SMARTER FINANCE FOR FAMILIES

Horizon 2020
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for Research & Innovation

Energy Efficiency of Buildings in Italy

Green Building Council Italia

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GREEN BUILDING COUNCIL ITALIA

Index

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1. 1. ENERGY PERFORMANCE OF BUILDINGS IN ITALY.

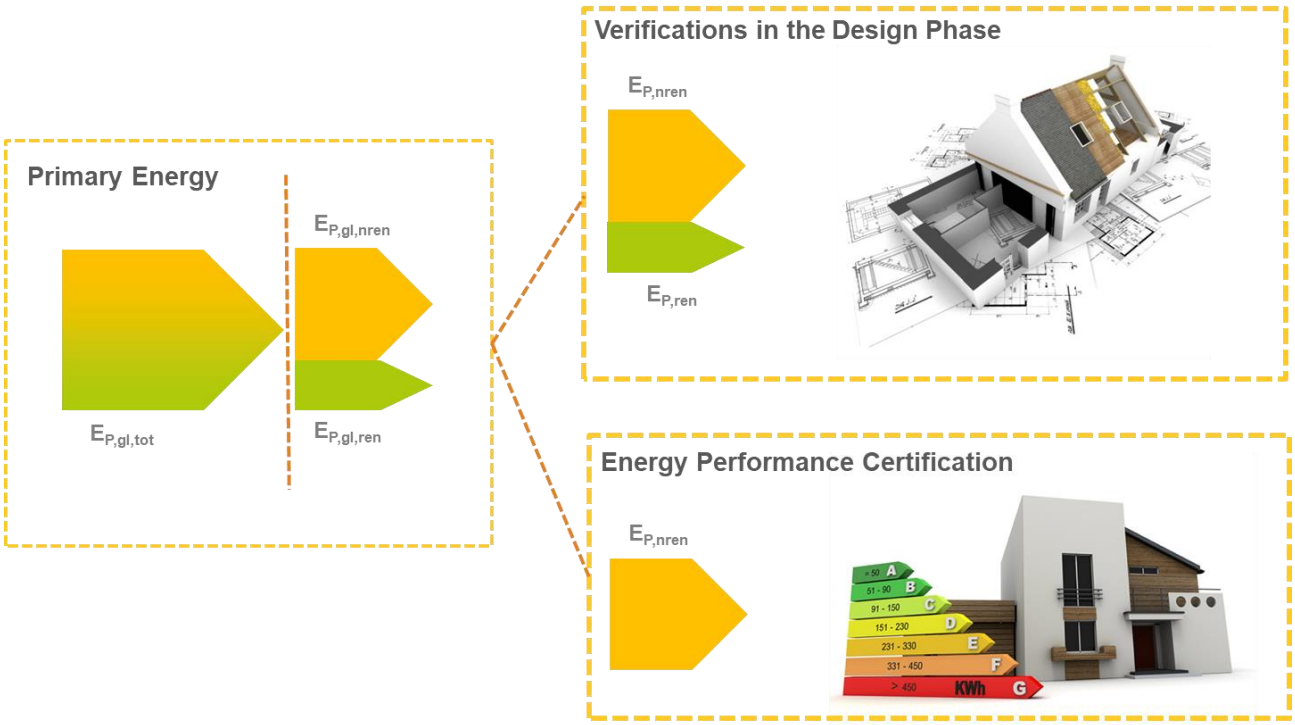
In Italy is in force the Ministerial Decree of 26 June 2015, which defines the minimum requirements for energy efficiency and energy needs in buildings, in compliance with Directive 2010/31 / EU.

The Decree defines and regulates:

- the **minimum energy performances**, drawn up during the **design phase of the building**
- the **energy performance certification**, drawn up upon completion **of the building**

The main difference b etween the two activities consists in the portion of Primary Energy considered in the calculation:

- in the **design phase** must be taken into account **non-renewable primary energy** and the **renewable primary energy**.
- for **Energy Performance Certification** must be taken into account **only non-renewable primary energy**



It should be noted that in Italy the competence to legislate on energy efficiency is delegated to the Regions and therefore in many cases there are rules and obligations different from the national ones, which still serve as a basic reference.

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1.1. STANDARDS AND METHODS FOR CALCULATING THE ENERGY REQUIREMENTS

The calculation of energy performance of a building, both for the verifications during the design phase and for the energy certification of the building, is established by the individual Regions.

However, all have adopted the following technical standards:

- UNI/TS 11300 - 1 – Calculation of the building's thermal energy needs for summer and winter air conditioning

UNI/TS 11300 – 2 Calculation of primary energy needs for winter air conditioning, hot sanitary water production, ventilation and lighting in non-residential buildings

- UNI/TS 11300 – 3 Calculation of primary energy requirements and yields for summer air conditioning
- UNI/TS 11300 – 4 Use of renewable surces and other generation methods for winter air conditioning and hot sanitary water production
- UNI/TS 11300 – 5 Calculation of primary energy and the share of energy from renewable sources
- UNI/TS 11300 – 6 Calculation of energy requirements for lifts and escalators

The guideline for the calculation of the **energy performance with a simplified hourly dynamic method**, based on the UNI EN ISO 52016: 2018 standard which replaces the UNI EN ISO 13790, is now being defined for the purpose of its possible introduction in the subsequent revisions of the decree of 26 June 2015.

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2. DESIGN ENERGY EFFICIENCY VERIFICATION

The Decree of 26 June 2015 also defines two sets of limit values for the thermo-physical characteristics and for the efficiency of the building and MEP components:

- One is valid until 2021 (2019 for public buildings)
- A second, more restrictive, will be valid starting from 2021 (2019 for public buildings)

This second set of values is the one that is of interest for the SMARTER project and that will come into force obligatorily throughout starting from 1 January 2021 (1 January 2019 for public buildings). In this regard it is noted that some regions[1], such as Lombardy, have advanced these deadlines by 2 years and therefore the most restrictive limits are already in force.

The energy performance limits of buildings, and the related checks, also depend on the intended use of the building and the type of building intervention to which it is subjected.

For all types of intervention (new construction, renovation, ...) the following checks must be performed:

1. **risk of interstitial condensation** and **risk of superficial mold**, with particular attention to thermal bridges in new buildings;
2. **the effectiveness**, in terms of cost-benefit ratio, **of the use of materials with high solar reflectance** for roofs (cool roof), assuming for these last ones a solar reflectance value not lower than: 0.65 in the case of flat roofs and 0.30 in the case of pitched roofs;

Considering that the SMARTER project is aimed not only at new construction but also at renovation of existing buildings, the following is a list of the energy performances required and the related verifications for the specific types of intervention:

1. ENERGY REQUALIFICATIONS OF EXISTING BUILDINGS
2. SECOND LEVEL RENOVATIONS OF EXISTING BUILDINGS
3. NEW CONSTRUCTION or FIRST LEVEL RENOVATION OF EXISTING BUILDINGS

[1] In Italy the competence to legislate on energy efficiency is left to the Regions, which are obviously obliged to comply with the national minimum requirements.

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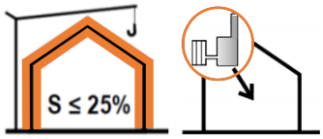
2.1. ENERGY REQUALIFICATIONS OF EXISTING BUILDINGS



The "energy requalification of an existing building" include all the operation that have an impact on the energy performance of the building and that:

- involve an area less than or equal to 25% of the total gross dispersant surface of the building
- consist in the new installation, or in the renovation of a thermal plant serving the building

In these cases the required energy performance requirements is applied only to the building components and installations subject to intervention, and refer to their relative thermo-physical or efficiency characteristics.

In particular, the following checks must be carried out on the structures of the enclosure and on the plants involved in the intervention:

1. **$U_i < U_{i\ limite}$** , where:
   U_i is the transmittance of the i-th structure, opaque or transparent.
   $U_{i\ limite}$ is the maximum transmittance value, for the same type of structure, allowed by the Decree of June 26, 2015;
2. For **generators**
   a. **□ > □ limite ,** where Ƞ limite is the value of the minimum useful generating efficiency of the **boiler**, depending on the generator power, indicated in the Decree 26 June 2015
   b. **COP > COP$_{limite}$** , where COP limite is the minimum value of the COP, indicated by the Decree of 26 June 2015, for the type of **heat pump** equal to that of the project
   c. **EER > EER limite** , where il EER limite is the minimum efficiency value, indicated by the Decree of 26 June 2015, for the type of **chiller** equal to that of the project

2.2. SECOND LEVEL RENOVATIONS OF EXISTING BUILDINGS

The “Second Level Renovations of existing buildings” is relative to building renovation that involve **envelope with an incidence greater than 25% of the overall gross surface area of the building** and may affect the heating system for the winter and / or air conditioning service for the summer.

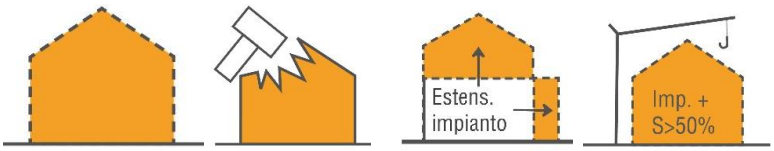
The verifications foreseen for this case study concern the performance check on the casing and/or on the plants based on the planned intervention.
In particular, the following checks must be carried out for shell and plants component involved in the intervention:

1. **$U_i < U_{i\ limite}$** , where:
   U_i is the transmittance of the i-th structure, opaque or transparent.
   $U_{i\ limite}$ is the maximum transmittance value, for the same type of structure, allowed by the Decree of June 26, 2015;
2. **$H'_T < H'_{T\ limite}$** where:
   H'_T [W/m^2 K] is the average global transmission heat exchange coefficient per unit of building surface of the project, determined for the entire portion of the envelope subject to the intervention (vertical wall, roof, floor, doors and windows, etc.)
   $H'_{T\ limite}$ [W/m^2 K] is the maximum allowed average global transmission heat exchange coefficient per unit of building surface, which depends on the climate zone[2], as defined by the Decree 26 June 2015.
3. For **generators**
   a. **□ > □ limite ,** where Ƞ limite is the value of the minimum useful generating efficiency of the **boiler**, depending on the generator power, indicated in the Decree 26 June 2015
   b. **COP > COP$_{limite}$** , where COP limite is the minimum value of the COP, indicated by the Decree of 26 June 2015, for the type of **heat pump** equal to that of the project
   c. **EER > EER limite** , where il EER limite is the minimum efficiency value, indicated by the Decree of 26 June 2015, for the type of **chiller** equal to that of the project

[2] In order to characterize the energy needs of buildings, the Italian territory is divided into 7 climatic zones corresponding to specific bands of Degree K * Day values:

Climate Zone	Degree K*day
A	< 600
B	600 - 900
C	901 - 1.400
D	1.401 - 2.100
E	2.101 - 3.000
F	> 3.000

2.3. NEW CONSTRUCTION or FIRST LEVEL RENOVATION OF EXISTING BUILDINGS



The interventions contemplated in this case are:

- Construction of **new buildings**
- **Demolition and reconstruction** of existing buildings
- **Extension** of the gross volume **> 15% of the existing gross heated volume**
- **Important first-level restructuring** involving the building envelope with an incidence**> 50% of the total gross building surface** and the restructuring of the heating system for the winter and/or air conditioning service for summer serving the entire building.

Within these building interventions the same Decree (26 June 2015) also defines the **NZEB**[3] for which it does not fix any absolute energy performance limit , but gives the indication that designer must implement and verify at once the respect of limit values for the thermo-physical characteristics and for the efficiency of the building and MEP components mandatory from 2021 (2019 for public buildings).

As previously mentioned for the SMARTER project it is useful to refer the analysis of energy requirements directly to these more restrictive limits that also correspond to what is required for the building to be defined as NZEB.

In particular, the following checks must be carried out on shell and plants component and on some energy performance of the building:

1. **$H'_T < H'_{T\ limite}$** where:

   H'_T [W/m^2 K] is the average global transmission heat exchange coefficient per unit of building surface of the project, determined for the entire portion of the envelope subject to the intervention (vertical wall, roof, floor, doors and windows, etc.)

   $H'_{T\ limite}$ [W/m^2 K] is the maximum allowed average global transmission heat exchange coefficient per unit of building surface, which depends on the climate zone, as defined by the Decree 26 June 2015.

[3] Definition of the NZEB building given in point 3.4 of Annex 1 of the Decree of 26 June 2015:

"3.4 Edifici a energia quasi zero
1. Sono "edifici a energia quasi zero" tutti gli edifici, siano essi di nuova costruzione o esistenti, per cui sono contemporaneamente rispettati:

a) tutti i requisiti previsti dalla lettera b), del comma 2, del paragrafo 3.3, determinati con i valori vigenti dal 1° gennaio 2019 per gli edifici pubblici e dal 1° gennaio 2021 per tutti gli altri edifici;
b) gli obblighi di integrazione delle fonti rinnovabili nel rispetto dei principi minimi di cui all'Allegato 3, paragrafo 1, lettera c), del decreto legislativo 3 marzo 2011, n. 28."

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2. **$A_{sol,est}/A_{sup\ utile} < (A_{sol,est}/A_{sup\ utile})_{limite}$**

Where:

$A_{sol,est}$ [m^2] is the summer equivalent solar area calculated as the sum of all the areas of the transparent surfaces of the envelope reduced by appropriate coefficients

$A_{sup\ utile}$ [m^2] is the useful surface of the building

$(A_{sol,est}/A_{sup\ utile})_{limite}$ is the maximum allowable value that depends on the intended use of the building (residential or all other destinations of use)

3. **$EP_{H,\ nd} < EP_{H,\ nd\ limite}$**

Where:

$EP_{H,\ nd}$ [kWh/m^2 anno] is the thermal performance index useful for heating the building;

$EP_{H,\ nd\ limite}$ [kWh/m^2 anno] is the maximum value of the thermal performance index useful for heating the building calculated for the reference building [4];

4. **$EP_{C,\ nd} < EP_{C,\ nd\ limite}$**

Where:

$EP_{C,\ nd}$ [kWh/m^2 anno] is the index of thermal performance useful for cooling the building;

$EP_{C,\ nd\ limite}$ [kWh/m^2 anno] is the maximum value of the thermal performance index useful for cooling the building calculated for the reference building:

5. **$EP_{gl,tot} < EP_{gl,tot\ limite}$**

Where:

$EP_{gl,\ tot}$ [kWh/m^2 anno] is the overall energy performance index of the building corresponding to the total primary energy requirement per unit area for services: heating (EP_H), sanitary hot water (EP_W), ventilation (EP_V),

cooling (EP_C), artificial lighting (EP_L) and transport of people / elevators and escalators (EP_T). For residential buildings these last 2 terms (EP_L and EP_T) are not taken into account.

$EP_{gl,\ tot\ limite}$ [kWh/m^2 anno] is the maximum value of the total global energy performance index calculated for the reference building

6. **$\eta_H > \eta_{H\ limite}$**

Where:

η_H is the average seasonal efficiency of the heating system

$\eta_{H\ limite}$ is the minimum value of the average seasonal efficiency of the heating system established by the Decree of 26 June 2015

[4] The Decree of 26 June 2015 defines the reference building as identical to the project building in terms of geometry (shape, volumes, floor area, surfaces of construction elements and components), orientation, location, intended use and boundary and having thermal characteristics and energy parameters defined by the Decree of 26 June 2015.
A reference building therefore means a building having a reference shell and technical reference facilities.
For all the input data and parameters not defined by the Decree of 26 June 2015 for the reference building the values of the real building are used.

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7. $\square_W > \square_{W\ limite}$

   Where:

   η_C is the average seasonal efficiency of the hot sanitary water system

   $\eta_{C\ limite}$ is the minimum value of the average seasonal efficiency of the hot sanitary water system established by the Decree of 26 June 2015

8. $\square_C > \square_{C\ limite}$

   Where:

   η_C is the average seasonal efficiency of the summer air conditioning system

   $\eta_{C\ limite}$ is the minimum value of the average seasonal efficiency of the summer air conditioning system established by the Decree of 26 June 2015

9. **50% of the energy requirement for the production of hot sanitary water produced from renewable energy sources**

10. **50% of the energy requirement for: heating + cooling + hot sanitary water produced from renewable energy sources**

11. **Installation of electricity production plant from renewable sources with a minimum power higher than the S / K ratio**

    Where

    S [m^2] is the plan surface of the building

    K [kW/m^2] is a fixed coefficient with a value of 50

Furthermore the project must contain:

o the evaluation of the **effectiveness of the shielding systems** of the glass surfaces, external or internal, such as to reduce the solar radiation heating;

o checking that the surface **mass value of the opaque building envelope** is greater than 230 kg / m^2, or that the value of the **periodic thermal transmittance module YIE** is less than 0.18 W / m^2K;

o verification that the **transmittance value (U) of the building structures separating** neighboring buildings or rooms not heated must be less than or equal to 0.8 W / m^2K.

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3. ENERGY PERFORMANCE CERTIFICATION OF BUILDING

The energy class of a building is defined starting from the non-renewable global energy performance index **$EP_{gl-nren}$**.

$$EP_{gl,nren} = EP_{H,nren} + EP_{W,nren} + EP_{C,nren} + EP_{V,nren} + EP_{L,nren} + EP_{T,nren} \text{ [kWh/m}^2 \text{ anno]}$$

Where:

$EP_{H,nren}$: non-renewable primary energy requirement for winter heating and air conditioning;

$EP_{W,nren}$: non-renewable primary energy requirement for hot sanitary water;

$EP_{C,nren}$: non-renewable primary energy requirement for winter cooling and air conditioning;

$EP_{V,nren}$: non-renewable primary energy requirement for ventilation;

$EP_{L,nren}$: non-renewable primary energy requirement for artificial lighting; (not included for residential buildings)

$EP_{T,nren}$: non-renewable primary energy requirement for the transport of people and things; (not included for residential buildings).

The scale of the building's energy classes is defined starting from the value of the non-renewable global energy performance index **$EP_{glnren,rif,standard\ (2019\text{-}2021)}$**. This index is the limit of separation between class A1 and B.

To determine the overall energy class of the building, proceed as follows:

1. the value of **$EP_{gl\text{-}nren,rif,standard\ (2019\text{-}2021)}$** is determined starting from the reference building[5] to which the reference values for the casing are set to 2019/2021 reported in DM 26/6/15 and assuming that the standard installations shown in the following table are installed in the building using the parameters in force for the years 2019/21;

[5] The **reference building** used for the energy certification differs from the reference building used in the design verifications:

- For the **design verifications** the reference building uses the reference structures and **plants with the same typology of the real building** but with efficiencies established by the Decree 26 June 2015
- For the **energy certification** the reference building uses the reference structures and **standard type plants** with efficiencies established by the Decree of 26 June 2015

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Tabella 1 - Tecnologie standard dell'edificio di riferimento

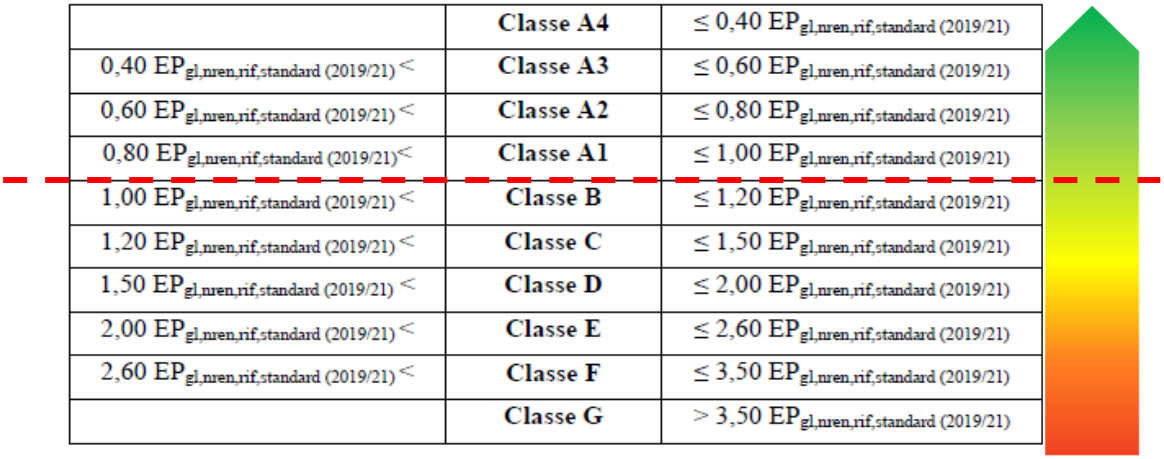
Climatizzazione invernale	Generatore a combustibile gassoso (gas naturale) nel rispetto dei requisiti di cui alla tabella 8 dell'Appendice A all'Allegato 1 del DM requisiti minimi e con relativa efficienza dei sottosistemi di utilizzazione di cui alla tabella 7 della stessa Appendice.
Climatizzazione estiva	Macchina frigorifera a compressione di vapore a motore elettrico nel rispetto dei requisiti di cui alla tabella 8 dell'Appendice A all'Allegato 1 del DM requisiti minimi e con relativa efficienza dei sottosistemi di utilizzazione di cui alla tabella 7 della stessa Appendice.
Ventilazione	Ventilazione meccanica a semplice flusso per estrazione nel rispetto dei requisiti di cui alla tabella 9 dell'Appendice A all'Allegato 1 del DM requisiti minimi
Acqua calda sanitaria	Generatore a combustibile gassoso (gas naturale) nel rispetto dei requisiti di cui alla tabella 8 dell'Appendice A all'Allegato 1 del DM requisiti minimi e con relativa efficienza dei sottosistemi di utilizzazione di cui alla tabella 7 della stessa Appendice.
Illuminazione	Rispetto dei requisiti di cui al paragrafo 1.2.2 dell'Appendice A all'Allegato 1 del DM requisiti minimi.
Trasporto persone o cose	Rispetto dei requisiti al DM requisiti minimi.

2. the value of $EP_{gl,nren}$ is calculated for the building being certified

3. the energy class to be assigned based on the following table.

Tabella 2 - Scala di classificazione degli edifici sulla base dell'indice di prestazione energetica globale non rinnovabile $EP_{gl,nren}$

	Classe A4	$\leq 0{,}40\ EP_{gl,nren,rif,standard\ (2019/21)}$
$0{,}40\ EP_{gl,nren,rif,standard\ (2019/21)} <$	**Classe A3**	$\leq 0{,}60\ EP_{gl,nren,rif,standard\ (2019/21)}$
$0{,}60\ EP_{gl,nren,rif,standard\ (2019/21)} <$	**Classe A2**	$\leq 0{,}80\ EP_{gl,nren,rif,standard\ (2019/21)}$
$0{,}80\ EP_{gl,nren,rif,standard\ (2019/21)} <$	**Classe A1**	$\leq 1{,}00\ EP_{gl,nren,rif,standard\ (2019/21)}$
$1{,}00\ EP_{gl,nren,rif,standard\ (2019/21)} <$	**Classe B**	$\leq 1{,}20\ EP_{gl,nren,rif,standard\ (2019/21)}$
$1{,}20\ EP_{gl,nren,rif,standard\ (2019/21)} <$	**Classe C**	$\leq 1{,}50\ EP_{gl,nren,rif,standard\ (2019/21)}$
$1{,}50\ EP_{gl,nren,rif,standard\ (2019/21)} <$	**Classe D**	$\leq 2{,}00\ EP_{gl,nren,rif,standard\ (2019/21)}$
$2{,}00\ EP_{gl,nren,rif,standard\ (2019/21)} <$	**Classe E**	$\leq 2{,}60\ EP_{gl,nren,rif,standard\ (2019/21)}$
$2{,}60\ EP_{gl,nren,rif,standard\ (2019/21)} <$	**Classe F**	$\leq 3{,}50\ EP_{gl,nren,rif,standard\ (2019/21)}$
	Classe G	$> 3{,}50\ EP_{gl,nren,rif,standard\ (2019/21)}$



In the Energy Performance Certificate of the building there are also other quality indicators regarding the winter and summer thermal performance of the building envelope assessed according to the minimum legal requirements.

Note that the energy classification of the building is therefore not strictly correlated in an absolute sense to its energy needs but is determined as a function of the relationship between its energy needs and that of the reference building having the characteristics mentioned above.

Two buildings of the same energy class can therefore have a different energy requirement, expressed in kWh / m^2 year .

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4. RECOMMENDED VALUES OF TOTAL PRIMARY ENERGY NEEDS

The total global demand for primary energy is strongly influenced by climatic conditions.

In Italy we have very different situation: alpine climates (in the northern mountains) and Mediterranean climates (on the southern coasts). For this reason it has perhaps little meaning to define an absolute value of maximum energy requirement.

In fact, in some areas of Italy a good bio-climatic design could strongly reduce the energy needed, while in other areas this is difficult.

Anyway, on the basis of the experience of some projects, a first indication of maximum primary energy requirement could be assumed, net of energy produced from renewable sources, equal to

- 90 kWh / m^2 per year for single-family single buildings up to buildings with 4 residential units
- 70 kWh / m^2 per year for buildings with more than 4 residential units

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