Green Building Standards

Sustainable Design Overview for Information Professionals

Kati Arzeta, MLIS
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Agenda

- Introduction
- Green Building Certification Programs
- Green Building Standards
- Verification and other associated programs
- Design Concepts
- Design Process
- Occupancy
- Closing/next steps
- Q&A
Why are we here?

Top 100 firms generated $4.73 billion in “green” design revenue in 2014
- ENR

More than 60,000 LEED projects across 150+ countries

In the US, buildings account for –
38% of all CO2 emissions
13.6% of all potable water
73% of electricity consumption
- USGBC

Top 100 firms generated $4.73 billion in “green” design revenue in 2014
- ENR

More than 60,000 LEED projects across 150+ countries

In the US, buildings account for –
38% of all CO2 emissions
13.6% of all potable water
73% of electricity consumption
- USGBC
What is green building?

**Sustainability**
A method for “meeting the needs of the present without compromising the ability of future generations to meet their own needs.”

--Brundtland Commission, 1987

*Resource & Waste Management*
- Energy, Water & GHG
A Paradigm Shift

Triple Bottom Line (TBL)

Or...

The 3 Ps: People, Planet, Profit
who

- Customers
- Employees
- Shareholders
- Communities

metrics

- Injury Rates
- Staff Productivity
- Employee Sick Days
- Staff Turnover Rates
- Dow Jones Sustainability Index
- % spent on Local Economy
- Third-Party Certifications (LEED, ISO, Energy Star)
what

- Energy
- Water
- Materials
- Sourcing

how

metrics

- Energy Usage Index (EUI)
- Power Usage Effectiveness (PUE)
- Energy Productivity (kWh/widget)
- Carbon Footprint (CO₂/widget)
- Water Footprint (Liters/widget)
- % Waste Diverted from Landfill
- Environmentally Preferable Product Standards
what

• Return on Investment (ROI)
• Total Cost of Ownership (TCO)
• Production Cost
• Life Cycle Cost (LCC)

metrics

• Profitability
• Stock Value
• Capital (CapX) vs. Operational (OpX) Expenses
• Utility Costs
• Regulatory Risk
What determines if a building is green?

- Technology
- Rating Systems
- Codes & Standards
- Client Requests
- Laws
- Marketplace
Rating Systems
Rating Systems

• Look at project as whole
• Can be single-attribute or multi-attribute
• Developed/maintained by independent, usually non-profit organizations
• Earn accreditation or compliance by a points system
• Different scale/model for various building types – office building, school, industrial, etc.
• Often refer to other product certifications, codes and standards
Major Green Building Rating Systems

- BREEAM
- Estidama
- Green Mark
- CASBEE
- Beam
- Green Star SA
- Energy Star
- Green Star
Energy Star

• Developed and maintained by EPA
• Rating system for both products, homes and commercial buildings
• Single-attribute system – energy
  • *Portfolio Manager* - Tool used to calculate score; must achieve 75 or higher to be certified
• Only licensed professionals can perform evaluations
• Industrial plants can also seek certification but must meet other EPA standards
BREEAM

- Building Research Establishment Environmental Assessment Method
- Oldest green building rating system
- Used heavily in UK & EU; though approved in other regions
- Includes both professional credentialing and building certification
- 425,000 buildings with BREEAM certification
- Can be used for any type of building or large scale development
LEED

- Leadership in Energy & Environmental Design
- USGBC and local/national GBCs
- GBCI
- Building rating system and professional credentialing system
- Developed in the US, but used globally
- Version 4 is latest version and rolled out last year
Credentials

LEED GREEN ASSOCIATE

LEED AP BD+C
LEED AP O+M
LEED AP ID+C
LEED AP ND
LEED AP HOMES
## Rating Systems/Project Types

<table>
<thead>
<tr>
<th><strong>BD+C</strong></th>
<th><strong>ID+C</strong></th>
<th><strong>O+M</strong></th>
<th><strong>ND</strong></th>
<th><strong>Homes</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>New Construction or major renovation</td>
<td>Complete interior fit-out</td>
<td>Improvement work to existing buildings with little to no construction</td>
<td>New land development projects or redevelopment</td>
<td>Single family homes, low-rise or mid-rise multi-family</td>
</tr>
</tbody>
</table>

- New Construction
- Core & Shell
- Schools
- Retail
- Healthcare
- Data Centers
- Hospitality
- Commercial Interiors
- Retail
- Hospitality
- Existing Buildings
- Data Centers
- Whse
- Hospitality
- Schools
- Retail
- Plan
- Project
- Homes / multi-family
- Lowrise
- Multi-family
- Midrise
USGBC has four levels of LEED:

- Leed Certified: 40 – 49 pts
- Leed Silver: 50 – 59 pts
- Leed Gold: 60 – 79 pts
- Leed Platinum: 80pts +
LEED for New Construction and Major Renovations (v4)

MATERIAL & RESOURCES

Prereq  Storage and collection of recyclables  REQUIRED
Prereq  Construction and demolition waste management planning  REQUIRED
Credit  Building life-cycle impact reduction  5
Credit  Building product disclosure and optimization - environmental product declarations  2
Credit  Building product disclosure and optimization - sourcing of raw materials  2
Credit  Building product disclosure and optimization - material ingredients  2
Credit  Construction and demolition waste management  2

LOCATION & TRANSPORTATION

Credit  LEED for Neighborhood Development location  16
Credit  Sensitive land protection  1
Credit  High priority site  2
Credit  Surrounding density and diverse uses  5
Credit  Access to quality transit  5
Credit  Bicycle facilities  1
Credit  Reduced parking footprint  1
Credit  Green vehicles  1

SUSTAINABLE SITES

Prereq  Construction activity pollution prevention  REQUIRED
Credit  Site assessment  1
Credit  Site development - protect or restore habitat  2
Credit  Open space  1
Credit  Rainwater management  3
Credit  Heat island reduction  2
Credit  Light pollution reduction  1

INDOOR ENVIRONMENTAL QUALITY

Prereq  Minimum IAQ performance  REQUIRED
Prereq  Environmental tobacco smoke control  REQUIRED
Credit  Enhanced IAQ strategies  2
Credit  Low-emitting materials  3
Credit  Construction IAQ management plan  1
Credit  IAQ assessment  2
Credit  Thermal comfort  1
Credit  Interior lighting  2
Credit  Daylight  3
Credit  Quality views  1
Credit  Acoustic performance  1

WATER EFFICIENCY

Prereq  Outdoor water use reduction  REQUIRED
Prereq  Indoor water use reduction  REQUIRED
Prereq  Building-level water metering  REQUIRED
Credit  Outdoor water use reduction  2
Credit  Indoor water use reduction  6
Credit  Cooling tower water use  2
Credit  Water metering  1

INNOVATION

Credit  Innovation  5
Credit  LEED Accredited Professional  1

ENERGY & ATMOSPHERE

Prereq  Fundamental commissioning and verification  REQUIRED
Prereq  Minimum energy performance  REQUIRED
Prereq  Building-level energy metering  REQUIRED
Prereq  Fundamental refrigerant management  REQUIRED
Credit  Enhanced commissioning  6
Credit  Optimize energy performance  18
Credit  Advanced energy metering  1
Credit  Demand response  2
Credit  Renewable energy production  3
Credit  Enhanced refrigerant management  1
Credit  Green power and carbon offsets  2

TOTAL

40-49 Points  CERTIFIED
50-59 Points  SILVER
60-79 Points  GOLD
80+ Points  PLATINUM

http://www.usgbc.org/credits/new-construction/v4
# Project Scorecard

**USGBC Headquarters**

**LEED ID+C: Commercial Interiors (v2009)**

## Sustainable Sites

<table>
<thead>
<tr>
<th>ID</th>
<th>Description</th>
<th>Awarded</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>SS1</td>
<td>Site selection</td>
<td>3/5</td>
<td></td>
</tr>
<tr>
<td>SS2</td>
<td>Development density and community connectivity</td>
<td>6/6</td>
<td></td>
</tr>
<tr>
<td>SS3.1</td>
<td>Alternative transportation - public transportation access</td>
<td>6/6</td>
<td></td>
</tr>
<tr>
<td>SS3.2</td>
<td>Alternative transportation - bicycle storage and changing rooms</td>
<td>2/2</td>
<td></td>
</tr>
<tr>
<td>SS3.3</td>
<td>Alternative transportation - parking availability</td>
<td>2/2</td>
<td></td>
</tr>
</tbody>
</table>

## Water Efficiency

<table>
<thead>
<tr>
<th>ID</th>
<th>Description</th>
<th>Awarded</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>WEc1</td>
<td>Water use reduction</td>
<td>11/11</td>
<td></td>
</tr>
</tbody>
</table>

## Energy & Atmosphere

<table>
<thead>
<tr>
<th>ID</th>
<th>Description</th>
<th>Awarded</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>EAc1.1</td>
<td>Optimize energy performance - lighting power</td>
<td>5/5</td>
<td></td>
</tr>
<tr>
<td>EAc1.2</td>
<td>Optimize energy performance - lighting controls</td>
<td>2/3</td>
<td></td>
</tr>
<tr>
<td>EAc1.3</td>
<td>Optimize energy performance - HVAC</td>
<td>10/10</td>
<td></td>
</tr>
<tr>
<td>EAc1.4</td>
<td>Optimize energy performance - equipment and appliances</td>
<td>4/4</td>
<td></td>
</tr>
<tr>
<td>EAc2</td>
<td>Enhanced commissioning</td>
<td>5/5</td>
<td></td>
</tr>
<tr>
<td>EAc3</td>
<td>Measurement and verification</td>
<td>5/5</td>
<td></td>
</tr>
<tr>
<td>EAc4</td>
<td>Green power</td>
<td>5/5</td>
<td></td>
</tr>
</tbody>
</table>

## Material & Resources

<table>
<thead>
<tr>
<th>ID</th>
<th>Description</th>
<th>Awarded</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRc1.1</td>
<td>Tenant space - long-term commitment</td>
<td>1/1</td>
<td></td>
</tr>
<tr>
<td>MRc1.2</td>
<td>Building reuse - maintain interior nonstructural elements</td>
<td>0/2</td>
<td></td>
</tr>
<tr>
<td>MRc2</td>
<td>Construction waste mgmt</td>
<td>2/2</td>
<td></td>
</tr>
<tr>
<td>MRc3.1</td>
<td>Materials reuse</td>
<td>0/2</td>
<td></td>
</tr>
<tr>
<td>MRc3.2</td>
<td>Materials reuse - furniture and furnishings</td>
<td>0/1</td>
<td></td>
</tr>
<tr>
<td>MRc4</td>
<td>Recycled content</td>
<td>2/2</td>
<td></td>
</tr>
<tr>
<td>MRc5</td>
<td>Regional materials</td>
<td>2/2</td>
<td></td>
</tr>
<tr>
<td>MRc6</td>
<td>Rapidly renewable materials</td>
<td>0/1</td>
<td></td>
</tr>
<tr>
<td>MRc7</td>
<td>Certified wood</td>
<td>1/1</td>
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</tr>
</tbody>
</table>

## Indoor Environmental Quality

<table>
<thead>
<tr>
<th>ID</th>
<th>Description</th>
<th>Awarded</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>EQc1</td>
<td>Outdoor air delivery monitoring</td>
<td>1/1</td>
<td></td>
</tr>
<tr>
<td>EQc2</td>
<td>Increased ventilation</td>
<td>1/1</td>
<td></td>
</tr>
<tr>
<td>EQc3.1</td>
<td>Construction IAQ Mgmt plan - during construction</td>
<td>0/1</td>
<td></td>
</tr>
<tr>
<td>EQc3.2</td>
<td>Construction IAQ Mgmt plan - before occupancy</td>
<td>0/1</td>
<td></td>
</tr>
<tr>
<td>EQc4.1</td>
<td>Low-emitting materials - adhesives and sealants</td>
<td>1/1</td>
<td></td>
</tr>
<tr>
<td>EQc4.2</td>
<td>Low-emitting materials - paints and coatings</td>
<td>1/1</td>
<td></td>
</tr>
<tr>
<td>EQc4.3</td>
<td>Low-emitting materials - flooring systems</td>
<td>1/1</td>
<td></td>
</tr>
<tr>
<td>EQc4.4</td>
<td>Low-emitting materials - composite wood and agrifiber products</td>
<td>1/1</td>
<td></td>
</tr>
<tr>
<td>EQc4.5</td>
<td>Low-emitting materials - systems furniture and seating</td>
<td>1/1</td>
<td></td>
</tr>
<tr>
<td>EQc5</td>
<td>Indoor chemical and pollutant source control</td>
<td>0/1</td>
<td></td>
</tr>
<tr>
<td>EQc6.1</td>
<td>Controllability of systems - lighting</td>
<td>1/1</td>
<td></td>
</tr>
<tr>
<td>EQc6.2</td>
<td>Controllability of systems - thermal comfort</td>
<td>0/1</td>
<td></td>
</tr>
<tr>
<td>EQc7.1</td>
<td>Thermal comfort - design</td>
<td>1/1</td>
<td></td>
</tr>
<tr>
<td>EQc7.2</td>
<td>Thermal comfort - verification</td>
<td>1/1</td>
<td></td>
</tr>
<tr>
<td>EQc8.1</td>
<td>Daylight and views - daylight</td>
<td>0/2</td>
<td></td>
</tr>
<tr>
<td>EQc8.2</td>
<td>Daylight and views - views</td>
<td>1/1</td>
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</tr>
</tbody>
</table>

## Innovation

<table>
<thead>
<tr>
<th>ID</th>
<th>Description</th>
<th>Awarded</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDC1</td>
<td>Innovation in design</td>
<td>5/5</td>
<td></td>
</tr>
<tr>
<td>IDC2</td>
<td>LEED Accredited Professional</td>
<td>1/1</td>
<td></td>
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</tbody>
</table>

## Regional Priority

<table>
<thead>
<tr>
<th>ID</th>
<th>Description</th>
<th>Awarded</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>EQc6.1</td>
<td>Controllability of systems - lighting</td>
<td>1/1</td>
<td></td>
</tr>
<tr>
<td>EQc7.1</td>
<td>Thermal comfort - design</td>
<td>1/1</td>
<td></td>
</tr>
<tr>
<td>WEc1</td>
<td>Water use reduction</td>
<td>1/1</td>
<td></td>
</tr>
</tbody>
</table>

**Total** 94 / 110

### Certification Levels

- **Certified**: 40-49 Points
- **Silver**: 50-59 Points
- **Gold**: 60-79 Points
- **Platinum**: 80+ Points

Codes & Standards
• **14000 series – Environmental Management**
  - 14001:2004 Environmental management systems – Requirements with guidance for use
  - 14004:2004 Environmental management systems – General Guidelines on principles, systems and support techniques
  - 14006:2011 Environmental management systems – Guidelines for incorporating eco-design
  - 14064-1:2006 Greenhouse gases – Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals

• **50000 series – Energy Management**
  - 50001:2011 Energy management systems – Requirements with guidance for use
  - 50004:2014 Energy management systems – Guidance for the implementation, maintenance and improvement of an energy management system
Codes

- International Green Construction Code
- CALGreen
- Many local jurisdictions have adopted more stringent codes, specifically in regards to energy efficiency
ASHRAE

• **189.1** Standard for the Design of High-Performance Green Buildings (Except Low-Rise Residential Buildings)
  – Co-sponsored by USGBC and IES

• **90.1** Energy Standard for Buildings (Except Low-Rise Residential Buildings)

• **Guideline 14** Measurement of Energy, Demand, and Water Savings
ASTM/CSA/BSI

• ASTM
  – E1527 Standard Practice for Environmental Site Assessments
  – E2129 Standard Practice for Data Collection for Sustainability Assessment of Building Products
  – E2432 General Principles of Sustainability Relative to Buildings

• CSA
  – C22.2 LED Modules for general lighting
  – Z768-1 Phase 1 Environmental Site Assessment

• BSI
  – 8895-1:2013 Designing for material efficiency in building projects
  – 8525-1:2010 Greywater systems – code of practice
Product Certifications

• Single-attribute certifications:
  – FSC
  – Energy Star
  – WaterSense
  – SCS
  – Round Table on Sustainable Palm Oil Certified

• Multi-attribute certifications
  – Green Seal
  – GreenGuard
Third-Party Verification and Awards

- Reporting – ex. Global Reporting Initiative, UN Climate
- Single-factor – ex. Carbon Disclosure Project
- Multi-factor awards – Corporate Knights Global 100, Dow Jones Sustainability Indices, EPA Climate Award

<table>
<thead>
<tr>
<th>General Standard Disclosures</th>
<th>Location</th>
<th>External Assurance</th>
</tr>
</thead>
<tbody>
<tr>
<td>G4-1 Letter from senior leadership</td>
<td>Our Pledge: Message from Senior Leadership</td>
<td>None</td>
</tr>
<tr>
<td>G4-2 Sustainability impacts, risks, opportunities, and performance</td>
<td>Our Pledge: Sustainability Strategy 2014 Highlights</td>
<td>None</td>
</tr>
</tbody>
</table>

**Organizational Profile**

| G4-3 Organization name | Our Approach and Report: Meet CH2M HILL | None |
| G4-4 Primary brands, products, and services | Our Approach and Report: Meet CH2M HILL | None |
| G4-5 Headquarters location | Our Approach and Report: Meet CH2M HILL | None |
| G4-6 Countries of operation | Our Approach and Report: Meet CH2M HILL Locations Worldwide | None |
| G4-7 Ownership nature and legal | Our Approach and Report: Meet CH2M HILL | None |
Sustainable Design Concepts
## Design Concepts

<table>
<thead>
<tr>
<th>Concept</th>
<th>Related Credit Category</th>
<th>Referenced Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Location and Transportation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjacent Brownfield</td>
<td>Surrounding Density &amp; Diverse Uses</td>
<td></td>
</tr>
<tr>
<td>Electric Vehicle Charging</td>
<td>Green Vehicles</td>
<td></td>
</tr>
<tr>
<td><strong>Sustainable Sites</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low-impact rainwater management</td>
<td>Rainwater Management</td>
<td></td>
</tr>
<tr>
<td>Green roof</td>
<td>Heat Island Reduction</td>
<td>ASTM E903</td>
</tr>
<tr>
<td><strong>Water Efficiency</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Greywater Recycling</td>
<td>Indoor Water Use Reduction</td>
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</tr>
<tr>
<td>Metered Indoor Plumbing</td>
<td>Metering</td>
<td></td>
</tr>
<tr>
<td><strong>Energy and Atmosphere</strong></td>
<td></td>
<td></td>
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<tr>
<td>Energy Modeling</td>
<td>Minimum Energy Performance</td>
<td>ASHRAE 90.1</td>
</tr>
<tr>
<td>Passive Heating</td>
<td>Optimize Energy Performance</td>
<td>ASHRAE 90.1</td>
</tr>
<tr>
<td>Solar Panels</td>
<td>Renewable Energy Production</td>
<td></td>
</tr>
<tr>
<td><strong>Materials and Resources</strong></td>
<td></td>
<td>ISO 14044</td>
</tr>
<tr>
<td>Multi-attribute assessment of furniture material source</td>
<td>Minimal Chemical Content</td>
<td></td>
</tr>
<tr>
<td>Diversion</td>
<td>Construction Waste Management</td>
<td></td>
</tr>
<tr>
<td><strong>Indoor Environmental Quality</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HVAC background noise reduction</td>
<td>Minimum Acoustic Performance</td>
<td></td>
</tr>
<tr>
<td>Low VOC paint</td>
<td>Low-Emitting Materials</td>
<td></td>
</tr>
<tr>
<td>Daylighting (with glare control)</td>
<td>Daylight</td>
<td>IES 83-12</td>
</tr>
<tr>
<td><strong>Innovation</strong></td>
<td></td>
<td></td>
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<tr>
<td>Occupant Education</td>
<td>Education</td>
<td></td>
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<tr>
<td><strong>Regional Priority</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Habitat Restoration</td>
<td>Site Development</td>
<td></td>
</tr>
</tbody>
</table>
Green roof example

http://upload.wikimedia.org/wikipedia/commons/b/b5/Portland_Central_Library_Oregon_(2012)___158_-_green_roof.JPG
Energy Modeling examples
Sustainable Design Process
## Integrated Design

<table>
<thead>
<tr>
<th>Traditional Design Process</th>
<th>Vs.</th>
<th>Integrated Design Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design team generally limited to architects and engineers</td>
<td>Vs.</td>
<td>Design team includes owner, architect, engineers, construction team, facility management team, future users, end users, etc.</td>
</tr>
<tr>
<td>Linear in Nature</td>
<td>Vs.</td>
<td>Cyclical in Nature</td>
</tr>
<tr>
<td>Serial collection of Discrete Tasks</td>
<td>Vs.</td>
<td>Collaborative, conscious effort to integrate design strategies between all disciplines</td>
</tr>
<tr>
<td>Thinking of the building as a collection of separate systems and materials</td>
<td>Vs.</td>
<td>Thinking of the building as a whole</td>
</tr>
<tr>
<td>Cost Decisions driven by Initial Capital Cost</td>
<td>Vs.</td>
<td>Cost Decisions driven by Whole Life Cost / Life Cycle Cost</td>
</tr>
<tr>
<td>Solutions yield optimized independent systems</td>
<td></td>
<td>Solutions yield multiple benefits and “Synergy” between systems</td>
</tr>
</tbody>
</table>
Sustainable Design Process Overview
Occupancy
What is like to work in a green building?
Final Thoughts
Roles for Information Professionals

- Resource Management
- Research/Market Intelligence
- Metrics
- Process / Workflow Design
Green Building Information Gateway - GBIG

The Green Building Information Gateway
Connecting people to data and insights for a more sustainable built environment.

CREATE YOUR PROFILE
Establish your identity on GBIG so others can find you.

ADD YOUR ROLES
Associate yourself with high performance buildings and share your contributions.

GET UPDATES
Follow the buildings and places that mean the most to you and your business.
Thank You

kati.arzeta@ch2m.com
Sources