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

Frank HOVORKA
President-elect REHVA
28 member associations

100,000 HVAC & Energy experts
Scope

Knowledge:
- Dissemination
- Education
- Research

Demand – helping to develop:
- EU & National Government influence
- International promotion

Supply:
- Mapping members activities
- Cross cutting activities

Knowledge:
- Dissemination
- Education
- Research
REHVA publications

- REHVA Journal - The European HVAC Journal [www.rehva.eu]

- Guidebooks and reports (>25)

- REHVA app. translation
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)785

1. IEQ standard shall be based on the principles of heating and cooling systems, and continuously improved to be able to support the sustainable development of the building energy performance.
2. IEQ standard shall be supported by the certification of heating and cooling systems, and continuously improved to be able to support the sustainable development of the building energy performance.
3. IEQ standard shall be based on the principles of heating and cooling systems, and continuously improved to be able to support the sustainable development of the building energy performance.

Setting and managing clearly defined targets in a transparent way

- The existing system for the setting and determining the energy performance of buildings is not transparent enough. Therefore, the national and European authorities should be involved in the process of setting and determining the energy performance of buildings.

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Main issues in 2nd recast of the EPBD

Provisionally agreed and sealed by 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

<table>
<thead>
<tr>
<th>Country</th>
<th>Residential Buildings (kWh/m²/yr or Energy Class)</th>
<th>Non-Residential Buildings (kWh/m²/yr or Energy Class)</th>
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<tbody>
<tr>
<td></td>
<td>New</td>
<td>Existing</td>
</tr>
<tr>
<td>Austria</td>
<td>160</td>
<td>200</td>
</tr>
<tr>
<td>Belgium</td>
<td></td>
<td>−54</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>−30–50</td>
<td>40</td>
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<tr>
<td>Cyprus</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>75–80% PE</td>
<td>75–80% PE</td>
</tr>
<tr>
<td>Germany</td>
<td>40% PE</td>
<td>55% PE</td>
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<td>Denmark</td>
<td>20</td>
<td>20</td>
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<tr>
<td>Estonia</td>
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<tr>
<td></td>
<td>n/a</td>
<td>n/a</td>
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</tbody>
</table>

No consensus on NZEB EP-value
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

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Offices kWh/(m²/y)</td>
<td>net primary energy</td>
<td>primary energy use</td>
<td>on-site RES sources</td>
<td>net primary energy</td>
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<tr>
<td>Mediterranean</td>
<td>20-30</td>
<td>80-90</td>
<td>60</td>
<td>0-15</td>
</tr>
<tr>
<td>Oceanic</td>
<td>40-55</td>
<td>85-100</td>
<td>45</td>
<td>15-30</td>
</tr>
<tr>
<td>Continental</td>
<td>40-55</td>
<td>85-100</td>
<td>45</td>
<td>20-40</td>
</tr>
<tr>
<td>Nordic</td>
<td>55-70</td>
<td>85-100</td>
<td>30</td>
<td>40-65</td>
</tr>
</tbody>
</table>

**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
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

<table>
<thead>
<tr>
<th>Country and Standard Reference</th>
<th>Whole Building Ventilation Rates</th>
<th>Living Room</th>
<th>Bedroom</th>
<th>Kitchen</th>
<th>Bathroom + WC</th>
<th>WC only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brussels (NBN D 50-001)</td>
<td>3.6 m³/(h m²) floor surface area</td>
<td>Minimum 75 m³/h limited to 150 m³/h</td>
<td>Minimum 25 m³/h limited to 72 m³/h (exhaust)</td>
<td>Open kitchen Minimum 75 m³/h (exhaust)</td>
<td>Minimum 50 m³/h limited to 75 m³/h</td>
<td>Minimum 25 m³/h</td>
</tr>
<tr>
<td>Denmark (SR 10)</td>
<td>Min. 0.3 l/(s m²) (supply)</td>
<td>Min. 0.3 l/(s m²) (supply)</td>
<td>20 l/s (exhaust)</td>
<td>15 l/s (exhaust)</td>
<td>10 l/s (exhaust)</td>
<td></td>
</tr>
<tr>
<td>France (Arrêté 24.09.82)</td>
<td>10-135 m³/h (depending on room number and ventilation system)</td>
<td>Continuous: 20 - 45 m³/h</td>
<td>45 m³/h (nominal exhaust flow)</td>
<td>45 m³/h (nominal exhaust flow)</td>
<td>Minimum 15 m³/h</td>
<td></td>
</tr>
<tr>
<td>Germany (DIN 1946-6)</td>
<td>15-285 m³/h (details see chapter)</td>
<td>45 m³/h (nominal exhaust flow)</td>
<td>45 m³/h (nominal exhaust flow)</td>
<td>25 m³/h (nominal exhaust flow)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Italy (Legislative Decree 192/2005, UNI EN 15251)</td>
<td>Naturally ventilated: 0.3 – 0.6 vol/h</td>
<td>0.011 m³/s per person for an occupancy level of 0.04 persons/m²</td>
<td>4 vol/h</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poland (Art.149 (1) – Journal of Laws 2002 No. 75, item. 690, as amended and PN-B-03430:1983/ A23:2000)</td>
<td>20 m³/h for each permanent occupant should be calculated according to the Polish standard but not less than 20 m³/h</td>
<td>20 -30 m³/h for each permanent occupant (for public buildings) For flats, it is a summary of flow from all rooms</td>
<td>80 m³/h to 70 m³/h without windows</td>
<td>30 m³/h</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sweden (BF52014:13 – BBR21)</td>
<td>Supply: min 0.35 l/(s m²) floor area</td>
<td>20 m³/h for each permanent occupant (for public buildings)</td>
<td>80 m³/h to 70 m³/h without windows</td>
<td>50 m³/h</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UK (Approved Document F)</td>
<td>13-29 l/s (depending on bedrooms)</td>
<td>13-60 l/s (extract)</td>
<td>8-15 l/s (extract)</td>
<td>6 l/s (extract)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EN 15251</td>
<td>0.35 – 0.49 l/(s m²)</td>
<td>14-28 l/s</td>
<td>10-20 l/s</td>
<td>7-14 l/s</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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 2\textsuperscript{nd} EPBD recast is going to introduce a new indicator, the \textit{Smart Readiness Indicator (SRI)}

\textit{“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”}

\textbf{Smart Readiness Indicator - SRI}

Measure the technological readiness of your building
SRI Indicator hierarchical structure

SRI INDICATOR

- 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

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

Investors ➔ Design team ➔ Constructors ➔ Property Managers ➔ Investors

Performance targets ➔ Design indicators ➔ Intrinsic indicators ➔ Performance indicators

Users ➔ Performance labelling

Construction labelling ➔ Facility Managers ➔ Performance labelling
Indicators list during the life cycle of a building

Investor’s targets ≈ 5
Design ≈ 15
Construction ≈ 50
Performance in use >100
# BIM Information Hierarchy & Information Classification

<table>
<thead>
<tr>
<th>OmniClass Table 11</th>
<th>OmniClass Table 12</th>
<th>OmniClass Table 21</th>
<th>OmniClass Table 20</th>
<th>OmniClass Table 41</th>
<th>OmniClass Table 49</th>
<th>OmniClass Table 13</th>
<th>OmniClass Table 14</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Construction Entity by Function) Building Type/Purpose</td>
<td>(Construction Entity by Form) Building Type/Form</td>
<td>Elements (legacy Uniformat)</td>
<td>Products</td>
<td>Materials</td>
<td>Properties/Defining</td>
<td>(Spaces by Function) Space type/purpose</td>
<td>(Spaces by Form) Space type/Form</td>
</tr>
</tbody>
</table>

**Building**

- Attributes
- Metrics

**IFC objects, relationships, space**

- Systems – Ex. Structural, MEP, Flooring, Ceiling, Exterior, Walls
- Attributes
- Metrics

**SPACE**

- Vertical, Horizontal, Void
- Attributes
- Metrics

- Zones
- Example: MEP-Safe Areas
- Attributes
- Metrics

**OVERLAYS** – Typically associated with building hierarchy elements

- Assets
- Personnel
- Example: Furniture, Equipment, Phone

- Business Groups
- Departments
- Example: Space Assignment, Business Group

- Example: Marketing, Administration

- Financial Classifications
- Example: Rentable Space, Circulation Area

**Hierarchy 1.5**

- 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.
<table>
<thead>
<tr>
<th>Uniformat Level</th>
<th>Omniclass Level</th>
<th>Termes anglais</th>
<th>Termes français (et liens vers les fiches)</th>
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<td>1 2 3 4 5</td>
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<td>ESPACE</td>
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<td>A 21-01</td>
<td>00 00 00 00</td>
<td>SUBSTRUCTURE</td>
<td>Sous-structure</td>
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<td>A 21-01</td>
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<td>Foundations</td>
<td>Fondations</td>
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<td>Standard Foundations</td>
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<td>Fondations spéciales</td>
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<td>Subgrade Enclosures</td>
<td>Enceinte en sous-sol</td>
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<tr>
<td>A 20 21-01</td>
<td>20 10 00 00</td>
<td>Walls for Subgrade Enclosures</td>
<td>Murs d’enceinte en sous-sol</td>
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<tr>
<td>A 20 21-01</td>
<td>40 00 00 00</td>
<td>Slabs-on-Grade</td>
<td>Dalle inférieure</td>
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<td>Standard Slabs-on-Grade</td>
<td>Dalle inférieure standard (dallage)</td>
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<td>Tranchées de dalles</td>
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<td>Pits and Bases</td>
<td>Puits et bases</td>
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<td>SlabOn-Grade Supplementary Components</td>
<td>Composants supplémentaires</td>
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<td>60 00 00 00</td>
<td>Water and Gas Mitigation</td>
<td>Atténuation de l’eau et du gaz</td>
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<td>A 60 21-01</td>
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<td>Sous-drainage du bâtiment</td>
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<td>Atténuation du dégagement de gaz</td>
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<td>Activités relatives à la sous-structure</td>
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<td>Roof Construction</td>
<td>Construction des toitures</td>
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<td>Étages</td>
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<td>Exterior Walls</td>
<td>Murs extérieurs</td>
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<td>Exterior Windows</td>
<td>Fenêtres extérieures</td>
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<td>B 20 21-02</td>
<td>20 50 00 00</td>
<td>Exterior Doors and Grilles</td>
<td>Portes extérieures</td>
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<td>Exterior Louvers and Vents</td>
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<td>Exterior Wall Appurtenances</td>
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<td>Toiture</td>
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<td>Ouvertures horizontales</td>
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<td>30 60 00 00</td>
<td>Overhead Exterior Enclosures</td>
<td>Couvertures externes</td>
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</table>
Building Passport

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

<table>
<thead>
<tr>
<th>Year</th>
<th>Design</th>
<th>Real</th>
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<tbody>
<tr>
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</tr>
<tr>
<td>1</td>
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<tr>
<td>2-9</td>
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<td>10</td>
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<td>11-24</td>
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<td>25</td>
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<tr>
<td>26-49</td>
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</tbody>
</table>

- **Embodied:**
  - kgCO₂/m²
  - g/kgCO₂/m

- **Operationa l:**
  - kgCO₂/m²
  - kgCO₂/m

- **Recyclin g:**
  - kgCO₂/m²

- **Energy:**
  - Renewable, building, users
  - Renewable, building, users

- **Energy:**
  - Display Energy Certificate
  - Annual Footprint

- **Recycling, reuse, demolish:**

- **Primary kWh/m²**
- **Energy Performance Certificate**
- **Designed carbon footprint of building**

- **Measured carbon footprint**

- **Measured user satisfaction:**
  - %

- **Indoor Environment Quality**

- **Measured user satisfaction:**
  - %

- **Designed indoor climate class:**
  - A/B/C

- **Recycling of waste %**
- **Landfill waste kg/pers, a**
- **Annual Footprint**
- **Display Energy Certificate**
- **Measured kWh/m²**
- **Embodied: kgCO₂/m², a**
- **Operationa l: kgCO₂/m², a**

- **Primary kWh/m²**
- **Energy Performance Certificate**
Building Passport

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

**Designed embodied carbon of building:**

- Materials and quantities from BIM
- Calculation rules according EN15978
- Repairs and refurbishment from service life planning (SLP)
- GWP of materials from environmental product declarations (EPD)

**Designed indoor climate class:**

A/B/C

**Indoor Environment Quality**

**Measured user satisfaction:** %

**Annual Footprint**

- Energy: Renewable, building, users
- Maintenance, repairs
- Recycling, reuse, demolish

- Embodied: kgCO₂/m²
- Operationa l: kgCO₂/m², a
- Designed carbon footprint of building

- Measured kWh/m²
- Display Energy Certificate

- Energy: kgCO₂/pers, a
- Travel: kgCO₂/pers, a
- Water: m³/pers, a

- Recycling: %
- Landfill waste: kg/pers, a

**Measured user satisfaction:** %

**Indoor Environment Quality**

**Measuring unit:**

- 0 1…5 6…9 11…24 25 26…49
# Holistic approach with 8 metrics

<table>
<thead>
<tr>
<th>Economy</th>
<th>Energy</th>
</tr>
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<tbody>
<tr>
<td>• Lifecycle Cost (EN 15643-4)</td>
<td>• Imported energy</td>
</tr>
<tr>
<td></td>
<td>• Imported primary energy</td>
</tr>
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<td>• Baseload power</td>
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<table>
<thead>
<tr>
<th>Global warming</th>
<th>Occupants</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Life-cycle carbon footprint (EN 15978)</td>
<td>• Indoor air quality classification</td>
</tr>
<tr>
<td>• Operating carbon footprint (GHG Protocol)</td>
<td>• Share of satisfied occupants</td>
</tr>
</tbody>
</table>
Communication but mainly translation
The challenge

Risk management & insurances
» BAS : Building As a Service ?