# Energy saving survey

## Company: DaunenStep SPA

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# 1. Objective

The purpose of this document is to estimate the energy savings of private homes, in the territory of Italy, with a temperature reduction of 2°C, during the heating period. These values will be used by the company DaunenStep SPA as a reliable and scientifically neutral basis for marketing purposes.

The underlying premise is that thanks to the high quality of the duvet produced by the company, the temperature of the bedroom can be reduced from 20°C to 18°C without adversely affecting sleeping comfort. The savings achieved are not only a purely economic indicator, but also take into account the aspect of sustainability through energy savings.

Since there are different climates on the Italian territory, a key element is based on characteristic properties (building properties, climate data, etc.), which are representative of the corresponding region.

# 2. Data Collection

In this section, all data necessary for evaluation are collected with reference to the source corresponding. Data collection is based on scientific standards so that the results are neutral and reliable.

## 2.1 Building structure

Due to the structure of buildings, which differs from region to region, the current situation is here described in order to derive a reference building with corresponding characteristics.

Data published by the Italian Institute of Statistics on existing buildings in Italy occupied by households are shown in the following graph. Note that these data refer to 2011 and do not take into account any renovations of the buildings. The blue line indicates the average for each region.

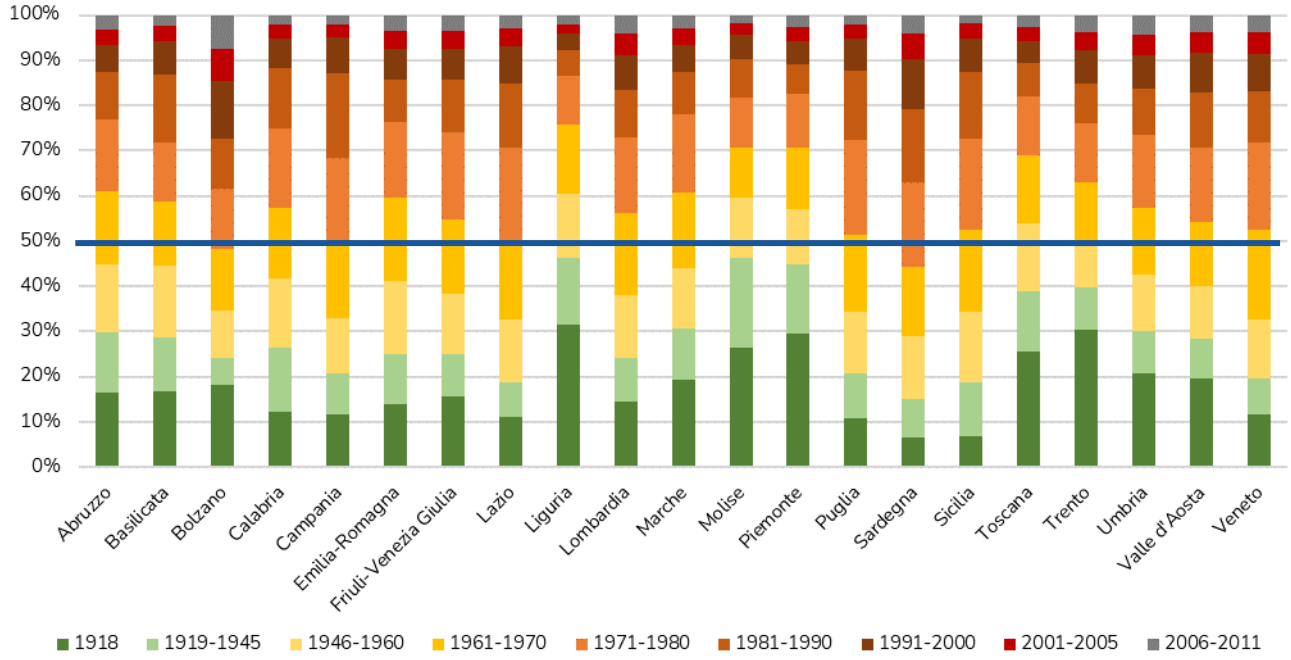


*Figure 1: Distribution of buildings in Italy by age.*
*Source: ISTAT1*

The Information System on Energy Performance Certificates (SIAPE) also periodically publishes data and reports from which properties on the building fabric can be derived. This includes first of all the distribution of certifications made for buildings by region and the corresponding building class. However, this only takes into account buildings for which a corresponding certification has been made. Again, the blue line shows the average for each region.

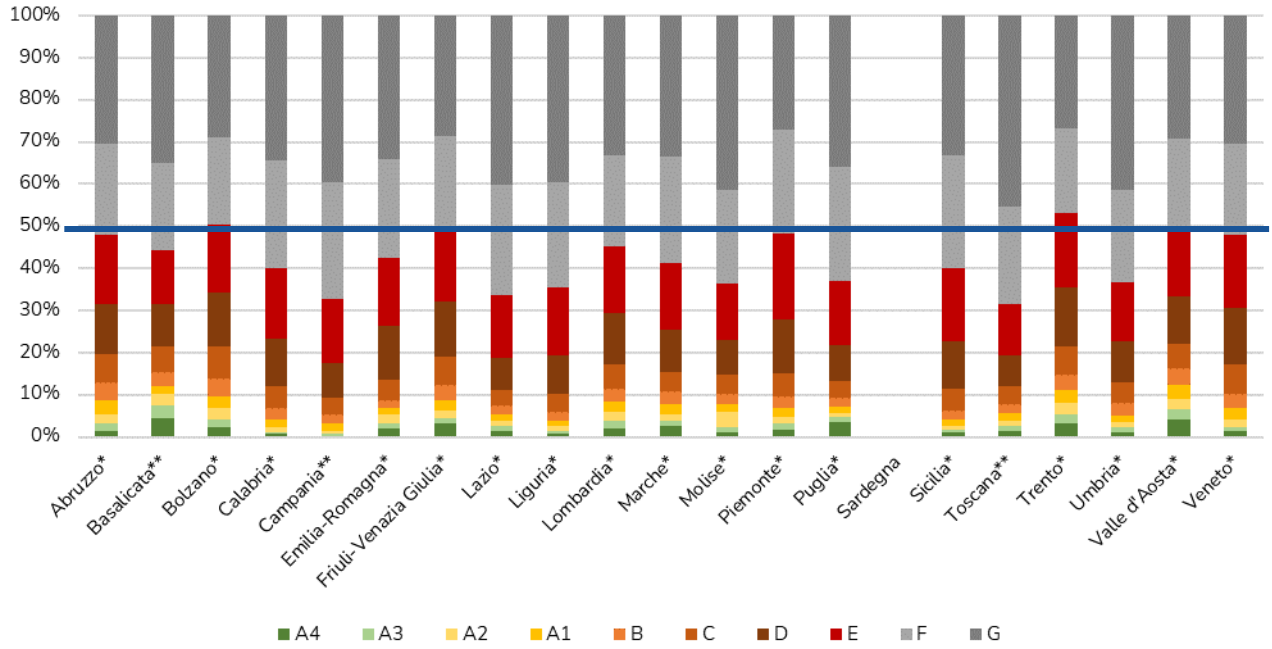


*Figure 2: Distribution of buildings in Italy by energy class.*
*Sources: *) SIAPE 20222; **) SIAPE 20213*

## 2.2 Climate data

Since regions differ considerably in their climatic characteristics, this aspect must also be taken into account in this assessment. Therefore, regions are assigned the climatic conditions of the respective regional capital city.
These data are automatically used by the software according to the Italian standard UNI 10349. These data include information on temperature and ambient pressure, wind speed, humidity and solar radiation at the respective locations.

## 3. Methodology and calculation

To evaluate the energy savings, Termolog® thermotechnical simulation software is used in order to evaluate the difference in energy consumption resulting from the comparison between the situation with an indoor temperature of 20°C and that of 18°C. This software is certified according to Italian standards. On the other hand, it is also certified to determine the energy classes of buildings according to Italian standards and is therefore qualified for this application. The starting point is a uniform room, of which two walls are adjacent to the outdoor environment and the other four walls are adjacent to other heated rooms. This room represents a typical bedroom and has an area of 36 m², a height of 2.70 m, and thus a volume of 97.2 m³. The 3D model of this room is shown in the figure below.

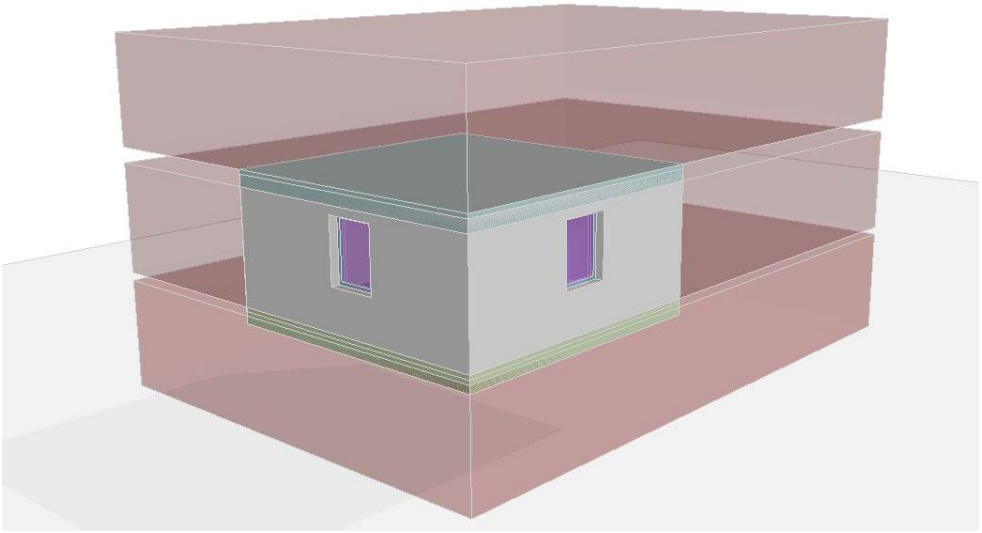

*Figure 3: 3D model of the standard space applied in Termolog®.*

This room is endowed with different properties for the different assessment situations of different regions, which are reflected accordingly on the thermal insulation with the external surroundings. The model used in the simulation corresponds to the typical properties of the corresponding energy class on the basis of the statistical survey in Figure 2. On this basis, 4 different models with the following characteristics:

| Variant | Characteristics of the wall strength – transmittance | Glazing | Applied per |
|---|---|---|---|
| A | 41 cm – 0,878 W/m²K | double (2,99 W/m²K) | Abruzzo, Basilicata, Emilia-Romagna, Lazio, Liguria, Lombardia, Marche, Molise, Piemonte, Puglia, Toscana, Umbria, Veneto |
| B | 41 cm – 0,70 W/m²K | triple (1,30 W/m²K) | Bolzano, Friuli-Venezia Giulia, Trento, Val d'Aosta |
| C | 41 cm – 0,878 W/m²K | single (5,00 W/m²K) | Calabria, Campania |
| D | 41 cm – 1,25 W/m²K | single (5,00 W/m²K) | Sicilia, Sardegna |

Table 1: Variants of the model used

The building features 41 cm thick uninsulated masonry. The installed window frames are wooden and have no thermal break. For the energy calculation, a combined central generator (heating and hot water) was used with a standard 20 kW gas-fired boiler with a closed.

Similarly, corresponding climatic conditions are applied for environmental conditions. In this case, the corresponding regional capital city is used as a reference point in the software.

The difference in energy required to heat the room ΔW at the corresponding temperature is the starting point for further calculations of economic and ecological savings. First, the primary energy savings are determined, assuming a heating system efficiency of 0,9. With the help of the calorific value HW of the energy source and its specific costs k, one can now determine the economic savings ΔP. The calculation method is shown in the following formula:

$$\Delta P = \frac{\Delta W}{0{,}9} \cdot \frac{k}{HW}$$

The energy savings ΔW can also be used as a starting point to estimate the savings of CO2 emissions ΔE. For this purpose, the energy savings are multiplied by the specific emissions, according to the energy source, always taking into account the efficiency of the plant. It should be mentioned that the emissions from biomass are assumed to be zero, as it is a renewable raw material that is therefore recovered through the CO2 emitted. The equation for this calculation is:

$$\Delta E = \frac{\Delta W}{0{,}9} \cdot e$$

The corresponding values used for the above calculations are given in the table below.

| Factor | Symbol | Value | Unit |
|---|---|---|---|
| Efficiency | - | 0,9 | - |
| Specific gas costs | k | 1,00 | €/Sm³ |
| Biomass specific costs | | 0,20 | €/kg |
| Calorific value | HW | 9,59 | kWh/Sm³ |
| Biomass calorific value | | 4,0 | kWh/kg |
| $CO_2$ Emission Gas | e | 202 | kg/kWh |

*Table 2: Reference values for calculations*

## 4. Results and conclusions

After running the simulations and calculations described in the previous chapter, a representative value of energy, financial and emission savings from lowering the temperature in the bedroom is obtained for each region. The exact values are shown in the table below.

| Region | Annual savings | Saving with gas heating | kgCO2/annual | Saving with biomass heating |
|---|---|---|---|---|
| Abruzzo | 1.004 kWh | 116 € | 225 kg | 56 € |
| Basilicata | 1.008 kWh | 117 € | 226 kg | 56 € |
| Bolzano | 869 kWh | 101 € | 195 kg | 48 € |
| Calabria | 825 kWh | 96 € | 185 kg | 46 € |
| Campania | 829 kWh | 96 € | 186 kg | 46 € |
| Emilia-Romagna | 1.007 kWh | 117 € | 226 kg | 56 € |
| Friuli-Venezia Giulia | 873 kWh | 101 € | 196 kg | 49 € |
| Lazio | 959 kWh | 111 € | 215 kg | 53 € |
| Liguria | 939 kWh | 109 € | 211 kg | 52 € |
| Lombardia | 1.011 kWh | 117 € | 227 kg | 56 € |
| Marche | 919 kWh | 106 € | 206 kg | 51 € |
| Molise | 1.016 kWh | 118 € | 228 kg | 56 € |
| Piemonte | 1.016 kWh | 118 € | 228 kg | 56 € |
| Puglia | 827 kWh | 96 € | 186 kg | 46 € |
| Sardegna | 995 kWh | 115 € | 223 kg | 55 € |
| Sicilia | 879 kWh | 102 € | 197 kg | 49 € |
| Toscana | 912 kWh | 106 € | 205 kg | 51 € |
| Trento | 875 kWh | 101 € | 196 kg | 49 € |
| Umbria | 1.016 kWh | 118 € | 228 kg | 56 € |
| Valle d'Aosta | 856 kWh | 99 € | 192 kg | 48 € |
| Veneto | 1.013 kWh | 117 € | 227 kg | 56 € |

*Table 2: Energy savings, costs and emissions by region*

From these results, it can be concluded that lowering the temperature from 20°C to 18°C in the bedroom can lead to significant savings in energy and financial resources. Depending on the energy source used, emission savings are also achieved.