit 1.2	Optimize Energy Performance: 17.5% New / 10.5% Existing	1
	1		Credit 1.2	Optimize Energy Performance: 21% New / 14% Existing	1
		1	Credit 1.3	Optimize Energy Performance: 24.5% New / 17.5% Existing	1
		1	Credit 1.3	Optimize Energy Performance: 28% New / 21% Existing	1
		1	Credit 1.3	Optimize Energy Performance: 31.5% New / 24.5% Existing	1
		1	Credit 1.4	Optimize Energy Performance: 35% New / 28% Existing	1
		1	Credit 1.4	Optimize Energy Performance: 38.5% New / 31.5% Existing	1
		1	Credit 1.5	Optimize Energy Performance: 42% New / 35% Existing	1
		1	Credit 2.1	On-Site Renewable Energy: 2.5%	1
		1	Credit 2.2	On-Site Renewable Energy: 7.5%	1
		1	Credit 2.3	On-Site Renewable Energy: 12.5%	1
1			Credit 3	Enhanced Commissioning	1
	1		Credit 4	Enhanced Refrigerant Management	1

Greening Case Study

HD Cooke

Materials & Resources

- Storage and collection of recyclables
- 75% retention of the existing structure
- 50% construction waste diverted
- 10% new recycled materials
- 10% new regional materials

Greening Case Study

HD Cooke

5	6	2	Materials & Resources	Possible Points 13	
Y	?	N			
Y			Prereq 1	Storage & Collection of Recyclables	
1			Credit 1.1	Building Reuse: Maintain 75% of Existing Walls, Floors & Roof	1
	1		Credit 1.2	Building Reuse: Maintain 95% of Existing Walls, Floors & Roof	1
1			Credit 1.3	Building Reuse: Maintain 50% of Interior Non-Structural Elements	1
1			Credit 2.1	Construction Waste Management: Divert 50% from Disposal	1
	1		Credit 2.2	Construction Waste Management: Divert 75% from Disposal	1
		1	Credit 3.1	Materials Reuse: 5%	1
		1	Credit 3.2	Materials Reuse: 10%	1
1			Credit 4.1	Recycled Content: 10% (post-consumer + 1/2 pre-consumer)	1
	1		Credit 4.2	Recycled Content: 20% (post-consumer + 1/2 pre-consumer)	1
1			Credit 5.1	Regional Materials: 10% Extracted, Processed & Manufactured Regio	1
	1		Credit 5.2	Regional Materials: 20% Extracted, Processed & Manufactured Regio	1
	1		Credit 6	Rapidly Renewable Materials	1
	1		Credit 7	Certified Wood	1

Greening Case Study
HD Cooke

Environmental Quality

- Outdoor air monitoring & increased ventilation
- Construction IAQ
- Low-emitting materials & pollutant source control
- Advanced lighting control
- Advanced thermal control
- Daylight & views
- Acoustic performance

15	3	2	Indoor Environmental Quality	Possible Points 20	
Y	?	N			
Y			Prereq 1	Minimum IAQ Performance	
Y			Prereq 2	Environmental Tobacco Smoke (ETS) Control	
Y			Prereq 3	Minimum Acoustical Performance	
1			Credit 1	Outdoor Air Delivery Monitoring	1
1			Credit 2	Increased Ventilation	1
1			Credit 3.1	Construction IAQ Management Plan: During Construction	1
1			Credit 3.2	Construction IAQ Management Plan: Before Occupancy	1
1			Credit 4.1	Low-Emitting Materials: Adhesives & Sealants	1
1			Credit 4.2	Low-Emitting Materials: Paints	1
1			Credit 4.3	Low-Emitting Materials: Carpet	1
1			Credit 4.4	Low-Emitting Materials: Composite Wood & Agrifiber Products	1
		1	Credit 4.5	Low-Emitting Materials: Furniture and Furnishings	1
1			Credit 4.6	Low-Emitting Materials: Ceiling and Wall Systems	1
1			Credit 5	Indoor Chemical & Pollutant Source Control	1
1			Credit 6.1	Controllability of Systems: Lighting	1
1			Credit 6.2	Controllability of Systems: Thermal Comfort	1
1			Credit 7.1	Thermal Comfort: Design	1
1			Credit 7.2	Thermal Comfort: Verification	1
	1		Credit 8.1	Daylight & Views: Daylight 75% of Spaces	1
		1	Credit 8.1	Daylight & Views: Views for 90% of Spaces	1
			Credit 8.1	Daylight & Views: Daylight 75% of Other Spaces	1
			Credit 8.2	Daylight & Views	1
	1		Credit 9	Enhanced Acoustical Performance	1
	1		Credit 9	Enhanced Acoustical Performance (Enhanced)	1
1			Credit 10	Mold Prevention	1

Greening Case Study
HD Cooke

Innovation & Design

- Green Cleaning
- Green Arts and Crafts
- School as teaching tool
- Exceptional performance:
  regional materials
- Exceptional performance:
  green power

Greening Case Study

HD Cooke

Y	?	N		Innovation & Design Process	Possible Points 6
	1		Credit 1.1	Innovation in Design: Green Cleaning	1
	1		Credit 1.2	Innovation in Design: 40% Regional Materials	1
	1		Credit 1.3	Innovation in Design: Green Arts & Crafts	1
	1		Credit 1.4	Innovation in Design: 70% Green Power	1

LEED® Credit Scorecard

LEED-S Green Building Rating System, First Edition 2007

HD Cooke Elementary School

Quinn Evans Architects

January 7, 2008

LEED

Sustainable Design Consulting

38	22	19	**Total Project Score**	Possible Points 79

Certified 29 to 36 points **Silver** 37 to 43 points **Gold** 44 to 57 points **Platinum** 58 or more points

Sustainable Sites — Possible Points 16

Y	?	N			
Y			Prereq 1	Construction Activity Pollution Prevention	
Y			Prereq 2	Environmental Contamination-Free Site	
1			Credit 1	Site Selection	1
1			Credit 2	Development Density & Community Connectivity	1
	1		Credit 3	Brownfield Redevelopment	1
1			Credit 4.1	Alternative Transportation: Public Transportation Access	1
1			Credit 4.2	Alternative Transportation: Bicycle Storage & Changing Rooms	1
1			Credit 4.3	Alternative Transportation: Low Emitting & Fuel Efficient Vehicles	1
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		1	Credit 5.1	Site Development: Protect or Restore Habitat	1
		1	Credit 5.2	Site Development: Maximize Open Space	1
1			Credit 6.1	Stormwater Design: Quantity Control	1
1			Credit 6.2	Stormwater Design: Quality Control	1
		1	Credit 7.1	Heat Island Effect: Non-Roof	1
1			Credit 7.2	Heat Island Effect: Roof	1
	1		Credit 8	Light Pollution Reduction	1
		1	Credit 9	Site Master Plan	1
	1		Credit 10	Joint Use of Facilities	1

Water Efficiency — Possible Points 7

Y	?	N			
1			Credit 1.1	Water Efficient Landscaping: Reduce by 50%	1
1			Credit 1.2	Water Efficient Landscaping: No Potable Use or No Irrigation	1
	1		Credit 2	Innovative Wastewater Technologies	1
1			Credit 3.1	Water Use Reduction: 20% Reduction	1
1			Credit 3.2	Water Use Reduction: 30% Reduction	1
	1		Credit 3.3	Water Use Reduction: 40% Reduction	1
		1	Credit 4	Process Use Reduction: 20% Reduction	1

Energy & Atmosphere — Possible Points 17

Y	?	N			
Y			Prereq 1	Fundamental Commissioning of the Building Energy Systems	
Y			Prereq 2	Minimum Energy Performance	
Y			Prereq 3	CFC Reduction in HVAC&R Equipment	
1			Credit 1.1	Optimize Energy Performance: 10.5% New / 3.5% Existing	1
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1			Credit 3	Enhanced Commissioning	1
	1		Credit 4	Enhanced Refrigerant Management	1

Materials & Resources — Possible Points 13

Y	?	N			
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1			Credit 1.1	Building Reuse: Maintain 75% of Existing Walls, Floors & Roof	1
	1		Credit 1.2	Building Reuse: Maintain 95% of Existing Walls, Floors & Roof	1
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	1		Credit 2.2	Construction Waste Management: Divert 75% from Disposal	1
		1	Credit 3.1	Materials Reuse: 5%	1
		1	Credit 3.2	Materials Reuse: 10%	1
1			Credit 4.1	Recycled Content: 10% (post-consumer + 1/2 pre-consumer)	1
	1		Credit 4.2	Recycled Content: 20% (post-consumer + 1/2 pre-consumer)	1
1			Credit 5.1	Regional Materials: 10% Extracted, Processed & Manufactured Regio	1
	1		Credit 5.2	Regional Materials: 20% Extracted, Processed & Manufactured Regio	1
	1		Credit 6	Rapidly Renewable Materials	1
	1		Credit 7	Certified Wood	1

Indoor Environmental Quality — Possible Points 20

Y	?	N			
Y			Prereq 1	Minimum IAQ Performance	
Y			Prereq 2	Environmental Tobacco Smoke (ETS) Control	
Y			Prereq 3	Minimum Acoustical Performance	
1			Credit 1	Outdoor Air Delivery Monitoring	1
1			Credit 2	Increased Ventilation	1
1			Credit 3.1	Construction IAQ Management Plan: During Construction	1
1			Credit 3.2	Construction IAQ Management Plan: Before Occupancy	1
1			Credit 4.1	Low-Emitting Materials: Adhesives & Sealants	1
1			Credit 4.2	Low-Emitting Materials: Paints	1
1			Credit 4.3	Low-Emitting Materials: Carpet	1
1			Credit 4.4	Low-Emitting Materials: Composite Wood & Agrifiber Products	1
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1			Credit 5	Indoor Chemical & Pollutant Source Control	1
1			Credit 6.1	Controllability of Systems: Lighting	1
1			Credit 6.2	Controllability of Systems: Thermal Comfort	1
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			Credit 8.2	Daylight & Views	1
	1		Credit 9	Enhanced Acoustical Performance	1
	1		Credit 9	Enhanced Acoustical Performance (Enhanced)	1
1			Credit 10	Mold Prevention	1

Innovation & Design Process — Possible Points 6

Y	?	N			
	1		Credit 1.1	Innovation in Design: Green Cleaning	1
	1		Credit 1.2	Innovation in Design: 40% Regional Materials	1
	1		Credit 1.3	Innovation in Design: Green Arts & Crafts	1
	1		Credit 1.4	Innovation in Design: 70% Green Power	1

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- Who I am
- Today's Green Building "Marketplace"
- Current Green Building Practice
- **Emerging Green Technologies**
- Facing the Carbon Challenge

Maximum Benefit Green

Green Roofs

Geothermal Heating & Cooling

Solar Technologies

Maximum Benefit Green

Green Roofs

Maximum Benefit Green
Green Roofs

Costs

- Extensive (shallow) Vegetated Roofs
  - 30 $/SF
  - 30 #/SF
- Intensive (deep) Vegetated Roofs
  - 100 $/SF
  - 100 #/SF
- 60-70% reduced run-off
- +/- R10 insulation

Maximum Benefit Green

Geothermal

Maximum Benefit Green
Geothermal

Costs

- save 40% energy over conventional heat pump systems
- save 70% energy over electric heating and cooling systems
- 1/2 ton heating/cooling per 250 ft well
- 2,500 $/ton heating/cooling (about 2x conventional heat pump system)

Maximum Benefit Green

Solar

Maximum Benefit Green
Solar

Costs – HD Cooke Array

- 100+ panels on Gym Roof
- 20+ kW maximum output
- $ 200,000 estimated installed cost
- $ 3,500 estimated annual energy cost savings

Outline

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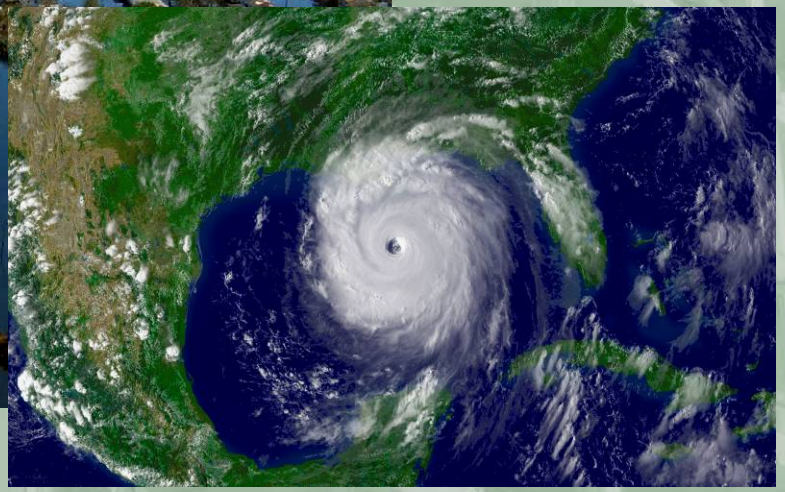
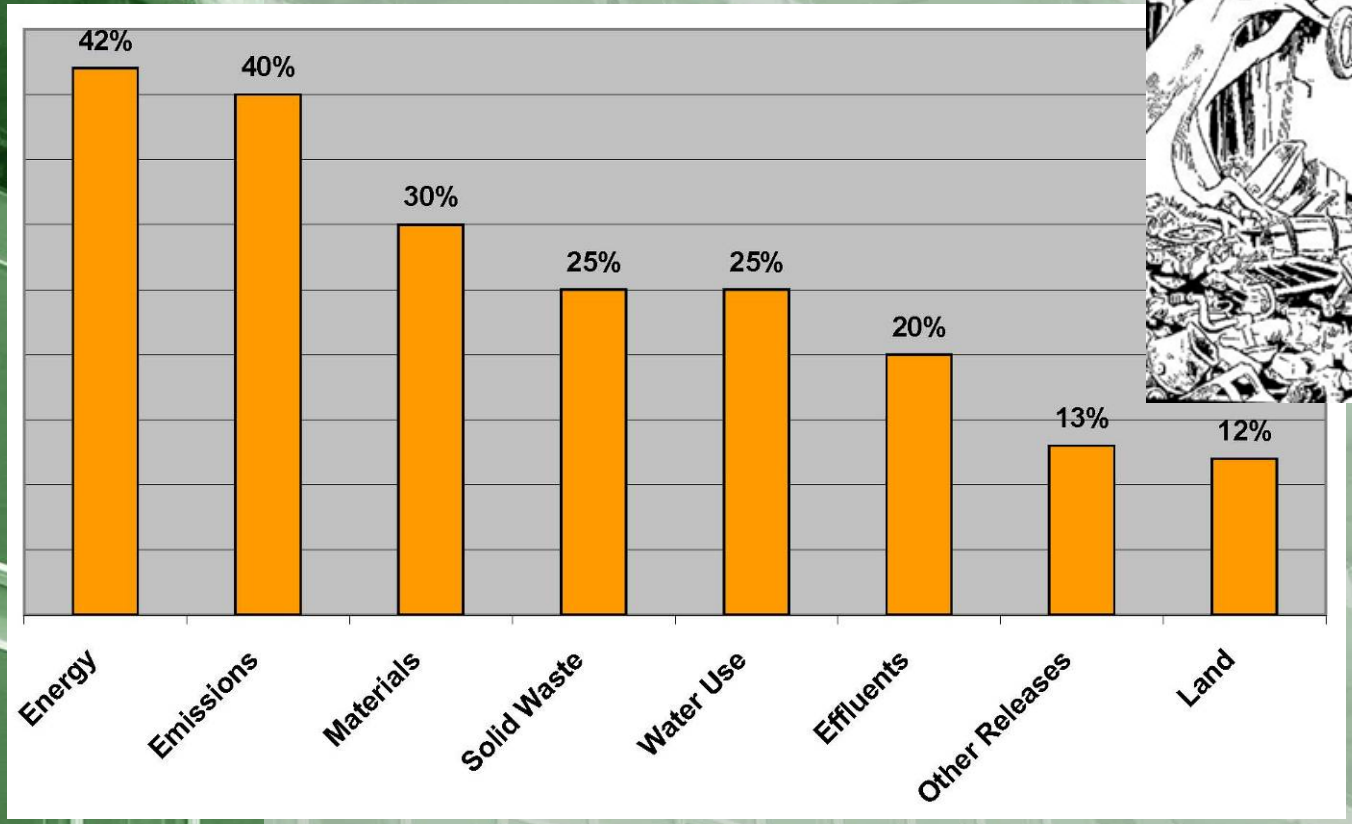
The Climate Change Imperative

Hurricane Katrina



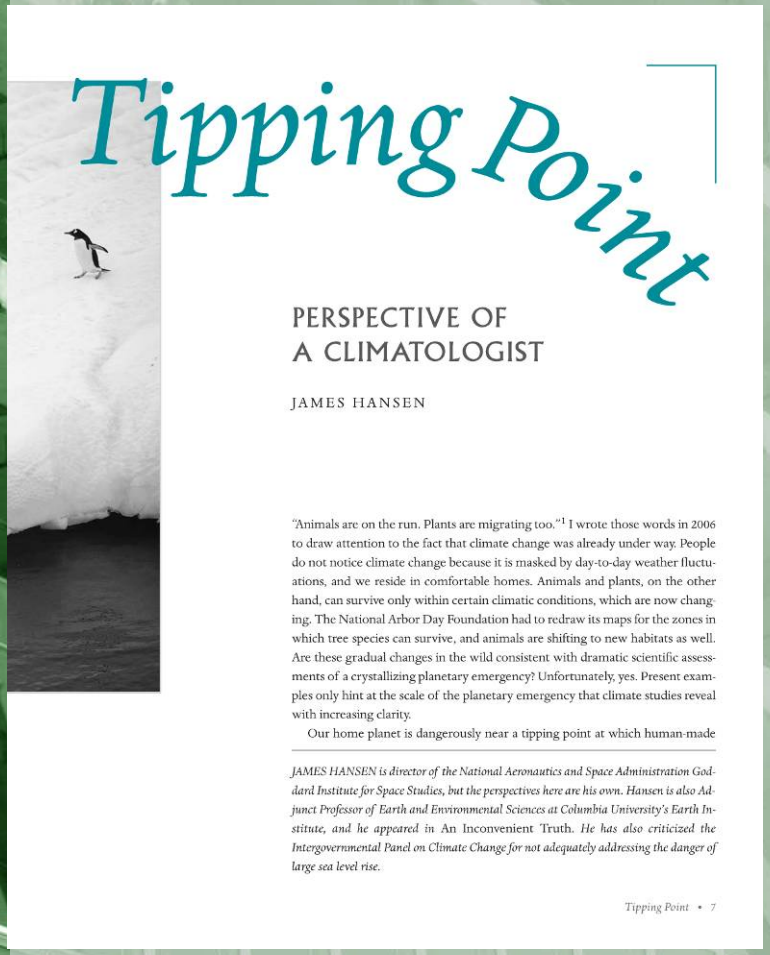
Building Impacts



Pogo
Earth Day 1971
Walt Kelly

Sustainable Buildings Industry Council

Climate "Tipping Point"



Tipping Point

PERSPECTIVE OF
A CLIMATOLOGIST

JAMES HANSEN

"Animals are on the run. Plants are migrating too."[1] I wrote those words in 2006 to draw attention to the fact that climate change was already under way. People do not notice climate change because it is masked by day-to-day weather fluctuations, and we reside in comfortable homes. Animals and plants, on the other hand, can survive only within certain climatic conditions, which are now changing. The National Arbor Day Foundation had to redraw its maps for the zones in which tree species can survive, and animals are shifting to new habitats as well. Are these gradual changes in the wild consistent with dramatic scientific assessments of a crystallizing planetary emergency? Unfortunately, yes. Present examples only hint at the scale of the planetary emergency that climate studies reveal with increasing clarity.

Our home planet is dangerously near a tipping point at which human-made

JAMES HANSEN is director of the National Aeronautics and Space Administration Goddard Institute for Space Studies, but the perspectives here are his own. Hansen is also Adjunct Professor of Earth and Environmental Sciences at Columbia University's Earth Institute, and he appeared in An Inconvenient Truth. *He has also criticized the Intergovernmental Panel on Climate Change for not adequately addressing the danger of large sea level rise.*

Tipping Point • 7

"Our home planet is dangerously near a tipping point at which human-made greenhouse gases reach a level where major climate changes can proceed mostly under their own momentum."

Tipping Point - Perspective of a Climatologist
James Hansen

The Tipping Point

CO_2 Levels

Pre-industrial level	280 ppm
2007 measured level	383 ppm
Tipping point	450 ppm
Delta	067 ppm
Current annual increase	002 ppm
Years to tipping point	67/2= 34

Climate Change Response Policy

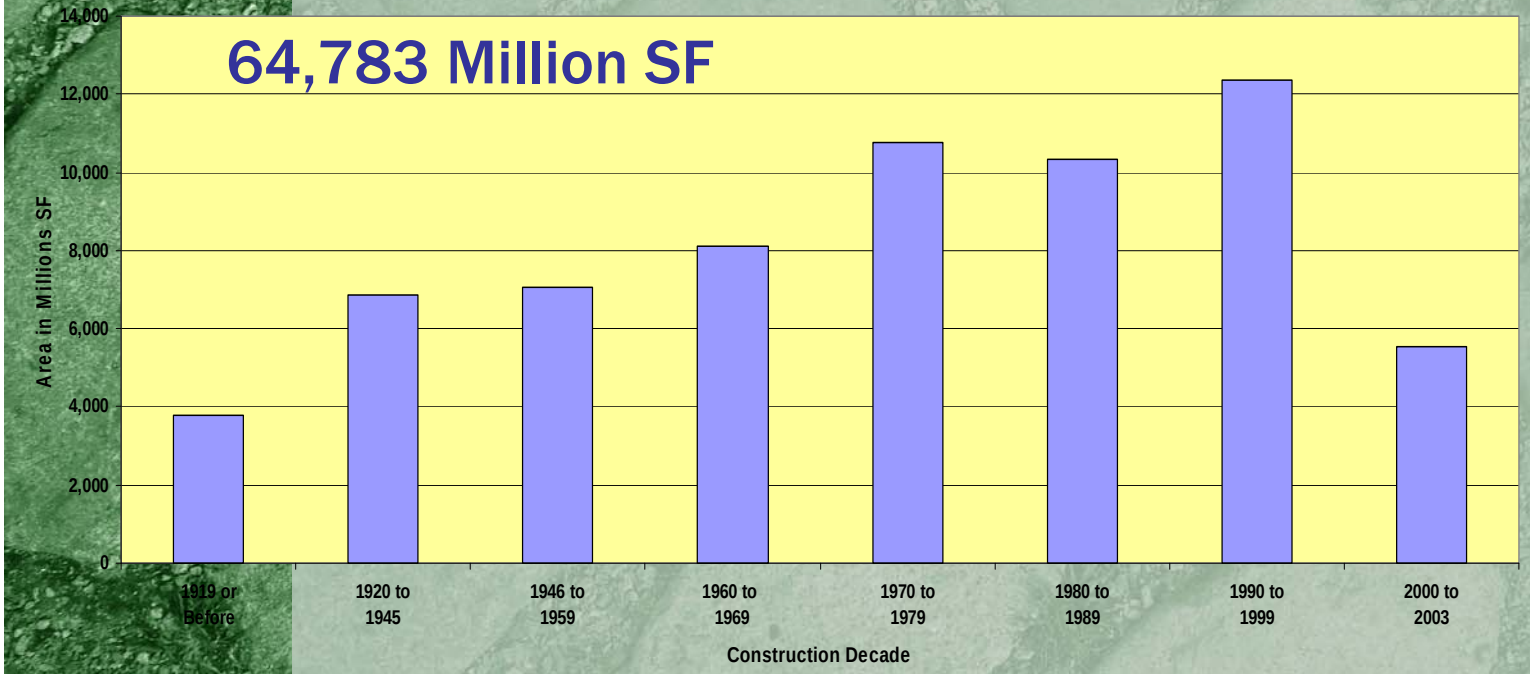
IPCC / ICLEI / US Conference of Mayors

Architecture 2030 Challenge

Montgomery County Sustainability Working Group (SWG)

Building Stock Statistics
Existing Stock by Decade Constructed

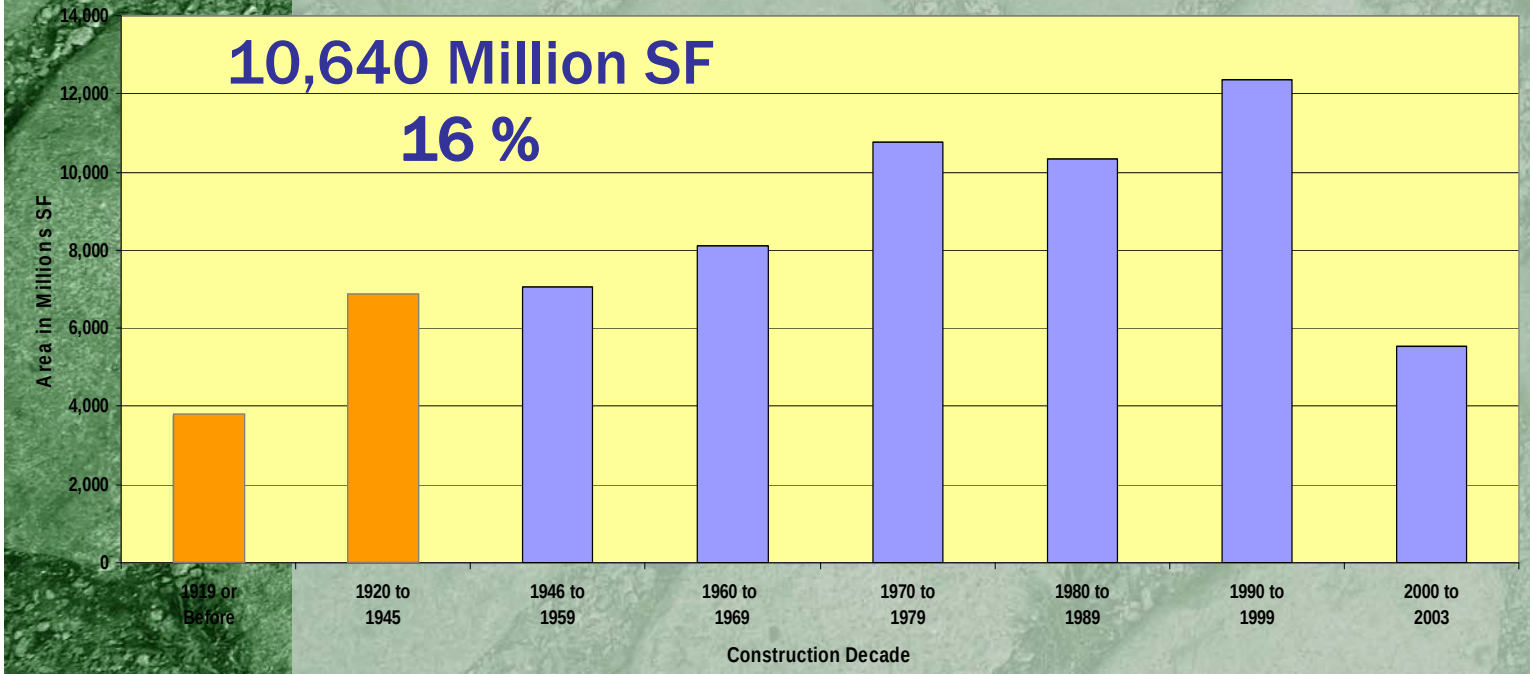
AREA: Non-Residential Buildings



2003 Commercial Building Energy Consumption Survey
U.S. Department of Energy

Building Stock Statistics
Traditional & Historic Buildings

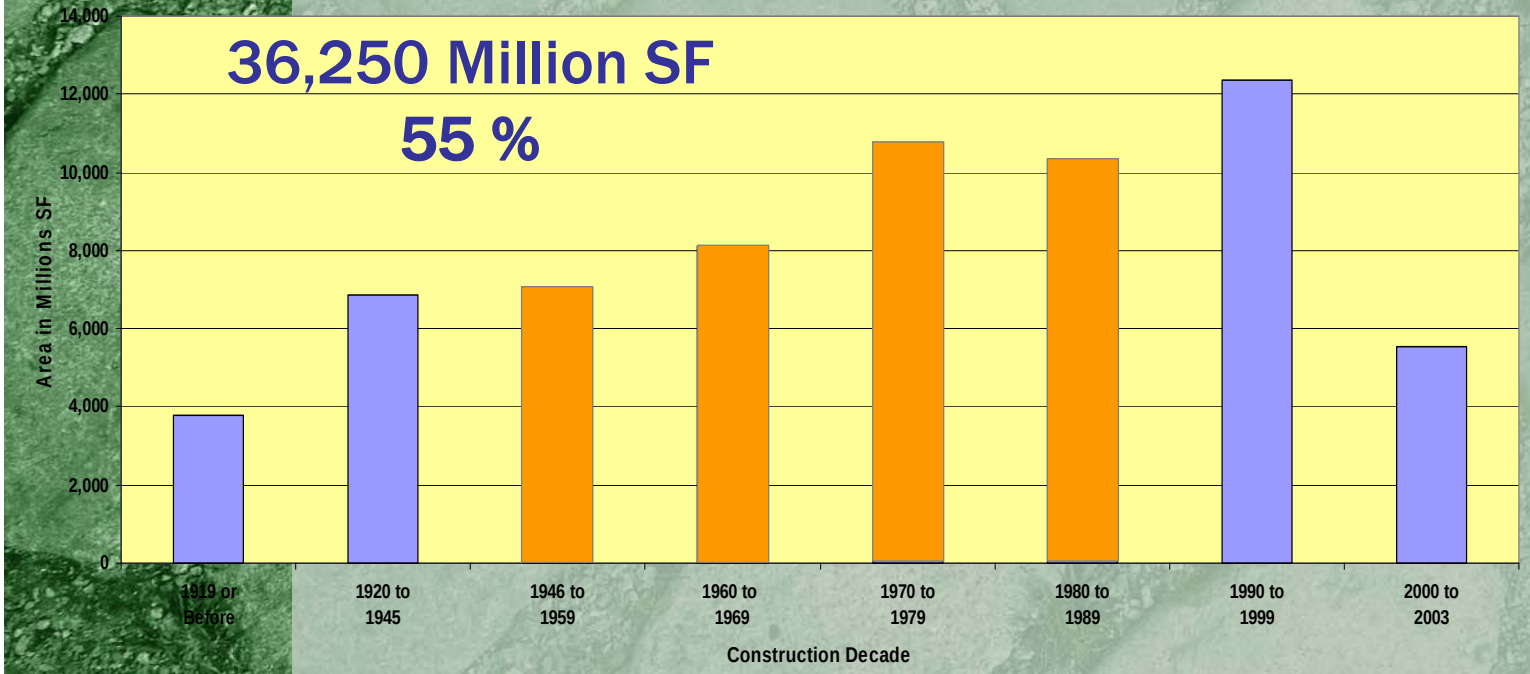
AREA: Non-Residential Buildings



2003 Commercial Building Energy Consumption Survey
U.S. Department of Energy

Building Stock Statistics
Modern-Era Buildings

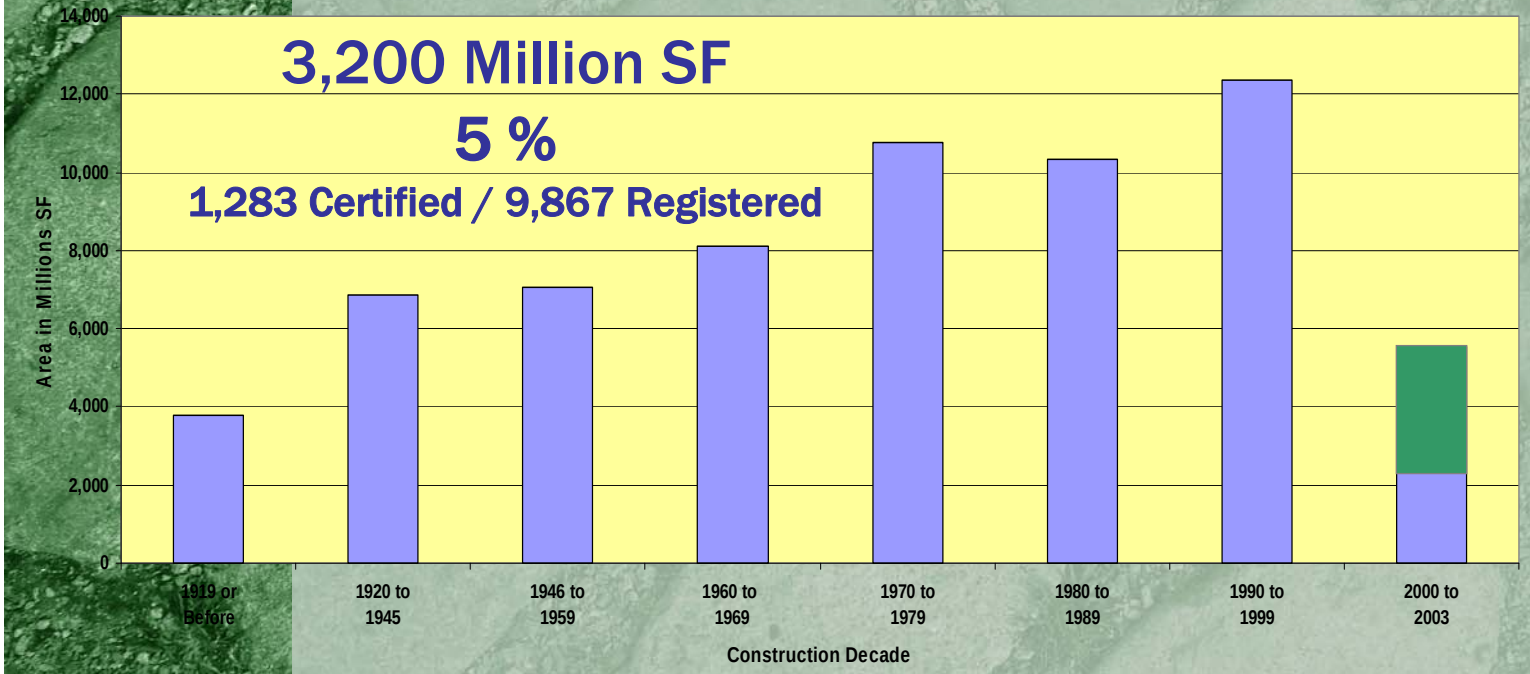
AREA: Non-Residential Buildings



2003 Commercial Building Energy Consumption Survey
U.S. Department of Energy

Building Stock Statistics
LEED Buildings

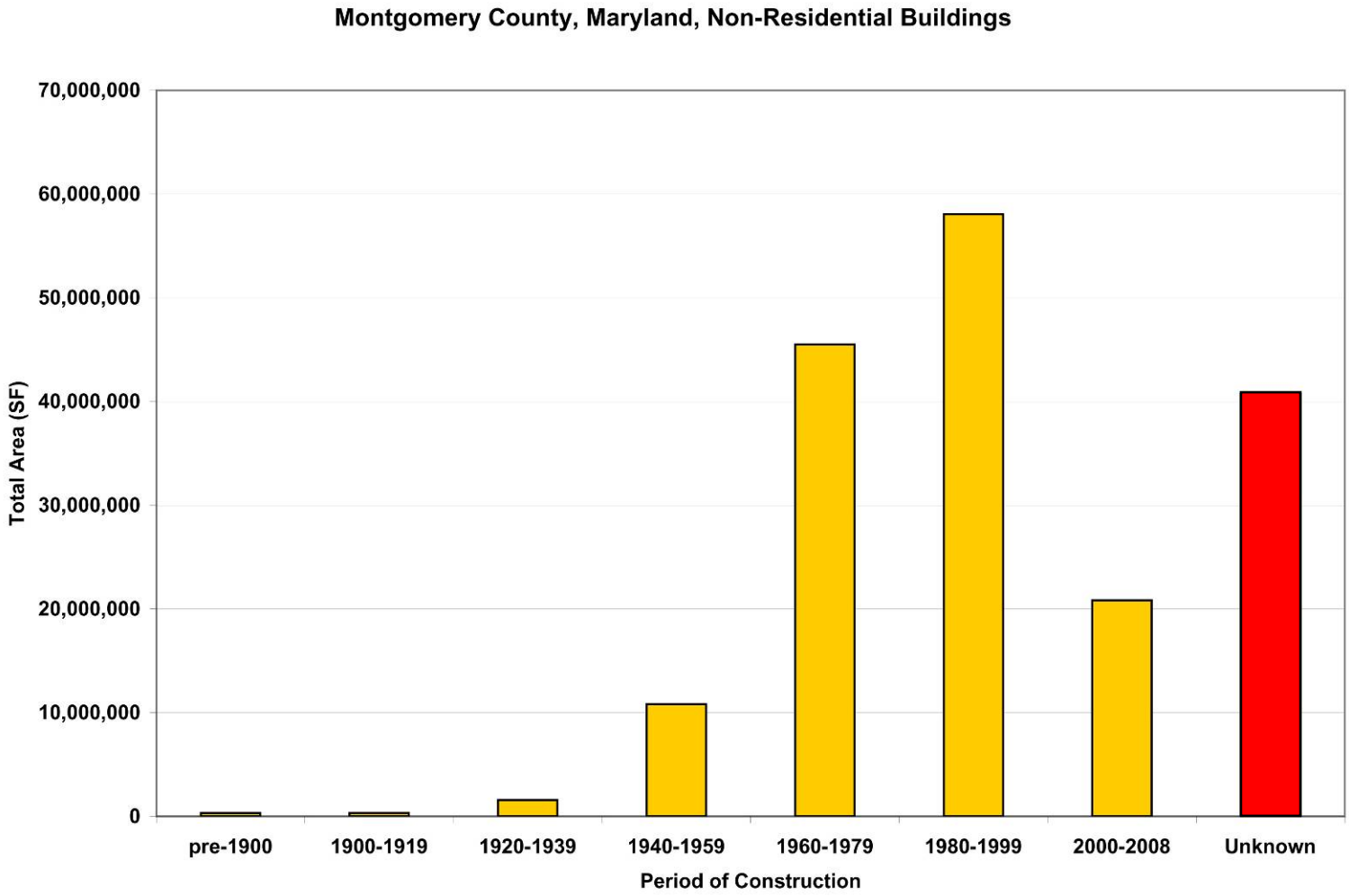
AREA: Non-Residential Buildings



2003 Commercial Building Energy Consumption Survey
U.S. Department of Energy

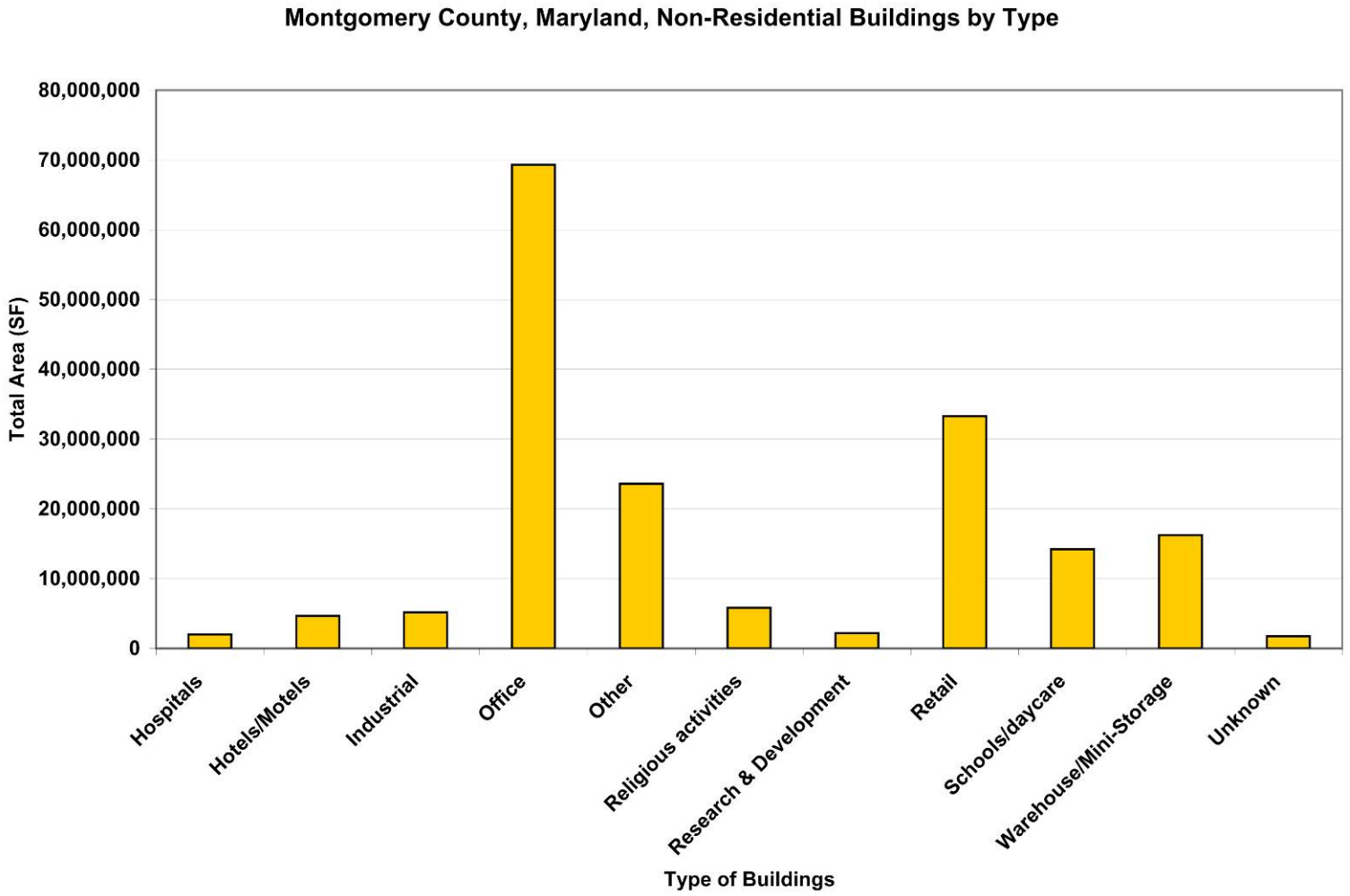
Montgomery County

Existing Stock by Period Constructed



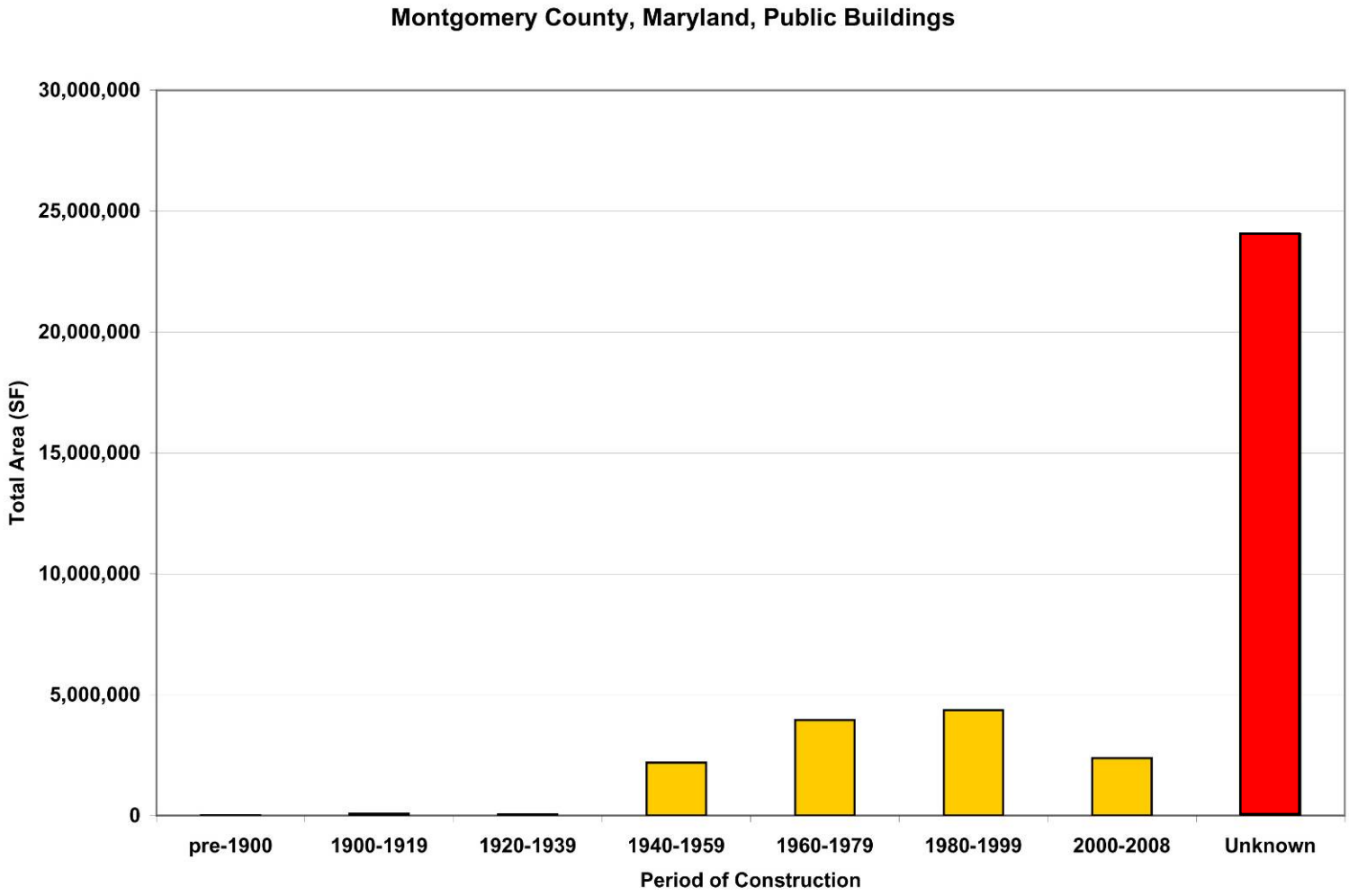
Montgomery County

Existing Stock by Type



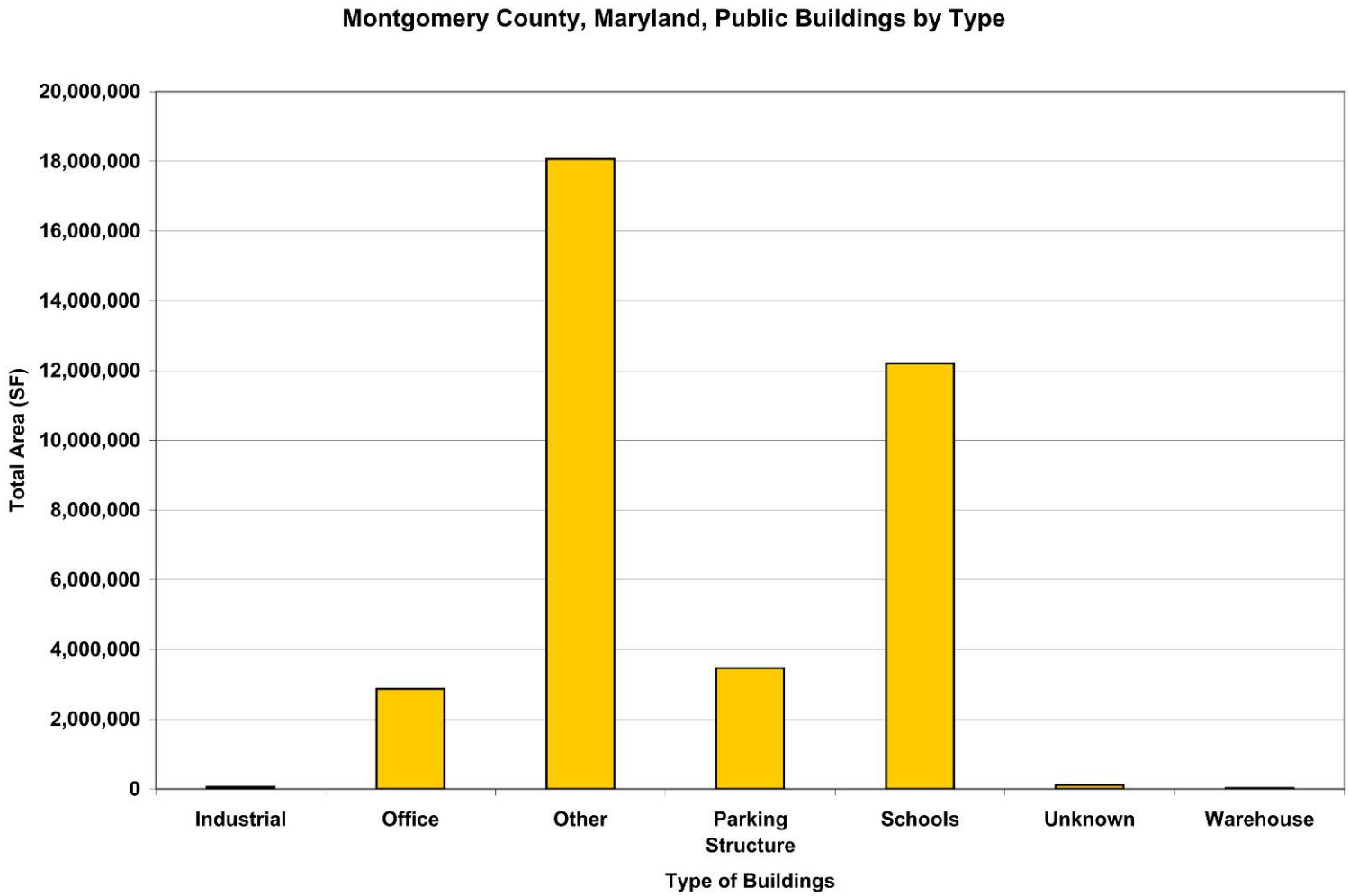
Montgomery County

Public Stock by Decade Constructed



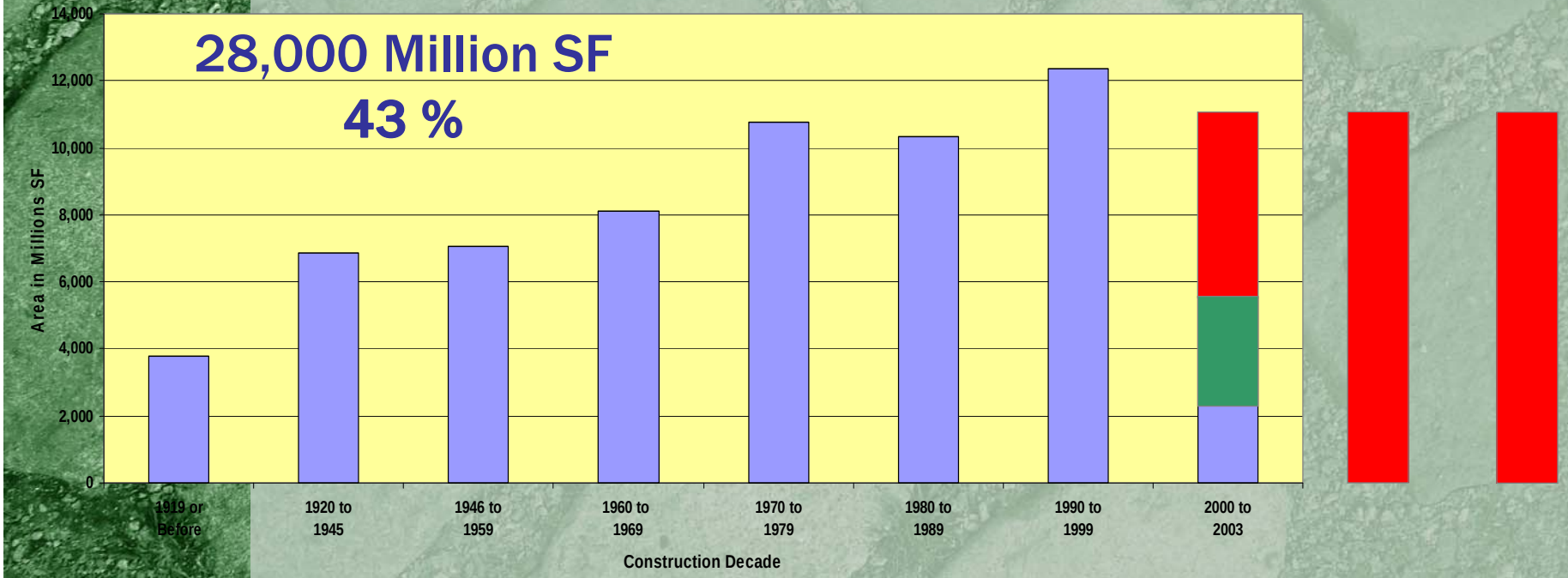
Montgomery County

Public Stock by Type



Projected Growth to 2030
New Building Construction

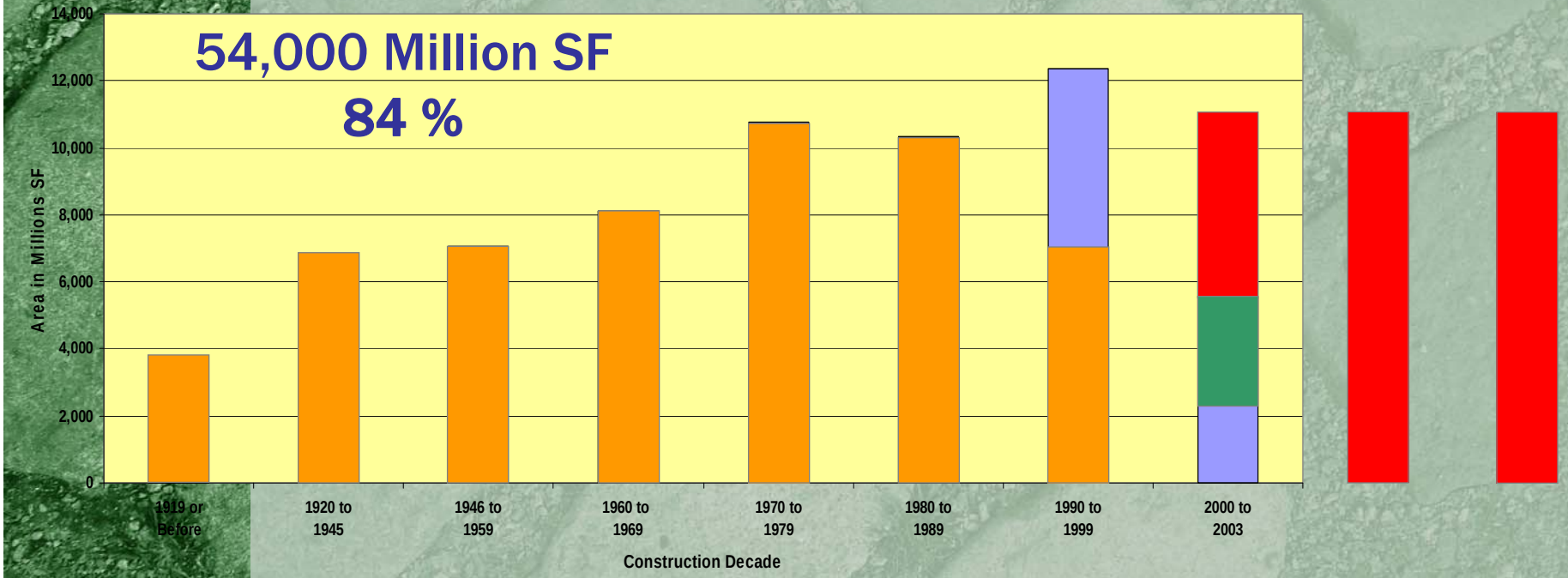
AREA: Non-Residential Buildings



The Boom To Come – America Circa 2030
Architect Magazine, October 2006

Projected Growth to 2030
Renovation

AREA: Non-Residential Buildings



The Boom To Come – America Circa 2030
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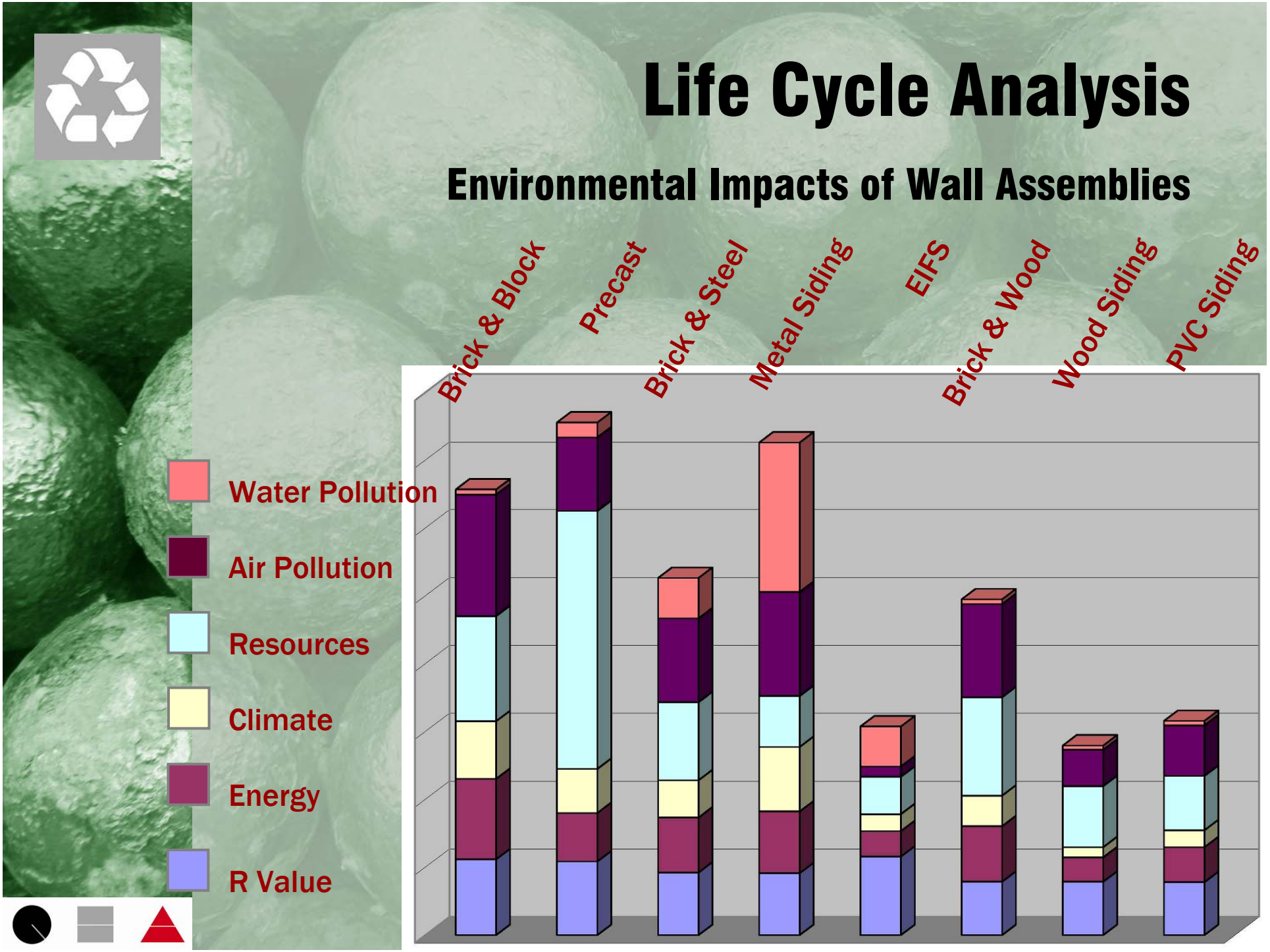
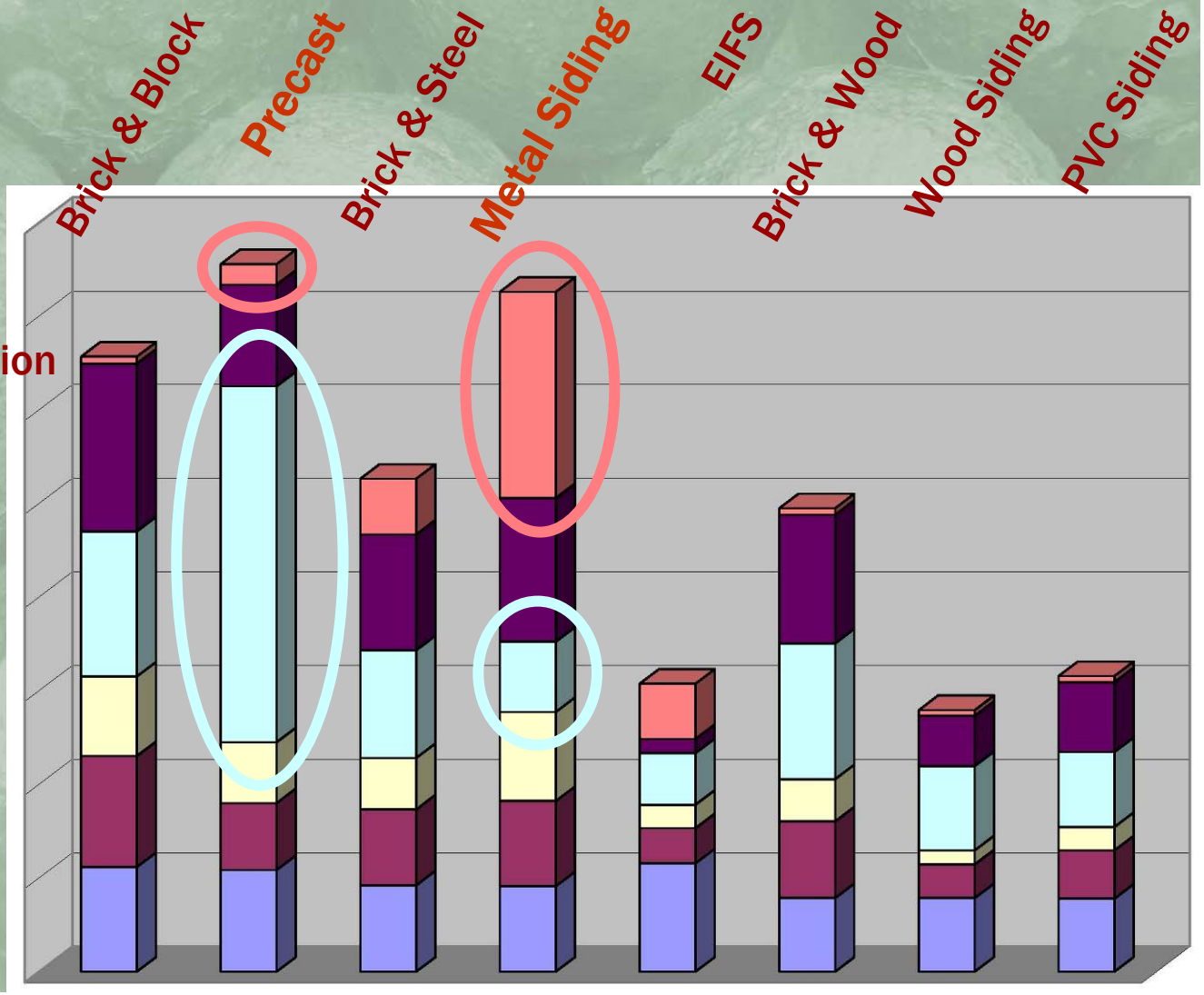
Life Cycle Analysis

Environmental Impacts of Wall Assemblies



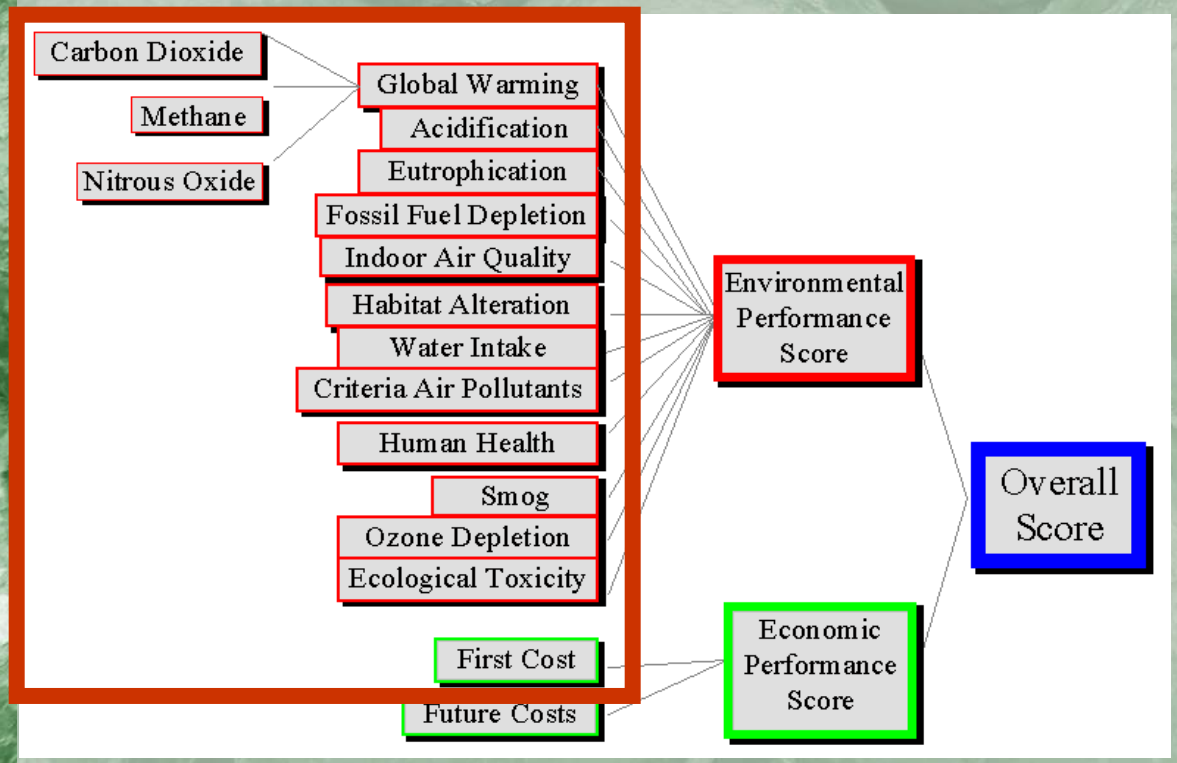
Life Cycle Analysis

Environmental Impacts of Wall Assemblies



Life Cycle Analysis
U.S. EPA & NIST BEES

Building for Economic and Environmental Sustainability

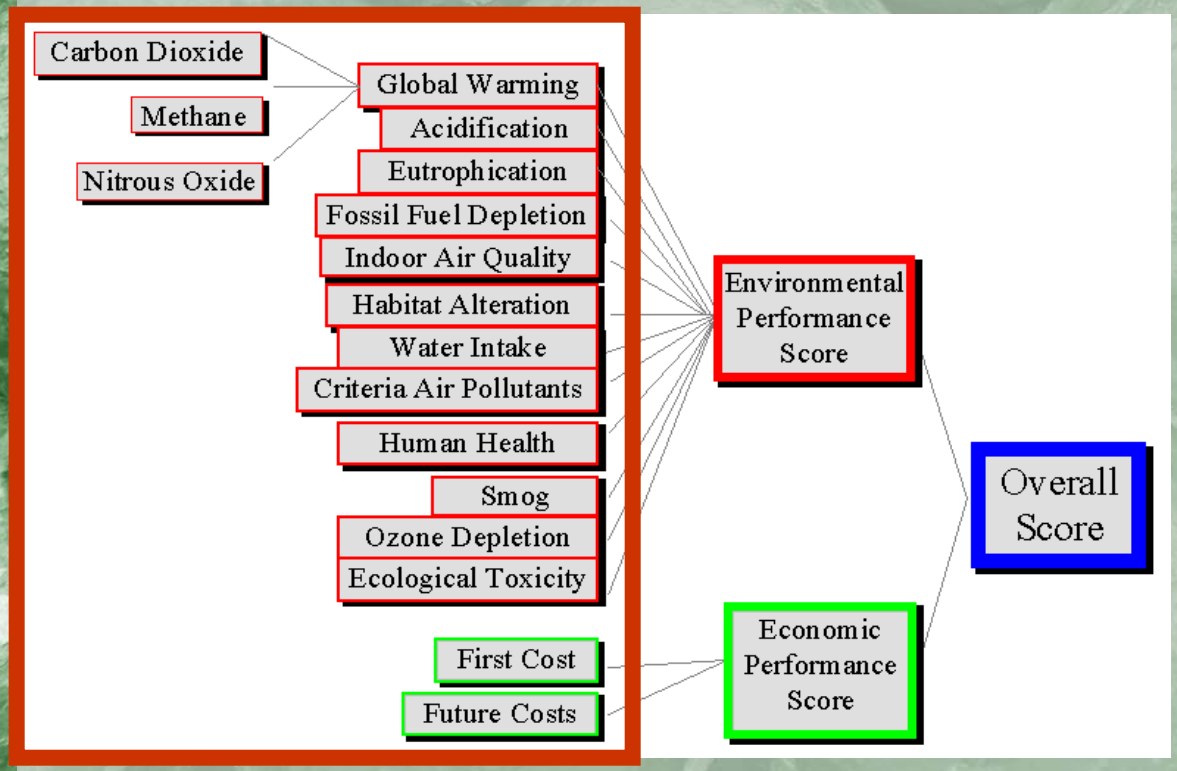


BEFORE USE

Extraction
Manufacture
Fabrication
Transportation
Construction

Life Cycle Analysis
U.S. EPA & NIST BEES

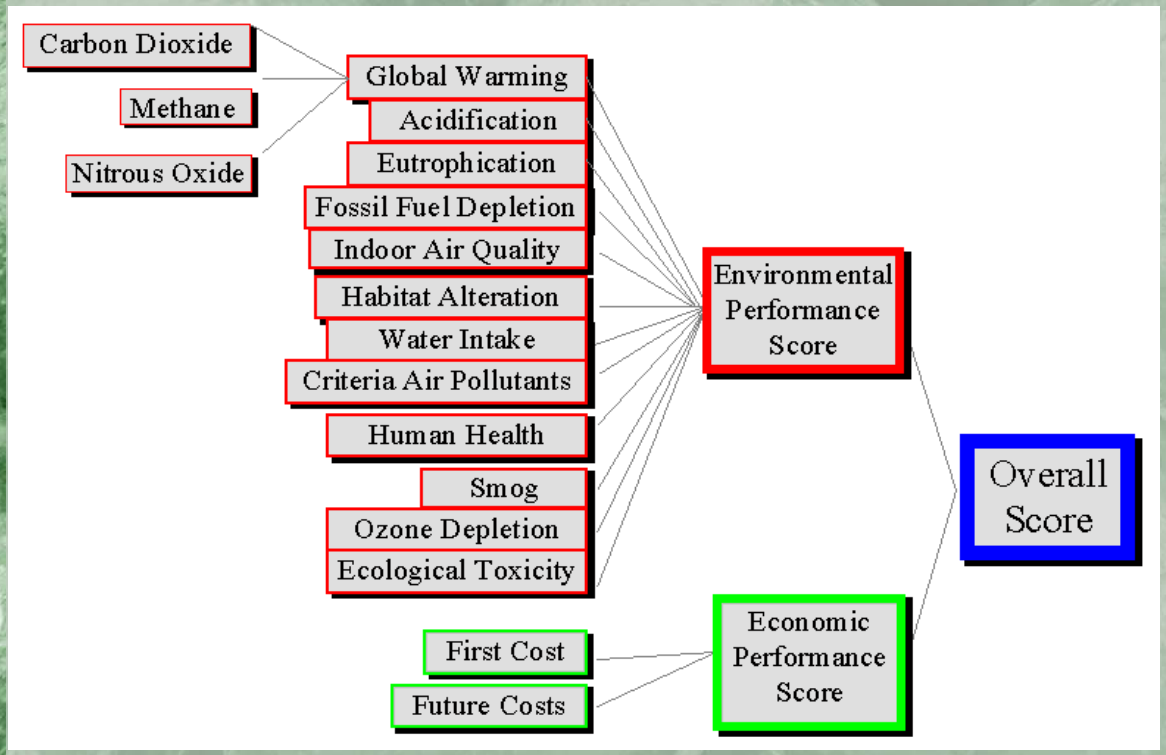
Building for Economic and Environmental Sustainability



DURING USE
Operation
Maintenance

Life Cycle Analysis
U.S. EPA & NIST BEES

Building for Economic and Environmental Sustainability



AFTER USE

Renewal

Removal

Re-use

Disposal

Life Cycle Impacts

Recapturing Environmental Impacts Through Improved Performance

Life Cycle Impacts

Recapturing Environmental Impacts Through Improved Performance

Recaptures Energy in

3.5 years

Life Cycle Impacts

Recapturing Environmental Impacts Through Improved Performance

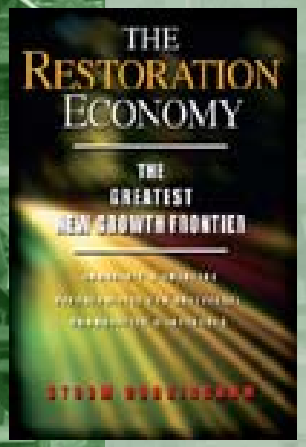
Recaptures Toxic Emissions in

22 years

E-Valuating Existing Buildings

E-Valuating Existing Buildings

Preservation Economics



Re-investment Driven

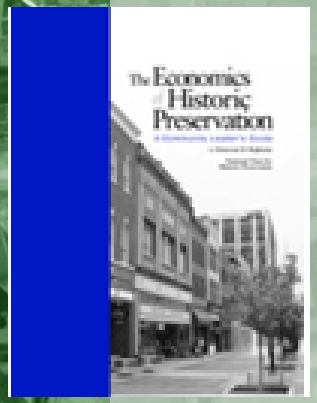
over $1 trillion annually

over $100 trillion inventory

The Restoration Economy
The Greatest New Growth Frontier
Storm Cunningham
www.restorationeconomy.com

E-Valuating Existing Buildings

Preservation Economics



Minimal Material Expenditure

Minimal Energy Expenditure

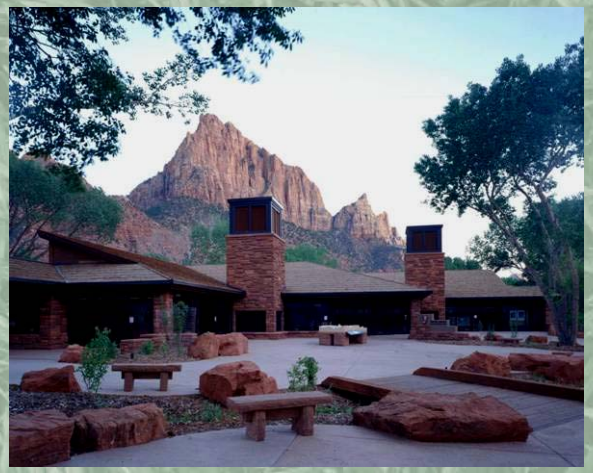
Skill and Craft Intensive

Creates Good Jobs

Cycles Money Through Local Economy

The Economics of Historic Preservation
A Community Leaders Guide
Donovan Rypkema
www.preservationbooks.org

The *Greenest* Building is …



… One That is *Already* Built.