Indoor Air Quality and Sustainability

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Sustainability

The ability of meeting the needs of the present without compromising the possibility of future generations to meet their own needs. (Brundtland Report)

Rational

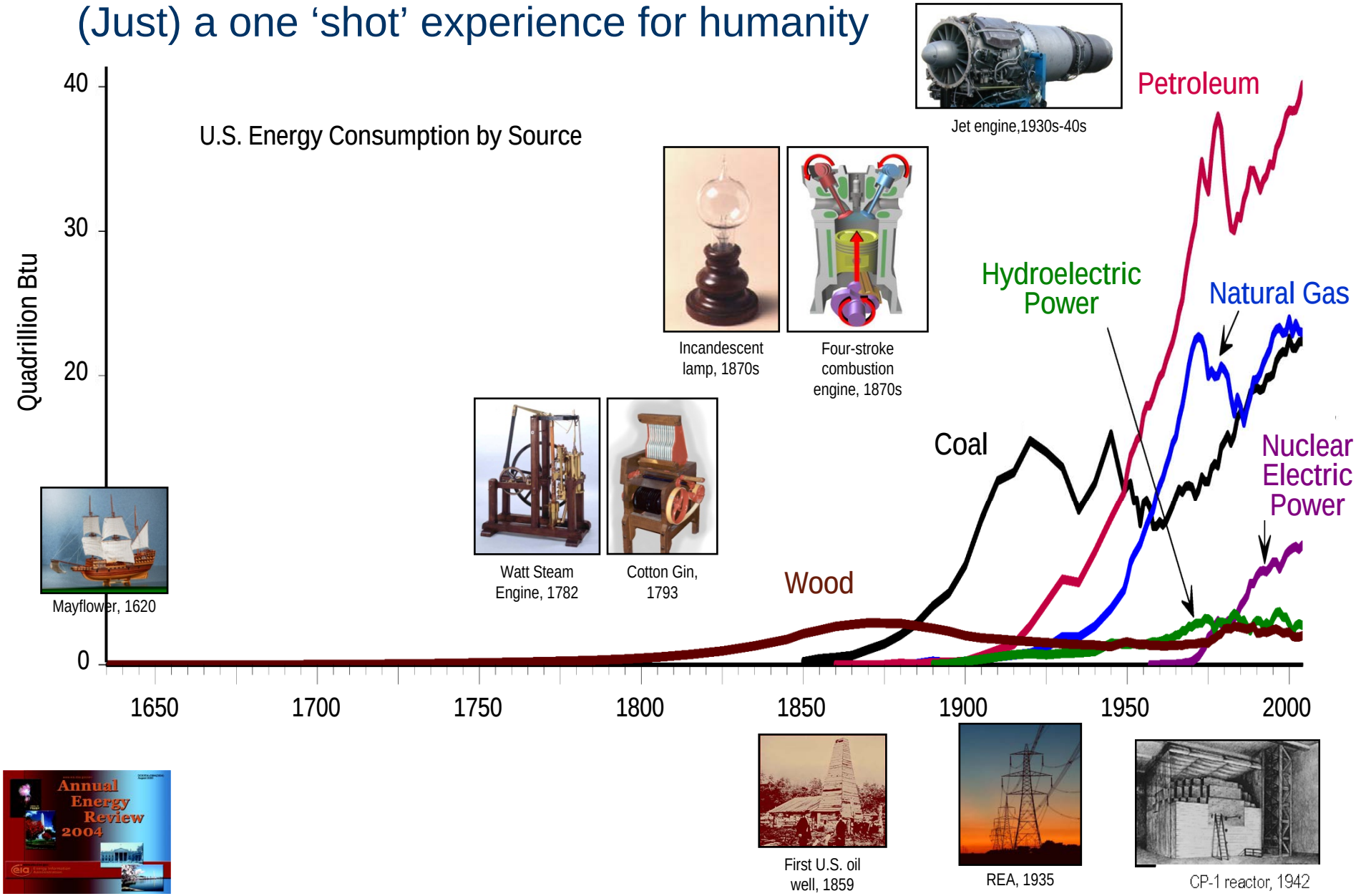
- Global warming
- Climate Change
- Anthropogenic CO_2

Sustainability

- Sustainability as the (new) permanent challenge for survival
- Fossil fuels (just) a ‘one shot’ experience for humanity
- Climate change (just) a dramatic ‘case study’

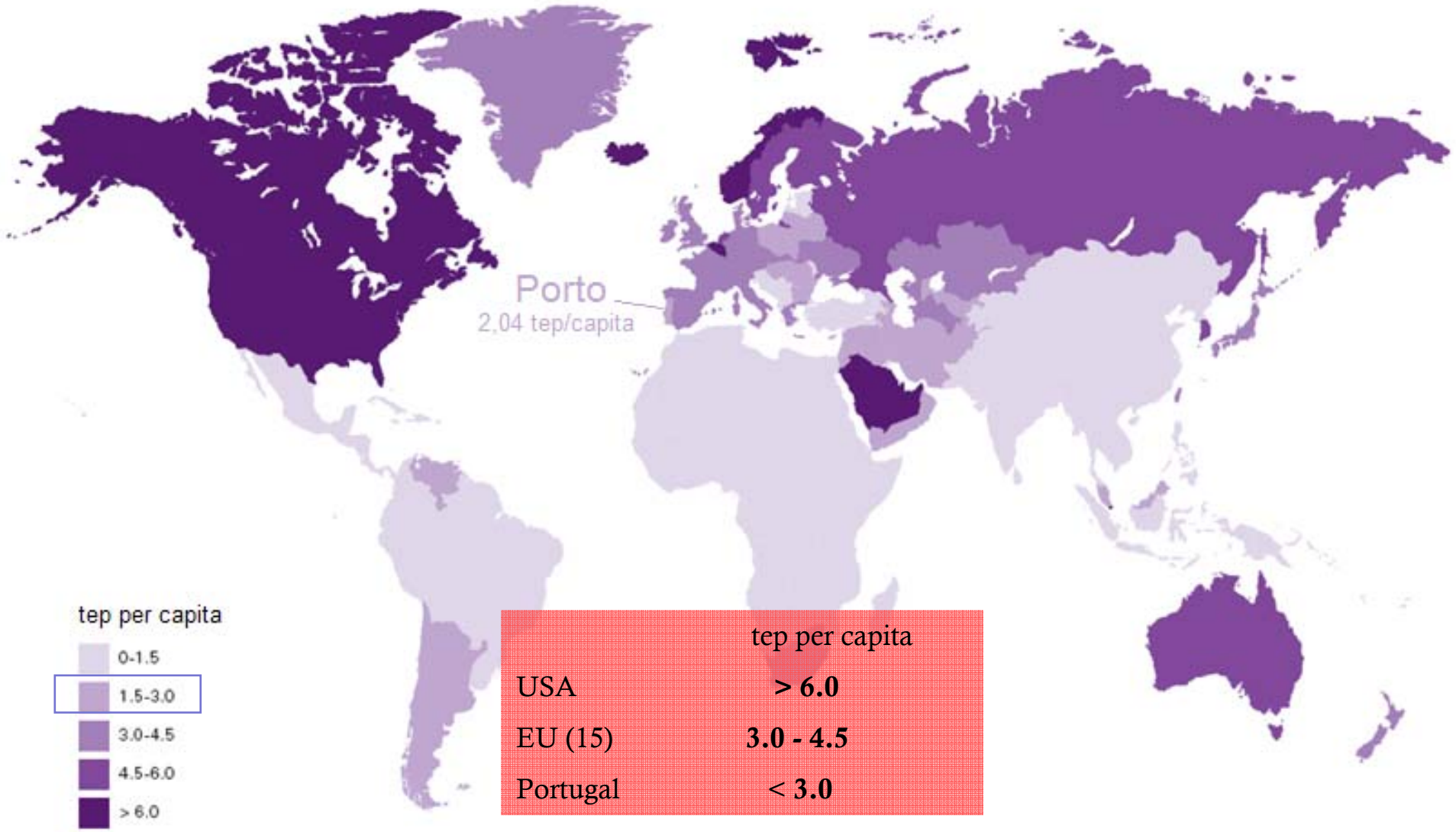
Fossil energy

(Just) a one ‘shot’ experience for humanity



Energy for people

Consumption per capita (2006)



	tep per capita
USA	**> 6.0**
EU (15)	**3.0 - 4.5**
Portugal	**< 3.0**

Impact of fossil energy

CO_2 emissions and energy use

	Ton CO_2/capita	GJ/capita	Ton CO_2/TJ
Vaxjo	3,8	101,8	37
Stockolm	3,9	95,9	41
Malmoe	4,9	105,0	46
Victoria-Gasteiz	6,4	102,0	63
Porto	5,5	85,3	64
Bizcaia	6,4	101,2	64
Pori	11,7	165,7	70
Burgos	8,0	115,0	70
Barcelona	2,8	38,6	71
Parma	8,4	103,6	81
Pavia	6,0	71,2	84
Tampere	8,1	94,8	85
Ancona	6,3	73,1	86
Provincia Torino	7,6	87,1	87
Verbania	8,6	97,1	89
Maribor	8,4	93,7	90
Nord Milano	8,8	89,8	98
Catarina	5,0	49,9	100

Växjö kommun
The Greenest City in Europe

City of Växjö received Sustainable Energy Europe Award 2007 during the European Sustainable Energy Week.

Fossil Fuel Free Växjö is an overall programme initiated by the City of Växjö to reduce human impact on the global climate change. In 1996, Växjö politicians decided unanimously to strive towards a fossil fuel free municipality. The share of renwable energy is now over 50%.

Critical: nature of the primary energy used!

Climate Change starts at home!

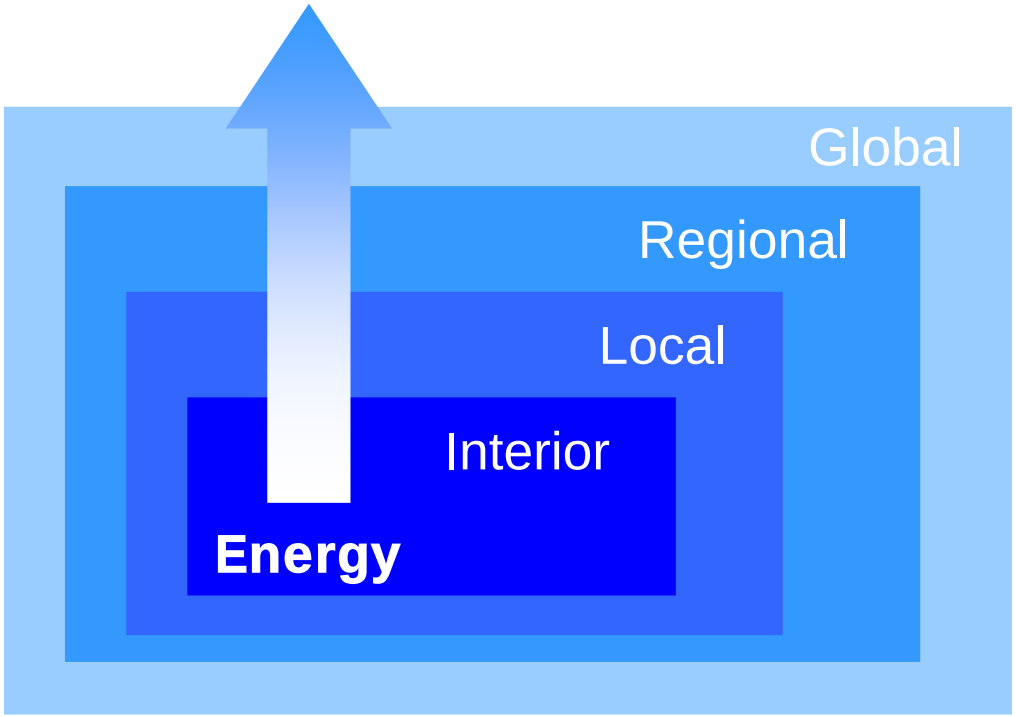
Energy is the unique environmental pressure factor that crosses all environmental levels

Global
Climate change
Biodiversity

Regional
Atmospheric pollution
Landscaping

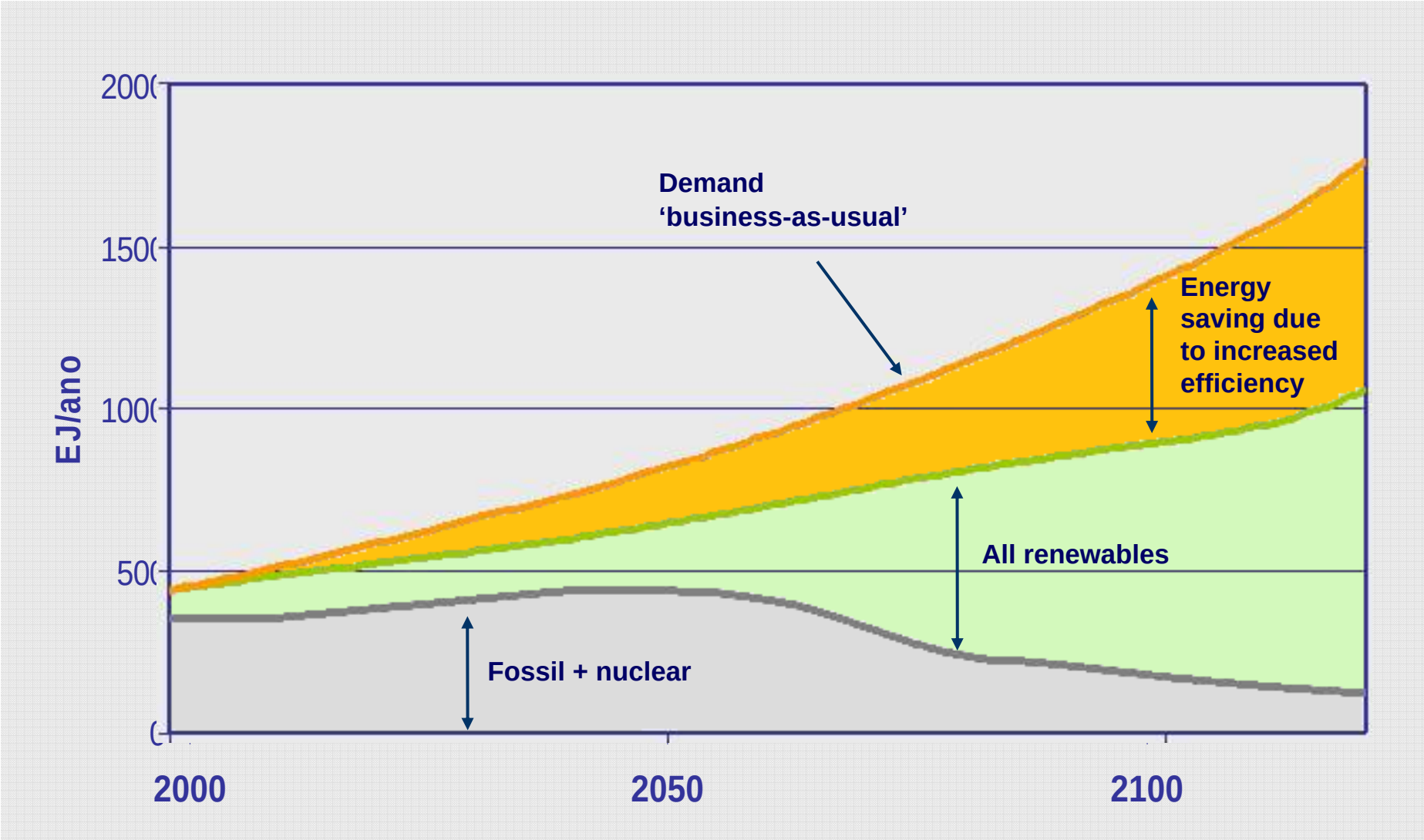
Local
Microclimate
Morphology

Interior
Indoor air quality
Comfort
Energy use & CO_2 emissions



Problem:	**Climate change**
Strategy:	**'act locally; think globally'**
Case:	**energy *vs* CO_2 production**

Energy efficiency: one more energy form



Source: IEA

Application to buildings

It is estimated from the **Life Cycle Analysis perspective** that the construction and use of buildings have greater impact on the global environment than any other human activity.

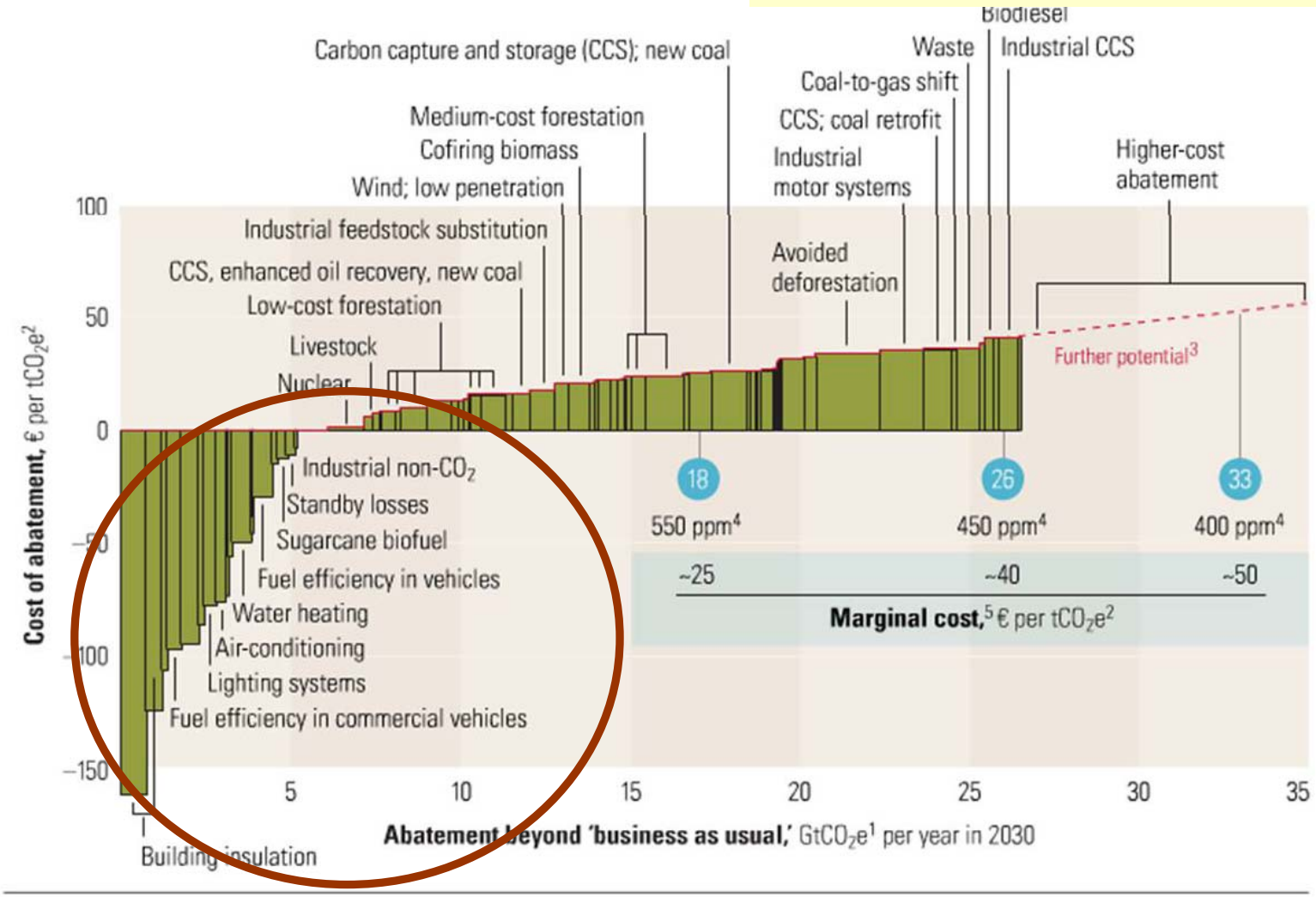
But, also, greater potential for contribution to the reduction of negative impacts on the environment.

Sustainable development

A cost curve for greenhouse gas reduction

P. Enkvist, T.Nauclér, and J. Rosander The McKinsey Quarterly June 2007

Global cost curve for greenhouse gas abatement measures beyond 'business as usual'; greenhouse gases measured in G tCO_2e[1]



[1] $GtCO_2e$ = gigaton of carbon dioxide equivalent; "business as usual" based on emissions growth driven mainly by increasing demand for energy and transport around the world and by tropical deforestation.

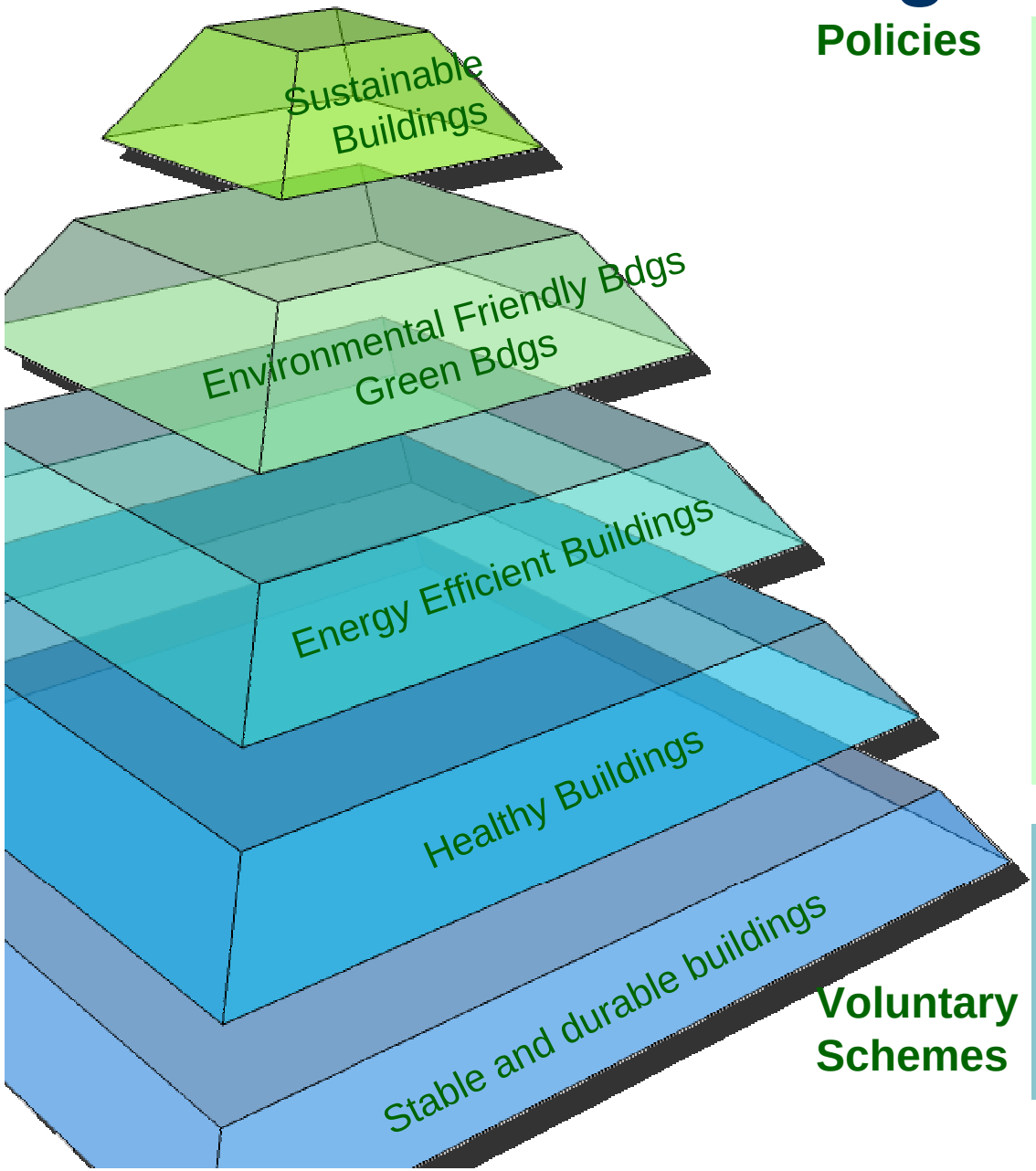
[2] tCO_2e = ton of carbon dioxide equivalent.

[3] Measures costing more than €40 a ton were not the focus of this study.

[4] Atmospheric concentration of all greenhouse gases recalculated into CO_2 equivalents; ppm = parts per million.

[5] Marginal cost of avoiding emissions of 1 ton of CO_2 equivalents in each abatement demand scenario.

Sustainable buildings



Policies

- **EPBD (2002/91/EC)**

  Energy Performance of Buildings Directive

- **CPD (89/106/EEC)**

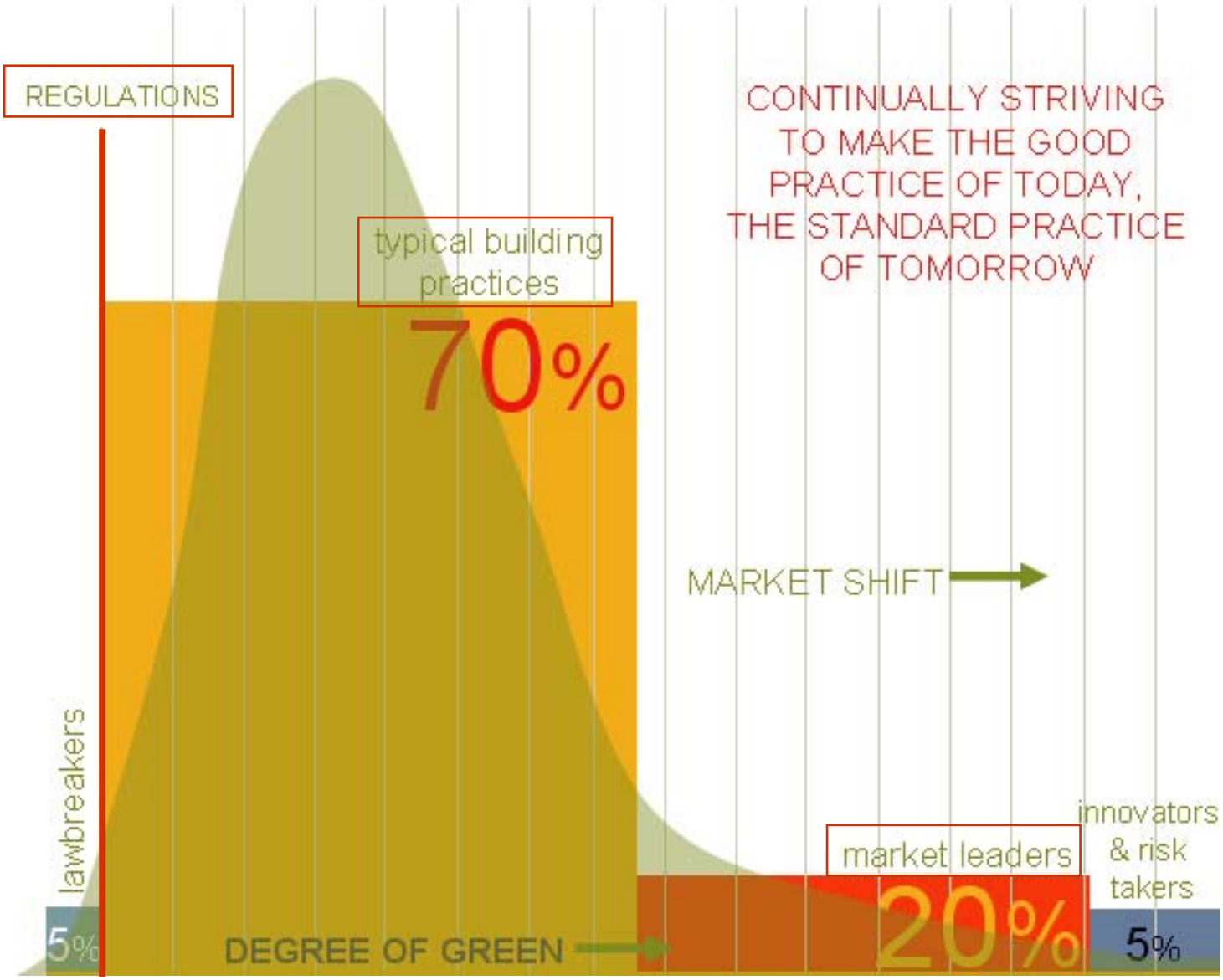
  Construction Products Directive

- **SCE (DL 78/2006 de 4 de Abril)**

  PT: System for Bdgs Certification on Energy and IAQ

Voluntary Schemes

- **BREEAM - UK**
- **CASBEE - Japão**
- **LEED - USA**
- **LCA - …**


REGULATIONS
CONTINUALLY STRIVING TO MAKE THE GOOD PRACTICE OF TODAY, THE STANDARD PRACTICE OF TOMORROW
typical building practices
70%
MARKET SHIFT
lawbreakers
5%
DEGREE OF GREEN
market leaders
20%
innovators & risk takers
5%

Buildings Environmental Performance

The goal is to promote buildings that are:

- **Healthy for living (welfare) and work (productivity)**
- **Environmental responsibility**
- **Economically advantageous**

to go beyond the rules (bdg codes) in order to improve the overall performance

Buildings Environmental Performance Methodologies

LCA -	Lyfe Cycle Analysis
BREEAM -	Building Research Establishment Environmental Assessment Method (UK)
LEED-	Leadership in Energy & Environmental Design (USA)
GREEN STAR-	Environmental leadership for buildings (AUS)
SEABEP -	Systematic Evaluation and Assessment of Building Environmental Performance (USA)
BEPAC -	Building Environmental Performance Assessment Criteria (CAN)
…	

Life Cycle Analysis

Objective methodology for the assessment of environmental impacts associated with a product, process, activity or to a system in general, within well-defined limits, throughout its life cycle ("from cradle to grave")

The standard ISO 14040 defines an LCA as follows

"LCA is the compilation and evaluation of the *inputs*, *outputs* and the potential environmental impacts of a product system throughout its life cycle."

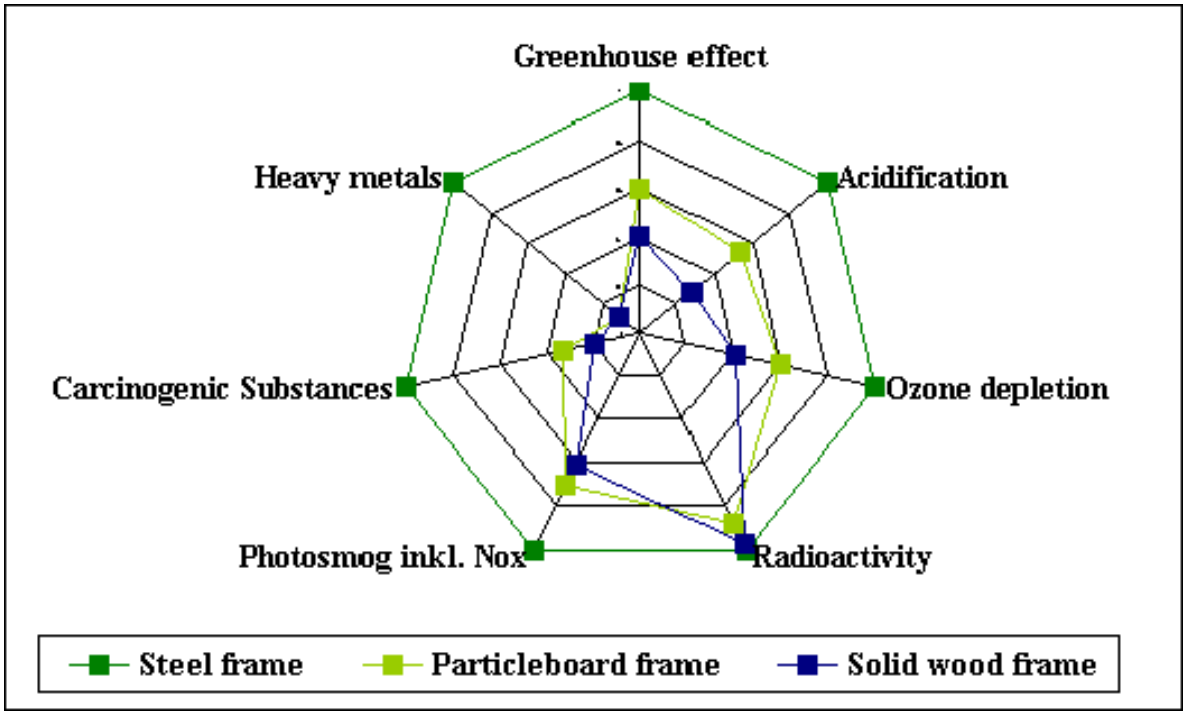
LCA Tools / methodologies

- ATHENA
- ENVEST
- EQUER
- OGIP
- BeCost
- Eco-Quantum
- …

Case studies

- Door frames

Contribution to environmental effects (life time 60 years)

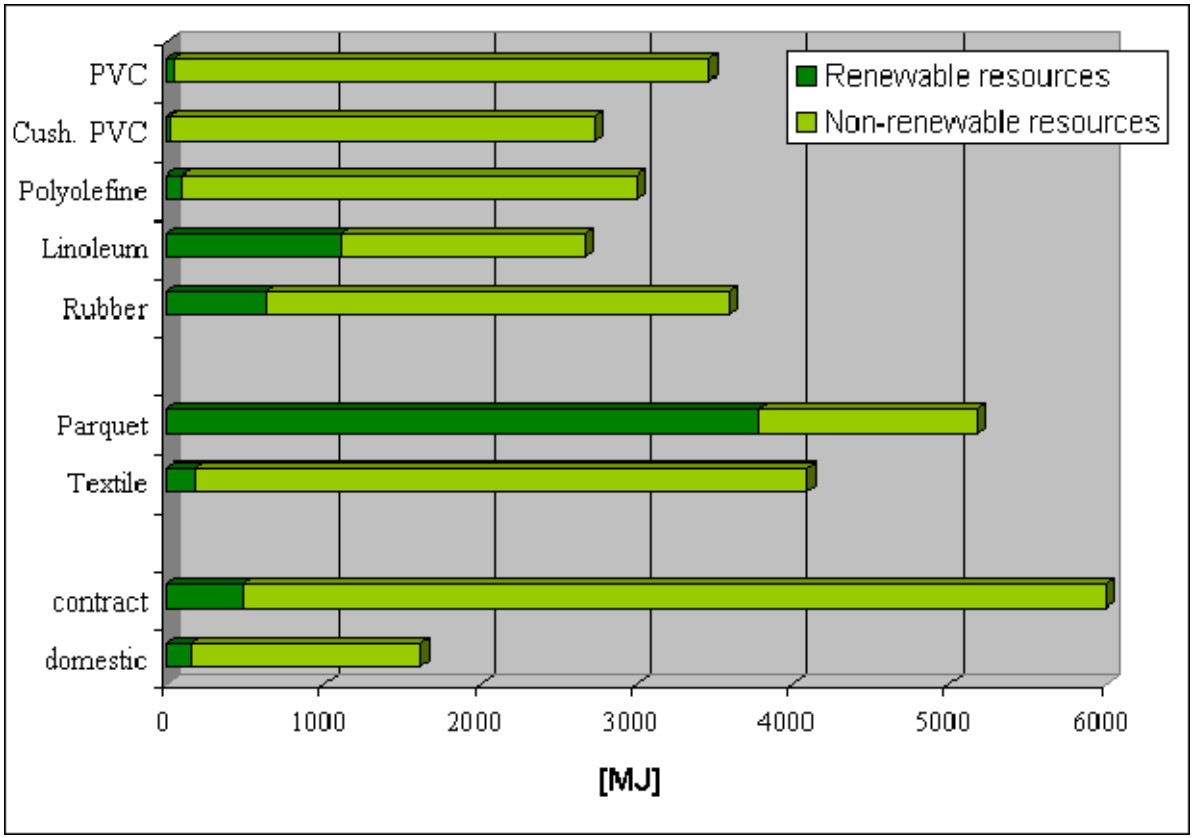


(Source: Carbon Dioxide Mitigation in Forestry and Wood Industry, Springer 1998)

Case studies

- **Resilient floor coverings**

Energy consumption [MJ] for renewable and non-renewable resources.
Reference: 20 m2 of floor, use for 20 years.
The stage of use is shown separately, it represents vacuuming.



(Source: Life Cycle Assessment Study on Resilient Floorcoverings for ERFMI, Fraunhofer IRB Verlag, 1998)

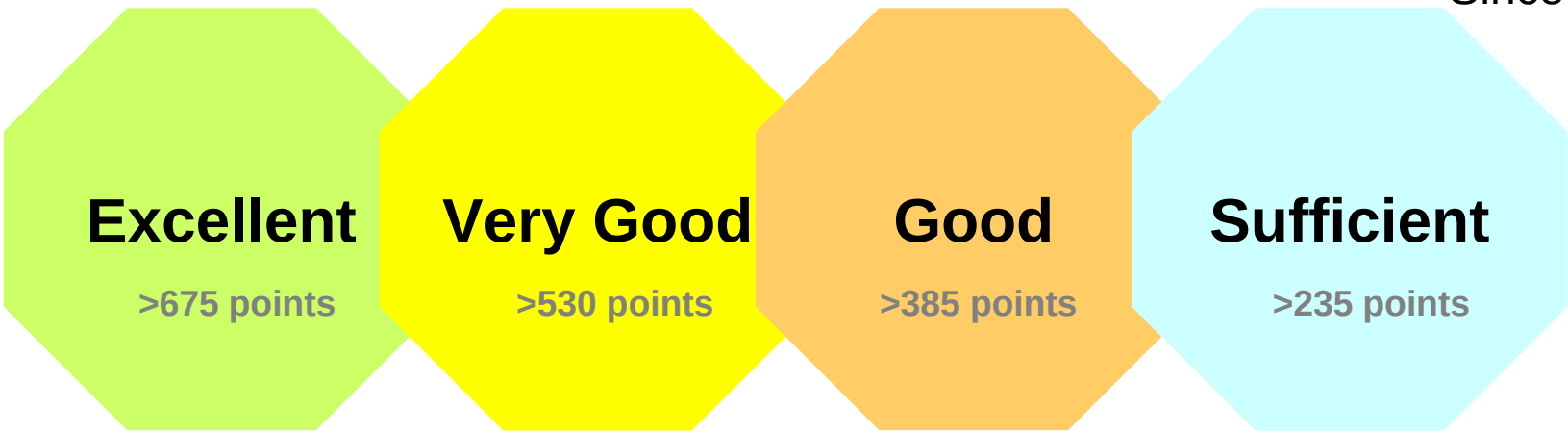
BREEAM

The BREEAM method was launched in 1990 with the purpose of providing a reliable guide on how to minimize the adverse effects of the buildings in the local and global environment while promoting an indoor environment healthy and comfortable

Certification levels

BREEAM

Since 1990



Building typologies

Services

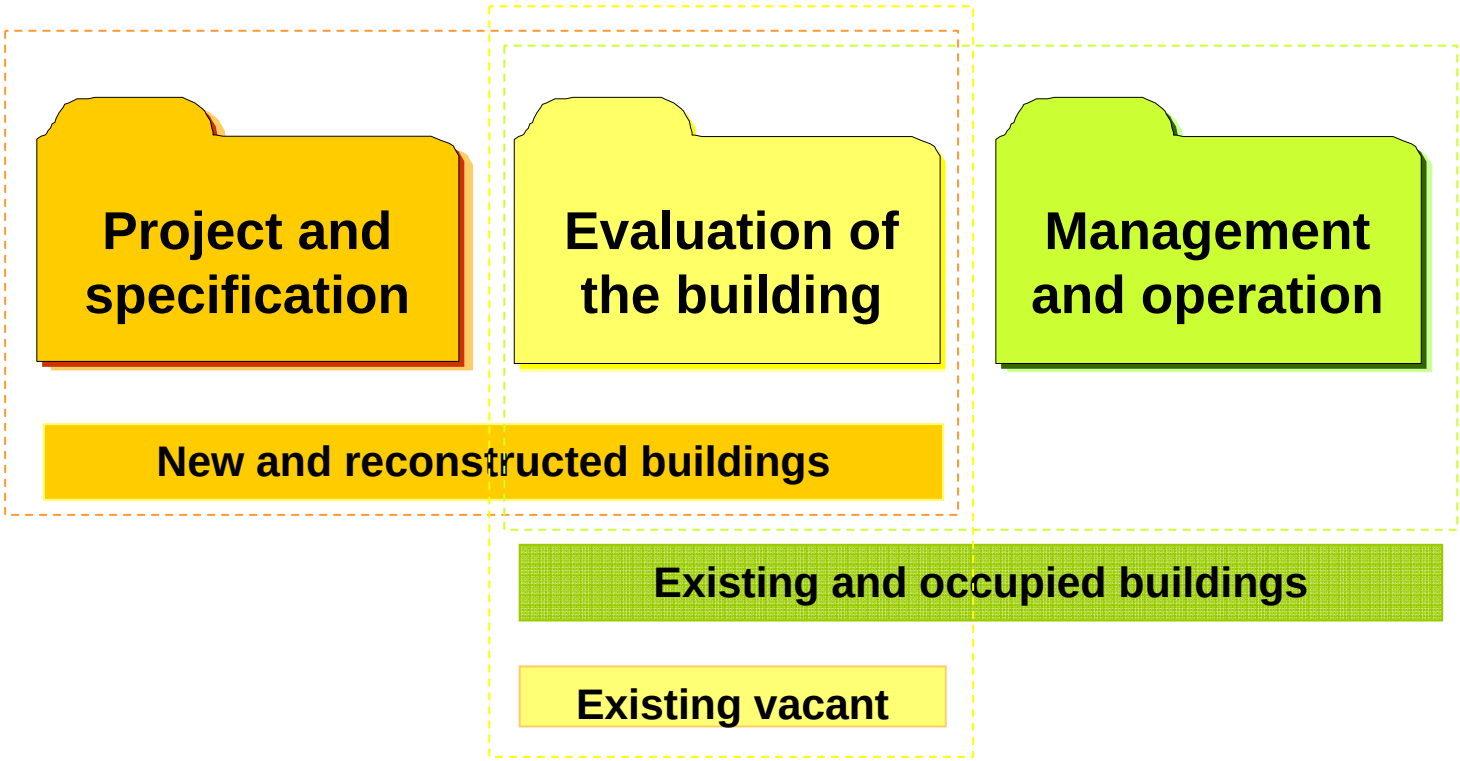
Residential
(Ecohomes)

Schools

Retail

Industrial units

BREEAM


Project and specification
Evaluation of the building
Management and operation
New and reconstructed buildings
Existing and occupied buildings
Existing vacant

BREEAM

MANAGEMENT (14,6%)

HEALTH AND WELL-BEING (13,6%)

ENERGY (12,3%)

TRANSPORTS (10,1%)

WATER (4,3%)

MATERIALS (18%)

SOIL USE (2,7%)

ECOLOGY (11,4%)

POLLUTION (13%)

Easy access to the cooling towers for cleaning, maintenance and replacement;

Hot water urban network or minimization of risk of Legionella;

Operational windows and distance to them;

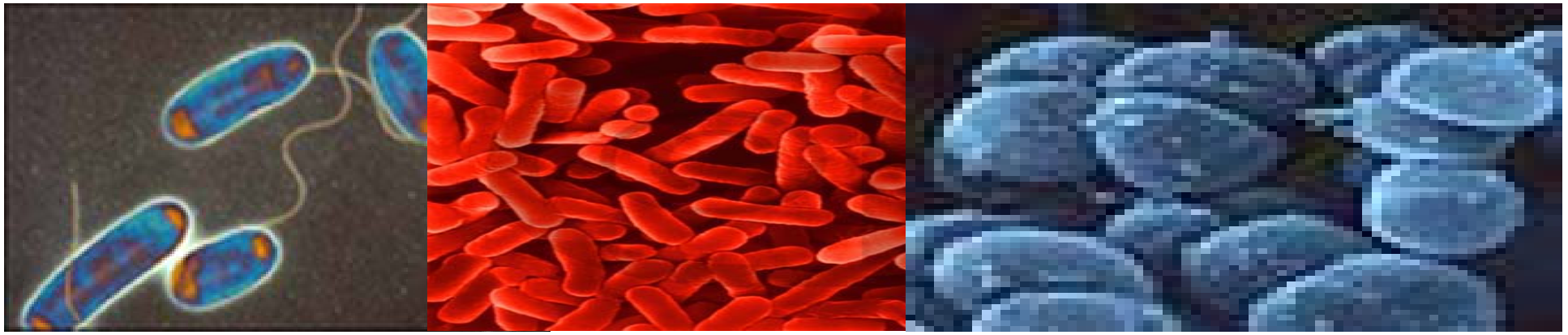
Capture of air ventilation systems, far from sources of pollution;

Ensuring rates 12 l/s in the case of mechanical ventilation or use fans in the natural ventilation cases;

Natural lighting natural, lumnic level and controllability;

Control of temperature and level of comfort;

Level of noise.



Represents 13,6% of maximum score

BREEAM

Annual consumption per capita;
Water meters;
Leaks and cut detectors.

Represents 4,3% of maximum score

BREEAM

Specification of materials in accordance with the 'Green Guide to Specification';

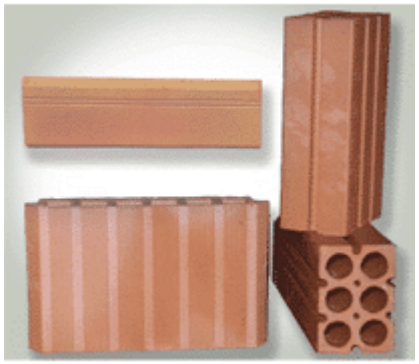
Re-use of facades and structure;

Prescription of sustained source or recycled wood;

Local for storing recyclable materials;

Existence of asbestos;

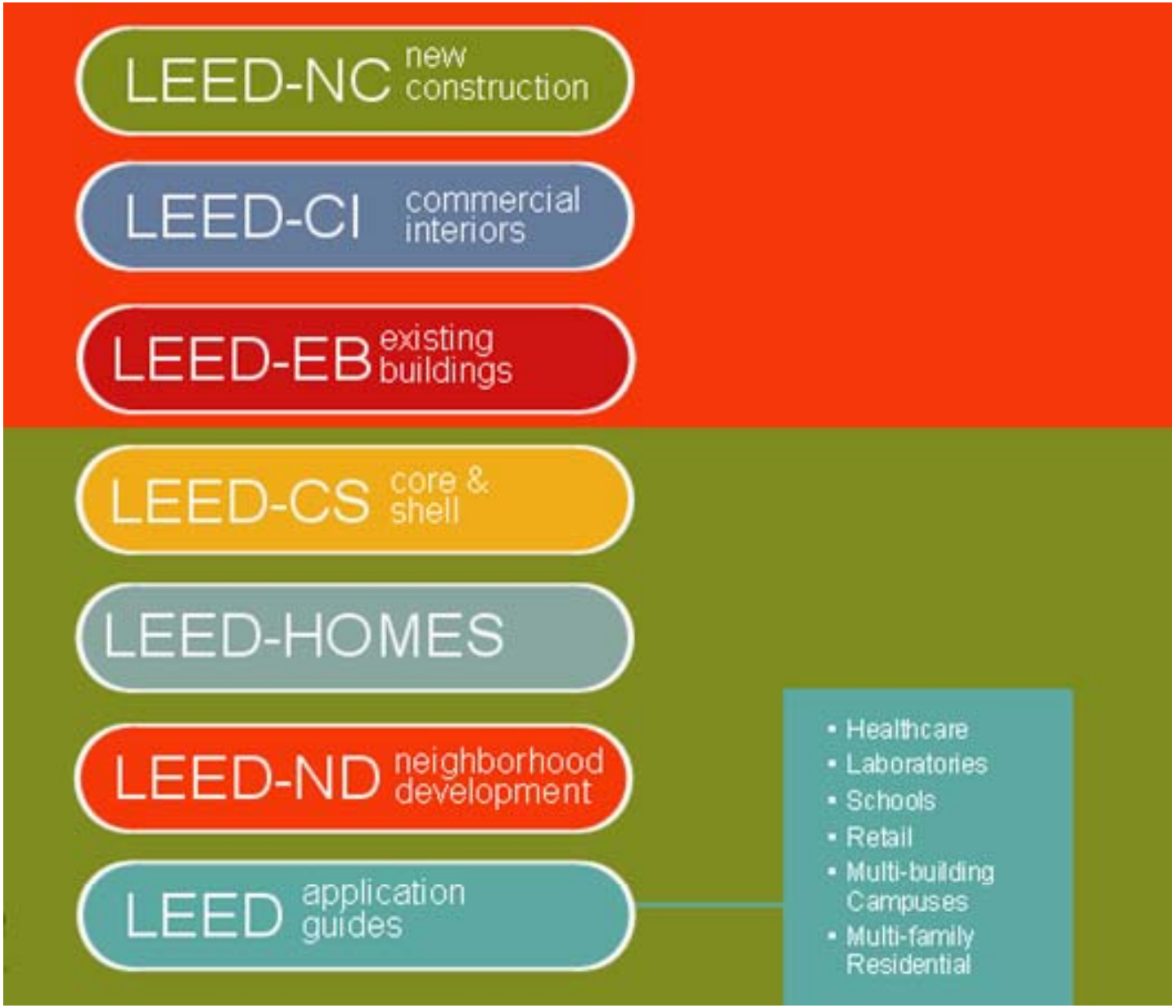
Restricted use of carpet.



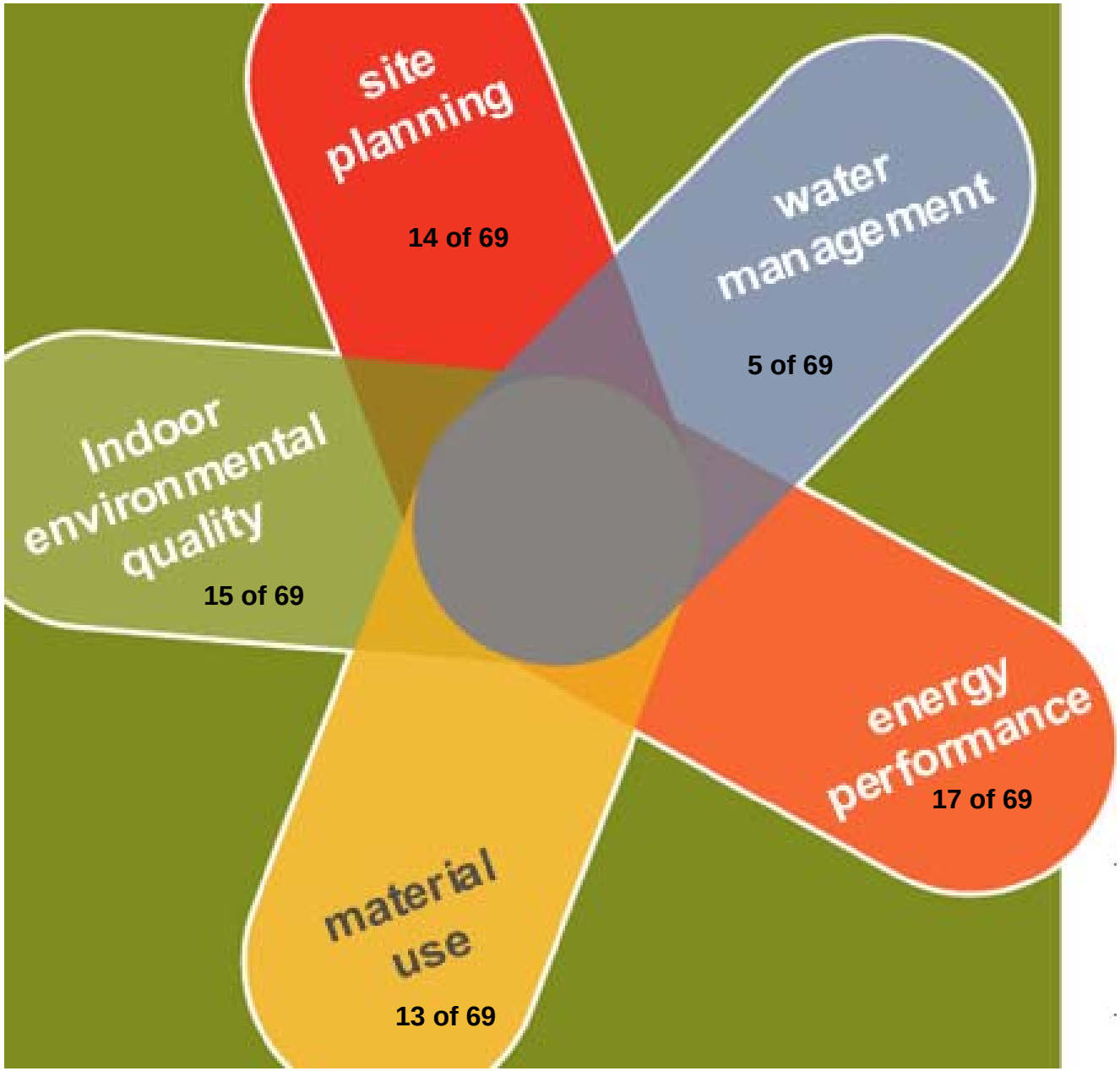
Represents 18% of maximum score

LEED™ is a voluntary system of classification of green buildings developed by the US Green Building Council (USGBC) for the US Department of Energy, Energy Efficiency and Renewable Energy in 1995

Typologies


LEED-NC new construction
LEED-CI commercial interiors
LEED-EB existing buildings
LEED-CS core & shell
LEED-HOMES
LEED-ND neighborhood development
LEED application guides
• Healthcare
• Laboratories
• Schools
• Retail
• Multi-building Campuses
• Multi-family Residential

Categories



LEED
LEADERSHIP IN ENERGY & ENVIRONMENTAL DESIGN

MATERIALS & RESOURCES

- Source Reduction & Waste Management
- Toxic Material Source Reduction

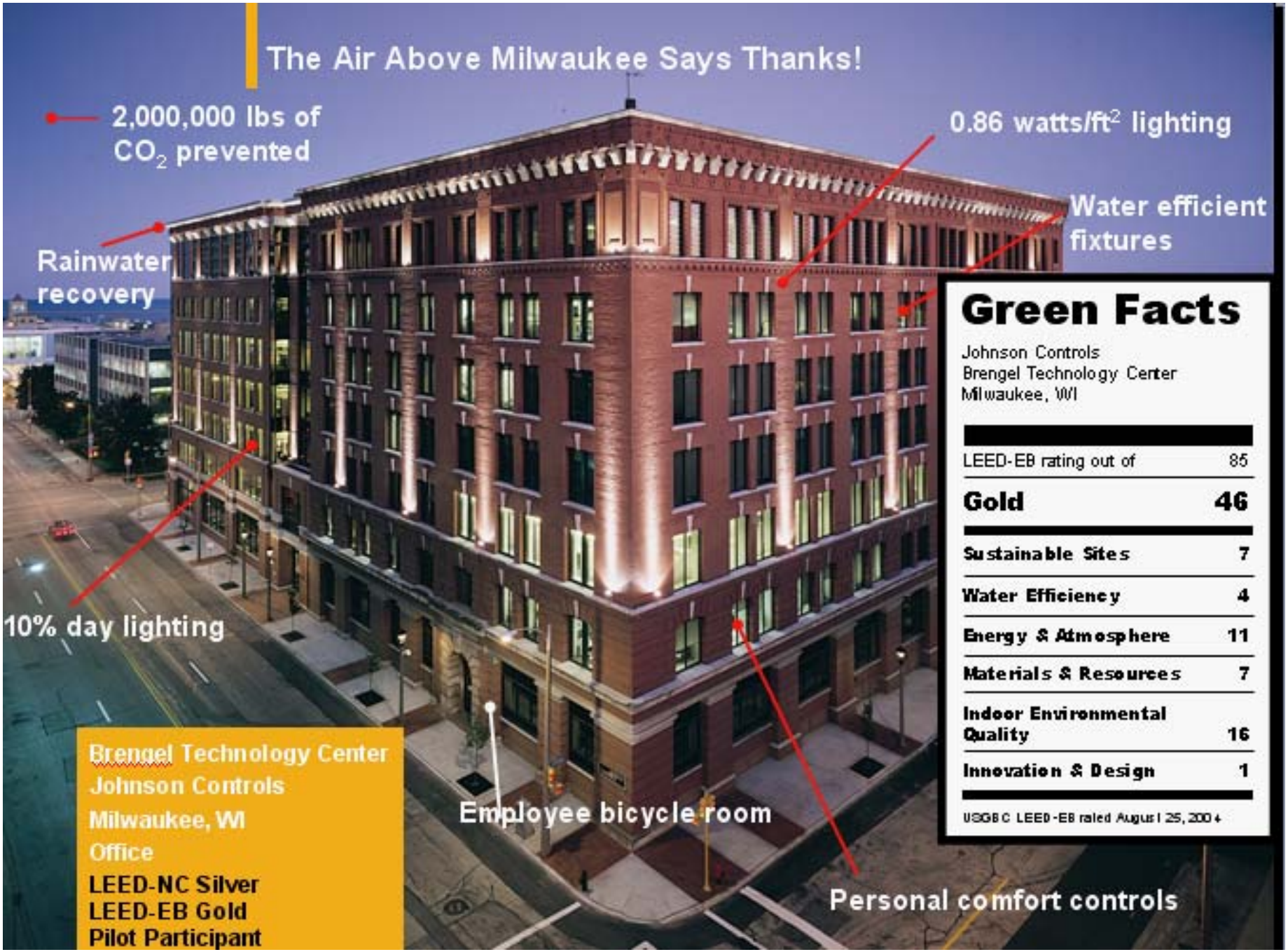
- Construction Waste Management
- Optimized Use of Alternative Materials
- Optimized Use of IAQ Compliant Products
- Sustainable Cleaning Products
- Occupant Recycling
- Additional Toxic Material Source Reduction

INDOOR ENVIRONMENTAL QUALITY

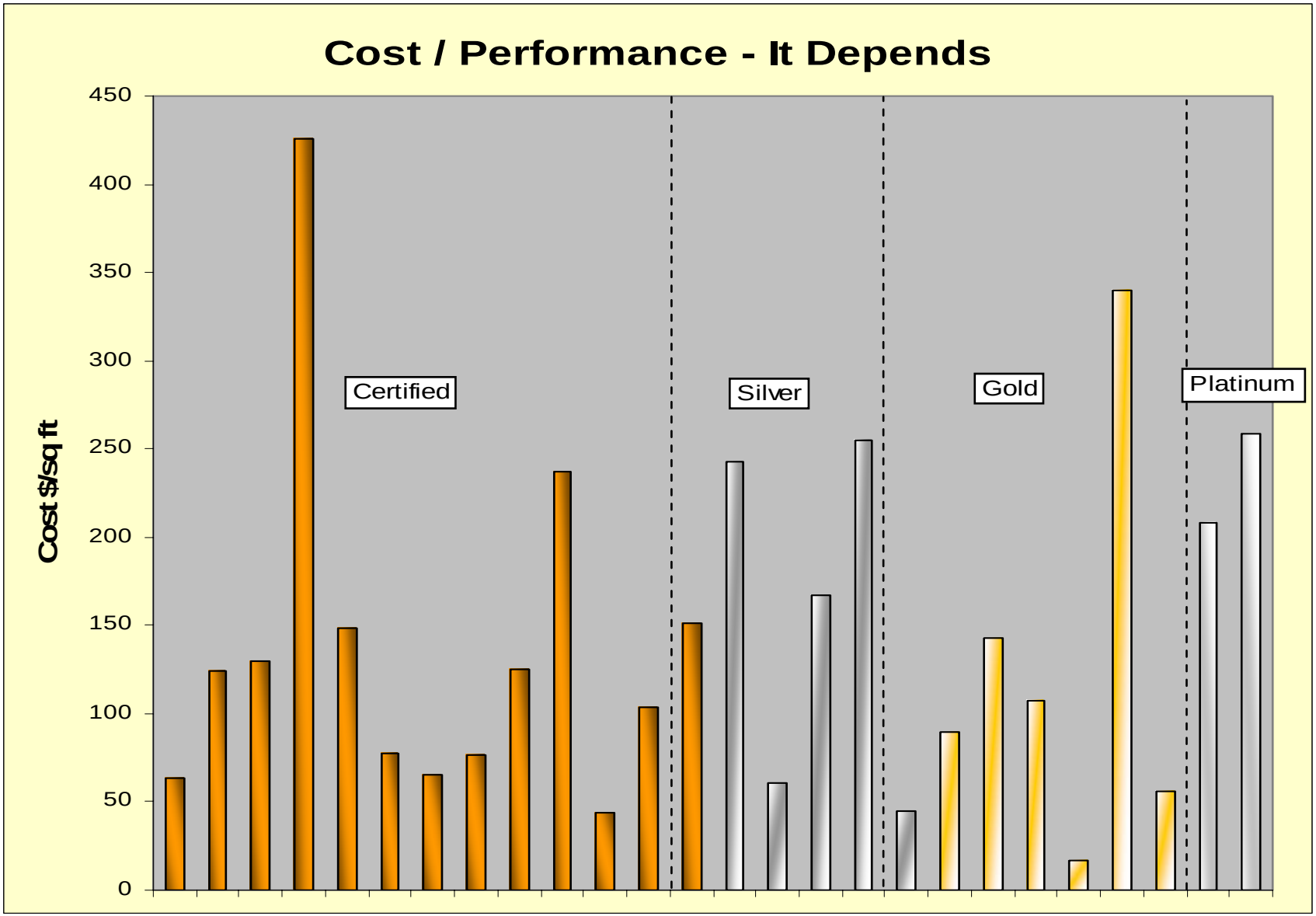
- Outside Air Exhaust
- Tobacco Smoke Control
- Asbestos/PCB Removal

- Outdoor Air Delivery Monitoring
- Increased Ventilation Construction
- IAQ Management Plan
- Documenting Productivity Impacts
- Indoor Chemical & Pollutant Source Control
- Controllability of Systems
- Thermal Comfort
- Daylighting & Views
- Contemporary IAQ Practice
- Green Cleaning


The Environment Around Denver Says Thanks!
T-8 fluorescent lamps & occupancy sensors
ENERGY STAR Rating = 88
Green Label vacuums
Two 550 ton plate & frame heat exchangers
natural gas radiant heat snow melting
Green Facts
Denver Place
Amerimar Realty Management
Denver, CO
LEED-EB rating out of 85
Gold 43
Sustainable Sites 8
Water Efficiency 3
Energy & Atmosphere 14
Materials & Resources 5
Indoor Environmental Quality 10
Innovation & Design 3
USGBC LEED-EB Pilot November 5, 2004
Denver Place
Amerimar Realty Management
Denver, CO
Office
LEED-EB Silver
Pilot Participant


The Air Above Milwaukee Says Thanks!
2,000,000 lbs of CO_2 prevented
0.86 watts/ft^2 lighting
Water efficient fixtures
Rainwater recovery
10% day lighting
Employee bicycle room
Personal comfort controls
Brengel Technology Center
Johnson Controls
Milwaukee, WI
Office
LEED-NC Silver
LEED-EB Gold
Pilot Participant
Green Facts
Johnson Controls
Brengel Technology Center
Milwaukee, WI
LEED-EB rating out of 85
Gold 46
Sustainable Sites 7
Water Efficiency 4
Energy & Atmosphere 11
Materials & Resources 7
Indoor Environmental Quality 16
Innovation & Design 1
USGBC LEED-EB rated August 25, 2004

Evidence from certified projects (LEED)



OBRIGADO !