



# Climate Finance for Cities and Buildings & Climate-related mechanisms to support Sustainable Public Procurement

**Joint Webinar**

**Cities and Lifestyles Unit**

Global Initiative for Resource Efficient Cities  
& Sustainable Public Procurement programme



*Webinar, 12<sup>th</sup> June, 2015*



# Webinar Agenda

Time	Topic	Panelist
3pm	Welcome and Introduction	<ul style="list-style-type: none"><li>Mr. Farid Yaker, UNEP, 10YFP SPP Programme Officer</li><li>Overview of the GoToWebinar functionalities, Ms. Irina Uzun, UNEP, SPP programme</li></ul>
3:05pm	Climate Finance for Cities and Buildings: tools and opportunities for Local Governments	<ul style="list-style-type: none"><li>Stephane Pouffary, ENERGIES 2050</li></ul>
	Climate-related mechanisms to support Sustainable Public Procurement	
3:20pm	“Public and Private Partnerships and their implications for climate change mitigation on a portfolio scale”	<ul style="list-style-type: none"><li>Mr. Kevin Kampschroer, Office of Federal High-Performance Green Buildings, US General Services Administration</li></ul>
3:35pm	“Procurement of sustainable buildings: using Core Indicators to establish a quantitative baseline”	<ul style="list-style-type: none"><li>Pekka Huovila, Consultant, Ministry of the Environment of Finland</li></ul>
3:50pm	Discussions & Closing	



# The 10-year Framework of Programmes

The 10YFP has been adopted at the Rio+20 Conference. It is a global framework of action to enhance international cooperation to accelerate the shift towards SCP patterns in both developed and developing countries.

It supports capacity building and provides technical and financial assistance to developing countries for this shift.

The 6 programmes of the 10YFP are:

- Consumer information
- Sustainable lifestyles and education
- Sustainable public procurement
- Sustainable buildings and construction
- Sustainable tourism, including ecotourism
- Sustainable food systems

More information here: <http://www.unep.org/10yfp/>

# The Climate Technology Centre and Network

- Operational arm of the UNFCCC Technology Mechanism
- Mission to stimulate technology cooperation and enhance the development and deployment of technologies in developing countries
- Provide technical assistance to developing countries at their request:
  - Access to free expertise on technologies (value up to 250,000 USD)
  - Expertise to identify, assess, promote and deploy technologies
  - Support to academic, government, NGO, private entities
  - Complementarity with financial mechanisms
  - Fast and short application process (3 pages)
- Assistance on wide range of technologies and sectors related to building and cities: transportation, building, waste, disaster management, efficient lighting, refrigerant technologies, monitoring of emissions at city-level, etc.



**For more information visit the [ctc-n.org](http://ctc-n.org)!**



# PANELISTS



**Mr. Stéphane Pouffary, Founder Honorary President of the NGO ENERGIES 2050**

He has been working in the field of international cooperation for over 25 years and has contributed to the design of national and regional policies on climate finance and energy efficiency/renewables finance mechanisms. He is author of numerous reports, studies and articles on climate change, sustainable development, renewable energies, energy efficiency, building and construction sectors, and cities and territorial challenges.



**Mr. Kevin Kampschroer, Director of the Office of Federal High-Performance Green Buildings at the U.S. General Services Administration (GSA)**

He has created the framework for which GSA responds to the challenges of greenhouse gas emissions reductions and of the American Recovery and Reinvestment Act's mandate to move GSA's Federal building inventory toward high-performance green buildings. He has devised a challenge for companies to dramatically improve the government's ability to achieve deep retrofits through Energy Savings Performance contracts.



**Mr. Pekka Huovila, Consultant, Ministry of the Environment of Finland**

He coordinates the Sustainable Buildings and Construction Programme for the Finnish Ministry of the Environment as part of the 10YFP SCP. He has had major responsibility in 25 international development projects on sustainability of the built environment during the past 10 years and has worked on sustainable city development projects in China, Colombia, Egypt, Kenya, Libya, Malaysia, Morocco, Tanzania and Zambia.

# Climate Finance for Cities and Buildings: tools and opportunities for Local Governments



Mr. Stéphane Pouffary,  
Founder Honorary President  
ENERGIES 2050



# Urban Carbon Mechanisms: A Handbook for Local Policy Makers

**ENERGIES 2050**  
**[www.energies2050.org](http://www.energies2050.org)**  
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**Stéphane Pouffary**  
*Chief Executive Officer*  
*& Founder Honorary President*  
[stephane.pouffary@energies2050.org](mailto:stephane.pouffary@energies2050.org)

**Climate Finance for Cities and Buildings and  
Climate-related mechanisms to support Sustainable Public  
Procurement**

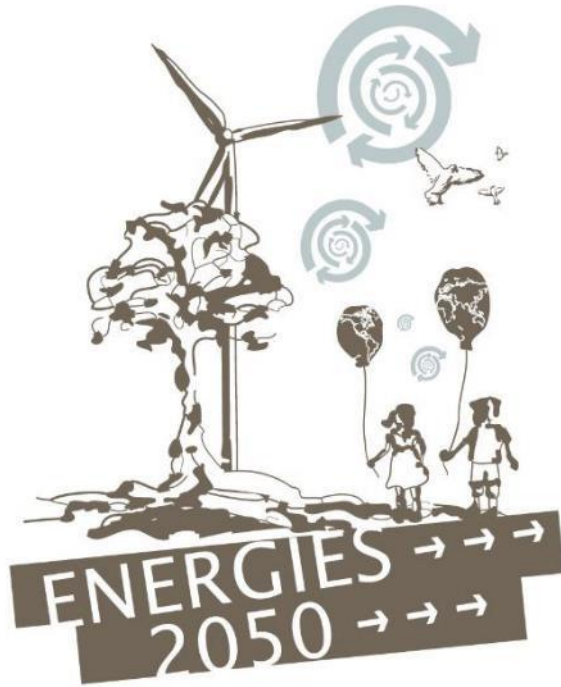
**Joint webinar: 12 June 2015, 15:00 – 16:00 CEST**



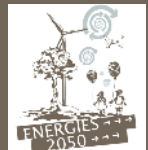


# The Road to Paris : as many opportunities as there are challenges

## ENERGIES 2050: together for a sustainable development



- Implementing demonstrative and replicable projects, accompanied with technical studies and research
- Organizing and participating in workshops, round-tables, conferences
- Publishing articles, research and project results
- Education and training
- Communicating to a wide audience, to inform, federate, mobilize





# The Road to Paris : as many opportunities as there are challenges

**“Sustainable cities and buildings to face climate change”**

**24, 25 and 26 June 2015 – Nice, France**

🌀 24<sup>th</sup> June - SUSTAINABLE AND COMPETITIVE HOTELS THROUGH ENERGY INNOVATION - Nearly Zero Energy Hotels 2015

🌀 25<sup>th</sup> and 26<sup>th</sup> June – UNEP-SBCI and GI-REC Joint Symposium

<http://www.nezeh.eu/nezeh2015conference/>



Co-funded by the Intelligent Energy Europe  
Programme of the European Union



**Sustainable Buildings  
and Climate Initiative**

*Promoting Policies and Practices for Sustainability*



**Cities, Engine to Sustainability**



**Contact:**  
[info@energies2050.org](mailto:info@energies2050.org)

**“Urban Carbon Mechanisms: A Handbook for Local Policy Makers”**

[www.energies2050.org](http://www.energies2050.org)

# Overview

1. Intro to the Handbook
2. The International climate negotiations context
3. Challenges for GHG mitigation in urban context
4. Metrics for measuring GHGs in built environment
5. The importance of MRV
6. Carbon & climate finance mechanisms - *overview of key mechanisms, relevance for built environment*
7. The way forward



# 1. Intro to the Handbook



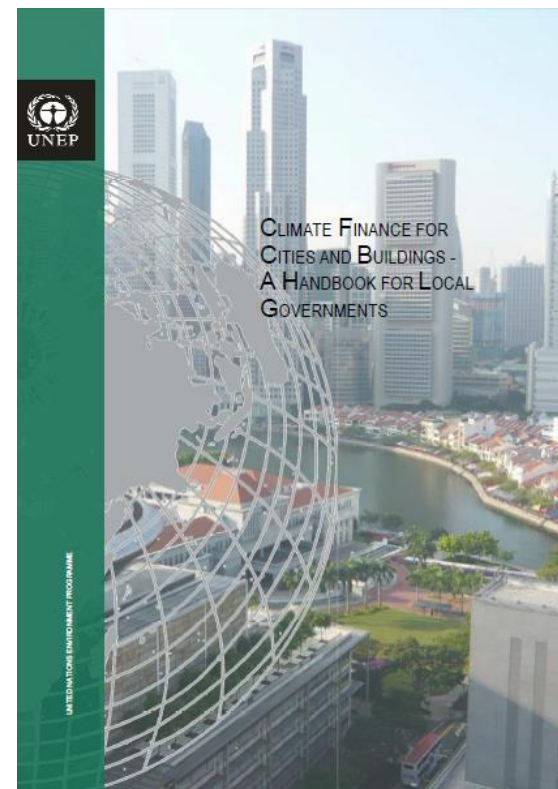
## “Urban Carbon Mechanisms: A Handbook for Local Policy Makers”

Published by UNEP in September 2014

ENERGIES 2050 lead author

### Objectives:

1. *Raise awareness of the potential for carbon & climate finance to support GHG mitigation in the built environment*
2. *Help local authorities to use carbon mechanisms as part of wider climate strategies, to increase energy performance of their district and generate revenue*



“Urban Carbon Mechanisms: A Handbook for Local Policy Makers”

[www.energies2050.org](http://www.energies2050.org)



## 2. The international climate negotiations context



🌀 **21st Conference of the Parties (COP21)** under the United Nations Framework Convention on Climate Change (UNFCCC) - Paris, France - 30 November to 11 December 2015

🌀 **Objective** : find a universal and binding agreement with ambitious targets for the post-2020 climate regime

🌀 **What's new?**

The Parties are asked to draw up a list of commitments and a positive agenda of measures (**INDCs – Intended Nationally Determined Contributions**)

In this context, decentralization and the role of local governments are crucial issues.

**MRV (Measuring, Reporting, Notifying)** is also an important aspect within the INDCs elaboration: a good opportunity to take advantage of climate finance towards low-carbon cities and buildings



### 3. Challenges for urban GHG mitigation – buildings

- ⌚ Buildings are one of the most **cost effective and expedient** opportunities for GHG mitigation (represent 1/5 of total emissions), often with co-benefits
- ⌚ But complex mix of buildings, stakeholders and technologies
- ⌚ Very local phenomenon (local needs, culture and policy)
- ⌚ Data availability is a key challenge
- ⌚ Specific obstacles include
  - ⌚ Range and distribution of emissions potential among building types
  - ⌚ “Landlord-tenant dilemma”,
  - ⌚ “Lock-in effect” of choices made regarding building components
  - ⌚ Transaction costs
  - ⌚ Rebound effect
- ⌚ We need consistency, transparency and diffusion of GHG data – hence SBCI work on the CCM

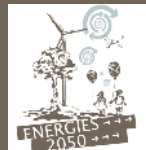


### 3. Challenges for urban GHG mitigation - cities

- ⌚ A key role to play in global climate action: generate 75% of CO<sub>2</sub> emissions
- ⌚ Plus an additional 2 billion urban inhabitants expected by 2030, meaning that the equivalent of 7 new cities of 10 millions inhabitants will have to be built every year
- ⌚ Decisions made now can have long-lasting impacts on GHG emissions
- ⌚ So cities hold **significant emissions reduction potential...**
- ⌚ ...BUT need a prominent place in climate negotiations and access to finance

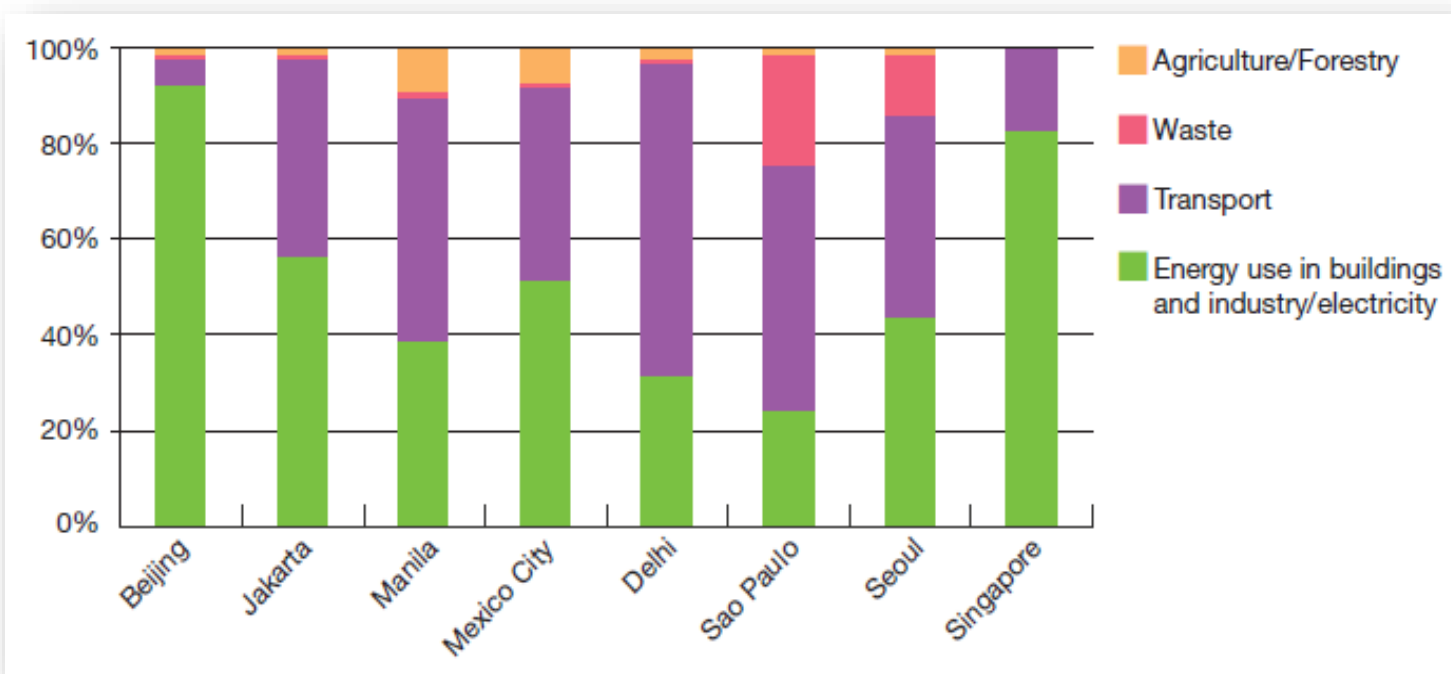
**“Cities are where the Climate Change battle will be won or lost over the next decades”**

*Marco Scuriatti, Senior Operations Officer  
at the World Bank, 2011*



## 4. Measuring GHGs in the built environment

- GHG emissions profile can vary widely by city, but the main sources remain buildings, transport, waste, industry and electricity production
- Each of these holds challenges & opportunities for GHG mitigation...but to maximize potential, local actors must be engaged



UNEP & Gwangju City 2012: *Cities and carbon finance: a feasibility study on an Urban CDM*



## 5. The importance of MRV

- Bottom line: MRV is a pre-requisite for participation in carbon finance – baseline and emissions reductions must be measured, reported and verified...



- What we cover in the research paper:
  - MRV basics (what is MRV, why is it important, what are the underlying principles)
  - MRV considerations for cities (apply to GHG inventory, available guidance, issues)
  - MRV considerations for buildings (approaches, challenges e.g. data availability)
  - General issues for MRV e.g. Types trade-off between accuracy vs complexity



## 6. Carbon & climate finance mechanisms

- ☞ Real heart of the Handbook is an overview of existing and developing carbon & climate finance mechanisms
- ☞ We define and compare **carbon finance** and **climate finance**  
And their potentially complementary role to support policy-based efforts and technology-based activities - realize greater mitigation overall
- ☞ Then we outline the mechanisms with an emphasis on their relevance for the urban context, what they do to address challenges, and their limitations  
...complimented by best practice examples



## 6. Carbon & climate finance mechanisms

### **CDM - Programme of Activities (PoA)**

*Moves validation burden away from project implementers (Component Project Activities), increased flexibility (can add more as it grows), but still technology-by-technology focus*

### **City-wide PoA**

*Momentum has gathered for multi-technology, multi-sector city scale mechanism. This could be rolled out within 1 city across several sectors – or in 1 sector across several cities*

### **NAMA**

*Climate finance approach – can be policy based...very much learning by doing. Linked closely to development objectives...city scale means sub-national government involvement*

### **NMM**

***Early days.** Definition work in progress...market readiness activities underway. Urban policy makers to watch with interest...but will they be given the chance to influence its design?*



## 6. Carbon & climate finance mechanisms

### Case Study - Large scale CDM in the transport sector - TransMilenio bus rapid transit system, Bogotá

☞ The TransMilenio integrated bus rapid transit (BRT) system:

- busways, stations and terminals adapted for large capacity buses,
- dedicated lanes with fast boarding and ticket services
- fare integrated operations
- smaller buses in the outskirt areas of the city
- centralized system that prevents congestion

#### Results:

- Clean vehicle technologies of the BRT system reduce GHG emissions by 40%
- safer transportation
- reduced travel time

The project has been registered with the CDM since 2006 and provided the model for the Bus Rapid Transit CDM methodology.

Similar projects have since followed in other cities.

**Further information:** <http://go.worldbank.org/DLIAKK1KZ0>



Bogota, Colombia. Photo: Alejandro Navarro

# 7. The way forward

## 🌀 Transform knowledge into action...

- 🌀 ...get more concrete projects in place – learning by doing, demonstrating success, testing the tools and methodologies available

## 🌀 Transform constraints into opportunities...

- 🌀 ...we know what the barriers are; newer more flexible mechanisms give us the chance to turn these around, to experiment with a multi-technology, multi-sector, city-scale approach – so long as the support is there to build capacity and get things off the ground

- 🌀 Give cities a prominent place in the negotiation process...they are the future, focus on those with rapid population growth rate

- 🌀 MRV MRV MRV MRV MRV!



# Urban Carbon Mechanisms: A Handbook for Local Policy Makers

*Thank you for your attention*

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# Public and Private Partnerships and their implications for climate change mitigation on a portfolio scale



Mr. Kevin Kampschroer,  
Federal Director,  
Office of Federal High-Performance Green Buildings,  
US General Services Administration





# Public-Private Partnerships for Energy Efficiency & Climate Change Mitigation



**GSA Office of Federal  
High-Performance Green Buildings**

**12 JULY 2015  
Kevin Kampschroer**

# GSA Performance Contracting

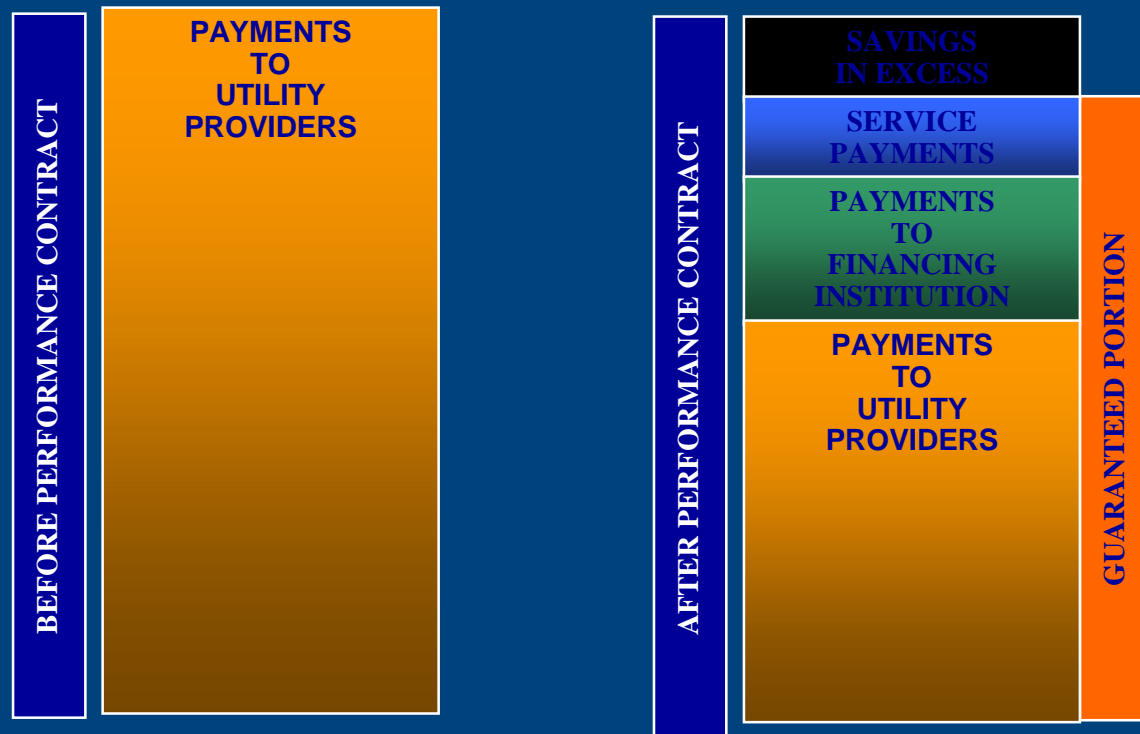
- Traditionally Prescriptive
- Code-based = Minimum Compliance  
..... vs. Maximum Performance
- Easier to Write
- Easier to Administer
- ***But...*** Requires Thinking
- Two Options:
  - Government Pays Up Front
  - Private Capital Up Front; Savings-Based Repayment

# Creating Change : Performance-Based Design-Build

- Not just procurement method
  - behavior change-agent
- Integration = path to success
  - all entities succeeded
- Competition ignited D-B team
  - fueled collaboration
- Performance spec with clear goal
  - leveraged change



# GSA Energy Savings Performance Contract (ESPC)

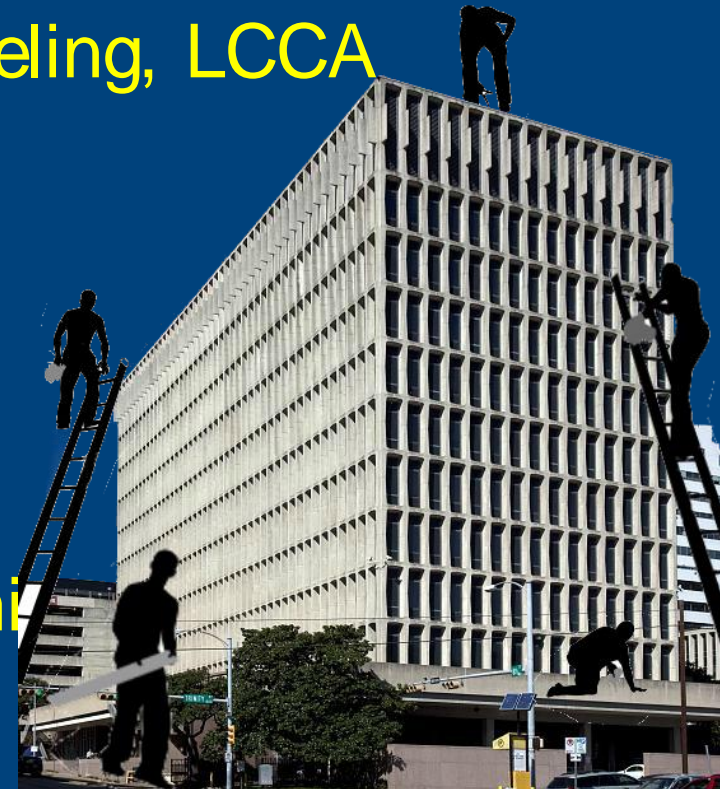


Zero or positive net impact on existing budgets.

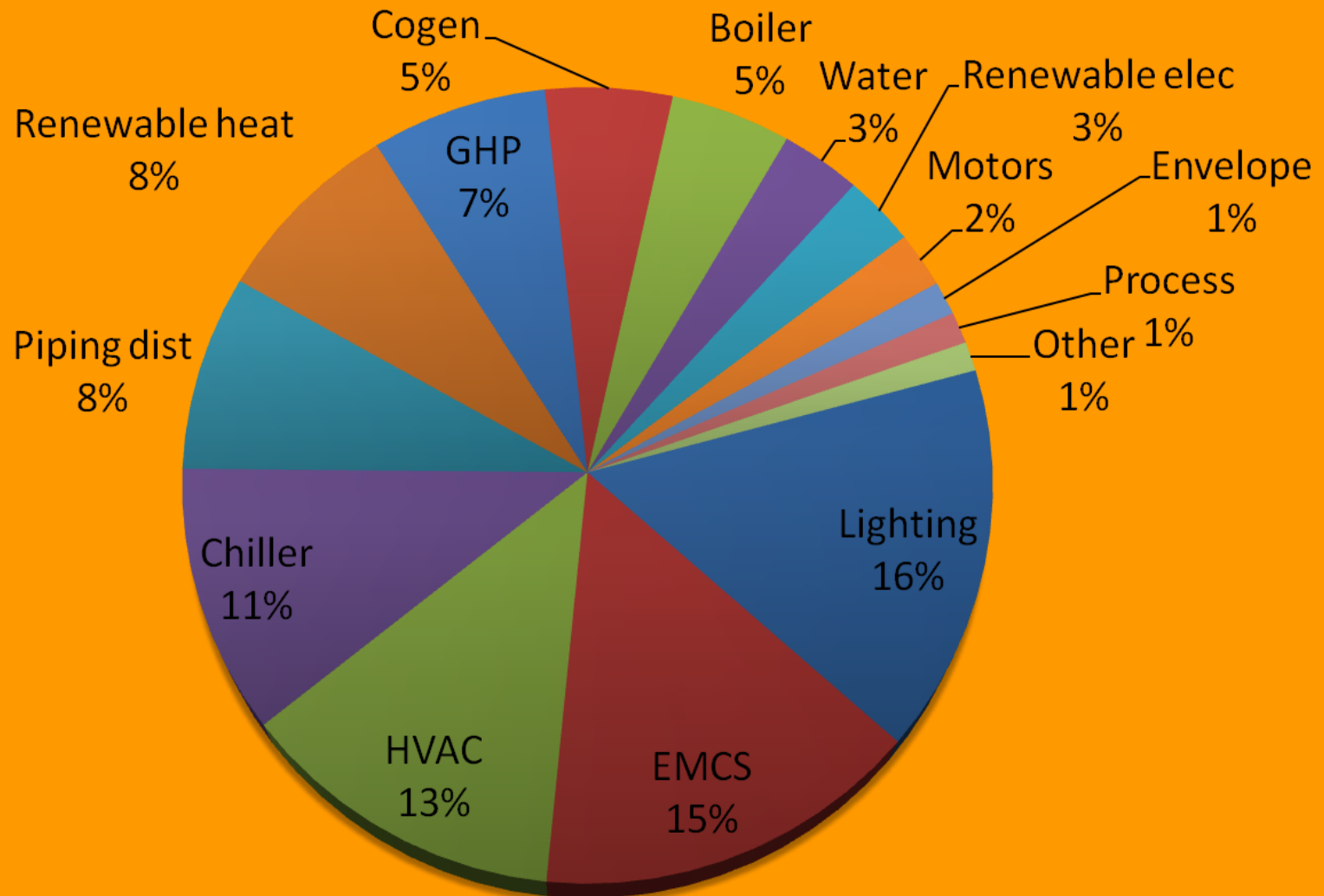


# “Deep Energy” Retrofit

- Process Differentiators
  - Building Owner Involvement
  - Integrative Design
  - Advanced Auditing, Modeling, LCCA
  - Ongoing M & V
  - Occupant Engagement
- Results:
  - Larger Energy Savings
  - Improved Project Economics



# ECMs in ESPCs



ECM's included in ESPC's by investment (Source: John Shonder, Oak Ridge National Laboratory, 2011)

# GSA Edith Green Wendell Wyatt

- 1975 Federal Building
- Never Upgraded

## Plan:

- Updating Cutting Edge 'Green' Design
- \$133 M from Recovery Act
- Full Building Modernization
- High Aims for Sustainability and Curb Appeal
- Construction procurement underway



Portland, OR



# GSA EGWW—Shading Reed Construction



- Integrated Design
- Reduced Load from Envelope
- Radiant Heating & Cooling
- Raised Ceiling (Water vs. Air: No Ducts)
- Lighting ↓ 50%: Daylighting & Controls
- Envelope Gave More Space + Systems Eliminated Risers = 1 Extra Floor

- Reduced Space Use
- 60% ↓ Energy Consumption
- 70 % ↓ Water Consumption
  - Collect All Rainwater
  - Create Cistern from Firing Range
  - No Potable Water for Chillers, Flushing or Landscape



# FEDERAL CENTER SOUTH REDEVELOPMENT



# GSA Federal Center South, Seattle, WA

- Energy = 75% Less than Average
- Integrated Design:
  - Soil Requires Deep Foundation Pilings
  - Ground Source Heat Pump Loops in Foundation
  - Phase Change Material
- Restore Wetlands
- Re-Use Timbers: Increase Span



The image shows the exterior of a modern building with a light-colored, textured facade. A large, multi-paned glass window is prominent on the upper left. A wide wooden overhang with a glass railing extends across the front of the building. The text "UNITED STATES ARMY CORPS OF ENGINEERS" is mounted on the underside of this overhang. Below the overhang is a glass entrance. The foreground is a paved plaza, and a person's head is visible in the bottom right corner.

UNITED STATES ARMY CORPS OF ENGINEERS









# Almeric Christian Federal Building St. Croix, US Virgin Islands

- \$6.4 million Energy Savings Performance Contract (ESPC)
- First Federal Buildings @ 100 % Net Zero Energy through an ESPC [No Capital Cost to Owner]
- 19-year contract with Schneider Electric
- \$13 million Energy Savings; > \$500,000 in the first year
- Building Automation System Upgrades
- Interior and Exterior Lighting Improvements
- Air Handling Unit Replacement with Variable Volume Chilled Water Distribution
- Solar Photovoltaics



# GSA New Carrollton Federal Building



**62%**  
**Energy Reduction**

**\$45 million**  
**Total Work**



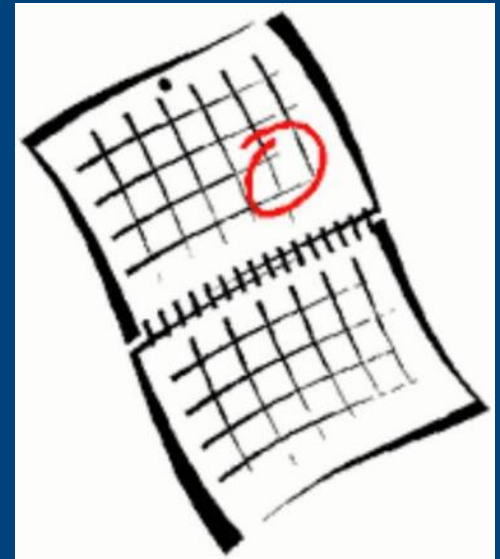
# GSA Silver Spring Metro Center Bldg 1



# GSA New Carrollton/SS Metro Center

- 1 megawatt (MW)= 10% of on-site renewable energy
- geothermal technologies
- 56% water reduction
- > 20,000 tons of GHG reduced per year
- first year savings nearly \$3 million.
- The project will include,
  - LED lighting fixtures,
  - sensors to adjust light output,
  - energy efficient chilled water plant,
  - solar canopies and
  - solar thermal heating systems.

- Planned Capital Improvement
- Major Occupancy Change
- Major System Replacement
- Upgrades to Meet Code
- Fixing an “Energy Hog”



# “Procurement of sustainable buildings: using Core Indicators to establish a quantitative baseline”



Mr. Pekka Huovila

Consultant, Ministry of Environment of Finland  
Coordinator of the 10YFP Sustainable Buildings  
& Construction programme



Ympäristöministeriö  
Miljöministeriet  
Ministry of the Environment



Ympäristöministeriö  
Miljöministeriet  
Ministry of the Environment

# Procurement of Sustainable Buildings: using Core Indicators to establish a quantitative baseline

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Pekka Huovila, Coordinator

**10YFP Sustainable Buildings and Construction Programme (SBC)**

Joint Webinar 12 June 2015

Climate Finance for Cities and Buildings and Climate-related  
mechanisms to support Sustainable Public Procurement



# Procurement of Sustainable Buildings

A proposed approach towards a quantitative baseline

- what are Sustainable Buildings?
- how to include innovation and sustainability in procurement?
- procuring “certification”, cases CASBEE, DGNB etc.
- the use of Core indicators
- case study: new UN office building in Nairobi
- future development, case: Building Information Models (BIM)



Eco-Viikki, Finland



Mwanza, Tanzania



Kigali, Rwanda



Masdar, UAE

# 10YFP SBC Programme

## Buildings and construction

- have major impacts on our environment in resource use (land, materials, energy, water), emissions (GHG, particulates, waste) and on biodiversity
- the sector can also play an important role in improving the environment by cleaning polluted areas and recycling not only its own waste streams but those of other sectors
- buildings contribute to human health, safety and comfort
- construction activities provide employment and innovation opportunities for both genders and to the youth
- the built environment represents an important share of national wealth

# Sustainability in building construction

## ISO 15392:2008

- sustainable development of buildings and other construction works
- brings about the **required performance** and functionality with **minimum adverse environmental impact**
- while encouraging improvements in economic and social (and cultural) aspects at local, regional and global levels

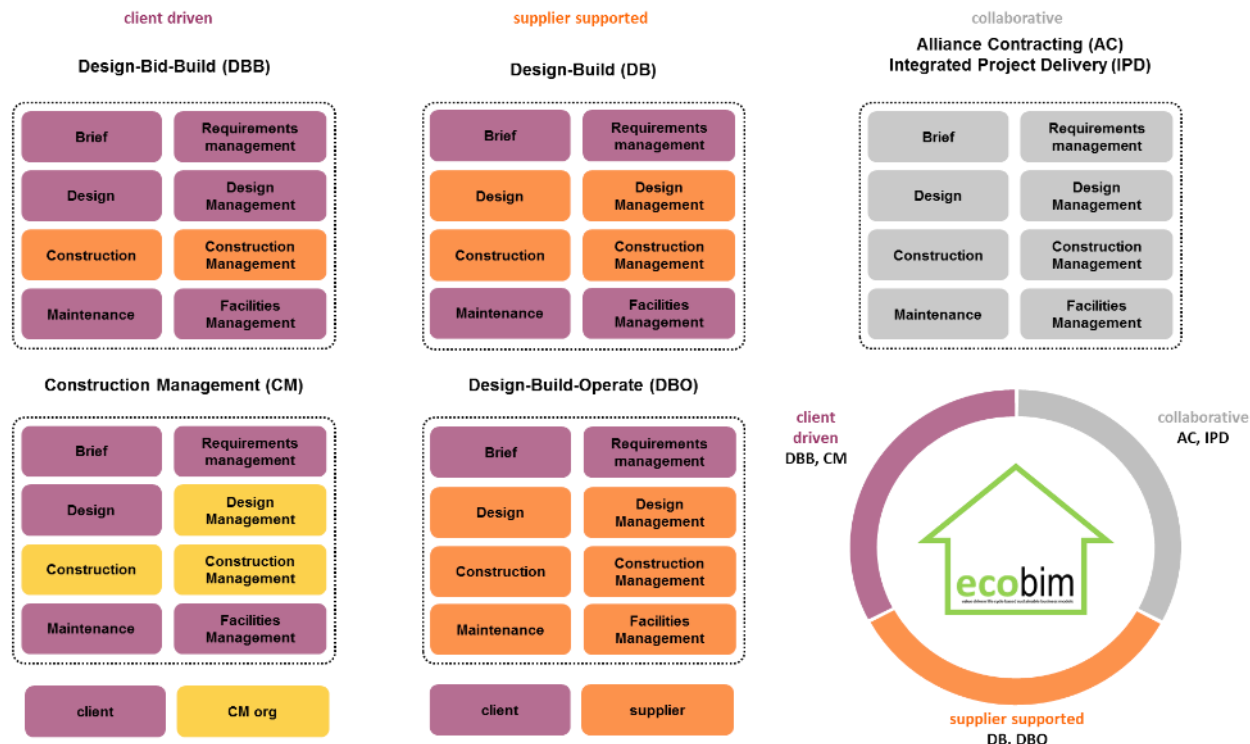
## Specific features

- long service life
- adaptability in use
- operation and maintenance

# Procuring Sustainable Buildings

## Project Delivery Systems (contracts)

- client driven (prescriptive, lowest price)
- supplier supported (performance based, life cycle concern)
- collaborative (partnering, BIM interaction)



ECOBIM PROJECT DELIVERY SYSTEM CLASSIFICATION

# Procuring Certification



## 1. Eco-Efficiency

$$= \frac{\text{Values of products or services}}{\text{Environmental load unit}}$$



## 2. Revised definition

$$= \frac{\text{Beneficial output}}{\text{Input + non-beneficial output}}$$



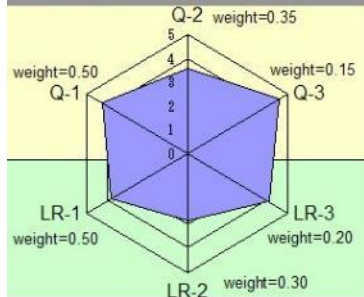
## 3. BEE in CASBEE

$$= \frac{\text{Building environmental Quality and performance}}{\text{Building environmental Loadings}}$$

### (2) Results of Comprehensive Assessment for Building Environmental Efficiency <sup>\*1,2</sup>

#### (2)-1 Results by Category

##### Radar Chart

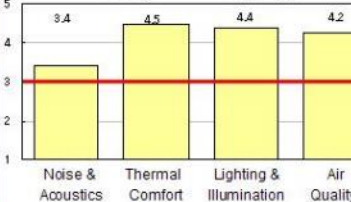


##### Q. Building Environmental Quality & Performance <sup>\*3</sup>

Score;  $S_Q = 4.0$  <sup>\*  $S_Q = 0.50 \times S_{Q1} + 0.35 \times S_{Q2} + 0.15 \times S_{Q3}$</sup>

##### Q-1 Indoor Environment

Score;  $S_{Q1} = 4.2$



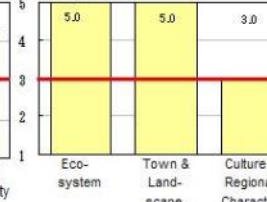
##### Q-2 Quality of Service

Score;  $S_{Q2} = 3.6$



##### Q-3 Outdoor Environment on Site

Score;  $S_{Q3} = 4.6$



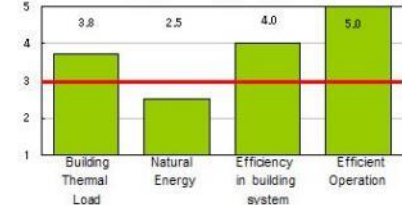
##### LR. Reduction of Building Environmental Loadings <sup>\*3</sup>

Score;  $S_{LR} = 3.6$

<sup>\*  $S_{LR} = 0.50 \times S_{LR1} + 0.30 \times S_{LR2} + 0.20 \times S_{LR3}$</sup>

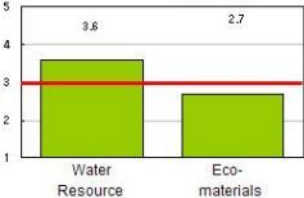
##### LR-1 Energy

Score;  $S_{LR1} = 3.8$



##### LR-2 Resources and Materials

Score;  $S_{LR2} = 2.8$



##### LR-3 Off-site Environment

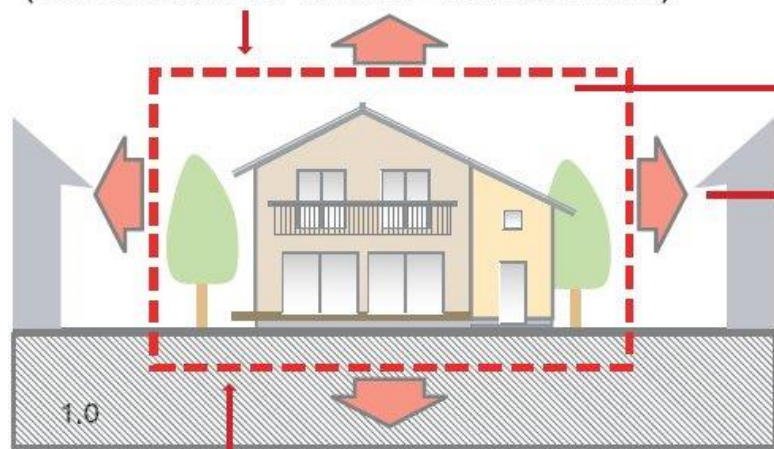
Score;  $S_{LR3} = 4.1$



# Procuring Certification



Virtual boundary  
(Demarcation for  $Q_H$  and  $L_H$  assessment)

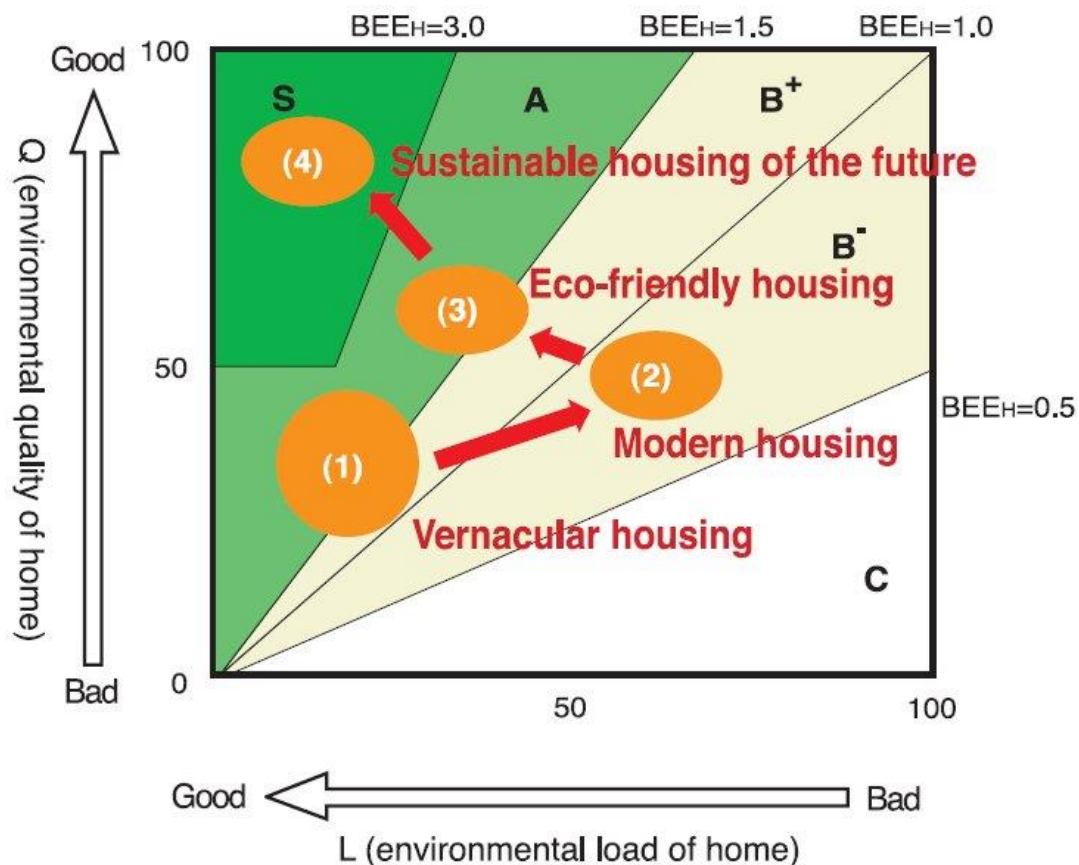


Site boundary

$Q_H$  (environmental quality)

$$BEE_H = \frac{Q_H}{L_H}$$

$L_H$  (environmental load)





# Procuring Certification

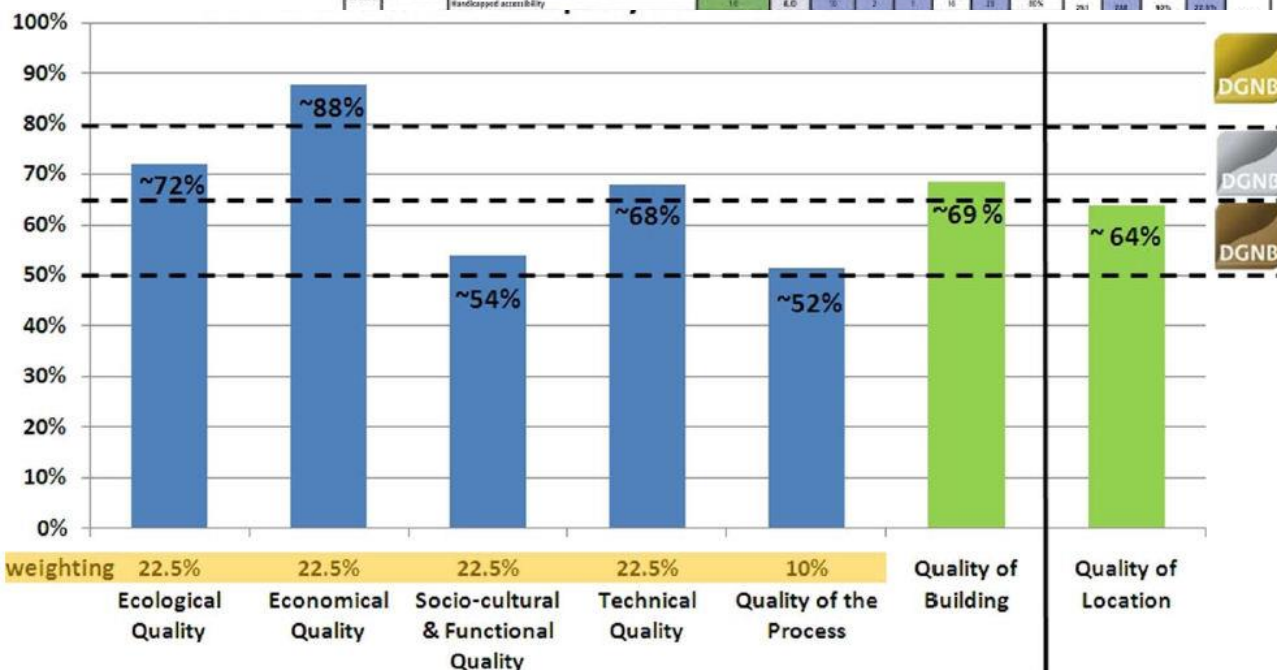
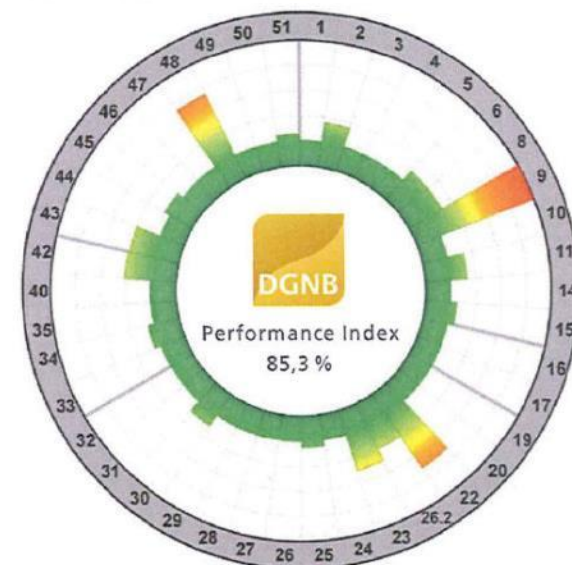
Main criterion group	Criteria Group	Criteria	Index		Criteria Points		Weighting Factor	Adaptation Factor	Weighted Points		Performance Index	Group Points		Group Performance Index	Group Weight	Total Performance Index
			Achieved	Maximum	Achieved	max. possible			Achieved	max. possible		Achieved	max. possible			
Ecological Quality	Life Cycle Analysis	Global warming potential	11	16,0	11	1	1	30	30	100%	178,5	348	89%	22,5%		
		Ozone depletion potential	11	16,0	12	1	1	10	10	100%						
		Photochemical ozone creation potential	11	16,0	12	1	1	10	10	100%						
		Acidification potential	11	16,0	11	1	1	10	10	100%						
		Eutrophication potential	11	2,9	11	1	1	1,1	1,1	178%						
	Effect on the environment (if relevant)	Risks to the local environment	11	8,8	12	1	1	24,8	8,8	82%						
		Sustainable use of resources	11	16,0	13	1	1	10	10	100%						
		Microclimate	-	-	-	-	0	-	-	-						
		Renewable primary energy demand	11	16,0	12	1	1	30	30	100%						
		Total primary energy demand and share of renewable primary energy	11	8,4	12	1	1	11	24	84%						
Resources Consumption (if relevant)	Drinking water demand and volume of waste water	11	5,8	12	2	1	10	20	50%							
	Space demand	11	16,0	12	2	1	20	20	100%							
	Economic Quality	Life Cycle Costs	Building Lifecycle Costs	11	9,6	12	1	1	21	30	90%	11	10	80%	4,0%	
Constructive Performance			Suitability for Conventions	45	10,0	10	2	1	30	30	100%					
Thermal Comfort in the winter			40	10,0	10	2	1	20	20	100%						
Socio-Cultural and Arts	Health, Comfort and Usability	Thermal Comfort in the summer	40	10,0	10	1	1	90	90	100%						
		Indoor Air Quality	11	10,0	10	1	1	30	30	100%						
		Acoustic Comfort	20	10,0	10	1	1	10	10	100%						
		Visual Comfort	70	6,5	10	1	1	26	30	85%						
		User Control Possibilities	40	6,5	10	2	1	13	20	65%						
	Quality of outdoor space	Quality of outdoor space	10	9,0	10	1	1	9	10	90%						
		Safety and risk of hazardous incidents	20	8,0	10	1	1	8	10	80%						
		Handicapped accessibility	10	8,0	10	2	1	16	20	80%						
		Socio-Cultural and Arts	Socio-Cultural and Arts	Handicapped accessibility	10	8,0	10	2	1	16	20	80%				
				Handicapped accessibility	10	8,0	10	2	1	16	20	80%				

The six fields in the DGNB certificate



Assessment chart of DGNB software

DGNB software supports those involved in the planning process. In this chart created with the program, you quickly see how the building performs in various criteria.



Example of an assessment matrix of a DGNB gold certified building, occupancy profile "New office and administrative buildings, version 2008"

# Procuring Certification

Life Cycle Management (Subject Editor: Gerald Rebitzer)

## Leadership in Energy and Environmental Design (LEED)

### A critical evaluation by LCA and recommendations for improvement

Sebastien Humbert<sup>1\*</sup>, Heike Abeck<sup>1,2</sup>, Nishil Bali<sup>1,3</sup> and Arpad Horvath<sup>4</sup>

<sup>3</sup>, University of California, Berkeley, USA

o, California, USA

ng, University of California, Berkeley, USA

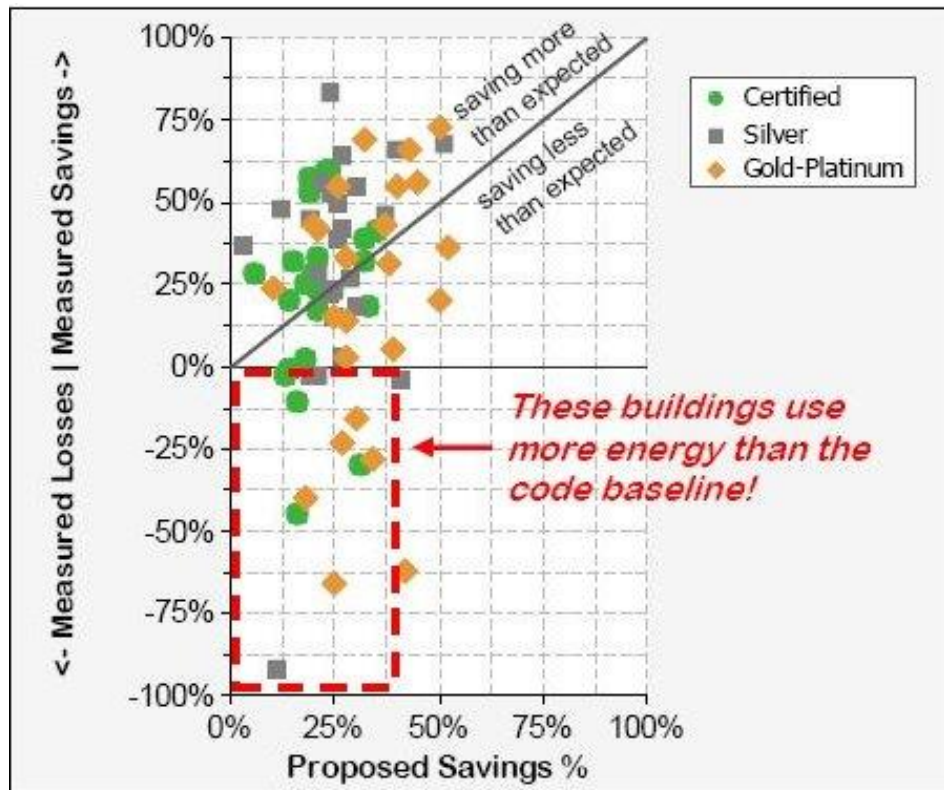


Figure ES- 5: Measured versus Proposed Savings Percentages

**Conclusions and Outlook.** Comparing the new scale with the observations on site shows that the LEED credits actually implemented are not always the most beneficial for the environment. This issue should be addressed in order to make LEED more efficient. The proposed rating system should help correct these discrepancies. The amount of reduction in employee commuting that the related credits really achieve, actual impacts of land and water use, along with the benefits of improved indoor air quality are among the main future challenges of the present study.

**Keywords:** Credits; ecoinvent database; green buildings; IMPACT 2002+; leadership in energy and environmental design (LEED); life cycle assessment (LCA); office building



# Core Metrics



<http://www.sballiance.org/our-work/publications/>

# Units for reporting data

## Green house gas emission

- CO<sub>2</sub> eq (kg)

## Energy

- primary energy (kWh)

## Water

- m<sup>3</sup>

## Wastes

- 4 type of wastes differentiated
  - hazardous (tonnes)
  - non hazardous (tonnes)
  - inert (tonnes)
  - nuclear (kg)

Data are reported for the different stages

## Thermal comfort

- % of occupied period where temperature exceeds a given value
  - e.g. 2% of time temperature above 26°C

## Indoor air quality

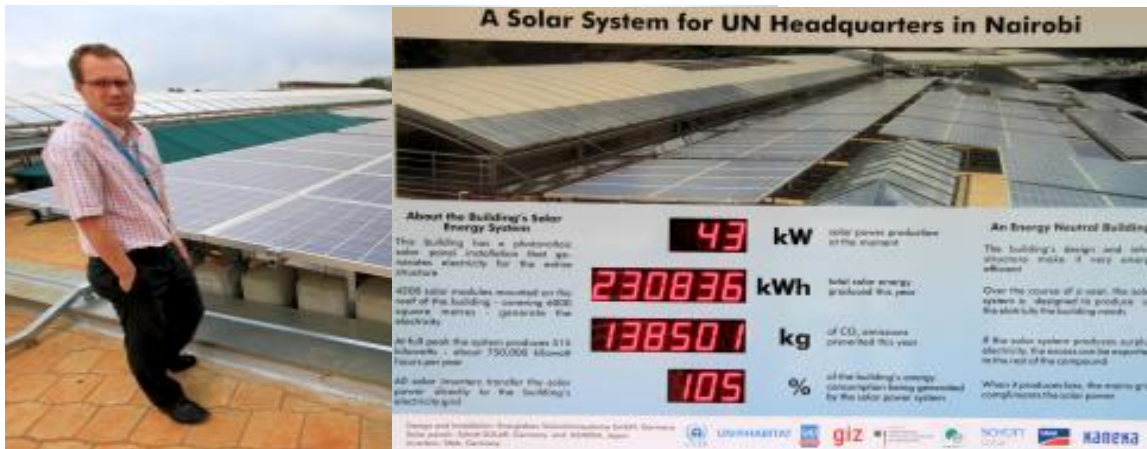
- CO<sub>2</sub> in ppm
- formaldehyde in [g/m<sup>3</sup>]

The indicators could be assessed at two stages:

- before use
- in use

# Case Study: energy, UN Nairobi

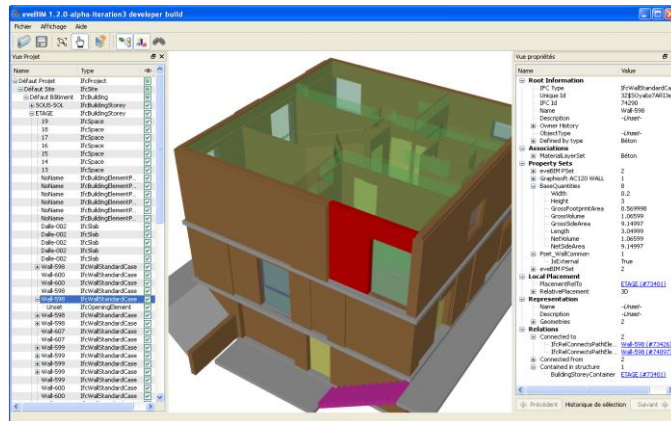
- UN objective: climate neutral building
- lowered target: energy neutral building
- estimated consumption: 147 kWh/m<sup>2</sup>/a
- new calculation: 120 kWh/m<sup>2</sup>/a
- assessment: 38... 75 kWh/m<sup>2</sup>/a
- recommendation: 70 kWh/m<sup>2</sup>/a, can be halved
- new objective: < 30 kWh/m<sup>2</sup>/a (75... 80% saving)
- measured consumption: 42,5 kWh/m<sup>2</sup>/a > energy+



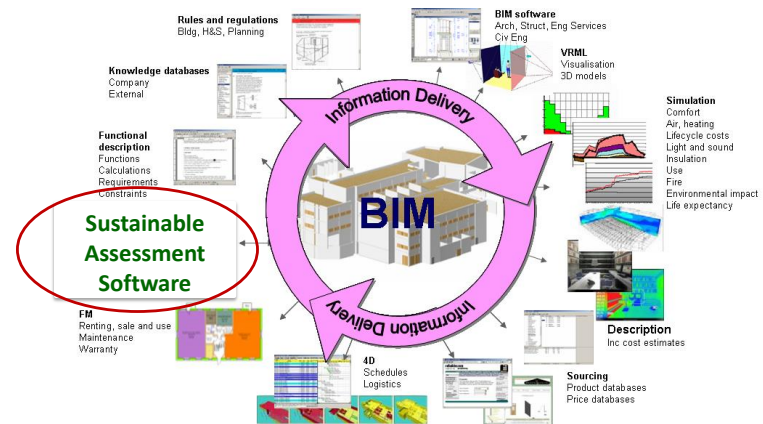
# Future development, case: BIM

## buildingSMART approach

- fit the Core metrics into IFC structures and use BIM/CAD tools to provide input data for LCA
- LCA modules integrated with commercial product model based building design software
- WEB and BIM based methodology for product manufacturers to publish Core metrics data



<http://www.sballiance.org/our-work/publications/>



# Discussion

## **Procurement of Sustainable Buildings**

using Core Indicators to establish a quantitative baseline

- set measurable targets
  - monitor, report and verify
  - improve, adjust, learn
- 
- standardization supported science based assessment
  - operable through accessible data and commercial software

# Thank you!



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