

Johann Zirngibl
CSTB
France



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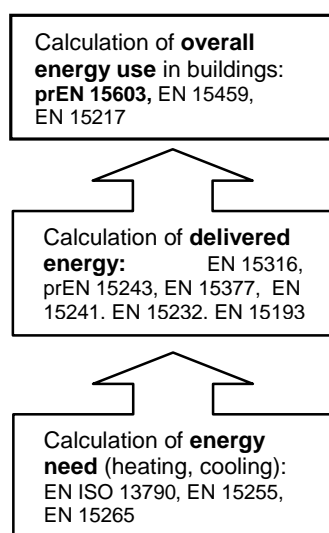


Figure 1: EN 15603, covers the final stage of calculation and is based on results from other standards

Information paper on Energy performance of buildings - Overall energy use and definition of energy ratings - Calculated energy rating EN 15603 (Overall energy use)

The Energy Performance of Buildings Directive (EPBD) requires a general framework and a methodology for calculating the integrated energy performance of buildings. The energy performance of a building is the amount of energy consumed or estimated to fulfil different energy requirements. This amount shall be reflected in one or more numeric indicators that take into account insulation, technical installation characteristics, design and sizing in relation to climatic variables. In order to be able to compare different energy sources, an aggregate value must also be calculated.

European Standard EN 15603 covers this final step in the set of CEN standards that implement the EPBD. It defines a general framework for the assessment of overall energy use in a building, and the methods that should be used to calculate overall energy ratings (see Figure 1).

This paper gives a short introduction to CEN standard 15603. It explains the calculated energy ratings and provides detailed information on the input and output data and on links to the other CEN standards.

1 > Scope of standard

This standard defines the energy services whose energy performance ratings must be determined in planned and existing buildings. Two principal types of energy rating for buildings are proposed in this standard:

- > the calculated energy rating;
- > the measured energy rating.

In this paper only the calculated energy rating is described. Information Paper P89 deals specifically with the measured energy rating.

The present standard specifies a general framework for the assessment of overall energy use of a building, and the calculation of overall energy ratings in terms of primary energy, CO₂ emissions and other parameters defined by national energy policy.

Separate standards calculate the energy consumption of services within a building (heating, cooling, hot water, ventilation, lighting) and produce results that are used here in combination to derive the overall energy use.

The assessment is not limited to the building alone, but takes into account the wider environmental impact of the energy supply chain.

Allowance is made for energy that may be generated within the building, or on its premises, whether it is used to offset fuel and power drawn from other sources or "exported" for use elsewhere.

This international standard is applicable to a part of a building (e.g. a flat), an entire building, or several buildings. It is up to national bodies to define under which conditions, for which purposes and for which types of building the various ratings apply.

The assessment of the energy performance of specific technical building systems is dealt with in the appropriate part of EN 15241, EN 15243 and EN 15316 series (see References).

The locally applicable values for factors and coefficients needed to calculate the primary energy consumption and CO₂ emissions related to the energy policy must be defined in a national annex.

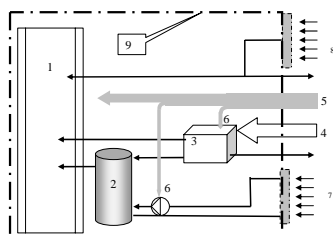


Figure 2: Examples of energy flows across the system boundary.

Key:

- 1: user; 2: storage;
- 3: boiler;
- 4: Fuel; 5: Electricity;
- 6: Auxiliary energy;
- 7: thermal solar collector;
- 8: photovoltaic panels;
- 9: boundary.

2 > Principle of the method

Energy uses

Any assessment of the annual energy used by the building must include the following services if they are present:

1. heating;
2. cooling and dehumidification;
3. ventilation systems and humidification;
4. domestic hot water;
5. lighting (optional for residential building);
6. other services (optional).

Annual energy use must include auxiliary energy and the energy lost by all of these systems.

Assessment boundaries

The system boundary defines the rated object (e.g. flat, building). Inside the system boundary the system losses are taken into account explicitly, outside the system boundary they are taken into account in the conversion factor for the different energy carriers.

Energy can be imported or exported through the system boundary (see Figure 2). For active solar, wind or hydraulic energy systems, the incident solar radiation on solar panels or the kinetic energy of wind or water is not part of the energy balance of the building: only the energy output from these systems is part of the energy balance. Energy generated on the building site and exported is credited explicitly, provided it is exported for use elsewhere.

Calculation procedure

The calculation direction goes from the needs to the energy source (see Figure 3), e.g. from the building's total energy needs to the primary energy.

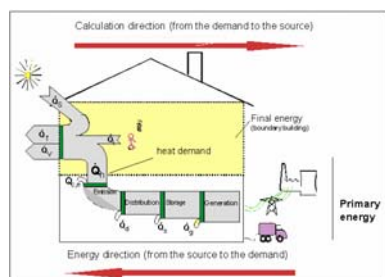


Figure 3: Illustration of the breakdown into energy needs and energy use in the different parts of the technical building systems

Specific electrical services (lighting, ventilation, auxiliary) and thermal services (heating, cooling, humidification, dehumidification, domestic hot water) are considered separately inside the building boundaries.

Any on-site energy production from locally available renewable resources and the disposition of the resulting energy are considered and reported separately.

Calculation step

The annual overall energy use, primary energy and CO2 emission for the different energy services can be calculated in one of the following ways:

- using annual average values;
- by dividing the year into a number of calculation steps (e.g. successive months, days, hours, etc.).

Calculation principles of the recovered gains and losses

The interactions between the different energy services (heating, cooling, lighting, etc.) are taken into account by calculating the heat gains and recoverable system losses that can have a positive and/or negative impact on the energy performance of the building.

Two approaches are envisaged for taking into account the recoverable thermal losses that are not initially included in the building energy needs at the starting point (see Figure 4):

- the holistic approach

In the holistic approach the totality of the effects of the heat sinks and sources in the building and the technical building systems that are recoverable for space conditioning, are taken into account in the calculation of the thermal energy needs of the building.

- the simplified approach

In the simplified approach the recoverable system heat losses, obtained by multiplying the recoverable thermal system losses by a conventional recovery factor, are directly subtracted from the loss of each considered technical building system.

The choice may be different for different technical building systems and is determined at the national level. A more detailed introduction to the holistic versus simplified approach is given in Information paper P95.

3 > Description of the method.

The method takes into account the main relevant parameters that affect the performance of a building:

- the building thermal needs,
- the technical building systems,
- the energy carriers.

In order to obtain a logically structured method, the same outputs are defined, independently of the energy use (heating, cooling, etc.). The common outputs are:

- the thermal losses,
- the recoverable thermal losses,
- the electrical energy use.

3.1 Building thermal needs

This part of the method is defined in Clause 6.2 of EN 15603. The building thermal needs, the building thermal transfers and the building heat gains and recoverable thermal losses are derived.

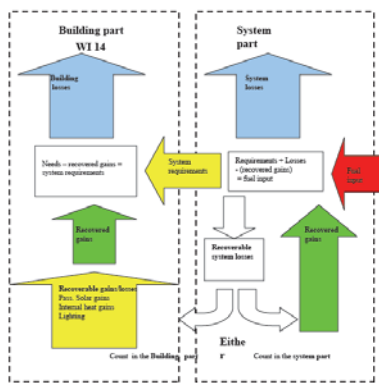


Figure 4: The CEN-alternatives: holistic or simplified approach

The recovered gains (green arrow) are either incorporated in the system part (right side) or in the building part (left side)



Figure 5: External building shell insulation

The annual energy requirements are calculated according to the referenced ENs:

- thermal need for space heating (without humidification) EN ISO 13790
- thermal need for space cooling (without dehumidification) EN ISO 13790
- thermal need for domestic hot water EN 16316-3-1 EN 15316-3.1
- heat transfer by transmission + ventilation of the building when heating EN ISO 13790
- heat transfer by transmission + ventilation of the building when cooling EN ISO 13790
- internal and solar heat gains of the building when heating EN ISO 13790
- internal and solar heat gains of the building when cooling EN ISO 13790
- recoverable thermal losses of technical building systems when heating EN 15316
- recoverable thermal losses of technical building systems when cooling EN 15243
- thermal energy for humidification EN 15241
- thermal energy for dehumidification EN 15243

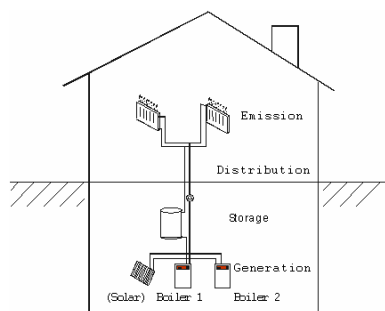


Figure 6: Technical building system structure (principle)

3.2 Technical building systems

The technical building systems (see Figure 6) are split up into two parts:

- technical system thermal losses, electrical and auxiliary energy without building generation devices,
- energy generation systems,

following the way the real structure of a technical building system is represented. In general the distribution system is linked to a specific energy use (heating, hot water, etc.), whereas a generator can be used for several purposes (e.g. heating and hot water).

3.2.1 Technical system thermal losses, electrical and auxiliary energy without building generation devices

This part of the method is defined in Clause 6.3.1 of EN 15603. The system thermal losses without the building generation devices include the emission, distribution and storage losses (if not included in the generation part) of the considered system.

The thermal output of the cooling distribution system includes the thermal need for dehumidification.

The thermal output of the ventilation system includes the thermal need for humidification.

The necessary inputs are calculated according to the referenced ENs as indicated below: EN 15316-1

- thermal losses, aux. energy heating syst. without generat. EN 15243
- thermal losses, aux. energy of cooling syst. without generation (including dehumidification) EN 15241
- thermal losses, aux. energy of DHW system without gen. EN 15316-3-2
- energy use for ventilation and system thermal losses (including humidification) EN 15241
- energy use for lighting and heat dissipated by lighting EN 15193

3.2.2 Energy generation systems

This part of the method is defined in Clause 6.3.2 of EN 15603. The thermal energy input of the distribution systems must be supplied by the thermal energy output of the building heat generation systems or by



Figure 7: Forced draught boiler

energy supplied from outside the building (e.g. district heating).

In the case of more than one generator servicing the same distribution subsystem, the heat input to the distribution system is obtained according to the system design from the different building generation devices and from the energy supplied directly from outside the building.

For a heat pump the difference between the energy input and the thermal output plus the thermal losses is taken into account in the building energy balance either as heat recovery (inside the system boundary, e.g. heat extracted from ventilation exhaust air) or as renewable energy produced on the building site if the heat is collected through the system boundary (e.g. heat pump with a ground source heat exchanger).

3.3 Choice of energy (weighted energy ratings)

This part of the method is defined in Clause 8 of EN 15603. The input to the building generation system (the sum of the thermal and electrical outputs of the energy generation systems, the generator thermal losses and the auxiliary energy) must be supplied by the energy input of the different energy carriers and the renewable energies produced on the building site.

A building generally uses more than one energy carrier. Therefore, a unit common to all energy carriers must be used to aggregate the environmental impact, such as kWh of energy, kg CO₂, etc.. The aggregated amount is called the energy rating.

The standard defines different aggregation methods, based on the following very different impacts of the use of energy carriers:

- > Primary energy use;
- > Production of carbon dioxide;
- > A parameter defined by national energy policy.

Cost is a parameter that may be used in the energy policy aggregation method.

An example of such values is given in Appendix E (informative) of the standard.

3.3 Report

This part of the method is defined in Clause 11 of EN 15603. This clause defines the content of the report on the assessment of the energy use of a building according to this standard.

The report must include the rating together with its confidence interval (when available). The minimum amounts of data to be reported are listed in Table 9 of EN 15603 for the calculated and measured rating.

Report- Table 9 EN 15603

Integral methodology for optimized and comparable solutions			
Building thermal needs without techn. build. syst Heating : 75 Hot water : 25 Cooling : 0	Technical systems (system losses) Heating + DHW : 30 Cooling : 0 Electricity (light) : 20	Energy delivered (energy carriers) Gas: 105 (75+30) Electricity : 20 Energy exported Thermal / Elect.: 0	Energy delivered (weighted) Gas: 105 (105x1) Electricity : 60 (20x3) Energy exported (weighted) : 0
		Renewable energy production : 25	Energy rating EP = 165

For buildings with active renewable energy systems, it is recommended to report as a supplementary value the rating that would be obtained if the renewable energy systems were not present.

The table is structured taking into account the main parameters that affect the energy performance of a building (see also "Description of the method). With only a few values, it is possible to have an overview of the strengths and weaknesses of the energy balance of a building. This table is a useful basis for suggesting building upgrades.

The aggregated amount of energy (the rating) is used as input in EN 15217. That standard takes care of the final assessment of the building, the goal of the calculations: it offers ways of expressing the energy performance and the energy performance requirements and suggests content and format for the energy performance classification and certificate.

4 > FAQ

Why is EN 15603 considered to be a top standard?

EN 15603 structures the overall energy use calculation of the energy consumption and production in a building according to the requirements of the EPBD. It includes the thermal characteristics of the building shell, the heating and air-conditioning installation and the installed lighting.

Which calculations are made in EN 15603?

Only the aggregation of different energy carriers to one or more numeric indicators (e.g. primary energy, CO₂ emissions) is defined in EN 15603. Other standards calculate the energy consumption or production in a building.

How can the results of the calculations in EN 15603 be used?

EN 15603 offers ways of expressing energy performance and suggests the content and format of energy performance. The aggregated value can be the basis for the rating according the standard EN 15217: "Energy performance of buildings - Methods for expressing energy performance and for energy certification of buildings".

The report defined in Clause 11 of EN 15603 takes into account the main parameters influencing the energy performance of a building. With only a few values it is possible to obtain an overview of the strong and weak aspects of the energy balance of a given building. The information summarised in the report can be a useful basis for making recommendations when upgrading a building. This information should therefore be indicated in the certificates in addition to the aggregated value.

National Documents and Laws regulate the application in detail.

Where can the relevant adjustment factors be found?

The adjustment factors to be applied in the different ratings, as for example the primary energy factor or the CO₂-emission coefficient, are defined at the national level. Informative values are given in EN 15603.

What is the difference between EN 15603 and CEN/TR 15615?

CEN/TR 15615 is a technical report that explains the relationship of the different standards covered by EN 15603.

5 > References

1. CEN/TR 15615: Explanation of the general relationship between various European Standards and the Energy Performance of Buildings Directive (EPBD) - Umbrella Document. European Committee for Standardization (CEN), Brussels (2007)

2. EN 15603, Overall energy use and definition of energy ratings, CEN, January 2008 (see also Info Paper P87)
3. EN ISO 13790, Energy performance of buildings - Calculation of energy use for space heating and cooling, (see Info Paper P92)
4. EN 15193, Energy performance of buildings - Energy lighting requirements (see Info Paper P91)
5. EN 15217, Energy performance of buildings – Methods for expressing energy performance and for energy certification of buildings
6. EN 15232, Calculation methods for energy efficiency improvements by the application of integrated building automation systems
7. EN 15241, Ventilation for buildings - Calculation methods for energy losses due to ventilation and infiltration in commercial buildings (see Info Paper P111)
8. EN 15243, Ventilation for buildings - Calculation of room temperatures and of load and energy for buildings with room conditioning systems (see Info Paper P113)
9. EN 15316-1, Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies - Part 1: General (see Info Paper P96)
10. EN 15316-2-1 Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies Part 2-1 Space heating emission systems (see Info Paper P97)
11. EN 15316-4, Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies Part 4: Space heating generation systems (see Info Paper P102 - P108)
12. EN 15316-2-3, Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies Part 2-3: Space heating distribution systems (see Info Paper P98)
13. EN 15316-3, Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies - Part 3: Domestic hot water systems (see Info Paper P99 - P101)

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