



PDHonline Course C765 (8 PDH)

Sustainability for Civil Engineers

PDH Online | PDH Center

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www.PDHonline.com

An Approved Continuing Education Provider

Olympic Park - Site Features

Master Plan

- 670 acres
- 9 venues at Olympic Park
- 2m m³ earthworks
- 40+ bridges
- 10km road



Olympic Park Site

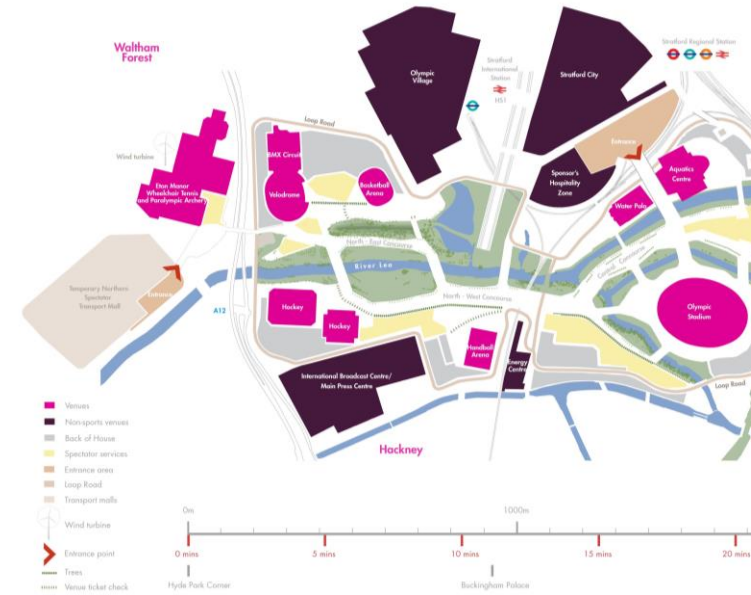
- Geographic – waterways, rail lines, major roads
- Contaminated site
- Existing infrastructure requires removal/diversion e.g. power lines, utilities
- Other major project interfaces – Stratford City, Town Centre, major transport projects (CTRL), DLR, Crossrail)
- Urban setting – adjacent neighbors



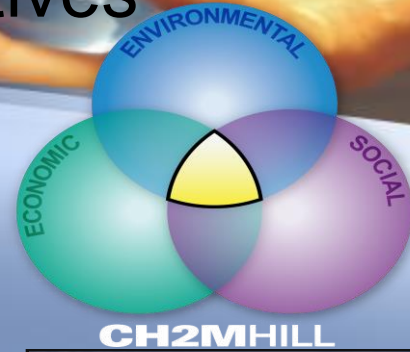
The Olympic Park

- 2.5km² (618 acres) Site Area
- 30 new bridges
- 190 buildings to be demolished
- 3 year construction programme
- 7.7m spectators
- 15,000 athletes
- 20,000 accredited media

Indicative map of the Olympic Park at Games-time



London 2012 Games Delivery Sustainable Development Objectives



Social

- Prioritize walking, cycling and the use of public transport
- Optimize the reduction of venues-related waste
- Identify, source, and use environmentally and socially responsible materials
- Involve, communicate, and consult effectively with stakeholders and surrounding communities

Environmental

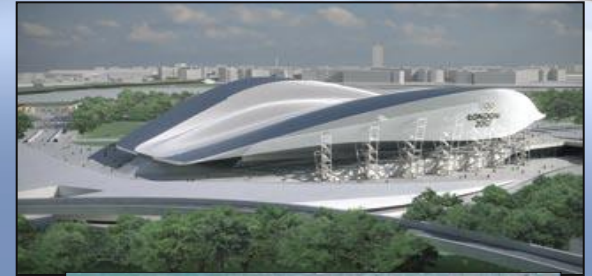
- Minimize carbon emissions (Olympic Park and venues)
- Optimize water use, reuse and recycling
- Protect and enhance biodiversity and ecology
- Maximize reuse and recycling of material arising from demolition, remediation and construction
- Optimize positive and minimize adverse impacts on land, water, noise and air quality



London 2012 Games Delivery Sustainable Development Objectives

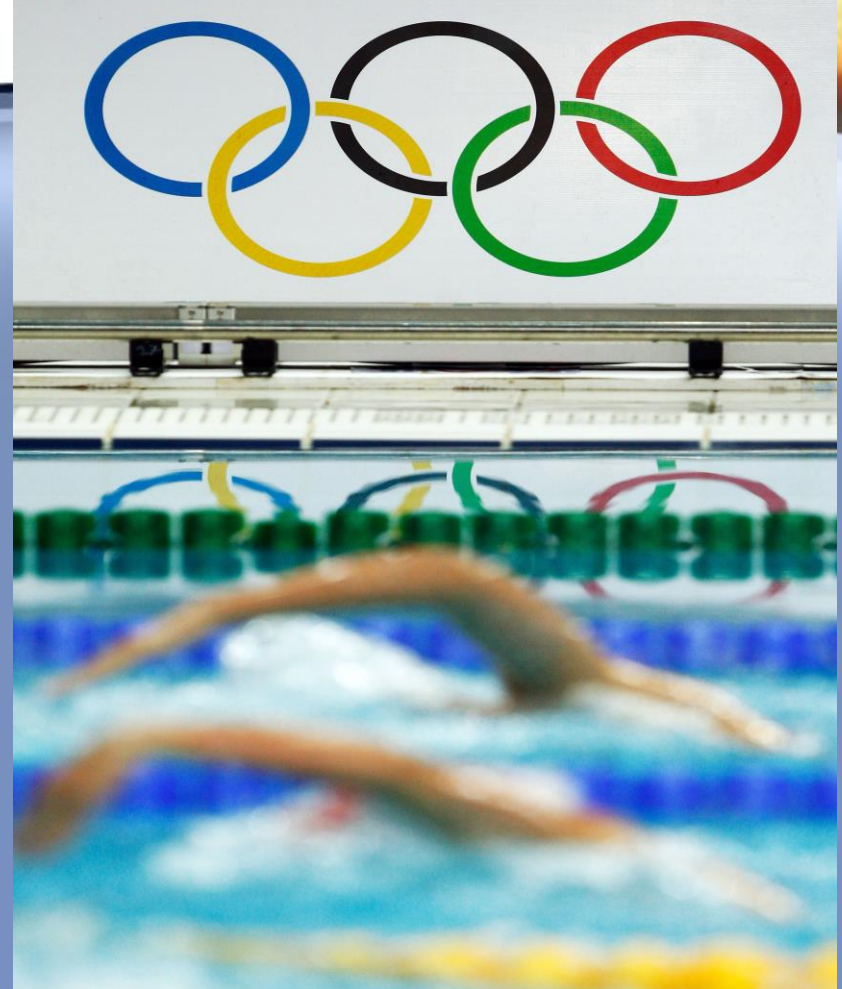
Economic

- Create new, safe, mixed-use public space, housing and facilities compatible with the demographics and character of the area
- Design a highly accessible Olympic Park and venues
- Create new employment and business opportunities locally, regionally and nationally
- Provide for healthy lifestyle opportunities



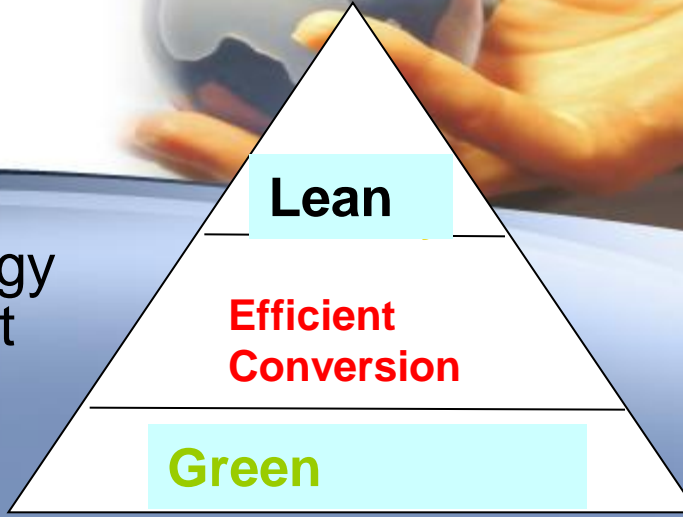
Sustainable Development Strategy (SDS)... A holistic approach

- Carbon
- Water
- Waste
- Materials
- Biodiversity
- Environmental impacts
- Supporting Communities
- Transport and Mobility
- Access
- Employment and Business
- Health and Well-being
- Inclusion

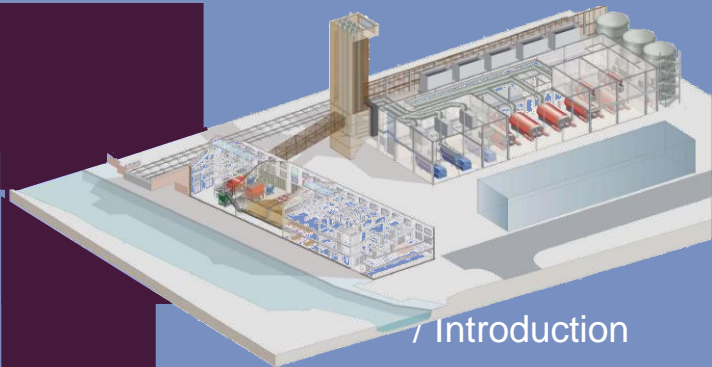


ODA Carbon Reduction Strategy

- All permanent venues to be 15% more energy efficient than 2006 Building Regulations Part
- CCHP delivers a 20% reduction in CO₂ emissions
- Renewable energy sources provide 20% reduction in remaining CO₂ emissions



← →
£ / CO₂ emission savings



ODA Waste Strategy

- 90% of site demolition waste to be reused or recycled.
- 80% of contaminated soil washed and reused
- Centralized waste management system during construction



ODA Water Demand Reduction Strategy



- Minimise water demand across the Park
- Site wide requirement to reduce potable water use by 40%
- Water efficient fittings and systems (demand reduction)
- Use non-potable water where effective (demand substitution)



Environmental Impacts – Land, air, water and noise

- Minimise adverse environmental impacts
- Establish Environmental & Sustainability Management System
- BREEAM excellent (permanent venues)
- CEEQUAL very good (civil works)
- 50% construction materials by sustainable transport



Materials

- 100% of timber procured from sustainable sources
- 20% materials, by value, to be from a secondary or recycled source
- 25% of aggregates to be from a secondary or recycled source
- Careful selection of environmentally friendly materials (BRE Green Guide)
- Reuse demolition waste
- Promote use of 'healthy materials'



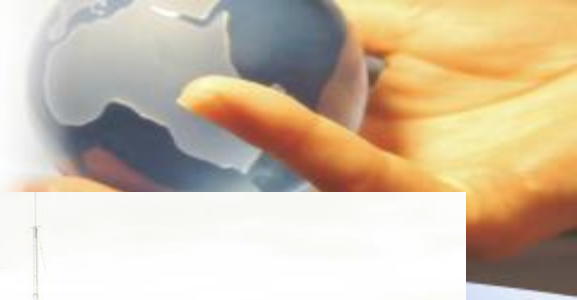
Goals for SDS embedded in planning and key commitments



- 50% by weight of construction materials delivered by rail and water
- 50% reduction in carbon emissions
- 20% reduction in carbon emissions from on site renewables
- 90% of material from demolition to be reused or recycled
- 40% reduction in potable water use
- Energy Savings - 15% Better than 2006 Building Regulations Part L Energy Code
- 25% OF Material (By Volume) Consisting of Recycled Material
- Responsible Resourcing for Goods, Materials and Services
- FSC Certified Timber
- No HFC'S or PVC'S



Challenge and opportunity



In 2012...

PRIOR EXISTING CONDITIONS



Demolition of Tower Blocks on CZ6b, Clays Lane



Demolition Material on Site



The Legacy Framework For The London 2012 Olympic Park



- For games, use some temporary facilities
- De-mountable, de-construct, reuse and recycle
- 110 ha open space
- Development platforms comprising > circa 950,000 sqm development
- 4,000 new housing units within the village (> 9,000 overall)
- Major investments in waterways, rims, park edges
- Venues transformed for legacy
- Provides strong basis for further development



Masdar City – Zero Carbon Footprint



The city will rely entirely on solar energy and other renewable energy sources, with a sustainable, zero-carbon, zero-waste ecology and will be a car free city. The city is being constructed 11 miles east-south-east of the city of Abu Dhabi, beside Abu Dhabi International Airport.



Summary

- Implementing Sustainability on Capital Projects
- Sustainability Project Example – London 2012 Olympics

“.... development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”

CH2M HILL Sustainability Assessment Framework (SAF)

| ENVIRONMENTAL | ECONOMIC | SOCIAL |
|--------------------------------|-------------------------|-------------------|
| Energy | Cost | Equity |
| Climate Change | Return on Investment | Aesthetics |
| Transportation/Land Management | Liabilities | Justice |
| Water | Assets | Health and Safety |
| Materials Use/Waste | Economic Development | |
| Biodiversity/Habitat | Life Cycle | |
| | Sustainable Procurement | |

Laws and Regulations about Sustainability

Example from the State of Washington

Environmental Sustainability

- Climate Change
- Environmentally Preferable Purchasing
- Green Building
- Toxics Reduction

Economic Sustainability

- Enacting the Evergreen Jobs Act

Social Sustainability

- Growth Management
- Energy
- Affordable Housing



Laws and Regulations about Sustainability



Example from the State of Washington – Climate Change

- Greenhouse Gas Emissions Limits
- Emissions Inventory and Reporting
- Creating Green Economy Jobs
- Reducing Emissions from Transportation
- Reducing Emissions from Electricity and Buildings
- Helping Communities Save Energy and Reduce Emissions
- State Agencies Reducing Emissions from their Operations
- Preparing for and Adapting to Climate Change
- Financing and Tax Incentives
- Executive Orders
- Other Important GHG Reduction Policies Enacted Prior to 2005

Industry Design Practices: Sustainability

Source: Hoffman Corp.

- Rating system for buildings and projects
- Points awarded based on achievement level
- Encourages responsible:
 - Development
 - Architecture
 - Engineering
 - Construction



Envision Rating System

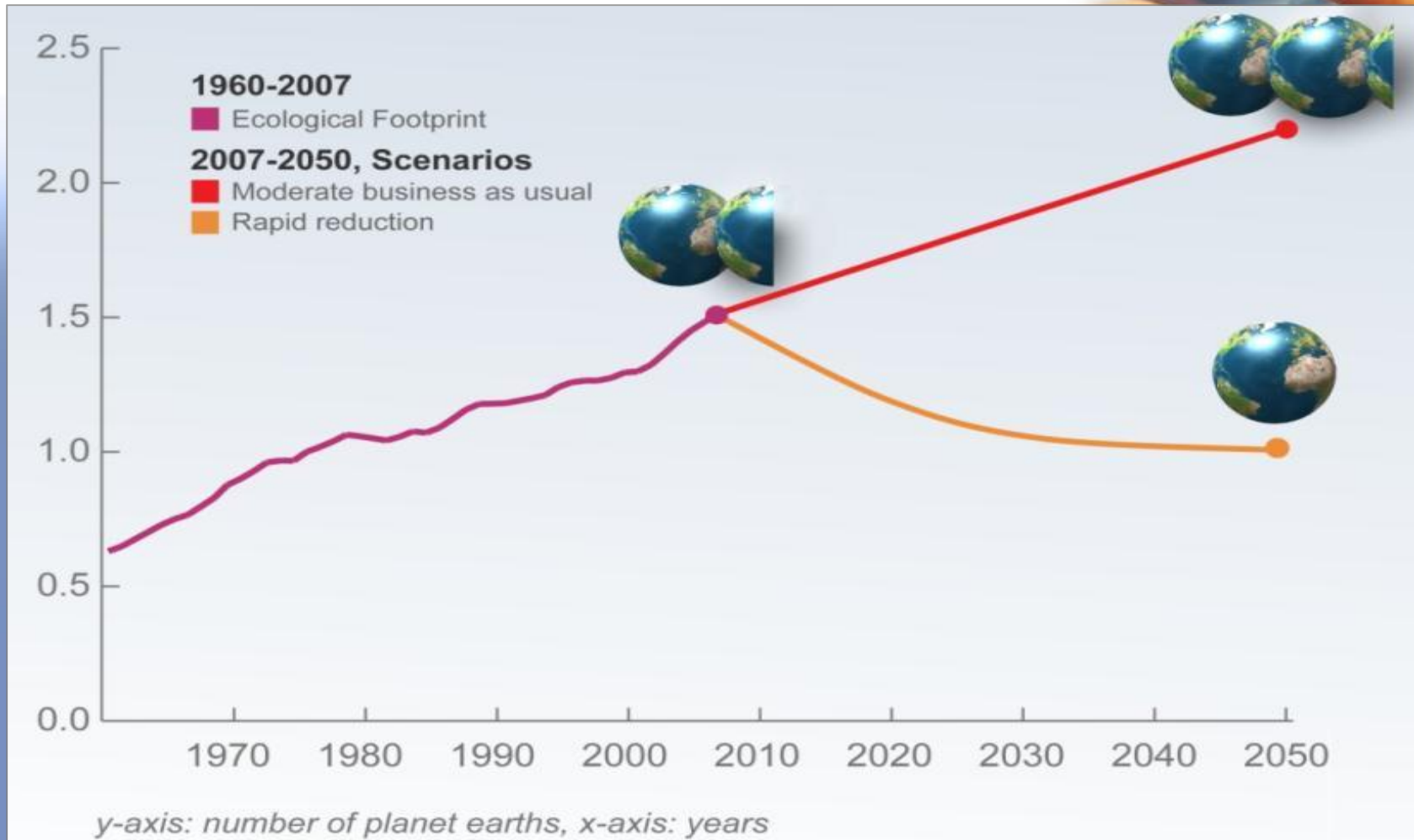


THE ENVISION™ RATING SYSTEM



THE NEED FOR ENVISION™

Resource Depletion



ASCE's Report Card for America's Infrastructure

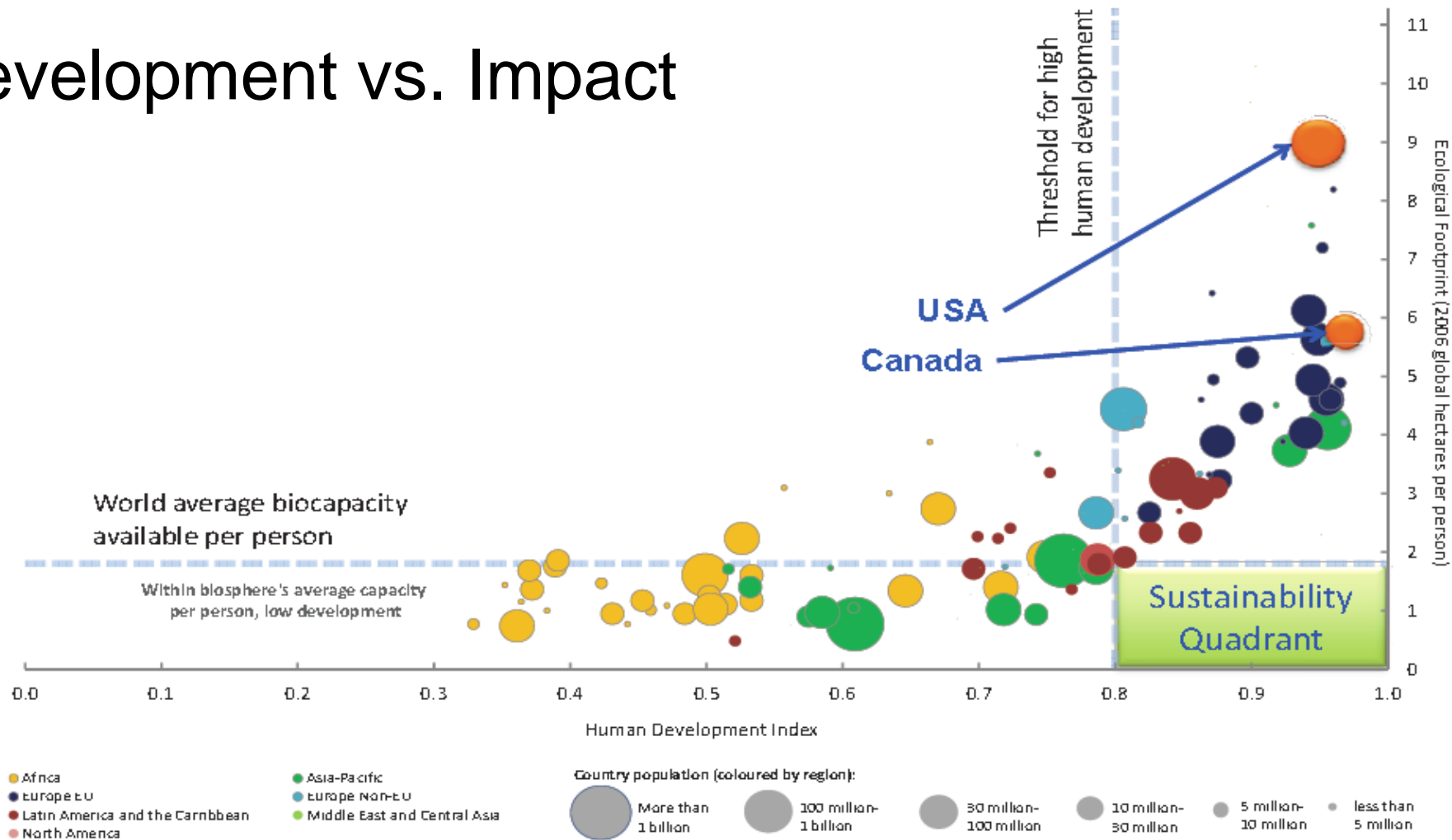
- 15 categories rated
- Overall grade of D
- \$2.2 trillion
- Ranked 23rd worldwide



America's Infrastructure Today



Development vs. Impact



Plotted by Irene Dhong, UFL ENV 6932

Figure 6: Human development index vs. ecological footprint by country (Source: Living Planet Report 2006, World Wildlife Fund).

The Future of Infrastructure



Envision™ Is Uniquely Qualified to Address America's Infrastructure



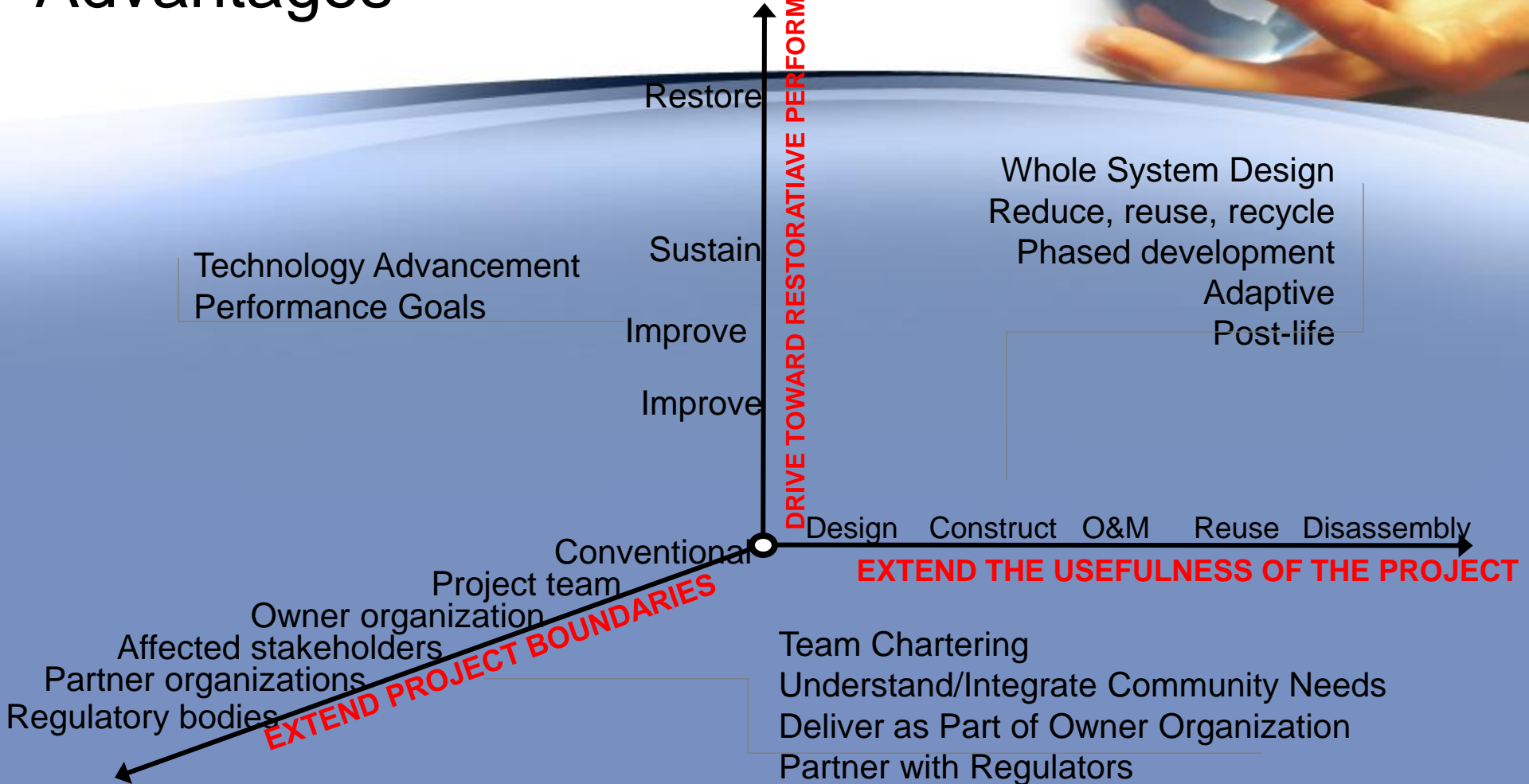
- Envision™ applies to all civil infrastructure
- Addresses design, planning, construction and maintenance
- Applicable at any point in an infrastructure project's life cycle
- Speaks to the triple bottom line: social, economic and environmental goals
- Designed to keep pace with a changing concept of sustainability

Why Was Envision™ Developed?

- Current rating systems for infrastructure in the U.S. are sector specific
- No U.S. system covers all aspects of infrastructure
- Envision™ is designed to fill the gap



Advantages



Collaboration



ZOFNASS PROGRAM
FOR SUSTAINABLE INFRASTRUCTURE

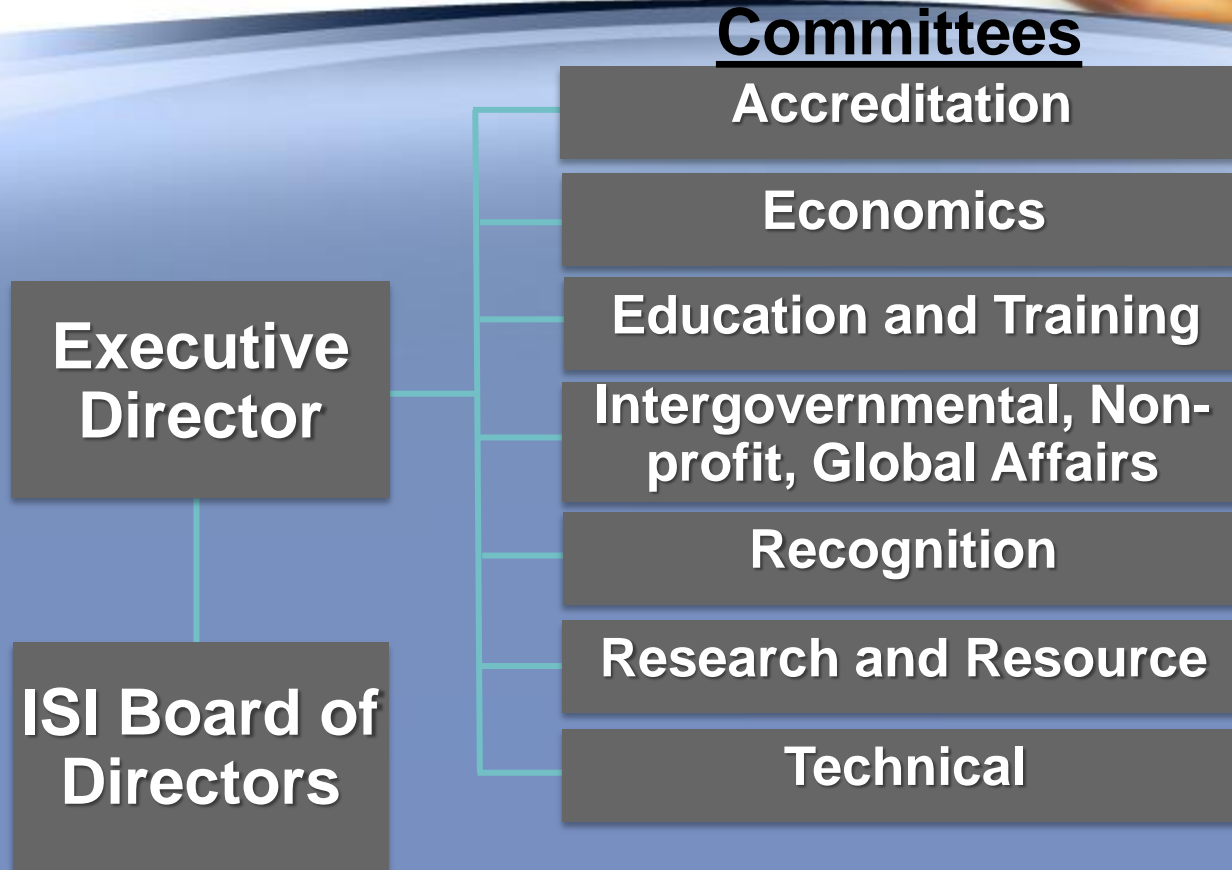


Graduate School of Design
Harvard University

ISI Founders (2010)



ISI Organization



ISI Members



- Charter
- Sustaining
- Public Sector
- Academia

□ Membership benefits

- Discounts on training and professional accreditation
- Discounts on project Verification
- Networking opportunities
- Listing in the member directory
- Opportunities to serve on committees

Envision™ Sustainability Professional



- Envision Sustainability Professional (ENV SP)
 - ISI Credentialed Practitioner Trained to Use the Envision Rating System
 - Available now
- Role
 - Guide the project team in using Envision

**Envision Credentialed
Professionals**

[Click here to search for a
credentialed ENV SP.](#)

Envision™ Verifiers



- Independent, Third-party Verification of Project Certification Applications
- Role
 - Mentor ENV SP in Application Process
 - Verify Documentation, Levels of Achievement, and Overall Score





The screenshot shows the ISI website homepage. At the top, there is a navigation bar with links for Home, About Us, Join ISI, Contact Us, Search, and Login. The ISI logo is on the left, and a search box is on the right. Below the navigation bar is a dark blue banner with the text "Better Communities" in green. The main content area is divided into several sections: "ISI Sustainable Infrastructure Rating System" with a sub-section for "Envision™ 2.0 is Now Available" and buttons for "Learn more about Envision™ 2.0" and "Login to Download or Comment"; "ISI Blog" with a link to "Visit the ISI Blog to find out how we are 'Building 2050 Today'"; "ISI Credential Application" with a link to "Register here"; "Accepted Applicants" with a link to "Click here"; "Envisions Credentialed Professionals" with a link to "Click here"; "What Would You Like to Do Today?" with links for "Join ISI", "Learn more about sustainable infrastructure", "Learn About the New Rating System", "Login to download and comment", and "Ask a question"; "Latest News" with a list of recent articles; and a "LinkedIn" logo at the bottom left.

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INSTITUTE FOR SUSTAINABLE INFRASTRUCTURE

ISI

News FAQs Rating System ISI Credentials Project Application Education & Training Case Studies Comments

Better Communities

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Envisions Credentialed Professionals

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ISI Forms Economics Committee; Names Chair ...[details](#)

LinkedIn

What Types Of Infrastructure Will Envision™ Rate?



ENERGY

Geothermal
Hydroelectric
Nuclear
Coal
Natural Gas
Oil/Refinery
Wind
Solar
Biomass



WATER

Potable water distribution
Capture/Storage
Water Reuse
Storm Water Management
Flood Control



WASTE

Solid waste
Recycling
Hazardous Waste
Collection & Transfer



TRANSPORT

Airports
Roads
Highways
Bikes
Pedestrians
Railways
Public Transit
Ports
Waterways



LANDSCAPE

Public Realm
Parks
Ecosystem Services



INFORMATION

Telecommunications
Internet
Phones
Satellites
Data Centers
Sensors

60 Credits in 5 Categories



**QUALITY
OF LIFE**

Purpose, Community, Wellbeing



LEADERSHIP

Collaboration, Management, Planning



**RESOURCE
ALLOCATION**

Materials, Energy, Water



**NATURAL
WORLD**

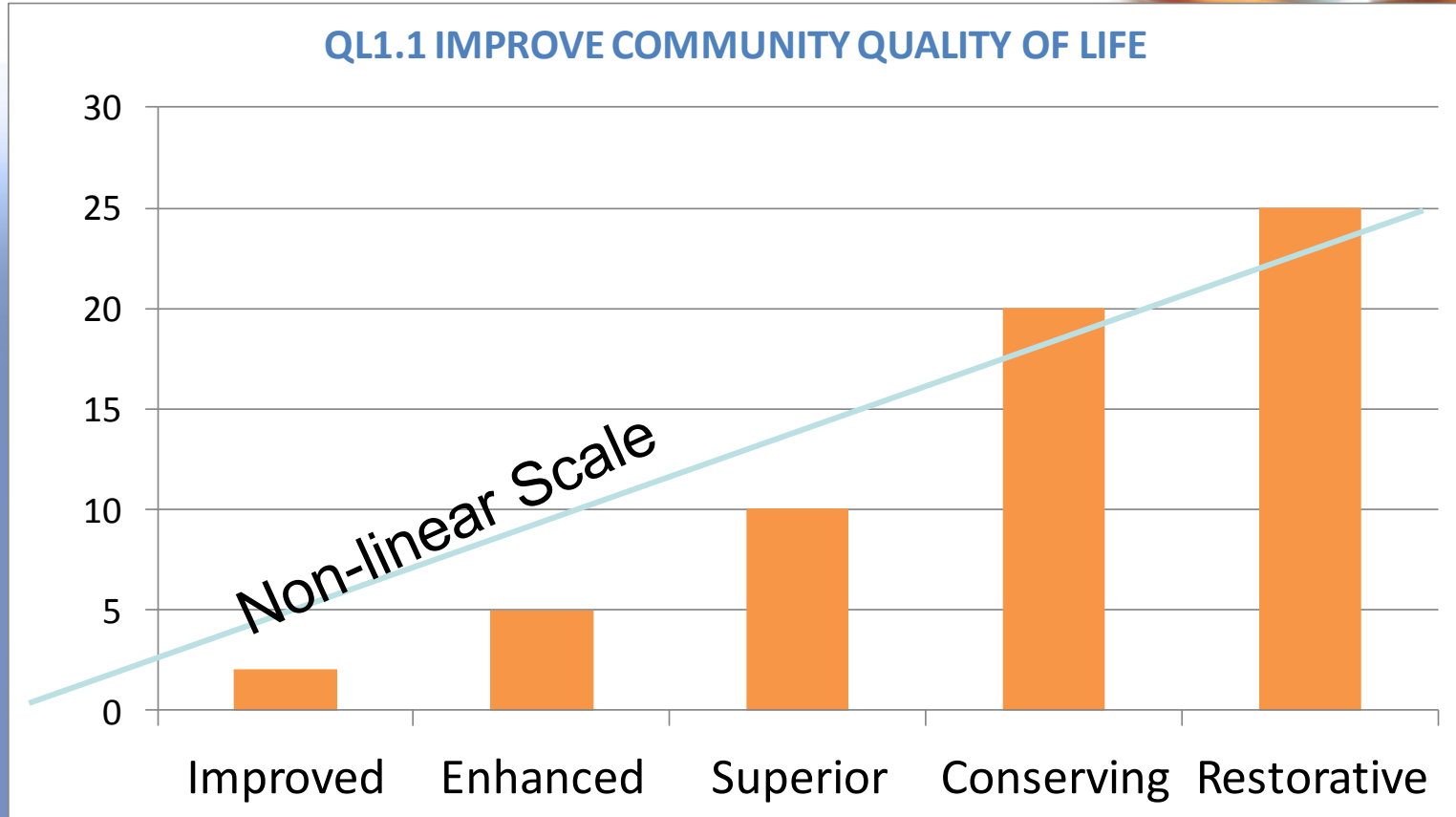
Siting, Land & Water, Biodiversity



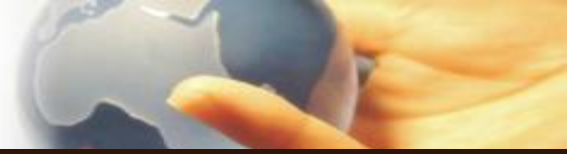
**CLIMATE
AND RISK**

Emission, Resilience

Levels of Achievement



Input Portal

[News](#)[FAQs](#)[Rating System](#)[ISI Credentials](#)[Project Application](#)[Education & Training](#)[Case Studies](#)[Comments](#)

Project Application

Envision™ Sustainable Infrastructure Rating System

[Instructions](#)[Projects](#)[Section Menu](#)[QL](#)[LD](#)[RA](#)[NW](#)[CR](#)[Section Totals Summary](#)[Report](#)

Section Menu

Please click on the links to take you to the relevant sections:



QUALITY
OF LIFE



LEADERSHIP



RESOURCE
ALLOCATION



NATURAL
WORLD



CLIMATE
AND RISK

[< Previous Page](#)[Next Page >](#)

Rating System



| | Section and Objective Numbers | Objectives | Required for Project | Level Of Achievement | Score | Objective Available Points |
|------------------------|---|--|---|--|-------|----------------------------|
| QUALITY OF LIFE | | | | | | |
| QL1 | QL1.1 | Improve community quality of life. Improve the net quality of life of all communities affected by the project and mitigate negative impacts to communities. details / guidance | YES | Restorative <input type="button" value="v"/> | 25 | 25 |
| | | | Notes: <input type="text"/> | | | |
| | QL1.2 | Stimulate sustainable growth and development. Support and stimulate sustainable growth and development, including improvements in job growth, capacity building, productivity, business attractiveness and livability. details / guidance | YES | Superior <input type="button" value="v"/> | 5 | 16 |
| | | Notes: <input type="text"/> | | | | |
| QL1.3 | Develop local skills and capabilities. Expand the knowledge, skills and capacity of the community workforce to improve their ability to grow and develop. details / guidance | Assessor Decision Include <input type="button" value="v"/> | Improved <input type="button" value="v"/> | 1 | 15 | |
| | | Notes: <input type="text"/> | | | | |

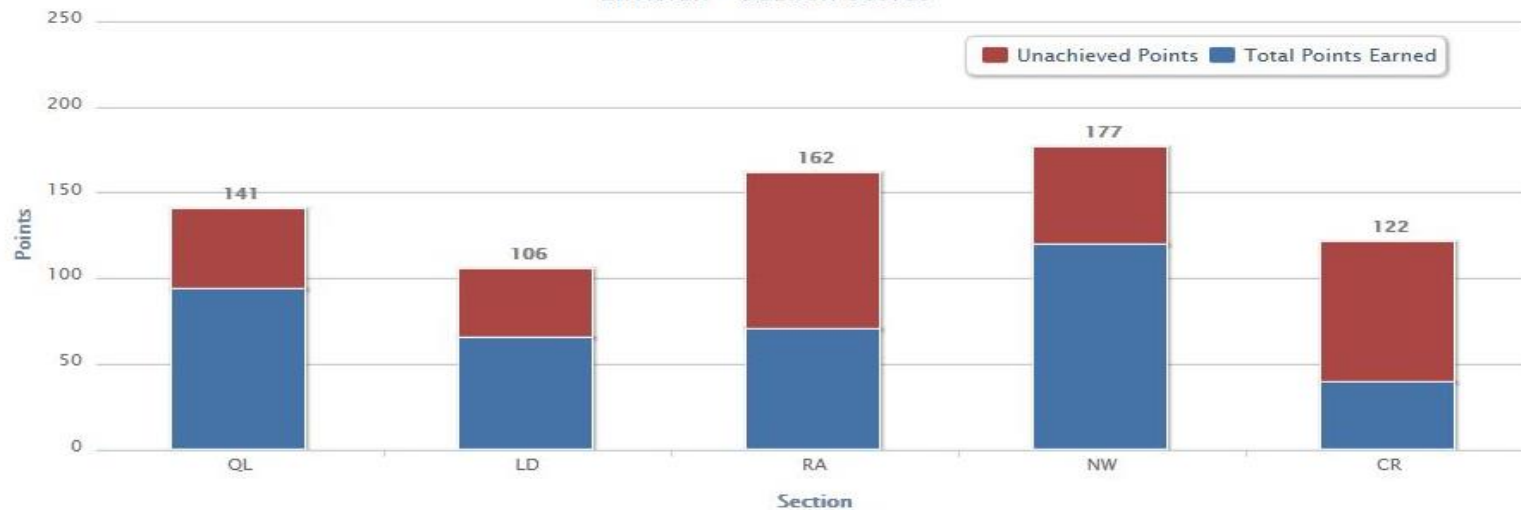
"Raingardens"

Scoring Summary

Section Totals Summary

| Section | Maximum Possible Score | Section Points | Innovation Points | Total Points Earned |
|-----------------------------|------------------------|----------------|-------------------|---------------------|
| QL | 141 | 91 | 3 | 94 |
| LD | 106 | 66 | 0 | 66 |
| RA | 162 | 71 | 0 | 71 |
| NW | 177 | 118 | 2 | 120 |
| CR | 122 | 40 | 0 | 40 |
| Total Project Points | 708 | 386 | 5 | 391 |

Envision™ Section Scores



Award Levels

| Recognition Level | Minimum Applicable Points | Minimum in Each Category |
|-------------------|---------------------------|---|
| Bronze | 20% | No minimum category percentage required |
| Silver Award | 30% | |
| Gold Award | 40% | |
| Platinum Award | 50% | |



Fee Schedule




Registration Fee: \$1000


Verification Fee


| Project Size (\$) | Non-Member Price | ISI Member Price |
|-------------------|--|------------------|
| Up to 2M | \$3000 | \$2400 |
| 2-5M | \$8500 | \$7000 |
| 5-25M | \$17,000 | \$14,000 |
| 25-100M | \$25,000 | \$21,000 |
| 100-250M | \$33,000 | \$28,000 |
| Over 250M | \$5000 per 100M above base price of \$20,000 | |

Appeals Fee: \$500 per credit



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Latest News

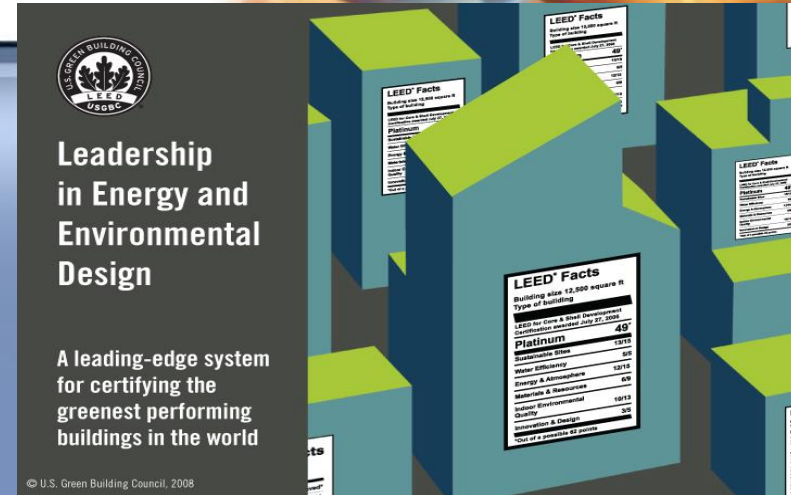
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LEED – Leadership in Energy and Environmental Design



USGBC LEED Certification – Recognized in US and Internationally

- Credits are voluntary and market-driven
- Based on existing and proven technology
- Whole-Building approach with 5 general categories of credit:
 - **Sustainable Sites**
 - **Water Efficiency**
 - **Energy and Atmosphere**
 - **Materials and Resources**
 - **Indoor Environmental Quality**
- 6th Category for advancing the technology
 - Innovation and Design Process
- LEED project checklist with 69 possible points



LEED certification levels:

| | |
|----------|--------------|
| Basic | 26-32 Points |
| Silver | 33-38 Points |
| Gold | 39-51 Points |
| Platinum | 52-69 Points |

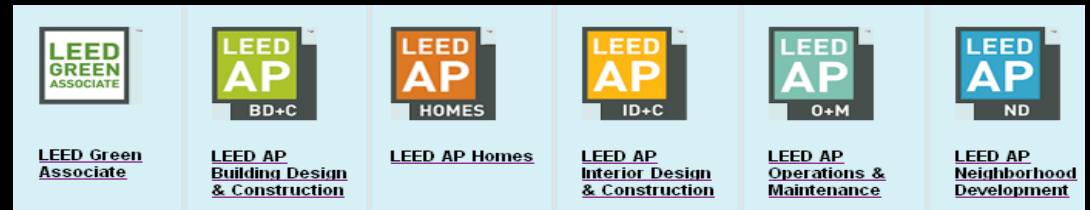
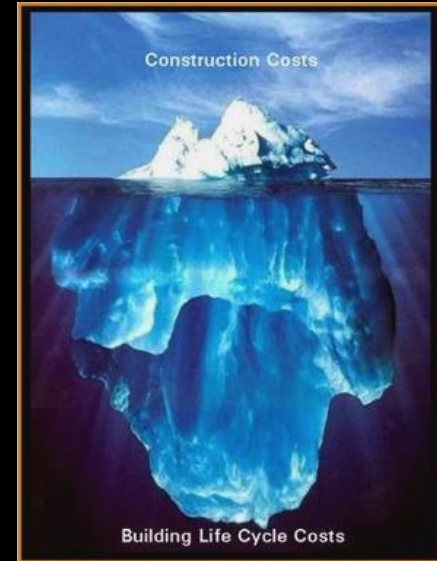
Benefits of LEED Accredited Professional:

- **Personal -**
 - Provides Marketable Credentials
 - Listing on USGBC (Networking)
 - Recognition for Involvement
 - Asset to Company & Clients
- **Contractors or Consultants –**
 - Strengthens RFP's
 - Exceed Client's Goals
 - Stay Ahead of Competitors
 - Encourages Growth of Knowledge
- **Industry Benefits –**
 - Promotes Higher Understanding of LEED
 - Help our Environment



LEED Professional Credentials

- LEED Green Associate
- LEED AP BD+C
- LEED AP Homes
- LEED AP ID+C
- LEED AP O+M
- LEED AP ND



LEED Project Rating Systems

Reference Guides

| Rating System | Reference Guide |
|-------------------------------|--|
| LEED for New Construction | GREEN BUILDING DESIGN & CONSTRUCTION 2009 Edition |
| LEED for Core & Shell | |
| LEED for Schools | |
| LEED for Healthcare* | |
| LEED for Retail* | |
| LEED for Commercial Interiors | GREEN INTERIOR DESIGN & CONSTRUCTION 2009 Edition |
| LEED for Retail Interiors* | |
| LEED for Existing Buildings | GREEN BUILDING OPERATIONS & MAINTENANCE 2009 Edition |
| LEED for Existing Schools* | |

LEED New Construction Categories


- **Sustainable Sites (SS) – 26 Points**
- **Water Efficiency (WE) – 10 Points**
- **Energy & Atmosphere (EA) – 35 Points**
- **Materials & Resources (MR) – 14 Points**
- **Indoor Environmental Quality (EQ) – 15 Points**
- **Innovation & Design Process (ID) – 6 Points**
- **Regional Priority Credits (RP) – 4 Points**


Certification Levels





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

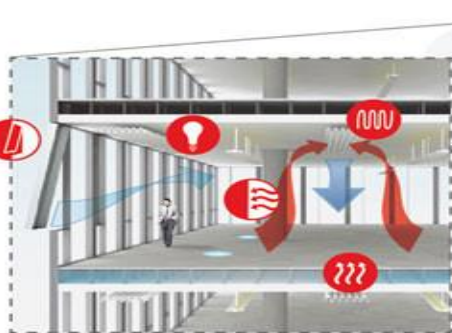
- Minimum Points Required = 40 Points
- Max. Possible Points = 110 Points


 Operable windows provide fresh air, natural cooling, and a connection to the outdoors.

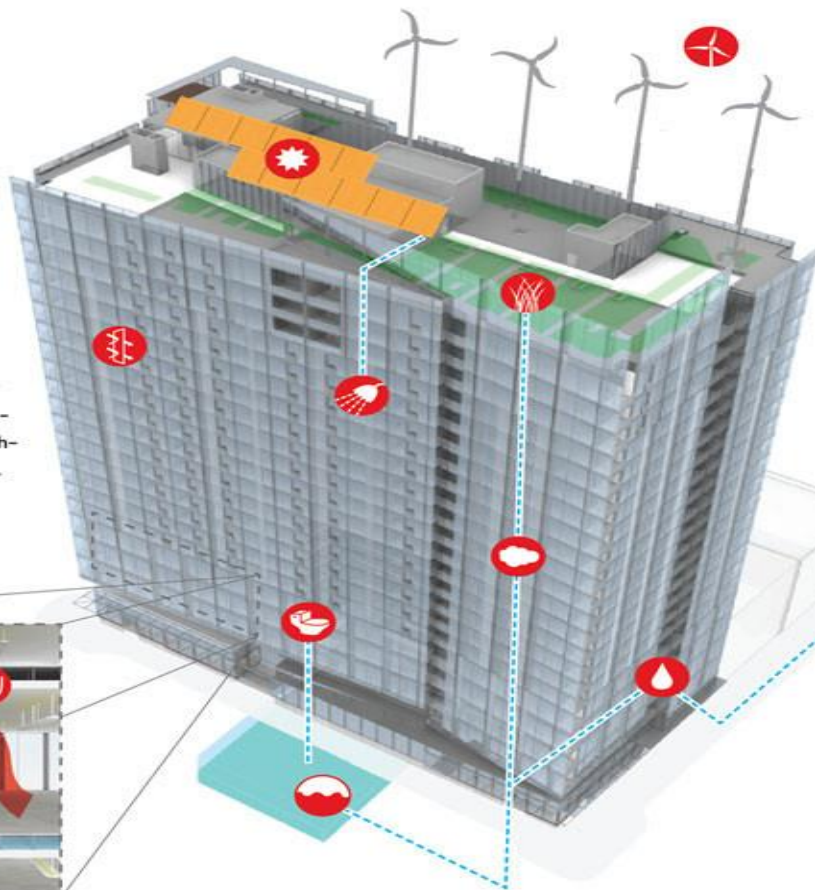
 Sensors switch off lights when there is ample sun, reducing lighting-related energy use by 60 percent.


 Exposed concrete moderates indoor air temperatures. In the summer, the building's mass absorbs excess heat throughout the day and is cooled with night air.


 Chilled beams provide energy-efficient cooling on the hottest days.





 Underfloor air distribution efficiently delivers temperate air directly to occupants. Adjustable floor vents provide personal control over ventilation.





 Four wind turbines produce 10,000–12,000 kWh of electricity per year. Monitoring the wind conditions and turbine performance at the office will improve future projects.


 Solar thermal panels heat 24 percent of the hot water in the building, offsetting natural-gas use.


 Roof gardens clean, collect, and filter rainwater and significantly reduce roof temperatures in warmer months.


 Low-E glass admits 35 percent of visible sunlight but reflects 74 percent of the associated heat, reducing energy use for lighting and cooling.


 Rainwater reuse in toilet flushing and green-roof irrigation reduces reliance on city water by 286,000 gallons per year.

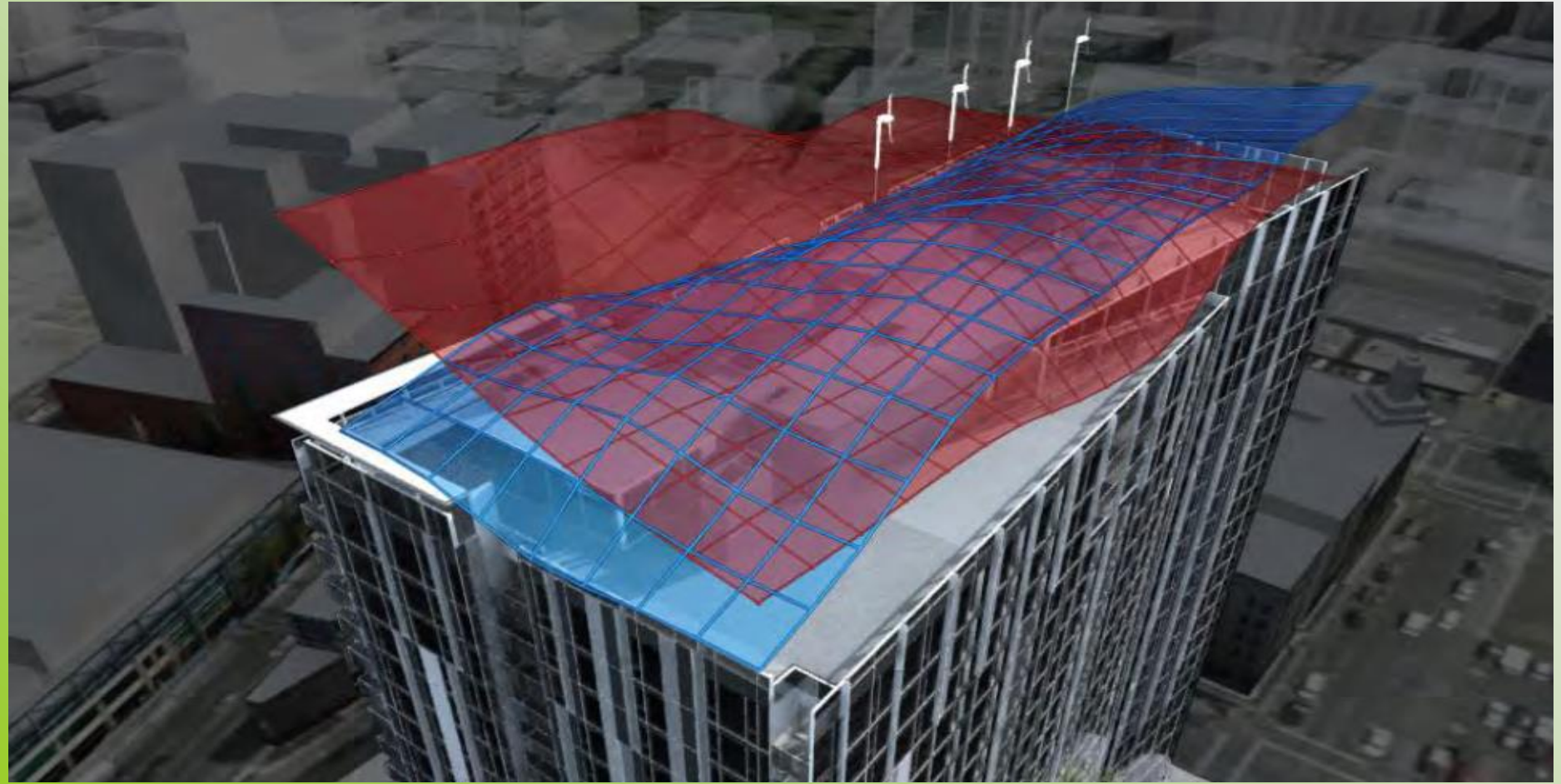
 Efficient plumbing fixtures reduce water use by more than 44 percent.

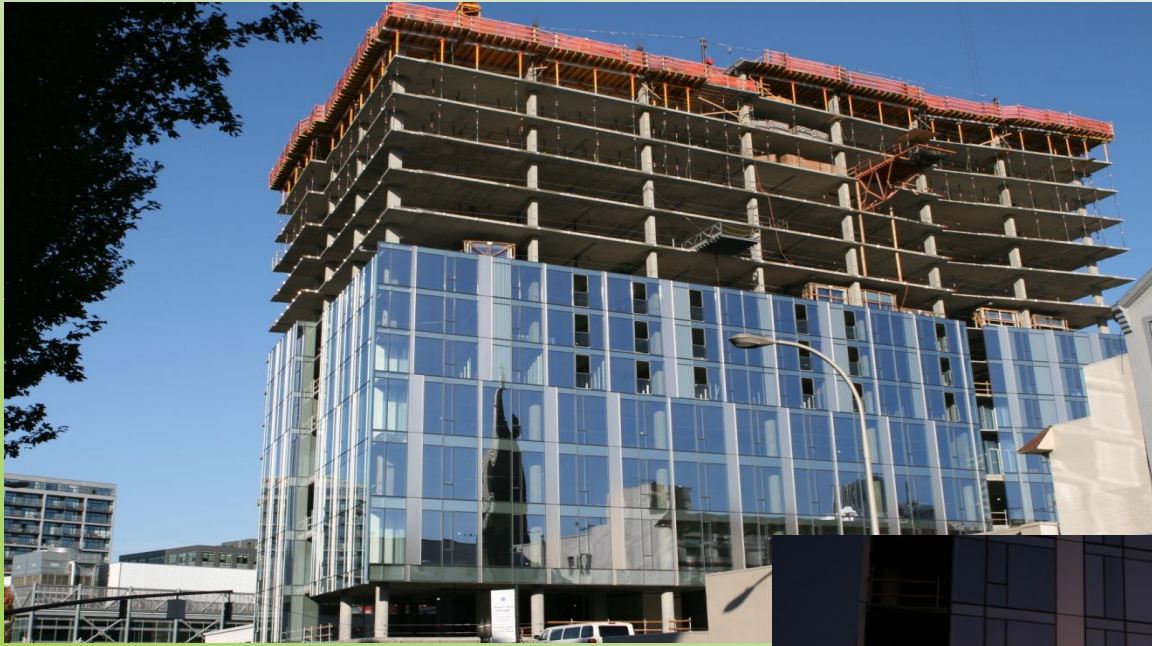
 A water-storage tank temporarily holds up to 23,000 gallons of rainwater and condensation for reuse.

 An efficient central-cooling plant in the nearby Brewery Blocks provides chilled water for space cooling.

 Rainwater-harvesting piping gathers 273,000 gallons of water from the roofs.

 Thirteen thousand gallons of condensation from the air-handler system will be collected during the summer months.





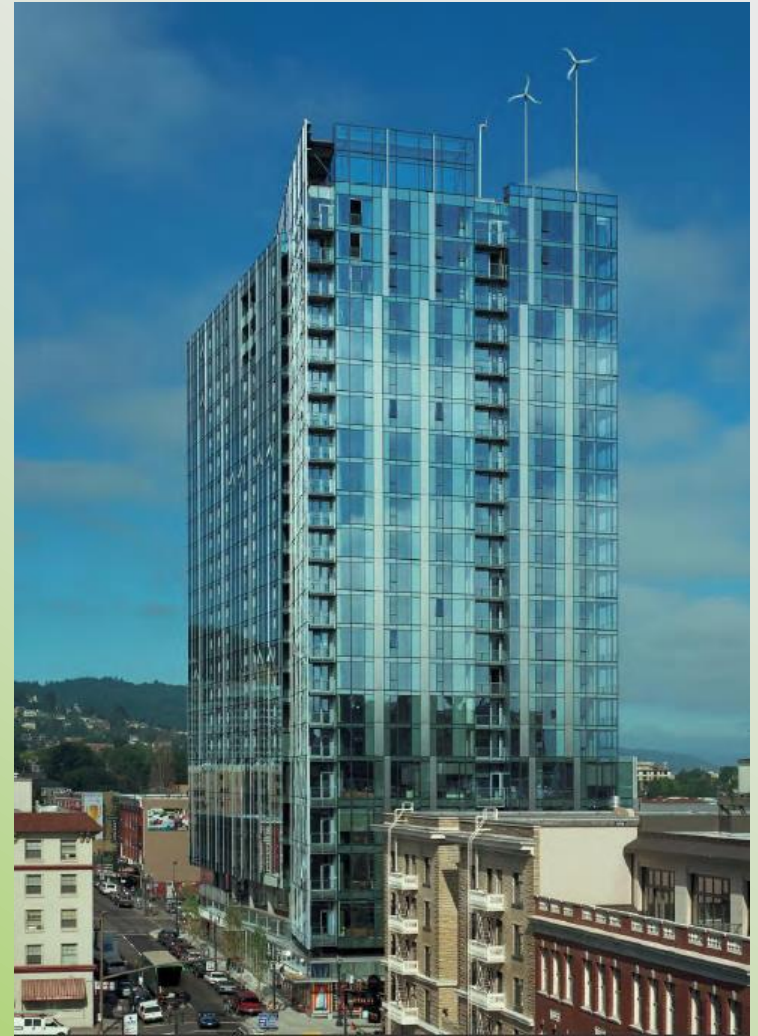
Wind Turbines







Twelve | West



Sustainable Sites

SS P1 to SS 8

- **SS P1 - Construction Activity Pollution Prevention (prerequisite)**
- **SS 1 - Site Selection**
- **SS 2 - Development Density & Community Connectivity**
- **SS 3 - Brownfield Redevelopment**
- **SS 4.1 - Alternative Transportation - Public Transportation Access**
- **SS 4.2 - Alternative Transportation -Bicycle Storage & Changing Rooms**
- **SS 4.3 - Alternative Transportation - Low Emission & Fuel Efficient Vehicles**
- **SS 4.4 - Alternative Transportation - Parking Capacity**
- **SS 5.1 - Site Development - Protect or Restore Habitat**
- **SS 5.2 - Site Development - Maximize Open Space**
- **SS 6.1 - Stormwater Design - Quantity Control**
- **SS 6.2 - Stormwater Design - Quality Control**
- **SS 7.1 - Heat Island Effect - Non-Roof**
- **SS 7.2 - Heat Island Effect - Roof**
- **SS 8 - Light Pollution Reduction**

Water Efficiency

WE P1 to WE 3

DUAL FLUSH TOILET
Flush up for liquids
Flush down for solids

- WE P1 – Water Use Reduction – 20% Reduction
- WE 1 - Water Efficient Landscaping
- WE 2 - Innovative Wastewater Technologies
- WE 3 - Water Use Reduction



Energy & Atmosphere

EA P1 to EA 6

- EA P1 - Fundamental Commissioning of the Building Energy Systems (prerequisite)
- EA P2 - Minimum Energy Performance (prerequisite)
- EA P3 - Fundamental Refrigerant Management (prerequisite)
- EA 1 - Optimize Energy Performance
- EA 2 - On-Site Renewable Energy
- EA 3 - Enhanced Commissioning
- EA 4 - Enhanced Refrigerant Management
- EA 5 - Measurement & Verification
- EA 6 - Green Power

Material & Resources

MR P1 to MR 7

- **MR P1 - Storage and Collection of Recyclables (prerequisite)**
- **MR 1.1 - Building Reuse, Maintain Existing Walls, Floors, & Roof**
- **MR 1.2 - Building Reuse, Maintain 50% of Interior Non-Structural Elements**
- **MR 2 - Construction Waste Management**
- **MR 3 - Materials Reuse**
- **MR 4 - Recycled Content**
- **MR 5 - Regional Materials**
- **MR 6 - Rapidly Renewable Materials**
- **MR 7 - Certified Wood**

Indoor Environmental Quality

IEQ P1 to IEQ 8.2

- IEQ P1 - Minimum IAQ Performance (prerequisite)
- IEQ P2 - Environmental Tobacco Smoke (ETS) Control (prerequisite)
- IEQ 1 - Outdoor Air Delivery Monitoring
- IEQ 2 - Increased Ventilation
- IEQ 3.1 - Construction IAQ Management Plan, During Construction
- IEQ 3.2 - Construction IAQ Management Plan, Before Occupancy
- IEQ 4.1 - Low-Emitting Materials, Adhesives & Sealants
- IEQ 4.2 - Low-Emitting Materials, Paint & Coatings
- IEQ 4.3 - Low-Emitting Materials, Flooring Systems
- IEQ 4.4 - Low-Emitting Materials, Composite Wood & Agrifiber Products

Indoor Environmental Quality

IEQ P1 to IEQ 8.2

Cont...

- IEQ 5 - Indoor Chemical & Pollutant Source Control
- IEQ 6.1 - Controllability of Systems, Lighting
- IEQ 6.2 - Controllability of Systems, Thermal Comfort
- IEQ 7.1 - Thermal Comfort, Design
- IEQ 7.2 - Thermal Comfort, Verification
- IEQ 8.1 - Daylight & Views, Daylight
- IEQ 8.2 - Daylight & Views, Views

Wind energy credits offset the Zody assembly CO₂ emissions—avoiding emissions of over 1.4 million pounds in the next two years, which is equivalent to planting 194 acres of mature trees, shaving 1.5 million miles off the average car or taking 124 cars off the road permanently.

Innovation & Design Process

ID 1.1 to ID 2

- **ID 1.1 - 1.4 - Innovation in Design**
- **ID 2 - LEED Accredited Professional**



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Regional Priority Credits

RP 1.1 to RP 1.4

- **RP 1.1 to RP 1.4 – Regional Priority**

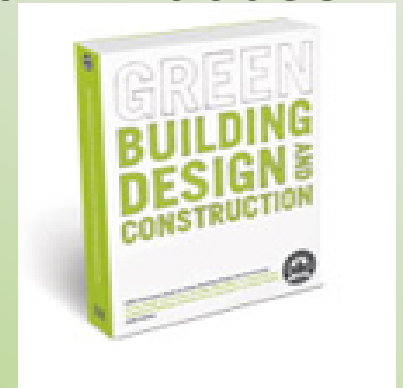


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Study Material for LEED Exams

- GBCI Candidate Handbook
- USGBC Study Guides
- USGBC Reference Books
- Online Project Registration & Certification Process



Other Rating Systems



CEEQUAL – Civil Engineering Environmental Quality Assessment and Award Scheme



- CEEQUAL is a UK based assessment and awards scheme for improving sustainability in civil engineering and public realm projects. It is promoted by the ICE and a group of committed industry organizations.
- The objective is to encourage attainment of environmental excellence in civil engineering and thus deliver improved environmental and social performance in projects.
- CEEQUAL scoring includes environmental and social aspects - use of water, energy and land, impacts on ecology, landscape, neighbors, archaeology, waste minimization and management, and community relations.

CEEQUAL Assessment System



- The CEEQUAL assessment has been designed to reward efforts that go beyond the legal minimums, striving for best environmental practice.
- The CEEQUAL Assessment has 12 sections or categories, as follows:
 1. Project Management
 2. Land Use
 3. Landscape
 4. Ecology & Biodiversity
 5. The Historic Environment
 6. Water Resources and the Water Environment
 7. Energy and Carbon
 8. Material Use
 9. Waste Management
 10. Transport
 11. Effects on Neighbors
 12. Relations with the Local Community and other Stakeholders

More Rating Systems



- STARS
- Greenroads
- BREEAM
- CASBEE
- GB Tool
- Green Globes
- RMI
- INVEST
- I-LAST
- BE2ST –in-Highways
- One Planet Living
- Green Light New York
- Other