

# Fundamentals of Green Building

**CLARK**  
CONSTRUCTION

Andy Fuhrmann

Chris Burek



# Green Building Overview

# Buildings are Responsible for:

- 39% of primary energy use
- 40% of raw materials use
- 14% of potable water use
- 136 million tons of construction and demolition waste per year

Green Building  
Addresses These  
Issues

# What is a Green Building?

A building with energy, economic, and environmental performance that is substantially better than standard practice.



Philip Merrill Environmental Center, LEED Platinum, Completed by Clark in 2000

# Green Building Assessment

## □ Before 1998:

- “no specific criteria existed to evaluate and compare the merits of green building design”

# The Solution: Green Building Assessment

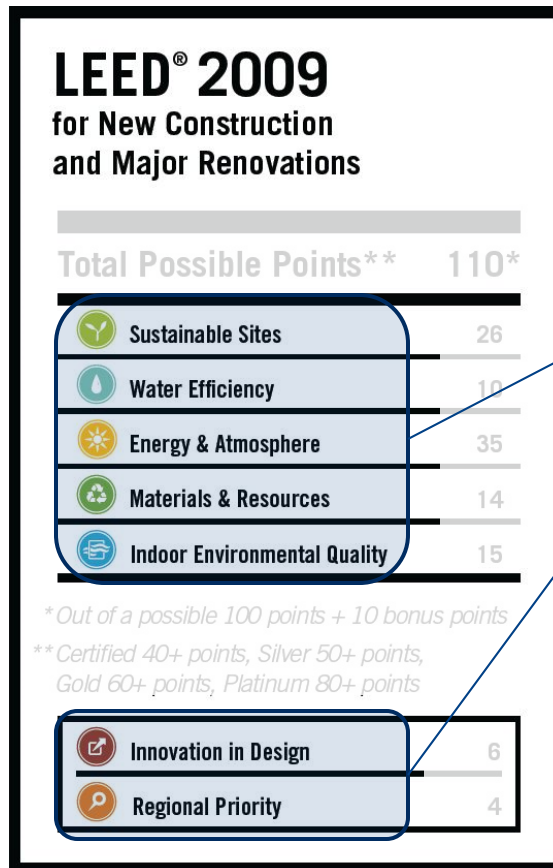
- In 1998, the US Green Building Council<sup>®</sup> (USGBC) created a building assessment system called, Leadership in Energy & Environmental Design<sup>®</sup> (LEED) *“which identified not only whether a building was green, but what specific shade of green it was.”*

# Concept Behind LEED:



If you can buy an \$0.89 box of cookies and know exactly what's in it, why is it that we don't know what's going into an \$89 million dollar building?

# Features of LEED



Buildings are scored on how sustainably they build in these 7 categories










# Features of LEED

**LEED® 2009**  
for New Construction  
and Major Renovations

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**Total Possible Points\*\* 110\***

 Sustainable Sites	26
 Water Efficiency	10
 Energy & Atmosphere	35
 Materials & Resources	14
 Indoor Environmental Quality	15
<i>* Out of a possible 100 points + 10 bonus points</i>	
<i>** Certified 40+ points, Silver 50+ points, Gold 60+ points, Platinum 80+ points</i>	
 Innovation in Design	6
 Regional Priority	4

Each category is worth a different number of points.








Points are attained through acquiring credits in those categories.

# Features of LEED

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Notice how the points have been weighted. LEED does this to place emphasis on credits that affect fossil fuel energy use.

# Features of LEED

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Buildings are awarded according to the total number of points earned.





**Sidwell Friends  
Middle School  
Washington, DC**

**90%** reduced municipal  
water use

**60%** less energy  
demand than a  
conventional school

**80%** native plant species  
planted on site

Owners can know **exactly**  
what's in their **LEED**  
building.



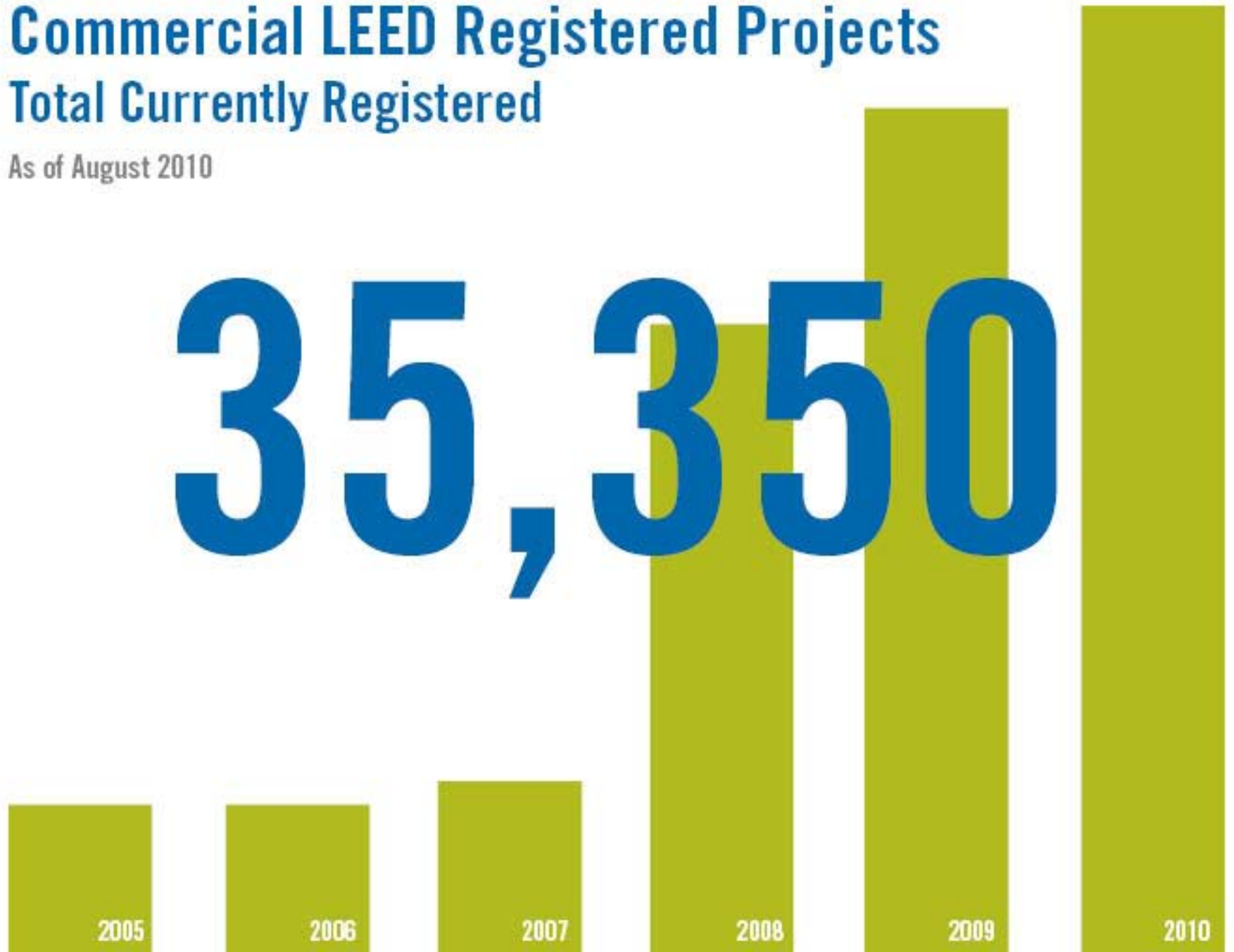
Photograph Courtesy of Peter Aaron/ESTO

# Commercial LEED Registered Projects

## Total Currently Registered

As of August 2010

35,350



2005

2006

2007

2008

2009

2010

# Local Green Legislation

## D.C. Green Building Act of 2006

### Requirements

All non-residential buildings must meet LEED® and EnergyStar requirements. New buildings must pay a Green Building Fee of \$.002/SF to the District at the application for the first building permit.

### Performance Bonds

Privately owned non-residential projects over 50K SF, must provide a green performance bond (or provide a letter of credit) upon the application of the first construction permit, which is due and payable prior to Certificate of Occupancy.

# Local Green Legislation

## Arlington, VA Green Building Incentive Program

Commercial projects that earn LEED® certification are given additional density between .15 and .35 FAR and/or additional height of up to 3 stories (the higher the certification level, the greater the density awarded).

If a project does not achieve LEED certification, the owner/developer must contribute \$.03/SF to Arlington's Green Building Fund.



# Local Green Legislation

## GSA Green Requirements

All GSA projects must be LEED certified.

- ❖ Projects are encouraged to exceed basic LEED certification and achieve the LEED Silver level.



# Economic Benefits of LEED

## U.S. GSA Survey (Evaluation of 12 GSA Buildings)

- 13% lower maintenance costs
- 26% less energy usage
- 27% higher levels of occupant satisfaction

# Cost of Green Building

## *Cost of Green Revisited*

*Reexamining the Feasibility and Cost Impact of Sustainable Design in the Light of Increased Market Adoption*

Davis Langdon 

## Executive Summary

The 2006 study shows essentially the same results as 2004: there is no significant difference in average costs for green buildings as compared to non-green buildings. Many project teams are building green buildings with little or no added cost, and with budgets well within the cost range of non-green buildings with similar programs.

# Clark as a Green Builder

- 22.2 million SF of LEED Certified Projects
- 14.5 million SF of LEED Projects Under Construction
- \$5.4 Billion in LEED Projects Completed
- \$6.5 Billion in LEED Projects Under Construction
- Over 275 LEED Accredited Professionals



# Core Concepts

# LEED Structure & Processes

## What to Understand About LEED and the LEED Process

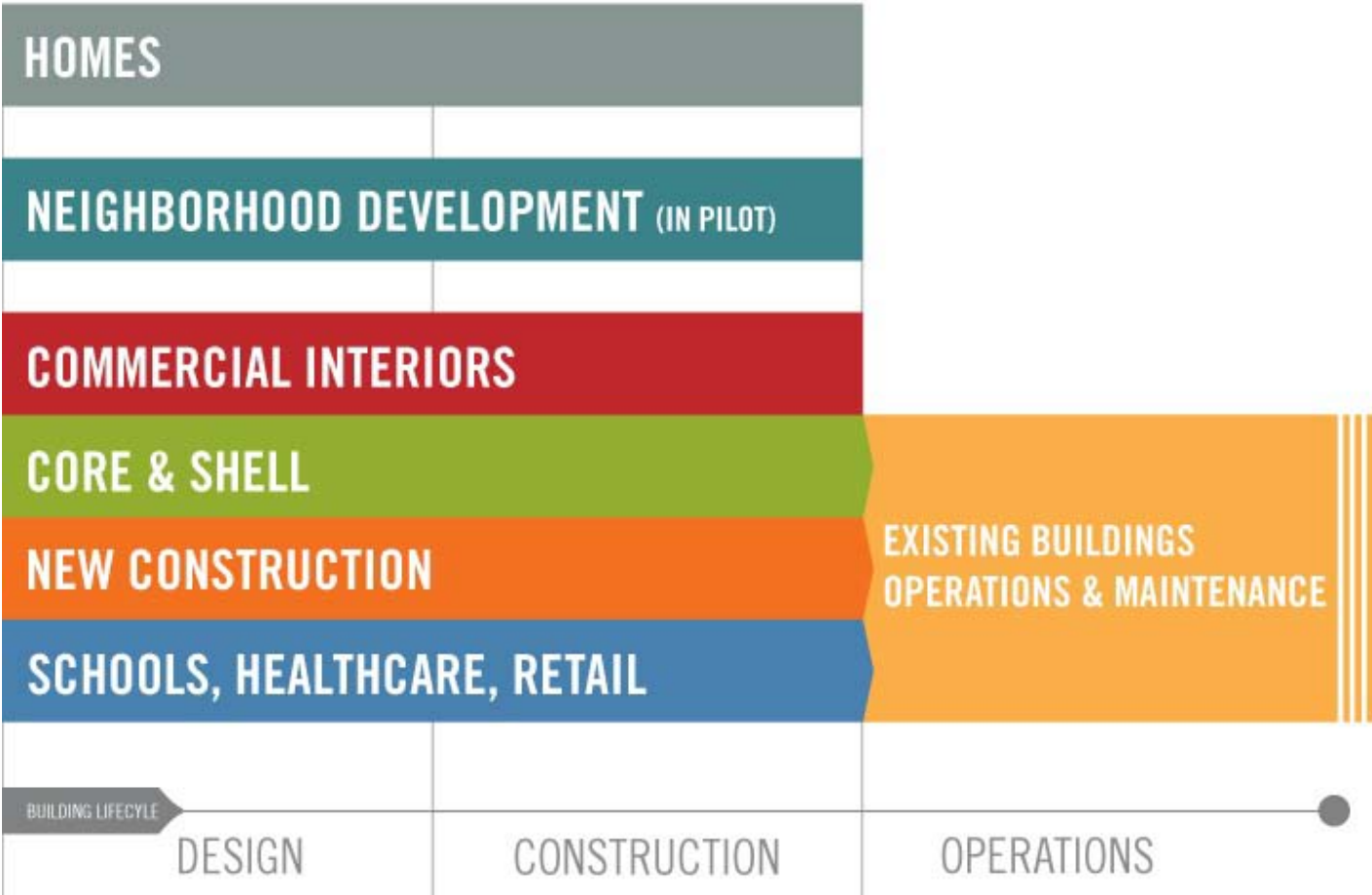
- Rating Systems
- Components of the LEED Score Card (Checklist)
- Minimum Program Requirements for LEED Certification
- Green Building Certification Institute™ (GBCI)
- LEED Credentialing
- USGBC Policies
- Project Registration
- Certification Process
- Credit Interpretation Rulings (CIRs)
- LEED Online

# USGBC<sup>®</sup> (U.S. Green Building Council)



- ❑ A 501(c)(3) non-profit organization dedicated to sustainability in the built environment.
- ❑ Developed the Leadership in Energy and Environmental Design (LEED) rating systems.

# Rating Systems



# Rating Systems







# LEED 2009 for New Construction and Major Renovation

Project Checklist

Project Name

Date

0	0	0	<b>Sustainable Sites</b>		Possible Points: 26
Y	N	?			
Y			Prereq 1	Construction Activity Pollution Prevention	
			Credit 1	Site Selection	1
			Credit 2	Development Density and Community Connectivity	5
			Credit 3	Brownfield Redevelopment	1
			Credit 4.1	Alternative Transportation—Public Transportation Access	6
			Credit 4.2	Alternative Transportation—Bicycle Storage and Changing Rooms	1
			Credit 4.3	Alternative Transportation—Low-Emitting and Fuel-Efficient Vehicles	3
			Credit 4.4	Alternative Transportation—Parking Capacity	2
			Credit 5.1	Site Development—Protect or Restore Habitat	1
			Credit 5.2	Site Development—Maximize Open Space	1
			Credit 6.1	Stormwater Design—Quantity Control	1
			Credit 6.2	Stormwater Design—Quality Control	1
			Credit 7.1	Heat Island Effect—Non-roof	1
			Credit 7.2	Heat Island Effect—Roof	1
			Credit 8	Light Pollution Reduction	1
0	0	0	<b>Water Efficiency</b>		Possible Points: 10
Y			Prereq 1	Water Use Reduction—20% Reduction	
			Credit 1	Water Efficient Landscaping	2 to 4
				Reduce by 50%	2
				No Potable Water Use or Irrigation	4
			Credit 2	Innovative Wastewater Technologies	2
			Credit 3	Water Use Reduction	2 to 4
				Reduce by 30%	2
				Reduce by 35%	3
				Reduce by 40%	4

## Components of LEED Score Cards (Checklist)

This is the LEED NC Checklist

It is a list of all available credits

Broken out into categories

0	0	0	Energy and Atmosphere	Possible Points: 35
Y		Prereq 1	Fundamental Commissioning of Building Energy Systems	
Y		Prereq 2	Minimum Energy Performance	
Y		Prereq 3	Fundamental Refrigerant Management	
		Credit 1	Optimize Energy Performance	1 to 19
			Improve by 12% for New Buildings or 8% for Existing Building Renovations	1
			Improve by 14% for New Buildings or 10% for Existing Building Renovations	2
			Improve by 16% for New Buildings or 12% for Existing Building Renovations	3
			Improve by 18% for New Buildings or 14% for Existing Building Renovations	4
			Improve by 20% for New Buildings or 16% for Existing Building Renovations	5
			Improve by 22% for New Buildings or 18% for Existing Building Renovations	6
			Improve by 24% for New Buildings or 20% for Existing Building Renovations	7
			Improve by 26% for New Buildings or 22% for Existing Building Renovations	8
			Improve by 28% for New Buildings or 24% for Existing Building Renovations	9
			Improve by 30% for New Buildings or 26% for Existing Building Renovations	10
			Improve by 32% for New Buildings or 28% for Existing Building Renovations	11
			Improve by 34% for New Buildings or 30% for Existing Building Renovations	12
			Improve by 36% for New Buildings or 32% for Existing Building Renovations	13
			Improve by 38% for New Buildings or 34% for Existing Building Renovations	14
			Improve by 40% for New Buildings or 36% for Existing Building Renovations	15
			Improve by 42% for New Buildings or 38% for Existing Building Renovations	16
			Improve by 44% for New Buildings or 40% for Existing Building Renovations	17
			Improve by 46% for New Buildings or 42% for Existing Building Renovations	18
			Improve by 48%+ for New Buildings or 44%+ for Existing Building Renovations	19
		Credit 2	On-Site Renewable Energy	1 to 7
			1% Renewable Energy	1
			3% Renewable Energy	2
			5% Renewable Energy	3
			7% Renewable Energy	4
			9% Renewable Energy	5
			11% Renewable Energy	6
			13% Renewable Energy	7
		Credit 3	Enhanced Commissioning	2
		Credit 4	Enhanced Refrigerant Management	2
		Credit 5	Measurement and Verification	3
		Credit 6	Green Power	2

# Components of LEED Score Cards (Checklist)

Broken out into categories

# Components of LEED Score Cards (Checklist)

0	0	0	Materials and Resources	Possible Points: 14
Y			Prereq 1 Storage and Collection of Recyclables	
			Credit 1.1 Building Reuse—Maintain Existing Walls, Floors, and Roof	1 to 3
			Reuse 55%	1
			Reuse 75%	2
			Reuse 95%	3
			Credit 1.2 Building Reuse—Maintain 50% of Interior Non-Structural Elements	1
			Credit 2 Construction Waste Management	1 to 2
			50% Recycled or Salvaged	1
			75% Recycled or Salvaged	2
			Credit 3 Materials Reuse	1 to 2
			Reuse 5%	1
			Reuse 10%	2
			Credit 4 Recycled Content	1 to 2
			10% of Content	1
			20% of Content	2
			Credit 5 Regional Materials	1 to 2
			10% of Materials	1
			20% of Materials	2
			Credit 6 Rapidly Renewable Materials	1
			Credit 7 Certified Wood	1

0	0	0	Indoor Environmental Quality	Possible Points: 15
Y			Prereq 1 Minimum Indoor Air Quality Performance	
Y			Prereq 2 Environmental Tobacco Smoke (ETS) Control	
			Credit 1 Outdoor Air Delivery Monitoring	1
			Credit 2 Increased Ventilation	1
			Credit 3.1 Construction IAQ Management Plan—During Construction	1
			Credit 3.2 Construction IAQ Management Plan—Before Occupancy	1
			Credit 4.1 Low-Emitting Materials—Adhesives and Sealants	1
			Credit 4.2 Low-Emitting Materials—Paints and Coatings	1
			Credit 4.3 Low-Emitting Materials—Flooring Systems	1
			Credit 4.4 Low-Emitting Materials—Composite Wood and Agrifiber Products	1
			Credit 5 Indoor Chemical and Pollutant Source Control	1
			Credit 6.1 Controllability of Systems—Lighting	1
			Credit 6.2 Controllability of Systems—Thermal Comfort	1
			Credit 7.1 Thermal Comfort—Design	1
			Credit 7.2 Thermal Comfort—Verification	1
			Credit 8.1 Daylight and Views—Daylight	1
			Credit 8.2 Daylight and Views—Views	1

Broken out into categories

# Components of LEED Score Cards (Checklist)

0	0	0	<b>Innovation and Design Process</b>	Possible Points: 6
			Credit 1.1 Innovation in Design: Specific Title	1
			Credit 1.2 Innovation in Design: Specific Title	1
			Credit 1.3 Innovation in Design: Specific Title	1
			Credit 1.4 Innovation in Design: Specific Title	1
			Credit 1.5 Innovation in Design: Specific Title	1
			Credit 2 LEED Accredited Professional	1
0	0	0	<b>Regional Priority Credits</b>	Possible Points: 4
			Credit 1.1 Regional Priority: Specific Credit	1
			Credit 1.2 Regional Priority: Specific Credit	1
			Credit 1.3 Regional Priority: Specific Credit	1
			Credit 1.4 Regional Priority: Specific Credit	1
0	0	0	<b>Total</b>	Possible Points: 110

Broken out into categories

Certified 40 to 49 points   Silver 50 to 59 points   Gold 60 to 79 points   Platinum 80 to 110

# Components of LEED Score Cards (Checklist)

Points Attempting  
 Maybe Attempting  
 Not Attempting

6	2	0	Water Efficiency	Possible Points: 10
Y			Prereq 1 Water Use Reduction—20% Reduction	
2			Credit 1 Water Efficient Landscaping	2 to 4
		2	Reduce by 50%	2
			No Potable Water Use or Irrigation	4
	2		Credit 2 Innovative Wastewater Technologies	2
4			Credit 3 Water Use Reduction	2 to 4
			Reduce by 30%	2
			Reduce by 35%	3
		4	Reduce by 40%	4

**Prerequisites:** No point values, but are required for certification.

**ALL** Prerequisites must be completed in order to become certified.

**Credits:** Have point values. “Project teams will select specific credits to pursue in order to attain the specific amount of points that will result in the desired level of LEED Certification.”

# Certification Levels



0			Credit 1.4 Regional Priority. Specific Credit	1
64	0	0	<b>Total</b>	<b>Possible Points: 110</b>
Certified 40 to 49 points		Silver 50 to 59 points		Gold 60 to 79 points
				Platinum 80 to 110

# Minimum Program Requirements (MPRs)



- The LEED 2009 Minimum Program Requirements (MPRs) define the minimum characteristics that a project must possess in order to be eligible for certification under LEED 2009.
  
- Example MPRs for LEED NC (and other rating systems):
  - The LEED project must include a minimum of 1,000 square feet of gross floor area.
  - No building or space that is designed to move at any point in its lifetime may pursue LEED Certification.



# GBCI™ (Green Building Certification Institute)



**USGBC®**

- ❑ Create and improve the LEED Rating System



**GBCI™**

- ❑ Project Certification
- ❑ Professional Credentials

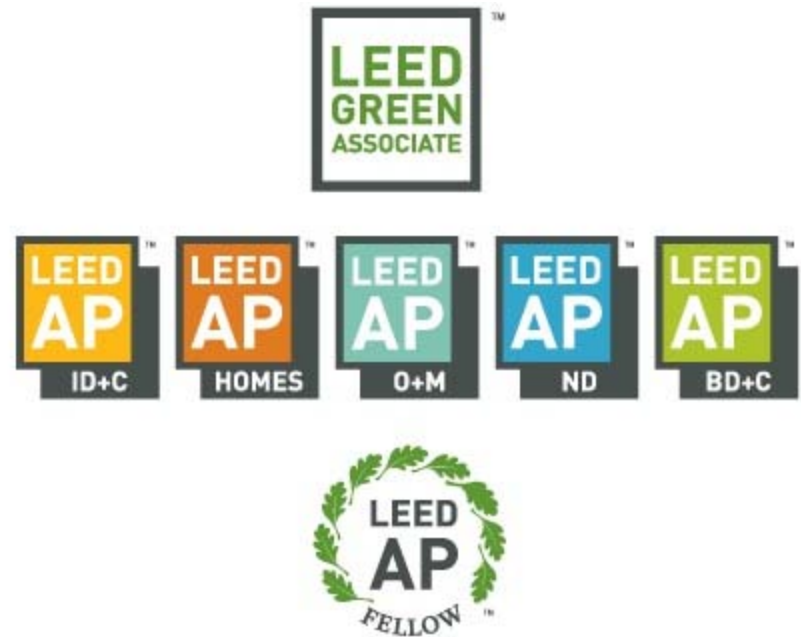




# LEED Credentialing



- LEED Green Associate
- LEED AP<sup>®</sup> with Specialty
- LEED Fellow



# Steps to LEED Certification

**REGISTER YOUR PROJECT**



**TRACK PROGRESS &  
DOCUMENT ACHIEVEMENT**



**APPLY FOR CERTIFICATION**

# Materials & Resources



Philip Merrill Environmental Center, Annapolis, MD, LEED Platinum



# Principles of Materials & Resources

# Reduce the Use of Virgin Materials

**Principle:** Using virgin materials uses up natural resources. It also creates a lot of waste when virgin materials are thrown away.



# Reduce Use of Nonrenewable Materials

**Principle:** We live in a world of scarce resources. Some of these resources grow back. Some never do.

# Reduce Transportation Burden of Materials

**Principle:** Materials that come from long distances have a heavy transportation impact associated with them.

- Regional materials have a lesser burden on transportation infrastructure.
- Regional materials require lower use of fossil fuels for shipping.

# Practice Sustainable Forestry

**Principle:** Practices like clear-cutting turn potentially renewable materials into being essentially nonrenewable.



# Divert Construction Waste from Landfills

**Principle:** Construction waste can be used again as product instead of being thrown away as trash.

- Construction & demolition waste make up approximately 40% of the United States' waste stream.

# Avoid Materials that are Harmful to Humans

**Principle:** When people are interacting with materials, we need to make sure that they are safe for us.

# Reduce Impact of a Building's Operation

**Principle:** Materials used in a building's operations should also be sustainable in the same ways that building materials are.

- Office supplies
  - Cleaning supplies
  - Furniture
  - Equipment
- } Ongoing Consumables
- } Durable Goods

# Which One is Greener? Why?

Toyota Prius



- 45 MPG
- Estimated Life: 109,000

VS.

H1 Hummer



- 13 MPG
- Estimated Life: 379,000

## Other environmental considerations:

Lifetime maintenance, accident repair, energy & resources from manufacturing process, transportation to retail, recyclables, non-recyclables, reusability, etc.

**Moral of the Story:** It's not always clear what's greener

## Bamboo Flooring



VS.

## Hardwood Flooring



- Rapidly Renewable
- Can be more durable
- Finishes sometimes contain formaldehyde
- Bamboo creates O<sub>2</sub> and absorbs CO<sub>2</sub> 4x more than traditional trees
- High transportation costs (Asian Import)

- Renewable
- Potentially lower transportation costs

**Moral of the Story:** It's not always clear what's greener

## Bamboo Flooring



- Rapidly Renewable
- Can be more durable
- Finishes sometimes contain formaldehyde
- Bamboo creates O<sub>2</sub> and absorbs CO<sub>2</sub> 4x more than traditional trees
- High transportation costs (Asian Import)

**But:** Bamboo is probably more sustainable if:

- it's sustainably harvested
- it doesn't contain formaldehyde
- if the bamboo is harvested at the right time so that it's hard and durable.



# Strategies for Materials & Resources

# Strategies for Sustainable Sites

- ❑ Building Reuse
- ❑ Recycled Materials
- ❑ Local or Regional Materials
- ❑ Rapidly Renewable Materials
- ❑ Reused or Salvaged Materials
- ❑ Certified Wood
- ❑ Healthy Materials
- ❑ Divert Construction Waste from Landfills
- ❑ Sustainable Purchasing



# Building Reuse

- There are a lot of existing buildings. If we are creative, we can create unique new spaces out of existing ones.

“The greenest building is the building  
you don’t have to build”

# Building Reuse

German-based TreuHandstelle transforms an abandoned coal mine into its corporate headquarters.



Before



After

# Recycled Materials

- Postconsumer Content – Consumer waste.
  - ▣ Bottles, newspapers, aluminum cans
  
- Pre-consumer Content – Manufacturing waste.
  - ▣ When a cardboard box company recycles cardboard scrap.
  - ▣ AKA “Post-industrial”

# Recycled Materials

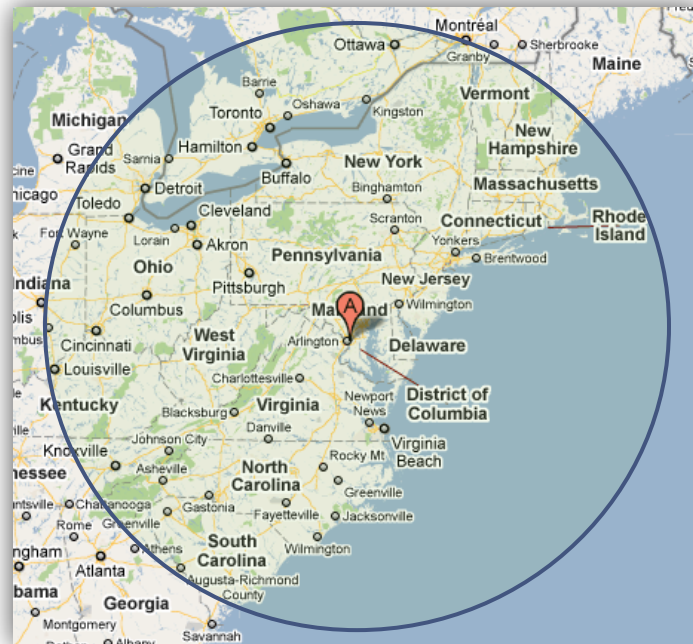
- How does LEED calculate Total Recycled Content?
  - ▣ Pre-consumer content only counts for half credit.
    - Perhaps this is because post-consumer products get more use, since they've already been products. Preconsumer products would still be on their “first life”
  
- Example: A Carpet is 40% Postconsumer & 20% Preconsumer.
  - ▣ Recycled Content:  $40\% + \frac{1}{2} \times 20\% = 50\%$

# Regional or Local Materials

- Considered Regional if:
    - ▣ Extracted within 500 miles of the project site.
  - AND ▣ Harvested or Recovered within 500 miles of the project site.
  - AND ▣ Manufactured within 500 miles of the project site.
- 
- ❖ Concrete will almost always be regional.
  - ❖ Steel almost never will.

# Regional or Local Materials

If extraction, harvesting, or manufacturing of the product took place outside of the 500 mile radius, it is NOT considered regional.



# Rapidly Renewable Materials

- Considered Rapidly Renewable if:
  - ▣ plants are typically harvested within a 10-year or shorter cycle.

## Examples:

- Bamboo
- Wool
- Cotton insulation
- Agrifiber
- Linoleum
- Wheatboard
- Strawboard
- Cork



Cotton Insulation



Wheatboard



Cork Flooring



# Reused or Salvaged Materials

Reuse differs from recycling because reuse maintains the product in its original form. It doesn't break it down and process it into a new product.



Home built by PCR Construction, A Utah Builder



Reclaimed Wood



# Certified Wood

- Independent organizations like the Forest Stewardship Council (FSC) have developed standards of good forest management and ensure that certain wood and paper products come from responsibly managed forests.
  - Reforestation of harvested forests
  - Protect from wildfire, pests, etc.
  - Protect soils



# Healthy Materials

- ❑ Use paints and glues with low or no VOCs (Volatile Organic Compounds).
- ❑ Use Formaldehyde-free wood products.



No VOC Paint

# Divert Construction Waste From Landfills – Salvage Programs

- If whole materials or products can be salvaged, set them aside.



# Divert Construction Waste From Landfills – Recycle

- Provide Separate bins for each material type.



# Sustainable Purchasing

- Develop a Sustainable Purchasing Policy
  - ▣ Ongoing consumables
  - ▣ Electronic equipment
  - ▣ Furniture



**CLARK**  
CONSTRUCTION

Thank You

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