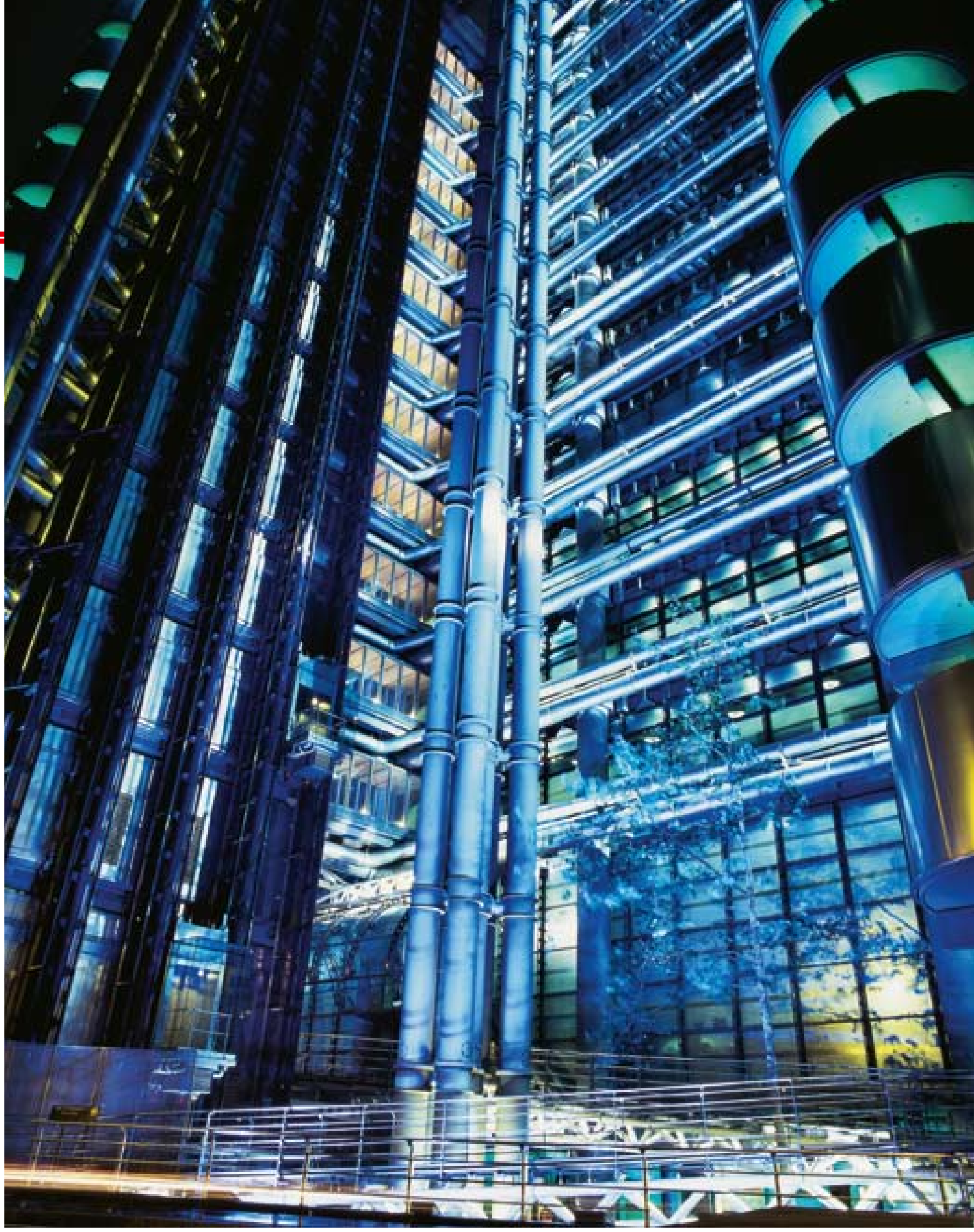

Energy efficiency in buildings

by Dick (H. A. L.) van Dijk and Prof. Essam E. Khalil, Co-Convenors, ISO/TC 163-ISO/TC 205 joint working group, Energy performance of buildings using holistic approach

The world is facing unprecedented energy challenges resulting from increased concerns over supplies of fossil fuels and clearly discernable climate change. Energy consumption in buildings represents close to 40 % of the world's total energy use[1], including climate control and energy used for appliances, lighting and other installed equipment.

There are many ways to reduce the energy requirements of buildings. The potential savings from energy efficiency in the building sector would contribute substantially to a worldwide reduction in energy consumption. The implications should not be underestimated, as the scale of energy efficiency in buildings is large enough to influence security policy, climate protection and public health on a national and global scale.

"The potential savings from energy efficiency in the building sector would contribute substantially to a society-wide reduction in energy consumption."

Studies by the International Energy Agency (IEA) show that a long-term 70 % reduction in energy consumption is possible in new buildings in most Organisation for Economic Co-operation and Development (OECD) countries, with little or no additional total costs for the owners. In some countries, requirements on new construction are closer to the least-cost optimum and the possible reduction is smaller.

The IEA estimates that the total feasible potential for energy savings by renovation and refurbishment in most OECD countries would be around 50 % of actual consumption. In transition economies, this potential will be even larger because of the poorer efficiency of existing buildings.

An urgent need

The lack of internationally agreed terms, definitions and procedures makes it very difficult to compare minimum energy performance requirements between countries,[2] or to understand and compare data gathered on measured energy use of buildings.[3]

For this reason, a coherent set of International Standards is urgently needed for assessment and calculation, rating and labelling, and standards for best practice and improvement of energy performance in buildings. Such standards would enable meaningful comparisons of actual energy use, and of the potential for novel energy saving and renewable energy technologies at a global level. They would also facilitate the market for services related to energy use in buildings.

Various ISO technical committees have been active in the field of energy in buildings, each from different perspectives. This is particularly true for ISO technical committee ISO/TC 163, *Thermal performance and energy use in the built environment,* and ISO/TC 205, *Building environment design.*

For this reason, these two committees have joined forces to establish a joint working group aimed at fostering a smooth and rapid development of energy efficiency standards for the global building industry.

1) **www.iea.org/g8/2008/Building_Codes.pdf**

2) **www.buildup.eu/publications/1466**

3) **www.enper-exist.com** (see Final report on building stock knowledge)

Thermal performance and energy use

ISO technical committee ISO/TC 163, *Thermal performance and energy use in the built environment*, produces sets of standards referencing the thermal, hygrothermal and energy performance requirements that can be expressed at various levels, from materials to complete buildings.

Several of the committee's standards were developed or revised in close cooperation with the European Committee for Standardization (CEN) and subjected, in accordance with the Vienna Agreement, to parallel approval in CEN and ISO, mainly in relation to the CEN mandate to develop a set of standards on energy performance in buildings that followed the publication of the 2002 Energy Performance of Buildings Directive in Europe (EPBD).

Examples of standards on thermal performance

ISO 6946:2007, *Building components and building elements – Thermal resistance and thermal transmittance – Calculation method*

ISO 13789:2007, *Thermal performance of buildings – Transmission and ventilation heat transfer coefficients – Calculation method*

ISO 13370:2007, *Thermal performance of buildings – Heat transfer via the ground – Calculation methods*

ISO 10211:2007, *Thermal bridges in building construction – Heat flows and surface temperatures – Detailed calculations*

Parts 1 and 2 of **ISO 10077** published under the general title, *Thermal performance of windows, doors and shutters – Calculation of thermal transmittance.*

Examples include:

- ISO 13790:2008, *Building energy performance – Energy use for space heating and cooling,* one of the key standards for the EPBD
- Some standards on thermal performance properties of building elements and components (see **box**, left)
- Various parts of ISO 15927, published in six parts under the general title, *Hygrothermal performance of buildings – Calculation and presentation of climatic data*
- Several standards on terminology, test and calculation methods for heat and moisture transfer, temperature conditions, energy use and heating and cooling loads in buildings.

Examples of standards on building environment design

ISO 16813:2006, *Building environment design – Indoor environment – General principles*

ISO 16818:2008, *Building environment design – Energy efficiency – Terminology*

ISO 16814:2008, *Building environment design – Indoor air quality – Methods of expressing the quality of indoor air for human occupancy*

ISO 23045:2008, *Building environment design – Guidelines to assess energy efficiency of new buildings.*

Building design made easier

ISO technical committee ISO/TC 205 develops standards for the design of new buildings and retrofit of existing buildings for acceptable thermal and visual comfort, indoor air quality, energy conservation and efficiency.

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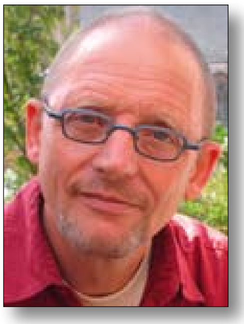
About the authors



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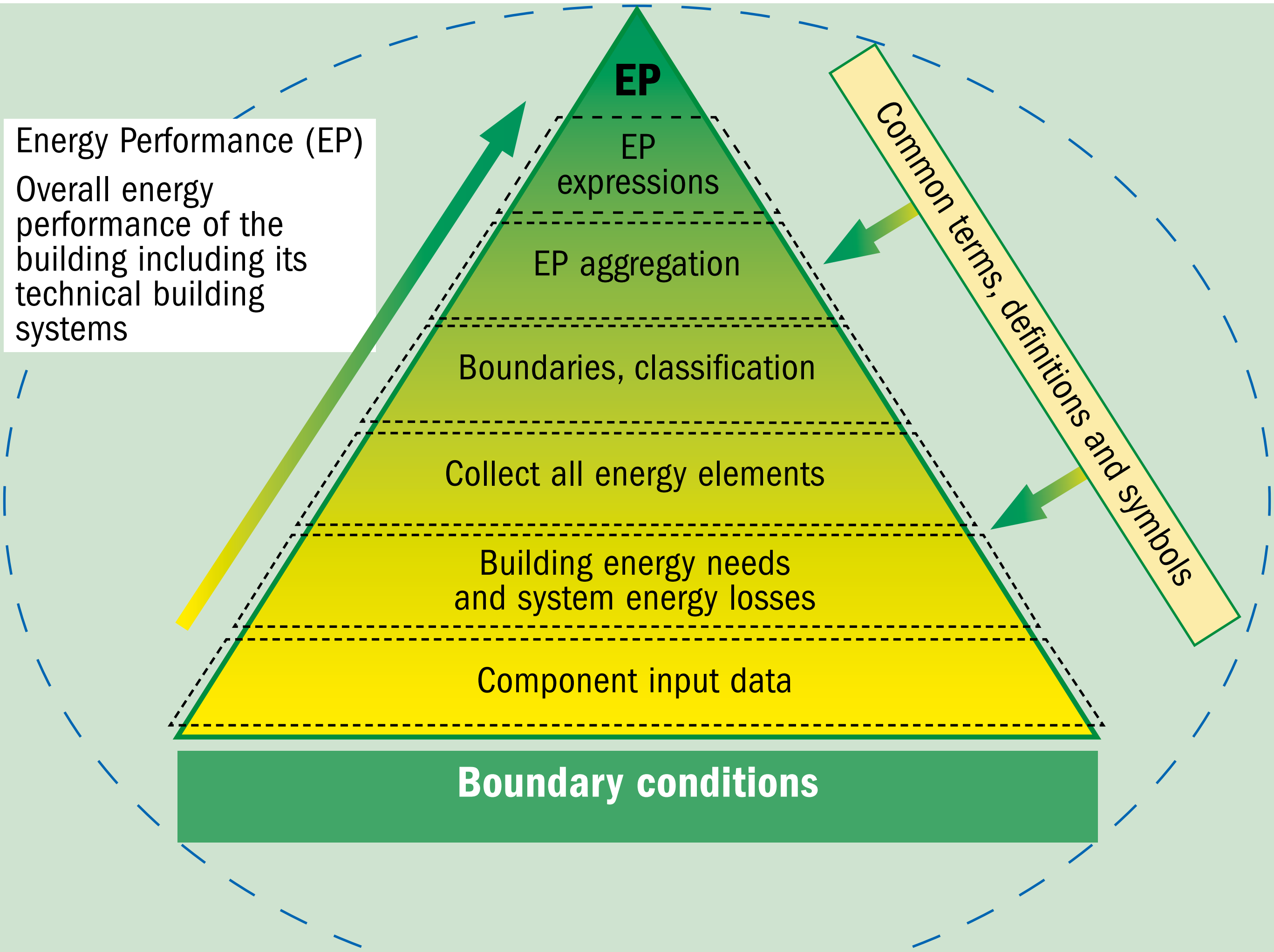


Overall building energy performance.

Harmonization of terms is essential.

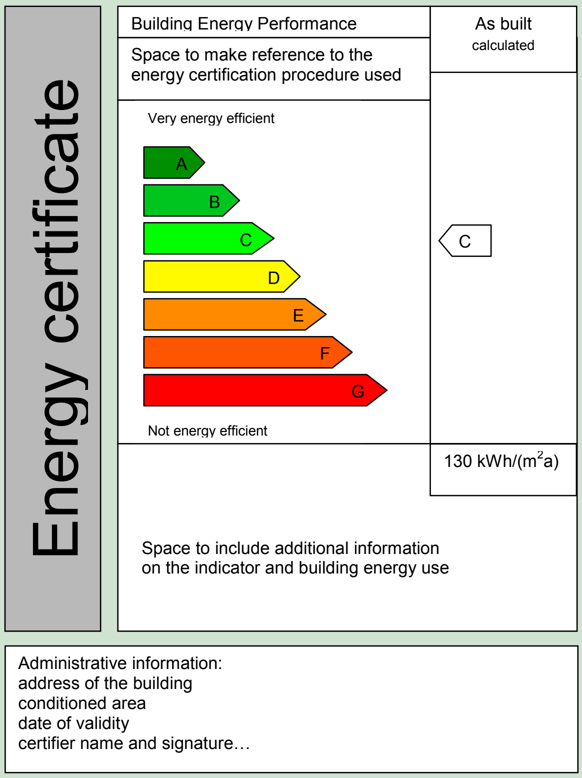
Think "Pyramids"

The assessment of the overall energy performance of a building, including the technical building systems, comprises a number of successive steps, which can be schematically visualized as a pyramid.

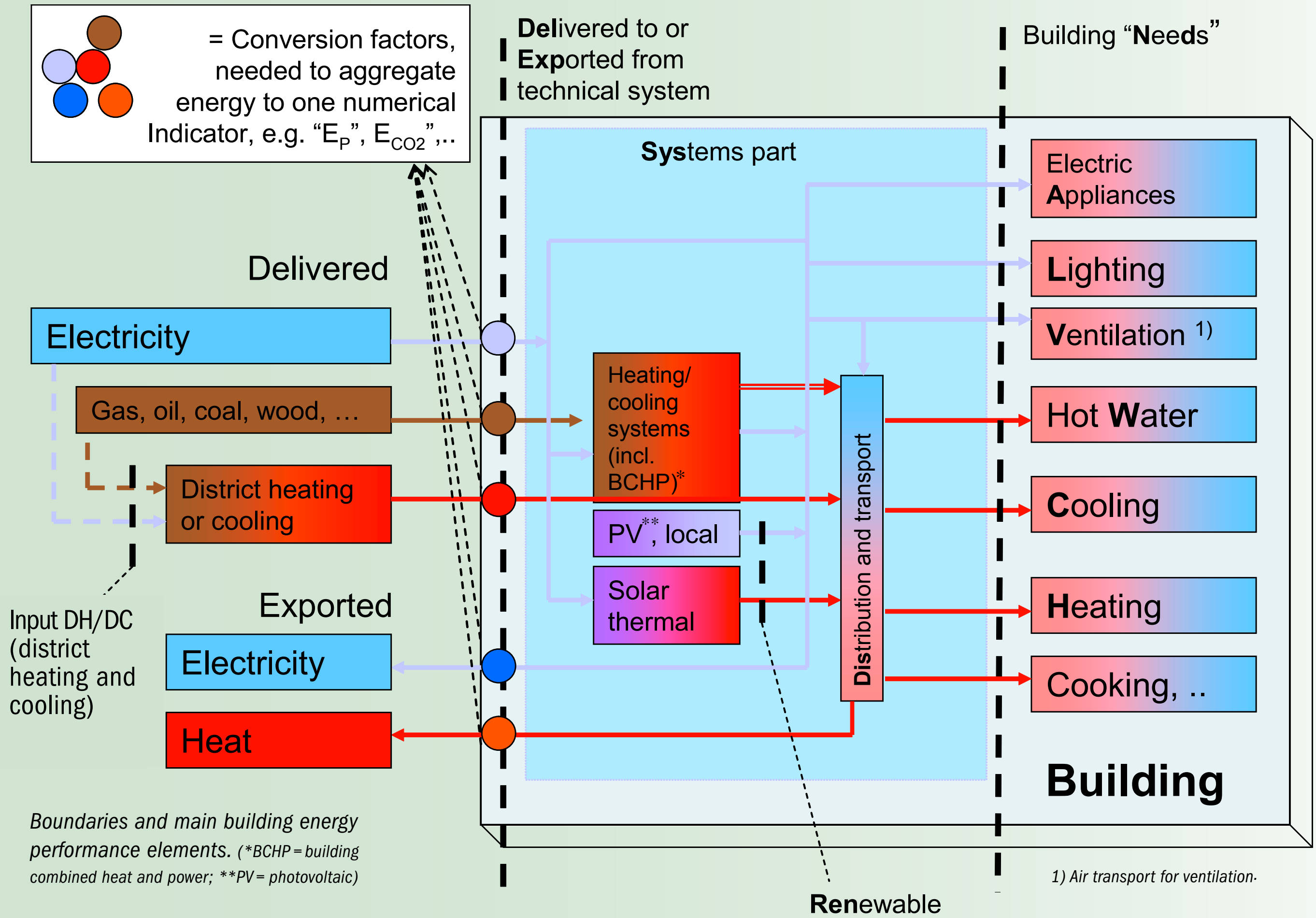
Sets of common terms, definitions and symbols are essential for all segments from top to bottom. These cover terms such as energy needs, technical building systems, auxiliary energy use, recoverable system losses, primary energy and renewable energy.

The top segment of the pyramid is the main output: the energy performance and the energy performance certificate of the building.

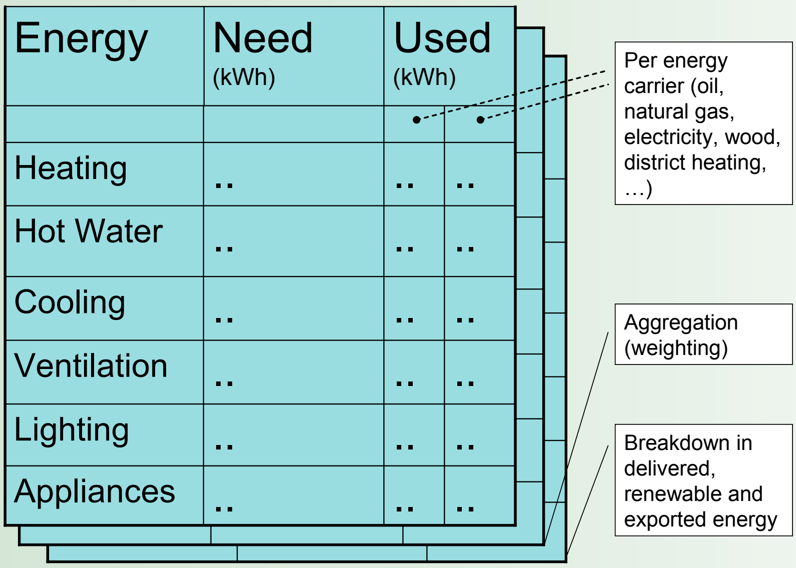
The second segment provides the inputs for the top segment: one or more numerical indicators expressing the energy performance (such as overall energy use per square metre conditioned floor area, EP), a classification and ways to express the minimum energy performance requirements (EPmax).



Example of energy certificate.



Boundaries and main building energy performance elements. (*BCHP = building combined heat and power; **PV = photovoltaic)



Procedures for a consistent breakdown of energy elements.

The third segment describes the principles and procedures on the weighting of different energy carriers (such as electricity, gas, oil or wood) when they are aggregated to overall amount of delivered (and exported) energy. For instance, this may be expressed as total primary energy (EP) or carbon dioxide emission (E_{CO2}).

The fourth segment specifies the categorization of building types (for example, office spaces, residential or retail) and specification of the boundaries of the building.

The fifth segment provides procedures on the breakdown of the building energy needs and system energy losses, aiming at gaining clear insights into where energy is used.

The sixth segment provides the building energy needs and energy use for each application (heating, cooling, etc.) and interactions between them.

The seventh segment provides the input data on components, such as thermal transmission properties, air infiltration, solar properties of windows, energy performance of system components and efficiency of lighting.

The standards on boundary conditions comprise external climatic conditions, indoor environment conditions (thermal and visual comfort, indoor air quality, etc.), standard operating assumptions (occupation) and national legal restrictions.

Although not part of the core activities of the JWG, the "lowest" segments will require attention from the JWG to ensure overall consistency.

The work of the committee recognizes that architectural engineering – the design of building systems – can no longer be undertaken separately from the overall design of buildings. The system of standards under development is intended to integrate across engineering sub-disciplines and to vertically integrate architectural engineering with the entire building design process.

In addition to lowering trade barriers for engineering design, ISO/TC 205 seeks to promote and facilitate the design of buildings that improve performance as economic assets for their owners, in providing an amenable indoor environment for their occupants, and with respect to resource utilization and environmental impact.

Examples include:

- Several parts of ISO 16484, *Building automation and control systems*
- Some standards on building environment design (see **box**, page **23**).

A holistic approach

Formed earlier this year, the joint working group (JWG) of ISO/TC 163 and ISO/TC 205 joins the expertise of both committees in this much needed collective effort. The JWG's goal is to master all standards and new or existing work items from both committees concerning energy efficiency and calculation methods, as well as energy performance of systems and whole buildings, to ensure maximum consistency and efficiency. The joint venture is very timely in view of the new work items on energy efficiency and energy performance recently defined or proposed within each technical committee.

"A coherent set of International Standards on the energy performance of buildings is within our reach."

In addition, the JWG will prepare proposals for the development of an ISO vision on energy performance of buildings for discussion in relevant technical and higher-level ISO committees.

Joining forces for a common cause

The work ahead for the JWG will be challenging. A prime application is to check compliance with (national) minimum overall energy performance requirements, and to classify buildings in terms of energy quality and potential for improvement. This requires transparent and verifiable, unambiguous, robust and reproducible procedures. In addition, the procedures should allow handling national differences in climate data, building traditions, occupant behaviour and choices imposed by national building regulations.

Another challenge is to establish efficient links to related areas, such as monitoring and inspection of energy performance and commissioning of systems, design of energy efficient buildings, validation of energy calculation methods, environmental impact of buildings and energy management.

The new JWG of ISO/TC 163 and ISO/TC 205 will make the best use of the work already done in ISO, the European Committee for Standardization (CEN)[4], and at national levels. It will focus even better on how best to respond to the expectations of the building sector, and what innovations and priorities we should adopt to develop effective energy efficient standards. It will disseminate and promote, through the development and use of International Standards, and as a matter of urgency, good practices and relevant technologies. A coherent set of International Standards on the energy performance of buildings is within our reach. ■

4) **www.iee-cense.eu**