DAYLIGHT – A MANDATORY REQUIREMENT OF GREEN BUILDING

Mario Seneviratne ***FIMechE, PEng.,***
LEED Faculty Member
Managing Director - Green Technologies FZCO

Summit on Climate Change

Power Green Growth, Protect the Planet

22 SEPTEMBER 2009, UNITED NATIONS HEADQUARTERS, NEW YORK

UN Climate Change Conference 2009
COPENHAGEN
SEAL THE DEAL!
Power Green Growth, Protect the Planet

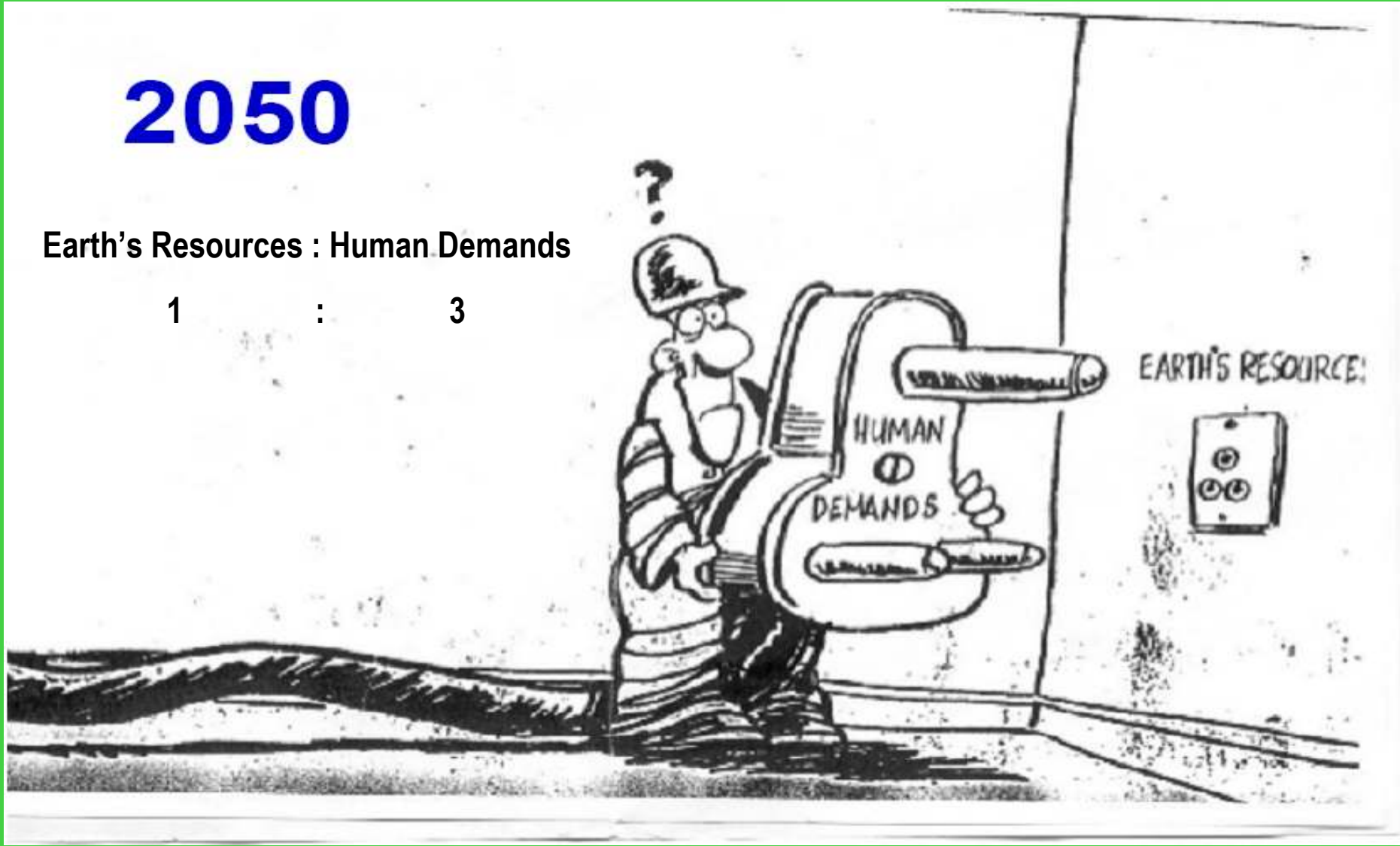
"The objective of the Summit on Climate Change, which I am convening on 22 September, is to mobilize the political will and vision needed to reach an ambitious agreed outcome based on science at the UN climate talks in Copenhagen."

UN Secretary-General Ban Ki-moon

- The Summit marked the first UN visit for the Presidents of **China and the United States (the largest GHG Emitters in the world)** as well as the newly elected Prime Minister of Japan.

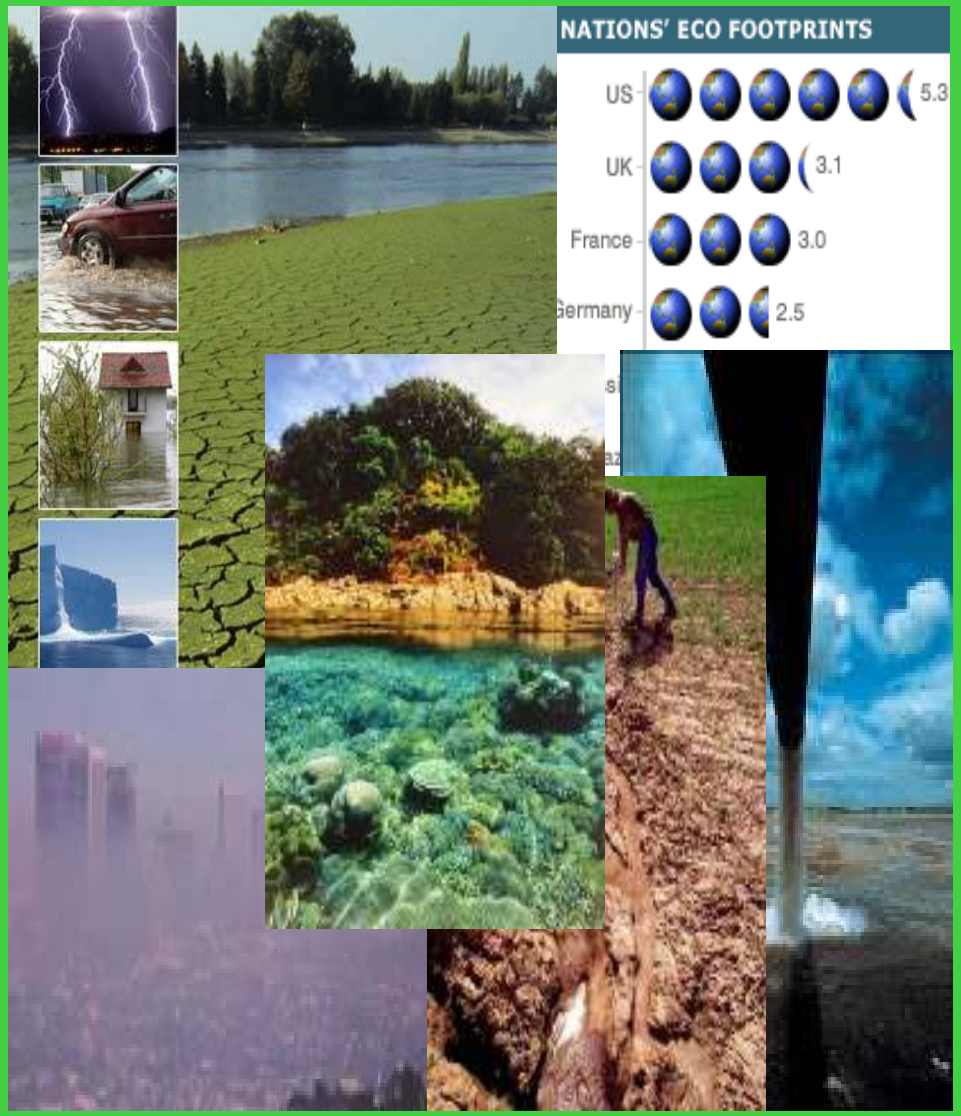
- **China's commitment of 2009;**
  - "Endeavour" to cut emissions of CO_2 by "a notable margin".
  - "Vigorously develop renewable energy and nuclear energy" to increase the share of non fossil fuels in total energy consumption to **15% by 2020**.
  - To increase forest cover by **40 million hectares** (> 150,000 sq. miles) **by 2020**.
  - Call to the USA to contribute more to the Climate Change solution.

HUMAN DEMAND VS EARTH'S RESOURCES



KEY ENVIRONMENTAL CHALLENGES

- Anomalous Climate Change
- Natural Resource Depletion
- Atmospheric Pollution and Acid Rain
- Contamination of Freshwater Resources
- Soil Erosion and Degradation
- Loss of Biodiversity

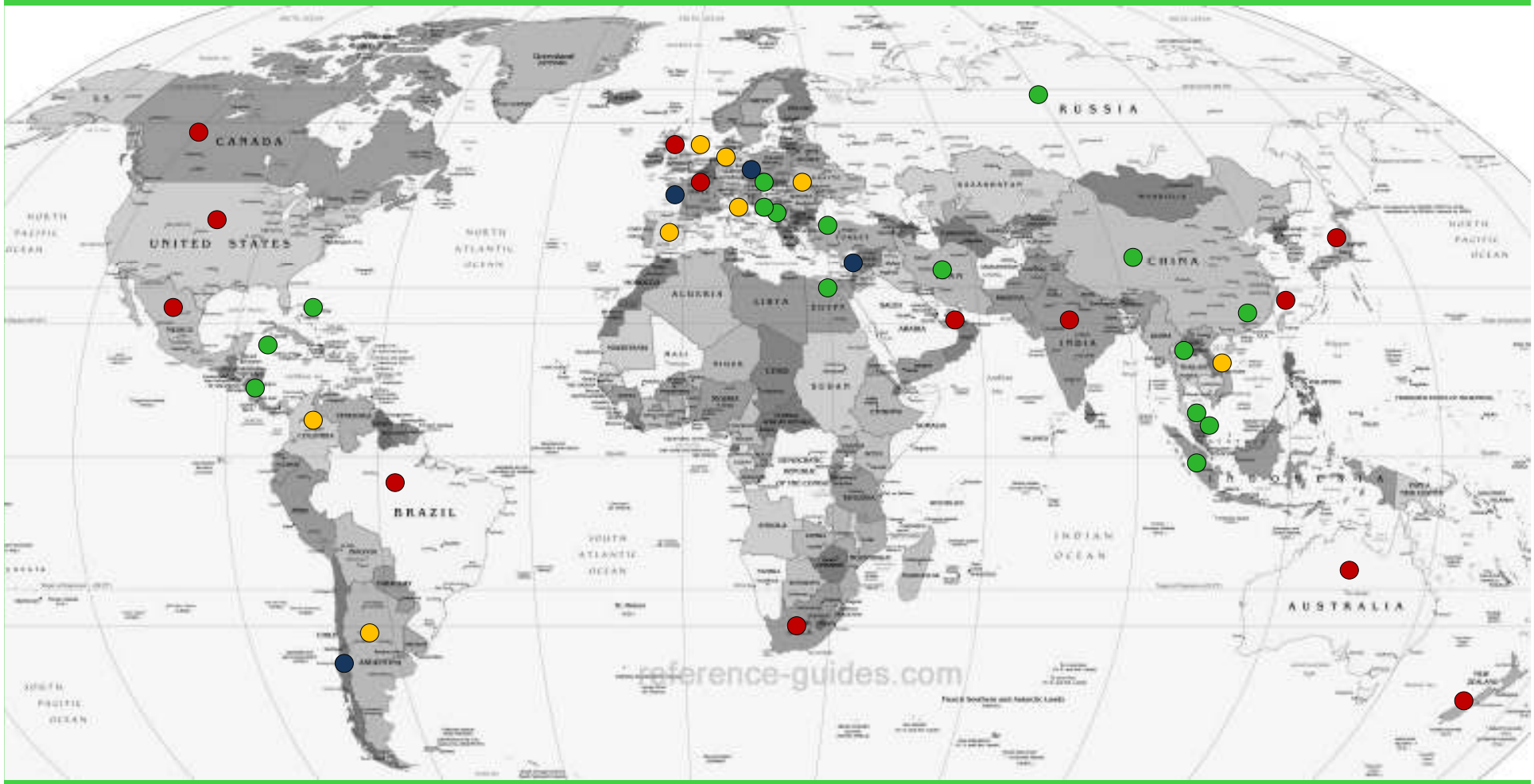


GREEN BUILDING
AN IMPORTANT PART OF THE
SOLUTION

WORLD GREEN BUILDING COUNCIL

Transforming the Built Environment

WORLDGBC MEMBERSHIP



- Full Members - 13
- Full Members by End 2009 - 8
- Emerging Members - 4
- Countries with Expressed Interest – 16

WORLDWIDE, BUILDINGS ACCOUNT FOR:

20%

~~17%~~

of fresh water consumption

25 %

of wood harvest

40%

~~33%~~

of CO_2 emissions

40%

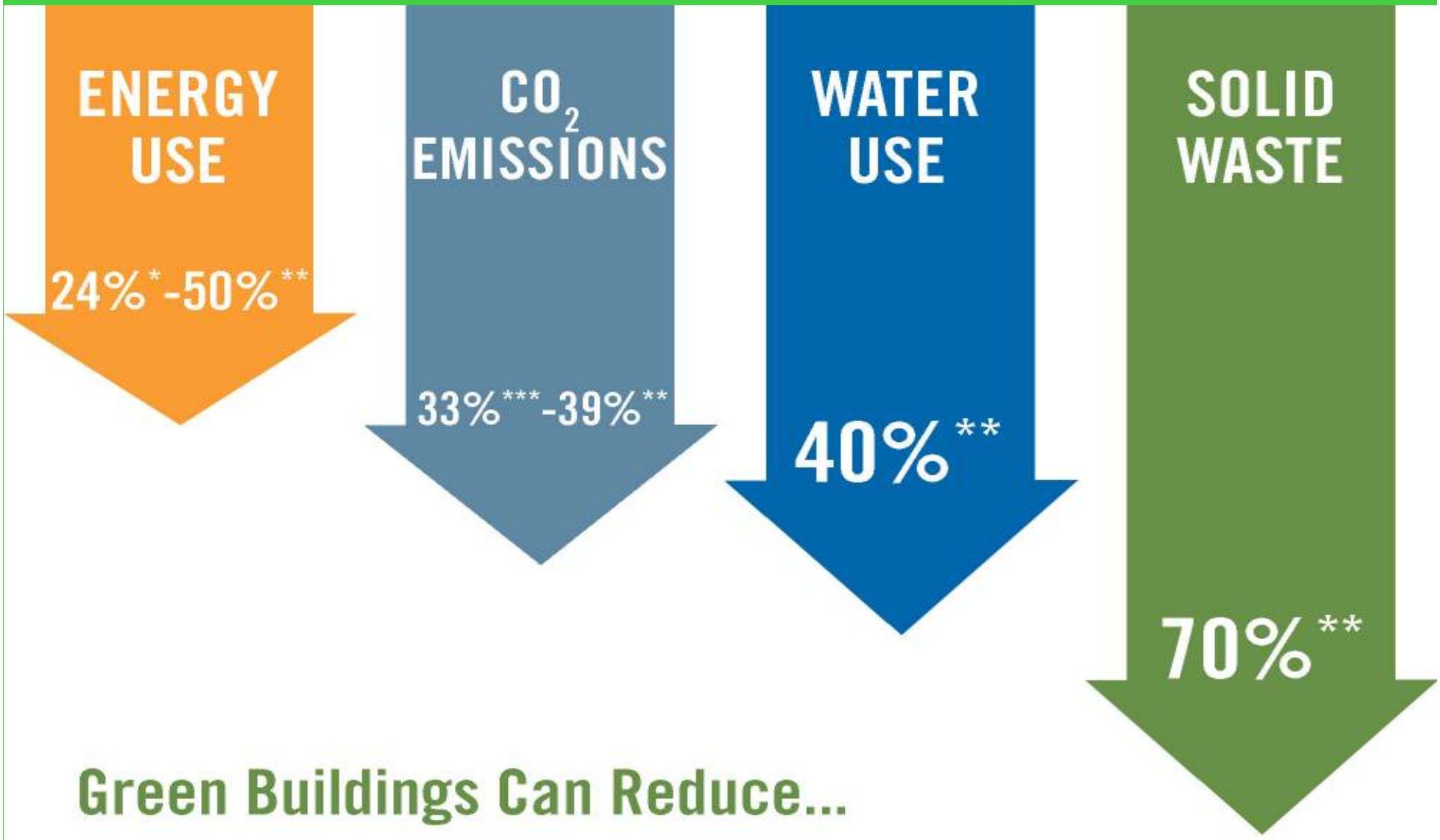
~~30-40%~~

of energy use

30%

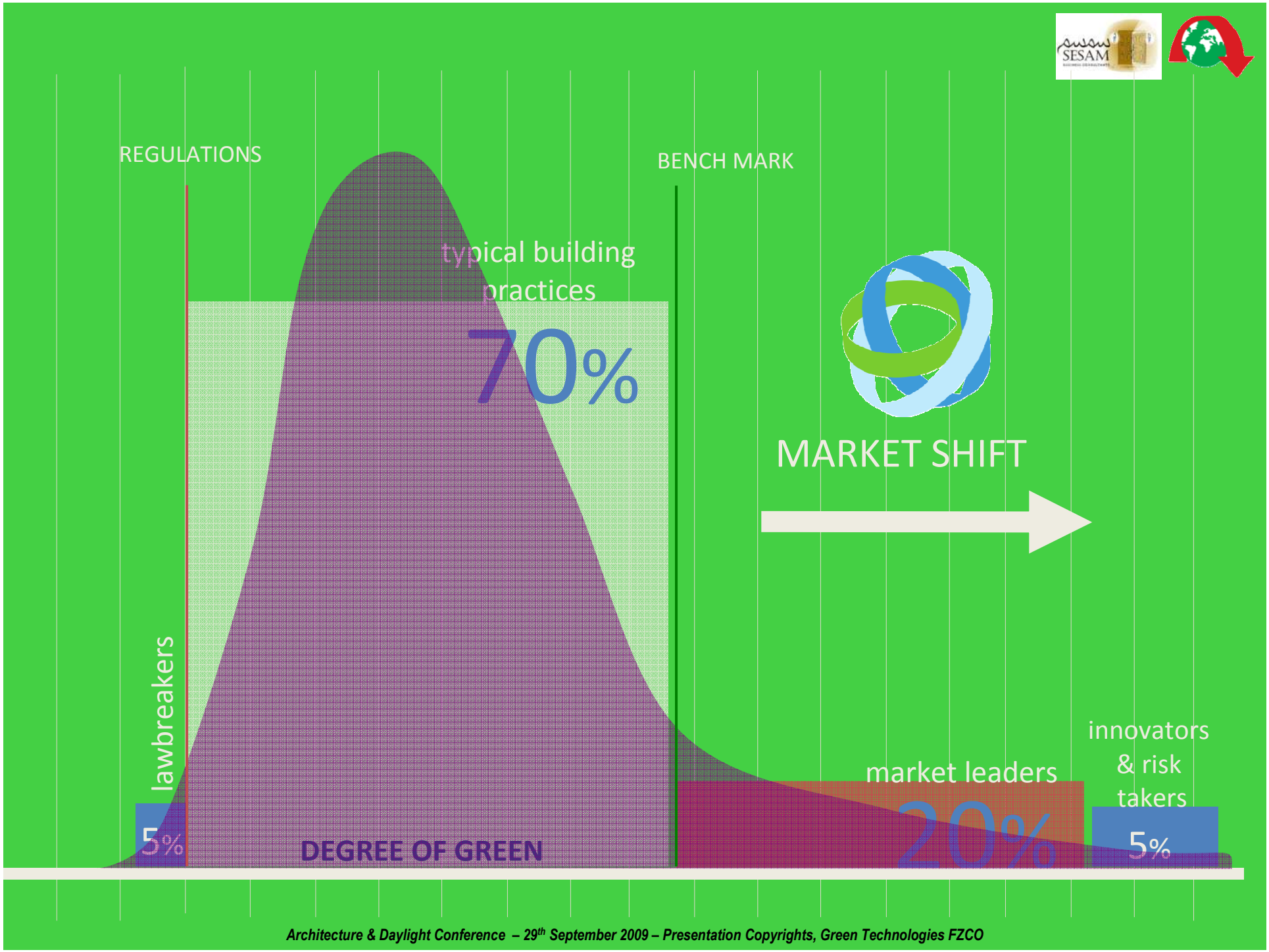
~~40-50%~~

of raw materials used



Green Buildings Can Reduce...

* Turner, C. & Frankel, M. (2008). Energy performance of LEED for New Construction buildings: Final report.
** Kats, G. (2003). The Costs and Financial Benefits of Green Building: A Report to California's Sustainable Building Task Force.
*** GSA Public Buildings Service (2008). Assessing green building performance: A post occupancy evaluation of 12 GSA buildings.


REGULATIONS
BENCH MARK
typical building practices
70%
MARKET SHIFT
lawbreakers
5%
DEGREE OF GREEN
market leaders
20%
innovators & risk takers
5%

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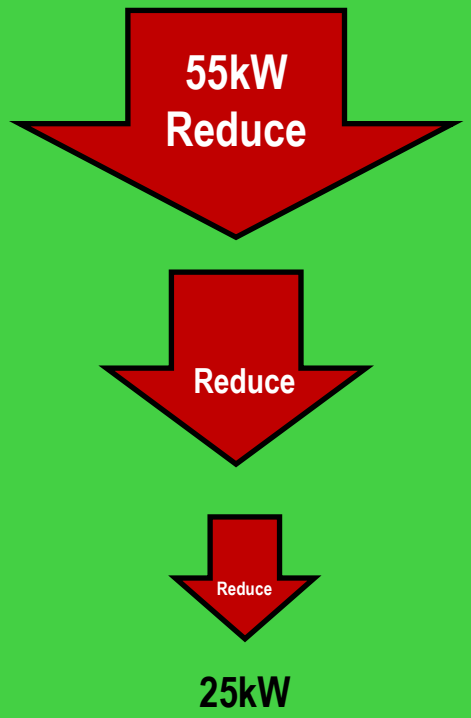
NETT ZERO ENERGY BUILDING

Energy Consumption - **Energy Recovery** - **100% Renewable Energy Supply** = **0**

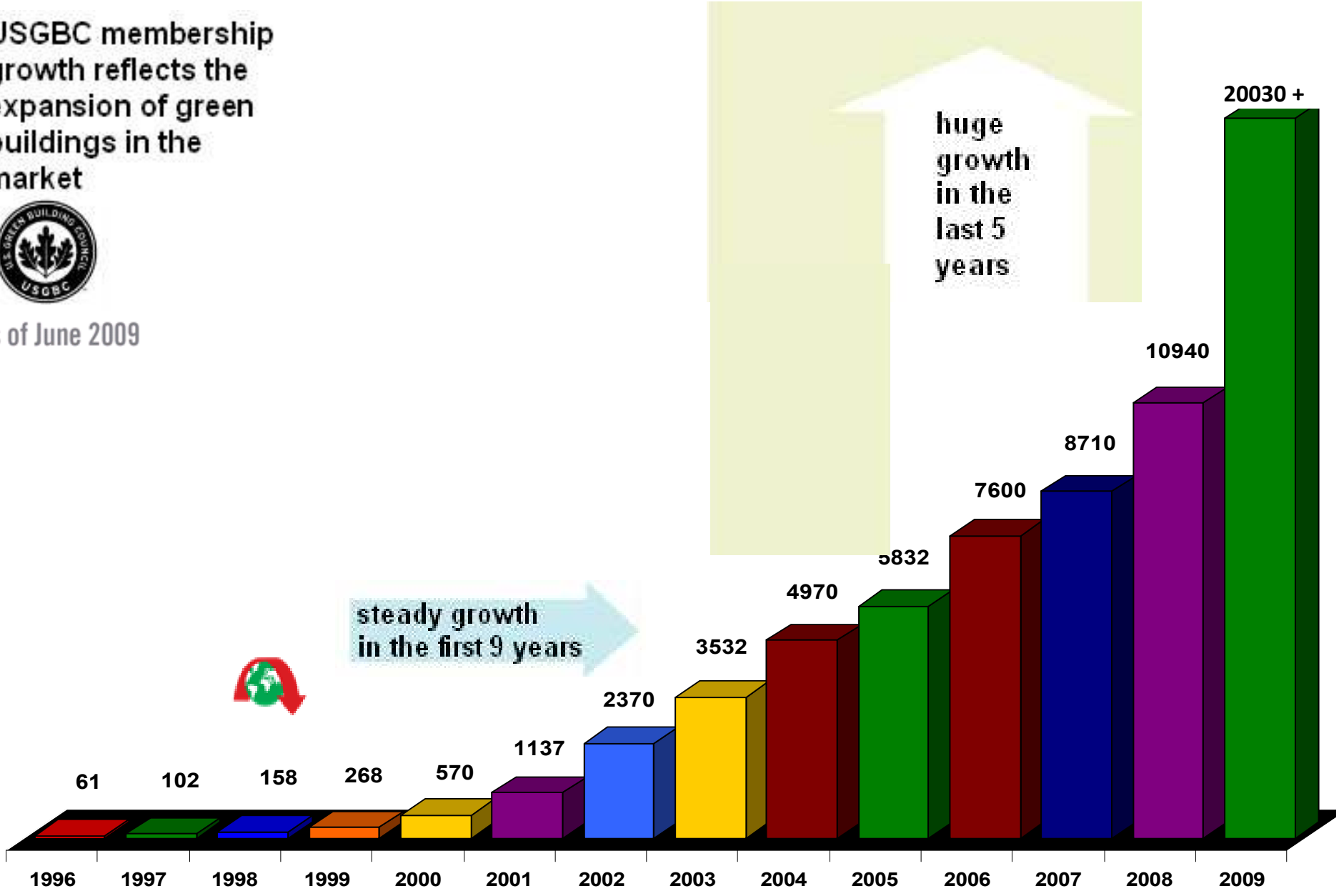


Green Strategies For Dummies

1. Improved Façade
2. Solar Hot Water Heating
3. Lower Lighting Power
4. Code Compliant HVAC System
5. Grey Water Treatment
6. Low Flow Water Fixture

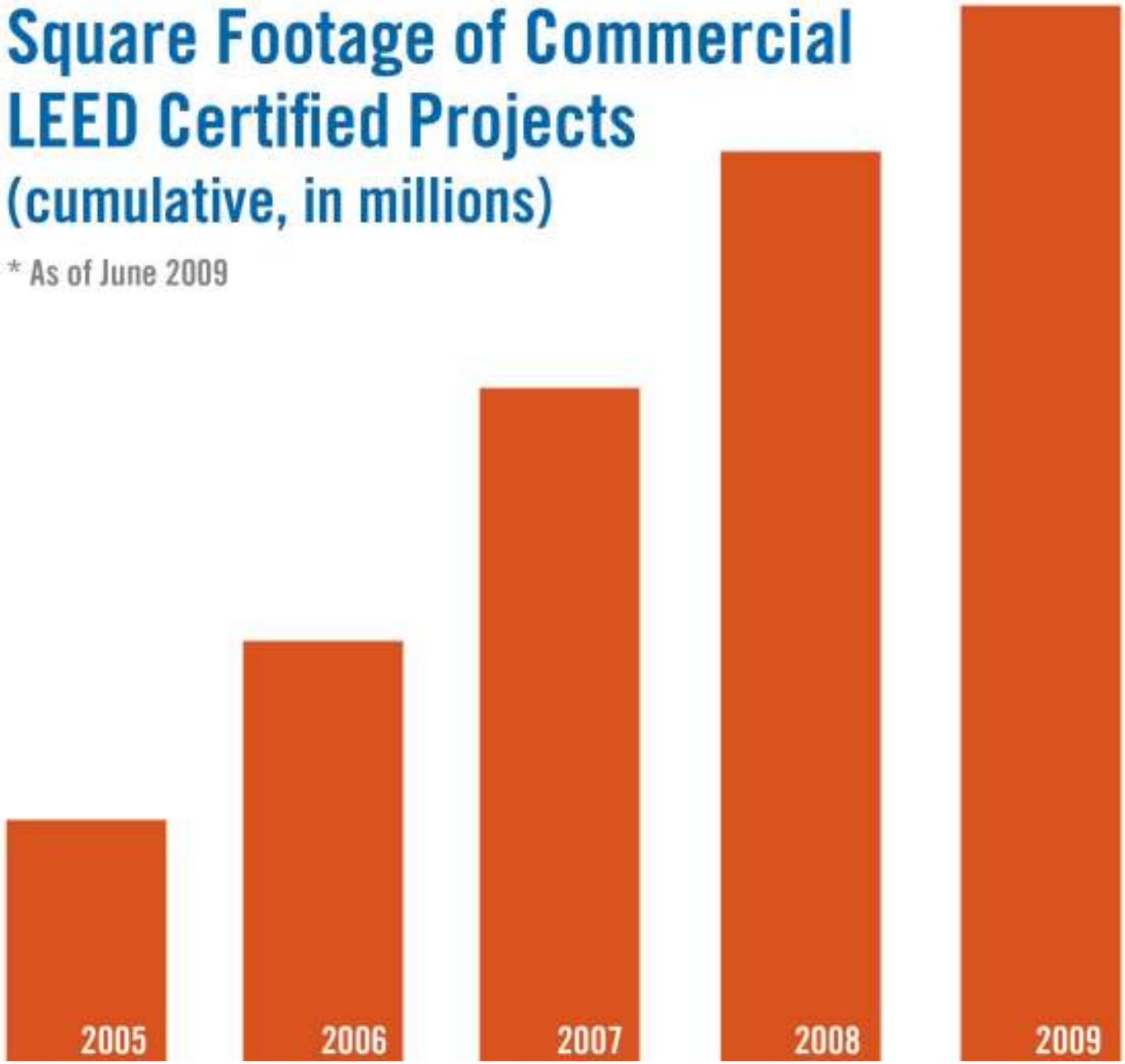
USGBC membership growth reflects the expansion of green buildings in the market

As of June 2009



Square Footage of Commercial LEED Certified Projects
(cumulative, in millions)

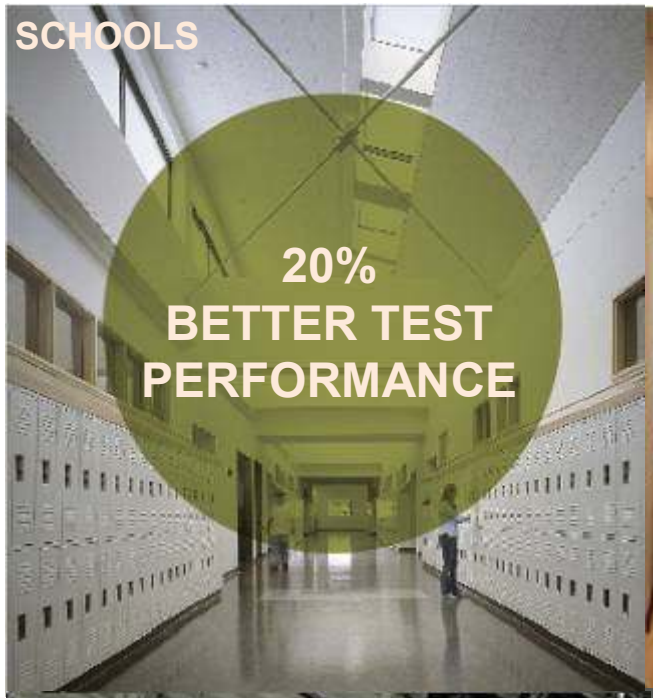
* As of June 2009

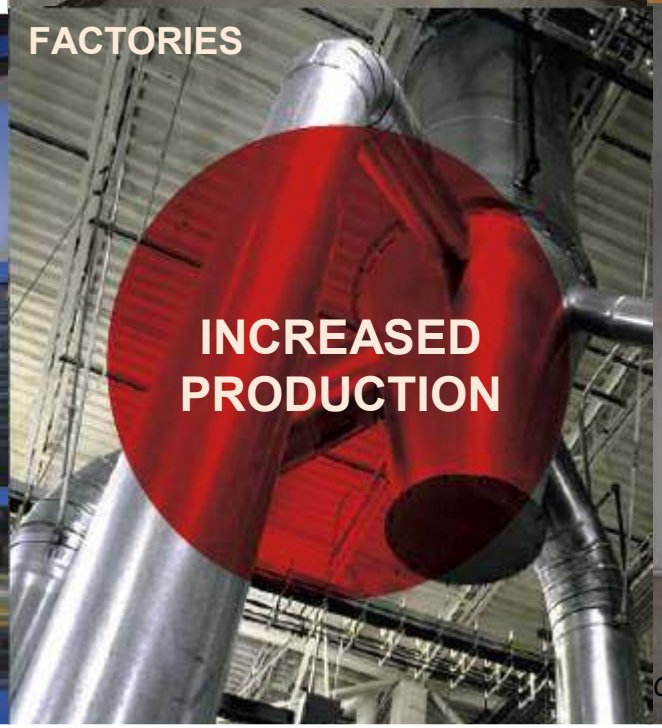


385* million

© U.S. Green Building Council, 2009

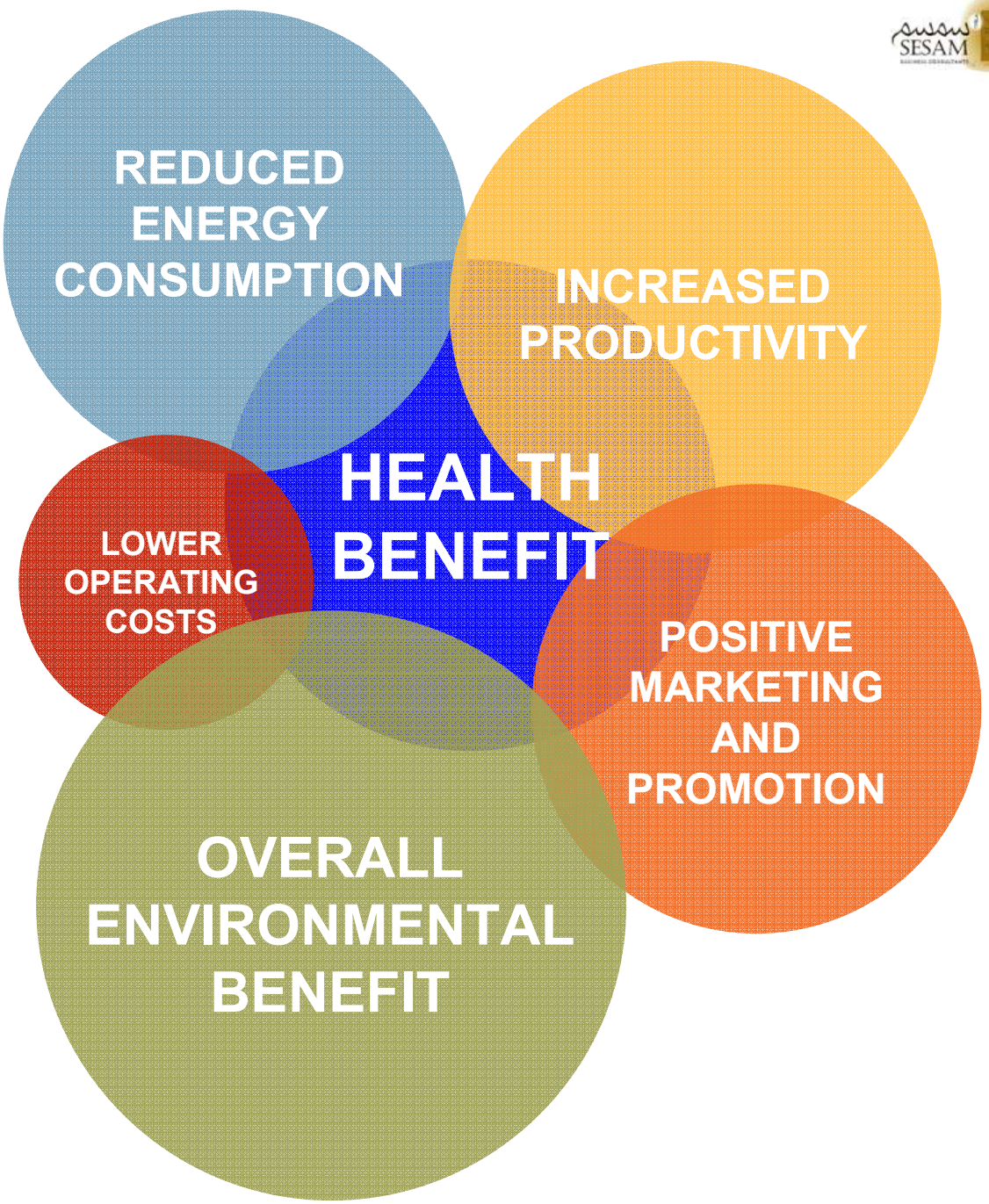
Increased Productivity through Daylighting





CO – www.greentechno.com

Occupants and tenants perceive value of working in a green building to be:



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SOLUTION

Sesam - Green Technologies Green Buildings Program

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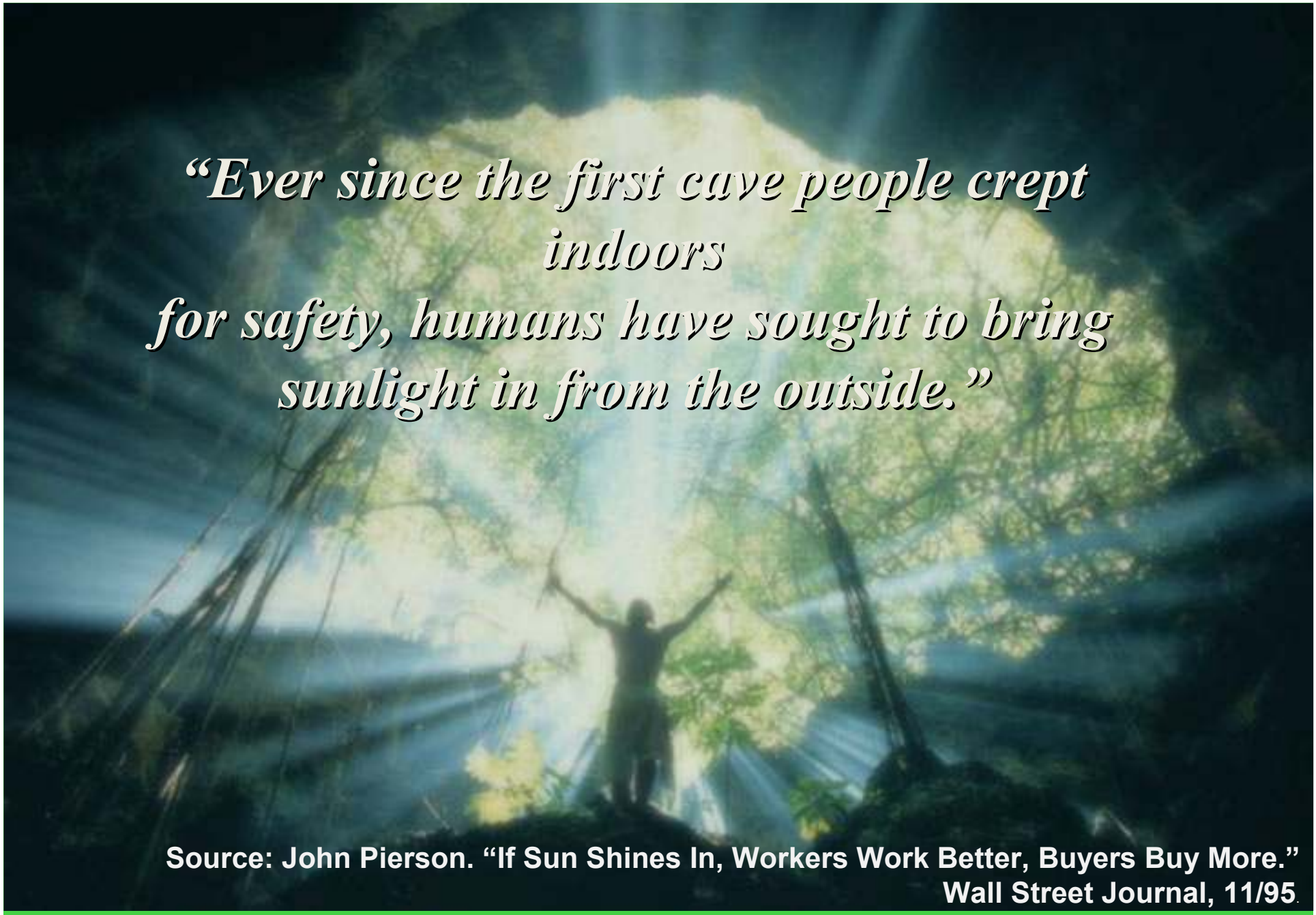
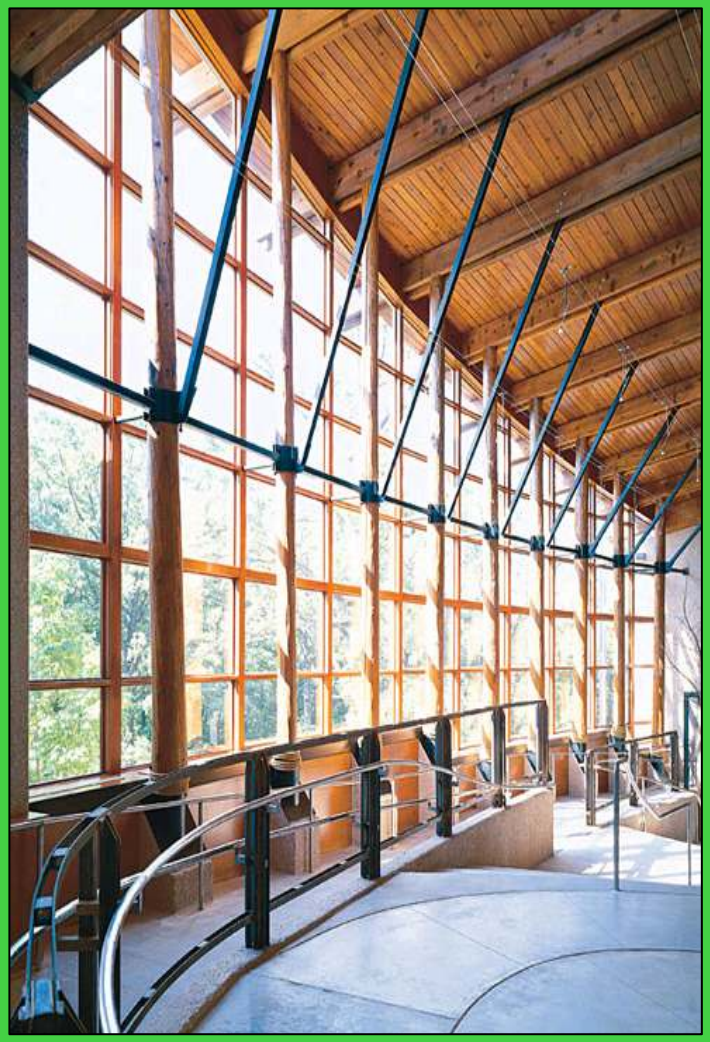


Source: John Pierson. "If Sun Shines In, Workers Work Better, Buyers Buy More." Wall Street Journal, 11/95.

DAYLIGHTING



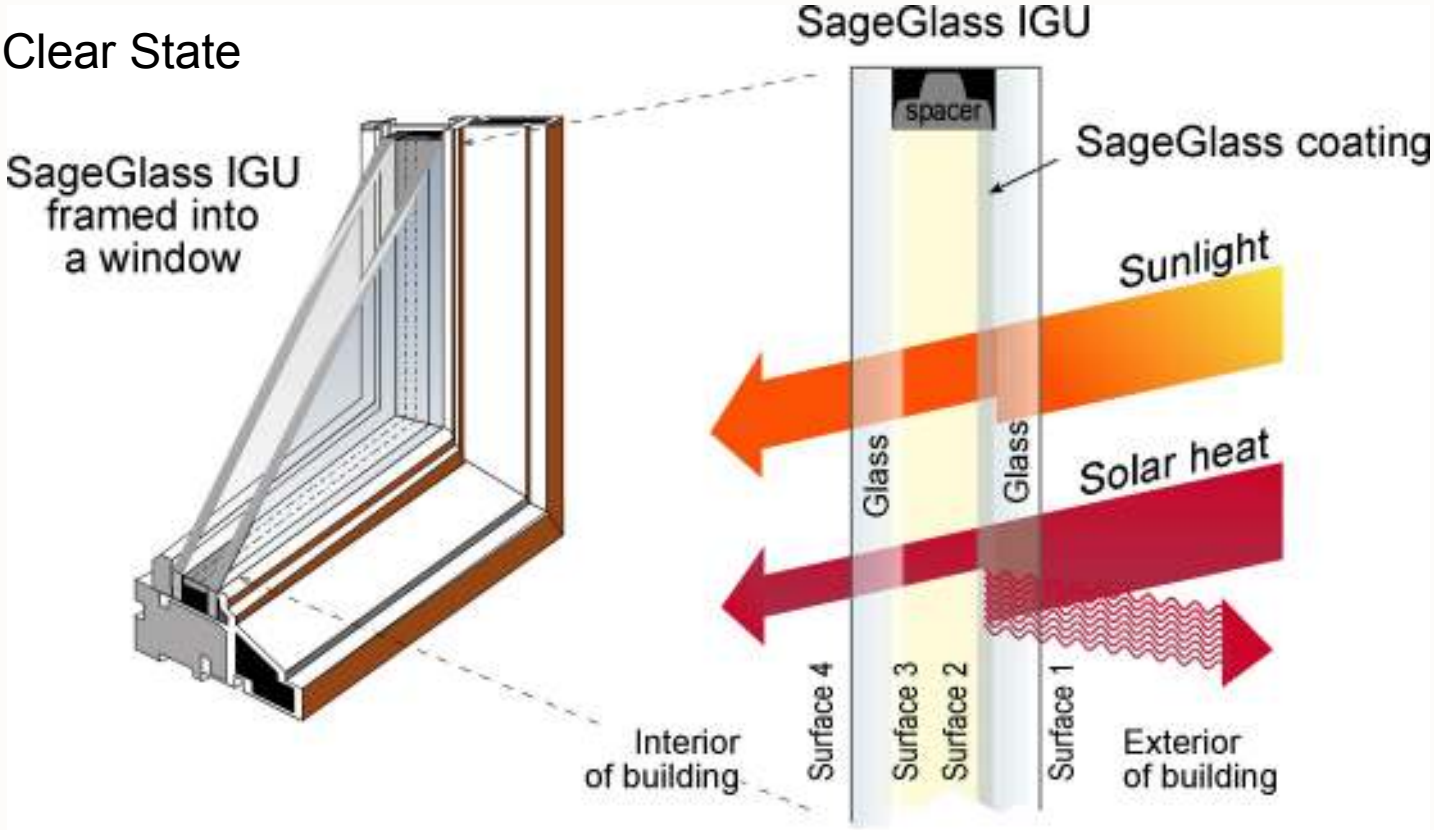
Daylighting:

Is the controlled admission of natural light into a space to reduce or eliminate electric lighting

With or Without Solar Gain

Light and Heating Effect of Sun Light

Clear State



BENEFITS OF DAYLIGHTING

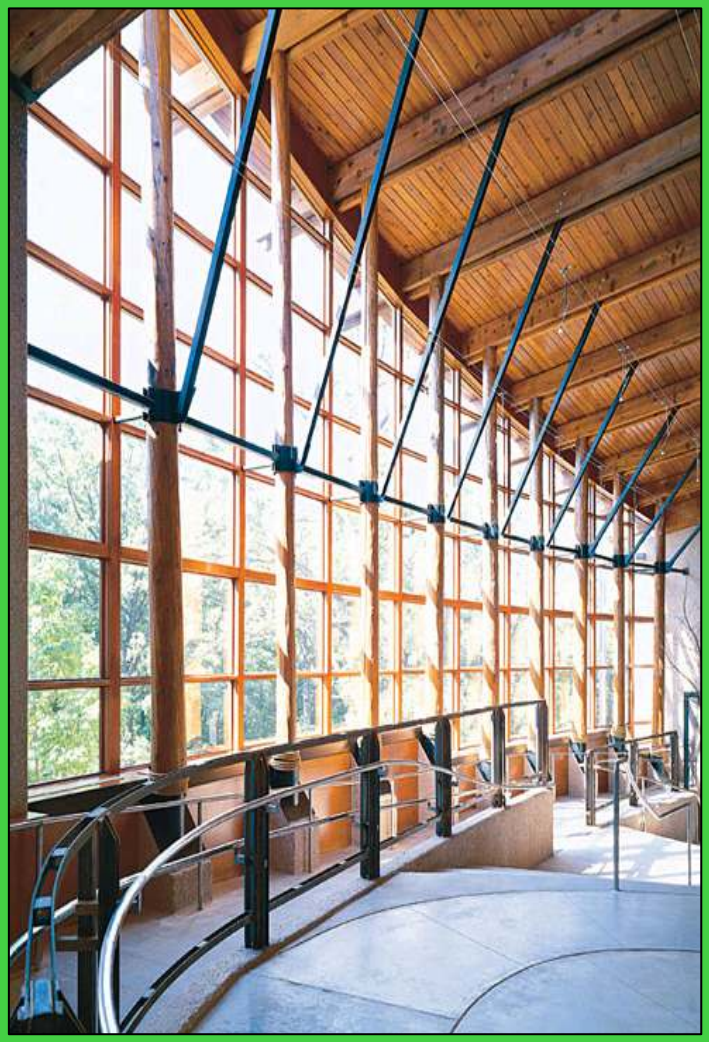
- Daylighting reduces the need for electric lighting of building resulting in decreased energy use.

- Reduces lighting energy use by 50% to 80%.

- Daylighting design involves a careful balance of heat gain and loss, glare control, visual quality, and variations in daylight availability.

- Indoor environments with sufficient natural daylight and a visual connection to outdoor environments have been proven to increase occupant productivity and comfort, leading to better employee retention.

SUCCESFUL DAYLIGHTING DESIGN



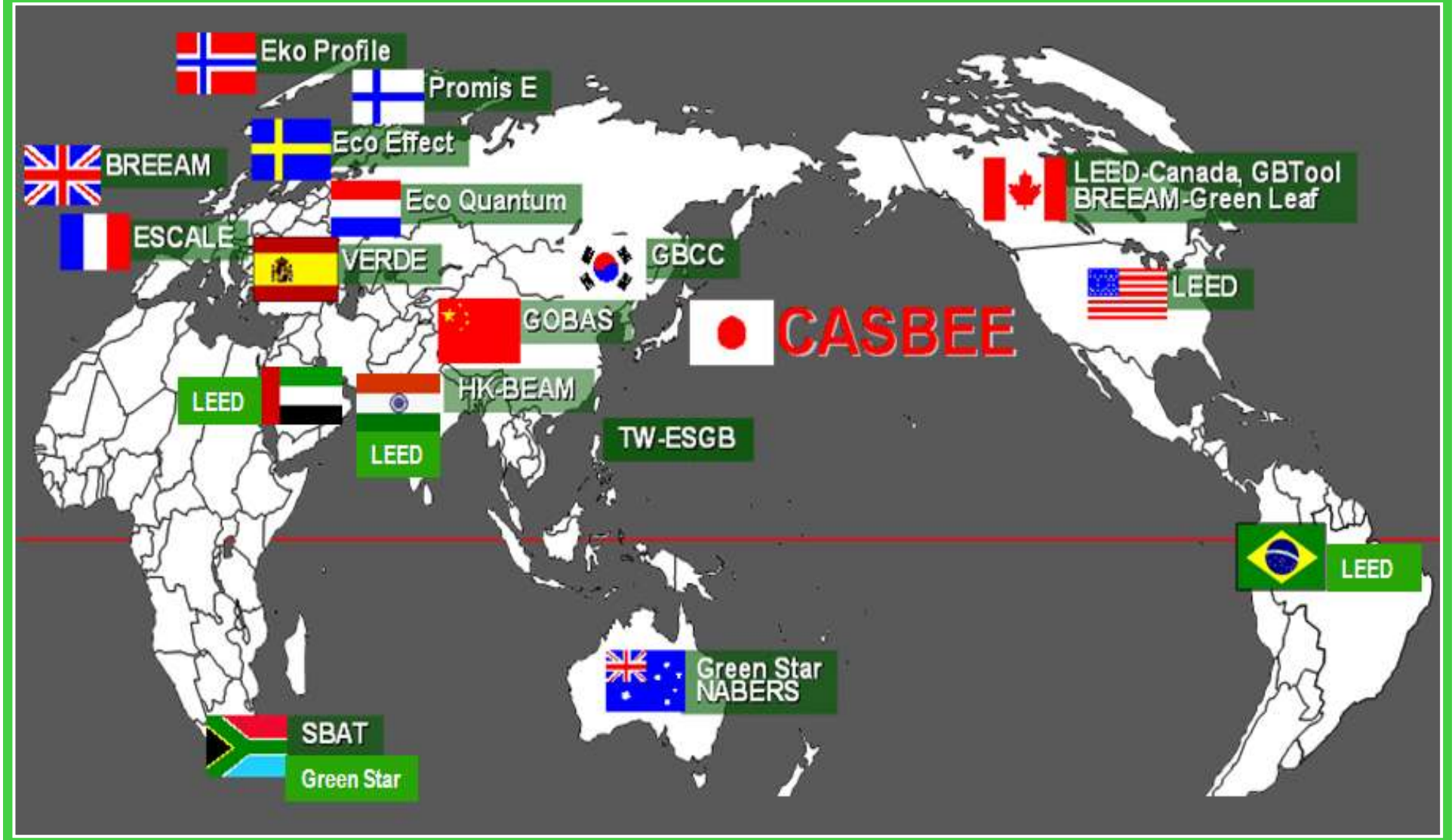
- Use of diffused light from the sky
- Integration with electric lighting system
- Daylight as primary source of illumination
- Quality visual environment
- Glare Control
- Energy savings

CITY OF GLASS - VANCOUVER

DAYLIGHTING TO SAVE ENERGY

- **kW (peak demand)**
- **kWh**
- **Therms**
- **Set performance goals** :
  - Lighting Power Density
  - EUI

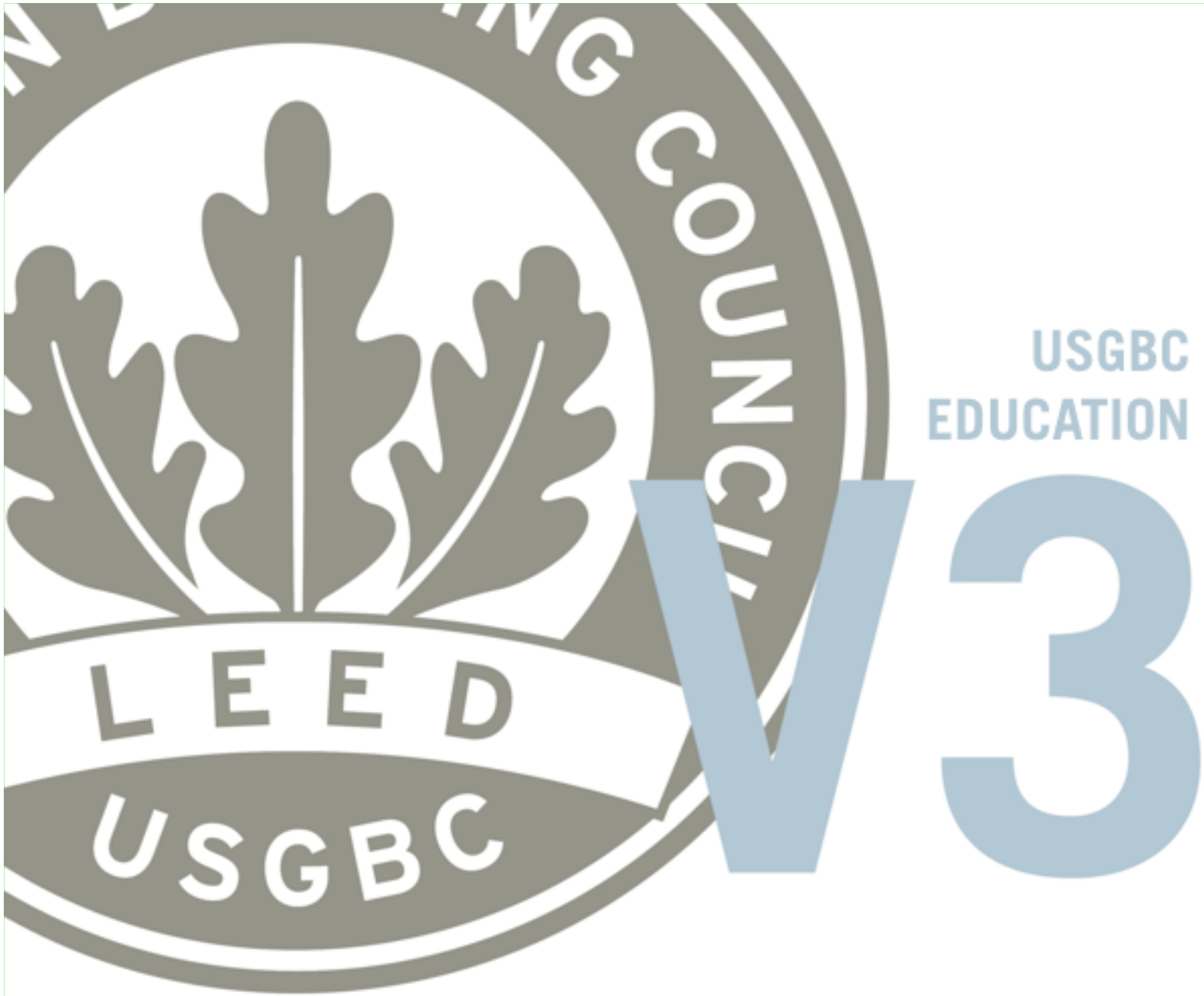
INTERNATIONAL RATING SYSTEMS



LEED™

LEADERSHIP IN ENERGY & ENVIRONMENTAL DESIGN

Leadership Energy Environmental Design


LEED
USGBC
USGBC
EDUCATION
V3

GREEN BUILDING DESIGN & CONSTRUCTION RATING SYSTEM

CATEGORY	AVAILABLE POINTS			ENVIRONMENTAL WEIGHTING
	NC	CS	Schools NC	
Sustainable Sites	26	28	24	~24%
Water Efficiency	10	10	11	~9%
Energy & Atmosphere	35	37	33	~32%
Materials & Resources	14	13	13	~12%
Indoor Environmental Quality	13	10	15	~12%
Daylight & Views	2	2	4	~2%
Innovation in Design	6	6	6	~5%
Regional Priority	4	4	4	~4%
Total	110	110	110	

EQ Credit 8.1: Daylight & Views Daylight

- **Intent**

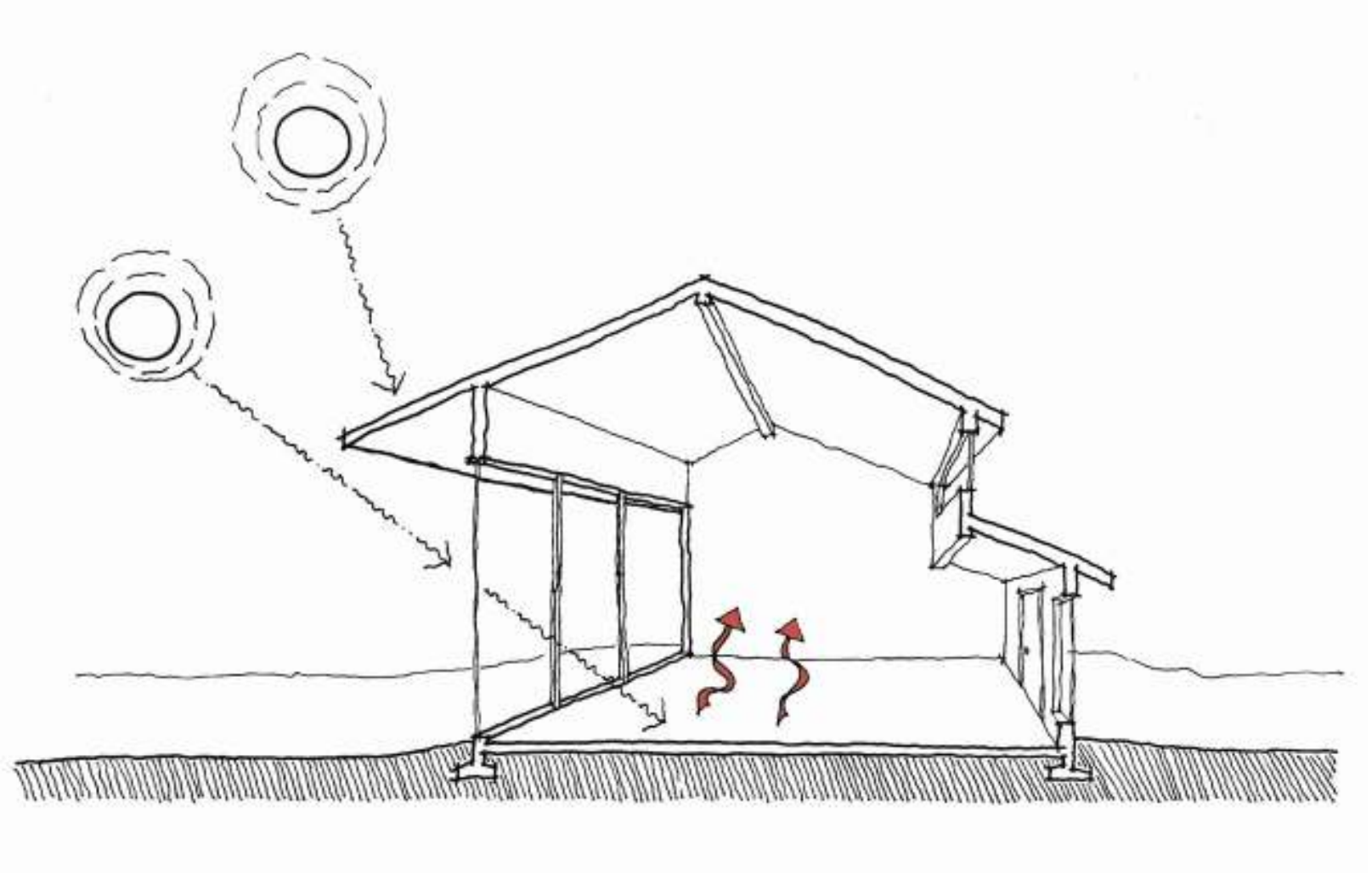
- To provide building occupants with a connection between indoor spaces and the outdoors through the introduction of daylight and views into the regularly occupied areas of the building.

- **Requirements**

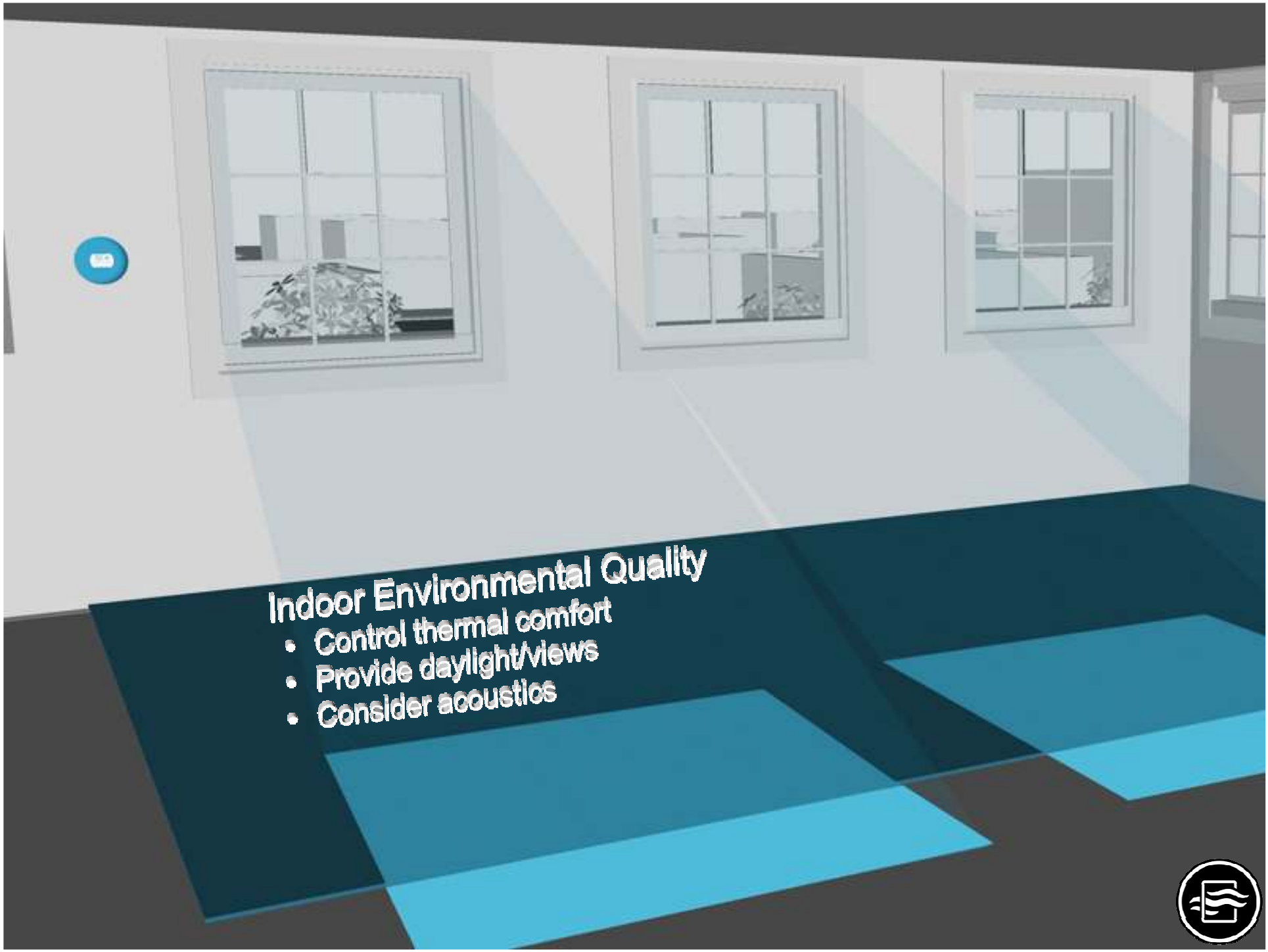
Through 1 of the 4 options, achieve daylighting in at least the following spaces:

Regularly Occupied Spaces	Points
75%	1

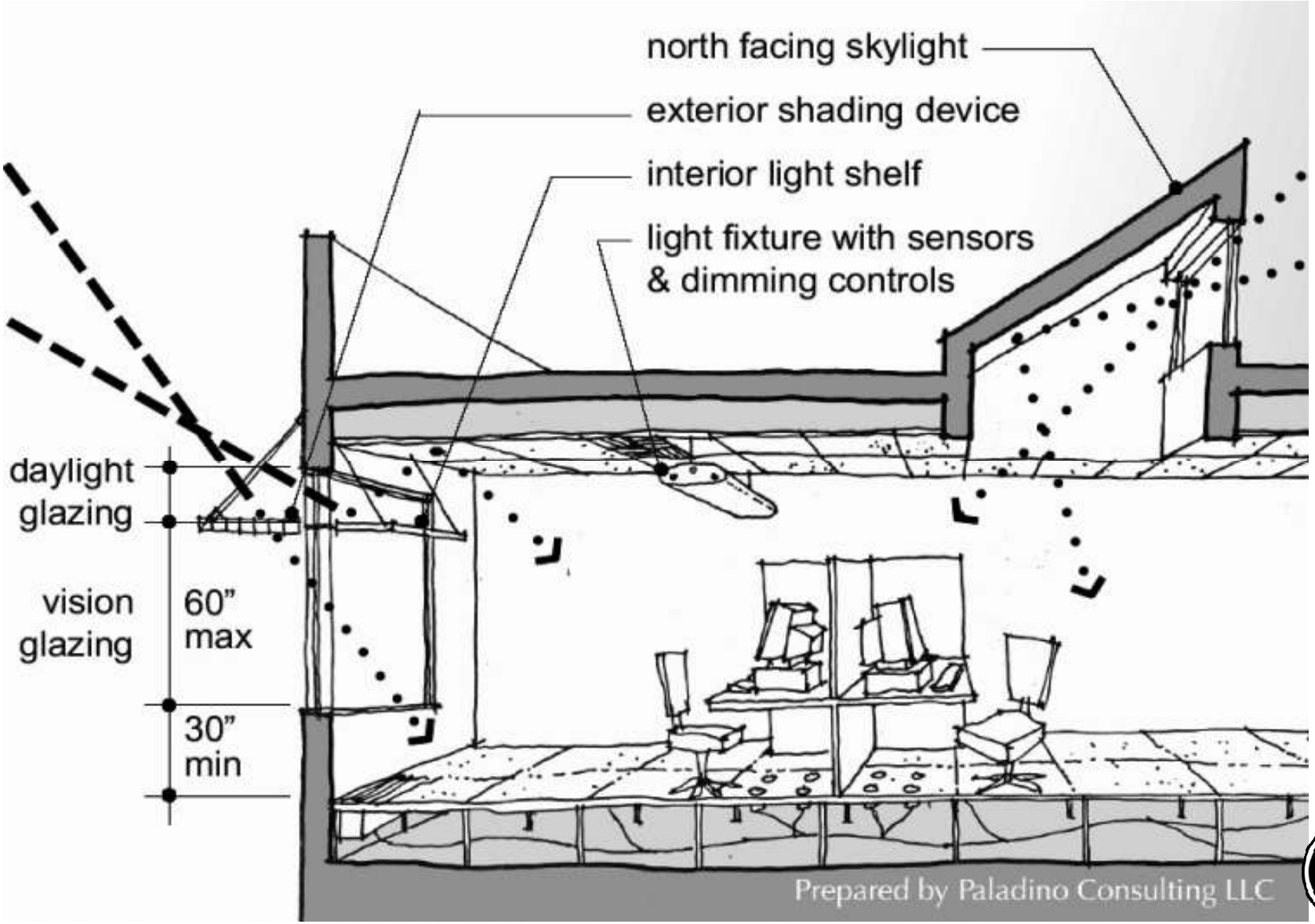
Example: Building Orientation



© 2007 The Green Studio Handbook: Environmental Strategies for Schematic Design, Alison G. Kwok, Walter T. Grondzik; used with permission.


Indoor Environmental Quality
• Control thermal comfort
• Provide daylight/views
• Consider acoustics

Strategies: Provide Daylight/Views



Glare and Solar Control

Glare:

- is any excessively bright source of light within the visual field that creates discomfort or loss in visibility.

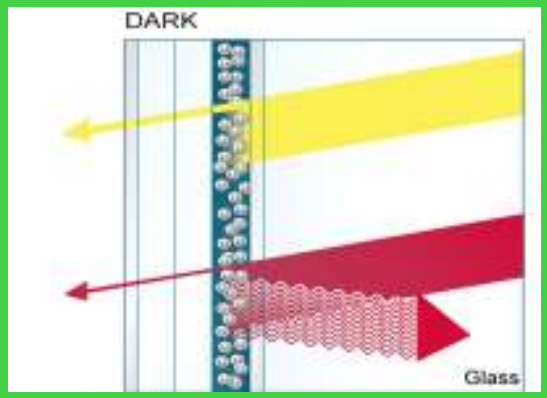
To control glare, use any of the following common strategies:

- Fixed exterior shading devices
  - Exterior light shelves
  - Interior light shelves
  - Interior blinds and louvers
  - Operable draperies and blinds
  - Fritted glazing
  - Electronic blackout glazing

Glare Control and Solar Control

External Shutters

Interior Shades



Electrochromatic Glass

EQ Credit 8.2: Daylight & Views Views

- **Intent**

- To provide building occupants with a connection between indoor spaces and the outdoors through the introduction of daylight and views into the regularly occupied areas of the building.

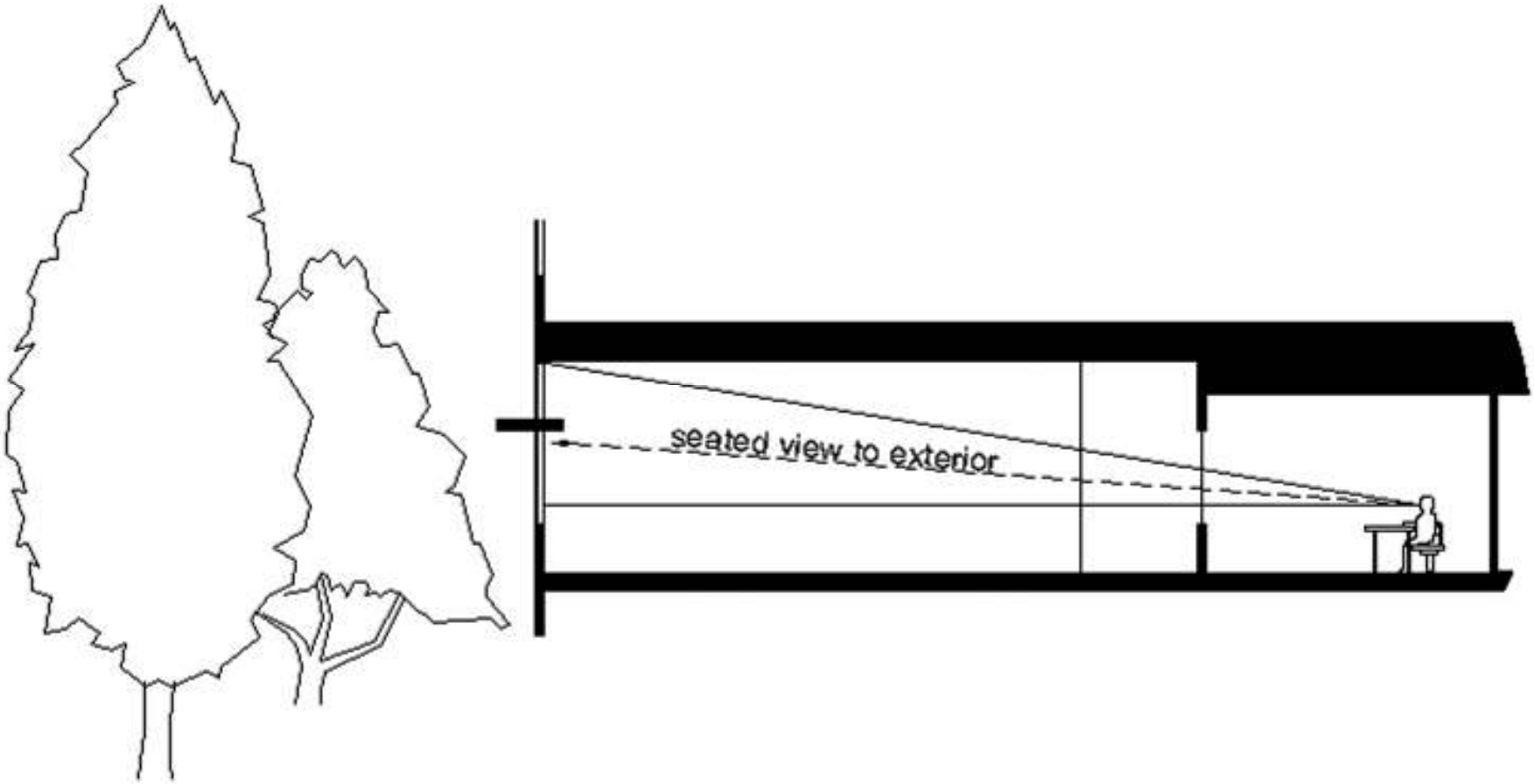
- **Requirements**

- Achieve a direct line of sight to the outdoor environment via vision glazing between 30 inches and 90 inches above the finish floor for building occupants in 90% of all regularly occupied areas. Determine the area with a direct line of sight by totaling the regularly occupied square footage that meets the following criteria:

- In plan view, the area is within sight lines drawn from perimeter vision glazing.
- In section view, a direct sight line can be drawn from the area to perimeter vision glazing.

The line of sight may be drawn through interior glazing. For private offices, the entire square footage of the office may be counted if 75% or more of the area has a direct line of sight to perimeter vision glazing. For multi-occupant spaces, the actual square footage with a direct line of sight to perimeter vision glazing is counted.

Metric: Horizontal View to Confirm View Access



ENERGY & ATMOSPHERE

LEED v2009 New Construction

Prerequisite 1	***Fundamental Building Commissioning***	***Required***
Prerequisite 2	***Minimum Energy Performance***	***Required***
Prerequisite 3	***Fundamental Refrigerant Management***	***Required***
Credit 1	**Optimize Energy Performance**	**3 -19**
Credit 2	**On – Site Renewable Energy**	**1 - 7**
Credit 3	**Enhanced Commissioning**	**2**
Credit 4	**Enhanced Refrigerant Management**	**2**
Credit 5	**Measurement & Verification**	**3**
Credit 6	**Green Power**	**2**
Total Possible Points		**35**

Creekside Village Community Center
Photo by K.C. Kratt

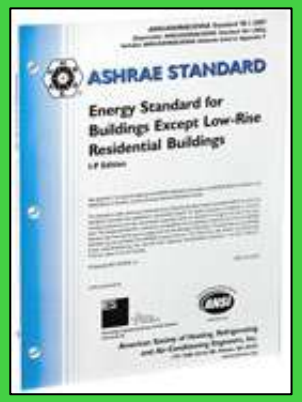
Strategies: Reduce Energy Demand

- Reduce demand for artificial heating, cooling, ventilation and lighting
- Use efficient equipment with controls and feedback

Presentation Copyrights, Green Technologies FZCO

EA Prerequisite 2: MINIMUM ENERGY PERFORMANCE

- **Intent**
  - Establish minimum level of efficiency for the proposed building and systems to reduce environmental and economic impacts associated with excessive energy use.
- **Requirements**
  - OPTION 1. Whole Building Energy Simulation
  - OPTION 2. Prescriptive Compliance Path: ASHRAE Advanced Energy Design Guide
  - OPTION 3. Prescriptive Compliance Path: Advanced Buildings™ Core Performance™ Guide



EA Credit 1: OPTIMIZE ENERGY PERFORMANCE

- **Intent**
  - Achieve increasing levels of energy consumption below the prerequisite standard to reduce environmental impacts associated with excessive energy use

- **Requirements**
  - Select 1 of the 3 compliance path options described below. Project teams documenting achievement using any of the 3 options are assumed to be in compliance with EA Prerequisite 2: Minimum Energy Performance.

Option 1: Whole Building Energy Simulation

Option 2: Prescriptive Compliance Path: ASHRAE Advanced Energy Design Guide

Option 3: Prescriptive Compliance Path: Advanced Buildings™ Core Performance™ Guide

THE KANDALAMA HOTEL, Dambulla – LEED Bronze; 2000

The First LEED Green Building outside USA
& the First LEED Green Hotel in the World

RBS MIDDLE EAST INTERIOR WORKS, DUBAI – LEED GOLD; 2008

TECOM MANAGEMENT OFFICE INTERIORS, DUBAI – LEED Platinum; 2009

The First LEED Platinum Commercial Interiors in the Middle East

TECOM INVESTMENTS

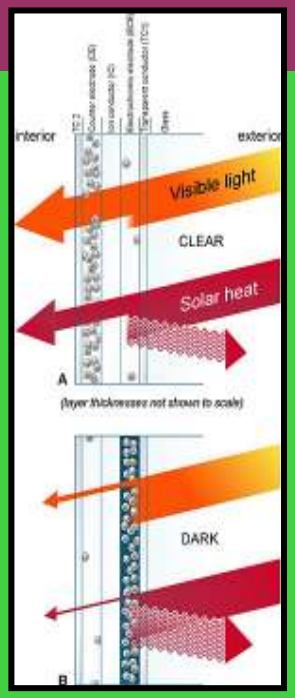
A member of DUBAI HOLDING

SUMMERTOWN INTERIORS, DUBAI

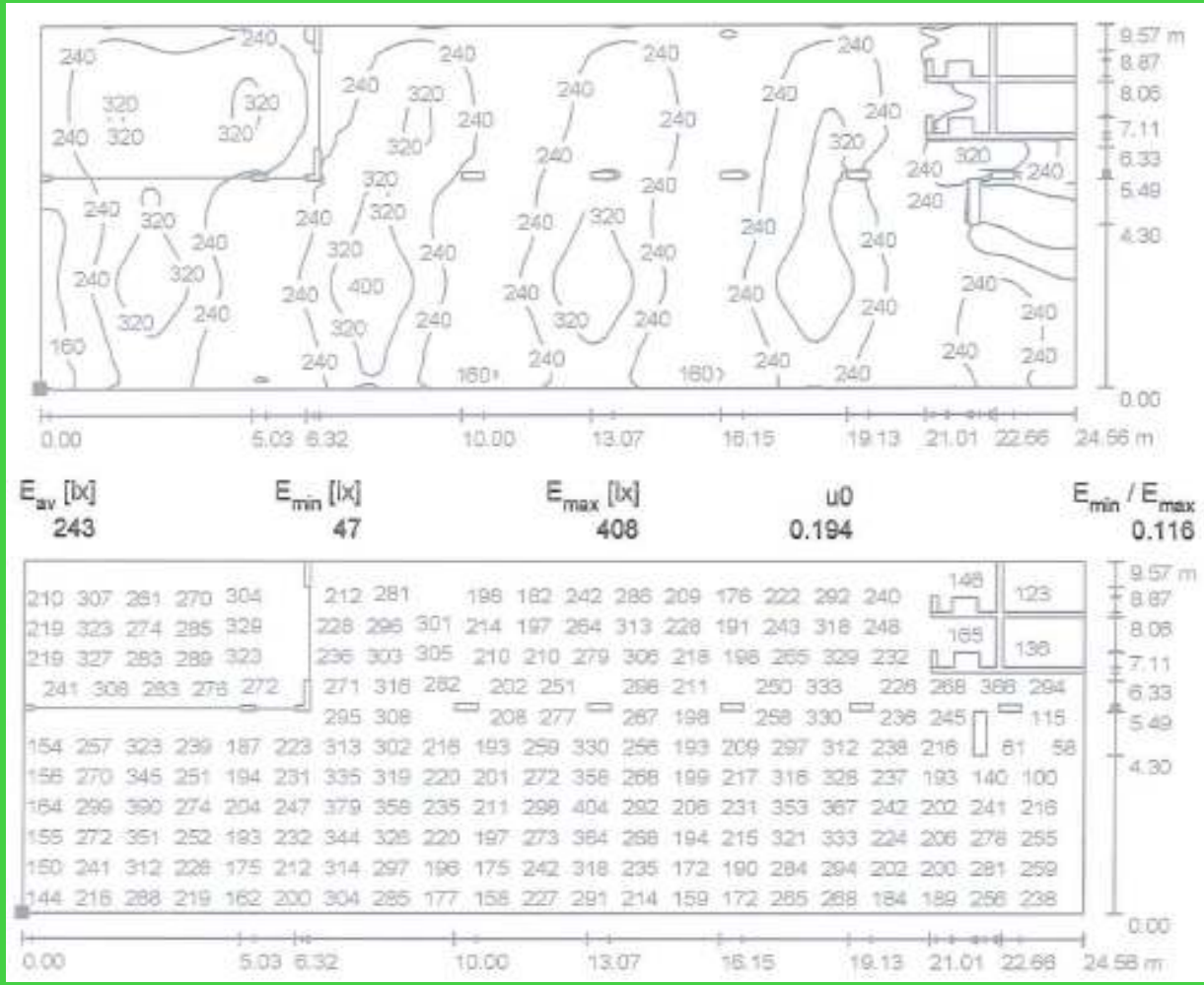
Pursuing LEED Gold

JEHAN GREEN WALLS, SHARJAH

Pursuing LEED Platinum



Lighting-Daylighting System Concepts



Artificial Lighting Photometrics Summary

Ground Floor

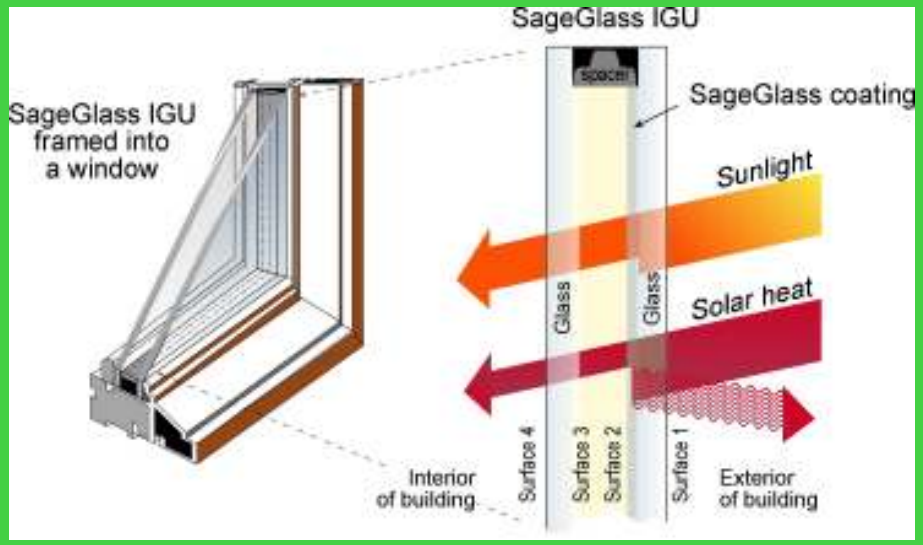
Lighting-Daylighting System Concepts

Lighting Raytrace Preview

Ground Floor

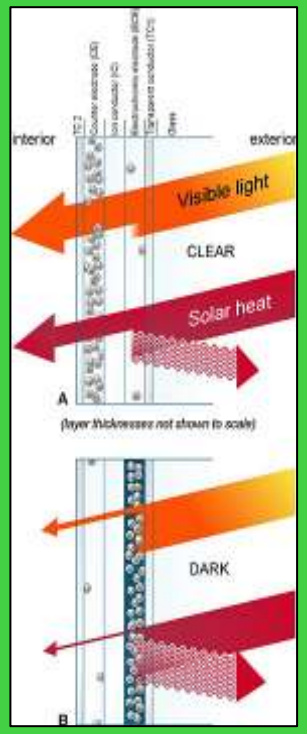
Sage Electrochromics

- Clear : 62% visible light and 0.48 SHGC
- Tinted: 3.5% visible light and 0.09 SHGC
- Uses less electricity per 1,500sf glass than 60w bulb
- Documented energy savings of 10-25%



One Option - SAGE ELECTROCHROMIC GLASS

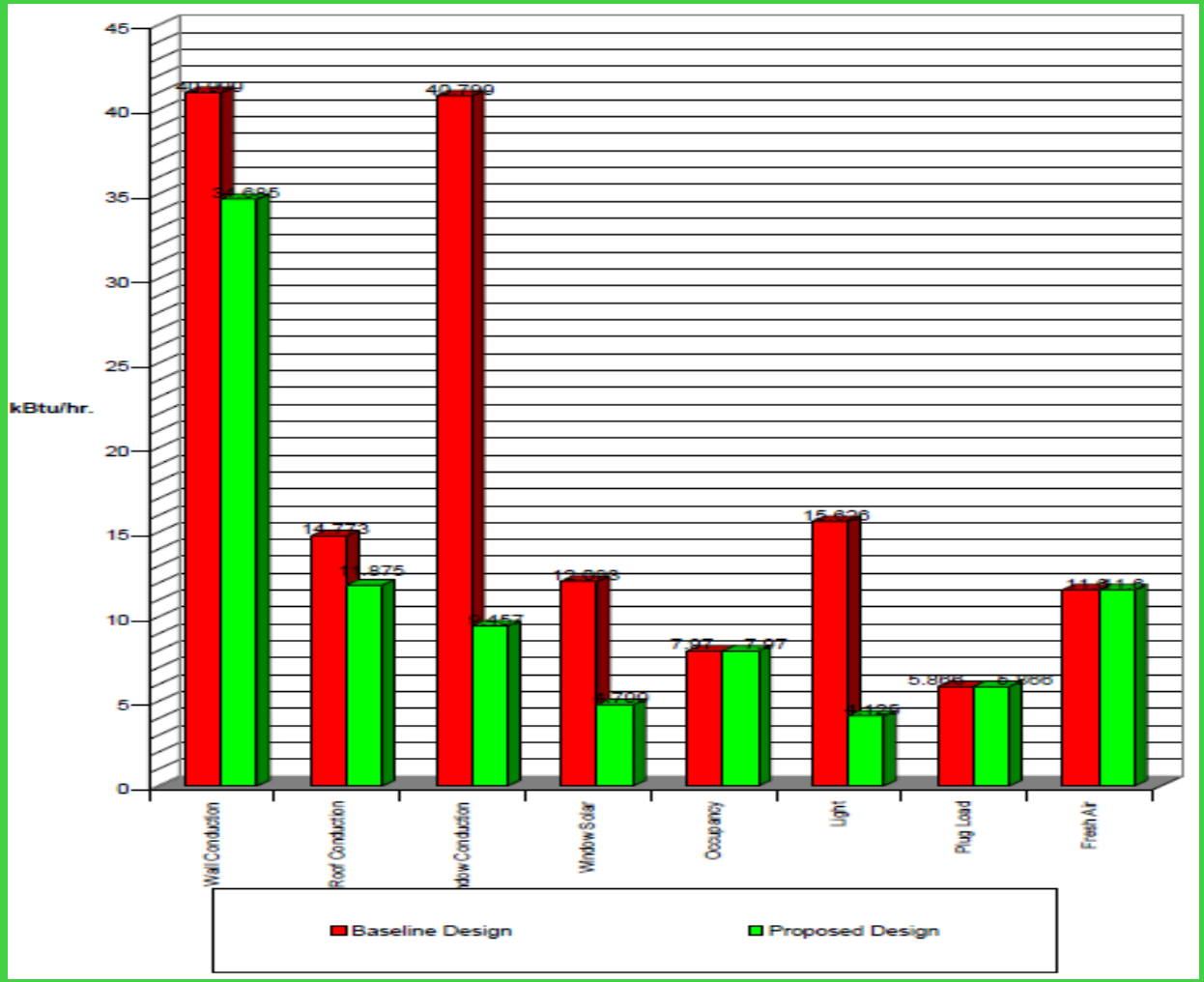
1. Application of Low Voltage (less than 5V DC) to Sage Glass coating of glass in the “clear” state.
2. Ion exchange from counter electrode to electrochromic electrode layer.
3. Glass darkens. Sun’s light and heat are absorbed. (0.09 SHGC)
4. Reverse of voltage polarity by “switching off”.
5. Ion exchange to original layer, the counter electrode.
6. Glass untints. Sun’s light and heat reradiated back to the outdoors.



Energy Simulation Results

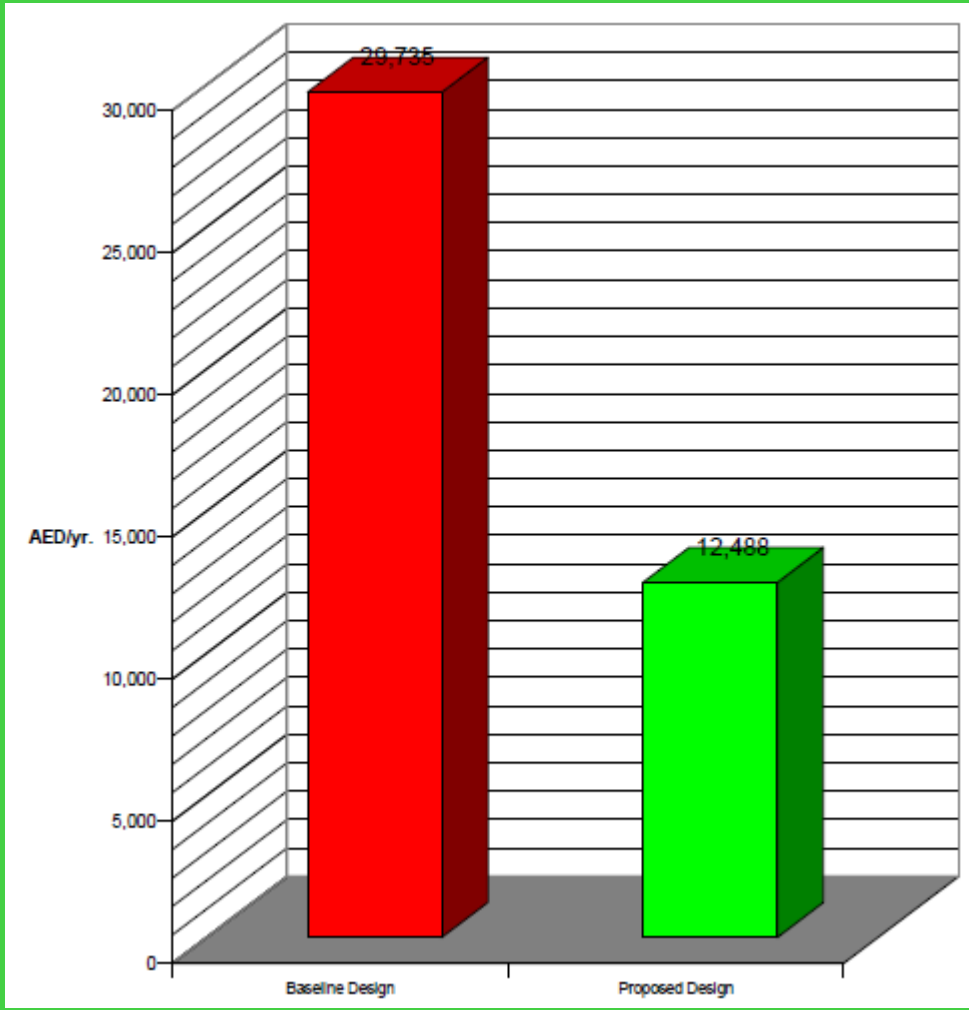
Summary in Graphs

Building Peak Cooling Load



Energy Simulation Results
Summary in Graphs

Building Annual Energy Cost

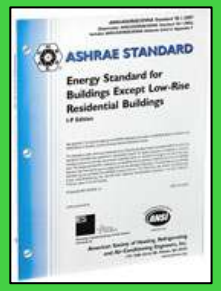


58.1% Energy Cost Improvement

19 POINTS out of 19 points for LEED NC Energy and Atmosphere Credit 1 + 1 POINT for Innovation in Design Credit

Mandatory Day lighting Will

1 - Reduce Energy Consumption



2 - Improve Indoor Environment Quality, Occupant Comfort and Productivity

3 - Lowers Requirement for Artificial Lighting

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