



2nd recast of the EPBD - Energy, IEQ, smart buildings & digitalisation

Frank HOVORKA

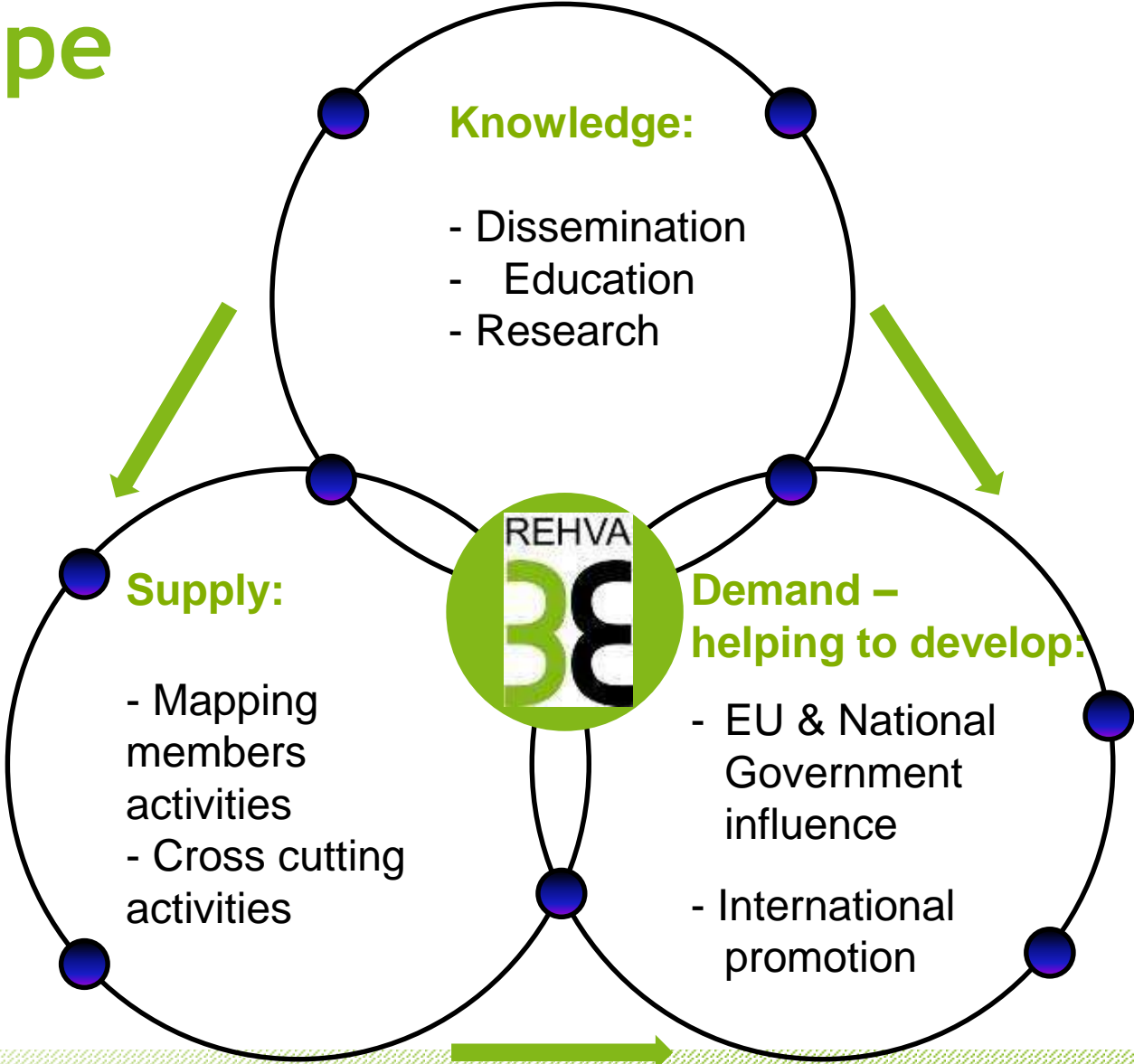
President-elect REHVA

28 member associations



100 000 HVAC & Energy experts

Scope



REHVA publications

- REHVA Journal - The European HVAC Journal www.rehva.eu
- Guidebooks and reports (>25)
- REHVA app. translation



03/2017



ACREX/2017



01/2017



02/2017

Federation of European Heating and Air-conditioning Associations (REHVA) = Professional non-profit organization with 28 member countries representing more than 100 000 HVAC & Energy experts in Europe



REHVA position paper on the European Commission proposal of the revised ENERGY PERFORMANCE OF BUILDINGS DIRECTIVE COM(2016)0765

General remarks

REHVA supports and appreciates the principles of EPBD aiming both at the improvement of energy performance in new buildings with cost optimal minimum requirements, as well as at the improvement of energy performance in existing buildings with incentives. REHVA welcomes the binding 39% energy efficiency target of the revised EPBD and is confident that the building sector can and should contribute more to achieving it. While staying on track with highly ambitious NZEB targets for new buildings, the EPBD must put more focus on the energy refurbishment of the existing building stock, including the replacement and upgrade of inefficient technical building systems that waste energy and don't deliver good indoor environment quality. The revised EPBD shall better tackle this challenge and aim at strengthening the implementation and its enforcement.

Ensuring high indoor environment quality and energy efficiency at the same time

Health and comfort of consumers should be ensured and improved in all buildings, especially when implementing deep energy retrofit projects. To achieve this, REHVA advocates for indoor environment quality (IEQ) related requirements in the EPBD. REHVA welcomes that Annex I of the legislative proposal mandates Member states to ensure minimum environment quality levels. However, to provide and maintain good and healthy indoor climate, IEQ aspects should be further strengthened in the directive.

1. The revised EPBD should set a clear mandate for Member States to define indoor environmental quality requirements that are monitored and reported in a harmonised way in building regulations across Europe.

2. IEQ criteria shall be part of the inspection of heating and cooling systems, and continuously monitored alongside the energy performance of the buildings.
3. REHVA recommends developing an indoor environmental quality indicator to be used beside the primary energy indicator. This IEQ indicator shall be reported in a transparent way in the energy performance certificates. EPC's shall provide information about indoor air quality (ventilation rate) and about the indoor thermal environment (summer and winter). This can be implemented based on the prEN 16798-1 standard (or its equivalent the ISO 17772-1), displaying in the EPC's a reference to the IEQ categories as defined by the standard.
4. The definition of technical building system should be changed to: "Technical equipment and systems for heating, cooling, ventilation, humidification, dehumidification, domestic hot water, lighting, building automation and control and electricity production used to control indoor environmental parameters in a building;" to cover also solar shading and daylight control, and air cleaning.

Ensuring quality, proper maintenance, and performance through mandatory inspection of heating, ventilation, and air-conditioning systems

The EPBD should address the quality of installed technical systems, including their regular maintenance, and support the replacement of the old equipment where appropriate. The inspection of technical building systems is of key importance in this process, because it can ensure quality, compliance with standards and building codes, as well as high energy performance. Therefore, the EPBD shall maintain and improve Articles 14-15 on the inspection of heating and air-conditioning systems. Furthermore,

it is advisable to extend the scope to ventilation and air-conditioning systems, as these are often combined and ventilation has a significant impact on energy and IEQ. The original articles were poorly implemented as it was not clear how the outcomes were to be used or enforced. REHVA welcomes that the Commission aims at improving the current requirements. However, some important aspects are not clear or missing in the proposed new version, and the requirements on the alternative continuous monitoring and IAC are technically and practically too complex to be implemented and enforced. The issues to improve are detailed below.

1. Setting and measuring clearly defined target values in a transparent way

The primary intention of the EPBD is to cost-effectively improve the energy performance of buildings. This primary intention can be achieved by setting performance requirements, but the technical means of implementation should be left open and technology neutral. Thus the market can find and optimal solutions that is important for encouraging innovation and continuous development.

The EPBD shall mandate Member States to set up and enforce a transparent inspection process with clearly defined criteria covering the following points:

- The inspection must be based on a set of generally defined system parameter values (system temperatures, flowrates, schedules, specific fan power, COPs etc.) for individual components and systems (e.g. boilers, air handling units, CHR chillers, heating circuits etc.). Data for the testing must be provided by the systems (components, BAC, monitoring systems, etc.) for inspection according to minimum standard data criteria (scope, format) that each system has to provide.
- Energy use and power demands shall be reported at the level of the various technical building systems and occupant controlled non-EPB uses (small power, lighting, and process loads).
- The measured values, design specification and product data shall enable a transparent and explicit evaluation for detecting whether a specified performance is met or not. These tests must be carried out in a technical system independent from the BAC (because the BAC data may be wrong) by an independent third party.
- Based on the results of the above evaluation, the inspection should provide guidance on the potential energy savings possible.

2. Continuous monitoring, energy management, and building automation and control (BAC)

REHVA promotes continuous monitoring and the analysis of operational data to operate buildings in a cost-effective way using automated data input. However, the currently proposed requirements (paragraphs 2, points a-c in article 14-15) mix the different competences and roles of proper operation and of the inspection process testing it. The requirements as defined now are technically too complex and difficult to implement and to enforce by the regulatory framework. Problems of the requirements a-c:

- "(a) continuously monitoring, analysing and adjusting energy usage." IAC can support this function from a central place, but not implement the complete process. The adjustment is usually done by a system operator, who is largely responsible for the building performance (e.g. by setting schedules, set points and manual operation) and has therefore to be part of the inspections scope.
- "(b) benchmarking the building's energy efficiency, detecting losses in efficiency of technical building systems and informing the person responsible for the facilities or technical building management about opportunities for energy efficiency improvement."

IAC, and all the connected services are part of the same system and therefore responsible for the performance of the building. BAC can help in detecting losses, however benchmarking a buildings energy efficiency and identifying improvement opportunities requires understanding of wider context beyond simply the building services. An external service should verify the achieved benchmarked performance, referring to wider world benchmarks and possibilities.

BAC systems are an important means of improving the energy efficiency of buildings, however, the performance of HVAC and BAC systems are highly sensitive to errors in design, construction, and operation. There are numerous examples of BAC systems not working as intended, as they are complex systems whose interaction with the buildings they serve are often not fully understood by their operators.

Therefore, equally important as the systems themselves is the quality management for testing the systems performance. Third party testing through well-defined regular inspections or continuous monitoring shall be a mandatory requirement for buildings. This can ensure the closing of the gap between designed and actual energy performance.

Main issues in 2nd recast of the EPBD

Provisionally agreed and sealed by the the third informal trilogue on 19 December 2017, approved by the European Parliament 17 April 2018, to be published in May 2018

The latest political issues addressed:

- the content, development and implementation of the long-term renovation strategy;
- electro-mobility;
- the Smart Readiness Indicator;
- energy performance databases;
- the inspections and their alternatives;
- primary energy and weighting factors;

New EPBD items discussed in this presentation

1. Renovation strategy and NZEB performance
2. Ventilation, indoor air quality and comfort levels to be defined by MS
3. Smart readiness indicator and building automation

Long-term renovation strategy

- It is stated that Member States shall establish a long-term strategy facilitating the cost-effective **transformation of existing buildings into nearly-zero energy buildings**
- This includes setting out a roadmap with measures and domestically defined measurable progress indicators, with a view to the long-term 2050 goal of reducing greenhouse gas emissions in the Union by 80-95% compared to 1990
- The roadmap shall include indicative milestones for 2030, 2040 and 2050
- The strategy should cover:
 - policies and actions to stimulate cost-effective deep renovations
 - mobilisation of investments into the renovation

Technical challenge of nZEB performance levels

JRC 2016 data:
Energy performance expressed by Member States

No consensus on NZEB EP-value

Country	Residential Buildings		Non-Residential Buildings	
	(kWh/m ² /y or Energy Class)		(kWh/m ² /y or Energy Class)	
	New	Existing	New	Existing
Austria	160	200	170	250
Belgium	45 (Brussels region) 30 (Flemish region) 60 (Walloon region)	~54	(95-2.5) *(V/S) (Brussels region) 40 (Flemish region) 60 (Walloon region)	~108
Bulgaria	~30-50	~40-60	~30-50	~40-60
Cyprus	100	100	125	125
Czech Republic	75%-80% PE	75%-80% PE	90% PE	90% PE
Germany	40% PE	55% PE	n/a	n/a
Denmark	20	20	25	25
Estonia	50 (detached house)	n/a	100 (office buildings)	n/a
		n/a	130 (hotels, restaurants)	n/a
		n/a	120 (public buildings)	n/a
Estonia	100 (apartment blocks)	n/a	130 (shopping malls)	n/a
		n/a	90 (schools)	n/a
		n/a	100 (day care centres)	n/a
France	40-65	80	70 (offices without AC)	60% PE
		n/a	110 (offices with AC)	n/a
Croatia	33-41	n/a	n/a	n/a
Hungary	50-72	n/a	60-115	n/a
Ireland	45 (Energy load)	75-150	~60% PE	n/a
Italy	Class A1	Class A1	Class A1	Class A1
Latvia	95	95	95	95
Lithuania	Class A++	Class A++	Class A++	Class A++
Luxemburg	Class AAA	n/a	Class AAA	n/a
Malta	40	n/a	60	n/a
Netherlands	0	n/a	0	n/a
Poland	60-75	n/a	45-70-190	n/a
Romania	93-217	n/a	50-192	n/a
Spain	Class A	n/a	Class A	n/a
Sweden	30-75	n/a	30-105	n/a
Slovenia	45-50	70-90	70	100
Slovakia	32 (apartment buildings)	n/a	60-96 (offices)	n/a
	54 (family houses)	n/a	34 (schools)	n/a
UK	~44	n/a	n/a	n/a



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EN

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RECOMMENDATIONS

COMMISSION RECOMMENDATION (EU) 2016/1318

of 29 July 2016

**on guidelines for the promotion of nearly zero-energy buildings and best practices to ensure that,
by 2020, all new buildings are nearly zero-energy buildings**

NZEB level of energy performance	Mediterranean Zone 1: Catania (others: Athens, Larnaca, Luga, Seville, Palermo)	Oceanic Zone 4: Paris (others: Amsterdam, Berlin, Brussels, Copenhagen, Dublin, London, Macon, Nancy, Prague, Warszawa)	Continental Zone 3: Budapest (others: Bratislava, Ljubljana, Milan, Vienna)	Nordic Zone 5: Stockholm (Helsinki, Riga, Stockholm, Gdansk, Tovarene)
	Offices kWh/(m2/y)			
net primary energy	20-30	40-55	40-55	55-70
primary energy use	80-90	85-100	85-100	85-100
on-site RES sources	60	45	45	30
	New single family house kWh/(m2/y)			
net primary energy	0-15	15-30	20-40	40-65
primary energy use	50-65	50-65	50-70	65-90
on-site RES sources	50	35	30	25

Appliances not included in offices

Appliances and lighting not included in single-family



EC recommendations and conclusions

- Set national definitions of NZEB at a high level of ambition – not below the **cost-optimal** level of minimum requirements (20/30 year LCC calculation for res/non-res).
Use **renewables in an integrated design concept** to cover the low energy requirements. Assure proper indoor environment to avoid deterioration of **IAQ, comfort and health**.
 - Most NZEB **definitions implemented** at national level.
No consensus on different aspects (e.g. system boundaries, single /building unit, on-site production, energy efficiency level, inclusion of lighting, household electricity, RES).
- **cost optimality the major NZEB criterion/tool to solve inconsistency between national NZEB and EC recommendations**

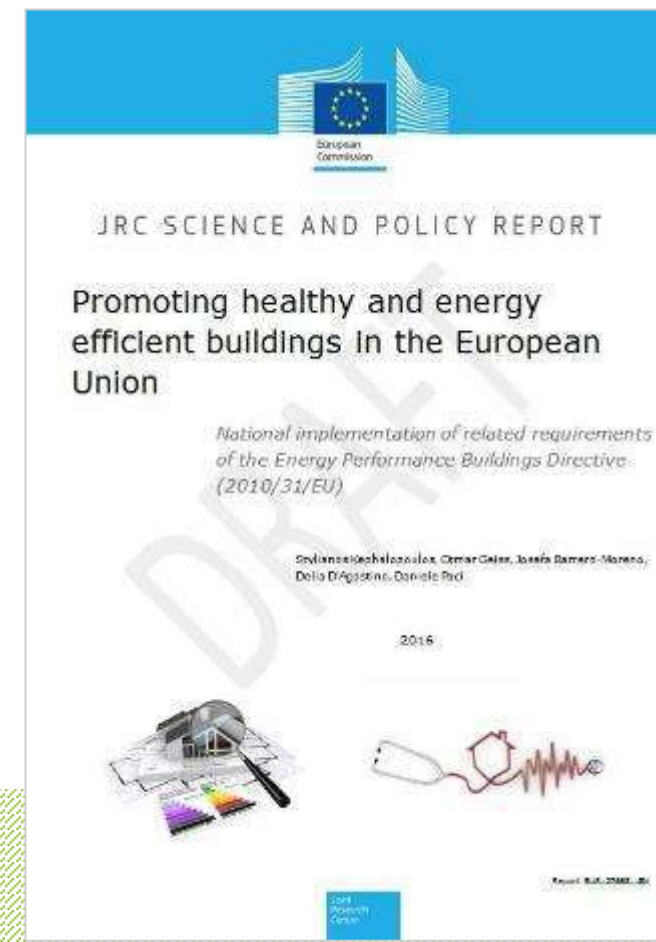
IEQ in new EPBD

Indoor Environmental Quality (IEQ) requirements in EU:

- Currently there are no binding ventilation and IEQ requirements at EU level
- From a regulatory point of view this remains under the competencies and responsibilities of the EU Member States

JRC assessment (2016) of the implementation status of the EPBD by the EU MS in terms of ventilation and indoor air quality criteria:

- Many inadequate ventilation problems reported from renovation
- New evidence that mechanical HR ventilation systems lead to an overall improvement of the IAQ and reduction of reported comfort and health related problems if properly designed and operated



Example of ventilation requirements (BPIE 2015)

- Ventilation is included in all surveyed EU MS building regulations but minimum requirements are set only for half of the countries while for the other half there are only recommended minimum ventilation rates

⇒ Is it possible to design and construct buildings without ventilation in EU?

⇒ No doubt that possible in renovation

Country and Standard Reference	Whole Building Ventilation Rates	Living Room	Bedroom	Kitchen	Bathroom + WC	WC only
Brussels (NBN D 50-001)	3.6 m ³ /(h·m ²) floor surface area	Minimum 75 m ³ /h (limited to 150 m ³ /h)	Minimum 25m ³ /h (limited to 72m ³ /h)	Open kitchen Minimum 75 m ³ /h (exhaust)	Minimum 50 m ³ /hour (limited to 75 m ³ /h)	Minimum 25 m ³ /h
Denmark (BR10)	Min. 0.3 l/s·m ² (supply)	Min. 0.3 l/(s·m ²) (supply)		20 l/s (exhaust)	15 l/s (exhaust)	10 l/s (exhaust)
France (Arrêté 24.03.82)	10-135 m ³ /h (depending on room number and ventilation system)			Continuous: 20 – 45 m ³ /h		Minimum 15 m ³ /h
Germany (DIN 1946-6)	15-285 m ³ /h (details see chapter)			45m ³ /h (nominal exhaust flow)	45 m ³ /h (nominal exhaust flow)	25 m ³ /h (nominal exhaust flow)
Italy (Legislative Decree 192/2005, UNI EN 15251)	Naturally ventilated: 0.3 – 0.6 vol/h	0.011 m ³ /s per person for an occupancy level of 0.04 persons/m ²			4 vol/h	
Poland (Art 149 (1) – Journal of Laws 2002 No. 75, item. 690, as amended and PN-B-03430:1983/Az3:2000)	20 m ³ /h for each permanent occupant should be calculated according to the Polish standard but not less than 20 m ³ /h	20-30 m ³ /h for each permanent occupant (for public buildings) For flats, it is a summary of flow from all rooms		30 m ³ /h to 70 m ³ /h without windows	50 m ³ /h	30 m ³ /h
Sweden (BFS2014:13 – BBR21)	Supply: min 0.35 l/(s·m ²) floor area					
UK (Approved Document F)	13-29 l/s (depending on bedrooms)			13-60 l/s (extract)	8-15 l/s (extract)	6 l/s (extract)
EN 15251	0.35 – 0.49 l/(s·m ²)	0.6 – 1.4 l/(s·m ²)		14-28 l/s	10-20 l/s	7-14 l/s

Requirement Recommendation European standard

EPBD ANNEX 1: ventilation, IAQ and comfort levels

- In EPBD Annex 1, new requirements are set:
 - “The energy needs for space heating, space cooling, domestic hot water, lighting, ventilation and other technical building systems shall be calculated in order to **optimise health, indoor air quality and comfort levels defined by Member States** at national or regional level”
- → clear mandate to MS to establish minimum ventilation and other IEQ requirements for new buildings and major renovations to implement the directive
- Mandate to The Commission to conduct before 2020 a feasibility study on stand-alone ventilation systems inspection, clarifying the possibilities/timeline to introduce this

Smart Readiness Indicator SRI

The 2nd EPBD recast is going to introduce a new indicator, the **Smart Readiness Indicator (SRI)**

“an assessment of the capabilities of a building or building unit to adapt its operation to the needs of the occupant and the grid and to improve its energy efficiency and overall performance”

Smart Readiness Indicator - SRI

Measure the technological readiness of your building



Readiness to
adapt in response
to the needs of the
occupant



Readiness to
facilitate main-
tenance and
efficient operation



Readiness to
adapt in response
to the situation of
the energy grid

SRI Indicator hierarchical structure

SRI INDICATOR

By VITO et al. based on multi-criteria decision making method

↳ 10 DOMAINS

Importance depends on building category

↳ SERVICES

each domain: 3 to 17

↳ FUNCTIONALITY LEVELS

each service: 2 to 5

Different importance given by the score

↳ IMPACT SCORES

8 impact categories

Impact categories provisionally equally important

SRI Domains

- 10 Domains:
 - Heating
 - Domestic hot water
 - Cooling
 - Mechanical ventilation
 - Lighting
 - Dynamic building envelope
 - Energy generation
 - Demand side management
 - Electric vehicle charging
 - Monitoring and control

SRI Final Assessment

Based on **multi-criteria** decision making (MCDM) method (**linear weighted method**), *SRI* is then:

$$SRI = \frac{1}{N_I} \sum_{I=1}^{N_I} NSC_I \cdot w_I \leq 100 \quad ; \quad \sum_{I=1}^{N_I} w_I = 1$$

to have a final *smart readiness indicator SRI* between 0 and 100 for the building.

In this case, $N_I = 8$ always, because all impacts have to be evaluated.

Method Overview

ONE SINGLE SCORE CLASSIFIES THE BUILDING'S SMART READINESS



8 IMPACT CRITERIA

energy 80%	flexibility 60%	self-generation 40%	comfort 90%	convenience 90%	health 70%	tech. follow-up 60%	info to occupant 80%
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total score is based on average of total scores on 8 impact criteria

energy a/b %

theoretical maximum
a= score b= max. building

an impact criterion score is expressed as a % of the maximum score that is achievable for the building type that is evaluated

not every domain is considered to be relevant for each impact criterion

10 DOMAINS

heating 66%

this % is the weight the domain contributes to the impact criterion

the qualitative scores for the different heating services are aggregated into a quantitative measure

domestic hot water 18%

a domain score is based on the qualitative evaluation of the implemented services on the impact criterion considered

EACH DOMAIN COVERS A SET OF SERVICES

heating serv. A	heating serv. B	heating serv. C	heating serv. D	heating serv. E	heating serv. F
heating serv. G	heating serv. H	heating serv. I	heating serv. J	heating serv. K	heating serv. L

QUALITATIVE IMPACT OF A SERVICE ON ALL IMPACT CRITERIA

heating serv. G

functionality level 1

functionality level 2

functionality level 3

functionality level 4

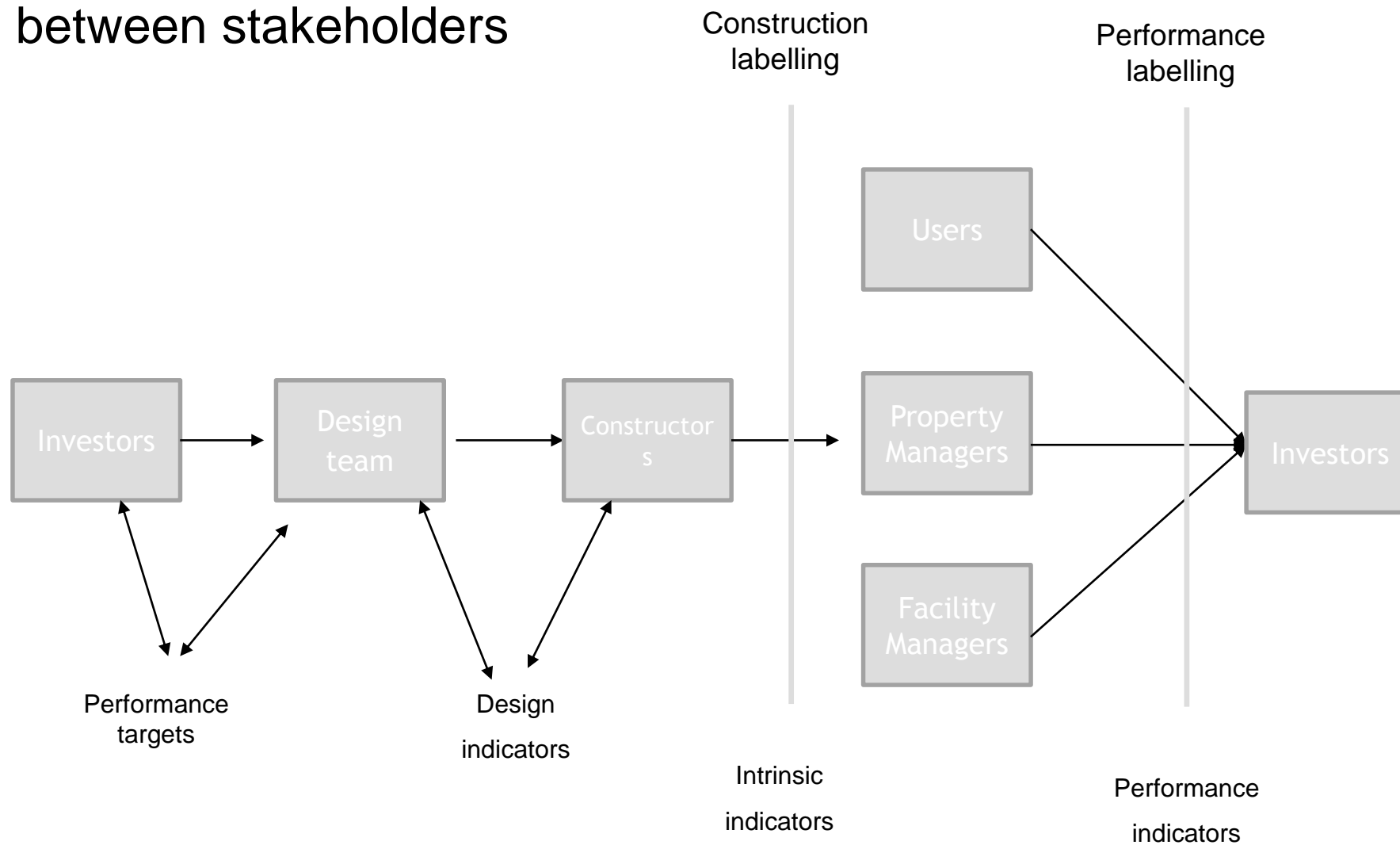
for each service several functionality levels are defined

the higher the functionality level, the higher it's expected contribution to an impact criterion

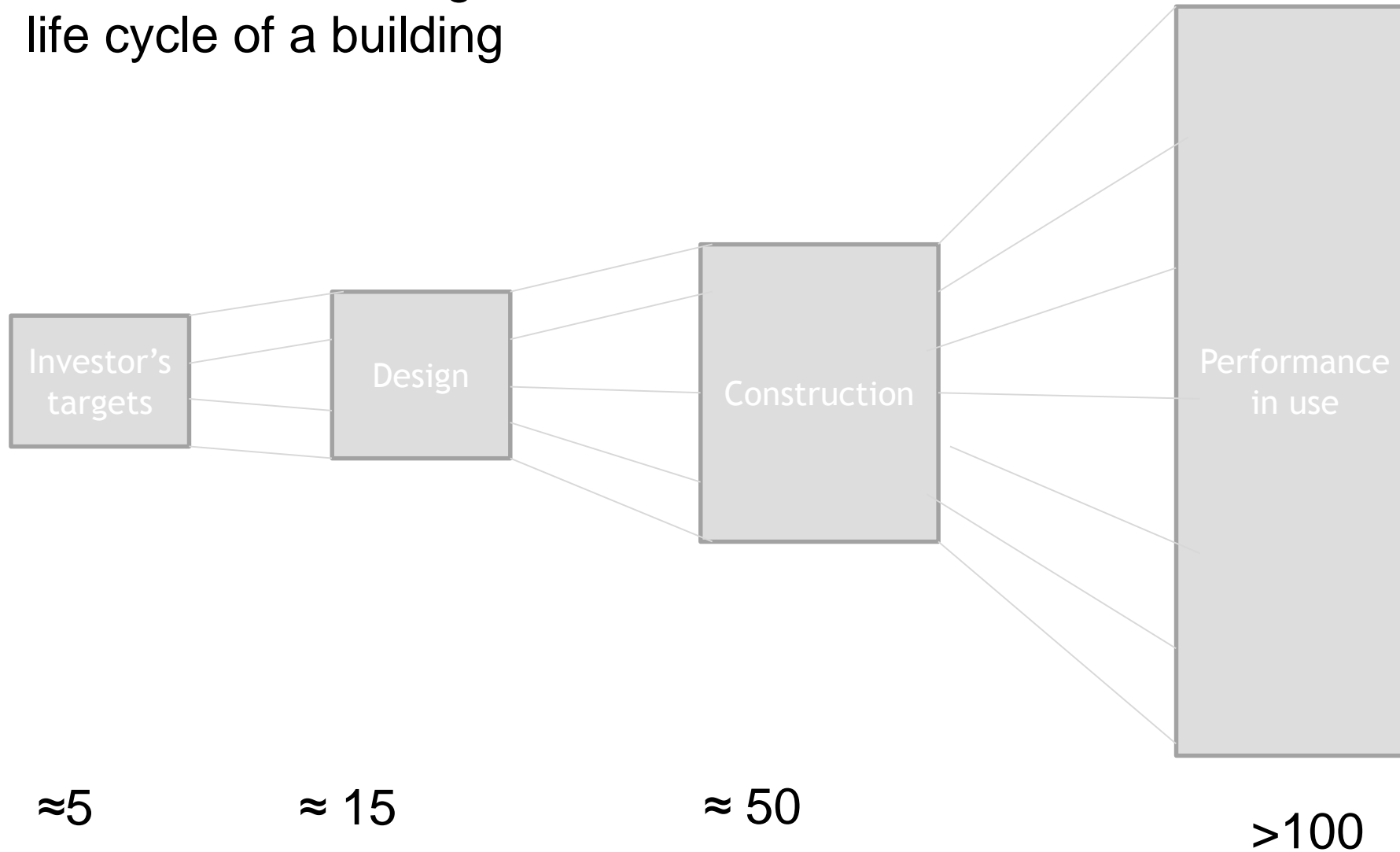
Weak points to be addressed

- Qualitative assessment of scores for almost all functionalities:
 - reference is made to EPBD standards, as EN15232 for BACS, but in an useless way: no any performance based scale is given; → **TOO MUCH SUBJECTIVE**
- The multi-criteria decision making (MCDM) method is based on weights at different levels:
 - to provide significant weighting coefficients a public enquire among buildings energy experts more than politicians has to be carried out;
 - this can be at the National level or at the European Level.

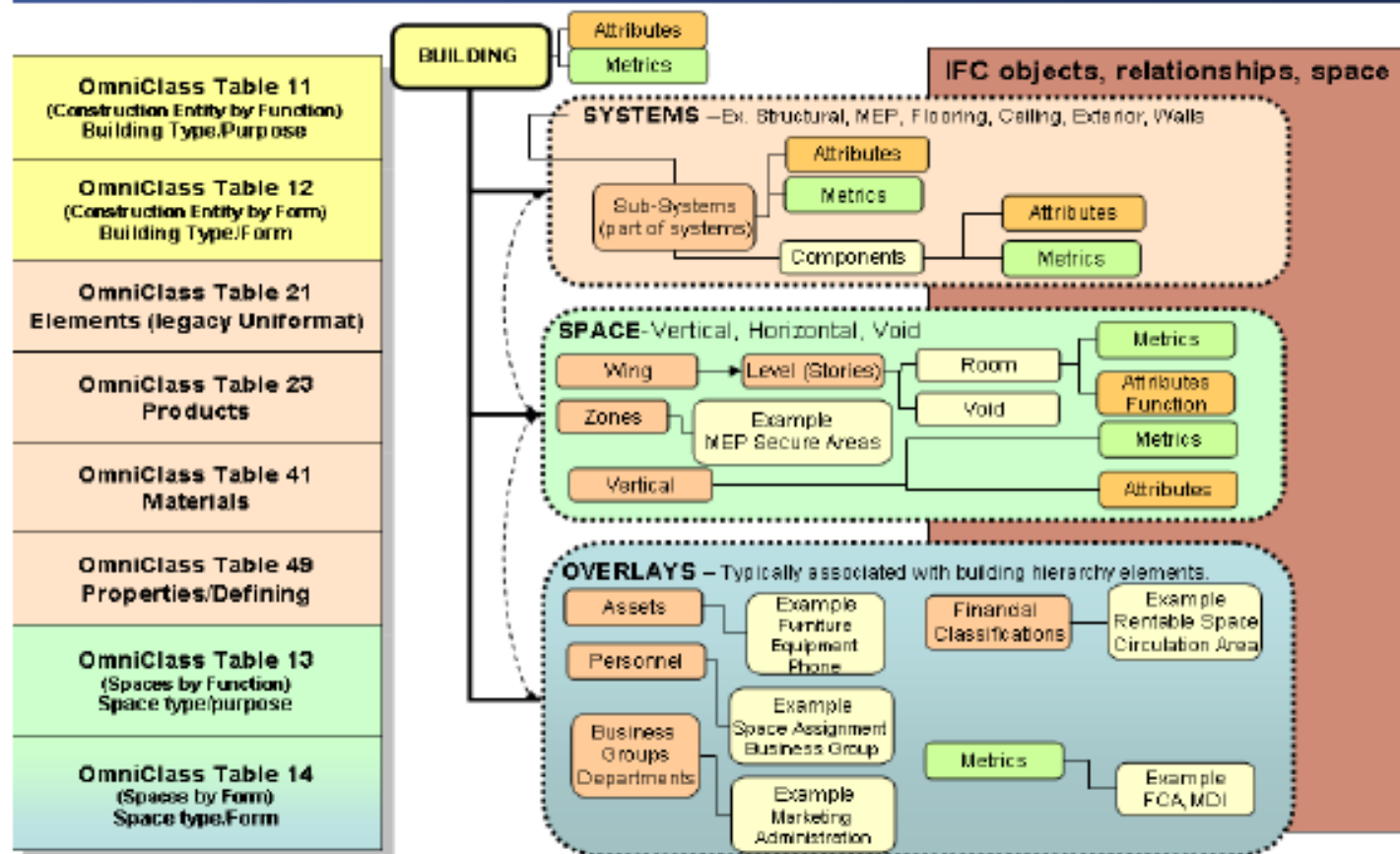
Data flow and disruption between stakeholders



Indicators list during the life cycle of a building



BIM INFORMATION HIERARCHY & INFORMATION CLASSIFICATION



Systems represent the physical entities of the building. Systems use NA classifications such as Omni-Class and Uniformat and are transported/exchanged via IFCs

Space is physical in nature, but can be unbounded (have no or cross physical boundaries) but it will always be tied to the physical structure or systems in some way

Overlays are more abstract data - organizational, operational, functional, financial, non-fixed assets, resources, personnel, etc. that is data tied to the Systems and Space

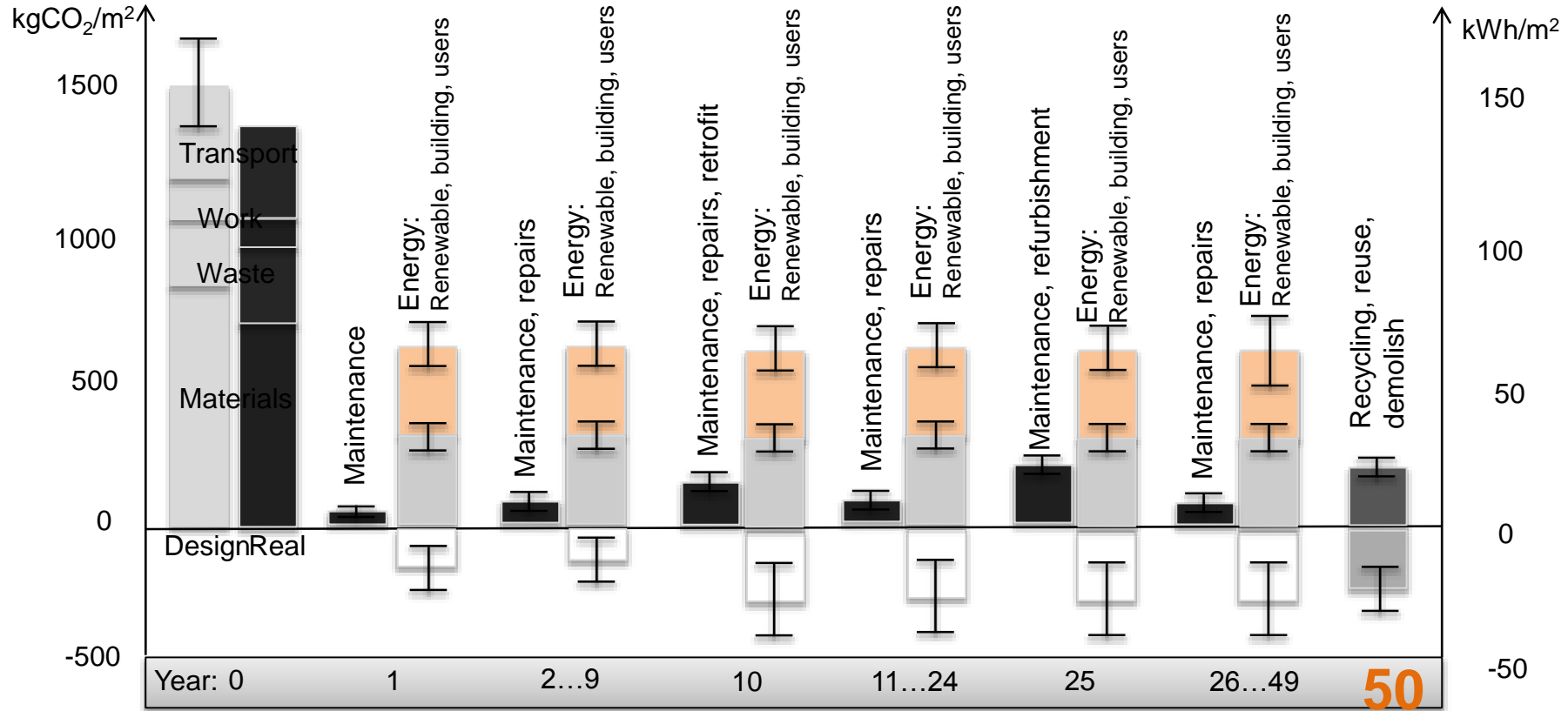
Hierarchy 1.5

Définition des exigences d'échanges d'informations (EIR)										-> Instructions		
Uniformat Level					Omniclass Level					Termes anglais	Termes français (et liens vers les fiches)	
1	2	3	4	5	Table	1	2	3	4			5
-					13-						SPACE	ESPACE
A					21-01	00	00	00	00	00	SUBSTRUCTURE	Sous-structure
A	10				21-01	10	00	00	00	00	Foundations	Fondations
A	10	10			21-01	10	10	00	00	00	Standard Foundations	Fondations standards
A	10	20			21-01	10	20	00	00	00	Special Foundations	Fondations spéciales
A	20				21-01	20	00	00	00	00	Subgrade Enclosures	Enceinte en sous-sol
A	20	10			21-01	20	10	00	00	00	Walls for Subgrade Enclosures	Murs d'enceinte en sous-sol
A	40				21-01	40	00	00	00	00	Slabs-on-Grade	Dalle inférieure
A	40	10			21-01	40	10	00	00	00	Standard Slabs-on-Grade	Dalle inférieure standard (dallage)
A	40	20			21-01	40	20	00	00	00	Structural Slabs-on-Grade	Dalle inférieure structurelle (radier)
A	40	30			21-01	40	30	00	00	00	Slab Trenches	Tranchées de dalles
A	40	40			21-01	40	40	00	00	00	Pits and Bases	Puits et bases
A	40	90			21-01	40	90	00	00	00	SlabOn-Grade Supplementary Components	Composants supplémentaires
A	60				21-01	60	00	00	00	00	Water and Gas Mitigation	Atténuation de l'eau et du gaz
A	60	10			21-01	60	10	00	00	00	Building Subdrainage	Sous-drainage du bâtiment
A	60	20			21-01	60	20	00	00	00	Off-Gassing Mitigation	Atténuation du dégagement de gaz
A	90				21-01	90	00	00	00	00	Substructure Related Activities	Activités relatives à la sous-structure
A	90	10			21-01	90	10	00	00	00	Substructure Excavation	Excavation en sous-structure
A	90	20			21-01	90	20	00	00	00	Construction Dewatering	Drainage
A	90	30			21-01	90	30	00	00	00	Excavation Support	Support à l'excavation
A	90	40			21-01	90	40	00	00	00	Soil Treatment	Dépollution
B					21-02	00	00	00	00	00	SHELL	Enveloppe
B	10				21-02	10	00	00	00	00	Superstructure	Superstructure
B	10	10			21-02	10	10	00	00	00	Floor Construction	Construction des dalles supérieures
B	10	20			21-02	10	20	00	00	00	Roof Construction	Construction des toitures
B	10	80			21-02	10	80	00	00	00	Stairs	Escaliers
B	20				21-02	20	00	00	00	00	Exterior Vertical Enclosures	Enceinte verticale extérieure
B	20	10			21-02	20	10	00	00	00	Exterior Walls	Murs extérieurs
B	20	20			21-02	20	20	00	00	00	Exterior Windows	Fenêtres extérieures
B	20	50			21-02	20	50	00	00	00	Exterior Doors and Grilles	Portes extérieures
B	20	70			21-02	20	70	00	00	00	Exterior Louvers and Vents	Jalousies et conduits extérieurs
B	20	80			21-02	20	80	00	00	00	Exterior Wall Appurtenances	Accessoires des murs extérieurs
B	20	90			21-02	20	90	00	00	00	Exterior Wall Specialties	Spécialités du murs extérieurs
B	30				21-02	30	00	00	00	00	Exterior Horizontal Enclosures	Enceinte horizontale extérieure
B	30	10			21-02	30	10	00	00	00	Roofing	Toiture
B	30	20			21-02	30	20	00	00	00	Roof Appurtenances	Accessoires de toit
B	30	40			21-02	30	40	00	00	00	Traffic Bearing Horizontal Enclosures	Toiture terrasse
B	30	60			21-02	30	60	00	00	00	Horizontal Openings	Ouvertures horizontales
B	30	80			21-02	30	80	00	00	00	Overhead Exterior Enclosures	Couvertures externes

Building Passport

Name:
 Address:
 Year of completion:
 Heated floor area:
 Number of occupants:

Designed indoor climate class: A/B/C	Measured user satisfaction: %
Indoor Environment Quality	



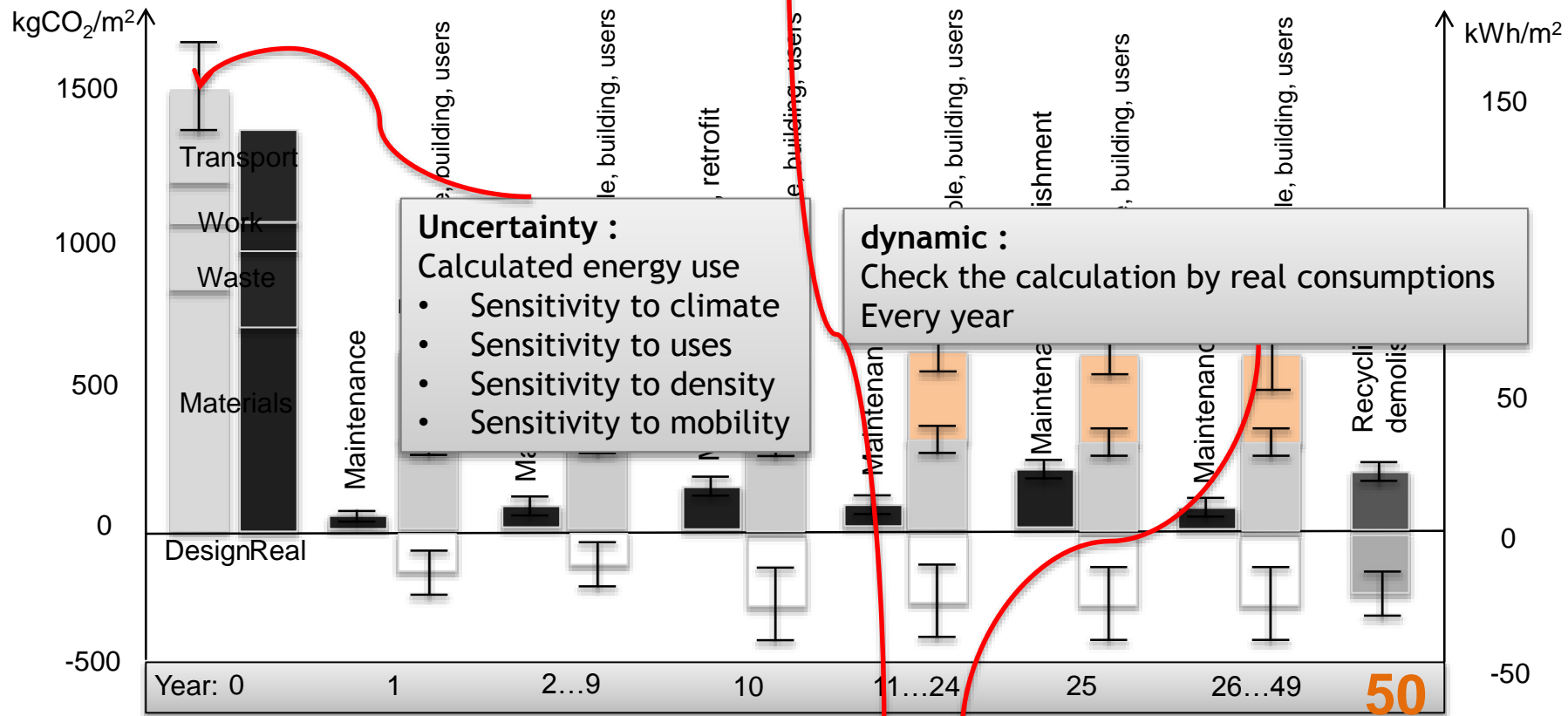
Primary kWh/m ²	Embodied: kgCO ₂ /m ²	Operational: kgCO ₂ /m ² , a	Embodied: kgCO ₂ /m ² , a	Recycling: kgCO ₂ /m ²	Measured kWh/m ²	Energy kgCO ₂ /pers, a	Travel kgCO ₂ /pers, a	Water m ³ /pers, a
Energy Performance Certificate	Designed carbon footprint of building				Display Energy Certificate	Annual Footprint	Recycling of waste %	Landfill waste kg/pers, a

Building Passport

Name:
Address:
Year of completion:
Heated floor area:
Number of occupants:

IPMS and IPMVP : Measurement definition

Designed	Measured user satisfaction: %
Indoor Environment Quality	



Uncertainty :

- Calculated energy use
- Sensitivity to climate
- Sensitivity to uses
- Sensitivity to density
- Sensitivity to mobility

dynamic :

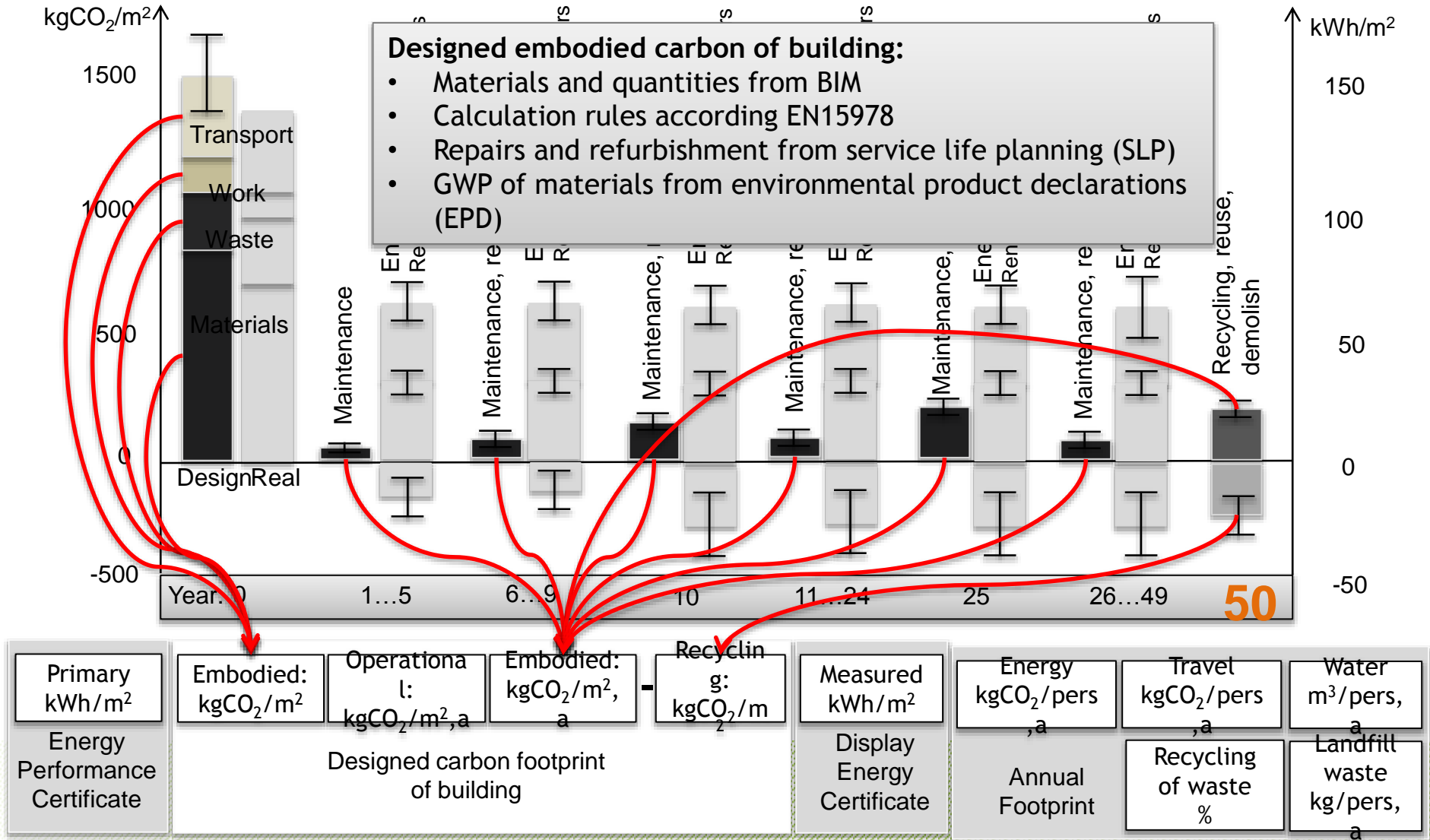
Check the calculation by real consumptions Every year

Primary kWh/m ²	Embodied: kgCO ₂ /m ²	Operational: kgCO ₂ /m ² , a	Embodied: kgCO ₂ /m ² , a	Recycling: kgCO ₂ /m ²	Measured kWh/m ²	Energy kgCO ₂ /pers, a	Travel kgCO ₂ /pers, a	Water m ³ /pers, a
Energy Performance Certificate	Designed carbon footprint of building				Display Energy Certificate	Annual Footprint	Recycling of waste %	Landfill waste kg/pers, a

Building Passport

Name:
 Address:
 Year of completion:
 Heated floor area:
 Number of occupants:

Designed indoor climate class: A/B/C	Measured user satisfaction: %
Indoor Environment Quality	



Holistic approach with 8 metrics

Economy

- Lifecycle Cost (EN 15643-4)

Energy

- Imported energy
- Imported primary energy
- Baseload power

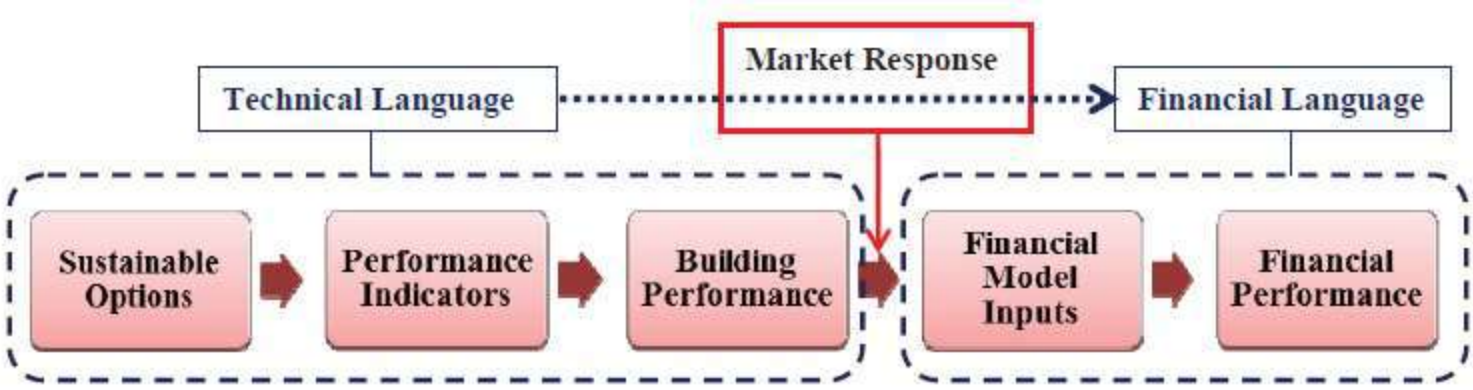
Global warming

- Life-cycle carbon footprint (EN 15978)
- Operating carbon footprint (GHG Protocol)

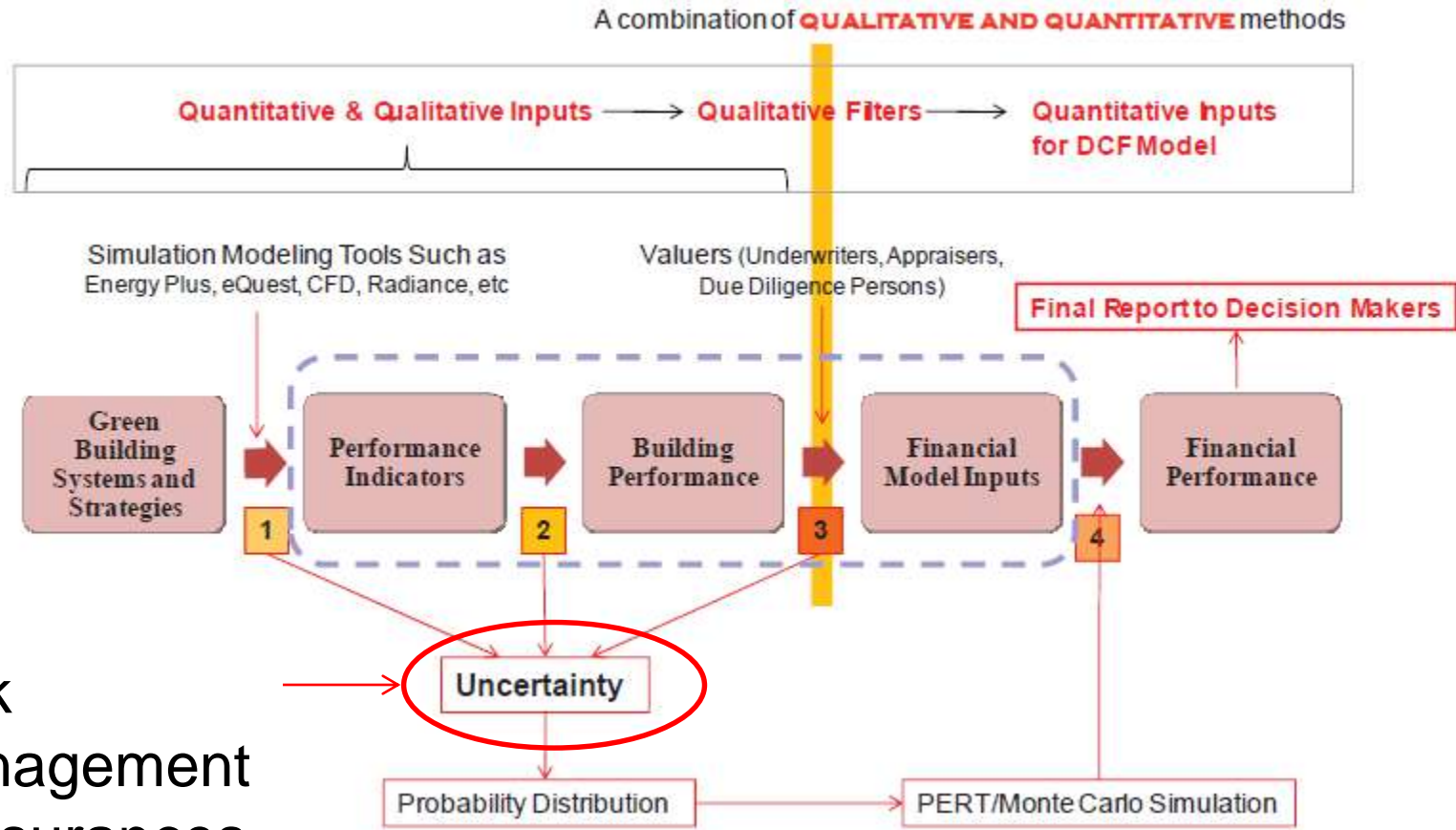
Occupants

- Indoor air quality classification
- Share of satisfied occupants

Communication but mainly translation



The challenge



Risk management & insurances

A FRAMEWORK FOR INTEGRATING VALUE AND UNCERTAINTY IN THE SUSTAINABLE OPTIONS ANALYSIS IN REAL ESTATE INVESTMENT

➤ BAS : Building As a Service ?