9 OCTOBER 2025

statistiche report

Istat | Istituto Nazionale di Statistica

HOUSEHOLD ENERGY EQUIPMENT | YEAR 2024

More households with individual heating systems and air conditioners

In 2024, 99.4% of households resident in Italy lived in dwellings equipped with space heating (98.6% in 2021): coverage was almost total in the Central and Northern regions, whereas in the South and Islands 1.7% of households lacked a heating system.

43.2% of households had multiple heating systems. The individual heating system was dominant and increased (79.0% of households, 72.2% in 2021); fixed or portable space heaters were widespread but declined (44.8%, down from 48.1%); central heating systems were less common (15.4% compared with 18.0% in 2021).

Domestic hot water was available in the main dwelling of 99.7% of households; 80.7% had an individual water heating system. For 70.4% of households, the water heating system coincided with the space heating system.

At least one space cooling system was present in 56.0% of households, up from 48.8% in 2021: 24.4% had a central or individual cooling system and 35.4% had single air-conditioning (AC) units. Additionally, 40.4% of households were equipped with a system that provides both space heating and cooling.

56.0%

Share of households with space cooling systems

66.6% in lowland municipalities, 21.3% in inland mountain municipalities.

40.4%

Share of households with combined space heating and cooling systems (heat pumps), 58.5% in the Islands

16.0%

Share of households consuming firewood in 2023

7.8% of households consumed wood pellets.

www.istat.it

PRESS OFFICE
phone +39 06 4673.2243/44
ufficiostampa@istat.it

CONTACT CENTRE
contact@istat.it

National and European policies and the internationally defined targets promote, along other measures, the energy efficiency to tackle climate change and the depletion of natural resources. Considering the expanding role of the residential sector in total energy consumption, Istat conducts a triennial Household Energy Consumption Survey to provide data on household energy equipment, its usage patterns, and domestic energy consumption.

This report analyses the survey results concerning the main dwelling equipment of households resident in Italy for space heating, water heating and space cooling, as of the interview date (2024). It also presents data on biomass consumption (firewood and wood pellets) by households during 2023, in accordance with European Regulation No 1099/2008. Quantitative data on the consumption of other energy sources and related expenditures will be presented in a subsequent analysis. Comparisons are also made with the results of two previous survey editions, conducted in 2021 and 2013[i].

Heating and domestic hot water almost universal

In 2024, 99.4% of households resident in Italy had at least one space heating system in the main dwelling (98.0% in 2013). Coverage was nearly universal in the Central and Northern regions, while in the South and Islands 1.7% of households lacked a heating system (3.4% in 2021 and 5.3% in 2013). In Sicilia, 4.0% of households did not have heating, although this share had decreased over time (6.4% in 2021 and 11.6% in 2013).

Domestic hot water was also widely available, reaching 99.7% of households, with homogeneous values across the national territory. 70.4% of households had a system capable of both heating the home and producing hot water.

Increasing share of households with individual heating systems

Households may have more than one space heating system. In 2024, the most widespread type remained individual heating system, present in 79.0% of households' main dwellings, up by 6.8 percentage points compared with 2021. Conversely, central systems declined, with a national share of 15.4% (18.0% in 2021). Local space heaters, whether fixed or portable, continued to be widely used: 44.8% in 2024 compared with 48.1% in 2021.

The spread of these heating methods showed clear territorial differences. Individual systems were most common in the North-east (86.6%) and were also widely used in the Centre (85.2%) and the South (82.0%), while the share was lower in the North-west (74.2%) and in the Islands (60.0%). Space heaters were more widespread in the Islands and in the South (64.5% and 50.9%, respectively) than in the rest of the country. Central systems were comparatively the least common among households: their highest share was recorded in the North-west (30.1%), where district heating networks are also well developed, while the lowest share was observed in the South and Islands (3.8%).

KEY FIGURES. HOUSEHOLDS EQUIPPED WITH SPACE HEATING, WATER HEATING AND SPACE COOLING SYSTEMS, BY TYPE AND GEOGRAPHICAL AREA.

Year 2024, percentages on total resident households

GEOGRAPHICAL AREA	Space heating			Water heating			Space cooling		
	Central system	Individual system	Local space heaters	Central system	Individual system	Water heaters	Central or individual system	Cooling-only AC units	Reverse-cycle AC units
North-west	30.1	74.2	33.1	13.6	77.2	12.5	23.4	10.7	19.1
North-east	13.7	86.6	47.0	9.7	87.5	5.5	30.8	13.1	27.7
Centre	14.9	85.2	42.0	4.6	86.5	12.3	22.7	11.0	23.0
South	3.8	82.0	50.9	2.3	82.4	19.3	20.7	14.4	28.0
Islands	3.8	60.0	64.5	0.9	63.2	40.3	26.1	11.0	41.6
ITALY	**15.4**	**79.0**	**44.8**	**7.3**	**80.7**	**15.5**	**24.4**	**12.1**	**25.9**

Source: Istat, Household Energy Consumption Survey, Year 2024

In 2024, central systems showed the highest diffusion in the Capital municipalities of metropolitan cities (40.5%) with respect to other municipality type and became progressively less common as municipal size decreased (6.1% in municipalities with up to 10 000 inhabitants). Individual heating systems, by contrast, were more widespread in smaller municipalities (85.3% in those with up to 10 000 inhabitants and 84.7% in those with 10 001-50 000 inhabitants) and less common in the Capital municipalities of metropolitan cities (59.5%). Local space heaters were also more frequent in smaller municipalities than in larger ones: from 51.6% in municipalities with up to 10 000 inhabitants to 36.7% in the Capital municipalities of metropolitan cities, partly reflecting the different types of residential buildings.

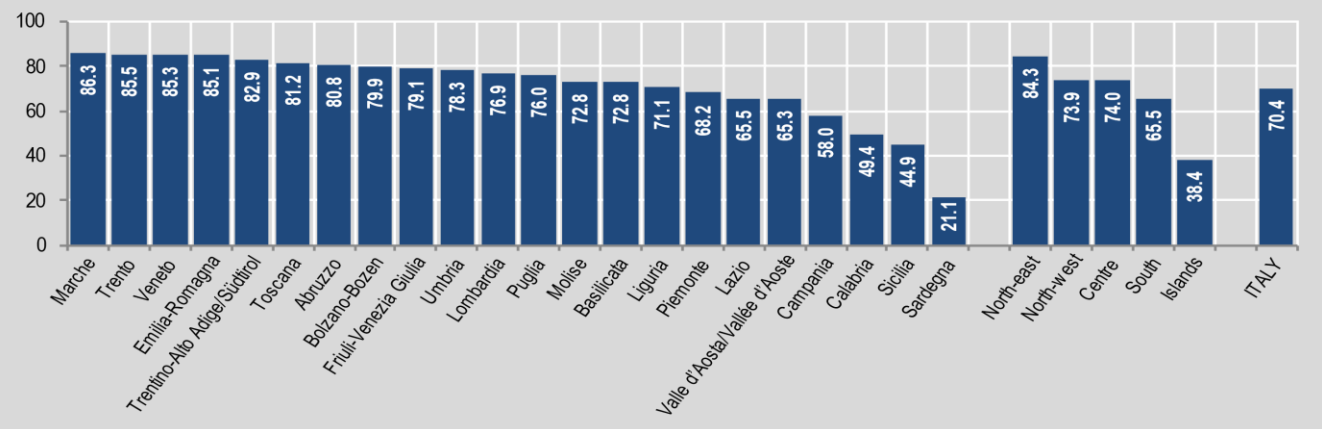
Households may have multiple systems for producing domestic hot water. As for space heating, also for water heating individual systems largely predominated: they were present in 80.7% of households, showing an increase compared with 2021 (73.9%). The use of individual appliances, such as an electric water heater serving a single tap, decreased (15.5%, down from 22.6% in 2021), while the spread of central systems for water heating remained stable and marginal (7.3%). The distribution breakdown of different water heating systems by municipality type mirrored that observed for space heating, reflecting the strong prevalence of systems performing both functions.

Multiple space heating systems often present in dwellings

In 2024, 43.2% of households had access to more than one space heating system in their main dwelling (all systems covered by the survey were operational and available, even if not in use at the time of the interview). Central systems are included (serving more than one apartment or house), as well as individual systems (such as a natural gas-fired boiler, a multi-split heat pump, or a solar thermal system) and individual appliances, either fixed (such as stoves, fireplaces or single-split AC units) or portable (such as electric or other fuel-based local space heaters). This shows a certain dynamism of households in seeking the most suitable solutions to meet their heating needs, not always directed towards the most energy-efficient options or resulting from a comprehensive energy efficiency strategy. Such behaviour is likely influenced by both the rapid development of multiple technologies available on the market and the significant variability in energy prices observed in recent years. However, compared with 2021, the share of households with multiple space heating systems decreased only slightly (from 44.5% to 43.2%), suggesting that the trend towards the rationalisation of systems remains weak.

The coexistence of different space heating systems was more common in the Islands (49.1%, with Sardegna standing out at 62.0%) and in the North-east (48.2%), and less frequent in the North-west (37.5%). It was also more widespread in smaller municipalities (48.6% in municipalities with up to 10 000 inhabitants) than in larger ones (39.2% in the Capital municipalities of metropolitan cities and 38.3% in municipalities with over 50 000 inhabitants), a distribution similar to individual heating systems and local space heaters and likely related to it. With respect to the altitude zones, multiple heating systems were more frequent in lowland municipalities (44.1%), coastal hill municipalities (43.0%) and inland mountain municipalities (42.8%).

FIGURE 1. HOUSEHOLDS EQUIPPED WITH COMBINED SPACE HEATING AND WATER HEATING SYSTEMS, BY REGION AND GEOGRAPHICAL AREA. Year 2024, percentages on total resident households



Source: Istat, Household Energy Consumption Survey, Year 2024

70.4% of households had a system capable of both heating the home and producing domestic hot water. These combined space heating and water heating systems were more widespread in the North-east (84.3%) and less frequent in the Islands (38.4%). At the regional level, Marche (86.3%), the Autonomous Province of Trento (85.5%), Veneto (85.3%) and Emilia-Romagna (85.1%) stood out, while Sardegna recorded the lowest value (21.1%, **Figure 1**). Territorial disparities are affected by both climatic conditions and the level of development of energy infrastructure across the country.

Individual systems primarily used even in households with multiple heating systems

In 2024, the individual system was the main (or sole) space heating system used, specifically for 69.6% of households with heating; 15.9% of households predominantly used a local space heater, while the remaining 14.4% primarily relied on a central system (**Figure 2**). Compared with 2021, the share of households predominantly using an individual system increased by 3.9 percentage points, whereas the share of those using a central system (−2.7 p.p.) or a space heater (−1.3 p.p.) decreased. Households' preference for individual systems clearly reflected the need for greater flexibility to match family schedules and requirements, and it may also have corresponded to improved energy efficiency depending on the type of system installed.

The use of the individual system as the main (or sole) heating system in the dwelling was most widespread in the North-east (76.1%), the Centre (75.5%) and the South (72.8%). In contrast, central systems were more frequently reported as the main (or sole) heating system in the North-west (29.1%) than in the North-east (12.8%) and the Centre (13.7%). Only 2.8% of households mainly used a central system in the South and Islands, where local space heaters were widely used as the main (or sole) system (45.3% in the Islands and 24.4% in the South). Sardegna was the region where local space heaters were used the most as the main (or sole) heating system (54.7%), largely due to the delayed development of natural gas infrastructure on the island, which has begun only in recent years.

Individual systems were also the most common option for water heating, being the main (or sole) system in the dwelling for 79.2% of households with domestic hot water, up from 72.6% in 2021 (**Figure 3**). Individual appliances, typically electric water heaters serving a single tap (usually energy-intensive), were the main system for 14.1% of households, down from 20.8% in 2021. Central systems were the main system for 6.7% of households, a share that remained stable compared with 2021.

Over half of households have at least one space cooling system

In 2024, more than half of households had at least one space cooling system in their main dwelling, such as a central system, an individual multi-split system, or single AC units, either fixed or portable. AC units may be cooling-only or reverse-cycle (heat pump), i.e. capable of providing cool air during summer and warm air during winter (**Figure 4**).

FIGURE 2. HOUSEHOLDS BY MAIN OR SOLE SPACE HEATING SYSTEM. Year 2024, percentage distribution of households with heating

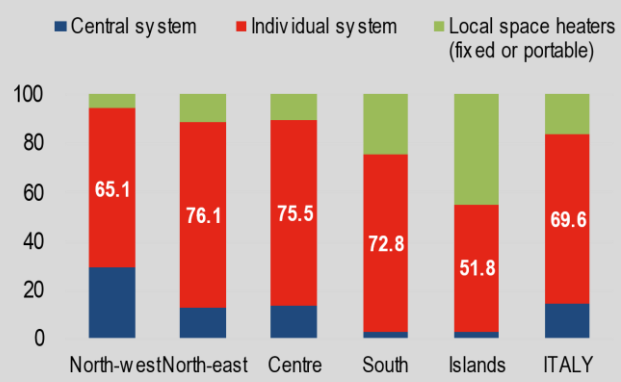
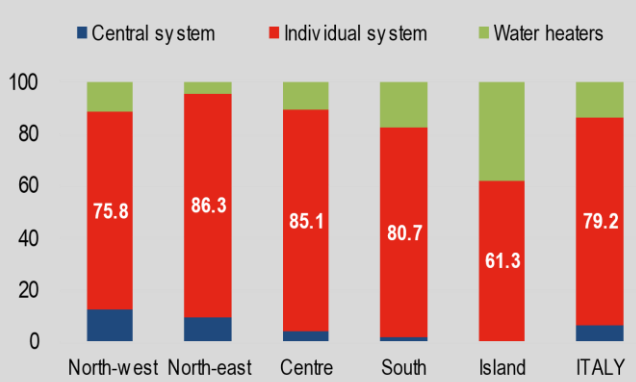


FIGURE 3. HOUSEHOLDS BY MAIN OR SOLE WATER HEATING SYSTEM. Year 2024, percentage distribution of households with domestic hot water



Source: Istat, Household Energy Consumption Survey, Year 2024

The share of households whose dwellings were equipped with space cooling systems in 2024 (56.0%) steadily increased over the years: it was 48.8% in 2021 and nearly doubled compared with 2013, when fewer than one in three households (29.4%) had such equipment. Compared with 2021, the increase was more pronounced in the South and Islands (+9.7 percentage points) and in the Centre (+7.2 p.p.).

In 2024, 6.4% of households had multiple space cooling systems of different types (for instance, both single AC units and an individual/central system, or both cooling-only and reverse-cycle appliances); in the Islands, this share reached 8.0%.

Space cooling systems were most widespread in the Islands (71.2%) and in the North-east (64.1%), while shares were below the national average in other geographical areas, particularly in the North-west (48.0%). At the regional level, Sicilia and Veneto recorded the highest prevalence (73.1% and 71.1% of households, respectively), followed by Emilia-Romagna (67.6%) and Sardegna (66.4%). Southern regions showed considerable variability, ranging from a maximum in Puglia (63.6%) to a minimum in Molise (30.7%). The lowest share, although increasing, was observed in Valle d'Aosta/Vallée d'Aoste (11.8%, +7.1 p.p. compared with 2021) and in Trentino-Alto Adige/Südtirol (20.0%, +4.8 p.p.).

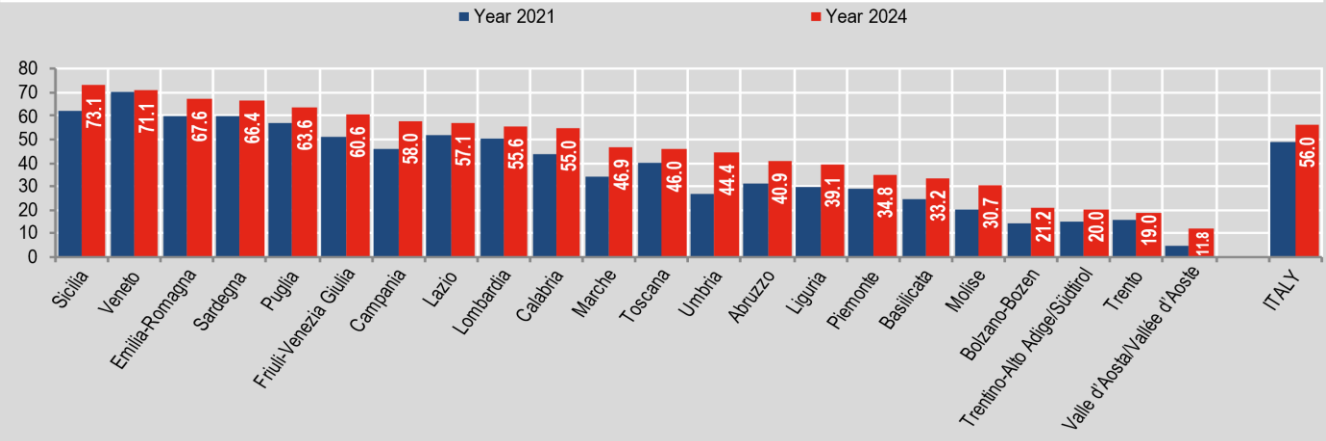
The use of space cooling systems seems to be more strongly associated with municipal size than with a North-South gradient: their spread was above the national average in Capital municipalities and in peripheral municipalities of metropolitan cities (63.2% and 63.3%, respectively), which are more affected by the "urban heat island" effect, compared with less populated municipalities. The prevalence of space cooling systems was also strongly related to the altitude zones, with the highest shares observed in lowland municipalities (66.6%) and in coastal hill municipalities (58.7%).

Among space cooling systems, heat pumps are on the rise

In 2024, 24.4% of households had a central or individual space cooling system in their dwelling, that is a system with a central unit and terminals serving multiple rooms. Compared with 2021, the share increased significantly (+12.9 p.p.). Conversely, the use of single air-conditioning units declined over time, from 40.9% of households in 2021 to 35.4% in 2024.

Combined space heating and cooling systems (heat pumps) recorded the largest relative increase: they were available to 32.6% of households in 2021, rising to 40.4% in 2024. Heat pumps, which can both raise and lower indoor temperatures, may be either multi-split systems or single-split AC units (fixed or portable). In 2024, their prevalence was highest in the Islands (58.5%) and the North-east (46.9%). The North-west, which had the lowest share in 2021 (24.2%), showed the strongest growth, reaching 34.0%, yet remained below the levels observed in the other geographical areas. In detail, 16.1% of households had a central or individual reverse-cycle system, while 25.9% used a single reverse-cycle AC unit.

FIGURE 4. HOUSEHOLDS WITH SPACE COOLING, BY REGION. Years 2021 and 2024, percentages on total resident households



Source: Istat, Household Energy Consumption Survey, Years 2021 and 2024

In terms of primary (or sole) use, households with space cooling equipment tended to rely on a central or individual system (39.6%, specifically multi-split heat pumps preferred by 26.3% of households with space cooling equipment) or on a single reverse-cycle AC unit (42.2%), i.e. individual heat pumps, either fixed or portable; the remaining 18.2% predominantly used a single cooling-only AC unit.

The use of firewood is most widespread in smaller municipalities

In a domestic context, firewood may be used for space heating, domestic hot water production and cooking[ii] and can be consumed through heating appliances or individual/central systems. During 2023, 16.0% of households used firewood for domestic purposes (excluding use in central systems), showing a slight decrease compared with the previous survey (17.0%), while it was 21.4% in 2013.

In the South, one in five households (21.3%) used firewood; lower shares were observed in the North-east (19.4%), the Centre (17.5%), the Islands (12.5%), and the North-west (9.9%). Firewood use varies greatly from region to region, reflecting resource availability, access to alternative fuels, as well as historical and cultural factors. It was most common in the Autonomous Provinces of Trento and Bolzano/Bozen (37.9% and 36.2%, respectively), in Calabria (35.5%), Umbria (34.8%), and Friuli-Venezia Giulia (30.3%). Conversely, its use was residual in Lombardia (6.8%), Sicilia (7.0%), and Liguria (9.6%) (**Figure 5**).

Firewood use was highest in municipalities with up to 10 000 inhabitants (30.9%) and lowest in Capital municipalities of metropolitan cities (1.5%). It was also frequent in inland mountain municipalities (36.7%), especially in mountain municipalities with up to 10 000 inhabitants, where 42.7% of households used firewood, and in inland hill municipalities (21.3%).

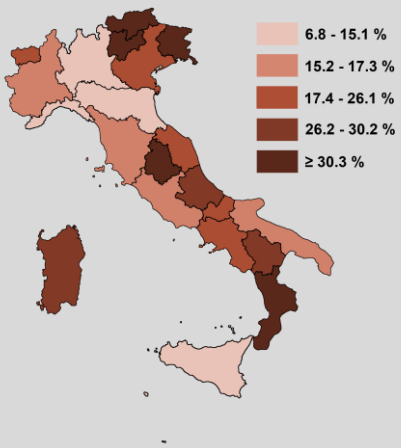
The use of wood pellets is increasing

Wood pellets are mainly used for space heating through individual systems and local space heaters such as stoves and fireplaces, whether traditional or innovative (e.g. connected to heating systems), and for hot water production or cooking.

During 2023, 7.8% of households used wood pellets (excluding use in central systems), a slight increase compared with the previous survey (7.3%), while the share was 4.1% in 2013. Pellet use was more frequent among households in the South (9.5%), the Islands (9.6%), and the North-east (8.6%), and lower in the Centre (7.0%) and the North-west (5.9%) (**Figure 6**).

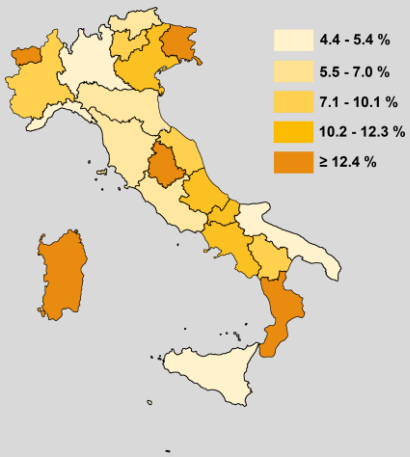
As with firewood, the use of wood pellets was highest in municipalities with up to 10 000 inhabitants (14.3%), particularly in mountain municipalities (16.2%), and decreased as the municipal population size increased. As for the altitude zones, maximum use was observed in inland mountain municipalities (14.1%) and inland hill municipalities (10.2%). Overall, 21.9% of households consumed firewood and/or wood pellets, which represented the two main kinds of biomass used for domestic energy purposes.

FIGURE 5. HOUSEHOLDS CONSUMING FIREWOOD. Year 2023, percentages on total resident households



Source: Istat, Household Energy Consumption Survey, Year 2024

FIGURE 6. HOUSEHOLDS CONSUMING WOOD PELLETS. Year 2023, percentages on total resident households



Source: Istat, Household Energy Consumption Survey, Year 2024

Glossary

AC units: air conditioning units, i.e. individual appliances designed to cool a single space; they may be fixed or portable. “Cooling-only” AC units provide only cooling, whereas “reverse-cycle” AC units can provide both heating and cooling by exchanging thermal energy with the outdoor environment (single-split heat pumps). Electric fans are excluded from the survey.

Altitude zone: the Italian National Institute of Statistics classifies Italian municipalities, based on altitude thresholds, into five zones. The classification criteria are outlined in the 1958 publication “*Istat, Circoscrizioni statistiche, Metodi e norme, serie C - n.1 agosto 1958*”. Three main altitude zones are distinguished: mountain, hill and lowland. To account for the moderating effect of the sea on climate, the mountain and hill zones are further subdivided into inland and coastal areas. Coastal areas include territories, excluding the lowland zone, which are bordered by or lie close to the sea.

Biomass: organic substances of plant or animal origin that have not undergone fossilisation, used as a renewable energy source to produce heat, electricity, or biofuels. Biomass includes firewood, wood pellets (including wood briquettes), wood chips, charcoal, almond or hazelnut shells, pomace (olive-pomace pellets, pomace pits), wood waste (from various sources), and other kinds of biomass. Wood pellets are a natural fuel made from sawdust compressed into small cylindrical briquettes, typically 1 to 5 cm long and with a diameter of 5 to 12 mm (larger sizes are also available on the market, in which case they are referred to as wood briquettes).

Combined systems: in a dwelling, a combined space heating and water heating system may be present, i.e. a system capable of both heating the indoor environment and producing domestic hot water. Examples include a central heating system, an individual natural-gas boiler, a solar thermal system, or a heat pump that provides both heating and hot water. Similarly, there are systems (such as heat pumps) that can both heat and cool the home, depending on the needs.

Dwelling equipment: systems and individual appliances for space heating, water heating, and space cooling are recorded if operational, even when not currently in use, provided they belong to the household’s equipment and are not intended exclusively for work-related purposes.

Heat pump: a machine, almost always electrically powered, that extracts heat from a system at a lower temperature (cooling it) and transfers it to another system at a higher temperature (heating it). It is considered efficient when the thermal energy exchanged with the system (removed if the purpose is cooling, delivered if the purpose is heating) exceeds the energy required to operate the machine. These devices can be used to heat and cool indoor spaces as well as to produce domestic hot water. In particular, reverse-cycle (heating/cooling) heat pumps are systems in which the operating cycle can be reversed to heat the dwelling in winter and cool it in summer. They generally consist of an outdoor unit (an electric motor with a fan) and one or more indoor units (splits or radiators), that heat or cool the indoor environment. Single-split heat pumps are classified as individual appliances, while heat pumps that serve multiple rooms (multi-split or connected to radiators) are considered individual or central systems.

Local space heaters: independent heating appliances, not connected to each other, that heat the room they are installed in; they differ from systems that provide heating to multiple spaces. The survey records all space heaters that function correctly, even if not used. They can be either fixed (such as traditional and ventilated fireplaces, single-split heat-pumps) or portable (portable stoves, electric portable fan heaters, wheeled portable air conditioners, etc.), excluding innovative stoves and fireplaces or other systems connected to a heat-distribution network for the entire dwelling.

Main (or sole) system (for space heating, water heating, and space cooling): the equipment, whether a central/individual system or an individual appliance, that the household identifies as the only one owned, or as the one most used when multiple systems are present.

System: provides heating or cooling to multiple rooms within a dwelling through a distribution network. It generally consists of a central unit (a heat generator, such as a boiler or a furnace, or a motor for heat pumps) and a distribution network (pipes) connecting the central unit to the terminals (radiators, splits). It is classified as a central system if it serves multiple dwellings, or as an individual system if it serves a single dwelling.

- space heating systems: the most common are central condominium systems (including district heating), individual systems that use a boiler, multi-split heat pumps, and solar thermal systems. Some individual systems, instead of a boiler, use thermo-fireplaces, thermo-stoves, or heat pumps connected via ducts to radiators or other terminals (e.g. air vents). A system can simultaneously provide space heating, cooling, and domestic hot water.

- water heating systems: systems for producing domestic hot water share characteristics similar to space heating systems. District heating typically provides both space heating and domestic hot water. Solar thermal systems and heat pumps can power either a central or an individual water heating system.

- space cooling systems: systems that cool multiple rooms within the dwelling, including multi-split heat pumps.

Water heaters: individual appliances that serve only a single point of use, such as a kitchen tap or a single bathroom; they can be powered by electricity, natural gas, diesel oil, LPG, heat pumps or biomass.

Methodological notes

This document describes the “Household Energy Consumption” survey and the methodology used to calculate sampling errors in the estimates.

Survey on Household Energy Consumption

Objectives and scope of the survey

The Household Energy Consumption Survey contributes to completing the national statistical framework on energy with regard to the residential sector, providing detailed information on households’ energy equipment and related patterns of use.

The 2024 edition of the survey collected detailed information on households’ energy equipment and on the ways such equipment was used at the time of the interview, while also reconstructing the overall picture of energy consumption in the previous year (2023), including quantities consumed and the related expenditures incurred.

The main topics covered by the survey include: the characteristics of dwellings; the systems and individual appliances available in the dwelling for space heating, domestic hot water production and space cooling; their number, energy source, technical features and patterns of use by households; electrical household appliances; the quantities consumed in the previous year for energy uses (electricity, natural gas, LPG, diesel oil and biomass), together with the associated expenditures.

Target population and data collection methodology

The survey was based on a sample of more than 42 000 households, representative at national and regional level (corresponding to a national population of 24 130 319 households). Only dwellings used as the households’ usual residences were included; secondary residences were therefore excluded.

Data were collected using a mixed-mode approach combining *CAWI* (*Computer-Assisted Web Interviewing*) and *CATI* (*Computer-Assisted Telephone Interviewing*).

The first edition of the survey was carried out in 2013 using a *CATI* technique on a sample of 20 000 households. The second edition, conducted in 2021 on 54 000 households, relied on a mixed *CAWI-CATI*[1] data collection strategy.

Sampling strategy and precision of estimates

Sampling design

The target population comprises households resident in Italy.

The study domains, i.e. the territorial levels for which population parameters are estimated, are:

- Regions (21 categories);
- Main geographical areas (5 categories: North-west, North-east, Centre, South, Islands);
- Municipality type crossed with altitude zone, defined as follows:
  - (1) Capital municipalities of metropolitan cities[iii];
  - (2) Peripheral municipalities of metropolitan cities[iv];
  - (3) Municipalities with over 50 000 inhabitants;
  - (4) Mountain (inland mountain + coastal mountain) municipalities with up to 10 000 inhabitants;
  - (5) Mountain (inland mountain + coastal mountain) municipalities with 10 001-50 000 inhabitants;
  - (6) Hill (inland hill + coastal hill) municipalities with up to 10 000 inhabitants;
  - (7) Hill (inland hill + coastal hill) municipalities with 10 001-50 000 inhabitants;
  - (8) Lowland municipalities with up to 10 000 inhabitants;

[1]The results from the 2021 and 2024 editions are not fully comparable with the results from the 2013 edition, due to the different data collection method used.

(9) Lowland municipalities with 10 001-50 000 inhabitants;

- Municipality type aggregated into five categories, defined as follows:

  (1) Capital municipalities of metropolitan cities;

  (2) Peripheral municipalities of metropolitan cities;

  (3) Municipalities with over 50 000 inhabitants;

  (4a) Municipalities with up to 10 000 inhabitants;

  (5a) Municipalities with 10 001-50 000 inhabitants.

The sampling design is a one-stage stratified design. The strata are defined by the cross-classification of region and municipality type.

The overall theoretical sample size was set at approximately 50 000 households, and its allocation across strata was determined using a multivariate optimal allocation procedure, considering the expected sampling errors for eight key estimates at the level of the study domains defined above.

The survey design envisaged splitting the sample into two independent subsamples: the first consisting of households for which a telephone contact was available and therefore interviewed using the *CATI* method; the second consisting of households without any telephone contact, to be interviewed using the *CAWI* method. For each stratum, the sample size obtained through optimal allocation was proportionally divided between the two subsamples. Sample households were selected with equal probabilities within each stratum.

The following table reports the distribution of households in the target population and in the sample by region. These figures can be used for the calculation of the confidence intervals presented in the following pages.

TABLE 1. Distribution of households by region, in Italy

	Number of households in the target population	Number of households in the sample
REGION		
Piemonte	1 844 577	2 756
Valle d'Aosta/Vallée d'Aoste	53 380	518
Liguria	683 977	1 138
Lombardia	4 240 538	6 702
Trentino-Alto Adige/Südtirol	419 424	690
Bolzano-Bozen	*195 019*	*230*
Trento	*224 405*	*460*
Veneto	1 989 651	3 812
Friuli-Venezia Giulia	510 203	931
Emilia-Romagna	1 851 071	3 709
Toscana	1 518 231	3 372
Umbria	345 758	757
Marche	589 479	1 356
Lazio	2 330 144	3 989
Abruzzo	525 878	1 144
Molise	122 950	799
Campania	2 026 428	2 685
Puglia	1 553 251	2 504
Basilicata	229 292	825
Calabria	728 654	997
Sicilia	1 870 254	2 693
Sardegna	697 179	1 388
ITALY	**24 130 319**	**42 765**

Estimation procedure

The estimation method is based on the principle that the units included in the sample also represent those in the population that were not selected. Therefore, each sampled unit is assigned a weight, indicating the number of population units it represents.

The procedure for constructing the weights assigned to the sampled units was carried out in three steps:

1. computation of the design weight, defined as the inverse of the inclusion probability of each selected unit, taking the sampling design into consideration;
2. adjustment for nonresponse, in order to ensure that the responding units also represent the non-respondents. For this purpose, a single model for total nonresponse was defined, using auxiliary variables known for all households in the theoretical sample[2].
3. computation of the adjustment factor to be applied to the base weight (the design weight multiplied by the nonresponse adjustment factor), known as the "calibration" factor, which satisfies the condition of equality between known population totals and the corresponding sample estimates[3].

Assessment of the precision of estimates

Each sample estimate is associated with a sampling error, which provides a measure of its precision. For the proper use of estimates, it is necessary to accompany each estimate with its corresponding relative sampling error $\hat{\varepsilon}(\hat{t}_{Y_d}) = \sigma(\hat{T}_{Y_d})/\hat{T}_{Y_d}$. However, since including these measures in the published tables would make them overly complex and less user-friendly, this is not possible. To address this issue, a synthetic representation of the relative errors was developed, based on the regression modelling approach (Wolter, 2007[4]). This method relies on the definition of a mathematical function that relates each estimate to its corresponding sampling error.

The model used for estimates of absolute frequencies, referring to a generic domain d, is specified as follows:

$$\log\left(\hat{\varepsilon}^2(\hat{t}_{Y_d})\right) = a + b\log(\hat{t}_{Y_d})$$

where the parameters a and b are estimated using the Ordinary Least Squares method on a set of estimates derived from the survey (together with their corresponding relative errors) that approximately cover the range of variation of the frequency estimates released for publication.

Table 2 reports the values of a and b for each estimation domain and the r^2 coefficient, which provides a measure of how well the relative sampling errors of absolute frequency estimates are represented by the model described above.

Based on the information presented in Table 2, the estimated relative sampling error for a given estimate can be calculated using the following formula:

$$\hat{\varepsilon}(\hat{t}_{Y_d}) = \sqrt{\exp\left[a + b\log(\hat{t}_{Y_d})\right]}$$

To facilitate the calculation of sampling errors, Table 2 also reports, for the different territorial domains of the estimates, the interpolated values of the relative sampling errors (in per cent) for some typical values of absolute frequency estimates.

Finally, Table 3 illustrates the calculation method for constructing a 95% confidence interval for two example estimates, and the point estimates of the number of households with individual heating in Italy and in one region, Toscana.

[2] The auxiliary variables used, drawn from the Population Census, refer to household characteristics: the highest educational attainment level of any household member, presence of foreign household members, geographical area of residence, and data collection method (*CAWI/CATI*).

[3] For this phase, the calibrated estimator (see Deville, Särndal, 1992; Särndal, 2007; Tillé, 2019) was applied to the two samples combined. This ensures that the sample exactly reproduces the regional population distributions by seven age classes (0-19, 20-29, 30-39, 40-49, 50-59, 60-69, 70+) and sex, citizenship (Italian, foreign), educational attainment level (up to lower secondary, upper secondary, tertiary and above), and labour status (employed, unemployed, outside the labour force).

[4] Wolter, K. (2007). Introduction to variance estimation. Springer Science & Business Media.

TABLE 2. Synthetic model parameters and interpolated values of relative sampling errors (per cent) for selected typical values of absolute frequency estimates across different estimation domains.

DOMAIN	a	b	r^2	10 000	20 000	50 000	70 000	100 000	500 000	1 000 000	5 000 000	10 000 000
ITALY	**11.053**	**-1.294**	**0.985**	**64.799**	**41.378**	**22.869**	**18.394**	**14.603**	**5.154**	**3.291**	**1.161**	**0.742**
North	11.033	-1.317	0.979	57.789	36.611	20.025	16.045	12.686	4.396	2.785	0.965	0.611
North-west	10.202	-1.264	0.980	48.650	31.391	17.590	14.220	11.350	4.104	2.648	0.957	0.618
North-east	10.936	-1.339	0.975	49.785	31.303	16.951	13.532	10.658	3.629	2.282	0.777	-
Centre	11.945	-1.407	0.981	60.138	36.925	19.378	15.293	11.898	3.834	2.354	0.759	-
South and Islands	9.410	-1.188	0.984	46.392	30.730	17.827	14.597	11.809	4.538	3.006	1.155	0.765
South	9.408	-1.190	0.976	45.960	30.425	17.636	14.436	11.675	4.480	2.966	1.138	0.753
Islands	8.707	-1.158	0.985	37.488	25.093	14.759	12.146	9.879	3.889	2.603	1.025	-
Capital municipalities of metropolitan cities	7.433	-1.074	0.971	29.208	20.128	12.305	10.270	8.480	3.572	2.462	1.037	-
Peripheral municipalities of metropolitan cities	10.062	-1.240	0.973	50.721	33.003	18.701	15.180	12.168	4.486	2.919	1.076	-
Municipalities with over 50 000 inhabitants	9.711	-1.220	0.987	46.629	30.550	17.469	14.227	11.445	4.288	2.809	1.052	-
Mountain municipalities with up to 10 000 inhabitants	9.095	-1.200	0.989	37.624	24.825	14.328	11.709	9.453	3.600	2.375	0.905	-
Mountain municipalities with 10 001-50 000 inhabitants	9.987	-1.315	0.966	34.614	21.947	12.017	9.632	7.619	2.645	1.677	0.582	-
Hill municipalities with up to 10 000 inhabitants	8.726	-1.154	0.980	38.539	25.831	15.221	12.534	10.202	4.029	2.701	1.067	-
Hill municipalities with 10 001-50 000 inhabitants	7.014	-1.047	0.976	26.908	18.722	11.591	9.719	8.065	3.474	2.417	1.041	-
Lowland municipalities with up to 10 000 inhabitants	8.450	-1.140	0.989	35.948	24.219	14.368	11.861	9.680	3.869	2.607	1.042	-
Lowland municipalities with 10 001-50 000 inhabitants	8.720	-1.184	0.979	33.595	22.291	12.960	10.620	8.599	3.317	2.201	0.849	-
Capital municipalities of metropolitan cities	7.433	-1.074	0.971	29.208	20.128	12.305	10.270	8.480	3.572	2.462	1.037	-
Peripheral municipalities of metropolitan cities	10.062	-1.240	0.973	50.721	33.003	18.701	15.180	12.168	4.486	2.919	1.076	-
Municipalities with over 50 000 inhabitants	9.711	-1.220	0.987	46.629	30.550	17.469	14.227	11.445	4.288	2.809	1.052	-
Municipalities with 10 001-50 000 inhabitants	8.039	-1.122	0.974	31.772	21.538	12.883	10.667	8.733	3.541	2.400	0.973	0.660
Municipalities with up to 10 000 inhabitants	8.560	-1.137	0.987	38.352	25.857	15.355	12.681	10.353	4.145	2.795	1.119	0.754
Piemonte	9.740	-1.253	0.963	40.697	26.364	14.851	12.029	9.621	3.511	-	-	-
Valle D'Aosta/Vallé d'Aoste	6.002	-1.183	0.991	8.648	5.739	3.337	2.735	2.214	-	-	-	-
Lombardia	10.160	-1.269	0.980	46.532	29.971	16.756	13.534	10.792	3.886	2.503	0.901	-
Trentino-Alto Adige/Südtirol	12.500	-1.523	0.962	46.529	27.444	13.657	10.570	8.055	2.364	1.395	-	-
Bolzano/*Bozen*	9.335	-1.212	0.959	40.004	26.279	15.078	12.296	9.905	3.734	-	-	-
Trento	9.070	-1.288	0.987	24.715	15.814	8.764	7.057	5.608	1.989	-	-	-
Veneto	10.458	-1.335	0.969	39.895	25.119	13.626	10.885	8.579	2.930	1.845	-	-
Friuli-Venezia Giulia	11.133	-1.425	0.980	36.898	22.516	11.719	9.221	7.151	2.271	1.386	-	-
Liguria	9.306	-1.252	0.978	32.911	21.327	12.020	9.737	7.789	2.845	1.843	-	-
Emilia-Romagna	9.464	-1.247	0.965	36.343	23.587	13.320	10.799	8.645	3.168	2.056	-	-
Toscana	9.612	-1.281	0.961	33.527	21.508	11.960	9.641	7.672	2.737	1.756	-	-
Umbria	9.201	-1.285	0.982	26.785	17.158	9.523	7.672	6.100	2.169	-	-	-
Marche	9.173	-1.279	0.952	27.187	17.454	9.715	7.835	6.237	2.229	1.431	-	-
Lazio	11.765	-1.399	0.976	57.190	35.220	18.556	14.665	11.428	3.708	2.283	0.741	-
Abruzzo	9.677	-1.318	0.965	29.152	18.460	10.091	8.083	6.390	2.212	1.401	-	-
Molise	8.213	-1.300	0.971	15.253	9.720	5.358	4.305	3.415	-	-	-	-
Campania	8.574	-1.120	0.967	41.817	28.362	16.976	14.060	11.514	4.674	3.170	-	-
Puglia	10.156	-1.289	0.975	42.373	27.105	15.016	12.088	9.605	3.404	2.177	-	-
Basilicata	7.517	-1.188	0.947	18.074	11.976	6.950	5.691	4.605	-	-	-	-
Calabria	9.254	-1.182	0.963	44.112	29.281	17.034	13.961	11.307	4.366	2.898	1.119	-
Sicilia	8.487	-1.135	0.982	37.382	25.223	14.995	12.388	10.118	4.059	2.739	1.099	-
Sardegna	9.473	-1.268	0.990	33.160	21.367	11.951	9.655	7.701	2.775	1.788	-	-

TABLE 3. Illustrative calculation of the confidence interval for an absolute frequency estimate

	Number of HOUSEHOLDS WITH AN INDIVIDUAL HEATING SYSTEM IN ITALY	Number of HOUSEHOLDS WITH AN INDIVIDUAL HEATING SYSTEM IN TOSCANA
Point estimate:	**19 064 418**	**1 356 328**
Per cent relative error (CV%)	**0.488**	**1.444**
Relative error (CV)	= 0.488/100=0.00488	= 1.444/100=0.01444
Interval estimate:		
Half-width of the interval	= 1.960 * 0.00488 * 19 064 418 = **182 529**	= 1.960 * 0.01444 * 1 356 328 = **38 396**
Lower confidence limit	= 19 064 418 – 182 529 = **18 881 889**	= 1 356 328 – 38 396 = **1 317 932**
Upper confidence limit	= 19 064 418 + 182 529 = **19 246 947**	= 1 356 328 + 38 396 = **1 394 724**

For further information:

Istat (2022). I consumi energetici delle famiglie. Anno 2021. Statistiche Report e tavole di dati. 21 giugno 2022 https://www.istat.it/comunicato-stampa/i-consumi-energetici-delle-famiglie-anno-2021/

Istat (2022). I consumi energetici delle famiglie. Anno 2021-2020. Statistiche Report e tavole di dati. 21 dicembre 2022 https://www.istat.it/comunicato-stampa/consumi-energetici-famiglie-anni-2020-2021/

Materiale sulla rilevazione https://www.istat.it/informazioni-sulla-rilevazione/consumi-energetici/

Istat (2014) I consumi energetici delle famiglie. Statistiche Report. 15 Dicembre 2014 https://www.istat.it/comunicato-stampa/i-consumi-energetici-delle-famiglie-anno-2013/

For technical and methodological clarifications

Giovanna Tagliacozzo
tagliaco@istat.it

Emilia Arcaleni
arcaleni@istat.it

Notes

[i] The results of the 2021 and 2024 surveys are not fully comparable with the 2013 edition due to differences in data collection methods.
[ii] Regulatory constraints exist on the use of stoves, fireplaces, and biomass-fired boilers in certain cities, in accordance with regional or municipal regulations.
[iii] The Capital municipalities of metropolitan cities are: Torino, Genova, Milano, Venezia, Bologna, Firenze, Roma, Napoli, Bari, Reggio Calabria, Palermo, Messina, Catania, Cagliari.
[iv] The peripheral municipalities of a metropolitan city are the municipalities within the Labour Market Area (LMA) that includes the Capital of the metropolitan city: (for details, see the variable "Comuni in SLL 2011 di Città metropolitana": https://situas.istat.it/web/#/home/in-evidenza?id=86&dateFrom=2025-09-10).