The evaluation of energy savings potential of building retrofit at a Regional or National scale

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Aims of the paper

The aims of this paper are

1. to propose a method to determine the Statistical Distribution Of Buildings according to heating demand and primary Energy use (E-SDOB).
2. to show how this tool may be used by the legislator to define a performance scale for building energy certification.
3. to show how E-SDOB may provide support to the legislator the definition of mandatory measures and incentives for building energy retrofits.

The global analysis for calculating the average specific heating energy consumption

From Enea [2] the overall energy balance on a national or regional scale is known for each year. In the following analysis year 2001 has been chosen in order to be coherent with the last Census data, referring to the same year (Census is performed once in ten years in our country).
In particular, the global (electrical and thermal) demand of residential buildings is known (see Figure 1, left).

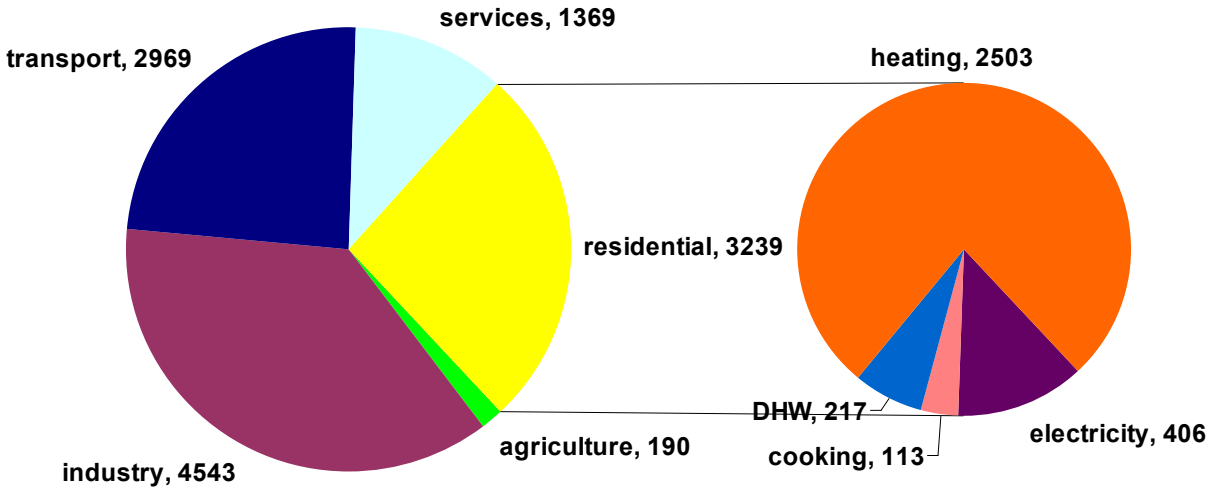

Figure 1 - Final use of energy in Piedmont (12.3 Mtoe in 2001)

Once electrical uses have been subtracted from the total, the other thermal uses such as Domestic Hot Water (DHW) and cooking have to be identified in order to obtain only the ambient heating demand.
The Piedmont energy consumption for DHW is known from interpolating data on a national basis [2] assuming it is substantially independent of the region concerned, and the fraction of thermal to total (electrical + thermal) DHW installations is known from Census [1]. Assuming the energy

demand by each installation does not depend on the energy source, the thermal DHW fraction - in terms of number of installations - is assumed to be equal to the fraction - in terms of energy consumption.
Energy for cooking may also be interpolated from national data [2], assuming also in this case that it is substantially independent of the region concerned.
In this way the heating demand of the residential sector is known (see, e.g. Table 1 and Figure 1).
Dividing this value by the floor area of all buildings [1] (occupied by residents, therefore presumably heated) the specific heating demand will result in **178 kWh/m^2** (see Table 1). This is a key figure for further analyses, a reference which will be used to validate the procedure outlined in the following paragraphs.
Since the population in Piedmont is about 4.2 million inhabitants, assuming the cost of one Toe to be around 1000 €, the yearly cost for residential heating will be around 2.5 G€, or 600 €/person/yr.

Table 1 - Example – Synthesis energy balance of Piedmont (2001)*

	Energy demand ktoe	**Specific energy kWh/m^2**
Total	**3239** [2]	**226**
Electricity	406 [1]	28
Thermal use	*2833*	*198*
DHW	217 [1]	12
Coking	113 [2]	8
Heating	**2503**	**178**

The analytical procedure for calculating the statistical distribution of specific heating energy consumption

The first step of the procedure was to define the input data to be used from each data source

1. Istat (National Institute for Statistics):
    a. # floors
    b. #dwellings per building
    c. Average floor area of a dwelling
    d. Number of adjacent buildings
    e. Age of buildings
    f. Population
2. UNI (Italian National Unification Institute) standards
    a. Wall technologies and typical U-values
    b. Energy use for domestic hot water (DHW)
    c. Energy use for cooking
3. ENEA (Italian National Agency for New Technologies, Energy and Environment)
    a. Overall electrical energy consumption in residential buildings
4. Meteo data
    a. Temperature
    b. Solar radiation
5. Authors experience
    a. Floor height
    b. Gross to net volume and floor area ratio
    c. Percent glazed area

d. Number of air changes
e. Data on boiler production efficiencies

The second step was to evaluate the typical terms of the energy balance for heating the building using the above input data. The logical flow chart is shown in Figure 2.