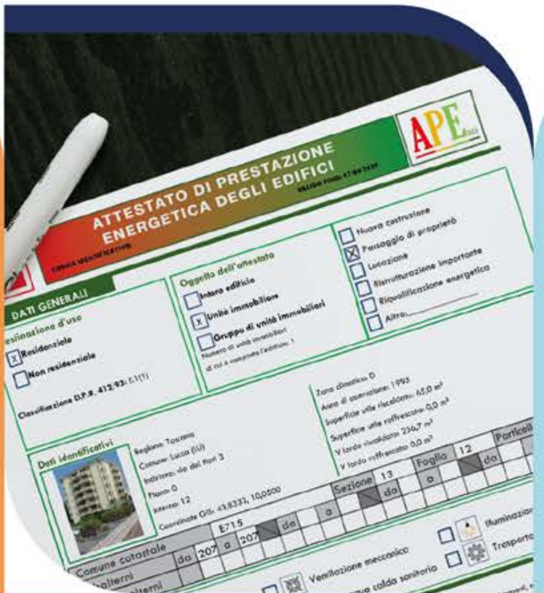
AGENZIA NAZIONALE PER LE NUOVE TECNOLOGIE, L'ENERGIA E LO SVILUPPO ECONOMICO SOSTENIBILE

ITALIAN ANNUAL REPORT ON BUILDING ENERGY CERTIFICATION

Year 2025



OBIETTIVI PER LO SVILUPPO SOSTENIBILE

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Programma Nazionale di Informazione e Formazione sull'Efficienza Energetica

The Italian Annual Report on Building Energy Certification (RACEE) was developed by the *Department for Energy Efficiency (DUEE) of ENEA* and the *Italian Thermotechnical Committee – Energy and Environment (CTI)*, based on the information and data available as of 15 June 2025.

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The Department for Energy Efficiency (DUEE) carries out the functions of the National Agency for Energy Efficiency, assigned to ENEA by the Italian Government. Its mission is to act as the national reference body for energy efficiency towards public administrations, citizens, enterprises, and regional authorities, providing methodologies, innovative solutions, and technical-scientific support for the efficient use of energy, the reduction of energy consumption, and the optimization of processes, with a strong commitment to quality, innovation, and social responsibility.

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The Italian Thermotechnical Committee – Energy and Environment (CTI) is a federated body of the Italian National Standardization Body (UNI). CTI is responsible for standardization and harmonization activities in the fields of thermotechnics, energy management, energy efficiency, and their environmental and sustainability implications. To achieve these objectives, CTI cooperates with industry associations, public authorities, professional organizations, standardization entities, and research institutions, contributing to the development of technical standards and guidelines that support the effective implementation of national and European energy and environmental policies.

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ENEA and CTI support the Sustainable Development Goals

Preface

The 2025 Annual Report on Building Energy Certification, produced in collaboration with the Italian Thermotechnical Committee (CTI), monitors the evolution of the energy efficiency of the national building stock and supports public policies aimed at achieving sustainability and decarbonisation objectives.

Following the adoption of the new European Directive, energy certification has assumed a strategic role in achieving a decarbonised and efficient building stock by 2050. It is no longer merely a technical tool, but a social and cultural instrument capable of raising awareness, guiding choices, and promoting responsible behaviour.

The 2025 dataset is composed of more than 1.2 million EPCs issued in 2024, transmitted to the Italian National Informative System on Energy Performance Certificates (SIAPE in Italian), and subjected to a rigorous verification process. This dataset is considered representative for its scope and quality and confirms a progressive improvement in energy performance, particularly in the residential sector, and an increase in intermediate and high-efficiency classes. These trends demonstrate that the undertaken measures are effective, although further progress is still required, especially for older and less efficient buildings.

Among the most significant developments are: the finalization of the connection between Campania Region energy cadaster and SIAPE; the introduction of semantic checks and preventive warning systems to improve EPC quality; and the upgrade of the National Portal on Building Energy Performance (PNPE[2]), offering new functionalities for citizens and public administrations, including the Digital Building Logbook and the Expert System for Energy Performance (SEPE).

The 2025 Report includes a specific focus on the social value of the EPC, viewed as a tool for empowerment and cultural change. When properly communicated and contextualised, the EPC can become a driver of informed decisions, fostering the energy transition through trust, understanding, and engagement. For professionals in the sector, these instruments represent a concrete opportunity as they facilitate communication with clients, enhance the quality of design proposals, and simplify access to incentive schemes.
The Report also highlights the growing importance of digitalisation and data interoperability, in view of the upcoming regulatory changes concerning the development of unified national cadastres for buildings and energy systems. ENEA is actively engaged in this process, working with the Regions and Competent Authorities to ensure an efficient, transparent, and coordinated management of energy information.

We wish to thank all those who contributed to the publication of this Report: ENEA and CTI colleagues, regional technical officers, and professionals who participated in the national survey. Our goal is to provide not only data and analysis but also tools and perspectives for building a more sustainable, fair, and resilient energy future.

Only through collective action and the dissemination of an energy culture will it be possible to successfully address future challenges.

Ing. Giorgio Graditi
Director General, ENEA

The 2025 edition of the Report continues along the path established by previous years, confirming a positive trend in the performance of the national building stock and, at the same time, a significant improvement in the quality of EPCs, which represent an essential knowledge base for policy-makers in developing building energy efficiency strategies.

On one hand, the steady improvement in the energy performance of Italian buildings is now a fact that is evidence of the progress achieved by the national system, even though there remains considerable room for further enhancement. On the other hand, it is important to stress that a continuous refinement process of the data management and quality control systems is necessary to ensure the robustness of the underlying data. The aim is to increase the reliability and consistency of the EPCs produced.

CTI has long invested resources in this context, working together with ENEA to conduct a detailed analysis of all EPCs recorded in SIAPE. This ongoing effort has led to the identification of possible actions to improve EPC data quality, including the design of preventive control mechanisms to avoid common input errors in data entry and calculation tools.

Improving the quality of EPCs is a primary objective, considering the strategic role of these data in shaping future energy policies. The fourth edition of the Energy Performance of Buildings Directive (EPBD IV), to be transposed into Italian law, represents a turning point in the field of building energy efficiency. Energy requirements will need to be adjusted, with particular attention to existing buildings. To achieve this, it is essential to have an accurate and comprehensive picture of the current condition of the Italian building stock. In this regard, the EPC is no longer simply a tool to inform citizens but has become a strategic instrument within a much broader decision-making framework, as demonstrated by the synthesis provided in the ENEA-CTI Report.
As in previous editions, a further added value of the 2025 Report is the outcome of the survey conducted by CTI, focused on the feedback from condominium administrators. Multi-unit residential buildings represent a specific building type with significant energy-saving potential on one side and particular challenges, as the presence of multiple decision-makers, on the other. This circumstance can make energy renovation processes more complex.

The analysis was carried out on the feedback from approximately 1,500 administrators, to whom we express our sincere thanks. The results provide an overall positive assessment, although with room for improvement, particularly regarding the clarity and reliability of EPC indicators. Respondents also expressed views on broader aspects of building energy efficiency, including synergies with seismic safety and fire protection measures.

In conclusion, the 2025 Report once again demonstrates the importance of collaboration among the various institutions involved. Under the coordination of the Ministry of the Environment and Energy Security (MASE), ENEA, as a research body, and CTI, as a standardization organization, must continue to leverage their expertise and capacities to advance this work synergistically and coherently.

Prof. Romano Borchiellini
President, CTI

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CONSTRUCTION SITE

1

Introduction

1.1 General Overview

The sixth Annual Report on the Energy Certification of Buildings (RACEE25), prepared by ENEA and CTI with data contributions from the Regions and Autonomous Provinces, represents the main tool for monitoring and analyzing the energy performance of the national building stock. Based on data from the Energy Performance Certificate Information System (SIAPE), the report provides an up-to-date and detailed picture of the energy efficiency of buildings in Italy, aiming to support public renovation policies and contribute to achieving the decarbonization targets set at the European level.

The 2025 edition comes at a crucial time for the building sector, marked by the approval of the new European Directive 2024/1275 on the Energy Performance of Buildings (EPBD IV), which requires Member States to adopt Energy Renovation Plans by 2026, based on reliable and representative data, particularly those contained in the national EPC database. In this context, improving the quality and coverage of energy certification becomes a strategic priority.

The report is based on the analysis of approximately 1.2 million EPCs issued in 2024 and transmitted to SIAPE within the legal deadline. These data, subjected to a rigorous verification process, constitute a representative and reliable sample for assessing the evolution of the energy performance of the Italian building stock. However, the overall representativeness of EPCs relative to the national real estate stock remains limited, highlighting the need to increase the number of EPCs issued by expanding mandatory cases and/or introducing incentive systems to encourage voluntary certification. The enhancement and further development and dissemination of the new and innovative tools introduced by the EPBD—such as the "Building Renovation Passport" and phased renovation—could prove fundamental in achieving this goal, especially when combined with appropriate stakeholder engagement and awareness-raising, which could act as a powerful driver for stimulating demand for building renovation.

In this perspective, the 2025 questionnaire prepared by CTI is addressed to Condominium Administrators, and a new concept has been introduced, whose technical feasibility will be developed during the year by a group of ENEA researchers. This involves complementing and integrating the current information system—based on the energy performance of individual Real Estate Units—with a system for assessing the energy performance of the entire building to which the certified Unit belongs. This new tool is clearly of strategic importance for more effectively defining and monitoring long-term energy efficiency strategies for the national building stock.

It is also worth noting that among the European initiatives currently being implemented is the establishment of a "Building Stock Observatory" (BSO) at the EU level, which will collect data sets from Member States on the energy performance of buildings. However, the standard data formats are still to be defined based on the specificities of the systems used in each Member State. ENEA is a partner in the European project "OBSERVE"[1] (link), which aims to develop and standardize protocols for collecting and aggregating data related to building energy performance.

1 https://webgate.ec.europa.eu/life/publicWebsite/project/LIFE23-CET-OBSERVE-101167643/support-for-setting-up-national-building-stock-observatories

Main innovations in the 2025 edition include:

- Completion of SIAPE integration by the Campania Region and the start of the process for the Sardinia Region, leading to full national coverage from 2026;
- Introduction of semantic checks on EPCs during upload and experimental implementation of a preventive alert system (ex-ante warnings) for certifiers to improve the quality of EPCs before submission, thereby enhancing the overall reliability of the data used in the National System;
- Evolution of the National Portal on Building Energy Performance ($PNPE^2$), with new features for citizens and public administrations.

The report is structured into several thematic chapters:

- **Chapter 2 –** Analysis of the energy performance of the certified building stock in 2024.
- **Chapter 3 –** Quality control systems for EPCs and ex-ante experiments.
- **Chapter 4 –** Progress of the Unified Energy Cadastre (CEU) and standardization prospects.
- **Chapter 5 –** Evolution of $PNPE^2$ and the Building Renovation Passport.
- **Chapter 6 –** Results of the national survey addressed to condominium administrators.
- **Annexes –** Regulatory, methodological, and regional insights.

The report aligns with the national strategies outlined in the new Integrated National Energy and Climate Plan (PNIEC 2024), which aims for a 43.7% reduction in non-ETS sector emissions by 2030 and an increase in the building renovation rate, with particular attention to poorly performing buildings and energy poverty situations. In this context, energy certification plays a central role not only technically but also socially.


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The Energy Performance of the Certified Building Stock in 2024

This chapter presents an assessment of the energy performance of the Italian building stock, based on the Energy Performance Certificates (EPCs) issued in 2024. The objective is to provide a detailed and up-to-date picture of the energy efficiency of Italian buildings, useful to support strategies for the renovation of the building stock and to monitor existing energy policies.

The data[1]*, collected through the Italian National Informative System on Energy Performance Certificates (SIAPE in Italian), which is fed by the regional energy cadastres, allow for an in-depth analysis that goes beyond the sole energy aspects of the certified buildings. In fact, the chapter is structured into several evaluations that include different types of information, such as*

- *Year of issuance*
- *Energy Performance class*
- *Climatic zone*
- *Reason for EPC issuance*
- *Construction period*
- *Building use category*
- *Property ownership*
- *Global energy performance index (EP_{gl}), expressed in kWh/m² per year, and its non-renewable ($EP_{gl,nren}$) and renewable ($EP_{gl,ren}$) components*
- *Useful thermal performance index for winter heating ($EP_{H,nd}$), expressed in kWh/m² per year*
- *CO^2 emissions, expressed in kg/m² per year*
- *Number of recommendations by type of recommended intervention*
- *Performance indices of individual energy services ($EP_{H,}$ EPC, EP_W, EP_V, EP_L, EP_T) for the non-renewable (EP_{nren}) and renewable (EP_{ren}) components, expressed in kWh/m² per year*

1 The results presented in this chapter are based exclusively on the data contained in SIAPE and have been subjected to a verification process.

2.1 The Informative System on Energy Performance Certificates and the evolution of building energy performance in 2024

SIAPE is the national tool for the collection and monitoring of EPCs. It has been active since 2016 and was developed by ENEA following the Ministerial Decree of 26 June 2015. SIAPE is fed by the data transmitted from the regional and autonomous provinces' energy cadastres, ensuring a systematic and structured collection of information on the energy performance of buildings and building units[2].
As of 01 April 2025, the legal deadline for submitting the EPCs issued in the previous year, almost the entire national territory was represented in the system, with a homogeneous presence of regional cadastres transmitting EPC data (Figure 2.1).

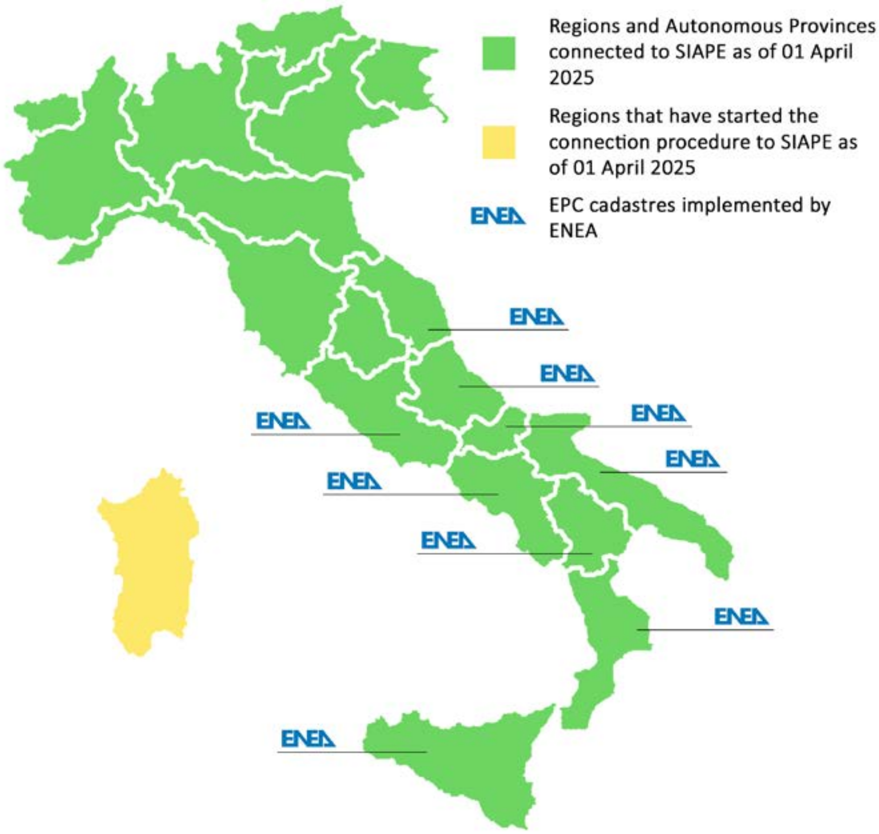


Figure 2.1
Mappatura nazionale delle Regioni e delle Province Autonome collegate al SIAPE al 01/04/2025 (elaborazione ENEA)

One of the most significant updates compared to the previous edition is that in 2025, the Campania Region finalized its connection to SIAPE, with the support of ENEA in developing its own regional energy cadastre. At the same time, the connection procedure for the Sardinia Region was initiated. This will complete the national framework, ensuring the inclusion of the entire certified building stock.

2 EPC usually refers to building units or buildings composed of single units, such as hotels, office buildings, and independent houses. Hereafter the word "building" refers to these categories.

Currently, nine regional cadastres are directly managed by ENEA, mainly located in the central and southern parts of Italy. This guarantees uniform management from both a technical and procedural point of view, especially regarding the joint development of systems for EPC quality control (Chapter 3).

Figure 2.2 compares the number of Italian municipalities recorded in SIAPE (with at least one EPC issued from 2015 to the legal deadline) with the total number of Italian municipalities, divided by climatic zone, according to the classification given in Annex A of Presidential Decree 412/1993, updated by ENEA with Italian National Institute of Statistics (ISTAT in Italian) data as of 01 January 2025.

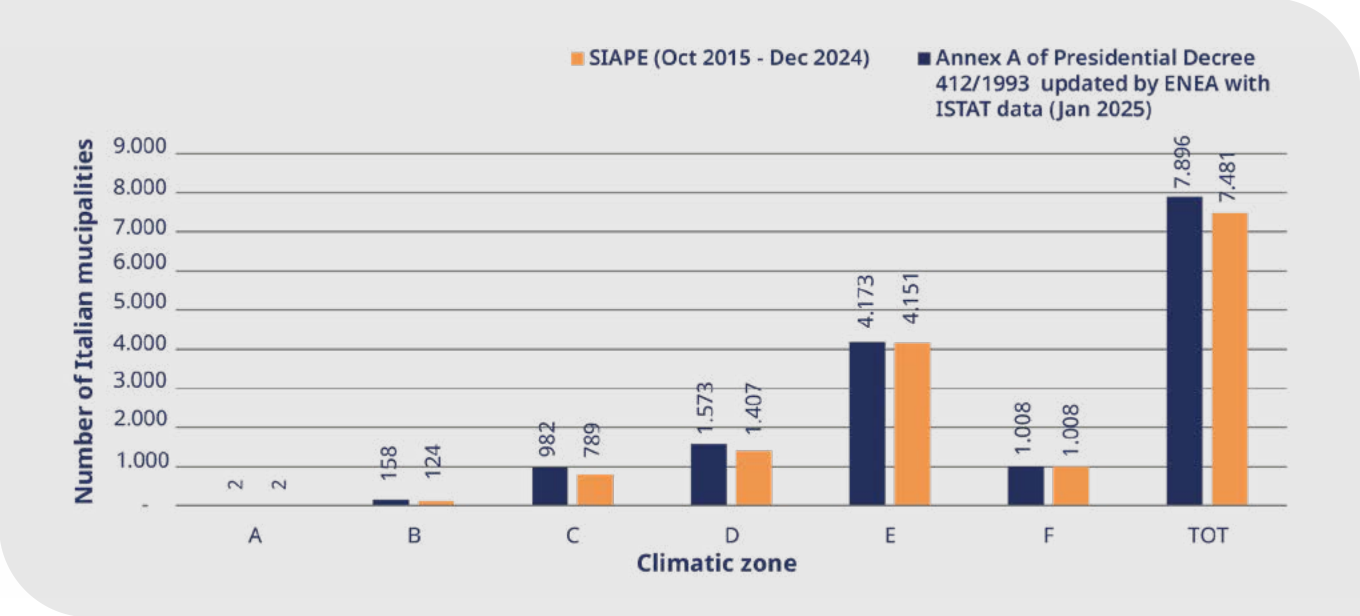


Figure 2.2
Comparison between the total number of Italian municipalities and those recorded in SIAPE by climatic zone (sources: Annex A of Presidential Decree 412/1993 updated to 01 January 2025 and ENEA)

The comparison shows wide and well-distributed territorial coverage: about 95% of Italian municipalities are represented in SIAPE, with at least one certified building or unit. Together with the completion of the regional connections, this strengthens the reliability of SIAPE as a knowledge tool to support energy renovation policies.

To better understand the dynamics of the certified building stock in 2024, it is useful to describe the data sample analysed in this Report. As of 01 April 2025, SIAPE contained about 6.4 million certificates issued between 2015 and 2024, submitted by 17 Regions and 2 Autonomous Provinces. The Campania Region is excluded, as its system started to transmit EPCs only from 2025, and the Sardinia Region is also absent. The database used for the detailed analyses presented in the following paragraphs (2.2-2.9) includes EPCs issued in 2024, transmitted to SIAPE, and verified through a quality check that led to the exclusion of about 14.7% of the initial sample. This verification process, refined over the years, now provides a more reliable, representative, and comparable dataset on a national scale: the 2024 sample consists of about 1.2 million EPCs considered valid. Further details can be found in Annex 2.

The analysis of the distribution by Energy Performance classes represents the first synthetic overview of the energy performance of the certified building stock in 2024 (Figure 2.3).

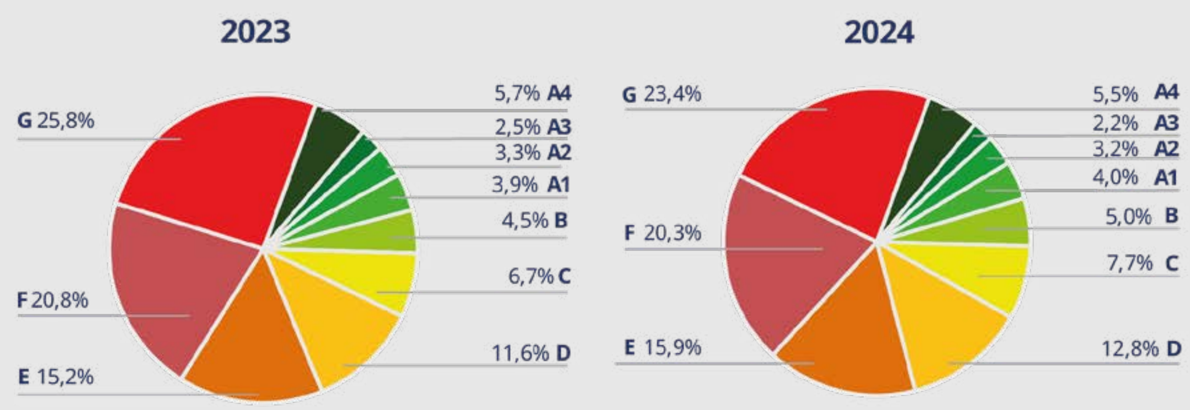


Figure 2.3
Distribution of EPCs issued in 2023 (N = 1,195,713) and 2024 (N = 1,208,710) after the verification performed by ENEA, by Energy Performance class (source: ENEA)

Compared to the previous year, the share of buildings in the least efficient classes continues to decrease. Classes F and G fell by about 3 percentage points, dropping below 44% of the total, while the share of buildings in the intermediate classes (C, D, and E) increased. The most efficient classes (from A4 to B) remained stable at around 20%. This trend confirms a gradual improvement in the average energy performance of the certified building stock, although with differences across sectors and geographical areas that will be analysed in the following sections.

The analysis of the evolution of the main energy indicators in the last five years (EP_{gl}, $EP_{gl,nren}$, $EP_{gl,ren}$, $EP_{H,nd}$, and CO_2 emissions) confirms that the improvement observed in the distribution of EPCs issued in 2024 is part of a broader trend, particularly in the residential sector. As shown in Table 2.1 and Figure 2.4, the median EP_{gl} value has decreased steadily, with the renewable component ($EP_{gl,ren}$) remaining stable and CO_2 emissions progressively declining.

Table 2.1
Median values of EP_{gl}, $EP_{gl,nren}$, $EP_{gl,ren}$, $EP_{H,nd}$, and CO_2 emissions by year of EPC issuance for residential buildings (N = 4,195,087) and non-residential buildings (N = 565,240). (source: ENEA)

Building use	Year of issuance	No. of EPCs	EP_{gl} Median value [kWh/m² per year]	$EP_{gl,nren}$ Median value [kWh/m² per year]	$EP_{gl,ren}$ Median value [kWh/m² per year]	$EP_{H,nd}$ Median value [kWh/m² per year]	CO^2 Median value [kg/m² per year]
Residential	2020	507.958	187,62	174,90	2,49	99,06	35,08
	2021	746.635	189,55	174,31	2,75	100,31	34,99
	2022	879.576	181,01	164,09	3,12	96,17	33,01
	2023	989.047	169,33	151,29	3,48	89,47	30,60
	2024	1.071.871	167,66	150,84	3,40	87,92	30,59
Non-residential	2020	79.600	335,79	286,05	26,92	147,27	60,46
	2021	104.467	324,48	274,39	26,32	143,70	57,97
	2022	114.592	323,70	272,79	26,89	144,77	57,64
	2023	129.742	315,69	262,73	26,64	143,07	55,70
	2024	136.839	312,58	257,70	28,43	141,27	54,87

Already from these preliminary results, some general observations emerge for the entire chapter. The residential sector shows lower median values than the non-residential sector for all analyzed indicators, confirming that non-residential buildings are usually characterized by a higher number of energy services and greater system complexity. In addition, the interquartile range (IQR) between the 25th and 75th percentiles is significantly wider in the non-residential sector, due to strong variability among building types and uses.

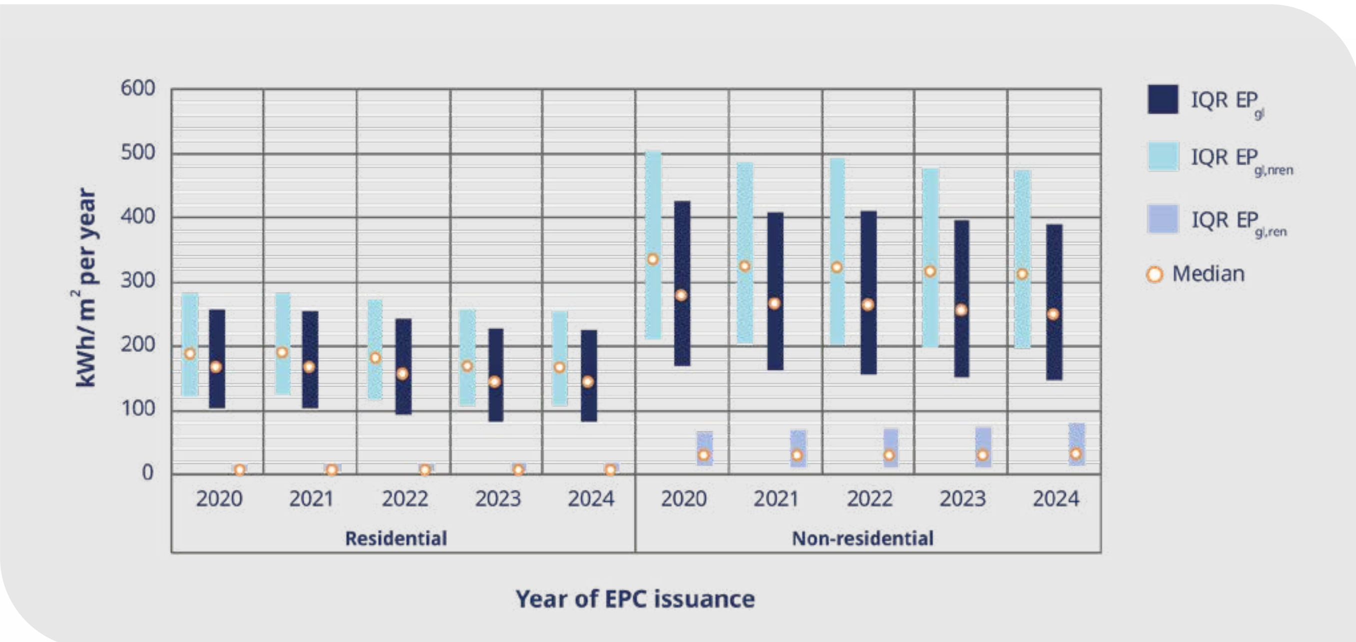


Figure 2.4
Interquartile range (IQR) between the 75th and 25th percentiles and median of EP_{gl}, $EP_{gl,nren}$ and $EP_{gl,ren}$ by year of EPC issuance for residential buildings (N = 4,195,087) and non-residential buildings (N = 565,240) (source: ENEA)

The results presented in this section form the basis for the more detailed analyses in the following parts of the chapter, which explore energy performance according to the building characteristics contained in the EPCs. The evolution of building energy performance was studied by comparing EPCs issued in 2024 with those issued in 2023 and published in the previous Report. In addition, historical data from SIAPE for the period 2015–2023 were also considered. For simplicity, in the remainder of the text, the abbreviations EPC2024, EPC2023, and SIAPE2015–2023 will refer to these three datasets, respectively.

2.2 Building use

The distribution of buildings certified by EPCs issued in 2024 shows that 88.7% belong to the residential sector and 11.3% to the non-residential sector. This is consistent with both the 2023 data and the 2011 census of ISTAT.
This analysis was further refined by applying the classification of building uses defined in Presidential Decree 412/1993, which includes:

Residential sector:
E.1: Residential buildings and similar

> *E.1(1): Dwellings used as permanent residences, such as civil and rural housing*
> *E.1(2): Dwellings used as non-permanent residences, such as holiday homes, weekend houses, and similar*

Non-residential sector
E.1(1)bis: Boarding schools, convents, prisons, military barracks

E.1(3): Hotels, guesthouses, and similar facilities

E.2: Office buildings, both public and private, whether independent or adjacent to industrial or craft buildings, provided they can be separated for thermal insulation purposes

E.3: Hospitals, clinics, nursing homes, and similar, including facilities for minors, elderly people, protected housing for drug rehabilitation, and other facilities managed by public social services

E.4: Recreational and religious facilities and similar

> *E.4(1): Cinemas, theatres, and conference halls*
> *E.4(2): Exhibition halls, museums, libraries, places of worship*
> *E.4(3): Bars, restaurants, dance halls*

E.5: Commercial buildings and similar, such as shops, wholesale and retail warehouses, supermarkets, and exhibition spaces

E.6: Sports facilities
> *E.6(1): Swimming pools, saunas, and similar*
> *E.6(2): Gyms and similar*
> *E.6(3): Service areas for sports facilities*

E.7: Educational buildings of all levels and similar

E.8: Industrial and craft buildings and similar

Figure 2.5 shows the distribution of EPC2024 by building use category according to the classification of Presidential Decree 412/1993. Categories E.4(1)–E.4(3) are grouped under E.4, while E.6(1)–E.6(3) are grouped under E.6. In the non-residential sector, the most common use categories remain commercial activities (E.5), offices (E.2), and industrial activities (E.8), which together account for about 85% of the total.

The comparison with the cumulative SIAPE2015–2023 dataset (Figure 2.6) confirms the stability of this distribution across both sectors, with residential use clearly prevailing, representing 86.1%. The internal composition by building use category shows no substantial differences compared to EPC2024.

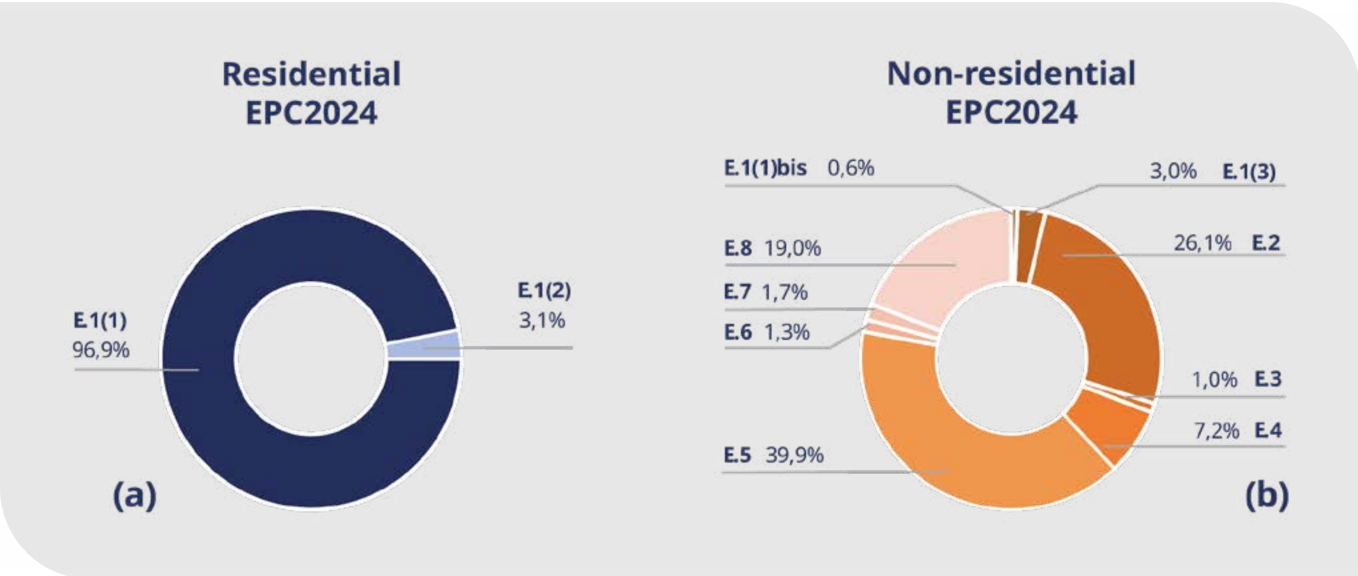


Figure 2.5
Percentage distribution of EPC2024 by use category according to Presidential Decree 412/1993 for residential buildings (a) (N = 1,071,871) and non-residential buildings (b) (N = 136,839) (source: ENEA)

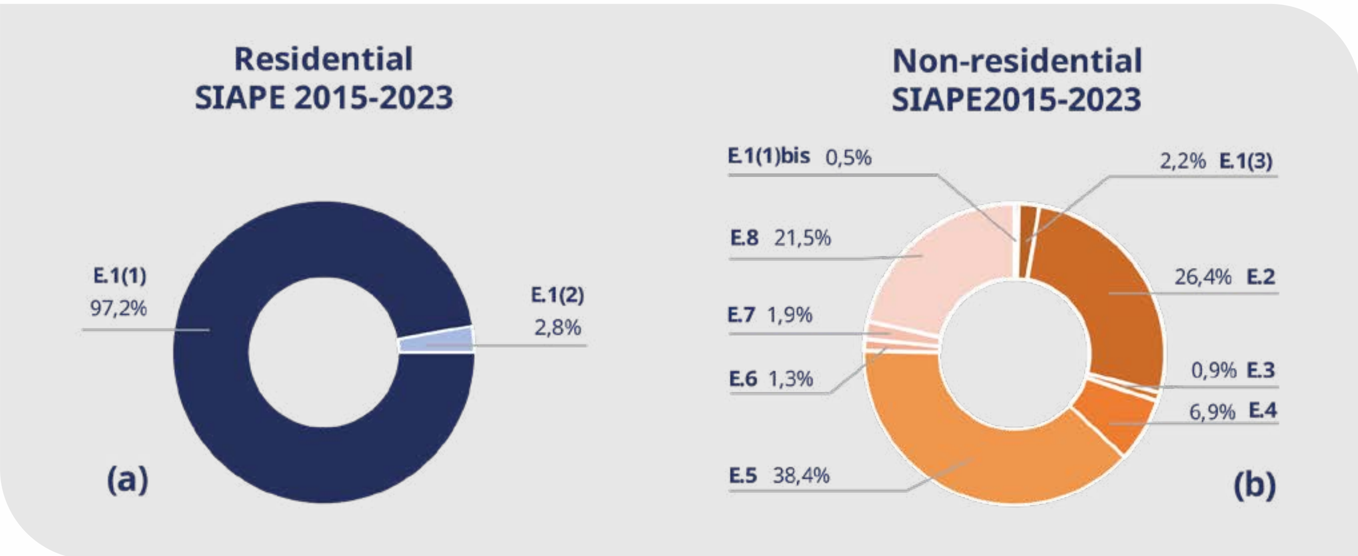


Figure 2.6
Percentage distribution of SIAPE2015–2023 by use category according to Presidential Decree 412/1993 for residential buildings (a) (N = 4,605,695) and non-residential buildings (b) (source: ENEA)

The heterogeneity of the non-residential sector becomes clear when looking at the median values of performance indices and CO^2 emissions (Table 2.2), as well as the interquartile range of global performance indices (Figure 2.7). Residential buildings, except for E.1(2), which represents only a small share, are characterized by lower median EP_{gl} values, below 170 kWh/m^2 per year. Non-residential buildings, instead, show median EP_{gl} values generally ranging between about 200 and 350 kWh/m^2 per year, except for recreational, cultural, and religious facilities (E.4), where the median EP_{gl} reaches almost 590 kWh/m^2 per year. This indicates high variability within this category. The same trend is observed for $EP_{gl,nren}$, $EP_{H,nd}$, and CO^2 emissions. For $EP_{gl,ren}$, median values are very low in permanent residences (E.1(1)), while in the non-residential sector, they are significantly higher, reaching almost 50 kWh/m^2 per year for healthcare facilities (E.3).

Category E.4 also shows the widest dispersion for all three indicators analysed (Figure 2.7), compared to other categories. In general, data are more compact towards the lower values (25th percentile) and more dispersed towards higher values (75th percentile).

Table 2.2
Median values of EP_{gl}, $EP_{gl,nren}$, $EP_{gl,ren}$, $EP_{H,nd}$, and CO_2 emissions from EPC2024 by building use category according to Presidential Decree 412/1993 (N = 1,208,710) (source: ENEA)

Building use category (Presidential Decree 412/1993)	No. of EPCs	EP_g Median value [kWh/m^2 per year]$_l$	$EP_{gl,nren}$ Median value [kWh/m^2 per year]	$EP_{gl,ren}$ Median value [kWh/m^2 per year]	$EP_{H,nd}$ Median value [kWh/m^2 per year]	CO_2 Median value [kg/m^2 per year]
E.1(1)	1.039.049	165,6	149,4	3,3	86,9	30,3
E.1(2)	32.822	255,3	203,6	12,1	129,5	43,0
E.1(1)bis	867	205,2	175,3	7,2	110,4	36,7
E.1(3)	4.165	303,2	235,0	42,0	119,8	50,6
E.2	35.768	256,2	207,2	24,9	113,8	44,9
E.3	1.352	334,1	265,9	49,6	121,5	57,9
E.4	9.870	588,9	471,7	43,9	270,4	100,2
E.5	54.559	348,6	284,9	37,2	150,4	60,6
E.6	1.815	342,7	277,6	32,1	150,9	58,9
E.7	2.377	258,0	225,8	14,4	156,8	47,7
E.8	26.066	293,8	254,6	20,4	140,5	53,4

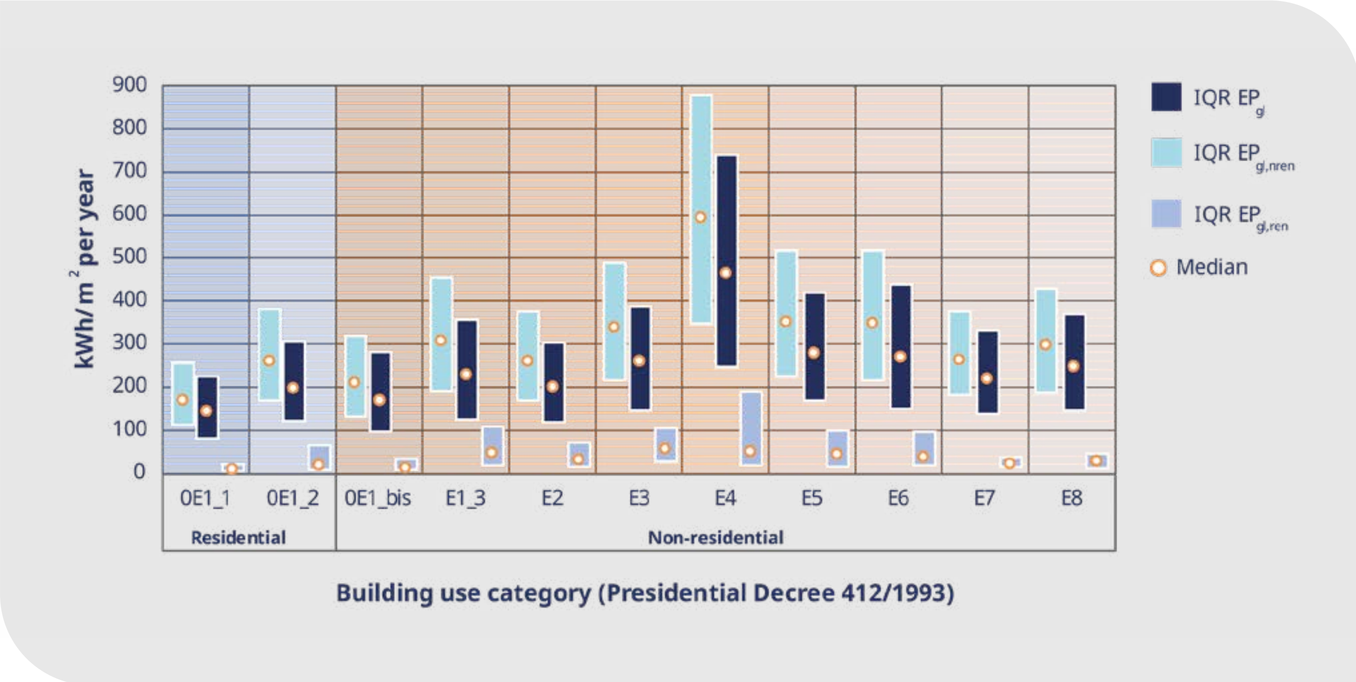


Figure 2.7
Interquartile range (IQR) between the 75th and 25th percentiles and median of EP_{gl}, $EP_{gl,nren}$ and $EP_{gl,ren}$ from EPC2024 by building use category according to Presidential Decree 412/1993: residential buildings (N = 1,071,871) and non-residential buildings (N = 136,839) (source: ENEA)

When comparing EPC2024 with EPC2023 (Figure 2.8), a significant improvement in EP_{gl} is observed only for categories E.1(1)bis (boarding schools and convents) and E.7 (educational buildings), with a slight improvement for E.1(1). For $EP_{gl,ren}$, there is a clear increase in all categories, except for E.1(1), which remains almost unchanged.

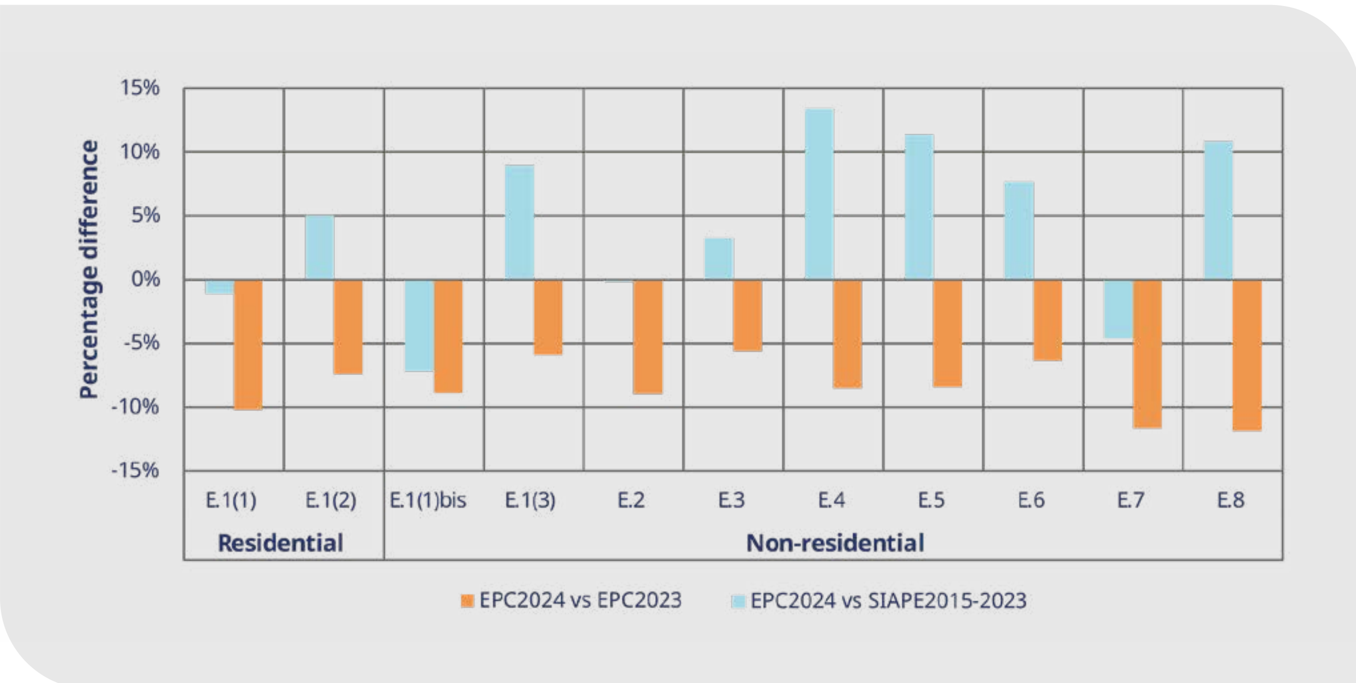


Figure 2.8
Percentage difference of median EP_{gl} between EPC2024 (N = 1,208,710), EPC2023 (N = 1,100,768), and SIAPE2015–2023 (N = 5,347,486), by building use category according to Presidential Decree 412/1993 (source: ENEA)

When EPC2024 is compared with the historical dataset SIAPE2015–2023, a significant reduction in $EP_{gl,nren}$ is evident across all categories, confirming an overall trend towards improved energy efficiency in the national building stock.

2.3 Energy Performance class

The distribution of EPCs issued in 2024 by Energy Performance class shows clear differences between the residential and non-residential sectors (Figure 2.9a and Figure 2.9b). In both cases, the share of EPCs in the best classes (A4–B) is around 20%. However, the non-residential sector records a higher proportion in the intermediate classes (C–E: 49.7% compared to 34.7% in the residential sector). Conversely, the least efficient classes (F–G) are more prevalent in the residential sector (45.3%) than in the non-residential one (30.9%).

Compared to the previous year, the residential sector shows a slight reduction in the share of buildings in the best classes (A4–B, -0.6%), a moderate increase in the intermediate classes (+2.7%), and a decrease in the worst-performing classes (-2.1%). On the other hand, the non-residential sector shows a more significant improvement, with an increase in both the best-performing classes (+4.2%) and the intermediate ones (+5.8%), and a sharp decline in the worst classes (-9.9%).

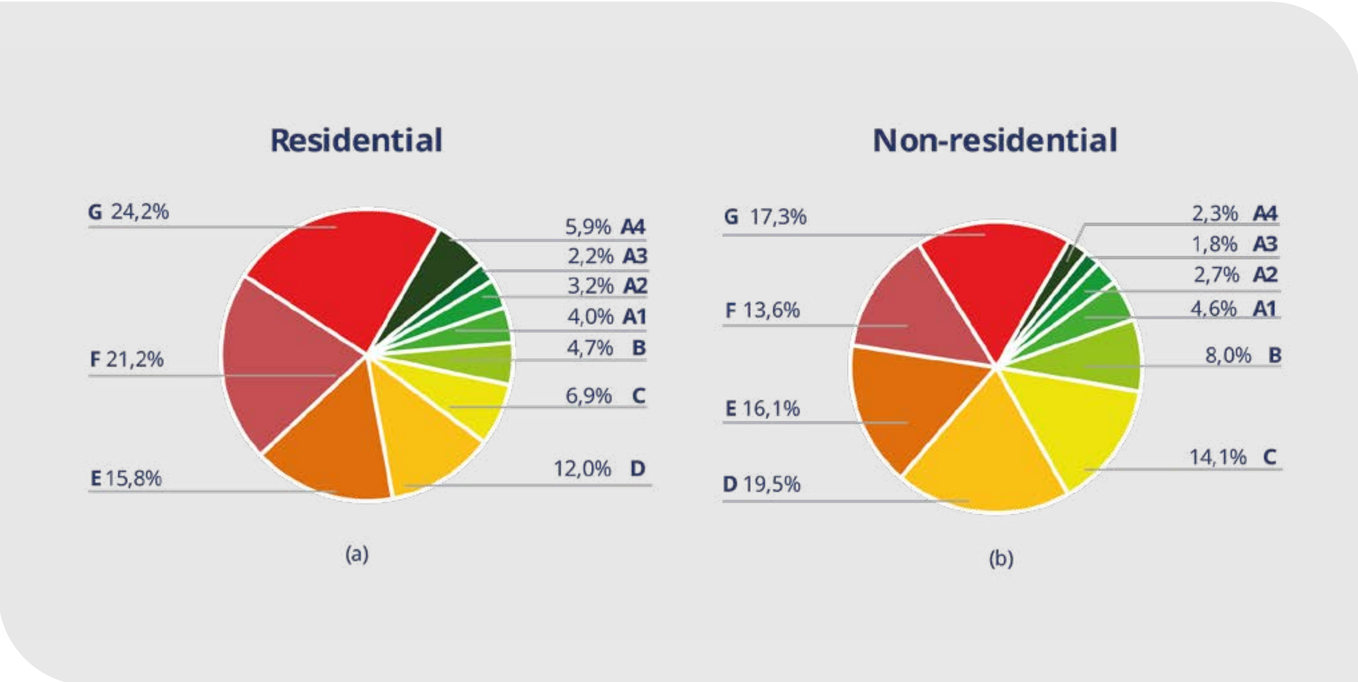


Figure 2.9
Percentage distribution of EPC2024 by Energy Performance class for residential buildings (a) (N = 1,071,871) and non-residential buildings (b) (N = 136,839) (source: ENEA)

Table 2.3 shows the median values for EP_{gl}, $EP_{gl,nren}$, $EP_{gl,ren}$, $EP_{H,nd}$, and CO^2 emissions by Energy Performance class. For the residential sector, median EP_{gl} values in the most efficient classes (A4–B) range from about 66 to 99 kWh/m² per year. Median EP_{gl} values increase steadily with lower classes, from about 116 kWh/m² per year in class C to nearly 293 kWh/m² per year in class G. $EP_{H,nd}$ follows a similar upward trend as the Energy Performance class decreases. $EP_{gl,nren}$, and CO^2 emissions also grow steadily with worsening performance. By contrast, $EP_{gl,ren}$ declines progressively, from about 50 kWh/m² per year in class A4 to about 1.8 kWh/m² per year in class G. It is also notable that in classes A4 and A3, $EP_{gl,ren}$ values are more than double compared to the next lower class (A2).

In the non-residential sector, median performance indices are generally higher than in the residential sector, except for class G, where EP_{gl} is similar (294 kWh/m² per year). EP_{gl} increases up to class D and then decreases gradually in the lower classes. A similar trend is found for $EP_{gl,nren}$, $EP_{H,nd}$, and CO^2 emissions. Unlike the residential sector, $EP_{gl,ren}$ initially increases slowly from class A4 (75 kWh/m² per year) to class B, then drops sharply in the lower classes, reaching about 5 kWh/m² per year in class G.

In both sectors, the renewable component ($EP_{gl,ren}$) is clearly higher than the non-renewable one in class A4.

Table 2.3
Median values of EP_{gl}, $EP_{gl,nren}$, $EP_{gl,ren}$, $EP_{H,nd}$, and CO_2 emissions from EPC2024 by Energy Performance class for residential buildings (N = 1,071,871) and non-residential buildings (N = 136,839) (source: ENEA)

	Energy Performance class	No. of EPCs	EP_{gl} Median value [kWh/m² per year]	$EP_{gl,nren}$ Median value [kWh/m² per year]	$EP_{gl,ren}$ Median value [kWh/m² per year]	$EP_{H,nd}$ Median value [kWh/m² per year]	CO_2 Median value [kg/m² per year]
Residential	A4	63.414	65,9	15,0	50,3	26,1	3,3
	A3	23.771	86,2	42,0	43,2	30,2	9,4
	A2	34.509	73,9	53,7	16,1	27,9	11,3
	A1	42.413	83,2	67,3	8,1	33,2	14,0
	B	50.061	98,6	83,0	7,8	42,2	17,2
	C	73.709	116,3	101,4	5,9	53,6	20,9
	D	128.159	138,7	126,3	3,9	69,1	25,8
	E	169.817	162,5	153,8	2,5	86,7	30,9
	F	226.867	196,4	190,2	1,8	111,8	37,9
	G	259.151	292,9	286,0	1,8	172,3	56,7

	Energy Performance class	No. of EPCs	EP_{gl} Median value [kWh/m² per year]	$EP_{gl,nren}$ Median value [kWh/m² per year]	$EP_{gl,ren}$ Median value [kWh/m² per year]	$EP_{H,nd}$ Median value [kWh/m² per year]	CO_2 Median value [kg/m² per year]
Non-residential	A4	3.120	108,4	30,4	75,1	57,0	7,1
	A3	2.407	174,4	84,7	84,9	78,0	19,3
	A2	3.676	213,2	120,7	82,8	89,1	28,2
	A1	6.286	264,0	166,5	85,3	89,7	38,4
	B	10.975	328,7	217,9	86,3	106,3	49,3
	C	19.355	342,3	256,5	52,3	123,2	56,4
	D	26.730	351,5	292,9	36,5	142,0	62,4
	E	21.965	335,3	295,1	22,8	161,1	61,9
	F	18.661	302,8	280,7	12,1	166,6	57,5
	G	23.664	294,3	281,3	5,4	170,2	56,5

The interquartile ranges by Energy performance class in the residential sector are shown in Figure 2.10. For EP_{gl}, class A4 has the lowest dispersion (about 43 kWh/m² per year). Classes A3 to C are slightly less compact, with IQR values around 65 kWh/m² per year. From class D onwards, dispersion increases steadily, reaching about 166 kWh/m² per year in class G. For $EP_{gl,ren}$, variability is highest in class A3, then decreases sharply from class D down to class G.

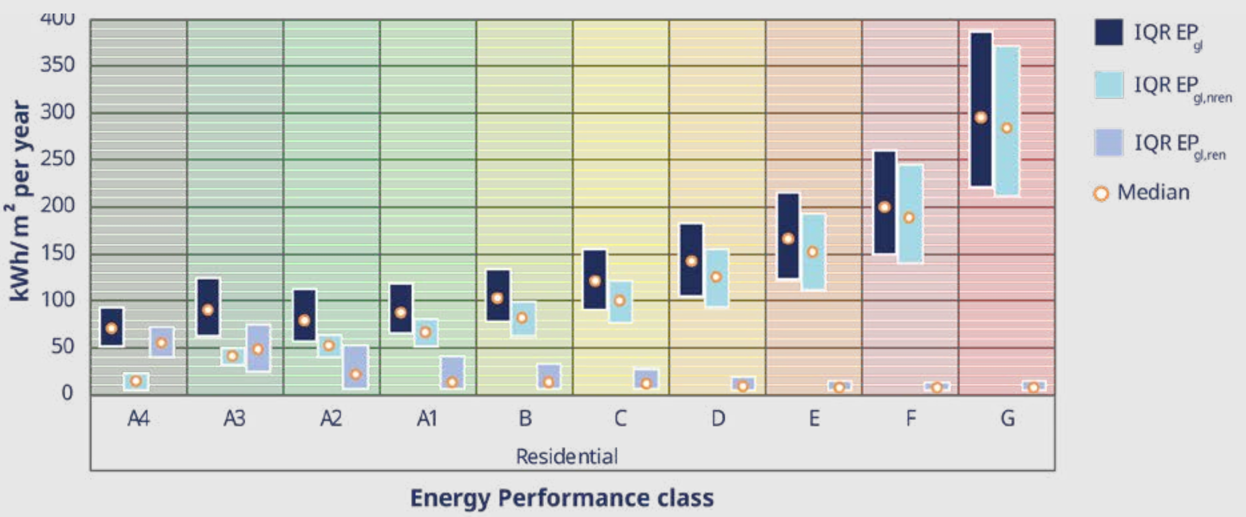


Figure 2.10
Interquartile range (IQR) between the 75th and 25th percentiles and median of EP_{gl}, $EP_{gl,nren}$ and $EP_{gl,ren}$ from EPC2024 by Energy Performance class for residential buildings (N = 1,071,871) (source: ENEA)

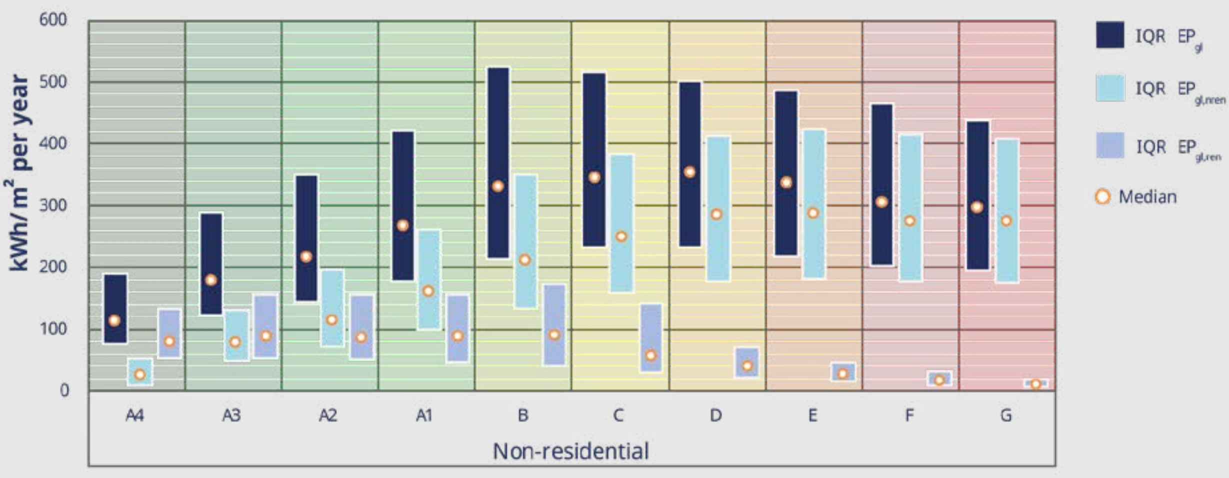


Figure 2.11
Interquartile range (IQR) between the 75th and 25th percentiles and median of EP_{gl}, $EP_{gl,nren}$ and $EP_{gl,ren}$ from EPC2024 by Energy Performance class for non-residential buildings (N = 136,839) (source: ENEA)

The comparison between EPC2024 and EPC2023 for residential buildings shows a general improvement, with decreasing EP_{gl} values in almost all classes from A4 to D. In the non-residential sector, this decrease is evident only when comparing EPC2024 with the historical SIAPE2015–2023 dataset, while the comparison with 2023 shows the opposite trend. In any case, the long-term tendency confirms an overall improvement of energy performance in both sectors.

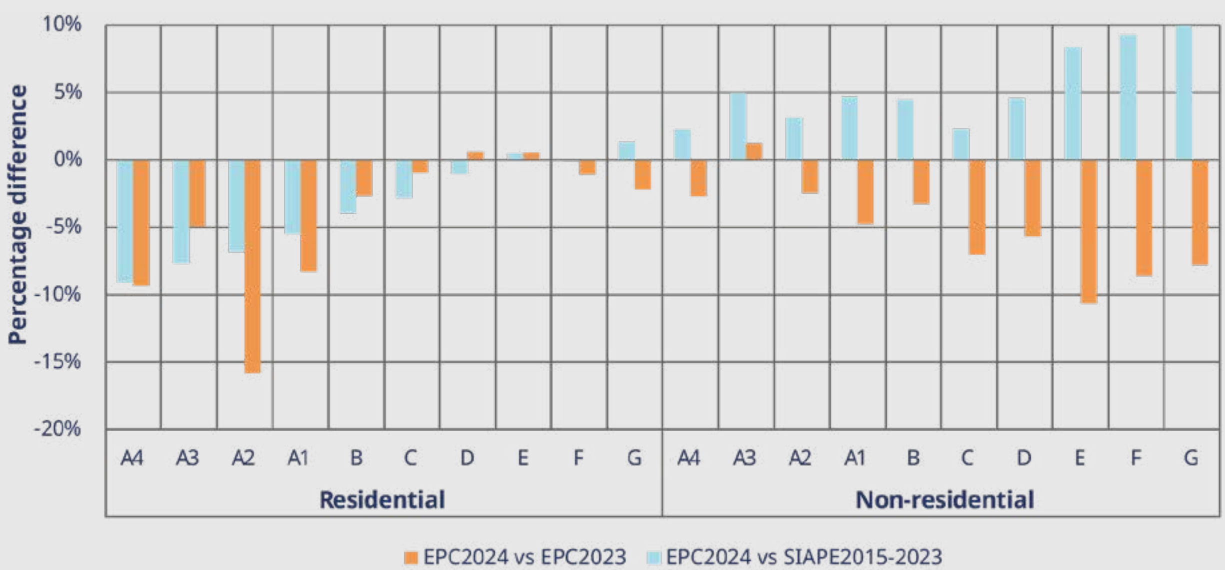
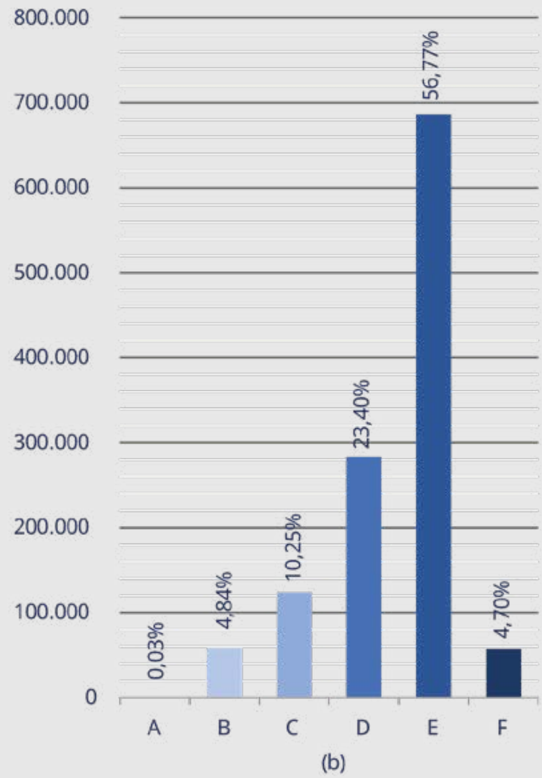


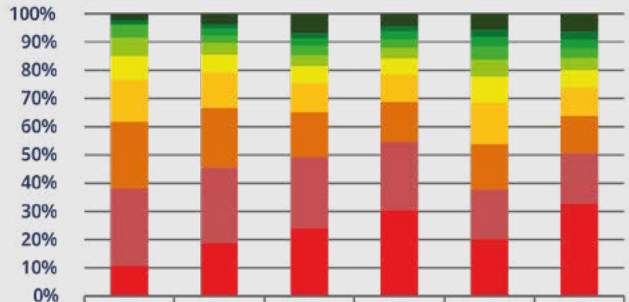
Figure 2.12
Percentage difference of median EP_{gl} between EPC2024 (N = 1,208,710), EPC2023 (N = 1,100,768), and SIAPE2015–2023 (N = 5,347,486), by Energy Performance class for residential and non-residential buildings (source: ENEA)

2.4 Climatic zone

The distribution of EPCs issued in 2024 by climatic zone shows that most certificates refer to zone E (Figure 2.13a), followed by zones D and C. This pattern is similar to what was observed in 2023, although in 2024 zone E gained about 4% mainly due to a decrease in certificates from zone C.

Zones A and E have the lowest share of buildings in the least efficient classes (38% and 37.5% respectively). The highest share of EPCs in the best classes (A4–B) is found in zones E (22%) and F (20%) (Figure 2.13b and Table 2.4). Zone F shows extreme results in both directions: the second-highest share in the best classes, but also one of the highest in the worst classes (F–G). This reflects the strong variability in building types, construction techniques, and technical systems in this zone.





	A	B	C	D	E	F
A4	2,1%	3,5%	6,8%	4,6%	5,8%	6,4%
A3	1,4%	1,6%	1,8%	1,7%	2,4%	2,7%
A2	0,5%	2,4%	2,8%	2,7%	3,5%	3,1%
A1	4,3%	2,8%	3,3%	3,1%	4,7%	3,5%
B	6,4%	4,0%	3,8%	3,8%	5,9%	4,2%
C	8,6%	6,3%	6,0%	5,7%	9,1%	6,1%
D	14,8%	12,7%	10,4%	9,6%	14,8%	10,2%
E	23,9%	20,9%	15,9%	14,4%	16,3%	13,1%
F	27,2%	26,8%	25,0%	24,2%	17,5%	18,1%
G	10,7%	18,8%	24,1%	30,3%	20,0%	32,7%

(b)

Figure 2.12
Distribution of EPC2024 by climatic zone (a) and percentage distribution of EPCs by climatic zone and Energy Performance class (b) (N = 1,208,710) (source: ENEA)

Compared with 2023 (Table 2.4), almost all climatic zones record an increase in the best classes (A4–B), except zones E and F. At the same time, the share of EPCs in classes F–G decreased everywhere except in zone F. When compared with the historical dataset SIAPE2015–2023, all climatic zones show a clear reduction in classes F–G and a parallel increase in classes A–B. Only in zones A and B is there also a reduction in classes C–E.

Table 2.4
Percentage distribution of EPC2024 (N = 1,208,710) by climatic zone and Energy Performance class, with differences compared to EPC2023 (N = 1,100,768) and SIAPE2015–2023 (N = 5,347,099) (source: ENEA)

	EPC2024			EPC2024 vs EPC2023			EPC2024 vs SIAPE2015-2023		
Climatic zone	**A4-B**	**C-E**	**F-G**	**A4-B**	**C-E**	**F-G**	**A4-B**	**C-E**	**F-G**
A	14,8%	47,3%	37,9%	1,5%	-0,3%	-1,2%	6,2%	-2,7%	-3,5%
B	14,4%	40,0%	45,6%	2,8%	1,0%	-3,8%	4,6%	-0,3%	-4,3%
C	18,5%	32,4%	49,1%	5,8%	3,3%	-9,0%	6,1%	0,1%	-6,2%
D	15,9%	29,6%	54,5%	2,1%	1,6%	-3,6%	5,3%	1,5%	-6,8%
E	22,3%	40,2%	37,5%	-3,0%	3,1%	-0,1%	5,5%	3,5%	-9,0%
F	19,8%	29,4%	50,8%	-2,4%	-0,3%	2,7%	5,1%	1,5%	-6,7%

Table 2.5 presents the median values of energy performance indicators and CO^2 emissions by climatic zone. Within the same sector, median values of $EP_{gl,nren}$, $EP_{H,nd}$, and CO^2 emissions increase as climate severity rises, consistent with the higher energy demand in colder climates.
For the residential sector, $EP_{gl,ren}$ is higher in warmer zones (A and B), decreases in zones C–E, and then rises again in zone F. Although absolute differences are limited, this trend may indicate a greater use of renewable or grid-connected energy technologies in warmer and colder climates.

In the non-residential sector, where electrification is more widespread, $EP_{gl,ren}$ increases progressively with climate severity, peaking in zone E (31 kWh/m^2 year), before declining in zone F. This trend likely reflects the adoption of electric and hybrid systems in colder areas.

Table 2.5
Median values of EP_{gl}, $EP_{gl,nren}$, $EP_{gl,ren}$, $EP_{H,nd}$, and CO_2 emissions from EPC2024 by climatic zone for residential buildings (N = 1,071,871) and non-residential buildings (N = 136,839) (source: ENEA)

	Energy Performance class	No. of EPCs	EP_{gl} Median value [kWh/m² per year]	$EP_{gl,nren}$ Median value [kWh/m² per year]	$EP_{gl,ren}$ Median value [kWh/m² per year]	$EP_{H,nd}$ Median value [kWh/m² per year]	CO_2 Median value [kg/m² per year]
Residential	A	382	123,5	106,6	9,5	46,6	22,6
	B	53.151	140,1	125,1	9,0	62,4	25,9
	C	112.676	154,1	138,6	5,2	75,0	28,1
	D	254.569	158,2	145,5	2,4	79,8	29,1
	E	598.853	173,2	155,4	3,4	94,3	31,5
	F	52.240	256,4	213,5	5,8	145,3	45,7
Non-residential	**A**	37	136,4	128,5	8,6	62,4	27,0
	B	5.351	189,6	156,4	19,0	70,3	33,6
	C	11.226	225,8	182,3	22,9	92,4	38,7
	D	28.284	255,4	205,4	24,9	112,4	43,8
	E	87.353	348,7	291,3	30,9	162,8	61,7
	F	4.588	390,1	326,9	21,4	202,3	72,9

Figure 2.14 shows the interquartile ranges of EP_{gl} and its components by climatic zone. Data dispersion grows with climate severity, meaning higher variability in colder areas, particularly in the non-residential sector. In zone F, non-residential buildings have median EP_{gl} and $EP_{gl,ren}$ values closer to the 25th percentile, which suggests that a large share of the sample performs better than average, although the presence of very high values increases overall variability.

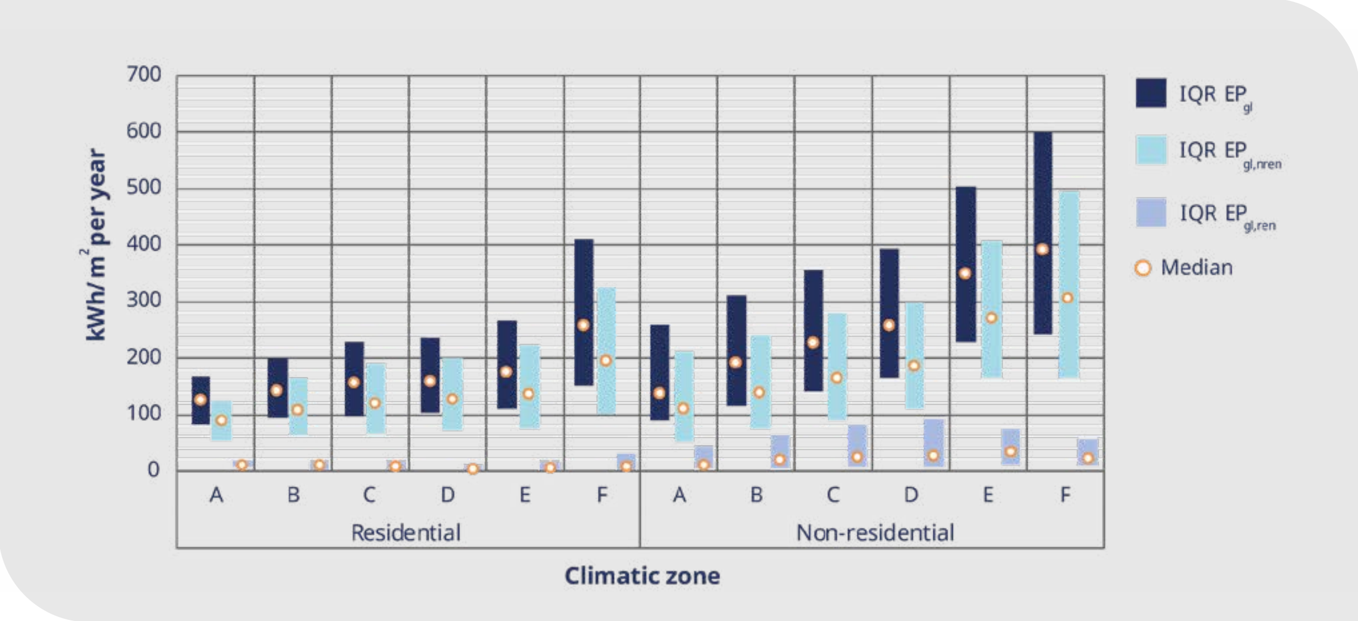


Figure 2.14

Interquartile range (IQR) between the 75th and 25th percentiles and median of EP_{gl}, $EP_{gl,nren}$ and $EP_{gl,ren}$ from EPC2024 by climatic zone for residential buildings (N = 1,071,871) and non-residential buildings (N = 136,839) (source: ENEA)

The comparison between EPC2024 and EPC2023 (Figure 2.15) shows that, in the residential sector, the median EP_{gl} increased in climatic zones A, E, and F. In the non-residential sector, increases are more widespread. When compared with the period 2015–2023, the median EP_{gl} decreases in almost all climatic zones and in both sectors. The only exception is non-residential buildings in zone A, but the sample is too small to provide a stable estimate.

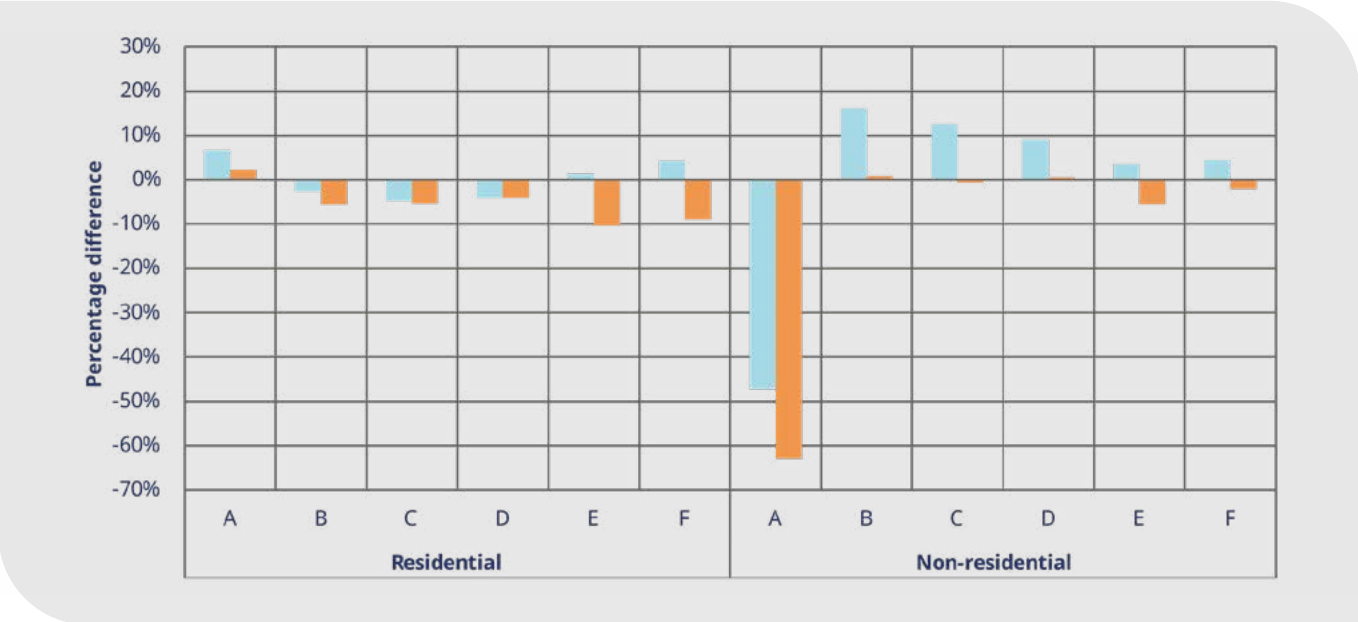


Figure 2.15

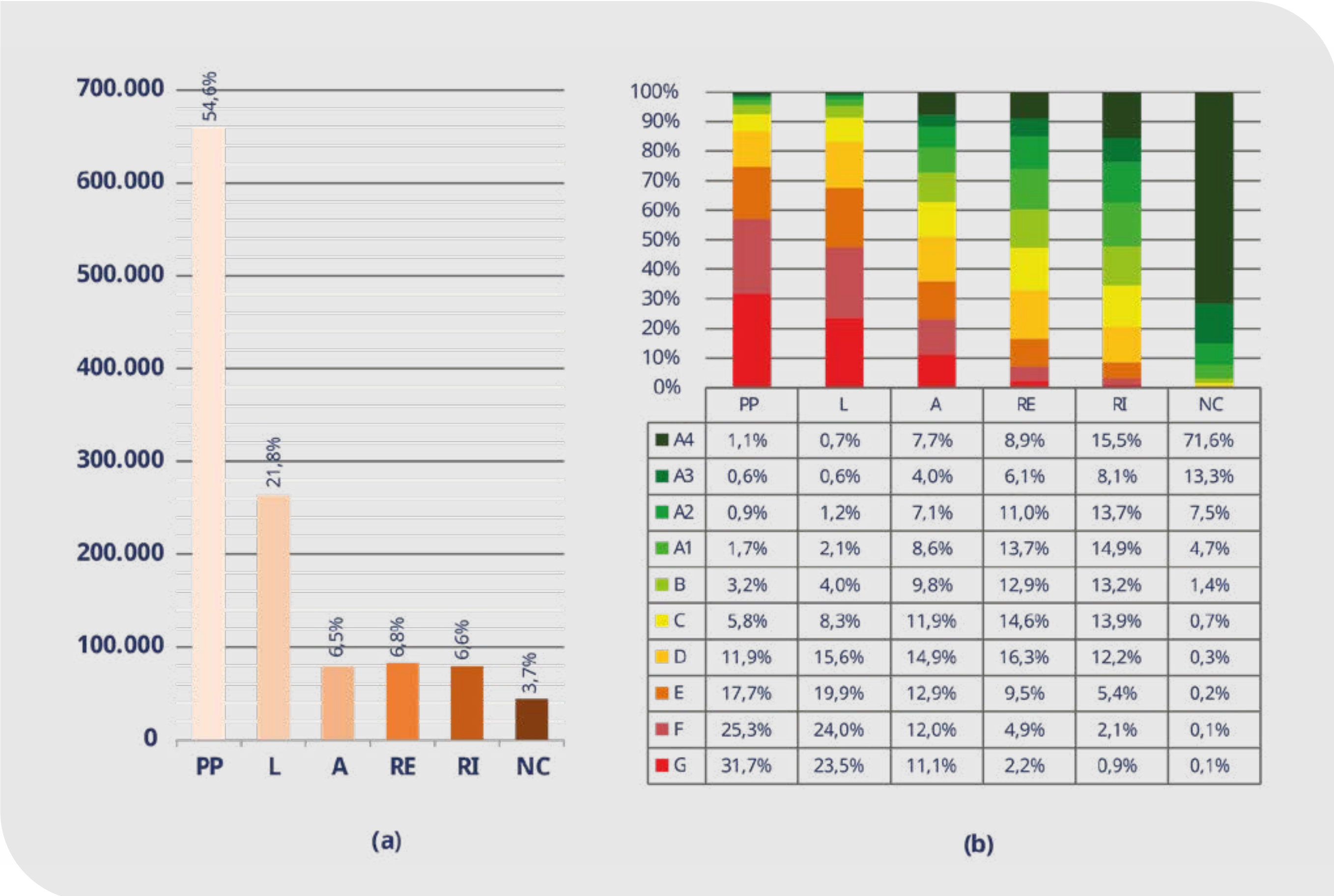
Percentage difference of median EP_{gl} between EPC2024 (N = 1,208,710), EPC2023 (N = 1,100,768) and SIAPE2015–2023 (N = 5,347,486), by climatic zone for residential and non-residential buildings (source: ENEA)

2.5 Reason for EPC issuance

The reason why an EPC is issued is essential to interpret the results, since it is often linked to renovation works that may have improved the building performance. At the same time, this information helps estimate the number of new buildings constructed and allows a more detailed assessment of their typical energy performance. The list of reasons is defined in the Ministerial Decree of 26 June 2015 and has also been used in previous editions of this Report.

In 2024, 3.7% of EPCs were issued for new constructions, a share consistent with 2023 (Figure 2.16a). EPCs linked to sales and rentals decreased slightly, together accounting for less than 80% of the sample. Compared with 2023, EPCs issued after minor renovations fell by 1.1%, while major renovations remained stable at 6.6% of the total.

The distribution of Energy Performance classes by reason for EPC issuance (Figure 2.16b) confirms that energy performance improves when renovation works are carried out, with better results for major renovations compared to minor ones. However, compared with EPC2023 (Table 2.6), there is an increase in the share of buildings in classes A4–B for sales and rentals, even though these procedures usually do not involve energy efficiency upgrades. For almost all reasons, except new constructions, the share of EPCs in classes C–E also increased. When comparing EPC2024 with SIAPE2015–2023, the improvement in energy performance is more widespread.



	PP	L	A	RE	RI	NC
A4	1,1%	0,7%	7,7%	8,9%	15,5%	71,6%
A3	0,6%	0,6%	4,0%	6,1%	8,1%	13,3%
A2	0,9%	1,2%	7,1%	11,0%	13,7%	7,5%
A1	1,7%	2,1%	8,6%	13,7%	14,9%	4,7%
B	3,2%	4,0%	9,8%	12,9%	13,2%	1,4%
C	5,8%	8,3%	11,9%	14,6%	13,9%	0,7%
D	11,9%	15,6%	14,9%	16,3%	12,2%	0,3%
E	17,7%	19,9%	12,9%	9,5%	5,4%	0,2%
F	25,3%	24,0%	12,0%	4,9%	2,1%	0,1%
G	31,7%	23,5%	11,1%	2,2%	0,9%	0,1%

Figure 2.16
Distribution of EPC2024 by reason for EPC issuance (a) and percentage distribution of EPCs by reason for EPC issuance and Energy Performance class (b) (N = 1,208,710) S: sale; R: rental; O: other; MiR: minor renovation; MaR: major renovation; NC: new construction (source: ENEA)

Table 2.6
Percentage distribution of EPC2024 (N = 1,208,710) by reason for EPC issuance and Energy Performance class, with differences compared to EPC2023 (N = 1,100,768) and SIAPE2015–2023 (N = 5,347,099)
S: sale; R: rental; O: other; MiR: minor renovation; MaR: major renovation; NC: new construction
(source: ENEA)

	EPC2024			EPC2024 vs EPC2023			EPC2024 vs SIAPE2015-2023		
Reason for EPC issuance	A4-B	C-E	F-G	A4-B	C-E	F-G	A4-B	C-E	F-G
S	7,5%	35,4%	57,0%	1,6%	2,5%	-4,1%	2,3%	2,1%	-4,4%
R	8,7%	43,8%	47,5%	1,9%	3,9%	-5,9%	3,2%	4,2%	-7,4%
O	37,1%	39,8%	23,1%	-3,6%	3,1%	0,5%	10,9%	0,0%	-10,9%
MiR	52,5%	40,4%	7,1%	-4,3%	3,7%	0,6%	11,0%	-2,1%	-8,9%
MaR	65,5%	31,5%	3,1%	-4,1%	4,4%	-0,3%	2,9%	1,0%	-3,9%
NC	98,5%	1,3%	0,3%	0,9%	-0,7%	-0,2%	1,6%	-1,5%	-0,1%

Table 2.7 reports the median values of EP_{gl}, $EP_{gl,nren}$, $EP_{gl,ren}$, $EP_{H,nd}$, and CO^2 by reason for EPC issuance. The results are consistent with the distribution by Energy Performance class: $_E$PCs linked to sales and rentals show the lowest performance.

Their low median values and narrow interquartile ranges can be attributed to the limited presence of renewable energy technologies, with $EP_{gl,ren}$ often reflecting only the renewable share of electricity drawn from the grid. New constructions show the best results, combining the lowest $EP_{gl,nren}$ values with the highest $EP_{gl,ren}$, even outperforming major renovations, especially in the residential sector. This confirms the ongoing trend towards decarbonisation of new buildings, driven by efficient technologies and renewable energy systems.

Table 2.7
Median values of EP_{gl}, $EP_{gl,nren}$, $EP_{gl,ren}$, $EP_{H,nd}$, and CO_2 emissions from EPC2024 by reason for EPC issuance for residential buildings (N = 1,071,871) and non-residential buildings (N = 136,839)
S: sale; R: rental; O: other; MiR: minor renovation; MaR: major renovation; NC: new construction
(source: ENEA)

	Reason for EPC issuance	No. of EPCs	EP_{gl} Median value [kWh/m² per year]	$EP_{gl,nren}$ Median value [kWh/m² per year]	$EP_{gl,ren}$ Median value [kWh/m² per year]	$EP_{H,nd}$ Median value [kWh/m² per year]	CO_2 Median value [kg/m² per year]
Residential	PP	601.461	195,1	180,5	2,4	107,5	36,4
	L	211.596	182,7	167,4	2,9	95,6	34,0
	A	67.575	130,7	107,2	6,2	65,5	22,2
	RE	74.711	110,9	83,0	10,1	54,1	17,4
	RI	75.037	90,1	67,0	10,6	38,1	13,8
	NC	41.491	68,0	20,6	45,0	21,5	4,6

	Reason for EPC issuance	No. of EPCs	EP_{gl} Median value [kWh/m² per year]	$EP_{gl,nren}$ Median value [kWh/m² per year]	$EP_{gl,ren}$ Median value [kWh/m² per year]	$EP_{H,nd}$ Median value [kWh/m² per year]	CO_2 Median value [kg/m² per year]
Non-residential	PP	58.290	326,2	280,5	22,5	152,9	59,4
	L	52.055	323,2	265,0	28,9	142,7	56,6
	A	11.569	295,8	234,4	35,7	130,7	50,4
	RE	8.078	278,9	197,8	52,9	121,9	43,5
	RI	4.216	235,0	164,9	50,4	101,8	35,9
	NC	2.631	140,4	64,1	66,2	52,0	14,8

The interquartile ranges of performance indicators are shown in Figure 2.17. Also in this case, the dispersion of EP_{gl} and $EP_{gl,nren}$ values tends to decrease for reasons that involve improvement works, confirming that EPCs issued for sales and rentals show greater variability. This is mainly due to the heterogeneity of the building stock in terms of construction period and technical systems. In contrast, EPCs for new constructions and major renovations – particularly in the residential sector – display more homogeneous values, largely because of stricter energy efficiency regulations. This effect is less visible in the non-residential sector, where the wide variety of building uses strongly influences the results.

These considerations do not apply in the same way to $EP_{gl,ren}$. For EPCs issued for sales and rentals in the residential sector, both the median and IQR values are low, which can be explained by the limited use of renewable energy technologies. In such cases, $EP_{gl,ren}$ often reflects only the renewable share of grid electricity.

In addition, for new residential constructions, the median and 75th percentile of $EP_{gl,nren}$ are lower than the median and 25th percentile of $EP_{gl,ren}$. This shows that construction techniques have increasingly aimed at decarbonising energy use. In the non-residential sector, however, the two medians are very close, but the IQR of $EP_{gl,nren}$ is much wider, with its 75th percentile higher than that of $EP_{gl,ren}$.

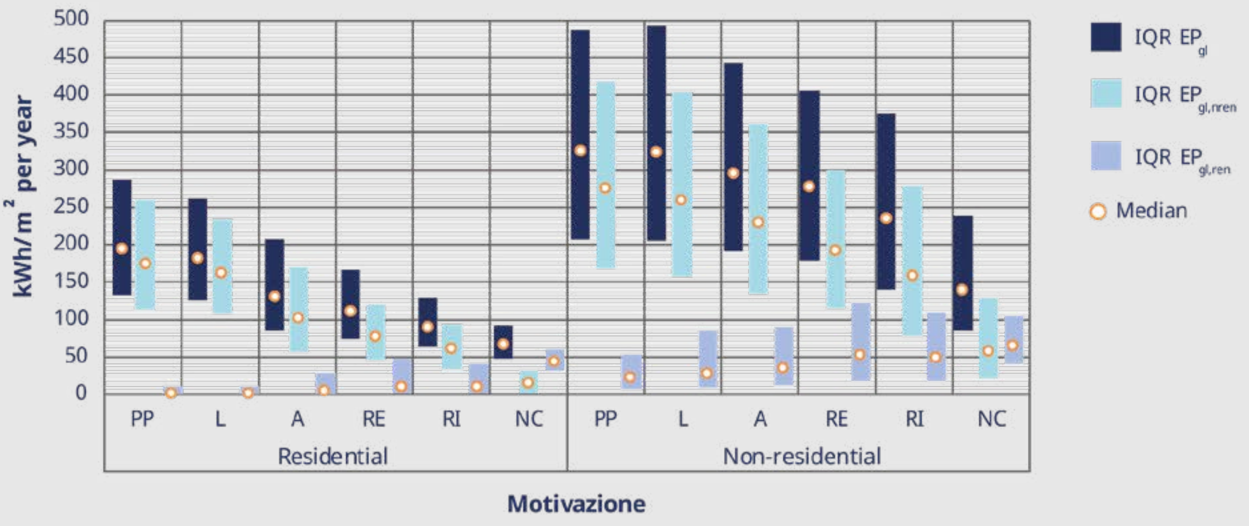


Figure 2.17
Interquartile range (IQR) between the 75th and 25th percentiles and median of EP_{gl}, $EP_{gl,nren}$ and $EP_{gl,ren}$ from EPC2024 by reason for EPC issuance for residential buildings (N = 1,071,871) and non-residential buildings (N = 136,839) S: sale; R: rental; O: other; MiR: minor renovation; MaR: major renovation; NC: new construction (source: ENEA)

Finally, when comparing EPC2024 with EPC2023 and SIAPE2015–2023 (Figure 2.18), the median EP_{gl} decreases for all reasons in the residential sector. In the non-residential sector, however, EP_{gl} increases compared with 2023, especially for sales and rentals, while compared with 2015–2023, the index decreases across almost all categories.

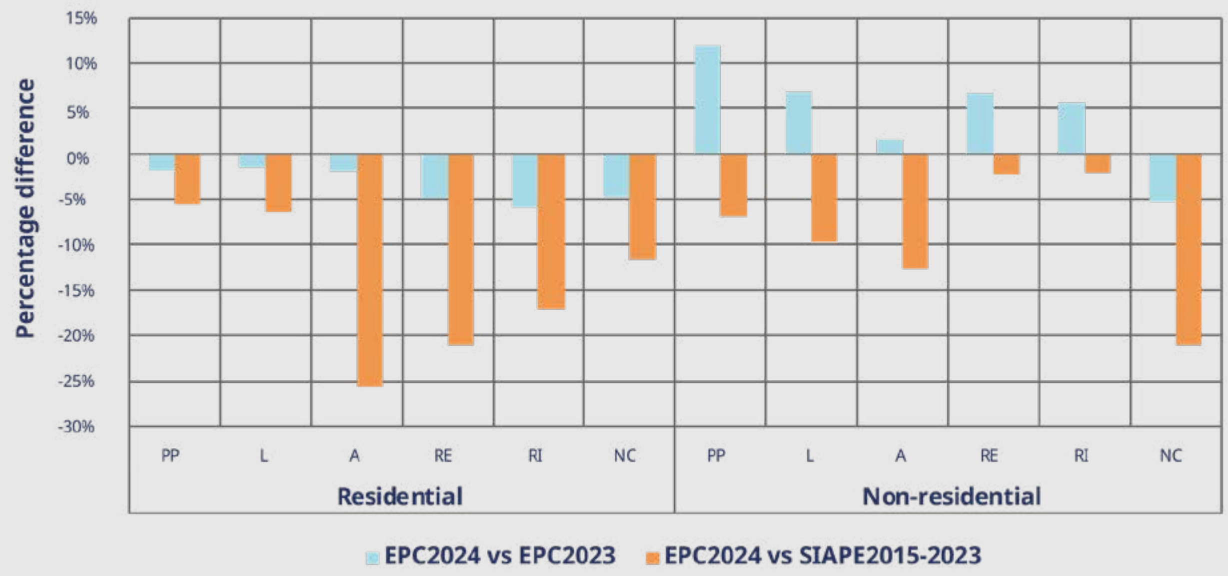
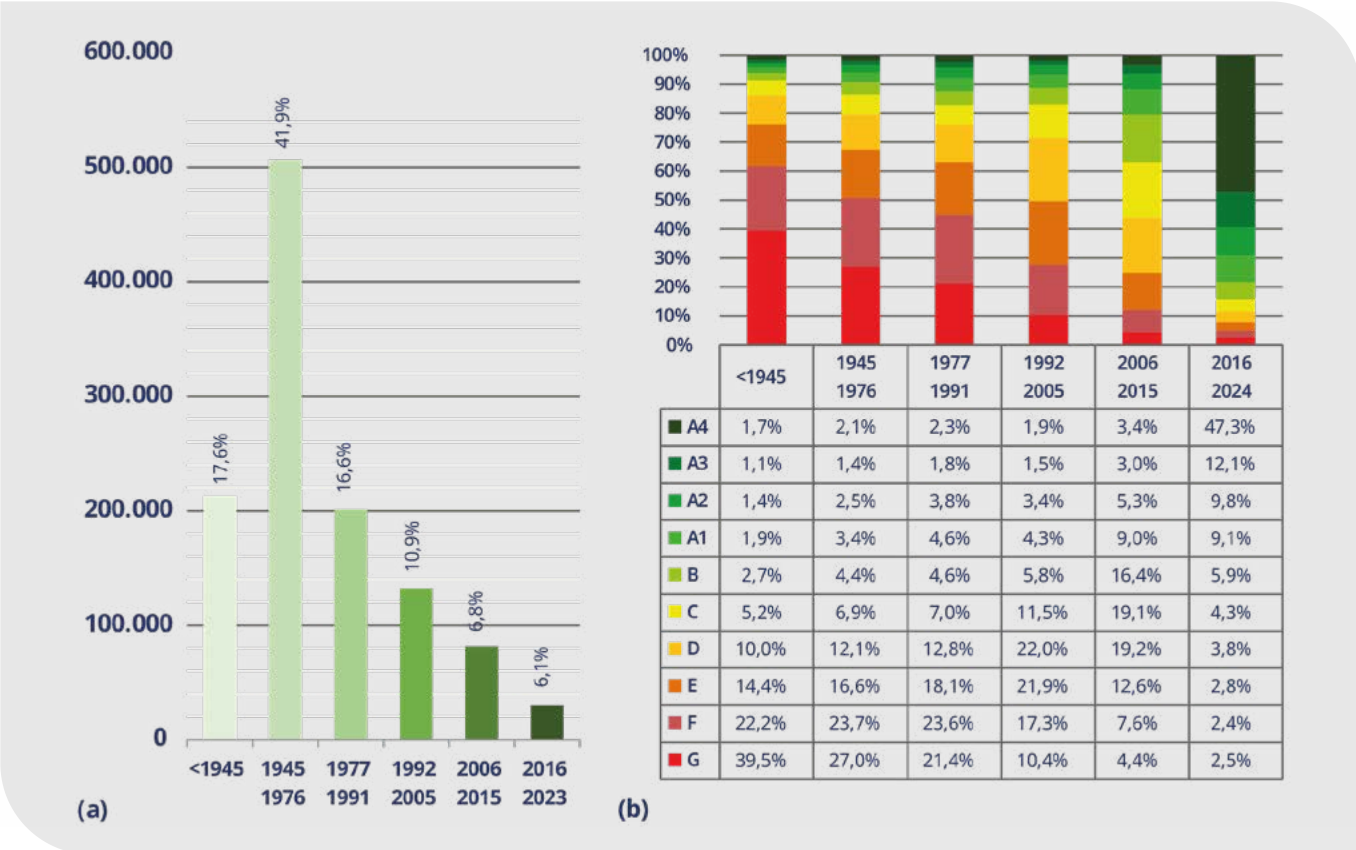


Figure 2.18
Percentage difference of median EP_{gl} between EPC2024 (N = 1,208,710), EPC2023 (N = 1,100,768), and SIAPE2015–2023 (N = 5,347,486), by reason for EPC issuance for residential and non-residential buildings S: sale; R: rental; O: other; MiR: minor renovation; MaR: major renovation; NC: new construction (source: ENEA)

2.6 Construction period

The analysis of the construction year of buildings was carried out by considering both the number of EPCs issued (Figure 2.19a) and the percentage distribution of Energy Performance classes (Figure 2.19b). Construction years were grouped into specific time periods, based on the adoption of the main national energy regulations.



	<1945	1945 1976	1977 1991	1992 2005	2006 2015	2016 2024
A4	1,7%	2,1%	2,3%	1,9%	3,4%	47,3%
A3	1,1%	1,4%	1,8%	1,5%	3,0%	12,1%
A2	1,4%	2,5%	3,8%	3,4%	5,3%	9,8%
A1	1,9%	3,4%	4,6%	4,3%	9,0%	9,1%
B	2,7%	4,4%	4,6%	5,8%	16,4%	5,9%
C	5,2%	6,9%	7,0%	11,5%	19,1%	4,3%
D	10,0%	12,1%	12,8%	22,0%	19,2%	3,8%
E	14,4%	16,6%	18,1%	21,9%	12,6%	2,8%
F	22,2%	23,7%	23,6%	17,3%	7,6%	2,4%
G	39,5%	27,0%	21,4%	10,4%	4,4%	2,5%

Figure 2.19
Distribution of EPC2024 by construction period (a) and percentage distribution of EPCs by construction period and Energy Performance class (b) (N = 1,208,710) (source: ENEA)

The distribution of buildings certified in 2024 across the construction periods is similar to the previous edition of the Report, with about 76% of the sample built before Law 10/1991. EPCs referring to buildings constructed between 2016 and 2024 account for 6.1% of the total, while those built only in 2024 represent 3.7%.

Energy Performance class distribution improves consistently over time, reflecting stricter regulatory requirements. Pre-1991 buildings remain concentrated in the worst-performing classes (Table 2.8). However, comparison between EPC2024 and EPC2023 highlights an increase in the share of buildings in the intermediate classes C–E and a reduction in both the best (A4–B) and the worst classes (F–G), in line with the general distribution shown in Figure 2.3. For buildings constructed after 2005, however, performance improves compared with 2023: the share of classes A4–B increases, while classes C–E and F–G decrease.

Following the adoption of Legislative Decree 192/2005, the share of classes F–G decreased significantly to about 12% (-2.4% compared with 2023), while classes A4–B rose to nearly 38% (+2.8% compared with 2023). Buildings constructed between 2016 and 2024 show the best performance, with about 84% in classes A4–B. This confirms the impact of the minimum requirements introduced by Ministerial Decree of 26 June 2015, which had the greatest influence on building energy performance. As in the case of new constructions (section 2.5), the presence of post-2015 buildings in classes lower than B is largely due to data quality issues.

Table 2.8
Percentage distribution of EPC2024 (N = 1,208,710) by construction period and Energy Performance class, with differences compared to EPC2023 (N = 1,100,768) and SIAPE2015–2023 (N = 5,347,099) (source: ENEA)

	EPC2024			EPC2024 vs EPC2023			EPC2024 vs SIAPE2015-2023		
Construction period	**A4-B**	**C-E**	**F-G**	**A4-B**	**C-E**	**F-G**	**A4-B**	**C-E**	**F-G**
Pre-1945	8,8%	29,6%	61,7%	-0,8%	1,4%	-0,7%	2,2%	1,9%	-4,1%
1945 - 1976	13,7%	35,6%	50,7%	-0,5%	3,7%	-3,2%	6,1%	5,2%	-11,3%
1977 - 1991	17,2%	37,9%	44,9%	-1,2%	3,6%	-2,4%	7,5%	1,7%	-9,2%
1992 - 2005	16,9%	55,4%	27,7%	-1,5%	4,3%	-2,8%	6,8%	-2,1%	-4,7%
2006 - 2015	37,0%	50,9%	12,1%	2,8%	-0,5%	-2,4%	5,7%	-3,8%	-1,9%
2016 - 2023	84,2%	10,9%	4,9%	-0,3%	1,5%	-1,2%	-0,2%	1,5%	-1,3%

These trends are also confirmed by the analysis of median values of performance indices and CO^2 emissions (Table 2.9). In the residential sector, the median EP_{gl} decreases steadily from 227 kWh/m² per year for pre-1945 buildings to 74.5 kWh/m² per year for those constructed between 2016 and 2024. Similar patterns are observed for $EP_{gl,nren}$, and CO^2 emissions. $EP_{gl,ren}$ remains nearly stable until 2005, but increases significantly in the most recent periods, following the introduction of stricter obligations on the use of renewable sources.

Table 2.9
Median values of EP_{gl}, $EP_{gl,nren}$, $EP_{gl,ren}$, $EP_{H,nd}$, and CO_2 emissions from EPC2024 by construction period for residential buildings (N = 1,071,871) and non-residential buildings (N = 136,839) (source: ENEA)

	Construction period	No. of EPCs	EP_{gl} Median value [kWh/m2 per year]	$EP_{gl,nren}$ Median value [kWh/m2 per year]	$EP_{gl,ren}$ Median value [kWh/m2 per year]	$EP_{H,nd}$ Median value [kWh/m2 per year]	CO_2 Median value [kg/m2 per year]
Residential	**Pre 1945**	186.774	226,8	204,2	2,5	132,1	41,0
	1945 - 1976	459.645	179,2	163,4	3,2	95,4	33,2
	1977 - 1991	175.883	167,2	151,7	2,6	89,9	30,7
	1992 - 2005	110.610	150,6	138,0	2,4	77,6	27,9
	2006 - 2015	70.645	119,9	103,4	4,9	53,1	21,1
	2016 - 2023	68.314	74,5	28,0	42,1	25,2	6,2

	Construction period	No. of EPCs	EP_{gl} Median value [kWh/m2 per year]	$EP_{gl,nren}$ Median value [kWh/m2 per year]	$EP_{gl,ren}$ Median value [kWh/m2 per year]	$EP_{H,nd}$ Median value [kWh/m2 per year]	CO_2 Median value [kg/m2 per year]
Non-Residential	Pre 1945	26.200	347,8	289,5	26,4	160,1	61,0
	1945 - 1976	47.023	338,7	285,0	25,4	158,9	60,4
	1977 - 1991	25.198	312,5	260,5	25,0	144,9	55,1
	1992 - 2005	21.374	291,1	238,7	28,7	127,4	51,3
	2006 - 2015	11.139	250,9	191,0	40,8	90,2	42,0
	2016 - 2023	5.905	165,8	94,6	61,5	61,7	21,5

The results observed for new constructions, major renovations, and minor renovations in the analysis of interquartile ranges (Figure 2.17) also apply when examined by construction period (Figure 2.20). Data dispersion decreases over time as performance becomes more uniform, reflecting regulatory requirements. For residential buildings constructed before 1945, the IQR of EP_{gl} is about 186 kWh/m² per year, while for those built between 2016 and 2024, it falls to about 54 kWh/m² per year. $EP_{gl,nren}$ shows a similar reduction in IQR, while $EP_{gl,ren}$ displays greater variability in recent periods (2006–2015 and especially 2016–2024), reflecting the wider adoption of renewable energy technologies.

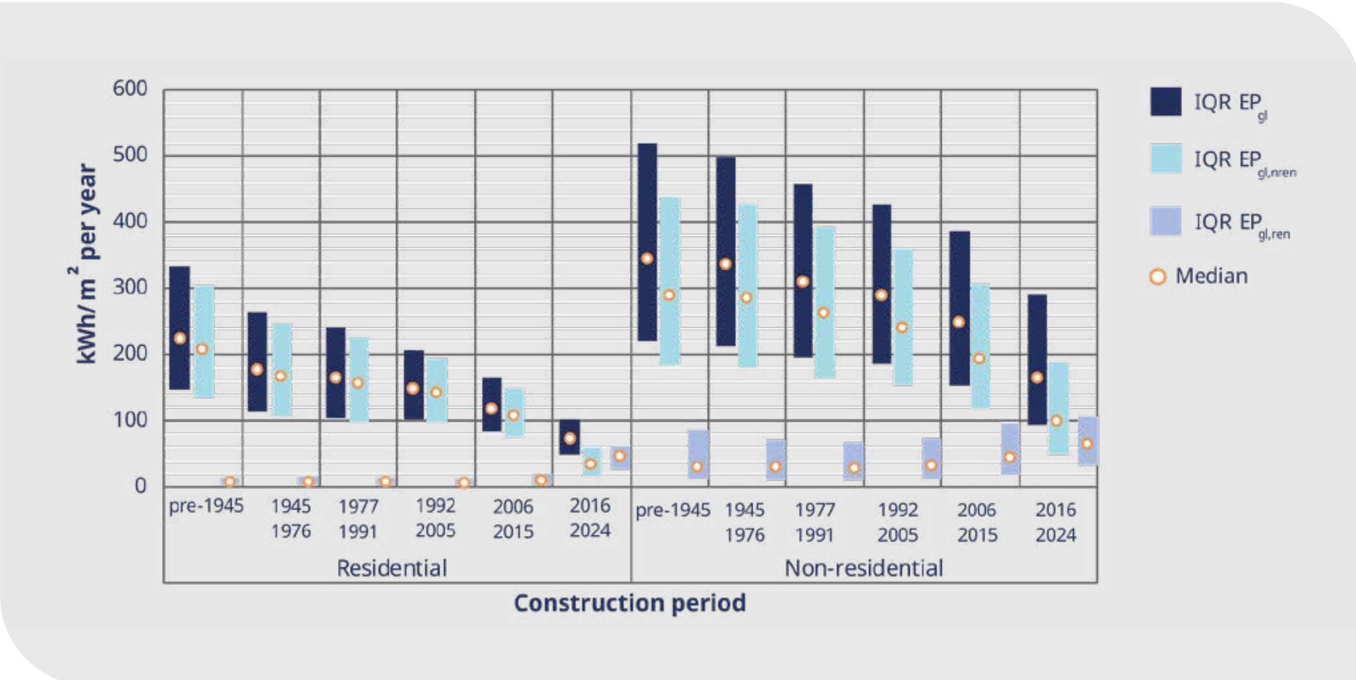


Figure 2.20
Interquartile range (IQR) between the 75th and 25th percentiles and median of EP_{gl}, $EP_{gl,nren}$ and $EP_{gl,ren}$ EP_{gl} from EPC2024 by construction period for residential buildings (N = 1,071,871) and non-residential buildings (N = 136,839) (source: ENEA)

The comparison between EPC2024, EPC2023, and SIAPE2015–2023 is presented in Figure 2.21. In the residential sector, median EP_{gl} decreases across all periods compared with the historical dataset, with the largest drop (-14%) for buildings constructed between 1945 and 1976. In the non-residential sector, EP_{gl} decreases by between 7% and 10.5% for buildings constructed up to 2015, and by more than 20% for the most recent buildings.

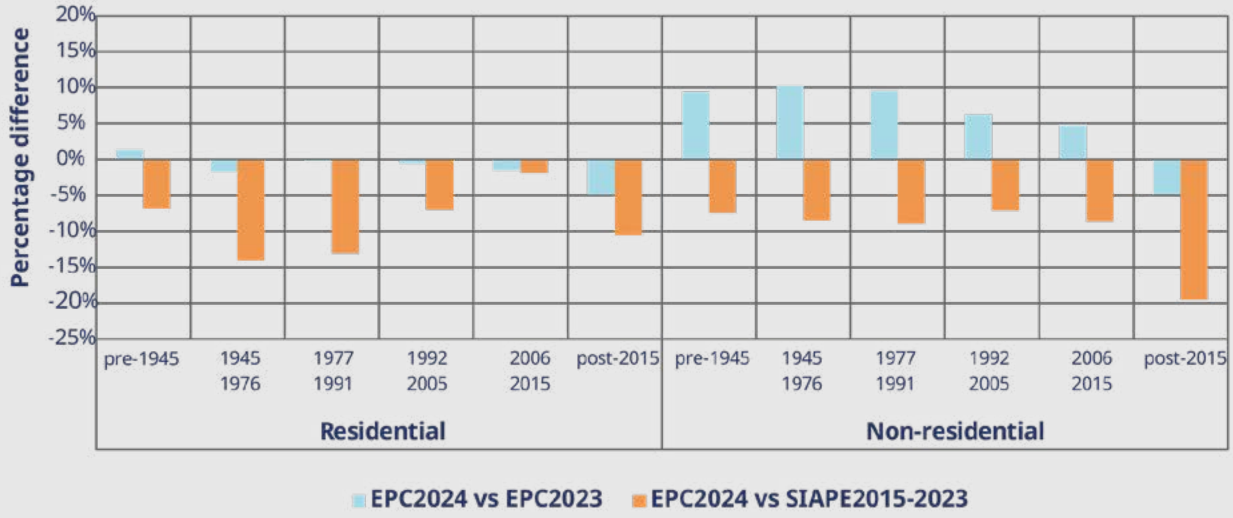


Figure 2.21
Percentage difference of median EP_{gl} between EPC2024 (N = 1,208,710), EPC2023 (N = 1,100,768) and SIAPE2015–2023 (N = 5,347,486), by construction period for residential and non-residential buildings (source: ENEA)

2.7 Building ownership: the certified public building stock in 2024

Of the roughly 1.2 million EPCs issued in 2024, about 1.2% refer to publicly owned assets, while 0.3% concern public-use buildings. Compared with 2023, although these samples are very small, the share for public ownership increased by 0.3 percentage points.

Because the current EPC template does not distinguish between public and private ownership for public-use buildings, the analysis focuses on EPCs issued in 2024 for publicly owned assets (14,735 EPCs), excluding EPCs for public-use buildings (3,037 EPCs).

Within the public buildings sample, 67% are residential and 33% are non-residential. The non-residential share fell by about 17% compared with 2023. In the non-residential sector, over 50% of EPCs refer to educational buildings (E.7) and offices (E.2) (Figure 2.22).

The comparison with SIAPE2015–2023 (Figure 2.23) shows a use-category distribution similar to 2024. However, the overall split between residential and non-residential differs: in 2015–2023, public building EPCs were almost evenly distributed (55.2% residential and 44.8% non-residential), whereas in 2024 the residential share clearly exceeds the non-residential share.

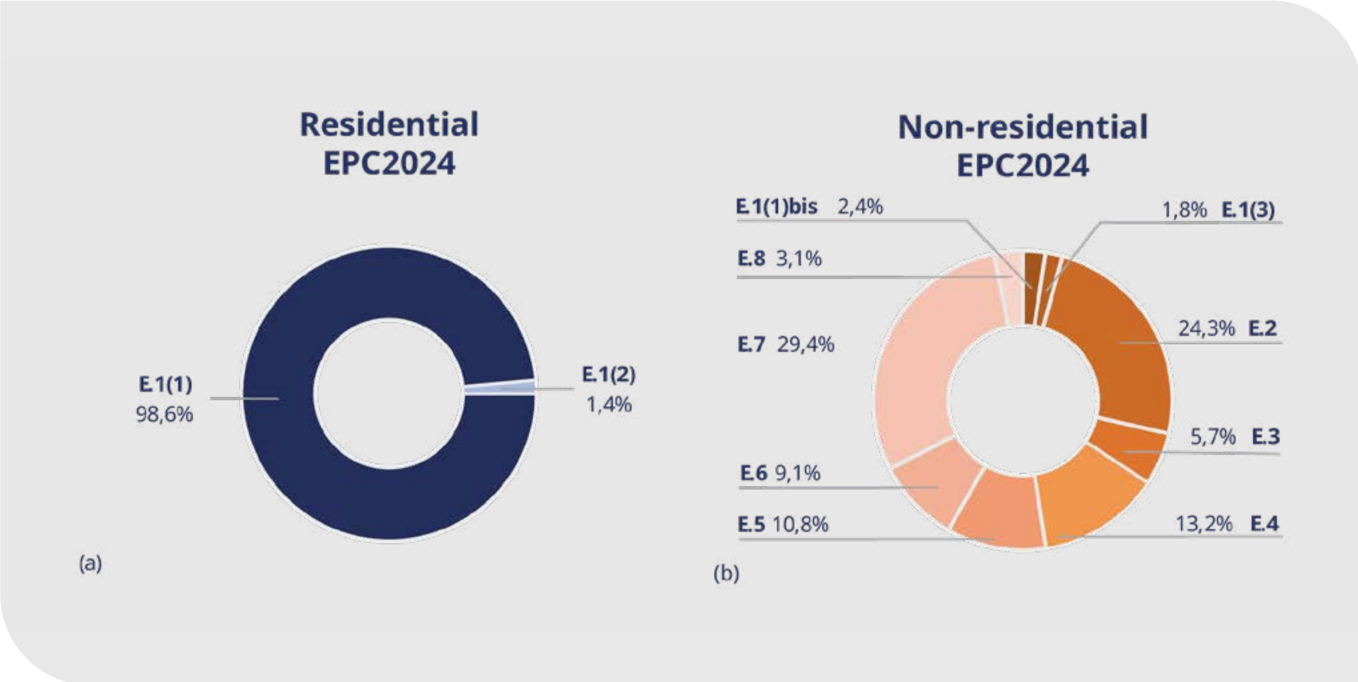


Figure 2.22
Percentage distribution of EPC2024 for public buildings by use category according to Presidential Decree 412/1993: residential (a) (N = 9,915) and non-residential (b) (N = 4,280) (source: ENEA)

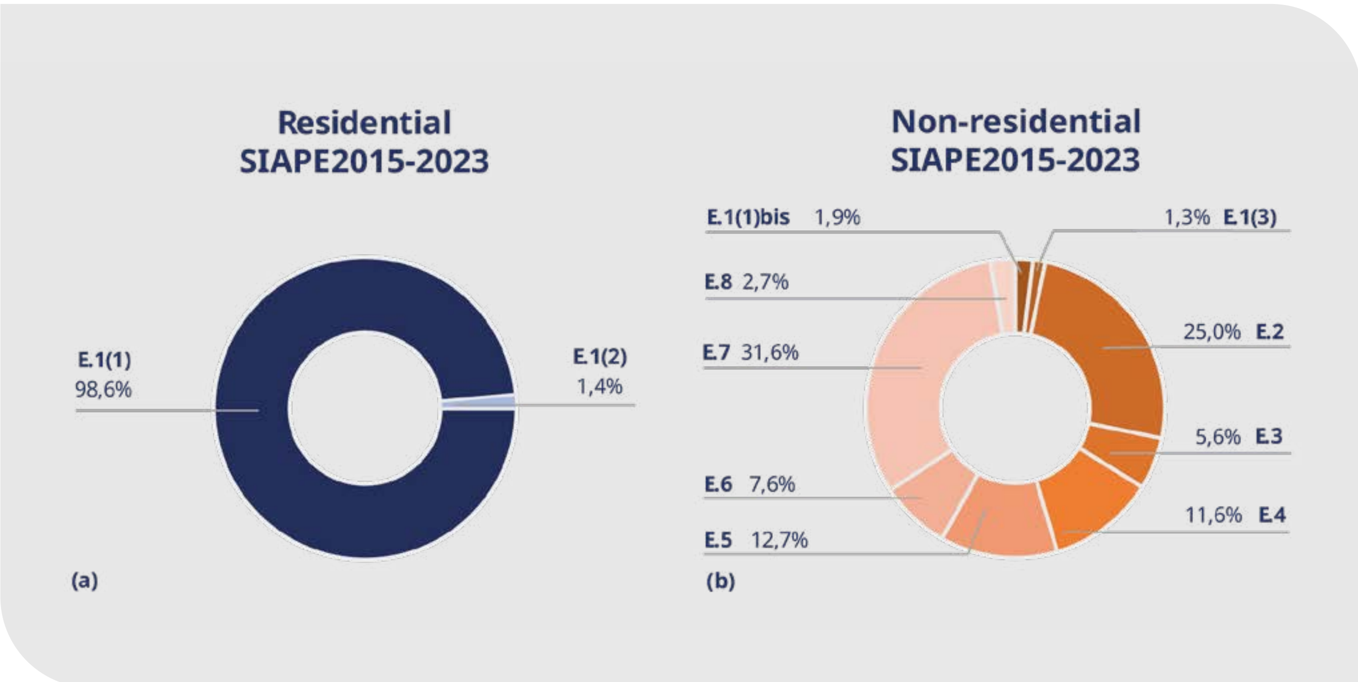


Figure 2.23
Percentage distribution of SIAPE2015–2023 public building EPCs by use category according to Presidential Decree 412/1993: residential (a) (N = 20,066) and non-residential (b) (N = 19,174) (source: ENEA)

Figure 2.24a shows that public residential buildings certified in 2024 perform better than the overall sample (Figure 2.9a): A4–B classes are more frequent (22.6% versus 20%), and E–F classes are less frequent (39% versus 45.3%) (Table 2.10). Figure 2.24b shows that non-residential public buildings are even more efficient than the overall non-residential sample, with about 21% in classes F–G compared with about 31% in the overall sample. In both sectors, the share in the most efficient classes increased by about 3 percentage points compared with 2023 (Table 2.10), while F–G decreased by 7.7 percentage points in residential and 3.7 percentage points in non-residential. The improvement is even clearer versus the cumulative SIAPE2015–2023 data.

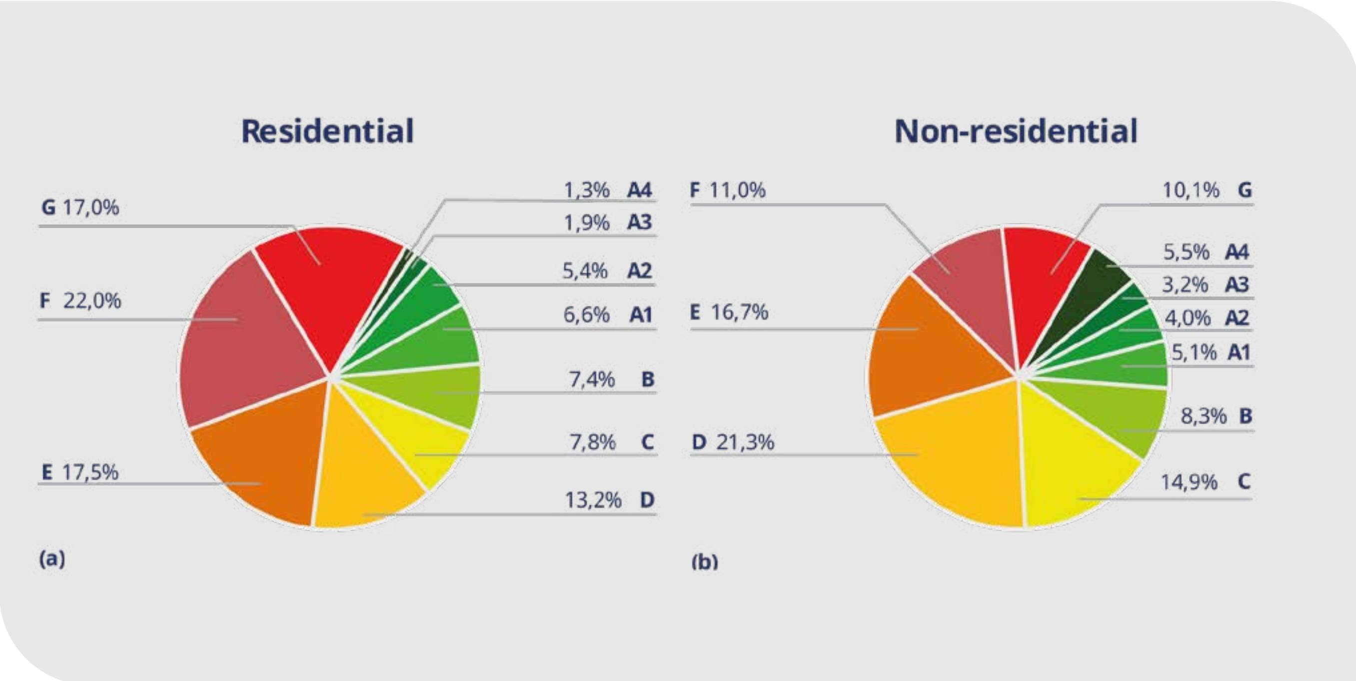


Figure 2.24
Percentage distribution of EPC2024 for public buildings by Energy Performance class: residential (a) (N = 9,915) and non-residential (b) (N = 4,820) (source: ENEA)

Table 2.10
Percentage distribution of EPCs for public buildings in EPC2024 (N = 14,850) by Energy Performance class range and use category, with differences versus EPC2023 (N = 9,761) and SIAPE2015–2023 (N = 44,843) (source: ENEA)

	EPC2024			EPC2024 vs EPC2023			EPC2024 vs SIAPE2015-2023		
Building use	**A4-B**	**C-E**	**F-G**	**A4-B**	**C-E**	**F-G**	**A4-B**	**C-E**	**F-G**
Residential	22,6%	38,5%	39,0%	2,6%	5,0%	-7,7%	11,7%	2,1%	-13,8%
Non-residential	26,1%	52,9%	21,1%	2,9%	0,8%	-3,7%	6,0%	-2,2%	-3,9%

Finally, a detailed comparison was carried out for public building EPCs by climatic zone, reason for EPC issuance, and construction period, highlighting differences versus the overall EPC2024 dataset (Figure 2.25) and versus EPC2023.

For climatic zones, public buildings in EPC2023 show a higher share in zone E (67.2%), up by 13 percentage points, while zone D fell from 25% to 17.6%. Zones C and B decreased by 4.9 and 1.4 percentage points, respectively; zones A and F remained stable. Compared with the overall EPCs issued in 2024, public building EPCs are more represented in zones E and F.

For the reason for EPC issuance, comparing EPC2024 and EPC2023 for public ownership shows a decrease in minor renovations (MiR, −7.6 percentage points) and in the other (O, −6.6 percentage points) category, while major renovations (MaR) and rentals (R) increased by +5.3 and +8.7 percentage points, respectively. Versus the overall 2024 sample, public building EPCs show lower shares of sales (S) and new constructions (NC), and higher shares of rentals (+17.1), other (+12.5), minor renovations (+6.7), and major renovations (+4.3).

For the construction period, public buildings certified and built before 1945 account for 16.6%, slightly down from 2023. Buildings constructed between 1945 and 2005 increased by about 1.0–2.5 percentage points. Overall, the EPC2024 public buildings sample is more evenly distributed by construction period than the overall 2024 sample.

These results point to stronger attention to energy renovation and to a more diverse distribution by climatic zone and construction period compared with the overall dataset.

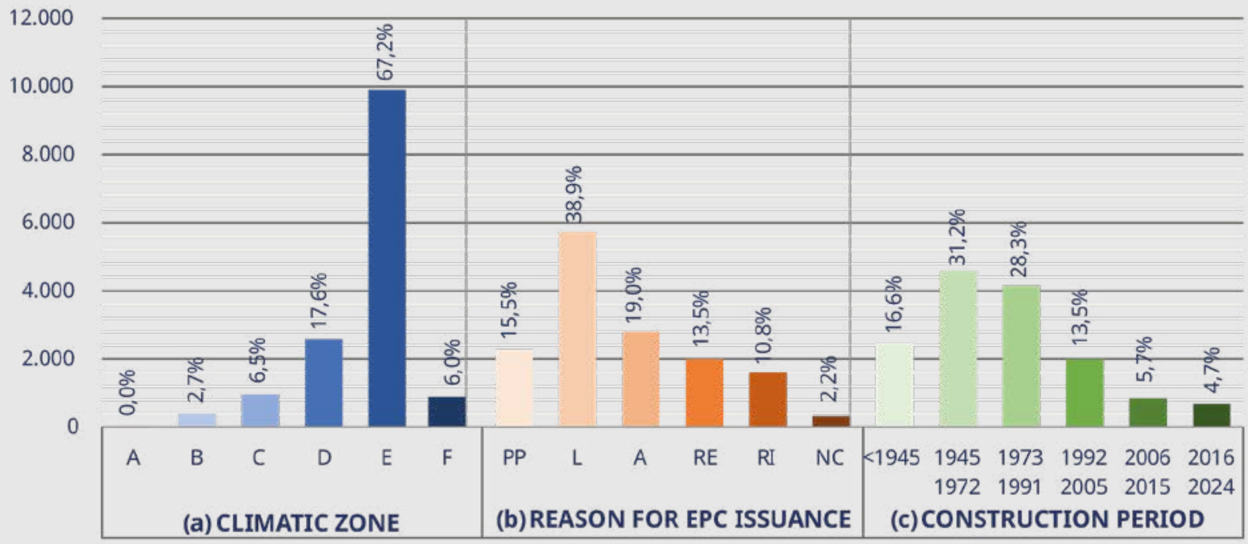


Figure 2.25
Distribution of EPC2024 for public buildings by (a) climatic zone, (b) reason for EPC issuance, and (c) construction period (N = 14,735) S: sale; R: rental; O: other; MiR: minor renovation; MaR: major renovation; NC: new construction (source: ENEA)

2.8 Energy services

The global energy performance index (EP_{gl}) and its non-renewable ($EP_{gl,nren}$) and renewable ($EP_{gl,ren}$) components are obtained by summing the performance indices of each energy service present in the building, namely: space heating (EPH), space cooling (EPC), domestic hot water production (EPW), mechanical ventilation (EPV), artificial lighting (EPL), and transport of people and goods (EPT).

Before presenting the analyses, the following two points need to be clarified:

- Sample filtering. The dataset was analysed after applying the filter system (Annex 2). EPCs that did not satisfy mandatory "presence" or "absence" conditions for certain energy services were excluded. Space heating must always be considered, and, for the residential sector only, so must domestic hot water. Annex 1 of the Ministerial Decree of 26 June 2015 specifies that lighting and transport service indices are not calculated for residential uses.

- Data quality. Due to the quality of data transmitted to SIAPE, the missing tick for a given energy service does not always correspond to a null value of its performance index, and vice versa.

According to SIAPE, the installation rate of energy services in 2024 for residential and non-residential buildings is reported in Table 2.11, based on what is declared on page 1 of the EPC form under "energy services present". Space cooling is installed in a relatively small share of certified residential buildings (30%) and in 46% of non-residential buildings. Both values are higher than in 2023. Mechanical ventilation and, for the non-residential sector only, transport of people and goods remain limited (3–8%). In the non-residential sector, 77% of buildings have domestic hot water production and 78% have artificial lighting. It is anomalous that roughly one quarter of non-residential buildings appear to lack the latter service.

Table 2.11
Installation rate of individual energy services in residential and non-residential buildings (source: ENEA)

Building use	Space heating (H)	Space cooling (C)	Domestic hot water (W)	Mechanical ventilation (V)	Artificial lighting (L)	Transport of people or goods (T)
Residential	**100%**	30%	100%	3%	N.A.	N.A.
Non-residential	**100%**	46%	77%	8%	78%	6%

As with EP_{gl}, the performance index of each service is split into a non-renewable share (EPnren) and a renewable share (EPren). These were analysed to identify which services most affect total primary energy demand (Table 2.12 and Figure 2.26). Space heating shows the highest median EP and EPnren in both sectors, with median EP values of 120.4 kWh/m² per year (residential) and 192.6 kWh/m² per year (non-residential). The non-renewable component predominates in energy demand, while the renewable share remains low for most services, except for artificial lighting and mechanical ventilation in the non-residential sector.

Table 2.12
Median values of EP, EP_{nren}, and EP_{ren} for each installed energy service in residential and non-residential buildings (source: ENEA)

Building use	Energy service	No. of EPCs declaring the service	EP Median Value [kWh/m² per year	EP_{nren} Median value [kWh/m² per year]	EP_{ren} Median Value [kWh/m² per year]
Residential	Space heating (H)	1.270.941	120,4	105,0	0,8
	Space cooling (C)	342.065	14,4	10,7	3,8
	Domestic hot water (W)	1.148.718	29,4	26,9	0,7
	Mechanical ventilation (V)	26.885	7,0	3,1	3,0
Non-residential	Space heating (H)	188.776	192,0	148,7	2,0
	Space cooling (C)	85.920	22,0	17,1	4,9
	Domestic hot water (W)	101.357	7,9	6,4	1,3
	Mechanical ventilation (V)	10.713	9,8	6,9	2,4
	Artificial lighting (L)	90.751	77,2	60,9	16,1
	Transport of people or goods (T)	9.590	4,2	3,3	0,9

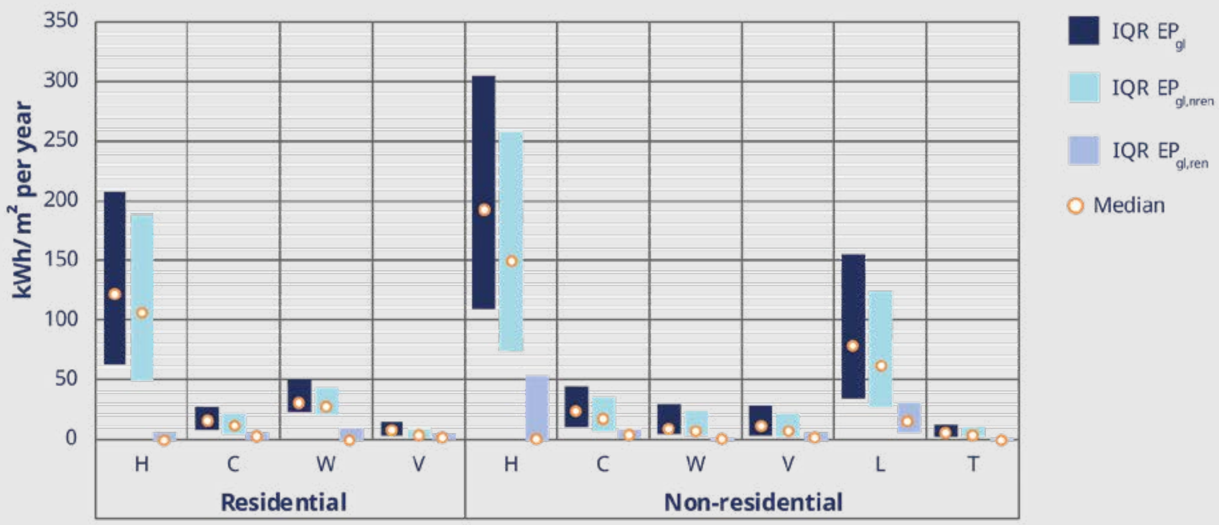


Figure 2.26
Interquartile range (IQR) between the 75th and 25th percentiles and median of EP, EP_{nren}, and EP_{ren} for each energy service installed in residential and non-residential buildings (source: ENEA)

In the residential sector, EP for space heating decreases compared with EPC2023, while EP increases for all other services. Versus SIAPE2015–2023, there is a general reduction across services, except for mechanical ventilation, which increases. In the non-residential sector, patterns are more heterogeneous. Compared with SIAPE2015–2023, space heating, space cooling, and artificial lighting show sizeable EP reductions (10–16%), while mechanical ventilation and transport of people or goods increase by about 4%, and domestic hot water rises by about 1%.

These dynamics (Figure 2.27) reflect both technological evolution, a gradual shift towards more efficient systems, and the growing prevalence of services that were previously less common, particularly in the non-residential sector. It is also plausible that part of the variation is influenced by improved EPC compilation quality.

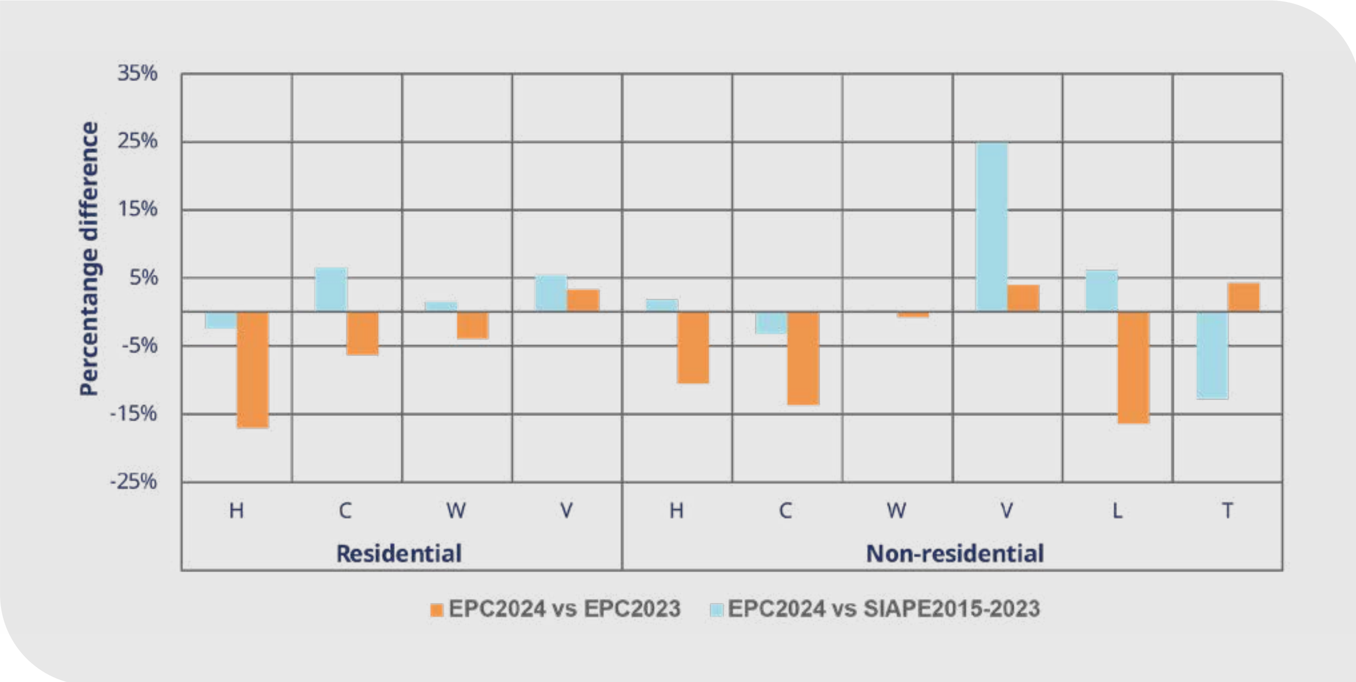


Figure 2.27
Percentage difference of median EP between EPC2024 and EPC2023, and between EPC2024 and SIAPE2015–2023 for each energy service installed in residential and non-residential buildings (source: ENEA)

2.9 Recommended improvement measures

The Guidelines of the Ministerial Decree of 26 June 2015 require that EPCs include recommendations for improving the building's energy efficiency; otherwise, the EPC is invalid. The recommendations section must contain at least one proposed measure, chosen among the following categories:

- **Ren 1: Building – Opaque envelope**
- **Ren 2: Building – Transparent envelope**
- **Ren 3: Heating system**
- **Ren 4: Cooling system**
- **Ren 5: Other systems**
- **Ren 6: Renewable sources**

The certifier selects the recommended measures based on several criteria, including cost-effectiveness. On the EPC, the certifier must indicate the payback time of the investment, whether a major renovation is required, and the achievable Energy Performance class and $EP_{gl,nren}$ both for each measure and for the full set of recommended measures.

As shown in Figure 2.28, in the residential sector, 50.7% of recommendations concern the opaque envelope, followed by 21.1% for the transparent envelope and 15.8% for heating systems. In the non-residential sector, the pattern is similar: 49.5% of recommendations involve the opaque envelope and 25.9% the transparent envelope. Compared with 2023, the distribution of recommended measures in 2024 is almost unchanged, with variations below 1%.

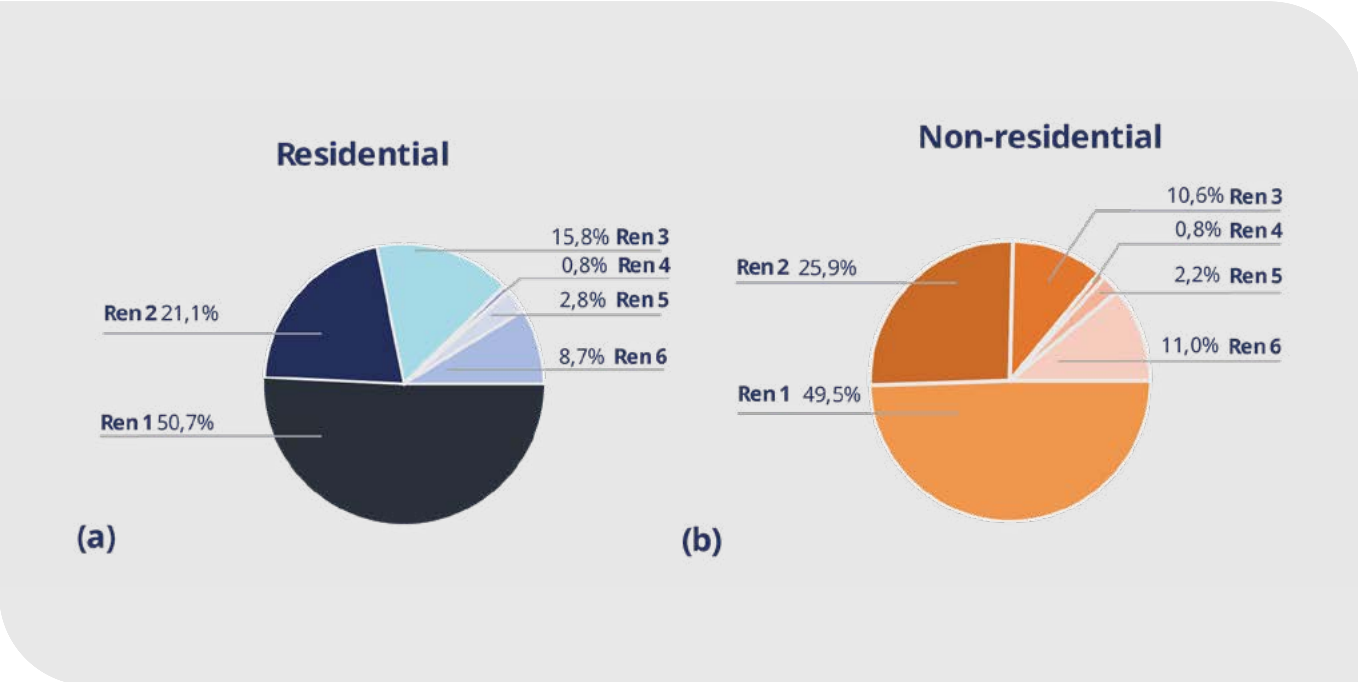


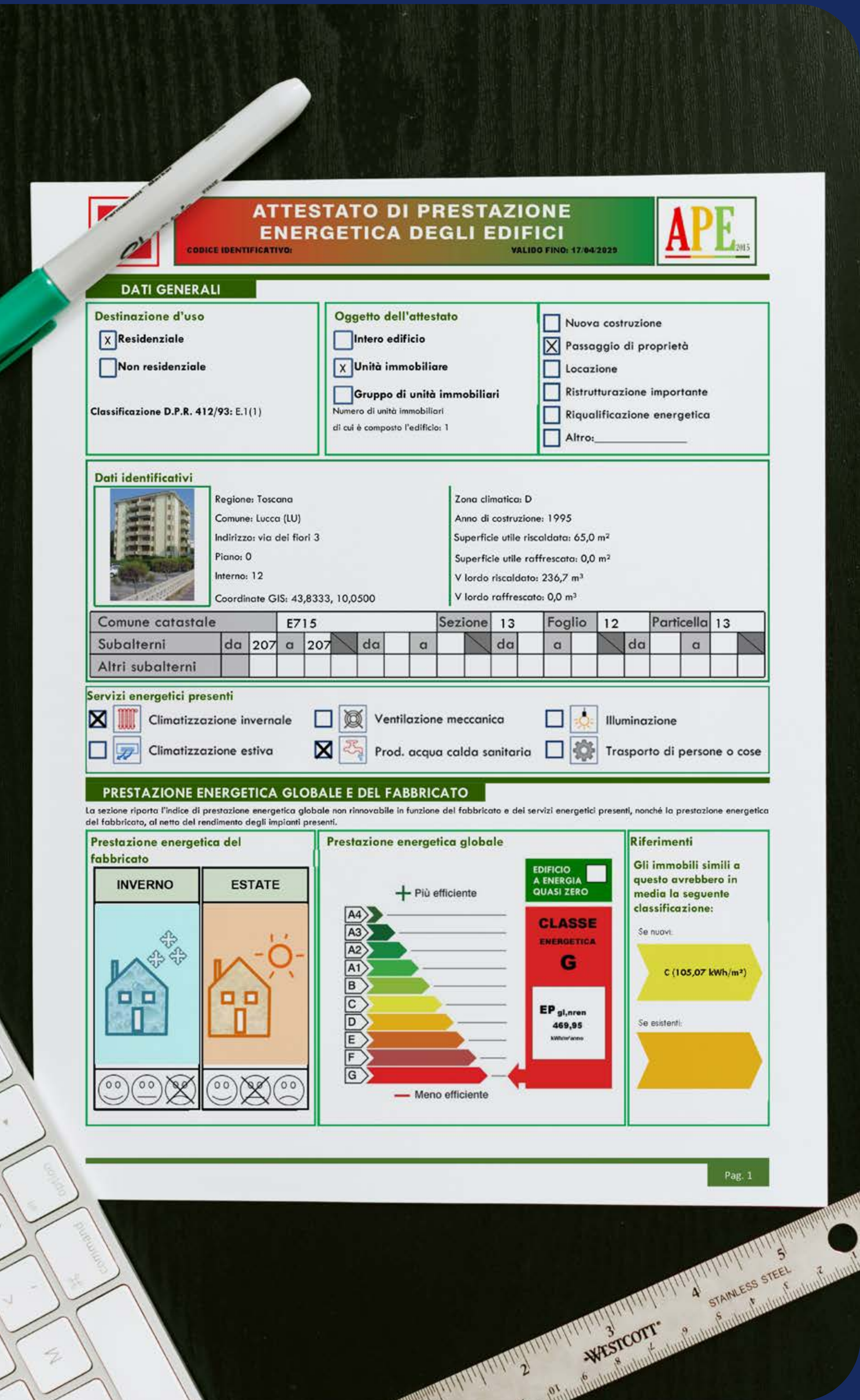
Figure 2.28
Distribution of recommendations for the residential sector (N = 1,392,735) and the non-residential sector (N = 177,294) Ren 1: Building – Opaque envelope; Ren 2: Building – Transparent envelope; Ren 3: Heating system; Ren 4: Cooling system; Ren 5: Other systems; Ren 6: Renewable sources (source: ENEA)

The share of recommendations requiring a major renovation remained stable: 12.1% in the residential sector and 10.7% in the non-residential sector (Table 2.13). These interventions mainly concern the opaque envelope, accounting for 18.5% in the residential sector and 16.7% in the non-residential sector. Detailed percentages by type of measure are reported below.

Table 2.13
Percentage of recommended measures requiring a major renovation by intervention type in the residential sector (N = 1,392,735) and the non-residential sector (N = 177,294) (source: ENEA)

Building use	Intervention type	Share of recommendations requiring a major renovation
Residential	Ren 1 – Building – Opaque envelope	18,5%
	Ren 2 – Building – Transparent envelope	5,9%
	Ren 3 – Heating system	4,9%
	Ren 4 – Cooling system	5,6%
	Ren 5 – Other systems	10,5%
	Ren 6 – Renewable sources	3,6%
	Total	12,1%
Non-residential	Ren 1 – Building – Opaque envelope	16,7%
	Ren 2 – Building – Transparent envelope	5,2%
	Ren 3 – Heating system	6,0%
	Ren 4 – Cooling system	4,8%
	Ren 5 – Other systems	4,1%
	Ren 6 – Renewable sources	3,2%
	Total	10,7%

The recommendations contained in EPC2024 confirm the trends observed in previous years: priority is given to the building envelope, while simple or low-invasiveness measures are more common overall. However, there remains clear room for growth in measures involving renewable sources, whose share is still relatively limited in both sectors.



ATTESTATO DI PRESTAZIONE ENERGETICA DEGLI EDIFICI

CODICE IDENTIFICATIVO: VALIDO FINO: 17/04/2029

APE 2015

DATI GENERALI

Destinazione d'uso

[X] Residenziale

[ ] Non residenziale

Classificazione D.P.R. 412/93: E.1(1)

Oggetto dell'attestato

[ ] Intero edificio

[X] Unità immobiliare

[ ] Gruppo di unità immobiliari

Numero di unità immobiliari di cui è composto l'edificio: 1

[ ] Nuova costruzione

[X] Passaggio di proprietà

[ ] Locazione

[ ] Ristrutturazione importante

[ ] Riqualificazione energetica

[ ] Altro:____________

Dati identificativi

Regione: Toscana

Comune: Lucca (LU)

Indirizzo: via dei fiori 3

Piano: 0

Interno: 12

Coordinate GIS: 43,8333, 10,0500

Zona climatica: D

Anno di costruzione: 1995

Superficie utile riscaldata: 65,0 m²

Superficie utile raffrescata: 0,0 m²

V lordo riscaldato: 236,7 m³

V lordo raffrescato: 0,0 m³

Comune catastale	E715	Sezione	13	Foglio	12	Particella	13
Subalterni	da 207 a 207	da	a	da	a	da	a
Altri subalterni							

Servizi energetici presenti

[X] Climatizzazione invernale

[ ] Climatizzazione estiva

[ ] Ventilazione meccanica

[X] Prod. acqua calda sanitaria

[ ] Illuminazione

[ ] Trasporto di persone o cose

PRESTAZIONE ENERGETICA GLOBALE E DEL FABBRICATO

La sezione riporta l'indice di prestazione energetica globale non rinnovabile in funzione del fabbricato e dei servizi energetici presenti, nonché la prestazione energetica del fabbricato, al netto del rendimento degli impianti presenti.

Prestazione energetica del fabbricato

INVERNO | ESTATE

Prestazione energetica globale

\+ Più efficiente

A4, A3, A2, A1, B, C, D, E, F, G

— Meno efficiente

EDIFICIO A ENERGIA QUASI ZERO

CLASSE ENERGETICA G

EP gl,nren 469,95 kWh/m²anno

Riferimenti

Gli immobili simili a questo avrebbero in media la seguente classificazione:

Se nuovi: C (105,07 kWh/m²)

Se esistenti:

Pag. 1

3

Checks on Energy Performance Certificates (EPCs)

The analysis of Energy Performance Certificates (EPCs) available in the National Information System on Energy Performance Certificates (SIAPE) and in the regional registries managed by ENEA revealed a relatively high percentage of parameters showing critical issues and/or anomalies following various verification procedures. To improve the reliability of the information contained in the national registry, it became necessary to implement a verification methodology prior to submission to SIAPE, aiming to create a reliable, standardized, and reusable tool for evaluating and checking the data contained in each EPC. The methodology was tested on a sample of real EPCs from a regional energy registry managed by ENEA, and the main inconsistencies identified are described below. Additionally, control activities carried out directly by some Regions were also analyzed.

3.1 The Importance fo Accurate EPC Verification

The EPC is a fundamental tool for the sustainability and energy efficiency of buildings. It provides an objective assessment of a property's energy consumption, offering valuable information. To fully serve its purpose, it must be drafted and verified with the utmost accuracy, and there are many reasons behind this necessity.

The EPC must represent an accurate snapshot of a building's energy performance. If the data entered is inaccurate, it risks providing misleading information. Careful verification during the drafting phase ensures the correctness of the data, guaranteeing that the final results are reliable and truly reflect the standardized performance of the building.

The availability of a system of verified energy performance certificates strengthens trust among buyers, sellers, investors, and institutions, creating a fairer and more competitive market. This is especially important in a context where sustainability and energy efficiency are increasingly central to development policies.

With an accurate EPC, it is possible to correctly identify areas for energy improvement in a building, reducing the risk of implementing unnecessary or ineffective measures and avoiding the neglect of more significant interventions.

National and regional regulations require that EPCs be drafted and verified by qualified professionals and that they comply with precise technical standards. Accurate verification ensures compliance with regulations, avoiding penalties or legal disputes that may arise from incorrect or irregular certifications.

Public incentives are often tied to the submission of an EPC; accurate verification ensures that interventions are properly documented and that tax benefits are granted only to those who have genuinely improved the energy performance of their property.

Public authorities use EPCs as tools for monitoring and planning energy and environmental policies. Reliable and verified certificates are essential for evaluating the effectiveness of adopted measures and for planning future interventions.

In summary, verification is essential to ensure the reliability of information, promote transparency, support effective energy retrofitting, comply with regulations, and sustain sustainability policies. Only through careful verification can the EPC fulfill its role as a key tool in the transition toward more sustainable and efficient buildings. Therefore, professionals, stakeholders, industry associations, and public institutions must jointly contribute to improving the quality and integrity of the EPC at every stage of its drafting and verification.

Within this framework, ENEA has been carrying out activities for several years that enable increasingly thorough and meticulous control of the energy certifications produced throughout the national territory and transmitted to the SIAPE .

3.2 Preventive Checks. Experimental Application to the Campania Registry, Description of the API Query Procedure (Application Programming Interface).

3.2.1 Preventive Checks (Ex Ante)

The analysis of EPCs in the national SIAPE registry revealed a relatively high percentage of documents failing verification. For some checks, nearly half of the sample analyzed showed incorrect or anomalous values. To ensure and improve the reliability of the information transferred to SIAPE, it became necessary to adopt a methodology that involves flagging and correcting certificates at the source, i.e., before final submission to the regional registry by the certifier.

To this end, several activities were carried out to investigate the extended XML format, identifying the most relevant elements for preliminary checks. Subsequently, a classification of the types of checks and related warnings was developed to systematically organize the verifications to be applied.

For each identified type of check, a representative sample of parameters was selected to test the effectiveness of the methodology. Based on this, a specific control strategy was defined for each parameter category to make the verification system as accurate and reliable as possible.

Finally, the developed methodology was tested on a newly established regional energy registry managed by ENEA, specifically that of the Campania Region. This test allowed for the verification of the system's ability to detect and correct potential errors or anomalies in EPCs during the preliminary phase, before their final entry into the registry. The activity led to the development of a preventive verification model (ex-ante) to be applied during the EPC submission phase to regional registries. This model allows the certifier to receive real-time alerts regarding possible errors or inconsistencies in the data entry, offering the opportunity to correct or confirm the data.

The proposed methodology is based on processing key parameters used in EPC calculations, going beyond the basic checks provided by the XSD (XML Schema Definition) format. The adopted approach is user-oriented, aiming to improve the usability of the experimental web interfaces developed for ENEA's regional registries. These new procedures aim to minimize input errors, incompleteness, duplication, or oversight.

The first step involved analyzing the IT structure of EPCs, particularly the XML format in its two versions: reduced (XML APE 2015 Reduced v.12) and extended (XML APE 2015 Extended v.5), along with the structural constraints defined by the corresponding XSD schema.

Based on this structure, a methodology for additional semantic checks was developed to complement the syntactic checks already provided by the XSD schema. The latter only ensures the formal correctness of the XML (which elements may appear, their relationships, and data types), but does not verify the logical consistency or reliability of the entered values.

The portals of the energy registries of the Regions and Autonomous Provinces that acquire EPC XMLs, in accordance with the most updated national reduced or extended versions, only perform XSD validation of the XML submitted by certifiers.

The implementation of semantic checks, however, allows for the identification of errors or anomalies in the data by comparing them with the general trends of the sample present in the registry, as illustrated in Figure 3.1.

During the upload of APE files in extended XML format, three main categories of checks have been identified:

- Attribute Consistency: Verification of the correspondence between the same parameters present in both the "datiCalcolo" tag (extended XML) and the ape2015 tag (reduced XML), allowing for a certain degree of approximation.
- Acceptability of Numerical Values: Validation that numerical values fall within predefined minimum and maximum thresholds, based on the distribution observed in the regional registry, in order to detect potential errors or anomalies.
- Cross-Checks Between Data:
    1. Simple Cross-Checks: Verifications based on one-to-one relationships between parameters (e.g., if x = a, then y = b).
    2. Complex Cross-Checks: Input-output type relationships (e.g., x is the result of an operation involving y and z).

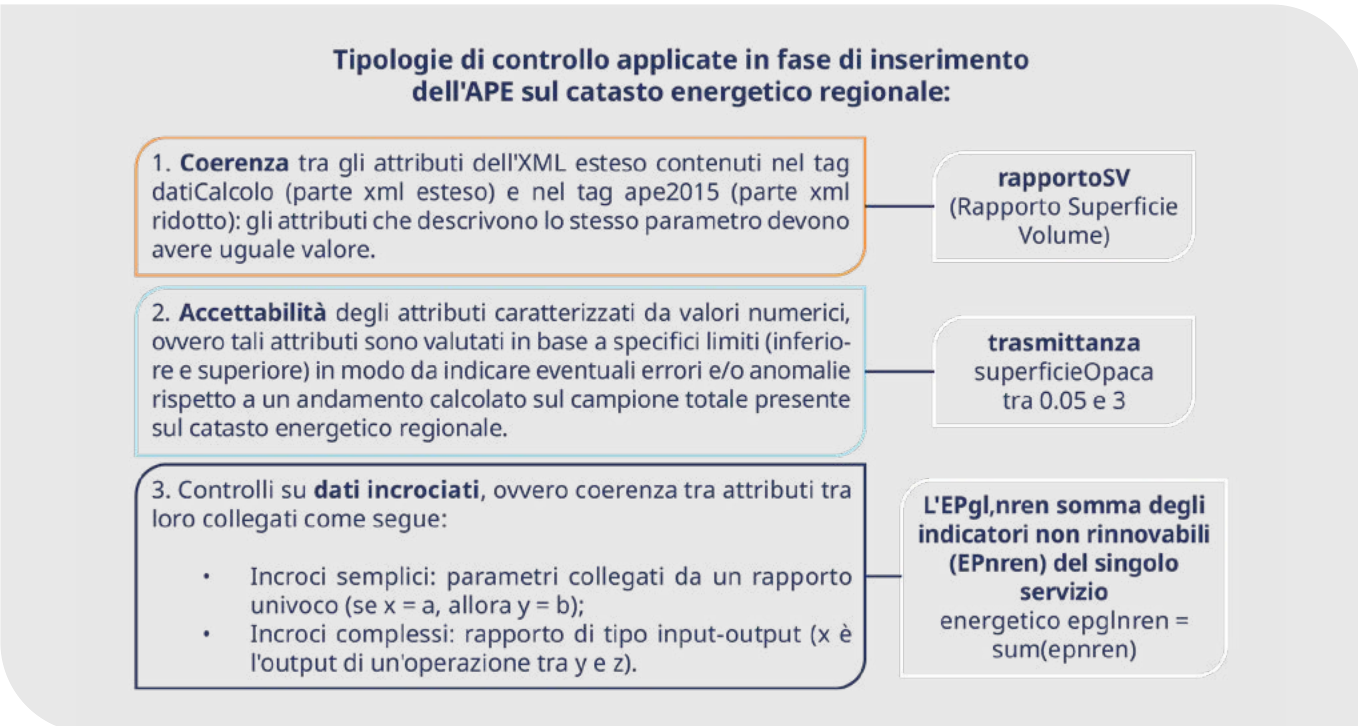


Figure 3.1
Types of Controls Applied

3.2.2 Description of the API Query Procedure

The development of the calculation methodology aimed to create a reliable, standardized, and reusable tool for evaluating and verifying the data contained in each EPC. A modular calculation logic was therefore defined, allowing for targeted checks (e.g., numerical validations, internal consistency, cross-variable checks) and statistical aggregations (e.g., comparisons with the reference sample in the regional energy registry).

Once the logic was defined, a formalized methodological model was developed, consisting of:

- semantic validation rules for each parameter or group of parameters,
- automatic control functions for out-of-range values, inconsistencies, duplications, and omissions.
- Classification of error or warning messages, with corresponding levels of severity (blocking error, warning, suggestion).

Based on this methodology, an API (Application Programming Interface) was developed to provide control and calculation services. The API was designed according to principles of modularity, scalability, and interoperability, to be easily integrated into regional information systems or those of other managing entities.

Specifically, the API allows users to:

- upload an EPC XML file in extended format and validate it using XSD version 5;
- automatically extract relevant parameters and apply the control rules in real time as defined by the methodology.
- return a structured output report with the results of the checks, including any warnings or errors.

The output is in JSON format, to facilitate integration with web interfaces, management systems, or public portals, as illustrated in Figure 3.2.

```
{
    "statusCode": 200,
    "data": [
        {
            "xsd": [
                {
                    "code": 1824,
                    "message": "Element 'superficieUtileRaffrescata':
'10a.00' is not a valid value of the atomic type
'typeSuperficieVolume'."
                }
            ],
            "warning": [
                {
                    "idwarning": "3015",
                    "description": "Regola 15 su controlli incrociati
latitudine GIS e longitudine GIS",
                    "peso": "0",
                    "valido": "1",
                    "message": "Regola 15 su controlli incrociati
latitudine GIS = 44.465 e longitudine GIS = 44.465 per codice ISTAT =
071024."
                },
                {
                    "idwarning": "1012",
                    "description": "Regola 12 coerenza su latitudine: ",
                    "peso": "0",
                    "valido": "1",
                    "message": "Regola 12 coerenza su latitudine 44.465
a fronte di 41.465"
                },
                {
                    "idwarning": "1014",
                    "description": "Regola 14 coerenza su volume lordo
riscaldato: ",
                    "peso": "0",
                    "valido": "1",
                    "message": "Regola 14 coerenza su volume lordo
riscaldato 143.63 a fronte di 343.63"
                }
            ]
        }
    ]
}
```


Figure 3.2
API – verification XML

3.2.3 Experimental Application to the Campania Registry and Evidence of Inconsistencies Reported by the System

The methodology and the related API, described in the previous section, were tested on a sample of real EPCs from a regional energy registry managed by ENEA. The tests allowed for:

- verifying the accuracy and reliability of the calculation model.
- calibrating the numerical acceptability thresholds.
- refining the management of warning messages and the clarity of the output.

Thanks to the use of the developed API, it was possible to test these checks within a Regional EPC System, where the results of each set of controls on the extended XML are displayed to the certifier with alerts (Figure 3.3).

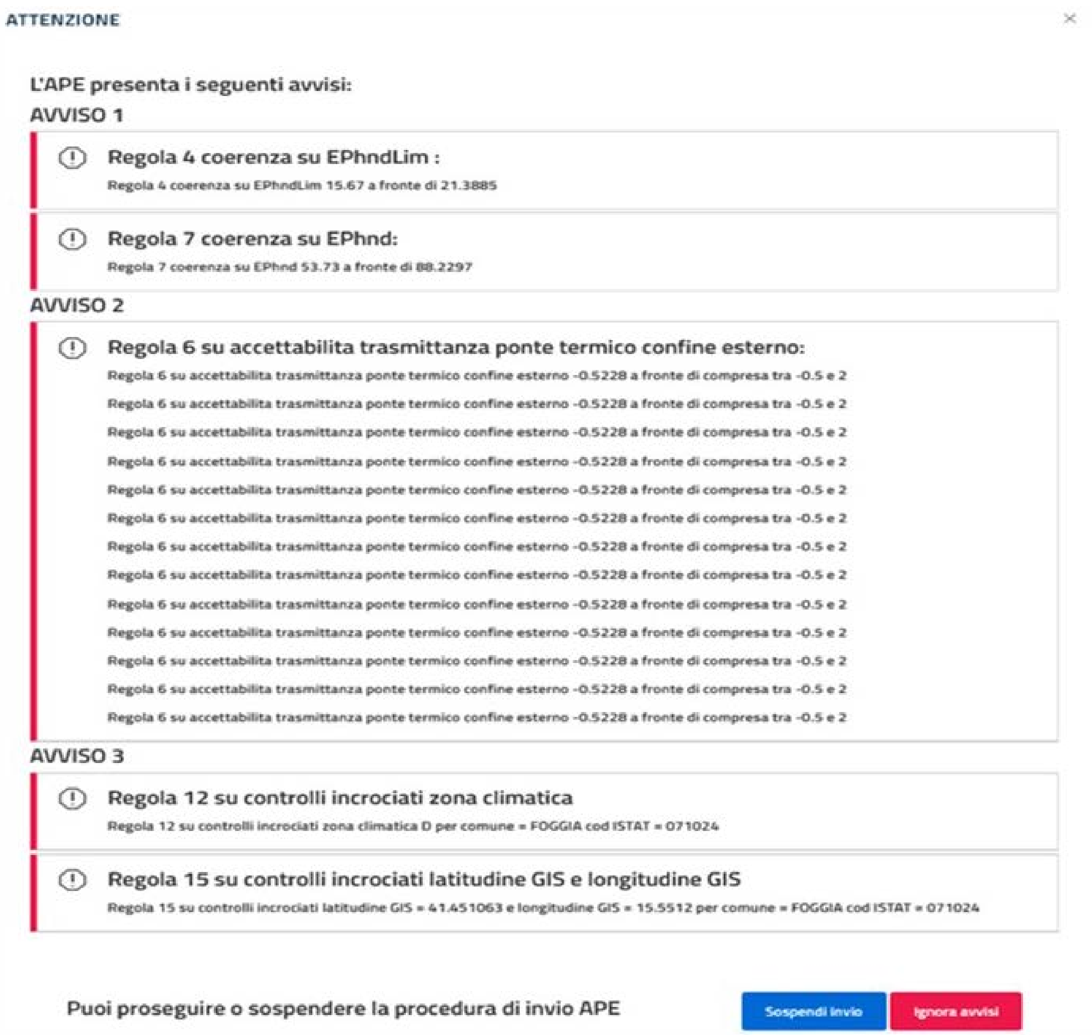


Figure 3.3
Example of warning notifications related to a submitted EPC

As of 26 March 2025, the new methodology for the preventive quality control of EPC certification has been operational on an experimental basis in the information system of the Campania Region for EPC management.

When uploading a new XML for submission, if the automatic preventive control systems detect one or more inconsistencies in the entered data, the system will provide one or more "Warning" messages to the certifier before the EPC is validated.

The certifier may choose to:

a. ignore the warnings and proceed with the final submission of the EPC;

b. carry out the necessary checks and possibly upload a revised EPC in light of the system's observations.

This new methodology aims to provide adequate support and assistance to professionals in the field, with the dual goal of improving the average quality of submitted EPCs and reducing the risk of penalties due to errors identified during the random checks required by law.

It should be noted that the absence of automatic alerts does not guarantee that the EPC is error-free, as only the most frequent cases of error have been considered at this stage.

Taking the period from 26 March 2025 when the new preventive control methodology became operational through 15 May 2025, a significant sample was extracted from the EPC registry for analysis. As shown in Table 3.1, approximately 13.851 EPCs were submitted during this period. Another noteworthy figure is the 10.456 submission attempts that were subsequently canceled and deleted by the certifier, for various possible reasons, before final submission to the regional registry.

Table 3.1
Number of EPCs classified by status in the period 26 March 2025 – 15 May 2025

EPC Status in the Registry	EPC number
Deleted gefore final submission	10.456
Submitted	13.851

To assess whether the introduction of the control procedure affected the number of EPC upload attempts before final submission, a 30 day period before and after the procedure's implementation was analyzed and compared with another regional registry. The results are shown in the following tables. The first two tables show the number of EPCs submitted and deleted before final submission in Campania, along with the ratio between them; the value is very similar to that observed in a comparable regional registry during the same period. Table 3.4, on the other hand, highlights a significant increase in the number of EPCs deleted before final submission compared to those actually filed in the registry, with the submitted/deleted ratio dropping from 5.27 in the period prior to the introduction of the control procedure to 1.19 in the subsequent period.

This sharp rise in EPC upload attempts may indicate that the certifier acknowledged the reported anomalies and made the necessary corrections, possibly through multiple submission attempts over time for the same EPC.

Table 3.2
Number of EPCs classified by status before the introduction of the warning (20 February 2025 – 22 March

EPC Status in the Registry	CAMPANIA	LAZIO
Deleted before final submission	1.722	2.527
Submitted	9.076	12.395

Table 3.3
Submitted/Deleted before final submission ratio in the Campania and Lazio registries

CAMPANIA	LAZIO
9.076/ 1.722= 5,27	12.395 / 2.524 = 4,91

Table 3.4
Number of EPCs classified by status after the introduction of the warning (26 March 2025 – 25 April 2025)

EPC Status in DB	Number of EPCs
Deleted before final submission	7.165
Submitted	8.466
Sent/Deleted ratio before final submission	8.466 / 7.165 = 1,18

Table 3.5 highlights the total number of warnings associated with EPCs deleted before final submission and the total number of warnings associated with EPCs actually filed during the entire observation period. The ratio decreases from 3,37 in the former case to 2,03 for EPCs that were definitively submitted, indicating a significant improvement in the number of reported anomalies.

Table 3.5
Number of warnings recorded by EPC status in the registry during the period 26 March 2025 – 15 May 2025

EPC Status	NUMBER of WARNINGS	Number of EPCs	Ratio
Deleted before final submission	35.274	10.456	3,37
Submitted	28.179	13.812	2,03

Specifically, the number of EPCs with "submitted" status and no warnings during the same analysis period (26 March 2025 – 15 May 2025) was 6.310 out of a total of 13.851. Of these, 4.425 were free of anomalies on the first submission attempt. The corresponding ratios are 2,19 and 3,13, respectively.

A key metric for assessing the impact of warnings on the submission process by certifiers is the number of XML upload attempts made after the warnings were displayed. Tables 3.6 and 3.7 present a comparison of averages based on the sample of submitted EPCs, distinguishing between those with multiple upload attempts and zero final warnings, and those with multiple attempts and more than zero final warnings, as well as the overall sample of EPCs during the period (26 March 2025 – 15 May 2025).

Table 3.6
Statistics on EPCs with multiple upload attempts and 0 final warnings (26 March 2025 – 15 May 2025)

Number of EPC submitted	1.110
Average number of upload attempts per EPC	4,3
Maximum number of upload attempts per EPC	56
Average number of warnings per EPC (across all attempts)	1,80
Highest average upload attempts per EPC	27,44
Lowest average upload attempts per EPC	0,16
Submitted/Deleted ratio before final submission	8.466 / 7.165 = 1,18

Table 3.7
EPCs with multiple upload attempts and more than 0 final warnings (26 March 2025 – 15 May 2025)

Number of submitted EPCs	8.649
Average number of upload attempts per EPC	1,71
Maximum number of upload attempts per EPC	43
Average number of warnings per EPC (on the attempts total)	3,84
Maximum number of warnings per EPC (on the attempts total)	203,40
Minimum number of warnings per EPC (on the attempts total)	0,33

Table 3.8
Sample of all EPCs in the period (26 March 2025 – 15 May 2025)

Number of submitted EPCs	13.812
Average number of upload attempts per EPC	1,72
Maximum number of upload attempts per EPC	56
Average number of warnings per EPC (on the attempts total)	2,23
Maximum number of warnings per EPC (on the attempts total)	203,4
Minimum number of warnings per EPC (on the attempts total)	0

Finally, the following two tables provide a summary classification of the warnings based on the "violated rule" and the number of warnings grouped into the three categories of checks identified in paragraph 3.2.1, Preventive Checks (ex ante).

Table 3.9
List of warnings by rule category and number of occurrences

Category rule	Parameter(s)	Rule description	Number
Consistency: correspondence of the parameter in the extended XML between 'datiCalcolo' and 'ape2015' tags	DPR412	Rule 1 mismatch of parameter 'DPR412' in tags.	583
	Comune	Rule 2 mismatch of parameter 'Comune' in tags.	93
	$EP_{gl,nren}$ riferimento standard	Rule 3 mismatch of parameter '$EP_{gl,nren}$ riferimento standard' in tags.	63
	$EP_{H,nd}$,limite	Rule 4 mismatch of parameter $EP_{H,nd}$,limite in tags.	4.333
	GG – gradi giorno	Rule 5 mismatch of parameter 'GG' in tags.	3
	Regione	Rule 6 mismatch of parameter 'Regione' in tags.	46
	$EP_{H,nd}$	Rule 7 mismatch of parameter '$EP_{H,nd}$' in tags.	2.506

Category rule	Parameter(s)	Rule description	Number
	Rapporto S/V	Rule 8 mismatch of parameter 'Rapporto S/V' in tags.	64
	Superficie disperdente	Rule 9 mismatch of parameter 'Superficie disperdente' in tags.	167
	Volume lordo	Rule 10 mismatch of parameter 'Volume lordo' in tags.	13
	Codice ISTAT	Rule 11 mismatch of parameter 'Codice ISTAT' in tags.	-
	Latitudine	Rule 12 mismatch of parameter 'Latitudine' in tags.	21
	Longitudine	Rule 13 mismatch of parameter 'Longitudine' in tags.	33
	Volume lordo riscaldato	Rule 14 mismatch of parameter 'Volume lordo riscaldato' in tags.	24
	Zona climatica	Rule 15 mismatch of parameter 'Zona climatica' in tags.	-
	$EP_{gl,nren}$	Rule 16 mismatch of parameter ' $EP_{gl,nren}$' in tags.	86
	NZEB	Rule 17 mismatch of parameter 'NZEB' in tags.	1.657
	$EP_{gl,nren}$ nuovo	Rule 18 mismatch of parameter '$EP_{gl,nren}$ nuovo' in tags.	1.410
	$EP_{gl,nren}$ servizi	Rule 19 mismatch of parameter '$EP_{gl,nren}$ servizi' in tags.	-
	$EP_{gl,ren}$ servizi	Rule 20 mismatch of parameter ' $EP_{gl,ren}$ servizi' in tags.	63
	Classe energetica	Rule 21 mismatch of parameter 'Energy Performance class' in tags.	65
Acceptability: the parameter value does not fall within the minimum and maximum allowable limits	Superficie netta	Rule 1 'Superficie netta' parameter value out of range 50-500.	512
	Volume netto	Rule 2 'Volume netto' parameter value out of range 60-1200.	352
	Trasmittanza superficie opaca su confine esterno	Rule 3 'Trasmittanza superficie opaca su confine esterno' parameter value out of range 0,05-3.	9.684

Category rule	Parameter(s)	Rule description	Number
	Trasmittanza infisso su confine esterno	Rule 4 'Trasmittanza infisso su confine esterno' parameter value out of range 0,5-6.	2.852
	Trasmittanza corretta infisso su confine esterno	Rule 5 'Trasmittanza corretta infisso su confine esterno' parameter value out of range 0,5-6.	2.519
	Ponte termico su confine esterno	Rule 6 'Ponte termico su confine esterno' parameter value out of range -0,5-2.	20.609
	Trasmittanza superficie opaca in ambiente non climatizzato	Rule 7 'Trasmittanza superficie opaca in ambiente non climatizzato' parameter value out of range 0,05-3.	331
	Ventilazione ricambi d'aria	Rule 8 'Ventilazione ricambi d'aria' parameter value out of range 0,2-2.	583
	Superficie opaca totale	Rule 9 'Superficie opaca totale' parameter value out of range 10.	147
	Superficie vetrata totale	Rule 10 'Superficie vetrata totale' parameter value out of range 2.	913
	Trasmittanza media superficie opaca	Rule 11 'Trasmittanza media superficie opaca' parameter value out of range 0,05-3.	132
	Trasmittanza media superficie vetrata	Rule 12 'Trasmittanza media superficie vetrata' parameter value out of range 0,5-6.	434
	Potenza nominale del generatore	Rule 13 'Potenza nominale del generatore' parameter value out of range 0,5-100.	-
Cross-checks: Parameter calculations and comparison	$EP_{gl,nren}$ and $EP_{gl,nren}$ riferimento standard and classe energetica	Rule 1 comparison between $EP_{gl,nren}$ e $EP_{gl,nren}$ riferimento standard and classe energetica.	289
	$EP_{gl,nren}$ servizi and $EP_{gl,nren}$ totale	Rule 2 comparison between sum $EP_{gl,nren}$ servizi and $EP_{gl,nren}$ totale.	2
	$EP_{gl,ren}$ servizi and $EP_{gl,ren}$ totale	Rule 3 comparison between sum $EP_{gl,ren}$ servizi and $EP_{gl,re}$n totale.	-
	$EP_{gl,nren}$ totale and $EP_{gl,ren}$ totale and EP totale	Rule 4 comparison between sum $EP_{gl,nren}$ totale and $EP_{gl,ren}$ totale and EP totale.	1

Category rule	Parameter(s)	Rule description	Number
	Rapporto area solare, superficie utile and Yie and prestazione estiva	Rule 5 comparison betweenRapporto area solare, superficie utile and Yie and prestazione estiva.	5.391
	Rapporto $EP_{H,nd}$ and $EP_{H,nd}$,limite and prestazione invernale	Rule 6 comparison betweenRapporto $EP_{H,nd}$ and $EP_{H,nd}$,limite Limite and prestazione invernale.	98
	Migliore classe energetica su singolo intervento raccomandato and $EP_{gl,nren}$ raggiungibile	Rule 7 comparison betweenMigliore classe energetica su singolo intervento raccomandato and $EP_{gl,nren}$ raggiungibile.	1.913
	Migliore classe energetica su interventi raccomandati and $EP_{gl,nren}$ raggiungibile	Rule 8 comparison betweenMigliore classe energetica su interventi raccomandati and $EP_{gl,nren}$ raggiungibile.	779
	Rapporto superficie lorda disperdente and volume lordo riscaldato and rapporto S/V	Rule 9 comparison betweenRapporto superficie lorda disperdente and volume lordo riscaldato and rapporto S/V.	237
	Zona climatica and gradi giorno	Rule 10 comparison between Zona climatica and gradi giorno.	16
	DPR412 and destinazione d’uso	Rule 11 comparison betweenDPR412 and destinazione d’uso.	520
	Zona climatica, codice ISTAT and codice catastale	Rule 12 comparison between Zona climatica, codice ISTAT and codice catastale.	254
	Area solare and superficie utile and rapporto AreaSolareSuperficieUtile	Rule 13 comparison betweenArea solare and superficie utile ratio and rapporto AreaSolareSuperficieUtile.	3.358
	Latitudine GIS, Longitudine GIS, codice catastale and codice ISTAT	Rule 15 comparison betweenLatitudine GIS, Longitudine GIS, codice catastale and codice ISTAT.	1.718

Table 3.10
Summary of warnings by control category

Acceptability of numerical attributes	39.068
Cross-checks on data	14.576
Consistency between extended XML attributes	11.230

3.2.4 Initial Engagement with ENEA/CTI/SW Houses Coordination for potential synergies

For several years, ENEA has been actively involved in the activities of the "Software-House" Advisory Group of the Italian Thermotechnical Committee (CTI), a technical working group established to foster collaboration among key stakeholders involved in the development and use of software for building energy certification. The group is coordinated by CTI and includes ENEA experts, major software developers (software houses) in the sector, and representatives from Italian Regions, as the authorities responsible for managing regional energy registries.

The group has a dual purpose: on one hand, it serves as a technical forum for discussion and for gathering useful input for the software verification and validation activities carried out by CTI; on the other, it plays a strategic role in facilitating dialogue between software developers and standard-setters, helping to bridge the gap between the evolution of technical standards and their actual implementation in the IT systems used for drafting EPCs.

One of the main achievements of this working group has been the definition and development of standardized XML schemas used for the structured exchange of input and output data related to EPCs between certification software and regional information systems. These schemas are essential tools for ensuring interoperability among the various actors and systems involved. These formats have since been updated and revised, partly at the request of the Regions, to better meet the operational needs of local systems. A major milestone was reached at the end of 2016, when ENEA officially adopted the reduced XML schema for the National Information System on Building Energy Performance (SIAPE), making it the reference standard for simplified energy data uploads.

Within the advisory group's activities, ENEA also presented the results of some of the most significant initiatives carried out under the National Electricity System Research (RdS) projects, focusing on two innovative aspects:

1. The development of an automated pre-validation procedure to be executed during the initial drafting phase of the EPC, aimed at improving data quality and consistency before submission to regional archives;;
2. The identification and inclusion, within the XML schema, of a specific $EP_{gl,nren}$ parameter for "similar buildings," to be used as a reference or benchmark value within the certificate.

The goal of this presentation was twofold: to encourage a technical discussion on the opportunity to integrate pre-validation checks directly into the EPC generation workflow, allowing energy certifiers to verify data accuracy and completeness during drafting, thus avoiding later rejections or warnings from the registries; and to propose a mechanism for accessing the $EP_{gl,nren}$ reference value for similar buildings, made available through an API developed by ENEA and provided to certified software. This API allows software to retrieve, in real time from SIAPE, comparison values for buildings with similar characteristics, thereby improving the reliability of the comparative analysis included in the EPC.

Both functionalities — the integration of pre-validation checks and the inclusion of the $EP_{gl,nren}$ parameter for similar buildings — have been proposed for incorporation, via API, into energy certification software already validated by CTI. This aims to enhance the quality of the final XML file of the EPC submitted by certifiers to regional registries.

Following this proposal, an implementation timeline was shared with software houses. It was agreed that in a first phase (starting July 2025), testing and integration of the $EP_{gl,nren}$ parameter for similar buildings would begin, as it is considered a priority in terms of impact and ease of implementation. In a second phase (starting September 2025), testing and implementation of the pre-validation checks will commence, which require greater design complexity and more thorough validation to ensure proper integration into existing application workflows.

These activities represent a significant step forward in the digitalization and continuous improvement of the energy certification process in Italy, promoting greater data uniformity, higher overall certificate quality, and closer collaboration among institutional bodies, technical experts, and industry stakeholders.

3.3 Regional Sampling Controls and Analysis of results

ENEA and CTI, during the preparation of this Report, invited individual Regions to collect and submit data and information on EPCs and the regional energy certification system. Among the requested data—besides the total number of EPCs and their distribution by energy class and/or disaggregated by parameters such as building use, climate zone, purpose, and construction period—particular emphasis was placed on information regarding controls carried out on EPCs issued in the previous year and the number of those subsequently invalidated.

It is important to note that Italy presents a highly diverse landscape in terms of quality control plans and procedures for energy performance certification, which are managed independently by each Region.
The current legislation (Legislative Decree 192/2005, Presidential Decree 75/2013, and Ministerial Decree 26/06/2015) establishes that controls must primarily target the most energy-efficient classes and must include:

- **Type A:** documentary verification of EPCs and compliance with the procedures outlined in the national guidelines (Ministerial Decree 26/06/2015);
- **Type B:** assessment of the consistency and accuracy of project or diagnostic data with the calculation procedure and expressed results;
- **Type C:** on-site inspection of the works or building.

The following table lists the Regions and Autonomous Provinces that implemented verification systems for EPCs issued in 2024 (total: 1,643,785), although not all types of controls (A, B, C) were carried out in every case.

Table 3.11
Submitted EPCs Verification 2024

	Total EPC 2024	Type A	Type B	Type C	Total EPC invalidated	% invalidated vs submitted EPC
Abruzzo	33.339	40.059	538	67	870	2,61
Basilicata	8.892	nd	nd	nd	nd	nd
Bolzano	6.166	56	nd	nd	nd	nd
Calabria	147.374	nd	nd	nd	nd	nd
Campania	104.391	nd	nd	nd	nd	nd
Emilia-Romagna	133.076	133.076	6.975	2.528	189	0,14
Friuli-Venezia Giulia	3.523	nd	nd	nd	nd	nd
Lazio	12.8855	2.634	136	nd	nd	nd
Liguria	56.524	1.130	nd	nd	nd	nd
Lombardia	308.430	nd	nd	nd	nd	nd
Marche	37.269	nd	nd	nd	nd	nd
Molise	5.570	nd	nd	nd	nd	nd
Piemonte	154.449	3.089	3.089	nd	nd	nd
Puglia	82.381	nd	nd	nd	nd	nd
Sardegna	nd	nd	nd	nd	nd	nd
Sicilia	105.570	nd	nd	nd	nd	nd
Toscana	107.935	1.919	879	nd	15	0,01
Trento	18.916	nd	nd	nd	nd	nd
Umbria	23.115	23.115	30	30	nd	nd
Valle d'Aosta	6.729	6.729	120	2	156	2,32
Veneto	140.241	nd	nd	nd	nd	nd

The previous table is not complete, as in many Regions one or more phases of the control procedures have not yet been concluded. In some Regions, the sampling of EPCs to be checked is carried out at the beginning of each semester of the following year. Therefore, at the time of drafting this Report, official and/or consolidated data on the EPCs subjected to control in 2024 are not yet available.

In almost all Regions that have implemented a control model (whether basic or advanced), the level of detail required for quality checks often causes delays in the verification of documents requested from certifiers whose EPCs are under review, significantly increasing the workload for inspectors.

ENEA, through its participation in ministerial technical working groups for drafting the regulations governing the preparation and verification of EPCs, has consistently worked to improve the quality of certificates. It contributes by proposing methodologies of varying levels of detail for all phases and types of control, suggesting a standard methodology that can be immediately applied in the Regions under its jurisdiction and easily scalable and extendable to the others.

To obtain a detailed overview of the procedures followed by the Regions for EPC controls in 2024, they were asked to provide information on:

- Statistical data on EPCs submitted to the registries and subjected to control;
- Regional regulations on the subject;
- Description of the sampling procedure used;
- Types of controls carried out and the entities responsible;
- The sanctioning plan for non-compliant certificates.

Below, by way of example only, is the contribution provided by the Abruzzo Region, which highlights the complexity of the entire process of control and analysis of the information contained in the EPCs.

3.3.1 Control Procedures Implemented by Abruzzo Region

In the Abruzzo Region, under Regional Law 32/2015 (as amended by Regional Law 50/2017), the Provinces are responsible for quality control of the energy certification service, while the Region retains regulatory authority.
A subsequent Regional Resolution established the “Operational Methodologies for Managing Quality Controls of the Energy Certification Service” for the provinces of Chieti, Pescara, Teramo, and L’Aquila, implemented through Technical Guidelines.
In accordance with current regulations, three levels of technical control have been defined. First-Level Control (applied to all EPCs submitted to the regional platform), It consists of documentary and technical checks concerning:

- Completeness of the certificate and all mandatory attachments
- Completeness of property identification data
- Compliance with procedures

- Verification of payment
- Presence of additional data and information required by regulations and law.

The second level of control, applied to a 2% sample selected with the support of ENEA, consists of a consistency check, including numerical verification, of the main energy efficiency indicators:

- Verification of the consistency and numerical accuracy of key energy performance indicators;
- Validation of data used for certification and the results reported in the EPC, including recommendations.

The sample is selected randomly via software, with priority given to the most energy-efficient classes.

Third-Level Control includes:

- Pre-inspection phase: analysis of EPC documentation, data processing, and planning of on-site inspections;
- Post-inspection phase: analysis of collected data, determination of outcomes, and drafting of control reports and any necessary measures

The four provinces in Abruzzo adopted similar approaches using different software tools and extracting different reference indices from the Regional EPC Portal. The following example focuses on the activities and results from the Province of Pescara, which are representative of the other provinces.
First-level controls may identify issues of a documentary, administrative, or technical nature, and each EPC may be subject to multiple findings.
Administrative checks may reveal deficiencies and/or anomalies as indicated in Table 3.12.

Table 3.12
Administrative Controls

Document / data to be checked	Anomalies	Management outcome
XML file versione (art.7, comma 2, lettera a) of the Regional Regulation	XML file in reduced format (version 12): the certifier is requested to transmit version 5 (extended version)	If requested, failure to transmit XML file version 5 of the within the indicated timeframe will result in the initiation of the APE expiry procedure.
Mandatory attachments (art.7, comma 2, lettere b,c,d of the Regional Regulation)	Missing or invalid or partially completed system booklet: the certifier is requested to send or integrate the booklet. The certifier must take an active part in drawing up or having drawn up and sending the requested document. Missing or invalid RCEE: the certifier is requested to send a valid RCEE (valid means referring to the current Thermal System Verification campaign or at most to the previous one). Missing or incomplete self-declaration pursuant to DPR 445/2000 of absence or deactivation of the thermal system: the certifier is requested to correct and/or integrate the documentation.	Failure to integrate, within the indicated terms, the required documentation if missing or inconsistent or in the case of corrupted or otherwise unreadable files, will result in the initiation of the APE expiry procedure.
Payment of the fee amount	Fee payment not made, invalid IUV used, multiple use of IUV: request to the certifier to regularize the payment.	Failure to regularize the payment of the fee, within the indicated terms, will lead to the initiation of the APE expiry procedure. At the same time, the certifier’s access to the Regional APE System will be suspended until the payment is regularized.
Certifier identification data	Lack of the unique identifier assigned to the certifier by the Regional APE System or other data relating to the certifying entity: the certifier is requested to integrate the missing information. Non-existence of the requirements prescribed by the legislation in force: the certifier is requested to transmit evidence of the requirements referred to in art. 3 of the Regional Regulation.	Failure to integrate the requested information within the indicated terms will result in the initiation of the APE expiry procedure and the suspension of the certifier's access to the Regional APE System.

Technical Controls are described in the following Table 3.13

Table 3.13
Technical checks

APE section	Parameter	Check level
GENERAL DATA	intended use	I
	subject of the certificate	I
	identification data	I and II
	Energy services	I
OVERALL ENERGY PERFORMANCE OF THE BUILDING	Energy Performance class	I and II
	$EP_{gl,nren}$	I
	Energy Performance class reference building	I
	$Ep_{gl,nren}$ reference building	I
	$EP_{gl,nren\ reachable}$ / $EP_{gl,nren}$	I
	minimum Energy Performance class verification	II
ENERGY PERFORMANCE SYSTEMS AND ESTIMATED CONSUMPTION	$EP_{gl,nren}$	I
	$EP_{H,nren}$	II
	$EP_{C,nren}$	II
	$EP_{W,nren}$	II
	$EP_{L,nren}$ (non-residential only)	II
	CO^2 emissions	I
RECOMMENDATION	$EP_{gl,nren}$ reachable and type of intervention(s) recommended	I
OTHER GENERAL ENERGY DATA	Energy exported	I
OTHER DETAILED DATA OF THE BUILDING	S/V	II
	Vl/Su	II
	Winter energy performance	I
	Summer energy performance	I
	$EP_{H,nd}$	II
DETAILED SYSTEMS DATA	ηH	II
	ηC	II
	ηW	II
SITE INSPECTION AND ENTRY DATA	Mandatory inspection	I
	Mandatory inspection date. < APE registration date	I

This first type of control highlights anomalies that can be grouped as shown in Table 3.14

Table 3.14
Types of Anomalies Identified

N	Types of Anomalies	Number of EPCs
1	Mandatory attachments	1.569
2	Year of renovation/construction	58
3	Energy Performance class and standards	56
4	DPR412 classification	81
5	Consumption	196
6	Cadastral data	6
7	Geometric data	877
8	System efficiency	542
9	Dispersing elements	3.128
10	Calculation data	3
11	Recommended interventions technical inconsistency	194
12	Recommended interventions numeric inconsistency	98
13	Reasons and Type of Intervention	552
14	Payment/billing	579
15	Procedures and methods	354
16	Heat exchange	145
17	Energy services	788
18	Software	13
19	Mandatory inspection	107
20	Cadastral registry errors	193

The results are consistent across the various provinces, with the highest number of findings recorded in the categories related to heat-dispersing elements, mandatory attachments, and geometric data.
It should be noted that first-level controls apply to all EPCs submitted to the regional platform and therefore refer to the 2024 reporting year. According to the regional regulation, the sample of certificates to be subjected to second-level controls is extracted during the first and second semesters of the year following the reference period (in the first and second semesters of 2024, samples were extracted for EPCs submitted between 01 January 2023 and 31 December 2023).
During the execution of second-level controls, each selected certificate is assigned a non-compliance score.
To this end, buildings are grouped into age classes, based on the evolution of regulations on building energy efficiency. The age classes are defined according to the breakdown shown in the following table:

Table 3.15
Building Age Classes

Class	Criteria	Reference year	Reference law
V1	<=1975	Ante 1975	(Legge 373);
V2	>1975 and <1993	1975-1993	(D.P.R. 412/1993);
V3	>=1993 and <=2005	1993-2005	(D.lgs. 192/2005);
V4	> 2005 and <=2011	2005-2011	(D.lgs. 28/2011);
V5	> 2011 and <= 2015	2011-2015	(D.M. 26-06-2015);
V6	> 2015	> 2015	

For each building age class, the maximum, average, and minimum values are calculated for 38 parameters, including the thermal transmittance of all opaque surfaces, transmittance of all thermal bridges, performance indices, efficiencies, and energy demands for each of the present energy services, as well as other parameters characterizing the energy behavior of the certified building.
Based on the activities carried out, the extracted certificates are distributed among the age classes as shown in Table 3.16.

Table 3.16
Distribution of EPCs by Building Age Class

Aggregate class	Reference year	Number selected
V1	Ante 1975	25
V2	1975-1993	17
V3	1993-2005	22
V4+V5	2005-2011+2011-2015	23
V6	>2015	44

Subsequently, 87 EPCs are eligible for review, disaggregated as shown in Table 3.17

Table 3.17
EPCs Eligible for Review by Age Class

Class	Number
V1	20
V2	12
V3	12
V4 + V5	13
V6	30

Summary of Control Outcomes:

- EPCs revoked due to failure to submit required documentation: 44
- EPCs subject to third-level control based on ranking: 38
- EPCs with positive outcome (below 50th percentile, no further action required): 38
- EPCs requiring clarification (between 43rd and 50th percentile or missing dispersing elements): 11

As with the timing of second-level controls, third-level controls also follow a one-year time shift. Therefore, in 2024, third-level checks were carried out on EPCs from 2022 that were deemed suitable for further investigation.

The third-level controls focused on cadastral data, building use, reason for issuance, available attached documents, building dimensional data, external heat losses, energy services, performance and efficiency indices, and the consistency and feasibility of the recommended interventions.

These controls resulted in the following outcomes, with corresponding reasons:

Table 3.18
Control Outcomes

Outcome	NUM	%
Revocation	42	67,7%
Positive	20	32,3%

Table 3.19
Details of Control Outcomes

Revocation's Reason	NUM	%
MATERIAL ERROR	2	3,2%
MATERIAL ERROR IN CADASTRAL COORDINATES	1	1,6%
CHANGES TO THE PROPERTY UNIT	11	17,7%
UNABLE TO PERFORM SUPPLMENTARY CALCULATION	1	1,6%
INSPECTION NOT POSSIBLE	21	33,9%
FAILURE TO PRIVIDE REQUESTED CLARIFICATIONS	6	9,7%
POSITIVE	20	32,3%

4

The roadmap towards the establishment of a National Unified Cadastre (Land Registry)

The revision of Presidential Decree (D.P.R.) 74/2013, currently under discussion at the State-Regions Unified Conference, assigns ENEA the task of developing the National Thermal System Register, to be integrated with SIAPE (Italian National Informative System on Energy Performance Certificates), the current national tool for collecting Energy Performance Certificates (EPCs). This evolutionary path will lead to the establishment of the National Unified Energy Register (CEU), integrating the two existing registers. This will require progressive digitalization and constant updating of the two currently existing regional registers: the EPC Register and the Thermal System Registers (CITs), which manage data related to the building stock.

Currently, most Italian regions have adopted their own EPC Register, while some are still developing their CIT. A data exchange standard for EPCs has been in use for about a decade, where as the standardization of the XML files and XSD schemas for the plant booklet, developed by ENEA, is still under validation in the regions that have requested its implementation. This standardization can be extended nationwide through a testing and validation process in collaboration with the Italian Thermotechnical Committee (CTI). The final step towards full operation of the CEU will be the integration of the two national registries, made possible by the adoption o fa unique cadastral identifier, provided by the Revenue Agency's Cadastre.

4.1 Revision of D.P.R. 74/2013: Impact on SIAPE and genesis of the National Unified Energy Register (CEU)

The enactment of the regulation that will replace D.P.R. 74/2013—which defines general criteria for the operation, management, control, maintenance, and inspection of thermal systems for winter and summer climate control and for the preparation of domestic hot water—introduces substantial changes that require careful consideration regarding their impact on the reorganization of Thermal System Registers (CITs).Every significant regulatory change, whether at the national or regional level, affects the organization of the relevant systems, whether digital or paper-based. For example, not only digital management applications but also paper-based procedures for protocol and archiving may require adjustments.

Some issues may arise in "first-level" registers used by Competent Authorities, i.e., systems that allow for the entry and management of plant data, some of which will inevitably need to be reorganized both technically and digitally. One of the goals of the new regulation is to simplify procedures and reduce the amount of data to be recorded. In contrast, "second-level" regional registers, which only collect data from Competent Authorities, should not be significantly affected.

The following section analyzes the commonalities and key differences between the current D.P.R. 74/2013 and the provisions in the draft of the new regulation, along with suggestions for how existing registers might be adapted. These changes will impact CIT systems to varying degrees and, consequently, the design and implementation of the CEU.

1) Hybrib Systems (definition absent in D.P.R. 74/2013):

It is necessary to introduce the ability to register this type of system in the CITs, as they have specific characteristics that are incompatible with the current data entry methods.

2) Total Nominal Useful Power and System Booklet:

The concept of total nominal useful power is introduced to define which systems must be registered in the system booklet and thus in the CITs. Specifically, if this power—calculated as the sum of the nominal useful powers of individual appliances within the same property unit that can operate simultaneously—is less than 10 kW (5 kW for systems with solid fuel generators), the system is not required to have a booklet. While this does not conflict with the current CIT version, the new registration methodology will affect the overall integrity of the register, since currently all thermal systems must be registered regardless of their nominal power.

3) System manager:

In the event of a change, the new manager must notify the Competent Authority within 30 days (a procedure not included in the previous decree). Many regions have already adopted this practice, even though it was not explicitly required, while others will need to at least include a warning in their system entry procedures and activate automatic checks to trigger inspections if deadlines are not met.

4) System Registration and Energy Efficiency Checks:

Energy efficiency checks—and thus the submission of the Energy Efficiency Control Report (RCEE) to the Competent Authority via the CIT—are only required for systems with at least one generator with a nominal useful power of 20 kW or more (10 kW for solid fuel systems).

Currently, checks are required for winter climate control systems over 10 kW and summer systems over 12 kW. This change complicates CIT management, as power thresholds are tied to automatic controls that require the entry of each new system and its corresponding RCEE. Therefore, the document entry process must be revised to accommodate inspections.

5) Mandatory Cadastral Data in RCEE and Booklet:

The RCEE must include the cadastral data of the property unit. While this was not required in the current decree, some regions had already made it mandatory in the system booklet to enable communication with the EPC register. Interoperability is ensured by shared data in both EPC and CIT registers—specifically, cadastral data as defined by the Revenue Agency. Thus, entering cadastral data in the CITs will become mandatory. The new decree will also require RCEE templates to be updated to include this data.

6) Requirements for Solid Biofuel Generators and District Heating Substation Exchangers:

Previously, these types of generators were not subject to efficiency checks due to the lack of applicable UNI 10389 standards. These standards are now available (parts 2 and 4), and CITs must be updated to compare legal minimum efficiency values with actual measurements.

7) RCEE Verification:

Competent Authorities will now perform document checks only on a sample of systems with a nominal useful power of 20 kW or more. Previously, checks were required for winter systems over 10 kW and summer systems over 12 kW. This change will reduce the number of checks recorded in the CIT and eliminate historical analysis for these systems.

8) Inspections by Competent Authorities:

Inspections will be conducted on systems flagged for violations (including by administrative or judicial authorities) and on systems over 70 kW that:

- Failed document checks
- Use solid fuel generators
- Have generators older than 15 years

The process begins with a PEC or registered letter to the system manager. This procedure is not included in the current decree, and regional regulations will need to be revised accordingly.

9) Exemption from Inspections:

Thermal systems with automation and control systems compliant with class B of UNI EN ISO 52120-1 are exempt from inspections (unless flagged or failed document checks). CITs must be updated to reflect this exemption.

10) Interconnection Between EPC and CIT Registers:

Regions must promote the interconnection of the Thermal System Register with the building's EPC register. Although not required by D.P.R. 74/2013, this need has been recognized in legislation for years (e.g., Italian Ministerial Decree of 10 February 2014, Interministerial Decree of 26 June 2015, and Legislative Decree 48/2020). Some regions have already implemented this. The creation of the national unified register will make this integration essential.

11) Implementation Timeline:

Within 24 months of the new regulation's entry into force, ENEA will establish a national information system for thermal systems integrated with SIAPE. This was not required by the current D.P.R. 74/2013. Regional implementation will simplify national interconnection. ENEA is already assisting regions in integrating their CITs with the EPC register.

It follows that, despite the need to adapt local registers to the new legal provisions, the revision process of Presidential Decree 74/2013 represents a strategic opportunity to promote convergence toward uniform and interoperable registration models, aimed at creating a national information infrastructure aligned with the principles of administrative efficiency and data transparency.

In recent years, ENEA and the Italian Thermotechnical Committee (CTI) have carried out in-depth monitoring and analysis activities regarding the implementation and functioning of the energy cadastre systems adopted by the Regions and Competent Authorities. These activities have revealed a highly fragmented and inconsistent landscape across the national territory, which hinders the full integration between the Thermal System Register and the Energy Performance Certificate (EPC) system, as envisaged by the simplification and interoperability goals established by legislation.

Therefore, it is believed that the issuance of the new provisions revising D.P.R. 74/2013 could offer a real opportunity to overcome these limitations.

4.2 Management and Use of Cadastral Data at the National Level Provided by Revenue Agency

The Revenue Agency, in compliance with EU Directive 2007/2/EC of 14 March, 2007, which established the Infrastructure for Spatial Information in the European Community (INSPIRE), has made the following services available in the past for consulting cadastral maps in raster format (i.e., image-only geographic data):

- WMS cadastral map consultation, based on the Web Map Service standard, accessible via GIS (Geographic Information System) software or specific user applications;
- Cadastral cartographic geoportal, a platform that allows users to search and view parcels on the Land Cadastre map. Additionally, in line with the EU Open Data Directive, the following services have been made available in the past year for accessing information on parcels in vector format (i.e., original geographic data):
- WFS cadastral map, based on the Web Feature Service standard, accessible via GIS software or specific applications;
- Bulk download of cadastral maps, allowing users to download parcel data in bulk for entire territorial areas (national and regional).

These data are aligned with the cadastral cartographic database, which is continuously updated automatically through technical documents submitted by authorized professionals. Bulk download data is updated semi-annually. Maps under confidentiality constraints or undergoing maintenance are not published.

The consultation and use of cadastral maps are available under a CC-BY 4.0[1] license, and the Revenue Agency is the data owner. When using the data, proper attribution is mandatory.

The choice of cadastral data as a common, interoperable reference stems from the need to rely on a standardized dataset that is more reliable than other identifiers of a building/unit's location, such as address (street, number, ZIP code), or geographic coordinates (latitude, longitude).

The availability of cadastral data in open format and under a free-use license (CC-BY 4.0)—whether accessed online or via bulk download—represents a significant step forward in terms of transparency, interoperability, and reusability of public information. It provides an official, constantly updated national reference for interoperability across datasets related to a property unit, specifically the EPC data (already included) and the system booklet data (required by the revision of D.P.R. 74/2013), including Municipality Code, Section, Sheet, and Parcel.

1 For further information, see https://creativecommons.org/licenses/by/4.0/deed.en

4.3 Issues Encountered between Regions and Competent Authorities

To date, nearly all Italian regions have adopted their own Thermal System Register (CIT), and some also allow access to information through Open Data tools. As previously mentioned, ENEA is tasked with establishing the National Thermal System Register and is currently working to standardize territorial data so it can be easily integrated first into regional registers and later into the national one (as discussed in section 4.4).It is believed that a more clearly defined coordinating role for ENEA, established through implementing decrees based on the draft revision of D.P.R. 74/2013, could significantly help resolve the challenges faced by Regions and Competent Authorities (ACs) in creating a Unified Regional Register. Figure 4.1illustrates the status of CITs in Italy as of 30 April 2025[2].

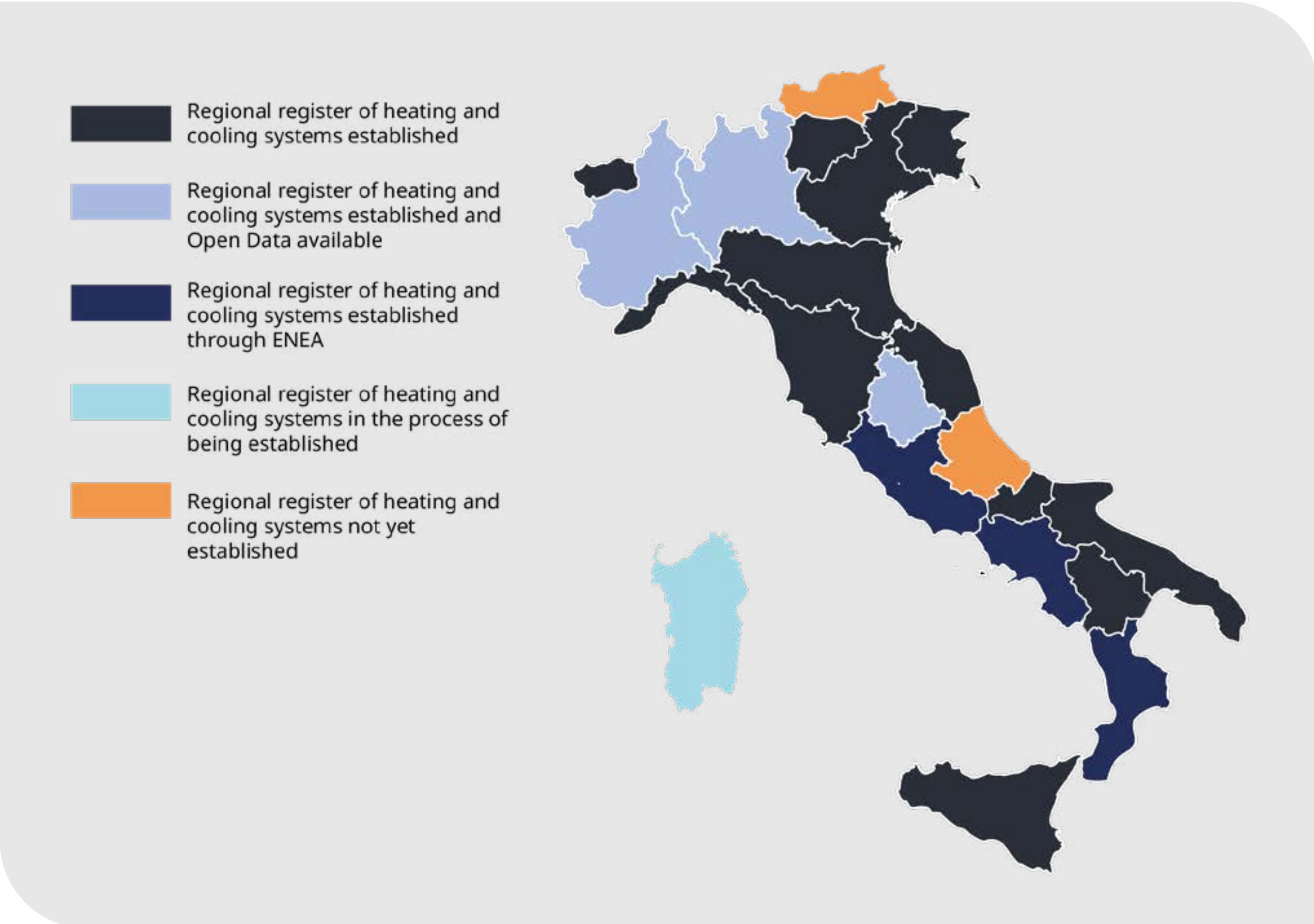


Figure 4.1
Situazione dei Catasti degli Impianti Termici al 30 aprile 2025

Competent Authorities (ACs) responsible for inspections and controls are designated by the Region or Autonomous Province through specific local regulations, and thus vary across regions. Generally, ACs remain those defined by Art. 11, paragraph 18 of D.P.R. 412/1993 (repealed by Legi-

2 In the Province of Bolzano, the thermal system register is managed offline by the Air and Noise Office of the Province. In the Region of Molise, the thermal system register includes data from the Energy Efficiency Inspection Reports and only Sheet No. 1 of the system booklet (Identification Sheet). In the Province of Trento, the thermal system register contains only the main data of the system (owner, person responsible, location, technical data).

slative Decree 192/2005 and amended by Legislative Decree 311/2006), i.e., municipalities with populations over 40,000, while provinces handle the rest of the territory.

By the end of 2024:

- There were 215 formally operational ACs across Italy, mainly municipalities with over 40,000 residents, and elsewhere, provinces or metropolitan cities
- An exception is the Veneto Region, where ACs are municipalities with over 30,000 residents, and the rest of the territory is managed by provinces and the Metropolitan City of Venice
- Of the existing ACs, 157 had an active CIT (at provincial, municipal, or regional level), while 58 did not
- Nationally, there are 31 types of CITs, including 15 regional and 16 provincial or municipal systems, managing highly heterogeneous data

ACs may also rely on an External Body to perform inspections, often represented by in-house companies, though not always. To integrate the National Thermal System Register with SIAPE, as required by the revision of D.P.R. 74/2013, strong coordination will be necessary to standardize data acquisition systems, which currently vary widely—especially in regions without a unified register and where multiple CITs are managed by ACs or delegated external bodies.

The national system will only be truly representative when all regions and their ACs have updated their local regulations in line with the new legislation. This will require a significant coordination effort, not only to standardize data acquisition systems but also to harmonize regulations, addressing any legal or regulatory gaps. Targeted actions will be needed to resolve territorial disparities between and within regions and among different ACs.

Following the enactment of the revised provisions, the optimized path toward establishing the National Unified Energy Register (CEU) must include:

1. Defining an effective digital transition plan for the data contained in:

- System Booklets
- Energy Efficiency Control Reports (RCEE)
- Inspection reports by inspectors

2. Developing a single national standard for XML and XSD formats for data collection by Competent Authorities or external bodies. This will enable:

- Comparability of data across different regions
- The creation of meaningful reports on the status of regional and national thermal system stocks, as long envisioned by legislation

3. Creating a complementary management model to the Information System, enabling:

- Real-time monitoring of the implementation status of regional registers
- Proper mapping of Regions, Competent Authorities, and any External Bodies

4.4 Analysis of the main features of the XML for the System Booklet and the related Regional XSD Schema Applicable Nationally

As part of collaboration agreements between ENEA and several regions, regional Thermal System Registers (CITs) have been developed (section 1.5 analyzes experiences with Puglia, Sicily, Lazio, and Campania) to manage thermal systems and their technical attachments, such as Energy Efficiency Control Reports (RCEE) and inspection reports. The CIT serves as the regional operational tool for collecting data on systems within its jurisdiction, fed directly by the Competent Authorities, who are responsible for enforcing regulations on installation, maintenance, and operation of thermal systems. One of the most significant aspects of digitalization introduced with the CIT is data standardization. By adopting a homogeneous, non-redundant information model, the system ensures the inclusion of all key information necessary for data structuring.

Digital data management adds another layer of efficiency. Unlike physical documents, digital data can be easily preserved over time, maintaining consistency, integrity, and durability through modern backup and archiving systems. Additionally, digital tools allow for continuous updates—both technically (e.g., through software upgrades) and legally—enabling the evolution of data structures and content. Interconnected digital systems also automate many operations, such as retrieving information from external databases and pre-filling data from official sources.

To define a data model compliant with the XSD standard (XML Schema Definition), a structured process was undertaken to model the structure of the system booklet in use before the enactment of D.P.R. 74/2013. This step was essential to understand the differences from the new regulatory model and to ensure proper data migration and validation according to updated technical requirements.

The thermal system booklet is a technical-regulatory document composed of 14 sections, each collecting specific information about the system's configuration, management, and control. These sections include:

1. System identification
2. Water treatment
3. Appointment of third-party system manager
4. Generators
5. Regulation and metering systems
6. Distribution systems
7. Emission systems
8. Storage systems
9. Other system components
10. Mechanical ventilation systems
11. Results of initial and periodic checks
12. Energy efficiency control interventions
13. Results of periodic inspections by the competent authority
14. Consumption records

A new section 15 has recently been introduced to align the current ministerial model (DM 10 February 2014) with the inclusion of cadastral data for the property unit, in anticipation of the new decree replacing D.P.R. 74/2013, where cadastral data are an integral part of the data model.

These sections contain:

- Cadastral information of the property
- Technical characteristics of the systems and installed components
- Personal data of the owner and system manager

The implementation of the XSD schema required a preliminary analysis of the paper booklet sections to identify relationships between a system and its components. This led to the creation of an Entity-Relationship (E/R) model (Figure 4.2) representing the logical structure of the booklet.

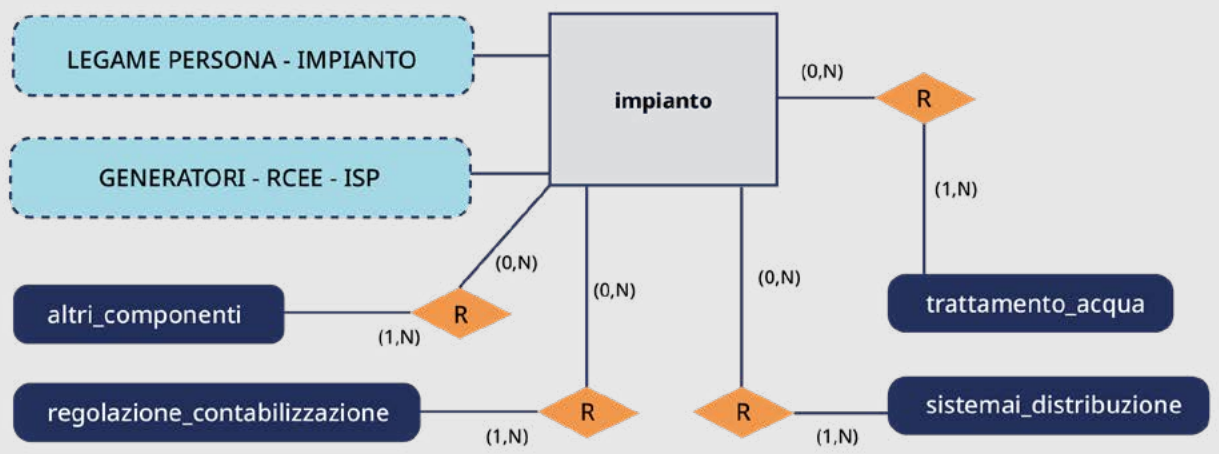
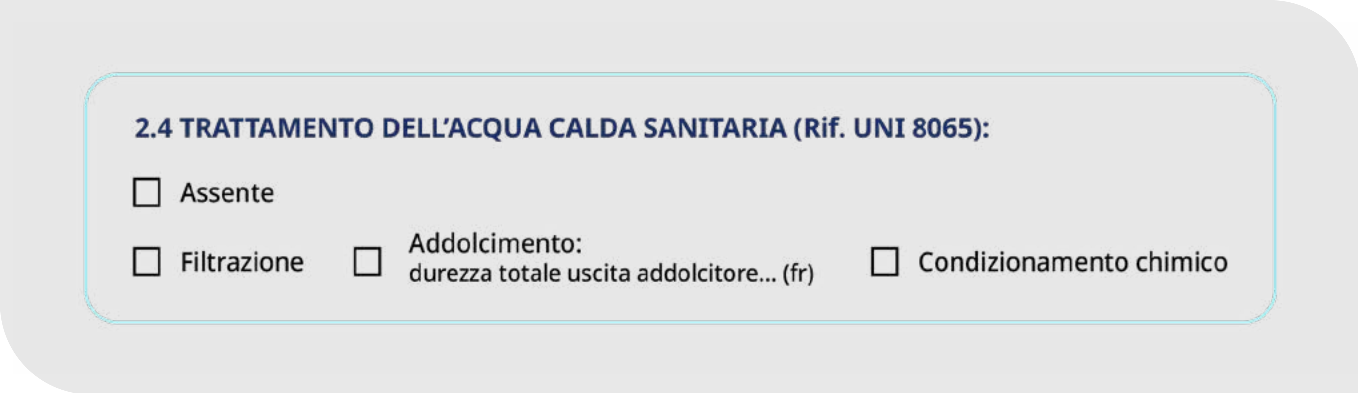


Figure 4.2
Excerpt of the E/R diagram of the system modeling

Following the conceptual modeling, the data contained in the booklet sections were rationalized and normalized to reduce redundancy and precisely define formats (e.g., numeric or alphanumeric) and data types. The analysis also included: Determining whether each section and field is mandatory or optional; Identifying technical dependencies between fields, i.e., values that depend on others. For example, in Figure 4.3, selecting the field “absent” implies that the fields “filtration,” “softening,” and “chemical conditioning” must not be filled in.



2.4 TRATTAMENTO DELL'ACQUA CALDA SANITARIA (Rif. UNI 8065):

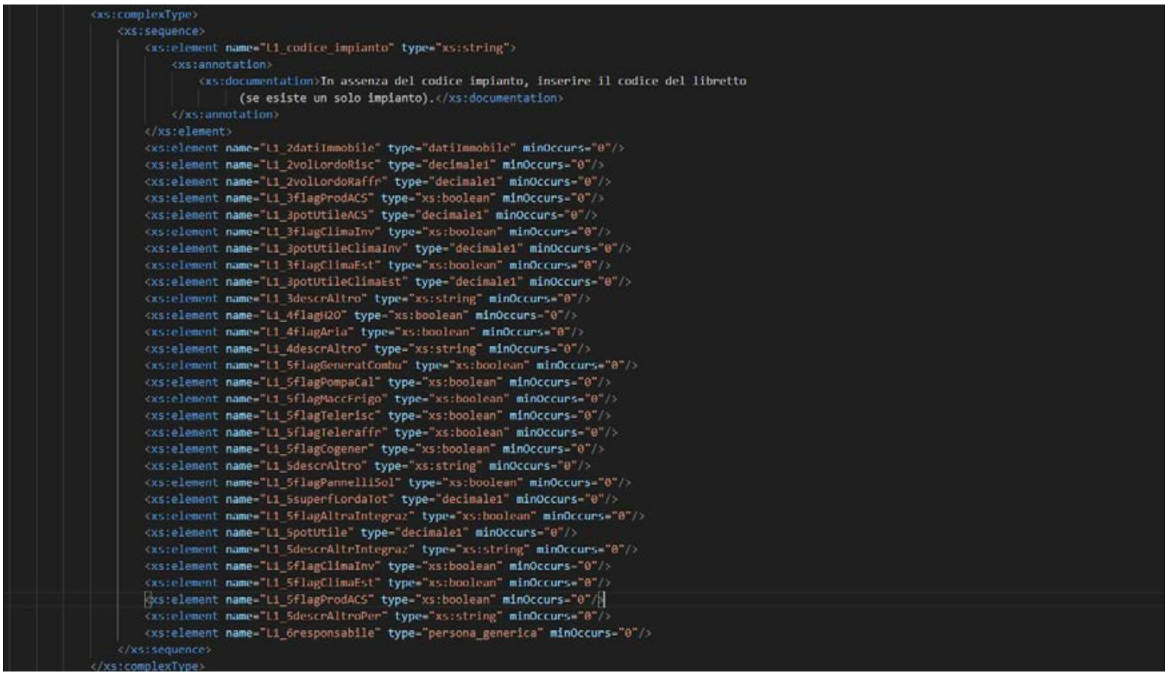
☐ Assente

☐ Filtrazione ☐ Addolcimento: durezza totale uscita addolcitore... (fr) ☐ Condizionamento chimico

Figure 4.3
Example of a conditional field related to the 'Water Treatment' section of the system booklet"

Such dependencies are not immediately evident from the structure of the booklet and must be inferred from a detailed analysis of the technical characteristics of the systems. This analysis was essential for two key purposes:

- The implementation of the XSD schema (Figure 4.4)
- The design of an interoperable database, compliant with ENEA standards and compatible with other information systems



```
<xs:complexType>
    <xs:sequence>
        <xs:element name="L1_codice_impianto" type="xs:string">
            <xs:annotation>
                <xs:documentation>In assenza del codice impianto, inserire il codice del libretto
                        (se esiste un solo impianto).</xs:documentation>
            </xs:annotation>
        </xs:element>
        <xs:element name="L1_2datiImmobile" type="datiImmobile" minOccurs="0"/>
        <xs:element name="L1_2volLordoRisc" type="decimale1" minOccurs="0"/>
        <xs:element name="L1_2volLordoRaffr" type="decimale1" minOccurs="0"/>
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        <xs:element name="L1_3potUtileACS" type="decimale1" minOccurs="0"/>
        <xs:element name="L1_3flagClimaInv" type="xs:boolean" minOccurs="0"/>
        <xs:element name="L1_3potUtileClimaInv" type="decimale1" minOccurs="0"/>
        <xs:element name="L1_3flagClimaEst" type="xs:boolean" minOccurs="0"/>
        <xs:element name="L1_3potUtileClimaEst" type="decimale1" minOccurs="0"/>
        <xs:element name="L1_3descrAltro" type="xs:string" minOccurs="0"/>
        <xs:element name="L1_4flagH2O" type="xs:boolean" minOccurs="0"/>
        <xs:element name="L1_4flagAria" type="xs:boolean" minOccurs="0"/>
        <xs:element name="L1_4descrAltro" type="xs:string" minOccurs="0"/>
        <xs:element name="L1_5flagGeneratCombu" type="xs:boolean" minOccurs="0"/>
        <xs:element name="L1_5flagPompaCal" type="xs:boolean" minOccurs="0"/>
        <xs:element name="L1_5flagMaccFrigo" type="xs:boolean" minOccurs="0"/>
        <xs:element name="L1_5flagTelerisc" type="xs:boolean" minOccurs="0"/>
        <xs:element name="L1_5flagTeleraffr" type="xs:boolean" minOccurs="0"/>
        <xs:element name="L1_5flagCogener" type="xs:boolean" minOccurs="0"/>
        <xs:element name="L1_5descrAltro" type="xs:string" minOccurs="0"/>
        <xs:element name="L1_5flagPannelliSol" type="xs:boolean" minOccurs="0"/>
        <xs:element name="L1_5superfLordaTot" type="decimale1" minOccurs="0"/>
        <xs:element name="L1_5flagAltraIntegraz" type="xs:boolean" minOccurs="0"/>
        <xs:element name="L1_5potUtile" type="decimale1" minOccurs="0"/>
        <xs:element name="L1_5descrAltrIntegraz" type="xs:string" minOccurs="0"/>
        <xs:element name="L1_5flagClimaInv" type="xs:boolean" minOccurs="0"/>
        <xs:element name="L1_5flagClimaEst" type="xs:boolean" minOccurs="0"/>
        <xs:element name="L1_5flagProdACS" type="xs:boolean" minOccurs="0"/>
        <xs:element name="L1_5descrAltroPer" type="xs:string" minOccurs="0"/>
        <xs:element name="L1_6responsabile" type="persona_generica" minOccurs="0"/>
    </xs:sequence>
</xs:complexType>
```

Figure 4.4
Excerpt of the XSD schema of the thermal system booklet

After defining the XSD standard, to enable the electronic transmission of system booklets, ENEA made available a data submission service via an API (Application Programming Interface) that accepts only XML files structured in accordance with the respective XSD schemas. This interface allows both the submission of data and their subsequent updates over time, thereby ensuring the continuous alignment of information related to thermal systems. Moreover, the transmission of the booklet can occur either as individual files or as multiple-file packages, making the entire process highly efficient. To support data consistency, the system performs a preliminary validation of the XML files against the expected XSD schema. In the event of inconsistencies or errors in the compilation, an error message is immediately returned, alerting the Competent Authority to any data discrepancies. This reduces the risk of errors and administrative non-compliance, while improving the reliability of the managed information.

Each intervention carried out on a system requires the submission of an updated version of the corresponding data set, always in XML format compliant with the XSD schema. Specifically, the CIT system must be updated via the dedicated API endpoint in the event of one or more of the following operations:

- Compilation of an existing booklet (full or simplified version);
- Compilation of the RCEE;
- Entry or modification of the responsible party’s or third-party manager’s personal data;
- Installation of a new system;
- Complete system renovation;
- Interventions based on checks by the competent authority’s validators or external body;
- Results of inspections carried out by the competent authority or external body;
- Decommissioning of an entire system;
- Addition or replacement of generators/accessory parts of the system;
- Decommissioning of generators/accessory parts of the system;
- Inspection test report;
- Registration of system consumption.

The data transmitted via the API are stored in a relational database, a robust and scalable data management system used for storing and managing the received information. Having separate transmission services for each update and modification operation offers numerous advantages in terms of clarity, security, maintenance, and scalability.

In conclusion, in accordance with the revision of D.P.R. 74/2013, which assigns ENEA the task of developing the National Thermal System Register as a centralized system for acquiring data from regional registers, it is clear that the standardization of XML files for the system booklet and their related XSD schemas, already adopted at the regional level, is a key element for the unification and efficiency of the national thermal system management system. The extension of this standardization to the national level is technically feasible through the implementation of a testing and validation protocol, to be carried out in collaboration with the Italian Thermotechnical Committee (CTI), in order to ensure interoperability and data consistency at the national level. The availability of homogeneous data nationwide paves the way for more accurate statistical analyses and the development of shared strategies for energy efficiency and emission reduction.

4.5 Stato di avanzamento delle esperienze pilota (Sicilia, Puglia, Lazio, Campania)

The issues identified in previous years are essentially confirmed. Particular attention was given to the Regions that have initiated pilot projects for the adoption of a Unified Energy Register, integrating information from EPCs and thermal systems. For these experimental initiatives, operational solutions were proposed to support data standardization and interoperability, along with recommendations for defining a shared standard for submitting information to the National Register of Thermal Systems, with the aim of supporting a coherent and federated information architecture. Among these, noteworthy are the suggestions for implementing, through appropriate regional regulatory measures, an additional page in the system booklet containing the cadastral data of the building served by the system.

The pilot experience began with the Lazio Region, the first to adopt ENEA's APE-R (Regional EPC) platform in 2018, followed by Puglia in 2020, Sicily in 2021, and more recently, Campania starting in November 2024. As for the Thermal System Register, service activation requests from the regions came at a later stage. In this context, operational complexity is heightened by the high fragmentation and heterogeneity of the collected data, as well as the multiplicity of institutional actors involved in the process of data transmission and updating. Currently, ENEA has made available the services for acquiring thermal system data from Competent Authorities only in the regions of Puglia, Sicily, and Campania.

Among these, only in Puglia have some Competent Authorities actually started transmitting data to the regional CIT. However, most submissions have been made in simplified mode, using only a minimum set of mandatory data. Table 4.1 presents the data submissions from the main Competent Authorities in Puglia.

Table 4.1
Number of systems transferred by the main Competent Authorities in the Puglia Region

Autorità Competente	Numero Impianti Trasferiti
Provincia di Foggia	72.331
Comune di Foggia	52.548
Provincia di Taranto	153.679
Comune di Brindisi	10
Provincia di Lecce	254.228

It is worth highlighting that the Province of Taranto is the only one to have transmitted both the complete data related to thermal systems (in the non-simplified version) and 80,610 Energy Efficiency Control Reports (RCEE), thus making a substantial contribution to the population of the regional CIT.

As for the Campania Region, a dedicated organizational and technological structure is currently being implemented to enable the structured, systematic, and compliant transmission of information to the register, with the goal of ensuring data uniformity and quality. At the same time, the Lazio Region, with the technical and operational support of ENEA, is finalizing the procedures necessary to activate its own CIT system, which is expected to be operational shortly. It is important to emphasize that regional unified registers can only be considered fully operational once they are simultaneously populated, in a complete and coherent manner, with both EPC data and thermal system data. This condition is essential for effective territorial energy management, based on reliable, integrated, and easily accessible information for Competent Authorities. Until then, the Thermal System Registers and their integration with the EPC register, although active and usable, will have limited representativeness.

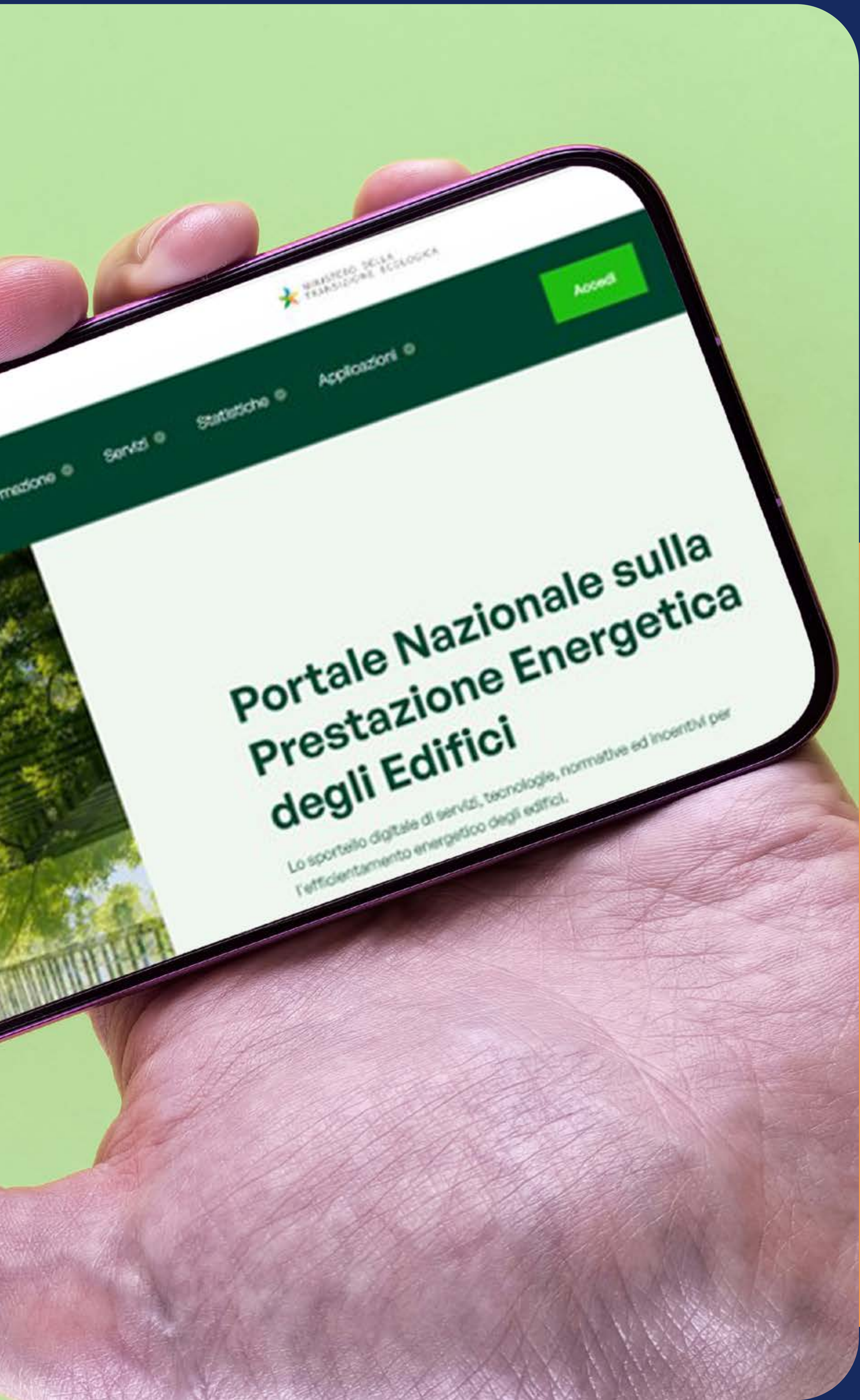
4.6 Further Developments and Critical Issues

The process of revising Presidential Decree 74/2013 and the resulting establishment of the National Unified Energy Register (CEU) represent a fundamental step in the evolution of thermal system management in Italy. ENEA will be responsible for building a centralized system that collects and organizes data from all regions, integrating it with SIAPE, the existing system for collecting Energy Performance Certificates (EPCs). This new approach will enable a transition from the current fragmented and inconsistent management model to a more coordinated, efficient, and user-friendly system. The goal is to have a single, reliable, and up-to-date national database that simplifies the work of authorities and improves the control and quality of information on thermal systems, effectively supporting energy and environmental policies.

In particular, the analysis conducted in this chapter has highlighted how the standardization of XML and XSD formats for the System Booklet and RCEE forms the technical foundation for ensuring data consistency and quality. The adoption of these standards, already successfully tested in some regions, enables not only the Automation of data transmission and updating processes, but also a strong Reduction of errors, and the increasing of reliability of information.

From an operational perspective, the pilot experiences in Puglia, Sicily, Lazio, and Campania demonstrate that, although the transition requires significant coordination among regions, Competent Authorities, and external bodies, it is technically feasible. However, the full operation of the national system will depend on the ability to overcome current territorial disparities, harmonizing regulations, procedures, and IT tools. A key element for successful integration is the use of official cadastral data provided by the Revenue Agency, which ensures a unique and up-to-date reference for interoperability between registers. The availability of these data in open format and under a free license (CC-BY 4.0) represents a concrete opportunity to enhance transparency and traceability of energy information.

In conclusion, the creation of the CEU is not just a regulatory requirement, but a strategic opportunity to build a national information system that is efficient, transparent, and sustainability-oriented. Digitalization, standardization, and data interoperability are the pillars on which to build a modern energy governance system capable of supporting effective public policies and addressing the environmental and technological challenges of the coming years.


MINISTERO DELLA TRANSIZIONE ECOLOGICA
Accedi
Servizi
Statistiche
Applicazioni
Portale Nazionale sulla Prestazione Energetica degli Edifici
Lo sportello digitale di servizi, tecnologie, normative ed incentivi per l'efficientamento energetico degli edifici.

5

The National Portal on the Energy Performance of Buildings: renewed interface and new features

The national Portal on the Energy Performance of Buildings (PNPE[2] in Italian), developed by ENEA, aims to support the planning process for energy renovation of buildings through the integration of data, tools and advanced functionalities. Its new graphical interface, accessible and intuitive, has been designed to improve user experience through simplified navigation.

One of the main tools offered by PNPE[2] is the "Building Passport", which collects, organizes, and makes accessible all technical and energy-related information for each housing unit. The Passport is like an "energy-cadastral identity card" of the building, useful both for citizens aiming to improve the performance of their housing unit and for technicians and public administrations planning actions on a broader scale.

The "Compare Building Unit" functionality of the Passport provides the distribution of already renovated units' energy performance classes among similar, for some features, to own. This helps to better understand the energy performance and improvement potential of their own building.

The Expert System for Energy Performance (SEPE in Italian) is another Passport functionality that suggests single or combined energy retrofitting actions, providing estimates on energy savings, achievable energy performance class, and environmental and economic impacts. SEPE thus serves as a guide for programming public energy policies and sustainable building planning in both public and private sectors.

5.1 The PNPE² building passport

The decarbonisation targets for European buildings by 2030, as set out in the revision of the Directive European Directive on the Energy Performance of Buildings (Energy Performance of Buildings Directive - EPBD IV[1]) requires for the use of monitoring and planning tools. These include the Building Renovation Passport (BRP) and the Digital Building Logbook (DBL), already introduced in 2020 with the Renovation Wave initiative[2]. These tools define an integrated information ecosystem that tracks the life cycle of a building by collecting detailed, structured and standardised data on the energy and construction characteristics of properties. Their digitalization transforms them into dynamic resources that are easy to consult and accessible to key stakeholders in the building sector. In this way, digital archives become strategic tools for more efficient planning of actions aimed at improving energy performance.

In Italy, the "Building Passport" (hereinafter referred to as the Passport) is an example of DBL a realization. It has been implemented as part of the National Portal on the Energy Performance of Buildings (PNPE²), developed starting on April 2022 by ENEA, in compliance with Legislative Decree 48/2020[3] which assigns ENEA the task of "providing citizens, businesses and public authorities with information on the energy performance of buildings, best practices for cost-effective energy refurbishment, and existing promotion tools for improving the energy performance of buildings"[4].

The PNPE² is configured as an integrated digital reference point (digital One Stop Shop (OSS)) for the management and analysis of the national building stock. Through systematic, transparent and structured data collection, PNPE² provides users – citizens, enterprise companies and public administrations – with centralised access to up-to-date information on the energy performance of buildings.

From PNPE² it is possible to consult:

1. Data on incentives and financing tools, such as:

- Available financial benefits (such as Ecobonus, Superbonus, Conto Termico in Italian)
- National and European funds for energy efficiency renovation
- Financing opportunities for citizens and public administrations

2. Legislative acts, such as:

- Current regulations on energy performance and building renovation
- Technical and administrative requirements for access to incentives
- Guidelines for energy efficiency

3. Statistical data, including:

- Geographical distribution of EPCs and ENEA financial bonus.

1 EU directive 1275/2024

2 https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/renovation-wave_en

3 https://www.gazzettaufficiale.it/eli/id/2020/06/10/20G00066/sg

4 Legislative Decree. 48/2020, art. 8, comma 1

The PNPE^2 is a tool that supports the planning of energy renovation measures through the Passport functionalities. The latter is like an 'energy-cadastral identity card' for the building unit, which also provides citizens and public administrations with comparison and guidance functions in the process of improving the energy efficiency of the building stock. Through targeted analyses and simulation tools, the Passport helps users identify the most suitable technical and technological solutions for improving energy efficiency and assessing the impact of interventions in terms of costs, benefits and emissions reduction. The Passport is therefore an innovative and strategic tool that centralises and simplifies the management of energy and cadastral information.
Furthermore, by integrating data and information about the national building stock, the Passport enables monitoring by planning authorities.
In the last year, Passport services have taken on a new graphical interface, involving the entire PNPE^2 (Figure 5.1).

Figure 5.1
Home PNPE^2, new graphical interface

The interface has been fully redesigned to offer a modern and minimalist digital environment, enhancing both user experience and usability. The new layout simplifies access to features and ensures more intuitive navigation. By adopting a user-centred design approach, the platform aims to better meet the needs of end users and improve overall usability. The brand identity was designed to clearly express the values of energy efficiency and sustainability. The green colour palette and image choices were selected to evoke buildings in harmony with the surrounding ecosystem. Each graphic element reflects the idea of energy transition and eco-friendly architecture.

The Passport user experience has also benefited of a semantic structuring of content, organised into the following sections (Figure 5.2):

- Building unit (“Unità immobiliare” in Italian)
- Energy (“Energia” in Italian)
- Systems (“Impianti” in Italian)

- Financial bonus (Bonus fiscali” in Italian)
- Building renovation (“Riqualificazione unità immobiliare” in Italian).

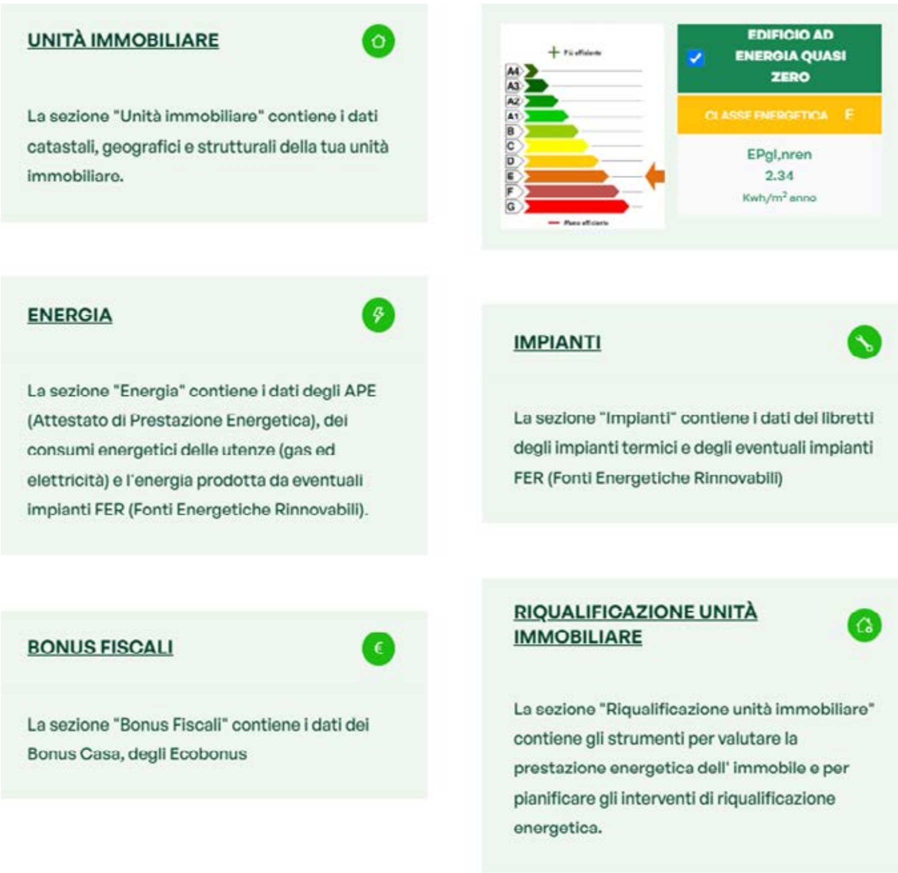


Figure 5.2
Building passport

The section “Housing unit” ("Unità immobiliare" in Italian) (Figure 5.3) collects key information about the building, such as:

- Cadastral details, such as section, sheet, parcel and year of building
- Geographical location, indicating the municipality and address
- Graphic representation, with a two-dimensional map showing the geometry of the building.

This section contains information relating to the cadastral identity and location of the building, extracted from the ENEA incentives bonus database[5].

5 Bonus Fiscali ENEA https://bonusfiscali.enea.it/

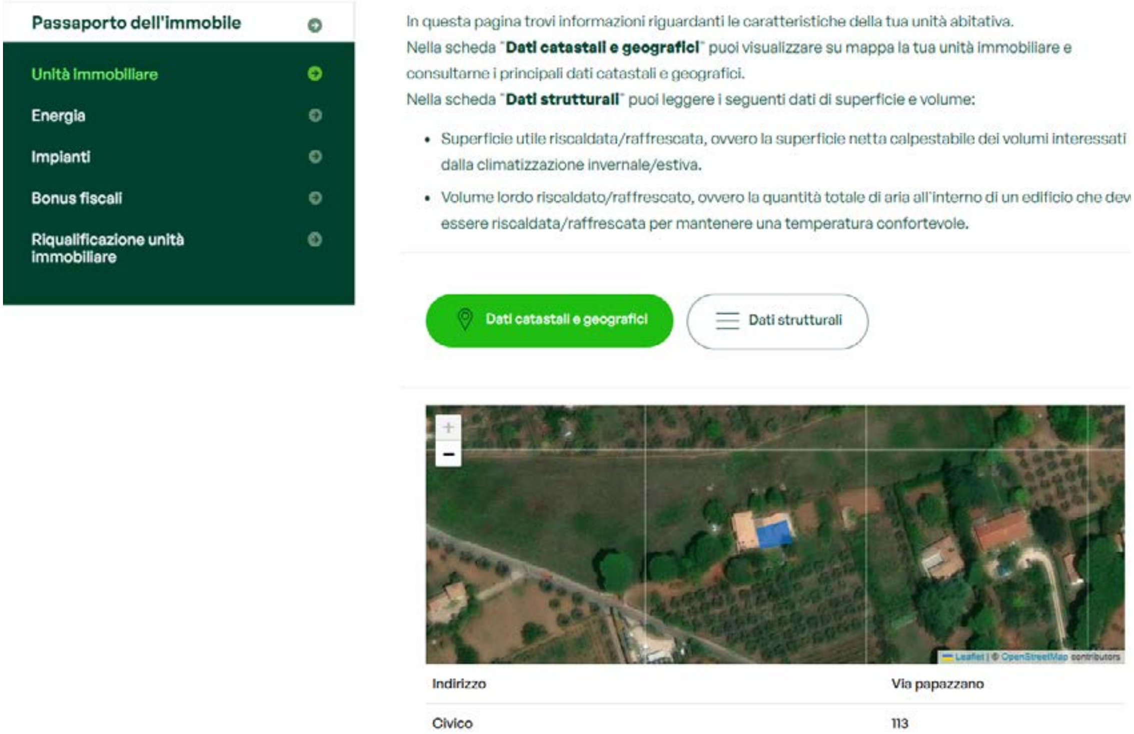


Figure 5.3
“Housing unit” section

The section “Energy” (“Energia" in Italian) (Figure 5.4) provides a detailed overview of the energy performance of each building unit. From this section, users can consult:

- The last valid EPC
- Energy efficiency indicators, including energy performance class and energy performance values for renewable and non-renewable sources ($EP_{gl,nren}$; $EP_{gl,ren}$)
- CO_2 emissions data, for an assessment of the building's environmental impact.

These data, extracted from “Italian National Informative System on Energy Performance Certificates” (SIAPE[6] in Italian), allow the energy characteristics of the building unit to be monitored and analysed. The Passport provides citizens with the digital format of the most recent EPC for the building, offering a service that no other institutional platform currently offers.

6 SIAPE https://siape.enea.it/

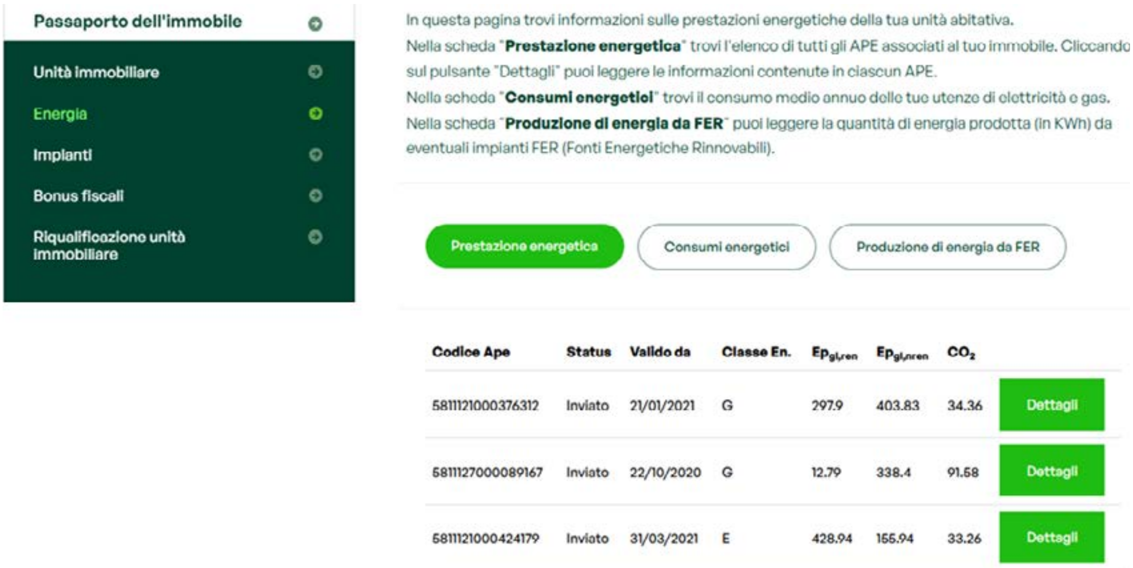


Figure 5.4
"Energy" section

The section “Financial bonus” ("Bonus fiscali" in Italian) (Figure 5.5) contains a list of ENEA financial bonus that the user has benefited from, such as:

- Bonus Casa
- Ecobonus
- Superbonus.

This section provides an history of benefited incentives, broken down by type, reporting information available from the ENEA financial incentives databases.

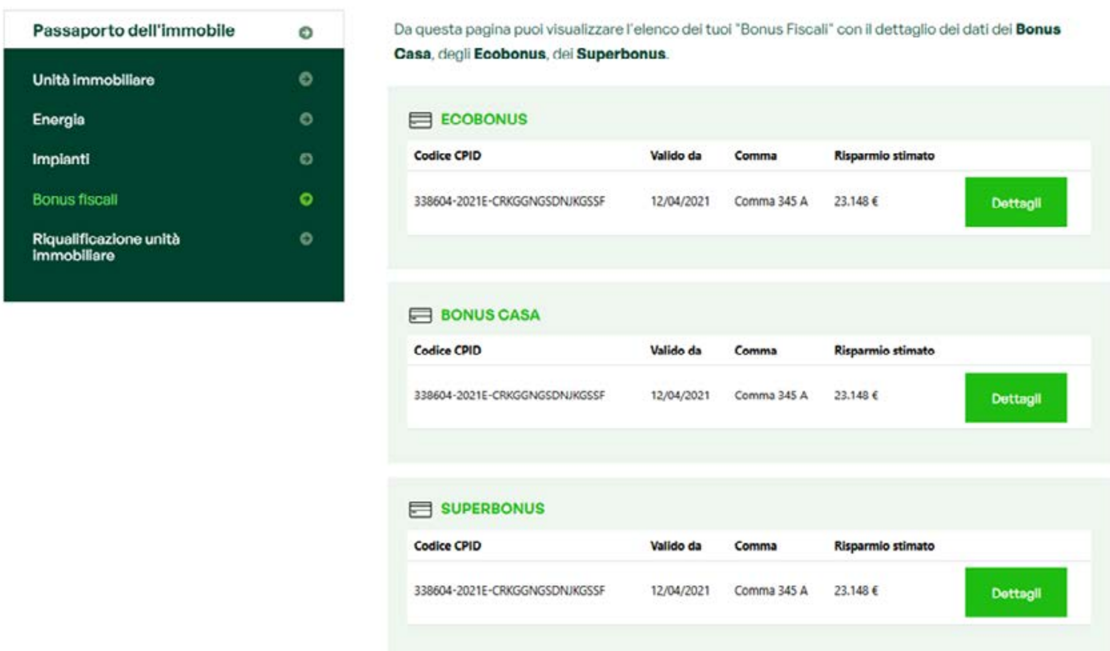


Figure 5.5
"Financial bonus" section

The section “Systems” ("Impianti" in Italian) (Figure 5.6) has two sections: “Heat systems” ("Impianti termici" in Italian) and “RES systems”[7] ("Impianti FER" in Italian). In the first, there is the list of all heating systems in the specific building. This section supplies a detailed overview of the systems, such as the type of system, its location, technical characteristics and operating status. This allows the status monitoring of the systems, facilitating maintenance and therefore optimal operation.

The above information will be extracted, where available, from the Italian unified energy cadastre system (“Catasto Energetico Unico” in Italian) (Chapter 4), which has already been implemented and is currently undergoing data integration and updating.

The "RES systems " tab is currently being designed, and it will contain a list of RES systems, if they are.

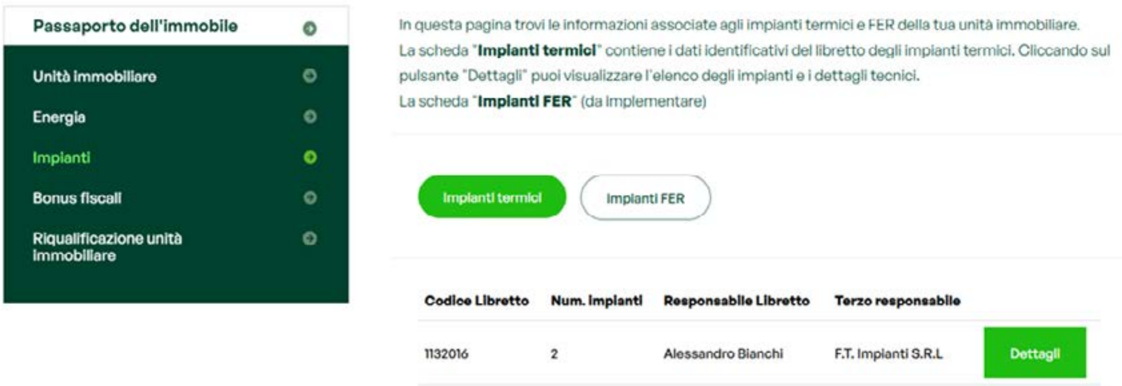


Figure 5.6
"Systems" section

Finally, the section “Renovation housing unit” ("Riqualificazione unità immobiliare" in Italian)(Figure 5.7) has two tabs: “Comparing housing unit” ("Confronta unità immobiliare" in Italian) and “Renovation proposals” ("Proposte di riqualificazione" in Italian).

Figure 5.7
"Renovation housing unit" section

7 RES (Renewable Energy Source) (FER in Italian)

The first tab provides a comparative analysis of your building compared to others with similar characteristics, selected based on specific criteria, such as climate zone and classification pursuant to Presidential Decree 12/93. The reference features were identified by an ENEA working group, in accordance with the provisions of Ministerial Decree on 26 June 2015, for the calculation of the average non-renewable global energy performance index and energy performance class of existing buildings like the one covered by the EPC in question. Details of the implementation of this functionality are discussed in the paragraph 5.2.

The "Renovation proposals" tab contains the following:

- A list of renovation actions selected based on the structural and energy characteristics and geographical location of the building. Each proposal is competed with energy and economic parameters included any applicable financial bonus;
- A set of combined solutions obtained by integrating two or more previous actions. These proposals can be ordered according to economic and efficiency criteria, depending on the user's priorities.

These solutions were developed using an Expert Decision Support System for Energy Performance (SEPE in Italian), the details of which are explained in the paragraph 5.3.

This tool not only facilitates understanding of the current state of buildings but also supports the planning of efficiency measures, providing guidance on the best technical solutions and opportunities for accessing incentives and financial benefits.

Passport services are intended for citizens, enterprises and public administration, but currently access to them is limited to citizens, since it is only possible to implement some of the services intended for them by using the information contained in the ENEA, SIAPE and financial bonus databases.

For public administrations, the ability to access up-to-date and certified data via the Passport will enable them to monitor local and national building stock and plan urban renovation strategies in line with ecological transition and emission reduction targets. However, the implementation of services for these users depends on the integration of ENEA databases with those of other bodies[8]. This process of data sharing is still ongoing and subject to interinstitutional agreements.

Therefore, Passport functionalities take advantage from the several interoperability between databases[9] in the energy and environmental sector. In this data integration process, the relatively recent digitisation of EPCs has played a key role, enabled the generation of new knowledge and significantly enriched the overall information heritage. Without its structuring in relational databases, which are essential for managing large volumes of heterogeneous data and performing complex analyses, this heritage would risk remaining unexpressed.

8 SIOPE https://www.siope.it/Siope/
Acquirente Unico https://www.acquirenteunico.it/
Agenzia del Demanio https://www.agenziademanio.it/it/
Portale PA https://portalepa.agenziademanio.it/PortalePA/
ISPRA - https://www.isprambiente.gov.it/
TERNA - https://www.terna.it/
GSE - https://www.gse.it/

9 ENEA and other public authorities' database in accordance with the following - Article 8 del D.M. 48/2020 (https://www.gazzettaufficiale.it/eli/id/2020/06/10/20G00066/sg) - Article 3 del D.M. 304/2022 (https://www.gazzettaufficiale.it/eli/id/2022/12/30/22A07318/sg)

5.2 The “Compare housing unit” feature

The "Renovation housing unit" section of the PNPE[2] contains a “Compare housing unit” ("Confronta unità immobiliare" in Italian) functionality enables to compare energy classes of similar building units. The implemented functionality refers to the theoretical framework developed in an activity within the Electrical System Research (RSE in Italian) programme[10]) concerning the "Definition of a methodology for calculating energy performance indices for similar buildings" for the calculation of the average non-renewable Global Energy Performance Index ($EP_{gl,nren}$), as required in paragraph 5.2.2 of Annex 1 to Legislative Decree on 26 June 2015 "Adaptation of national guidelines for the energy certification of buildings", concerning the comparison of the energy performance of buildings.

The similarity between existing buildings is defined based on the following six input parameters:

- Climate zone
- Classification according to Presidential Decree 412/93
- Construction type
- Heated usable area
- Gross volume
- Surface area to volume ratio (SV).

These parameters appropriately classified (as reported in Table 5.1), enable the identification of homogeneous groups of EPCs with comparable characteristics.

Table 5.1
Classes of values identified for each input parameters

Parametro	Classi di dati
Climatic zone	1. A 2. B 3. C 4. D 5. E 6. F
Classification DPR 412/93	1. Residential (0-2) 2. E.1(1)a colleges, shelters, prisons, barracks, convents (1) 3. E.1(3) Hotels, guesthouses and similar activities (3) 4. E.2 Offices and similar premises (4) 5. E.3 Hospitals, clinics, nursing homes and similar establishments (5) 6. E.4 Recreational or religious activities and similar (6,7,8) 7. E.5 Commercial and similar activities (9) 8. E.6 sporting activities (10, 11, 12) 9. E.7 School activities (13) 10. E.8 Industrial, craft and similar activities (14)

10 https://www.ricercasistemaelettrico.enea.it/

Parametro	Classi di dati
Construction type	1. Load-bearing masonry (0-12) 2. Reinforced concrete (1-2-3-8-9-10) 3. Steel (4-5-6-11) 4. Wood (7) 5. Other (13-14)
Heated usable area	1. Between 1 and 100 square metres 2. Between 101 and 200 square metres 3. Between 201 and 1000 square metres 4.Llarger than 1000 square metres
Gross volume	1. Between 1 and 300 cubic metres 2. Between 301 and 600 cubic metres 3. Between 601 and 3,000 cubic metres 4. Greater than 3000 cubic metres
SV report	1. Greater than 0 and less than 0.5 2. Greater than 0.5 and less than 1 3. Greater than 1

This PNPE[2] functionality is designed to operate automatically: the system extracts the six input values needed to identify the group to which the building unit belongs, its size and its distribution by energy performance class from the latest EPC for the building unit, using specific API calls. In addition, the same distribution is reported for those building units in the group that have undergone energy upgrading, as indicated in Figure 5.8.

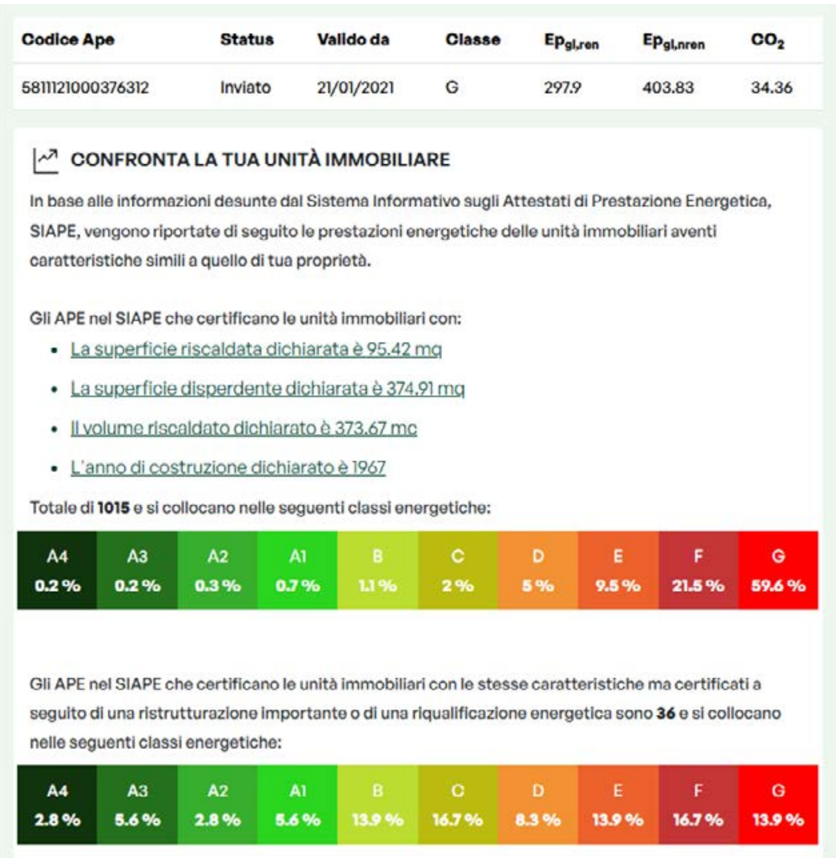


Figure 5.8
"Compare housing unit" functionality interface

The size of the group to which the building belongs, and the distribution of energy performance class shows a clear and transparent overview of the comparative context of the building. This information can also be useful for public administrations or operators in the sector to monitor the distribution of energy performance across the territory and define more targeted intervention strategies.

Furthermore, automatic data extraction from the EPC simplifies interaction with the system and reduces the margin of error. This feature offers a clear and immediate benchmark to compare the energy performance of one's own building with similar ones, helping users better understand its improvement potential. The reliability and validity of the results obtained is guaranteed by a methodology that is fully compliant with the national regulatory framework.

5.3 The Expert System for Energy Performance: SEPE

Expert System for Energy Performance (SEPE in Italian) is an automatic decision support system designed for users who are not specialists in the field of energy efficiency. The system guides users in selecting renovation measures for buildings. It processes and proposes targeted solutions, both individual and combined, aimed at improving the energy performance of buildings. The proposals are based on an analysis of the energy profile of the building, obtained from the data contained in the EPC files stored in SIAPE. This approach allows for the formulation of personalised suggestions, accompanied by an estimate of the expected effects, both in terms of energy savings and economic impact. This provides a clear and quantifiable overview of the benefits of implementing the suggested measures.

The use of data from SIAPE is a key element in the development of SEPE, as it provided a structured and consistent information base that could be used directly without further processing of the input data used by the system. At the same time, the value of this data was enriched by its mutual correlation, allowing new information to be generated that was useful for defining customised efficiency strategies. Automated processing increased the value of existing data, translating it into operational suggestions that could facilitate decision-making and promote wider dissemination of energy retrofitting practices in the residential sector.

The proposals, while considering the recommendations contained in the EPC, provide more detailed information on the energy performance that can be achieved following the implementation of individual renovation measures. The system also proposes integrated intervention scenarios and provides the following quantitative parameters:

- **Energy performance** – The system quantifies the reduction in overall energy requirements, improvements in the efficiency of the building envelope and systems, and the reduction in CO_2 emissions. These parameters make it possible to accurately estimate the impact of the action on the sustainability and energy consumption of the building
- **Economic assessment** – Each scenario is accompanied by an

estimate of the implementation costs, broken down by type of intervention. In addition, the system provides a projection of the economic return resulting from the reduction in energy consumption, assessing both the payback period of the investment and the savings that can be achieved in the long term. This analysis is carried out considering two distinct scenarios: both with and without incentives, to provide a complete picture of the financial impact of the interventions

- **Financial bonus** – The system integrates financial breaks opportunities and economic incentives available under current legislation into the assessment, quantifying the impact of incentive mechanisms on expenses incurred. Through the integration of energy, economic and bonus data, users can obtain a clear and sufficiently comprehensive picture, which is useful for selecting the most effective and sustainable solutions based on the specific characteristics of the building and the economic resources available.

This multidimensional approach provides guidance in choosing actions and scenarios, without however replacing the opinion of professionals in the field. The proposals generated should not be interpreted as binding prescriptions, but rather as preliminary indications that require further evaluation by qualified technicians. SEPE therefore provides non-expert users with only an initial analysis and rough assessment of the applicable interventions, which must then be confirmed by advanced technical expertise.

SEPE was developed with reference to the ENEA VICTORIA application[11] which has been adapted to the specific context of the PNPE².

VICTORIA is an application for simulating energy efficiency scenarios in buildings, also available on the DeciWatt platform[12], a single digital portal developed as part of a collaboration between ENEA and the Metropolitan City of Milan. The software allows users to model various interventions on building systems and structures, assessing their impact in both energy and economic terms.

The adaptation of VICTORIA to the context of PNPE² was necessary because, while the VICTORIA algorithm proposes an assessment of the interventions applicable to the building, SEPE focuses on the building unit. The whole building and the building unit represent two distinct concepts[13], both from a structural and functional point of view. The building unit constitutes the minimum heated portion of a building and, as such, has specific energy and performance characteristics. The building, on the other hand, is generally composed of several building units and its energy performance derives from the aggregation of the characteristics of the individual components. This distinction implies a different level of detail in the information associated with the two entities, with significant consequences in terms of calculation methods, simulation models and intervention strategies adopted for energy efficiency assessment. The adaptation of calculation models at the building unit level required a thorough review of existing procedures. In fact, the methodologies originally developed for the building were specifically reworked to ensure consistency and accuracy in the assessment of the energy performance

11 V.I.C.T.O.R.I.A. (Valutazione degli Interventi incentivabili dal Conto Termico e relativi Risparmi in Italian) https://victoria.enea.it/#/login - https://PNPE².enea.it/victoria

12 https://deciwatt.cittametropolitana.mi.it/

13 “the property unit consists of a portion of a building, or a building, or a group of buildings, or an area which, in its current state and according to local usage, has the potential for functional and income autonomy.” – Financial Ministerial Decree on 2 January 1998 no. 28

of individual building units. This process involved optimising the input parameters and redefining the simulation logic to better respond to the peculiarities of the new application context.

Another difference between the VICTORIA and SEPE systems concerns the method of input data acquisition. In VICTORIA, the user can enter the data needed for the simulation, whereas in SEPE this is not possible. In SEPE, the input data is estimated based on the information contained in the EPC, using extrapolation and automated reprocessing procedures. This approach allows the analysis to be standardised and reduces the margin of error associated with manual data entry.

Furthermore, SEPE's modular architecture, defined from the design stage, makes it a flexible system with respect to the regulatory context. This enables it to quickly incorporate and integrate new regulations, particularly those deriving from strategies and measures related to ecological transition. The modules are independent but interoperable, this allows for timely intervention on specific components of the system, reducing update times and costs and minimising the impact on the entire application ecosystem.

In this way, SEPE is a dynamic and resilient tool, capable of ensuring continuous compliance with constantly evolving regulatory requirements without compromising operational efficiency and the consistency of the processes managed.

5.3.1 The SEPE interface

SEPE is a digital tool integrated into the Building Passport contained in the PNPE[2], with the aim of providing an advanced decision support system for selecting energy renovation measures for building units. This system is designed to be used by both building owners and public administrations, enabling them to identify and evaluate the most appropriate energy efficiency solutions based on the specific characteristics of the building unit and their energy and economic savings objectives.

The services offered by SEPE can be accessed from the "Renovation proposals" tab (Figure 5.9) contained in the "Renovation housing unit" section of the Passport.

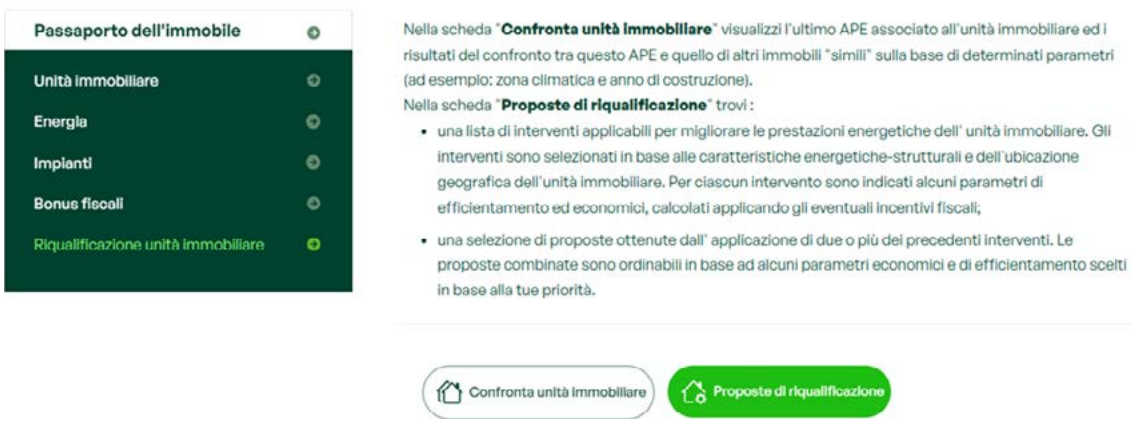


Figure 5.9
Section "Renovation housing unit"

From this tab, users can explore the available measures options, analysing the potential for improving energy and economic performance resulting from their implementation. Users can view the list of renovation actions identified by the system (Figure 5.10) based on an analysis of the energy and structural characteristics of the housing unit, as well as its specific geographical location. In this way, the proposed solutions are appropriate for the energy context in question.

Figure 5.10
List of renovation actions selected by SEPE

For each identified measure, the system will only provide an estimate of the following parameters (Figure 5.11):

- Cost of the procedure
- Achievable energy performance class, determined based on current regulations and the performance of the building-system unit
- Energy savings, expressed in terms of reduction in primary energy demand
- Cost savings and return on investment calculated both with and without financial bonus (Figure 5.12). In the absence of these one, the assessment provides an indication of the return on investment based exclusively on savings in utility bills. The return obtained by including any financial breaks can significantly influence the economic viability of the action.

The values of the above parameters, except for the cost of the intervention, will be calculated based on the energy consumption reported in the EPC. Therefore, they will not represent actual data in any way but will be exclusively theoretical estimates useful for providing a rough indication of the order of magnitude of the energy and economic impact of the intervention.

This feature will therefore allow users to compare the possible interventions that could theoretically be applied, guiding their choice based on their needs and priorities.

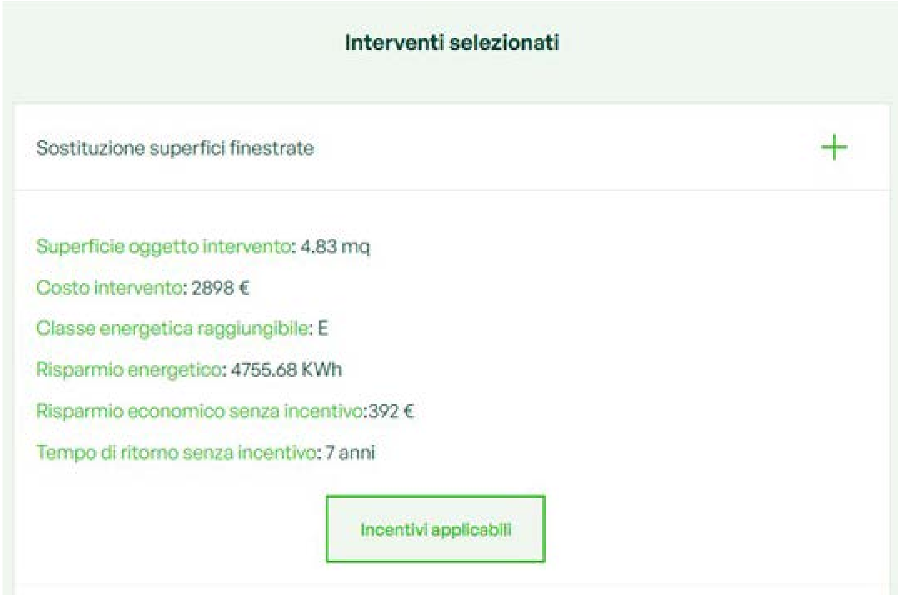


Figure 5.11
Example details of the outputs of a measure proposed by SEPE. The values of the energy and economic parameters are a theoretical estimate of the impact of the measure.

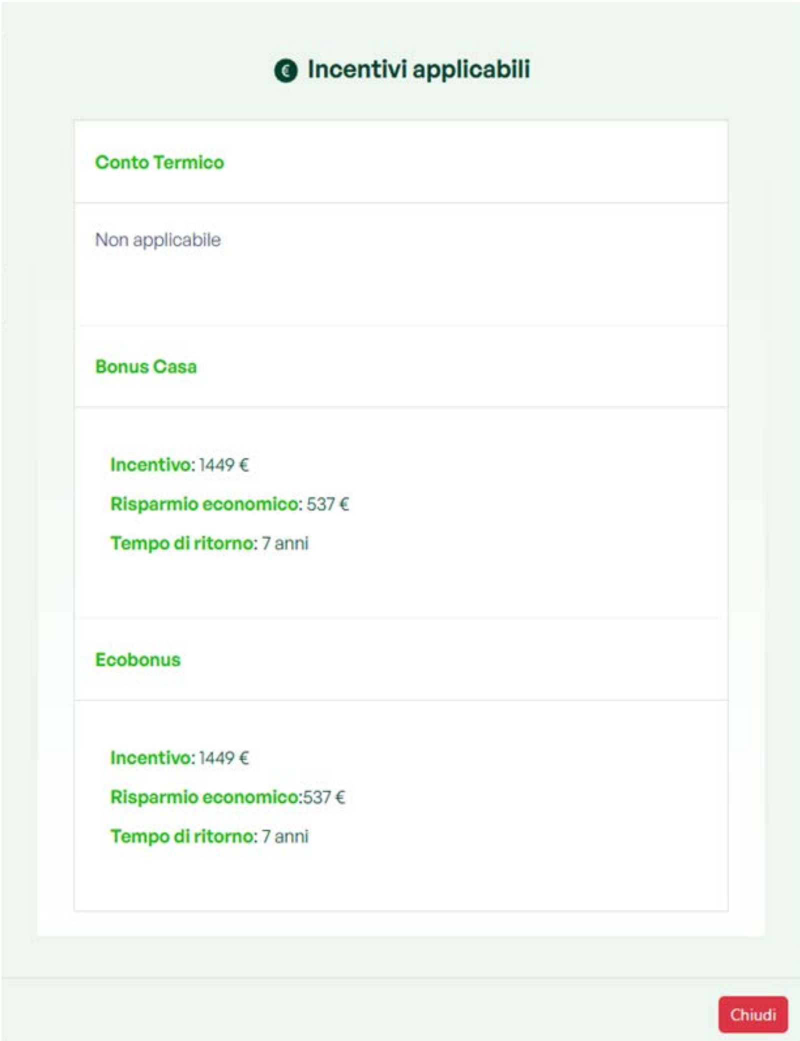


Figure 5.12
Details of applicable incentives. Financial savings and payback periods are not calculated based on actual data but are derived from the data reported in the EPC.

In addition, the system also proposes solutions obtained by combining them (Figure 5.13). The integrated configuration (hereinafter referred to as 'scenario') aims to optimise energy and economic performance compared to that resulting from individually applied measures. For each scenario produced, the system provides the user with the achievable energy performance class, calculated based on current regulatory parameters and energy performance coefficients. This information represents the first level of output, allowing the overall effectiveness of each scenario in terms of energy to be immediately assessed.

Figure 5.13
Proposals of combined actions (scenario)

The scenario alternatives can be sorted according to four criteria (Figure 5.14):

1. Maximisation of energy savings: assessment of the effectiveness of the proposed solutions in terms of reducing overall energy consumption, calculated based on energy performance indicators (e.g. kWh saved per year)
2. Maximisation of economic savings: analysis of the economic impact of solutions, considering the initial cost of the intervention, the savings generated and any incentives available, to determine the maximum financial benefit for the user
3. Improvement in energy performance class achievable: the new energy performance class of the building after the intervention, based on regulatory parameters and energy certification methodologies (e.g. $EP_{gl,nren}$, global non-renewable energy performance index)
4. Minimisation of return on investment time: assessment of the time required for the economic savings resulting from the intervention to offset the initial cost, providing a parameter for assessing short- to medium-term profitability.

Figure 5.14
Sorting parameters for scenarios

The ranking is carried out using a multi-criteria analysis algorithm, ensuring a structured decision-making process based on quantitative and performance parameters. The system output therefore allows for a structured comparison of the available alternatives, providing a hierarchy of the most advantageous solutions in relation to the preferences expressed by the user. In this way, it is possible to select the optimal scenario not only from an energy efficiency point of view but also based on the user's economic and time requirements.

For each renovation scenario, the system performs a quantitative analysis, providing an estimate of the main energy and economic efficiency parameters (Figure 5.15), similarly to what happens for a single renovation action. The assessment is carried out using a simulation model that integrates regulatory data, the thermophysical characteristics of the building and the plant parameters, to determine the overall effectiveness of the combined intervention compared to the initial conditions.

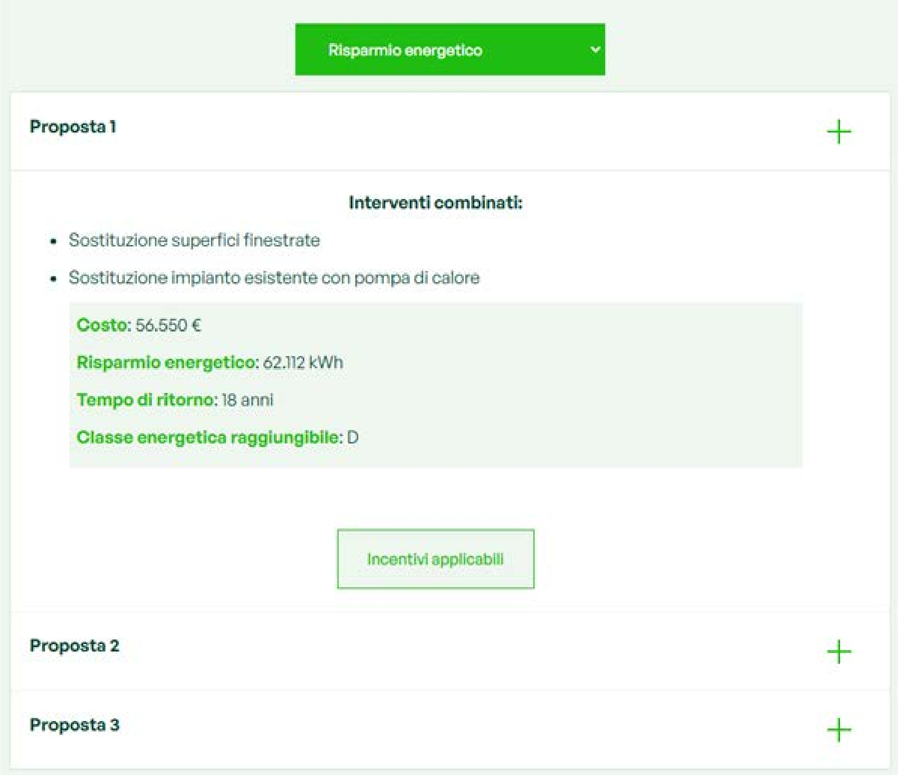


Figure 5.15
Scenario details

SEPE is therefore able to assist users in selecting the intervention strategies that are most consistent with their priorities. This approach provides a clear and comprehensive overview of the impact of different strategies, facilitating informed choices geared towards efficiency and sustainability. The SEPE system is therefore an effective tool for decision support in the planning and optimisation of energy interventions, without replacing the opinion of professionals in the sector.

5.4 PNPE^2: characteristics and potential

Il PNPE^2, as a digital one stop shop, provides an access point to a heterogeneous set of energy and economic data currently available through various digital platforms. The Portal offers integrated information support on the energy renovation of buildings to public administrations, enterprises and citizens.
The centralisation and structuring of data in a single digital space significantly improves its usability and accessibility for various stakeholders in the sector, such as:

- Building owners and managers: to monitor the energy efficiency of buildings and effectively plan renovation work
- Public authorities and regulatory bodies: to assess the impact of decarbonisation policies, ensure compliance with regulations and plan new strategies
- Financial institutions: to allocate economic resources in a targeted manner based on verifiable and certified data
- Professionals in the construction and energy efficiency sectors: to access detailed technical data useful for designing efficient and optimised projects.

Among these, public administrations need a comprehensive, integrated and up-to-date overview of their real estate assets to properly assess the energy policies to be adopted. In fact, public decision-makers need certified, reliable and constantly updated data to define intervention strategies in line with European and national carbon emission reduction targets. The availability of this information allows for continuous monitoring of the energy performance of buildings and systematic assessment of the effectiveness of the policies implemented, not only from an energy and environmental perspective, but also from a financial and social perspective. On the other hand, citizens also need advanced but easy-to-use tools to understand and improve the energy performance of their homes.

In response to these needs, the PNPE^2 has been enhanced with the functionalities and services contained in the Building Passport. The latter provides a structured representation of the energy and cadastral profile of the building unit and its potential for efficiency improvements.

In fact, it is possible to view the results of a comparison between the performance of a given housing unit and that of similar buildings in terms of energy and construction characteristics. This allows for benchmarking a building against its reference context and increasing citizen awareness and knowledge on energy efficiency issues.

Moreover, SEPE proposes structured retrofit scenarios to aid in planning single or combined interventions in line with European energy standards. SEPE can concretely promote the energy sustainability of the national building stock.

The EPCs' digitalization and their systematic archiving in SIAPE, together with progressive interoperability with other regional and national energy registers, were decisive factors in the implementation of services related to the Passport. This has enabled the standardisation and centralisation of energy information, promoting greater efficiency in data management and easier integration between heterogeneous systems.

The PNPE[2] has considerable potential for development, much of which is already in the design phase. Among the most significant features currently being implemented is the ability to aggregate the data contained in the EPCs of individual building units to obtain an overall assessment of the energy performance of the entire building.

ENEA has already been involved in a similar initiative developed in collaboration with the Metropolitan City of Milan, which led to the creation of the DeciWatt platform, a digital one stop shop dedicated to energy efficiency in buildings. The platform, updated in October 2024, allows for detailed energy characterisation of buildings, thanks to a structured system for collecting, analysing and returning energy data.

In the medium to long term, the integration of other databases into the PNPE[2] and advanced information systems for building management, such as digital models of *Building Information Modelling* (BIM) and *Geographic Information System* (GIS) platforms, will be strategic for the creation of a national digital building register. This register could constitute a fully-fledged integrated digital database for the collection, management, analysis and sharing of data relating to the national building stock, in accordance with the most advanced European best practices in the field of digitalization and information management of the building stock.

The Portal database could also contribute to feeding supranational building databases, such as the more recent European Building Stock Observatory[14] (BSO), the European Union's information hub dedicated to monitoring and analysing the European building stock, as provided for in Article 22[15] of the recast EPBD, approved in March 2024.

Overall, this digital architecture will contribute substantially to the planning and implementation of public policies for the energy upgrading of the building stock, the definition of targeted decarbonisation strategies and the transition to high energy performance and low emission buildings. Strengthening the digital governance of the building sector, promoted through these tools, is therefore a key element in achieving the objectives of the European Green Deal.

14 https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/eu-building-stock-observatory_en

15 "Each Member State shall establish a national database on the energy performance of buildings… At least once a year, Member States shall ensure that information is transferred from the national database to the European Building Stock Observatory. (BSO)"

6

Questionnaire: The Perspective of Condominium and Property Managers on Energy Certification

In the 2025 edition of this report, it was deemed useful to explore the perspective of condominium and property managers on the topics of energy efficiency and energy certification.

Analysis of the responses provided (approximately 1,500) reveals a generally positive assessment by managers regarding EPCs and various aspects of energy efficiency. Nonetheless, there are suggestions for improvement. The Energy Performance Certificate (EPC) is a valid and useful tool, but it can be improved in terms of clarity and reliability to better support the overall process of building energy transition.

6.1 Introduction

ENEA (National Agency for New Technologies, Energy and Sustainable Economic Development) and CTI (Italian Thermotechnical Committee for Energy and Environment), in collaboration with ANACI (National Association of Condominium and Property Managers), prepared a questionnaire addressed exclusively to these professionals. The questionnaire was distributed thanks to the collaboration with ANACI.

A total of 1,505 professionals responded to the questionnaire, representing approximately 21% of the target audience. It is estimated—though no official data exists—that there are about 60,000 professional condominium managers in Italy. Therefore, the respondents represent 2.5% of the total number of professional managers. The sample of 1,505 professionals is nonetheless considered significant. We take this opportunity to thank ANACI and all those who responded, contributing to this report.

The data were collected and summarized anonymously and in aggregate form, in compliance with privacy regulations. Sections 6.2 to 6.6 present summaries and comments on the responses, divided by topic.

Before the questionnaire results, a brief interview (section 6.1.1) with ANACI President, Eng. Francesco Burrelli, is presented. The interview addresses the role of condominium managers in promoting energy efficiency, the informational value of building-level EPCs, and the professional evolution of the manager's role.

6.1.1 Interview with Anaci

Question: In your opinion, what role can and should condominium managers play in promoting a culture of energy efficiency within condominiums, and in raising awareness about the importance of a high-quality EPC?

Answer: *The condominium manager—or more accurately, the "real estate asset manager"—must have appropriate training and knowledge of both the building envelope and the systems that make up the condominium, in order to properly evaluate renovation and efficiency projects carried out by industry professionals. Especially today, it is essential to be well-versed in the European EPBD 2024 directive, which the government uses to define intervention strategies for the entire Italian building stock. Clearly, a precise understanding of what is meant by an EPC for a housing unit and a "conventional EPC" for the building allows both the manager and the residents to be aware of the building's energy class. The manager is obliged to promote energy audits to propose tailored solutions for each building. Therefore, the manager's knowledge of the sector becomes central to effective communication in all meetings.*

Question: Do you believe that the generalized association of a building-level EPC with the current system of EPCs for individual housing units could add value to the Italian National Informative System on Energy Performance Certificates (SIAPE in Italian)

Answer: *Understanding the tools we use to improve energy efficiency is always beneficial. Informing users about estimated energy consumption—whether when purchasing or renting a unit—is crucial for guiding their choices. Clearly, the EPC for a housing unit offers only a partial representation, but with the widespread development of the "conventional" (building-level) EPC, the data will become more complete and meaningful. Keep in mind* *that having data on individual units already provides valuable insights into efficiency improvement factors, such as insulation, windows, wall coverings, and generator replacement. An integrated information system would thus be an important tool for dissemination and sharing among citizens, who could, during major renovation works on the condominium, begin to consider individual upgrades—thereby increasing interest and expectations for the overall quality of the complex (and its real estate value).*

Question: What transition path should condominium managers follow to become a reference point for the "Condominium Community," not only for energy efficiency interventions but also for providing financial and real estate advice related to the managed property, or for raising awareness about other technical needs (seismic safety, general safety, etc.)?

Answer: *The path for managers with cross-disciplinary knowledge is certified by UNI 10801-2024. This certification is crucial because, in addition to meeting the requirements of Article 71bis of the Civil Code's implementing provisions, the manager must also possess appropriate knowledge as a "Property Facilitator," "Building Manager," and "Real Estate Appraiser." This is to ensure a comprehensive view of the real estate asset, not just condominium matters. This new professional figure must be able to advise and guide clients in the right direction when purchasing buildings. Nowadays, acquiring new properties always requires an energy audit, structural assessment, network connection evaluation, and cost estimation for renovations that meet EPBD 2024 parameters. Additionally, proper verification of intrinsic safety, compliance of systems, and seismic risk assessment are needed. Today, it is realistically possible to carry out conservative restorations with upgrades to seismic and energy classes, significantly reducing costs and leveraging innovative technological solutions. The manager, as a "real estate asset professional," must become the main reference for implementing applicable laws and regulations across the 1.2 million condominiums in Italy, home to over forty million Italians.*

6.2 General Information

The first question of the questionnaire was designed to understand the geographical distribution of respondents. Considering that a professional might manage properties located in multiple regions, respondents were asked to indicate the region or autonomous province where the majority of the properties they manage are located. The responses are summarized in Table 6.1.

Table 6.1
Geographical distribution of the properties managed by respondents

Region	Answers	Region's Inhabitants	Ratio answers / 100.000 Inhabitants
Lombardia	341	10.035.481	3,40
Lazio	169	5.710.272	2,96
Emilia-Romagna	161	4.465.678	3,61
Veneto	144	4.851.851	2,97
Piemonte	129	4.255.702	3,03
Liguria	124	1.509.908	8,21
Toscana	118	3.660.834	3,22
Prov. Bolzano	43	539.386	7,97
Puglia	41	3.874.166	1,06
Marche	38	1.481.252	2,57
Campania	33	5.575.025	0,59
Friuli V.G.	31	1.194.095	2,60
Prov. Trento	31	546.709	5,67
Sicilia	25	4.779.371	0,52
Abruzzo	23	1.268.430	1,81
Sardegna	17	1.561.339	1,09
Calabria	11	1.832.147	0,60
Val d'Aosta	11	122.714	8,96
Basilicata	6	529.897	1,13
Umbria	6	851.954	0,70
Molise	3	287.966	1,04

In relation to the population size, the highest number of responses came from: Aosta Valley, Liguria, Province of Bolzano, Province of Trento, Tuscany, Emilia-Romagna, Lombardy, and Piedmont.

Assuming a roughly uniform distribution of condominium managers (affiliated with ANACI) across the Italian territory, and also a uniform ratio between the number of condominiums and the number of residents, the number of responses was normalized by the population (number of responses per 100,000 inhabitants). This was done not only to assess the representativeness of the sample but also to gain a general indication of the level of awareness and/or interest among managers regarding these topics.

With reference to the last column of Table 6.1, the national average value of the "responses per 100,000 inhabitants" ratio is 3.03. Therefore, the significance of the data collected and/or the sensitivity to these issues is higher in regions that exceed this percentage: Aosta Valley, Liguria,

* From ISTAT al 1° gennaio 2025.

Province of Bolzano, Province of Trento, Tuscany, Emilia-Romagna, Lombardy, and Piedmont. It is worth noting that these are areas in Northern Italy, where interest in energy-related aspects is evidently greater.

To better understand the type of properties represented in the sample, respondents were asked about the predominant size of the buildings they manage, in terms of the number of housing units per condominium (Figure 6.1). The results show that 66.6% of the managers interviewed oversee medium-to-large buildings (between 9 and 20 units), and 28.2% manage buildings with more than 20 units.

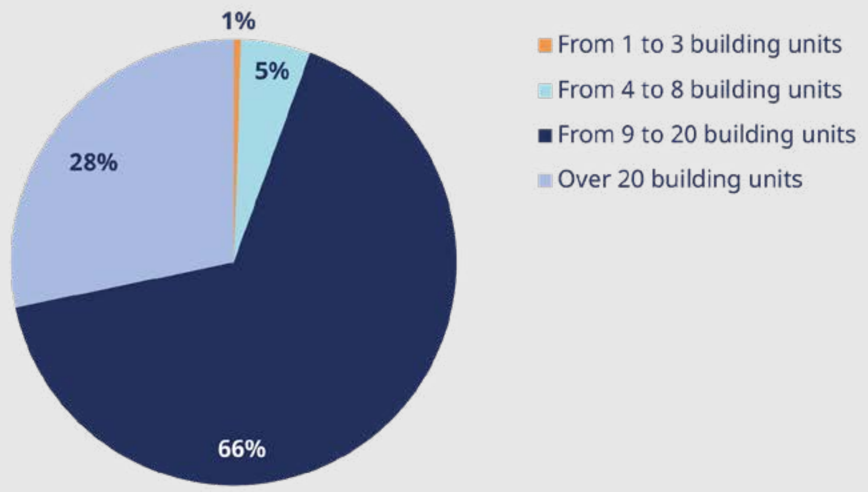


Figure 6.1
Average number of housing units per managed property

6.3 EPC's

The second section of the questionnaire included questions about the Energy Performance Certificate (EPC), with the aim of investigating how condominium managers relate to this strategically important document for energy policies in the residential sector.

First, respondents were asked whether the contents of the EPC were understandable (Figure 6.2), and how useful they considered the EPC as a reference tool for building energy efficiency interventions (Figure 6.3). Overall, the managers' assessment was positive or very positive in more than 75% of the responses.

However, it is noteworthy that the remaining 25% expressed some difficulty in understanding the information contained in the certificate or considered it of little or no use. This should be taken as an important cue for improvement, aimed at making the contents of the EPC more comprehensible to such a key audience in the sector. Enhancing its clarity will likely also make its usefulness more evident.

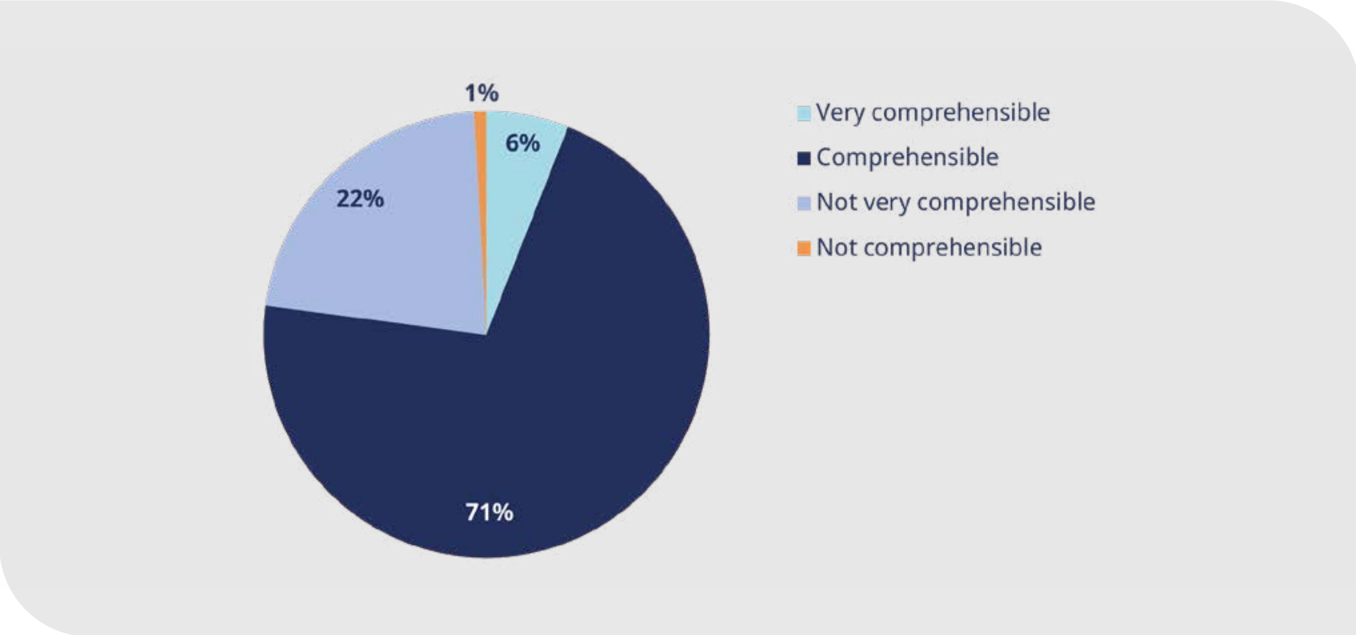


Figure 6.2
Comprehensibility of EPC contents

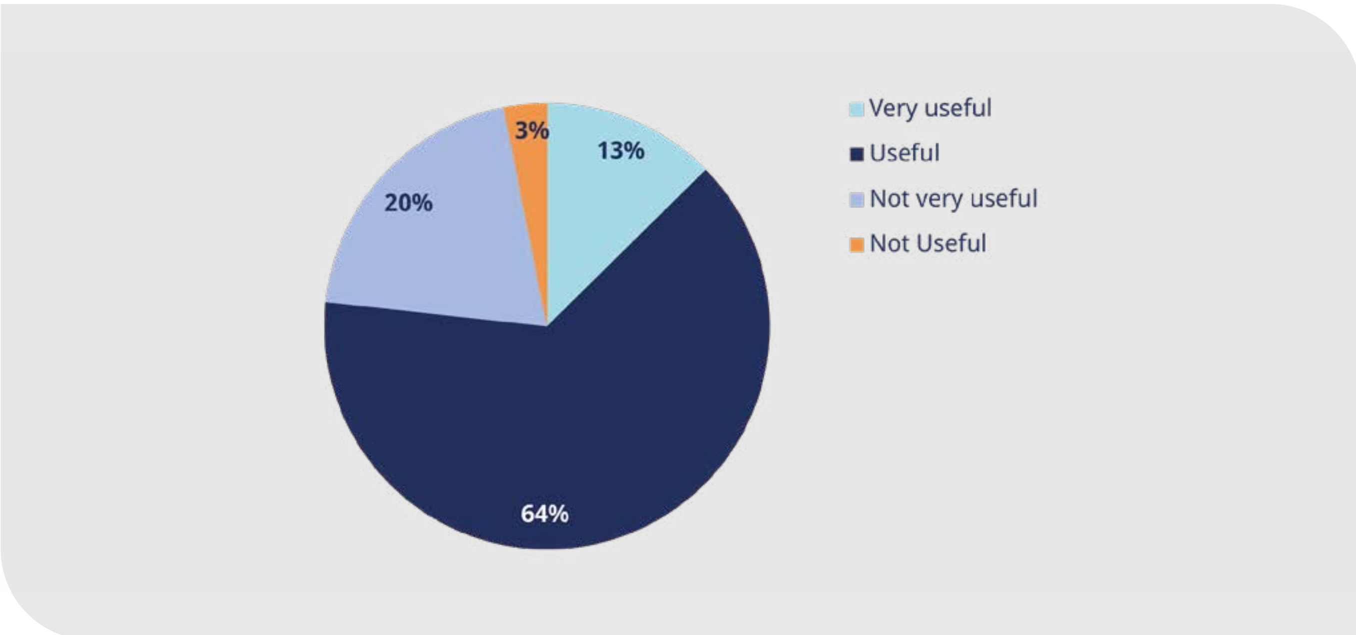


Figure 6.3
EPC Usefulness

A slightly more technical topic was then addressed: the usefulness of the current EPC for individual housing units (Figure 6.4) and the potential usefulness of an EPC calculated for the entire building (condominium) (Figure 6.5).The results show that administrators appreciate the fact that the EPC captures the specific characteristics of an individual apartment, but at the same time they also consider potentially useful the introduction of an assessment for the entire building as a complement to the existing one. The percentages consistently hover around 75%, with a quarter of the responses—similarly to previous questions—indicating that they find the certificate of little or no use, both at the individual unit level and at the condominium level.

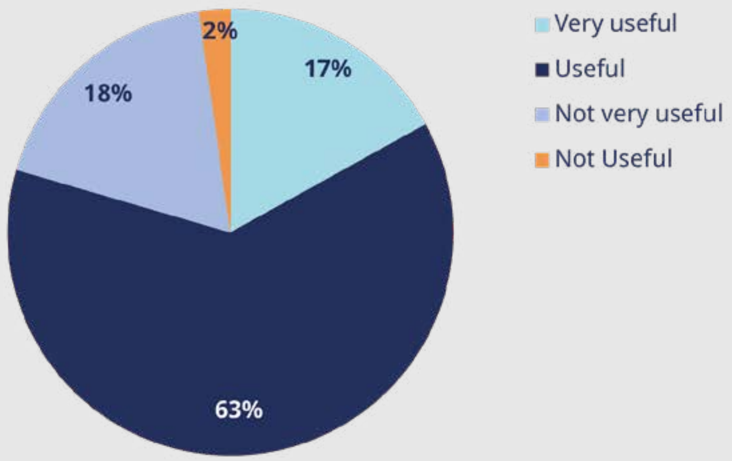


Figure 6.4
EPC's usefulness for individual housing units

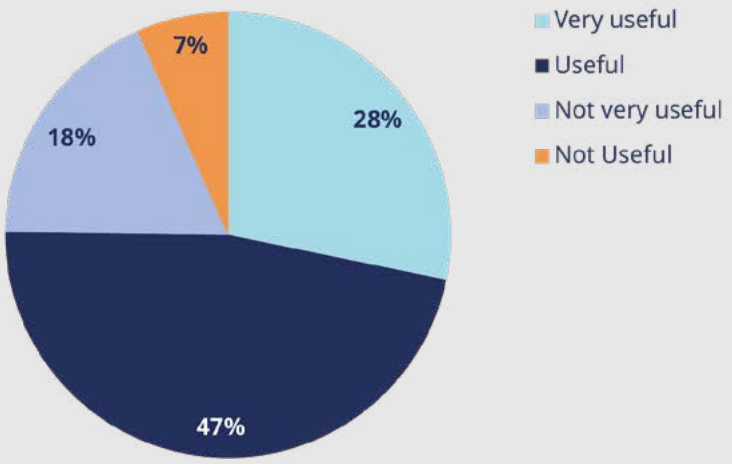


Figure 6.5
Usefulness of integrating a building-level energy performance assessment

6.4 Consumptions and energy efficiency

The third section of the questionnaire aimed to explore the level of awareness regarding energy efficiency among the respondents. First, administrators were asked whether, in their perception, energy consumption is considered a relevant issue by condominium residents (Figure 6.6). Over 80% of the responses were affirmative, and it is suggested to keep this in mind for a later comparison with the answers to a subsequent question, which investigated the perceived importance of energy efficiency improvements compared to other types of interventions—such as those related to acoustic comfort or seismic safety (Table 6.2).

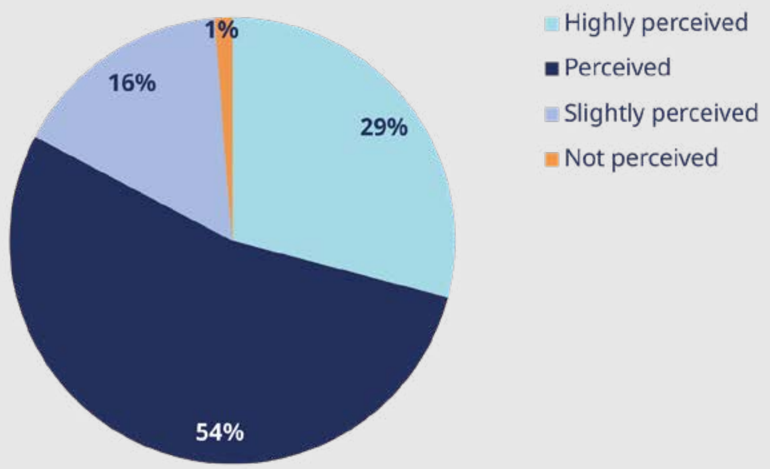


Figure 6.6
Perceived relevance of energy consumption as an issue

The next step was to investigate the recent past, characterized by an incentive scheme that had a significant impact on the entire residential sector, albeit for a short period.
Two temporally related questions were asked on the topic of incentives, aimed at assessing how significant the Superbonus period was at the condominium assembly level, at least in terms of discussions about possible energy efficiency interventions.
The results show that the 110% incentive was strongly perceived by end users (Figure 6.7), and its discontinuation led to a decline in attractiveness and interest in energy efficiency interventions (Figure 6.8).

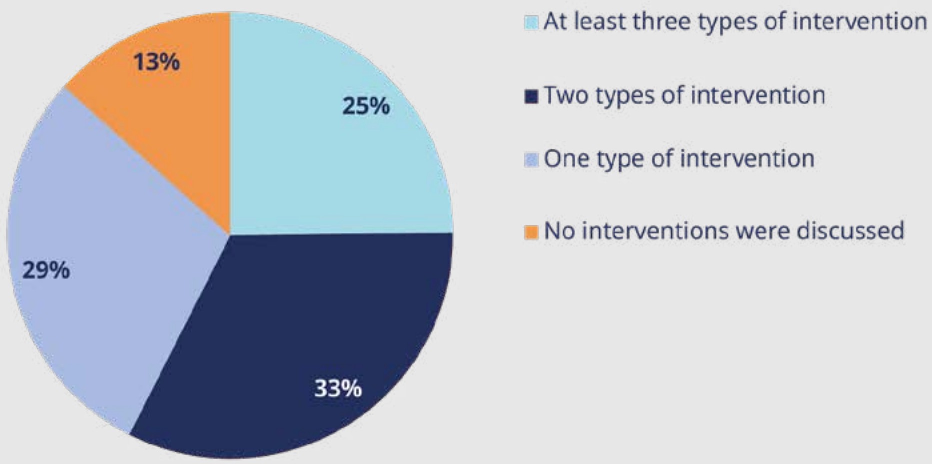


Figure 6.7
Number of interventions considered during the Superbonus period

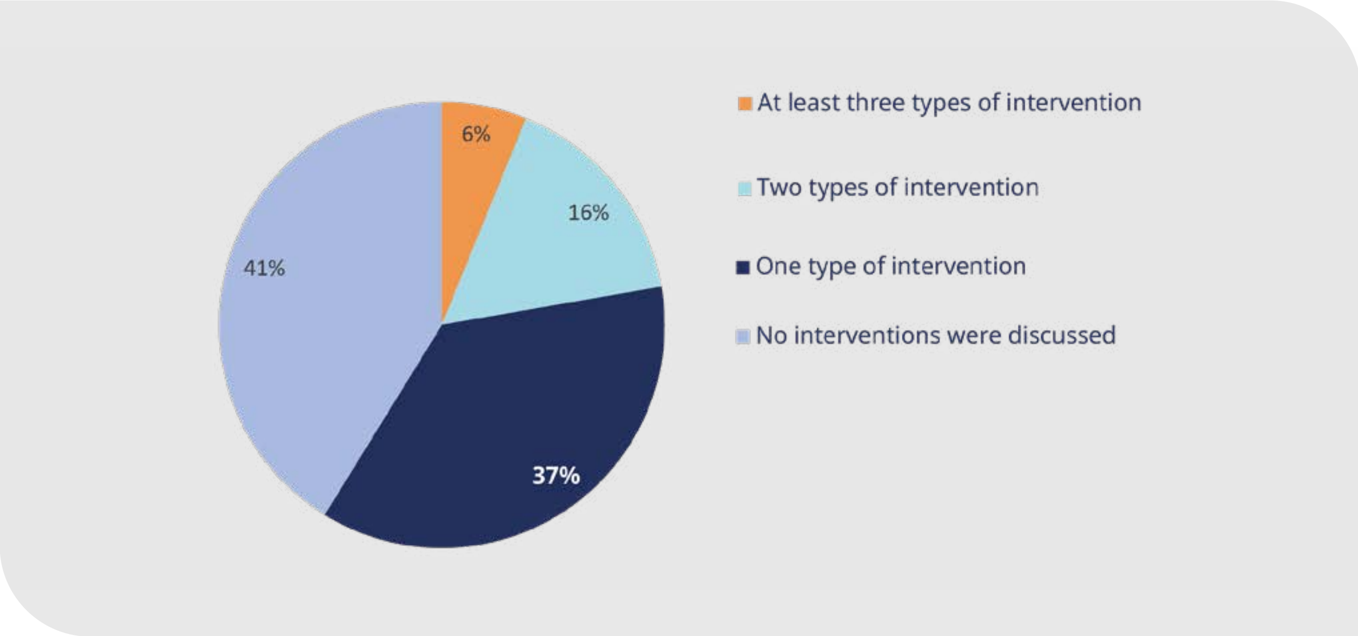


Figure 6.8
Number of interventions considered after the Superbonus period

The next step was to investigate the main barriers identified by administrators that prevent the implementation of energy efficiency interventions in condominiums (Figure 6.9). As expected, over 80% of the respondents indicated the lack of financial resources as the main obstacle, while 47% pointed to excessive bureaucracy and regulatory uncertainty. It is also significant that a quarter of the respondents reported a certain level of distrust in the quality of the technical information provided during condominium meetings.

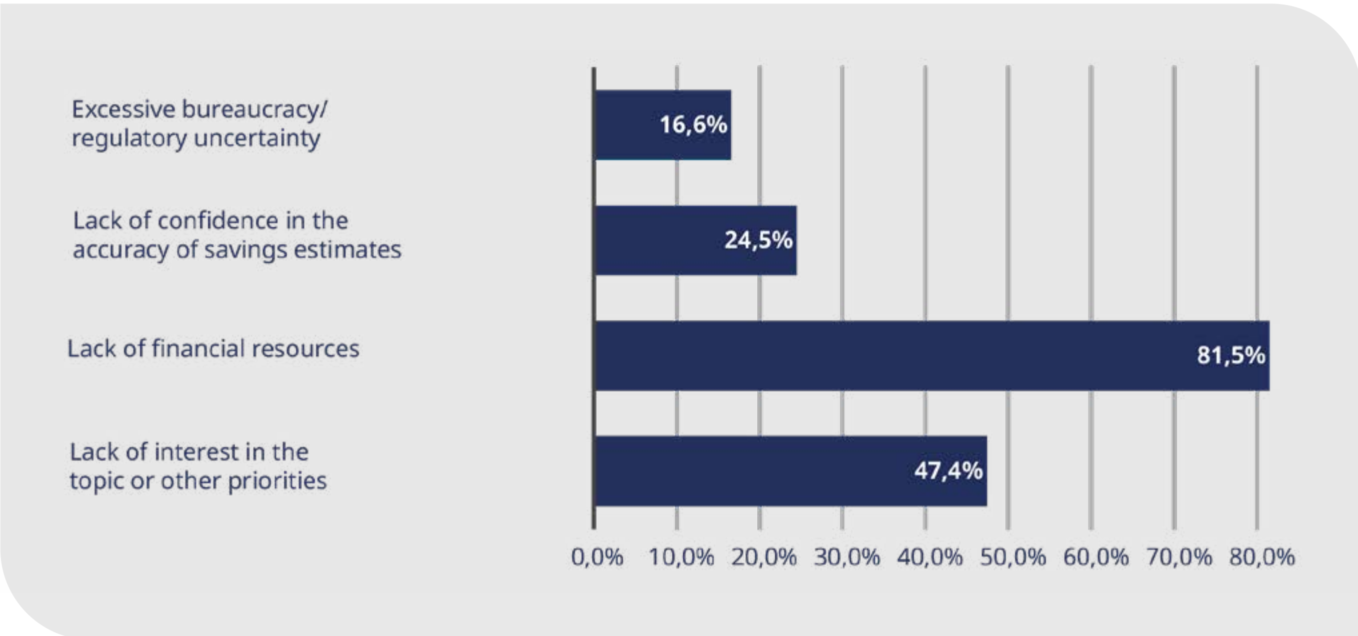


Figure 6.9
Main barriers to the approval of energy efficiency interventions

In addition to this, it is important to consider that a condominium may include several rental units. According to the results of a specific question (Figure 6.10), in such cases, a potential barrier may be the perception among landlords that investing in energy efficiency is less worthwhile, as the benefits would primarily affect the tenant's daily energy use—i.e., their utility bills—rather than, at least for now, significantly increasing the property's value.

The responses confirm that this issue is real and quite significant.

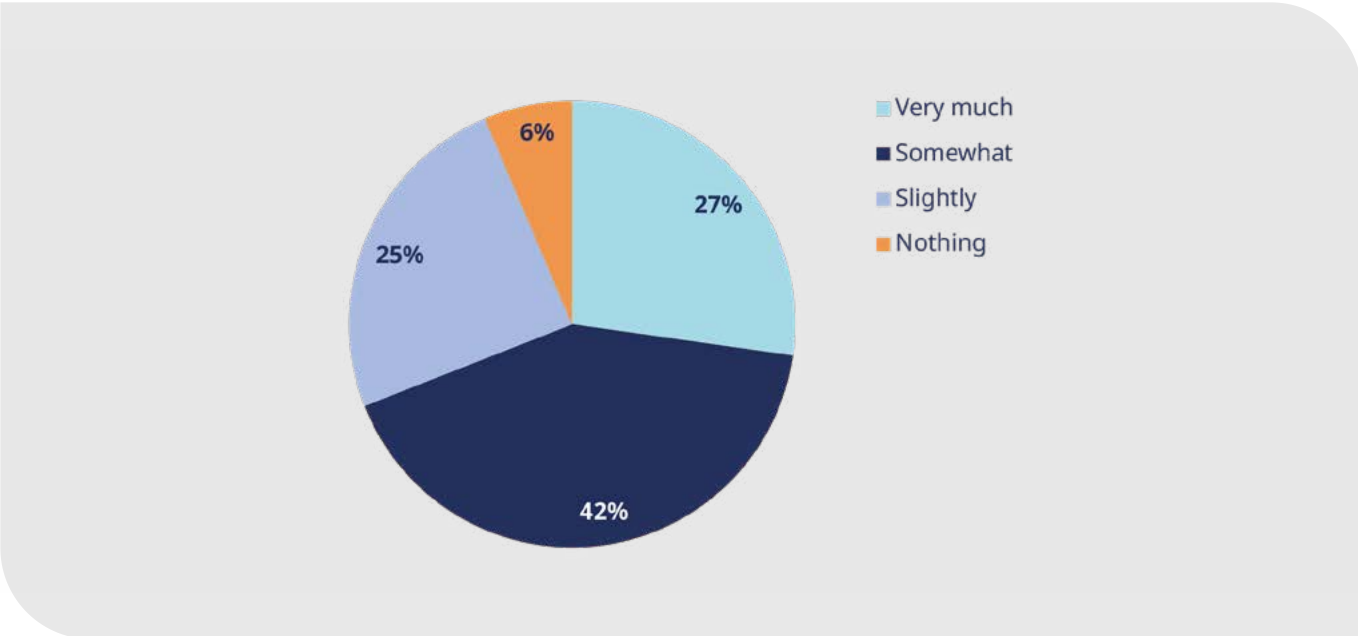


Figure 6.10
Impact of rental units on the decision to carry out energy efficiency investments/interventions

6.5 Relationships with other professionals and suggestions for improvement

Finally, it is acknowledged that energy efficiency is not the only topic deserving attention when it comes to buildings. Respondents were therefore asked to highlight which other building-related topics or aspects they consider similarly useful or interesting compared to the EPC, in the event that the certificate could be integrated with additional information.

Table 6.2
Which of the following types of information do you believe could make the EPC more interesting for condominium residents

Topic	Answers	%
Fire safety	865	60%
Seismic safety	722	48%
Acoustic Comfort	692	46%
Indoor Air Quality	415	28%
BACS Systems	381	25%
Radon levels detected	159	11%

The responses received (Table 6.2) highlight the relevance of fire safety compared to the other proposed topics. However, when interpreting the feedback to this question, it is important to consider that certain issues, such as seismic safety in high-risk areas, are likely to be more strongly felt in specific regions. A noteworthy finding, in any case, is the marked sensitivity toward fire safety.

As for the relationships between condominium administrators and energy certifiers, a general assessment was requested, with the understanding that good communication among the various actors in a process is essential to achieving effective results. In summary, the results of the second-to-last question (Figure 6.11) show that administrators' opinions on these relationships are positive or very positive. The same applies to the level of expertise of professionals (designers, installers, maintenance technicians) working in the energy efficiency sector and interacting with administrators, confirming an adequate level of competence in the field (Figure 6.12).

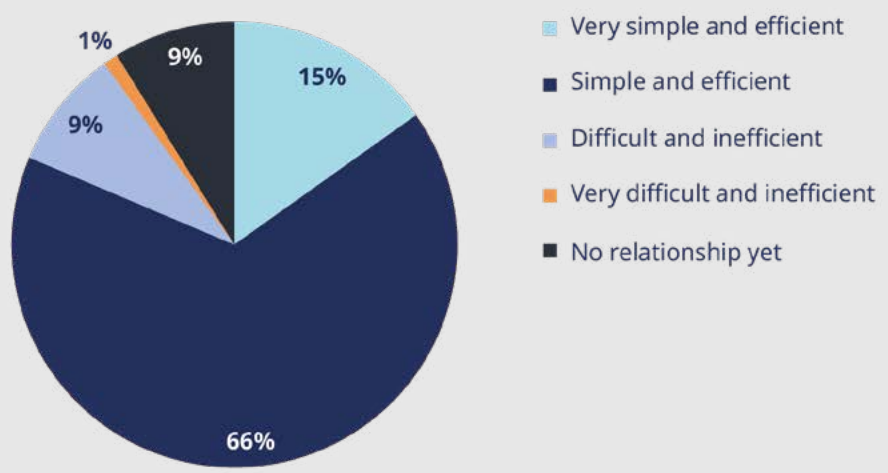


Figure 6.11
Ease of interaction with professionals responsible for drafting EPC

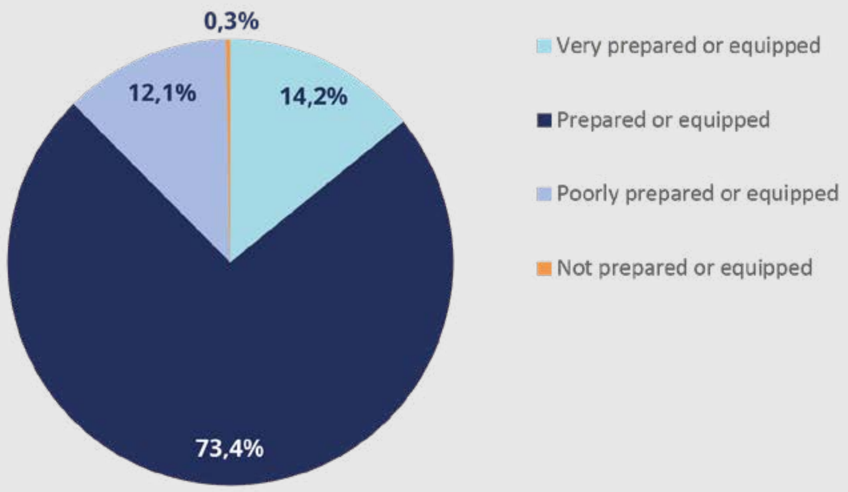


Figure 6.12
Level of expertise of professionals (designers, installers, maintenance technicians) working in the energy efficiency sector

6.6 Suggestions for Improvement and Conclusions

The final question of the questionnaire allowed for open-ended responses: Participants were asked to suggest possible improvements regarding the topics of building energy efficiency and the Energy Performance Certificate (EPC). The answers were varied, but some recurring and clearly relevant themes emerged:

- the difficulty and cost of interventions on existing buildings;
- the need for incentives or other forms of support for investments;
- the need to simplify and clarify sector regulations;
- the need for more understandable and effective informational tools.

In conclusion, although the overall feedback from administrators on these topics and how they have been managed is generally positive, there is no shortage of suggestions for improvement. Comparing these results with those from past questionnaires addressed to other stakeholders, the areas to focus on appear to be fairly consistent over time. EPC is a valid and useful tool, but it can be improved in terms of clarity and reliability to better support the overall process of energy transition in buildings.

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