INTERNATIONAL JOURNAL OF HEAT AND TECHNOLOGY

ISSN: 0392-8764
Vol. 34, No. 3, September 2016, pp. 491-497
DOI: 10.18280/ijht.340320

A publication of IIETA

IIETA International Information and Engineering Technology Association
Advancing the World of Information and Engineering

http://www.iieta.org/Journals/IJHT

A Methodology for the Generation of Energy Consumption Profiles in the Residential Sector

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ABSTRACT

The residential sector has been achieved in the last years more and more importance in the total energy consumption scenario by stimulating the research for solutions to promote energy efficiency and to raise awareness on energy consumption by end user.

The profile of an end-users energy consumption assumes a central role in finding solutions to reduce energy demand and increase the efficiency in the production of the same energy.

European regulations impose an obligation on Member States to provide annually data on energy consumption of households for end use and energy product. Data will be provided for Italy basing on data collected by ISTAT Survey on energy consumption in the residential sector, appropriately processed by ENEA and ISTAT.

In this paper it is presented a methodology that allowed to define a series of dwelling types, representative of the entire national sample, as a function of building, family and environmental characteristics. These dwellings, through the application of a dynamic simulation model, allowed the generation of monthly energy consumption profiles (for heating, cooling and domestic heat water) for each cluster of dwelling types and the evaluation of the energy consumption distribution of the residential sector for end use and energy product.

Keywords: Energy consumption, Residential sector, Dwelling types, Energy efficiency, Energy demand.

1. INTRODUCTION

The European and national policies, aimed at containing the energy product consumption and at promoting the diffusion of renewable sources, have stimulated the search for ways to reduce the energy demand and to boost the efficiency in energy production. In particular, for the residential sector, the knowledge of the consumption habits of the families is of vital importance for achieving the goals set by the various European directives, as well as for raising awareness on energy consumption and for stimulating rational behaviors on energy use by end-users.

The regulation (EC) No 1099/2008 of the European Parliament and of the Council of 22 October 2008 on energy statistics, and the amending Commission Regulation (EU) No 431/2014 of 24 April 2014 on energy statistics, as regards the implementation of annual statistics on energy consumption in households, impose an obligation on Member States to provide annual data on energy consumption of households for final destination and energy source. In this framework, ISTAT in collaboration with ENEA and MiSE (Italian Ministry of Economic Development) carried out the survey on households energy consumption [1, 2], as part of the Italian National Statistics Plan. The survey was conducted in 2013 for the first time in Italy, on a representative sample of 20,000 households at regional level and made it possible to obtain information on characteristics, consumption habits, types of plant and energy costs of Italian households, specified by energy product (primary energy sources and energy carriers) and end-use (heating, cooling, domestic hot water, cooking, lighting and electrical equipment).

This paper describes the methodology used to estimate the energy consumption for heating and the creation of monthly load profiles for residential dwellings. For the sake of simplicity we have chosen to present the results for the Veneto Region and heating systems fueled by natural gas; the calculation method remains the same for other energy products and for the entire Italian national territory.

Furthermore, this methodology will be used in the activity ENEA-ISTAT to estimate the energy consumption of households for the years between two replications of the ISTAT survey, starting from the ISTAT 2016 survey that will be used to deliver the first data to Eurostat.

2. METHODOLOGY

The presented methodology is based on the processing of the provided statistical data from the ISTAT 2013 survey on households energy consumption, and on the identification of dwelling-type classes representative of the entire Italian residential building stock.

The information provided by the ISTAT 2013 survey and used for the methodology are mainly:

- dwelling characteristics (type of dwelling, year of build, floor surface, opaque envelope type, transparent envelope type, main exposure of the external walls);
- characteristics of heating, cooling and DHW systems (number, energy products, systems type –centralized, individual or single device-, emission and temperature control system, frequency of use and daily hours of use);
- frequency of use of the systems;
- energy cost by energy product.

The classification of the dwellings was chosen as a function of:

- period of build: before 1950, 1950-1969, 1970-1989, from 1990;
- type of dwelling: single family house, multi-family house, ground floor apartment, middle floor apartment and top floor apartment.

Table 1 summarizes the 20 identified dwelling-type classes (DTC).

Table 1. Dwelling-type classes

	Before 1950	1950-1969	1970-1989	From 1990
Single fam. House	DTC1	DTC6	DTC11	DTC16
Multi-fam. House	DTC2	DTC7	DTC12	DTC17
Ground fl. apt.	DTC3	DTC8	DTC13	DTC18
Middle fl. apt.	DTC4	DTC9	DTC14	DTC19
Top fl. apt.	DTC5	DTC10	DTC15	DTC20

The evaluation of the energy product consumption for heating has been carried out in different stages, as exemplified in Figure 1:

a. determination of the thermal energy demand, in continuous heating mode, of the dwelling-type [kWhy] by means of a dynamic simulation software; the simulations were performed assuming a continuous heating mode (heating system on 24 hours a day), because the survey answers do not allow to determine an hourly power profile; the simulation results also provide the time profile of the heating demand of each dwelling-type;

b. calculation of the reduction factor for intermittent heating as a function of the average number of daily hours during which the heating system is switched on, based on the answers of the survey;

c. assumption of the efficiency of the different types of plant for each dwelling-type, and estimation of the heating consumptions per floor area [kWh/m^{2}y];

d. estimation of the total annual energy product consumption for heating for each class (m^3, kg, l, etc.) for a certain energy product, obtained by multiplying the consumption per area by the total area of the dwellings, that use that specific energy product for heating, that fall in each dwelling-type class.

The decision to estimate the thermal energy demand for all the dwelling-types by means of a dynamic simulation of the dwelling, and then calculate the energy product consumption by multiplying the heating demand calculated in continuous mode by the reduction factor for intermittent heating and by the average total efficiency of the heating system was related to the information provided by survey about the type and the characteristics of the heating systems. Clearly, the information provided by the survey can not have a level of detail sufficient to estimate a management profile of the heating systems, which is instead essential to perform a dynamic simulation of the building-plant system.

Since the energy performances of buildings are strongly influenced by climatic conditions, the same dwelling-type was simulated in each climate zone. For each climatic zone in which the country is divided, the input weather data (temperature, radiation and humidity) adopted for the simulations were those of the chief town whose degree days are "barycentric" with respect to the degree days interval of the climatic zone.

3. DEFINITION OF THE DWELLING-TYPE CLASSES

Each dwelling-type class is characterized by thermo-physical and dimensional parameters, determined on the basis of both the information gathered from the ISTAT survey results, appropriately processed, and the input data required by the simulation model. Below, the main properties that define each dwelling-type class, are listed and described.

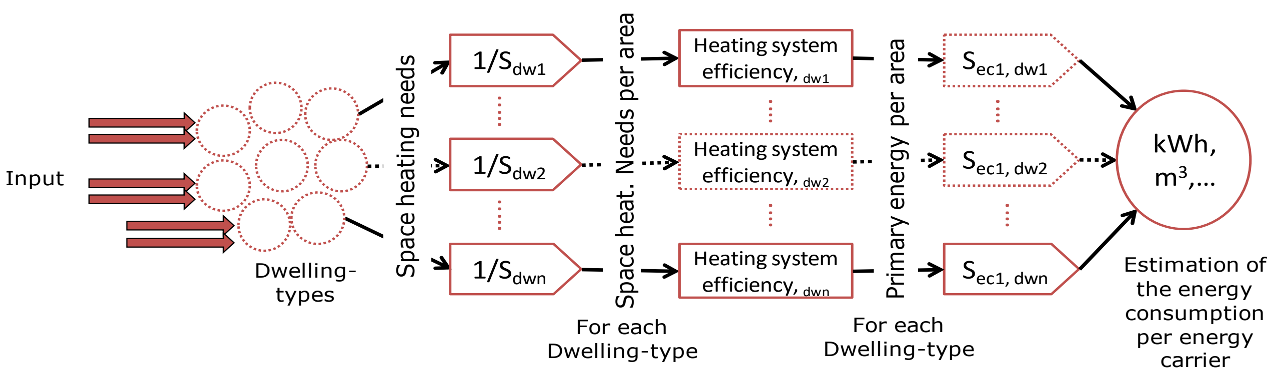

Figure 1. Methodology scheme, for space heating and for a single energy product

- Thermal transmittance of the opaque envelope: for each period of build a specific structure was deduced for the exterior walls, the floor and the ceiling. The corresponding thermal transmittance was determined, using data from the Italian standard UNI/TR 11552:2014. Table 2 summarizes the adopted values.

Table 2. Thermal transmittance of the opaque envelope by period of build [kW/m^{2}K]

	Before 1950	1950-1969	1970-1989	From 1990
Walls	1.093	1.065	0.675	0.456
Floor	0.781	0.781	0.850	0.442
Roof	1.376	1.376	0.777	0.441

- Thermal transmittance of the transparent envelope: the survey provided as possible answers two types of glass (single, double) and three types of frame (wood, metal, PVC): for these types the average transmittance values were calculated according to the Italian standard UNI/TR 11552: 2014 [3]; the equivalent transmittance of the glass and of the frame for each dwelling-type, was determined weighting the thermal transmittances corresponding to the answers of the survey on their incidence on the total number of dwellings that fall in the class; since the transparent surface is not an information inferable from the survey, a transparent surface equal to 1/8 of the floor surface was assumed to calculate the transmittance of the window. Table 3 summarizes the obtained values.

Table 3. Thermal trasmittance of the trasparent envelope by period of build and type of dwelling [kW/m^{2}K]

	Before 1950	1950-1969	1970-1989	From 1990
S. F. House	3.320	3.490	3.280	2.450
Multi-fam. House	3.010	3.230	2.950	2.400
Apartments	3.240	3.530	3.400	2.560

- Floor surface: since the survey answers are provided for 10 m^2 surface intervals, the floor area of the dwelling-type is calculated as the average of the central values of the surface intervals weighted on the frequency of the answers for each surface interval (Table 4).

Table 4. Dwelling-types' heated floor surfaces [m^2].

	Before 1950	1950-1969	1970-1989	From 1990
S. F. House	121.5	115.0	119.9	130.3
Multi-f. House	122.0	103.7	115.9	122.6
Gr. Fl. Apt.	86.3	92.4	82.1	83.1
Mid. Fl. Apt.	90.8	83.6	89.1	92.8
Top Fl. Apt	98.5	89.6	93.4	90.8

- Exposure: the survey provides information about two main exposures (without specifying the prevailing one) of the external walls of the dwelling. Analyzing the frequency of all possible answers and the combinations between them it was assumed that the multi-family dwellings have two possible types of exposure: two opposite sides or three adjacent sides exposed to the outside; for apartments the types of exposure are three: one single side, two opposite sides and two adjacent sides exposed to the outside; for the single family house all the 4 sides are considered exposed to the outside. Table 5 summarizes all the 34 considered types of exposure, corresponding to the simulations to be performed for each period of build. The weight of each type of exposure is proportional to the number of dwellings that fall in it; Table 6 summarizes the weight of the identified types of exposure and of their consequent simulations.

Table 5. Dwelling walls' main exposures and consequent simulations.

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
SFH	all	-	-	-	-	-	-	-	-	-
MFH	N+S	E+W	N+E+S	-	-	-	-	-	-	-
GFApt	N	E	S	W	N+S	E+W	N+E	N+W	E+S	S+W
MFApt	N	E	S	W	N+S	E+W	N+E	N+W	E+S	S+W
TFApt	N	E	S	W	N+S	E+W	N+E	N+W	E+S	S+W

Table 6. Weight of each identified type of exposure and consequent simulation.

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
SFH	100.0%	-	-	-	-	-	-	-	-	-
MFH	44.1%	23.9%	32.0%	-	-	-	-	-	-	-
GFApt	14.2%	11.7%	12.6%	4.9%	10.5%	10.8%	7.6%	7.6%	12.4%	7.9%
MFApt	14.2%	11.7%	12.6%	4.9%	10.5%	10.8%	7.6%	7.6%	12.4%	7.9%
TFApt	14.2%	11.7%	12.6%	4.9%	10.5%	10.8%	7.6%	7.6%	12.4%	7.9%

- Heat losing surfaces: the vertical heat losing surfaces are determined in accordance with the previously identified types of exposure, considering a square shaped floor and assuming the height of the walls for each type of dwelling; the total window surface, assumed to be equal to 1/8 of the floor surface, is divided equally among the walls exposed to the outside. For both the single and the multi-family house, the floor and the ceiling are considered heat losing surfaces. As far as the apartments are concerned, the middle floor apartment has no horizontal heat losses, the ground floor has heat losses through the floor and the top floor apartment has heat losses through the ceiling.

4. THE SIMULATION MODEL

Since the aim of the work is the determination of both the energy consumption and the thermal load profiles, we chose to use a dynamic simulation model, made by the University of Catania, based on the equivalent resistance-capacitance model proposed in the European standard EN ISO 13790 [4].

Dynamic models for the evaluation of energy consumption in buildings are developed taking into account the variability of both the external climatic conditions of the internal loads. In general, the calculation of the heat load in summer is done with dynamic methods that take into account the thermal capacity and the thermal transients of the buildings.

The European standard EN ISO 13790 proposes an electro-thermal dynamic model simplified with five thermal conductance and a heat capacity, called 5R1C, shown in Figure 2.

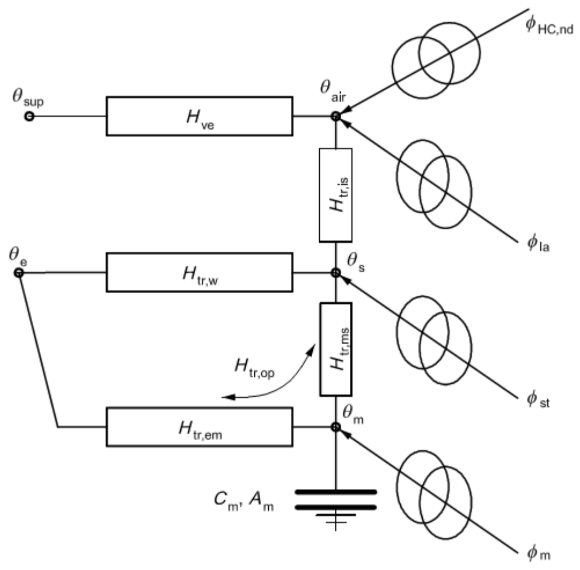

Figure 2. 5R1C Model Scheme

The nodes in the model scheme represent the ventilation (θ_{sup}), the outdoor air (θ_e), the envelope mass (θ_m), the envelope indoor surface (θ_s) and the indoor air (θ_{air}) temperatures. The heat transfer coefficients are: the ventilation heat transfer coefficient (H_{ve}), the transmission heat transfer coefficient for windows ($H_{tr,w}$), the emissive transmission heat transfer coefficient for the opaque envelope towards the envelope mass ($H_{tr,em}$), the conductive transmission heat transfer coefficient for the opaque envelope towards the envelope indoor surface ($H_{tr,ms}$), the coupling conductance between the envelope indoor surface and the indoor air ($H_{tr,is}$). The heat flows are: heat flow rate from internal and solar sources towards the envelope mass (Φ_m), heat flow rate from internal and solar sources towards the envelope indoor surface (Φ_{st}), heat flow rate from internal sources towards indoor air (Φ_{ia}), heating or cooling needs ($\Phi_{HC,nd}$).

The EN ISO 13790 standard defines uniquely the heat transfer coefficients and proposes a mode of solution refers to the monthly average daily conditions and monthly average daily time conditions.

The direct solution, set the temperature and the thermal conductance, allow the calculation of the net flux exchanged, $\Phi_{HC,nd}$, under changing climatic conditions. This solution involves the solution of a differential equation related to the heat balance to Φ_m node:

$$C\frac{dT_m}{dt}+\left(H_{tr,em}+H_{tr,ms}-H_{tr,ms}\frac{H_{tr,ms}}{H_{tr,w}+H_{tr,ms}+H_{si}}\right)T_m=$$
$$=\Phi_m+H_{tr,em}T_e+H_{tr,ms}\frac{\Phi_{si}+H_{tr,w}T_e+H_{si}T_{air}}{H_{tr,w}+H_{tr,ms}+H_{si}}$$

For the net flow we have:

$$\Phi_{HC,nd}=H_{ve}\left(T_{air}-T_{\sup}\right)+H_{si}\left(T_{air}-T_{si}\right)-\Phi_{air}$$

The recursive solution based on Heun method is:

$$T_m\left(t_{n+1}\right)=\left(1-\lambda\frac{T}{2}\right)T_m\left(t_n\right)+\frac{T}{2}\left(-\lambda T_m\left(t_n\right)+g\left(t_n\right)\right)+\frac{T}{2}g\left(t_{n+1}\right)$$

where:

$$\lambda=\frac{H_{tr,em}+H_{tr,ms}-H_{tr,ms}\dfrac{H_{tr,ms}}{H_{t,w}+H_{tr,ms}+H_{si}}}{C}$$

$$g=\frac{\Phi_m+H_{tr,em}T_e+H_{tr,ms}\dfrac{\Phi_{si}+H_{tr,w}T_e+H_{si}T_{air}}{H_{tr,w}+H_{tr,ms}+H_{si}}}{C}$$

The calculation thus prepared is sufficient and can be quickly implemented on Excel spreadsheet.

The input data required for the model are:

- thermal transmittance of the component, W / (m².K).
- participation factor (required by UN EN 13790)
- total surface of each element m².
- solar absorption factor for opaque walls and global solar transmittance for transparent surfaces;
- shading factor (as per UNI EN 13790).
- total building height, m;
- number of air changes per hour in the absence of VMC;
- air flow temperature of ventilation in the case of controlled mechanical ventilation;
- ambient temperature that you want to have during the night attenuation.
- specific flow to the sky;
- reference temperature for plant regulation (set equal to 20 °C in winter and 26 °C in summer);
- total atmospheric pressure for the town considered;
- humidity of the ventilation;
- latent heat intensity for internal sources.

An important feature of the method is the ability to customize the input vectors as a function of weather data, the real profiles for plants and internal gains.

As output, the model provides for each day (representative of the month) a time profile of the latent load, the total load required, the attenuation coefficient, the indoor air temperature and the inner surface of the walls.

5. ESTIMATION OF THE ENERGY PRODUCT CONSUMPTION

The consumption of primary energy from the thermal energy demand is determined according to the following parameters:

- number of hours of daily usage of the plant for each dwelling-type, calculated as the average of the answers and divided into climatic zones;
- reduction factor, $a_{H,red}$,for intermittent heating;
- average overall efficiency of the heating plant.

The $a_{H,red}$ coefficient takes into account that the plants do not run for all day, the solar and inner gains and the building time constant and are calculated according to the formula proposed in the UNI TS 11300-1 / 2014 [5]:

$$a_{H,red}=1-b_{H,red}\left(\tau_{H,O}/\tau\right)\gamma_H\left(1-f_{H,hr}\right)$$

The overall performance of thermal plants is calculated as the product of the efficiencies of the subsystems in which is divided, namely the generation, distribution, control and emission.

The efficiency of each subsystem is determined as a weighted average for the plant surface of each type of dwelling inferred from the survey responses, to which a value as indicated in the UNI TS 11300-2 / 2014 [6] was assigned.

The efficiency of the generation subsystem is dependent on the primary source used, while other subsystems are independent. In the case of single or portable heating systems, it was assigned to each type a single overall efficiency.

The types of considered subsystems, are:

- emission: radiators, fan coils and radiant panels;
- control: on-off and thermostatic valves;
- distribution: before and after 1990 with different efficiency values for single and multi-family house, ground floor autonomous apartments, middle and top floor autonomous apartments, last and centralized apartments.

For the generation subsystem supplied by natural gas, it was considered the boiler for centralized and autonomous systems and stoves for those individuals.

Table 7 shows the values of the overall efficiency calculated:

Table 7. Global efficiency of natural gas heating systems, for each dwelling-type class [-]

	Before 1950	1950-1969	1970-1989	From 1990
S. F. House	0.767	0.765	0.767	0.768
Multi-f. House	0.766	0.767	0.769	0.761
Gr. Fl. Apt.	0.794	0.788	0.792	0.771
Mid. Fl. Apt.	0.788	0.795	0.797	0.773
Top Fl. Apt	-	0.794	0.798	0.785

6. RESULTS, DISCUSSION AND FUTURE WORK

The first result, which is also the most important for the many activities in which it can be used, is the classification of the whole Italian residential housing stock in 20 classes of dwelling-types, determined as previously described.

6.1 Thermal load

For each dwelling-type, the profiles of the indoor air temperature, of the thermal energy demand (assuming a continuous heating mode) and of the thermal load (that is the dwelling energy demand with a power profile for a total number of hours equal to the maximum allowed), were obtained.

Figure 3,

Figure 4 and

Figure 5 show an example of the available hourly profiles for the dwelling-type class "top floor apartment", period of build "before 1950", in the case of controlled mechanical ventilation.

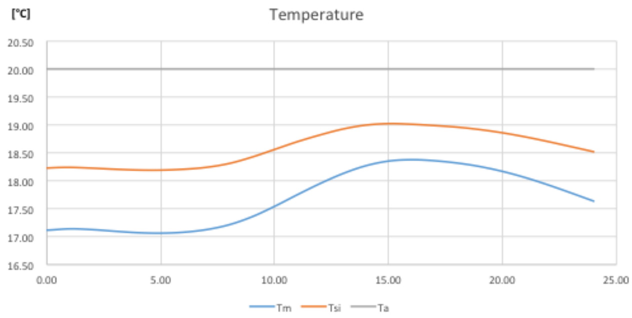

Figure 3. Indoor temperature hourly profile, continuous heating mode [°C]

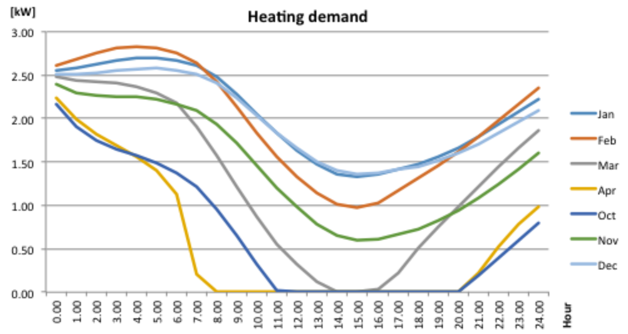

Figure 4. Heating demand hourly profile of the average day for each month, continuous heating mode [kW]

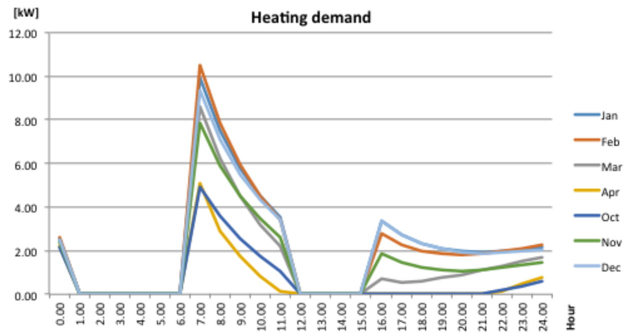

Figure 5. Thermal load hourly profile of the average day for each month, intermittent heating mode [kW]

Figure 5 clearly shows how the presence of a power profile highlights a different distribution of the thermal output required by the heating system, providing much more detailed information closer to a real trend.

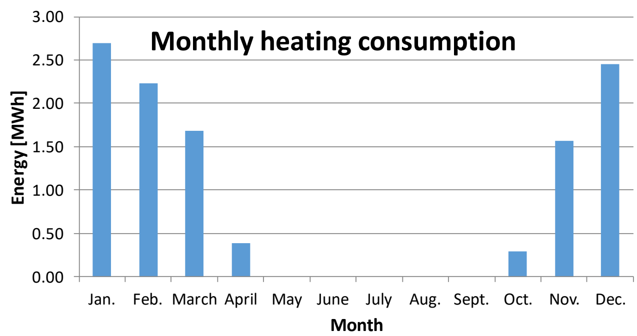

Figure 6. Monthly heating consumption profile [MWh]

In

Figure 6 an example of a monthly consumption of thermal energy for heating profile is plotted: it is referred to a single simulation run of the 34 possible for each period of build and for each climatic zone.

6.2 Energy product consumption

Starting from the results of the 34 simulations performed for each period of build (Table 5), it is possible to obtain the thermal energy consumption of each dwelling-type, as the average weighted on the table of weights (Table 6) multiplied by its corresponding reduction factor for intermittent heating, $a_{H,red}$ (Table 8).

Table 8. Reduction factor for intermittent heating ($a_{H,red}$) corresponding to each simulation, period of build "before 1950", climatic zone E [-]

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
SFH	0.70	-	-	-	-	-	-	-	-	-
MFH	0.83	0.81	0.82	-	-	-	-	-	-	-
GFApt	0.80	0.74	0.77	0.78	0.77	0.73	0.75	0.77	0.73	0.75
MFApt	0.71	0.62	0.66	0.67	0.72	0.68	0.70	0.73	0.67	0.70
TFApt	0.73	0.64	0.68	0.69	0.70	0.66	0.68	0.71	0.66	0.69

Since four periods of build have been identified, for each climatic zone 136 simulations are performed, and their results, weighted on Table 6 and multiplied by their corresponding reduction factors for intermittent heating, allow the calculation of the thermal energy consumption of the 20 identified dwelling-types, as shown in Table 9.

Table 9. Heating consumption for each dwelling-type, climatic zone E [kWhy]

	Before 1950	1950-1969	1970-1989	From 1990
S. F. House	19342	18232	17957	18500
Multi-f. House	24138	21245	22979	23325
Gr. Fl. Apt.	9947	11287	9802	9704
Mid. Fl. Apt.	5832	5678	5966	6018
Top Fl. Apt	11154	9669	10774	10174

Dividing the heating consumption table of the dwelling-types (Table 9) by the table of the dwelling-types' heated floor surfaces (Table 4), the heating consumption per area for each dwelling-type class, for the considered climatic zone, is obtained (Table 10).

Table 10. Heating consumption per area for each dwelling-type class, climatic zone E [kWh/m^{2}y].

	Before 1950	1950-1969	1970-1989	From 1990
S. F. House	159.20	158.54	149.77	141.99
Multi-f. House	197.85	204.88	198.27	190.26
Gr. Fl. Apt.	115.27	122.16	119.39	116.78
Mid. Fl. Apt.	64.24	67.93	66.96	64.86
Top Fl. Apt	113.24	107.92	115.35	112.05

The procedure described above is then applied for all climatic zones, and a table similar to Table 10 is obtained for each climatic zone.

For each dwelling-type class, is then possible to calculate the weight of each climatic zone by considering the share of floor surface of the class, falling in each zone: in the case of the Veneto Region, for instance, the single family house class is distributed between zone E (91.5 % of the heated floor surface) and zone F (8.5 % of the heated floor surface).

This distribution is then summarized for each climatic zone, as shown in Table 11 for the climatic zone E.

Table 11. % of floor surfaces of the building-type classes falling in the climatic zone E [-]

	Before 1950	1950-1969	1970-1989	From 1990
S. F. House	91.5%	95.6%	94.7%	96.6%
Multi-f. House	94.6%	93.4%	95.6%	97.2%
Gr. Fl. Apt.	100.0%	97.2%	94.5%	94.3%
Mid. Fl. Apt.	96.6%	95.6%	98.6%	100.0%
Top Fl. Apt	100.0%	95.9%	76.4%	75.8%

Weighting the simulation results of each climatic zone by the percentage of floor falling in the zone itself, the heating consumption per area for each dwelling-type class is calculated. The results for the Veneto Region are summarized in Table 12.

Table 12. Heating consumption per area for each dwelling-type class [kWh/m^{2}y]

	Before 1950	1950-1969	1970-1989	From 1990
S. F. House	145.69	151.58	141.69	137.22
Multif. House	187.27	191.28	189.62	184.93
Gr. Fl. Apt.	115.27	118.75	112.82	110.14
Mid. Fl. Apt.	62.03	64.92	66.01	64.86
Top Fl. Apt	113.24	103.47	88.18	84.99

Multiplying the heating consumption per area by the total area of the dwellings, that use a specific energy product for heating (in the present example: natural gas), that fall in each dwelling-type class (Table 13) and dividing by the respective system's global efficiency (Table 7), it is possible to assess the total energy product consumption for heating of each dwelling-type class for the specific energy product, as shown in Table 14.

Table 13. Total floor surface of each dwelling-type class, using Natural gas as energy product for heating [m^2]

	Before 1950	1950-1969	1970-1989	From 1990
S. F. House	5135	7785	11520	5665
Multi-f. House	1915	4950	6370	7865
Gr. Fl. Apt.	3340	7330	7375	3960
Mid. Fl. Apt.	720	3135	3400	2500
Top Fl. Apt	0	225	525	690

The sum of the elements of Table 14, reporting the total annual consumption of the dwelling-type classes for the considered energy product provides the overall annual energy product consumption for heating of the residential building stock for the considered energy product which, in the case of the Veneto Region and of natural gas, is approx. 15,014 MWh.

Table 14. Total annual energy product consumption for heating of each dwelling-type class, natural gas [MWhy]

	Before 1950	1950-1969	1970-1989	From 1990
S. F. House	975.3	1542.9	2129.3	1011.5
Multi-f. House	468.3	1234.0	1570.6	1910.9
Gr. Fl. Apt.	484.9	1105.2	1050.0	565.4
Mid. Fl. Apt.	56.7	255.9	281.5	209.8
Top Fl. Apt	0.00	29.31	58.03	74.69

The project activity is still in progress. The present step, in progress, is the comparison between the consumption data calculated with the presented methodology and those estimated by the ISTAT survey, the final results of the comparison will be published later.

7. CONCLUSIONS

The above presented methodology has enabled, by means of processing the data on energy consumption of Italian families provided by the ISTAT survey and with the aid of a dynamic simulation model, the realization of a tool able to estimate the energy consumption and to create the thermal load profiles of the representative dwellings of the Italian residential sector.

In particular the methodology allowed to group the entire national sample in 20 cluster of type dwellings, as a function of building (dimensions, equipment, energy characteristics, etc.), family (number of occupants, consumption habits, etc.) and environmental (region, climatic zone, etc.) characteristics.

The methodology is able to estimate energy consumptions distinguished for end use (heating, cooling and domestic hot water) and energy product.

The aim of the work is to increase knowledge of consumer habits of end user to outline a real scenery of the buildings consumption useful to address the choice of the most efficient technological solutions and to provide guidance on the policy actions of support for the dissemination of the most promising technologies.

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