STRATEGY FOR ENERGY RETROFITTING OF NATIONAL BUILDING STOCK

Italy

Ministry for Ecological Transition

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Contents

1. Introduction

The civil sector is currently responsible for around 45% of final energy consumption and 17.5% of direct CO_2 emissions in Italy. These figures show the importance of upgrading the energy efficiency of buildings in this sector in order to achieve the energy and emission reduction targets set out in the Integrated National Energy and Climate Plan (INECP), while also guaranteeing economic and social benefits.

The 2030 energy savings target set out in the INECP is 9.3 Mtoe per year of final energy; 60% of these savings are to be achieved in the civil sector, which still has significant potential and should therefore be one of the sectors most impacted by new efficiency measures. These savings can be achieved by introducing new materials and technologies into the home, adopting new building standards and end-use devices, upgrading the building envelope, increasing use of thermal renewables and district heating, and more widespread, deep renovation of the existing building stock.

As part of measures to achieve both the 2030 targets and the almost complete decarbonisation of the civil sector envisaged in the Long Term Strategy (LTS) for 2050, it is therefore necessary to develop a mix of technical, fiscal and regulatory measures which promote the wider implementation of energy-efficient interventions and increase deep renovation, in particular conversion to 'nearly zero energy buildings' (nZEB). These measures, which will need adjustment depending on the type of intervention and the target group, may also incorporate different functions, including, for example, combining the energy retrofitting with earthquake protection measures, since integrated interventions cost significantly less and produce better results. Important aspects also include optimising the management of existing systems, installations and components, as well as the use of new materials and generation systems that maximise production from renewable sources. All of the above is facilitated by the development of increasingly specialised skills in energy efficiency, focusing on the building plant system and the current status of the buildings, which are important for comparing the various improvement solutions, supported by energy audits which, when carried out properly and with the requisite qualifications, more than anything else provide sufficient knowledge about the actual consumption profile of the buildings themselves and raise public awareness of the importance of efficiency, including in terms of monetary savings.

This document, prepared in accordance with Article 2a of Directive 2010/31/EU on the energy performance of buildings, as amended by Directive 2018/844/EU, sets out an overview of the national building stock and, subsequently, identifies the current and target rates for energy retrofitting of buildings, also highlighting the opportunity to carry out energy retrofitting through an integrated approach that improves cost-effectiveness. We will therefore briefly set out some information about the cost-optimal methodology that formed the basis for developing the modelling tool used to estimate the m^2 to be retrofitted in the residential sector and in some non-residential sub-sectors. After having estimated the m^2 that needs to be retrofitted in order to achieve the saving targets for 2030 and 2050 pursuant to the INECP and the LTS, we will set out the existing measures and actions, alongside the planned developments intended to achieve the estimated retrofitting rate. Specifically, we will describe the policies and actions relating to residential buildings, distinguishing between the public and private sectors, and those relating to non-residential buildings, distinguishing between private and public services. Lastly, we will discuss initiatives that are more cross-sector in nature, that is to say actions aimed at promoting smart technologies, skills and training, and financial mechanisms.

The strategy takes into account the guidance provided by the European Commission in Recommendations (EU) No 2019/786 of 8 May 2019 on building renovation and No 2019/1019 of 7 June 2019 on building modernisation, as well as the observations made following the public consultation (see box below).

Public consultation

Involvement of local and regional authorities

As already indicated in the National Energy and Climate Plan, due to Italy's constitutional set-up, the Regions have a fundamental role to play in achieving energy and climate targets. The role of local authorities is equally important.

The Strategy has therefore been discussed with the Regions and with local authorities. The discussion took place during the Joint State-Regions and State-Cities and Local Autonomies Conference, involving the Ministries of Economic Development, of the Environment (now merged into the Ministry of Ecological Transition as regards environmental energy issues) and of Infrastructure, all of the Regions (represented by energy and environmental experts) and the Association of Italian Municipalities. Comments and additions, also prepared in light of the European Commission's recommendations, were presented and examined during this discussion and have been included in the final version of the document. From a formal point of view, the Unified Conference expressed a positive opinion on the Strategy in a document dated 25 March 2021.

Public consultation with interested parties

By means of a public notice and a dedicated mailbox, everyone (citizens, businesses, workers' associations, trade associations, non-profit organisations, professionals in the sector, financial institutions and investment funds, etc.) was given the opportunity to make observations on the proposed strategy. The online public consultation ran from 26 November to 16 December 2020.

The consultation provided a good number of issues for analysis: there were 32 responses in total (of which 22 came from trade associations and 10 from companies). The consultation primarily revealed the benefit of improving knowledge of the national building stock, in order to better target retrofitting policies and to further clarify the roadmap for decarbonising the civil sector by 2050, determined on the basis of the retrofitting rate, in relation to the challenging targets of the European Renovation Wave.

Many of the contributions received also address the issue of promotion measures, and a large number of them point to the need to stabilise tax incentives in the medium to long term. The consultation also highlighted the need to simplify and reform the range of incentives in the building sector, which are currently too fragmented and uncoordinated, starting with tax deductions and in particular the Superbonus. In addition, the most recurrent themes advocate the use of promotional measures to encourage the combining of projects involving neighbourhoods or small municipalities and placing particular focus on, or even prioritising, less energy-efficient buildings.

Several contributors propose introducing obligations to upgrade the buildings that consume the most energy, especially in the public sector. In addition, responses to the consultation also advocated the use of energy performance contracts and public-private partnerships (PPP) as a means of increasing the number of interventions by the public authorities, for example by linking their use to the bonuses granted when contractual results are achieved.

From a technological point of view, many technologies were mentioned by the trade associations and companies who took part in the consultation. In particular, there was frequent reference to the need to promote the integration of automation and control tools in buildings, making the building stock smarter and implementing the *smart readiness indicator* recently launched by the European Commission. The opportunity presented by integrating electric vehicle charging infrastructure into buildings was frequently cited in this regard, and the opportunity to exploit the economic potential of expanding efficient district heating was also mentioned several times.

Lastly, one topic that frequently came up in the papers sent in response to the consultation is the importance of placing a greater focus on training professionals dealing with energy retrofitting and with installing efficient systems and building components, potentially making use of tools such as the certificates issued on the basis of the technical regulations in the sector.

2. Overview of national building stock

Italy lies between the 35th and 47th parallel north, with an extensive coastline that stretches for around 7 458 km. The terrain is predominantly hilly (41.6%), with some mountainous (35.2%) and lowland areas (23.2%). The average altitude is approximately 337 metres above sea level.

Due to its latitude, Italy's climate ranges from a Mediterranean subtropical climate in the south (with summer temperatures that can exceed 40 °C), to a continental temperate climate in the north (where temperatures can fall to -20 °C in winter). The climate is therefore extremely variable, as shown by the number of 'degree days', which range from 568 in Lampedusa (province of Agrigento) to 5 165 in Sestriere (province of Turin). The global solar radiation incident on a horizontal surface is also affected by the different latitudes in Italy, ranging from 1 214 kWh/m^2 in Ahmtal (province of Bolzano) to 1 679 kWh/m^2 in Pachino (province of Siracusa), with an average of 1 471 kWh/m^2 (0.127 toe/m^2). These data illustrate Italy's unique climate and the difficulties in defining clear building and technical standards and solutions that can be adapted to the diverse conditions.

Table 1 lists Italy's climate zones and the number of municipalities in each one. In the case of municipalities created from the amalgamation of different local authorities, the degree-day value represents the arithmetic mean of degree days in the original municipalities at the time of the administrative merger into the new single municipality. These newly created municipalities have been assigned to the climate band shown in the table on the basis of this procedure, even if, in reality, each original municipality remains in its original climate band for legislative purposes and the latter is used to calculate the resident population and buildings per climate band.

Table 1 – Number of Italian municipalities per climate zone and 'degree-days'

CLIMATE ZONE	DEGREE DAYS (DD)	NUMBER OF MUNICIPALITIES as of 1.1.2019	RESIDENT POPULATION as of 2018	% RESIDENT POPULATION
A	DD≤ 600	2	23 266	0.04%
B	600 <DD ≤ 900	157	3 217 288	5.33%
C	900 <DD ≤ 1 400	981	12 826 700	21.25%
D	1 400 <DD ≤ 2 100	1572	15 168 668	25.13%
E	2 100 <DD ≤ 3 000	4 176	27 482 108	45.53%
F	DD> 3 000	1 026	1 641 892	2.72%

Source: Processing by the Italian Agency for New Technologies, Energy and Sustainable Economic Development (ENEA) of data from the Italian National Institute of Statistics (ISTAT).

For the winter heating of existing buildings, national energy consumption can be considered proportional to the number of degree days multiplied by the population. Therefore, climate zone E, which is the most densely populated, has the highest percentage of consumption, while climate zone B has the lowest, excluding climate zone A, where only 0.04% of the population lives and which is represented by only two municipalities.

Final energy consumption in 2018 totalled 116.5 Mtoe (excluding non-energy use)[1], a 1.1% increase on 2017. The breakdown of consumption data in terms of final consumption in 2018 illustrates the impact of the civil sector, with 45% of all final consumption, unchanged in relation to 2017. Residential consumption represents 28% of the total, a decreasing value over the last five years, and the service sector 17%, showing an increase

[1] The way that Eurostat calculates energy balances changed as of 2017: under the new methodology, the level of final consumption in 2018 is 114.4 Mtoe, an increase of 0.7% compared with the previous year. The level reported in the text is provided by Eurostat applying the methodology previously used, to allow monitoring of the 2020 and 2030 targets, and is reported in the Article 7 EED Report attached to the INECP.

over the same period. The existing building stock is the sector with extremely high potential for energy savings. However, the high investment costs pose a problem both for the government and the private sector.

The next two paragraphs discuss residential and non-residential buildings, with a brief mention of nearly zero-energy buildings (nZEB) and their numbers at national level, and provide an in-depth look at the Information System on Energy Performance Certificates for Buildings (APE), a fundamental tool for knowing the energy performance of the national building stock.

nZEBs

As of 2021, all new buildings or those undergoing 'first-level' major renovation must meet the technical and performance requirements imposed by Annex 1 to the Ministerial Decree of 26 June 2015 for nearly zero energy buildings (nZEB). In addition to the overall limit on energy consumption, the minimum nZEB requirements at a national level include requirements relating to thermal performance indicators in comparison with the reference building, to the overall average coefficient of heat transfer by transmission, to the summer equivalent solar area per useful floor area and to the efficiency of heating, air conditioning and hot water production systems.

It has been estimated that all regions of Italy have seen an increase in nZEBs, which totalled around 1 400 buildings in 2018, mostly newly constructed (90%) and for residential use (85%), as indicated in the nZEB Monitoring Centre. Non-residential nZEB buildings are thus also on the increase, thanks in part to incentive policies currently in place for public buildings. In this context, the most common interventions generally involve the building envelope (opaque, transparent and solar shading), replacing or upgrading air conditioning, ventilation, lighting and hot water systems, installing automatic control and management technologies for thermal and electrical systems, including thermoregulatory and heat metering systems, installing monitoring, control and regulation systems and installing systems for generating renewable energy for self-consumption (solar energy, photovoltaics, heat pumps, biomass generators).

As reported in the ENEA publication 'Monitoring Centre for Nearly-Zero Energy Buildings (nZEB) in Italy 2016-2018', analyses of national and regional promotional tools show that more than 130 public buildings, mainly non-residential, are expected to have been renovated to nZEB standard by 2020[2]. However, the proportion of nZEBs in the existing building stock is no greater than 0.03% at a regional level and fewer than 10% of the total nZEBs are existing buildings upgraded to this standard, mainly small detached or semi-detached houses and schools. Another problem is the adoption of a reduced set of technologies to achieve this standard, which very often does not take account of the climate zone in which the buildings are located (increased insulation of the building envelope, electric heat pumps/condensing boilers, photovoltaic and solar energy systems for the production of hot water). This highlights that there is still a lot to be done in order to achieve a building stock with very high energy efficiency standards that is consistent with the goal of almost complete de-carbonisation of the civil sector.

[2] ENEA, Costanzo E., Basili R., Hugony F., Misceo M., Pallottelli R., Zanghirella F., Labia N., 2019. Monitoring Centre for Nearly-Zero Energy Buildings (nZEB) in Italy 2016-2018.

2.1. Residential buildings

Italy has 12.42 million buildings intended for residential use, with almost 32 million dwellings. Over 65% of this building stock is more than 45 years old, i.e. it predates Italian Law No 373[3] of 1976, the first law on energy saving. Of these buildings, over 25% have annual consumption ranging from a minimum of 160 kWh/m^2 per year to over 220 kWh/m^2. Of the total number of dwellings, 22% are unoccupied, predominantly older buildings.

The current state of residential building stock is shown below, with the number of buildings and the relative heated useful floor area, broken down by period of construction[4] (Table 2) and climate zone (Table 3). Only the floor area values per construction period are calculated by assuming the same average building floor area for all construction periods[5]. Table 4 also indicates the state of preservation of buildings by climate zone.

Table 2 – Number and floor area of residential buildings in 2018, per period of construction

Period of construction	Number of buildings	Period of construction	m^2
pre-1919	1 832 503	**pre-1945**	678 743 665
1919-1945	1 327 007		
1946-1960	1 700 834	**1946-1976**	1 293 138 628
1961-1970	2 050 830		
1971-1980	2 117 649		
1981-1990	1 462 766	**1977-1990**	600 244 196
1991-2000	871 017	**1991-2014**	439 536 250
2001-2005	465 092		
2006-2011	359 991		
2011-2018	232 714	**post 2014**	38 143 445
Total	12 420 403	**Total**	3 049 806 184

Source: Processing of various data by Cresme.

Table 3 – Number and floor area of residential buildings in 2018, by climate zone

	Number of buildings	m^2
Zone A	5 217	170 118 357
Zone B	710 079	
Zone C	2 737 222	615 486 151
Zone D	2 896 204	734 707 925
Zone E	5 340 672	1 383 758 265
Zone F	731 009	145 735 486
Total	12 420 403	3 049 806 184

Source: Processing of various data by Cresme.

[3] Rules for reducing energy consumption for heating in buildings.

[4] This breakdown has already been employed to develop a cost-optimal methodology, used to define the minimum energy performance requirements for buildings on the basis of cost-optimal levels. This topic is discussed in more detail in Chapter 4.

[5] As the floor area per construction period was not available, an approximation was made whereby the total floor area of the Italian building stock was divided by the total number of buildings and then this value was multiplied by the number of buildings per construction period.

Table 4 – Number of residential buildings per state of preservation in each climate zone in 2018

State of preservation	Very good	Good	Average	Poor
Zone A	1 060	2 672	1 332	182
Zone B	153 554	374 118	161 533	20 844
Zone C	657 071	1 519 139	505 024	55 988
Zone D	829 538	1 551 451	464 356	50 861
Zone E	2 020 939	2 591 860	658 495	69 376
Zone F	284 263	344 705	91 680	10 362
Total	3 946 423	6 383 945	1 882 420	207 613

Source: Processing of various data by Cresme.

The increasing prevalence of energy poverty suggests that it is important to focus on public housing, i.e. dwellings owned or managed by companies that were formerly part of the Italian Autonomous Institute for Public Housing (IACP)[6]. There are just over 710 000 of these homes in Italy, as shown in the table below.

Table 5 – Number and floor area of ex-IACP residential buildings in 2018, by climate zone

	Number of dwellings in ex-IACP residential buildings	m^2
Zone A	323	25 525
Zone B	47 370	3 707 379
Zone C	149 549	12 248 408
Zone D	189 043	14 282 064
Zone E	306 167	22 115 704
Zone F	18 142	1 291 259
Total	710 594	53 670 340

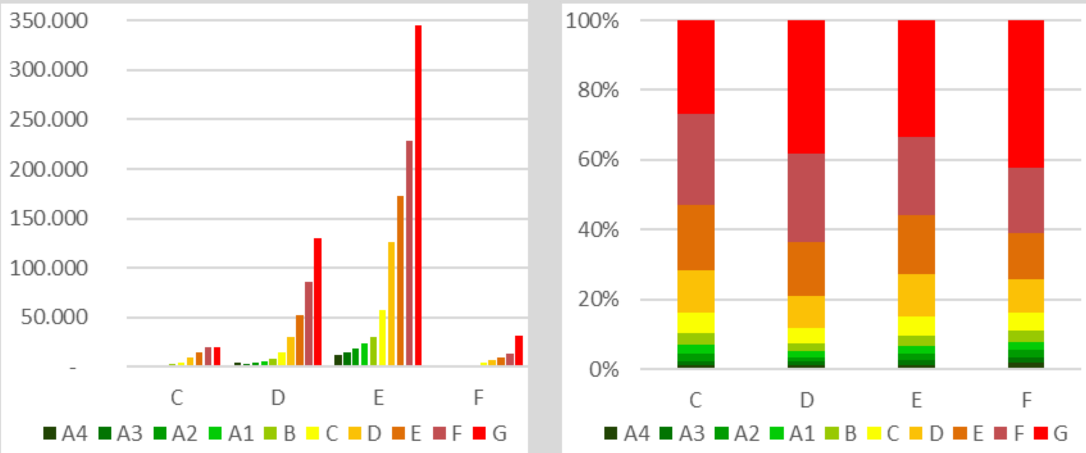
[6] When discussing public housing, it is preferable to talk about dwellings, given that ownership of different properties within a building is often mixed, as some residents may have bought their home and also subsequently sold it.

The Energy Performance Certificate Information System

The Energy Performance Certificate Information System (Il Sistema Informativo sugli Attestati di Prestazione Energetica – SIAPE) is the national tool for collating energy performance certificates, set up in accordance with the Interministerial Decree of 26 June 2015. The SIAPE, created and managed by ENEA, is supplied with data from the Regions and the Autonomous Provinces, thanks to a single shared XML path, which creates a connection between the national land register and the regional and provincial land registers. Access is granted to Regions and Autonomous Provinces on the basis of their geographical area of competence; data relating to the rest of the national territory can only be consulted in aggregated form. This second form of access is also open to citizens, as is the opportunity to generate statistics relating to existing energy performance certificates.

At the end of 2019, the database contained data on approximately 1 550 000 energy performance certificates, granted during the 2016-2019 issuance period and belonging to eight Regions and two Autonomous Provinces; a new Region was added at the start of 2020 and a further 7 Regions have requested access credentials. One of the Regions currently on the SIAPE started uploading data at the end of December 2019; for this reason, these data were not considered in the analyses. The certificates stored in the SIAPE and issued in the period 2016-2019 for the most part cover the central and northern areas of Italy, and quite closely track the actual distribution of Italian climate zones, in particular zones E and F. The distribution of this data shows 5% in climate zone C, 22% in D, 68% in E and 5% in F (**Error! Reference source not found.**).

Figure 1 – Distribution of energy performance certificates per energy class and climate zone in the period 2016-2019



a. Numerical distribution **b. Percentage distribution**

Numbers drop significantly in each climate zone as the energy class improves, confirming the low level of energy retrofitting of the national building stock. In fact, more than half of the buildings fall into the worst energy classes (F-G), with a peak in climate zone F, where energy class G alone accounts for just over 40% of buildings. However, climate zone F also has the highest percentage of buildings in the best energy classes (A4-B).

85% of the certificates entered in the SIAPE and issued during the period 2016-2019 relate to the residential sector and 15% to the non-residential sector. However, this distribution varies according to energy class, especially in the intermediate energy classes, where the non-residential sector is more representative (30% of cases). In fact, in the analysis of the distribution by energy class (Table 5a), the majority of properties in energy classes C and D are from the non-residential sector, whereas the residential sector clearly predominates in energy classes F and G.

Table 5a – Distribution of energy performance certificates per energy class and intended use in the period 2016-2019

	A4	A3	A2	A1	B	C	D	E	F	G
Residential	1.0%	1.0%	1.4%	1.7%	2.2%	4.1%	9.8%	16.5%	25.0%	37.3%
Non-residential	0.5%	0.7%	1.3%	2.5%	5.4%	11.9%	21.2%	18.6%	15.2%	22.6%

Source: Processing of SIAPE data by ENEA.

Surveys looking at the year of construction partly explain the large number of buildings in the worst energy classes, showing that most of the national building stock (more than 40%) dates from the period between 1945 and 1972. In addition, an analysis of the reasons for drawing up an energy performance certificate reveal that it is predominantly due to a transfer of ownership and leasing (more than 80% of cases), procedures which do not lead to improvements in energy performance. 3.7% of the energy performance certificates analysed relate to major renovations, followed by new constructions (3.4%) and energy retrofitting (2.7%).

2.2. Non-residential buildings

According to ISTAT, there are 1 576 159 buildings and building complexes for non-residential use in Italy, representing about 11% of the total; these buildings are grouped by ISTAT into the following categories: manufacturing, commercial, offices/tertiary, tourism/hospitality, services and other kinds of use. For the purposes of the analysis, non-residential buildings have been grouped into the most widespread categories, with the exception of manufacturing: schools, offices, shopping centres, hotels, healthcare, penal institutions, barracks.

Schools: nationwide, there are about 56 000 buildings entirely or partly reserved for use as schools. 30% of school buildings are concentrated in 10 provinces (the top three being Rome, Milan and Naples). More than half (51%) are distributed over 24 provinces. About 29% of schools are located in very small municipalities (up to 5 000 inhabitants), and roughly the same percentage in medium-small municipalities. The floor area of school buildings is 84.3 million m^2 and their total volume is 256.4 million m^3. The largest share of school buildings (39%) have a floor area between 1 000 and 3 000 m^2 with an average of 1 819 m^2. Some 43% of school buildings can be broken down by floor area into the following three categories: 16% have a floor area between 751 and 1 000 m^2 (average 899 m^2), 14% between 501 and 750 m^2 (average 631 m^2) and 13% between 351 and 500 m^2 (average 435 m^2). Table 6 shows the number of school buildings and their useful floor area by climate zone and Table 7 gives a further breakdown by climate zone and period of construction.

Table 6 – Number of school buildings and corresponding floor area per climate zone

	Number of school buildings	m^2
Zone A	17	21 180
Zone B	3 340	4 412 730
Zone C	11 471	17 223 700
Zone D	13 867	19 671 840
Zone E	24 839	40 236 020
Zone F	2 515	2 773 500
Total	56 049	84 338 970

Source: Processing of various data by Cresme.

Table 7 – Floor area of school buildings (thousands m^2) broken down by period of construction and climate zone

Period of construction	A - B	C	D	E	F	Total
Pre-1945	804.4	2 269	3 646.4	8 117.7	586.5	15 424
1946-1976	1 457.6	8 364.9	10 345.3	20 178.1	1 539	41 885
Post 1976	2 171.9	6 589.8	5 680.1	11 940.2	648	27 030

Source: Processing of various data by Cresme.

Offices: nationwide, there are around 74 358 private buildings entirely or mainly for office use. The breakdown by period of construction and climate zone is shown in Table 8, the number and floor area per climate zone in

Table 9 and the state of preservation by climate zone in

Table 10. A total of 30% of office buildings are concentrated in 12 provinces (the top three being Rome, Milan and Turin) and 50% are located in 26 provinces. About half (53%) are located in small and medium-sized municipalities (up to 20 000 inhabitants). Office buildings have a total floor area of around 63 million m^2.

Table 8 – Number of office buildings by period of construction and climate zone

Period of construction	A	B	C	D	E	F
Pre-1919	0	596	2 224	3 678	5 373	429
1919-1945	0	671	1 178	1 273	2 379	138
1946-1960	0	1 083	1 379	1 705	2 682	119
1961-1970	6	414	1 239	2 041	3 487	191
1971-1980	6	346	1 273	1 607	3 279	131
1981-1990	0	553	1 676	1 415	3 536	137
1991-2000	0	463	1 947	2 065	4 953	256
2001-2011	0	1 096	1 999	2 496	4 782	147
2012-2018	12	639	2 257	1 880	2 918	204
Total	24	5 861	15 172	18 160	33 389	1 752

Source: Processing of various data by Cresme.

Table 9 – Number of office buildings and corresponding floor area per climate zone

	Number of office buildings	Up to 2 floors m^2	3-5 floors m^2	More than 5 floors m^2	Tot m^2
Zone A-B	5 885	1 175 800	2 732 600	343 500	4 251 900
Zone C	15 172	3 753 800	5 070 100	1 589 200	10 413 100
Zone D	18 160	3 669 000	9 614 200	2 106 900	15 390 000
Zone E	33 389	7 698 520	17 880 220	5 895 820	31 474 560
Zone F	1 752	200 300	1 214 410	69 000	1 483 610
Total	74 385	16 497 420	36 511 530	10 004 420	63 013 170

Source: Processing of various data by Cresme.

Table 10 – Office buildings per state of preservation in each climate zone

State of preservation	Very good	Good	Average	Poor
Zone A	0	12	12	0
Zone B	257	1 613	2 040	1 951
Zone C	498	3 023	6 266	5 385
Zone D	416	4 071	9 389	4 284
Zone E	781	7 529	16 775	8 304
Zone F	9	207	1 050	486
Total	1 961	16 455	35 532	20 410

Source: Processing of various data by Cresme.

The above office data includes around 17 000 public buildings entirely or mainly for office use, covering a total area of almost 27 million m^2, broken down by climate zone as follows:

Table 11 – Number of public offices and corresponding floor area per climate zone

	Number of public buildings for office use	m²
Zone A	2	2 210
Zone B	1 111	2 238 557
Zone C	3 565	5 942 715
Zone D	4 721	9 373 066
Zone E	7 114	9 443 497
Zone F	716	845 528
Total	17 229	27 845 573

In addition to the above, it is also important to consider the number of office units located within buildings with a different primary use. These total 662 847 property units, corresponding to a floor area of 72 798 800 m², of which 55% are located in climate zone E[7].

Publicly owned real estate entered into the SIAPE

The certificates entered into the SIAPE during the 2016-2019 issuance period include around 18 500 energy performance certificates relating to public property and around 6 000 energy performance certificates related to buildings for public use, representing almost 2% of the overall total; the remaining certificates refer to privately owned buildings.

The following analyses only relate to the energy performance certificates of publicly owned buildings, as it is not possible to specify the actual ownership of certificates relating to buildings for public use. The distribution of the certificates relating to public property entered into the SIAPE in terms of period of construction (Table 12) follows the general pattern, with slightly lower percentages for more recently constructed buildings.

Table 12 – Distribution of energy performance certificates relating to public property issued in the period 2016-2019 by period of construction

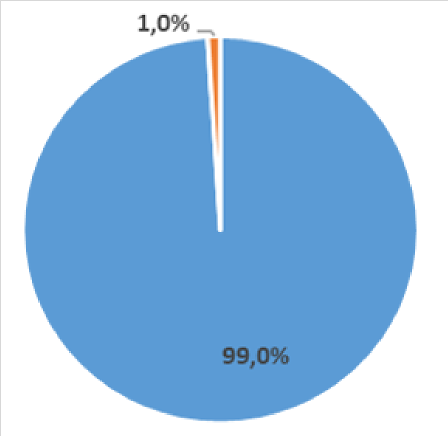
pre-1945	1945-1972	1972-1991	1992-2005	2006-2015	2016-2019
21.3%	36.8%	21.9%	13.1%	3.8%	3.1

Source: Processing of SIAPE data by ENEA.

The distribution of certified publicly owned buildings entered in the SIAPE and issued with a certificate in the period 2016-2019 shows 65% of properties in the residential sector and the remaining 35% in the non-residential sector; the majority of buildings in the latter fall into the following categories set out in Italian Presidential Decree No 412/1993: E.7 (schools), E.2 (offices), E.5 (commercial activities) and E.4 (recreational activities).

[7] It should be noted that the m² of these property units, as well as the floor area relating to property units for commercial and catering use which will be described below, are not counted in the categories to which they belong, i.e. office and commercial respectively. The approach developed does not in fact allow for retrofitting of individual property units, as it focuses on the types of interventions that, by their very nature, involve retrofitting of entire buildings for residential, office or school use.

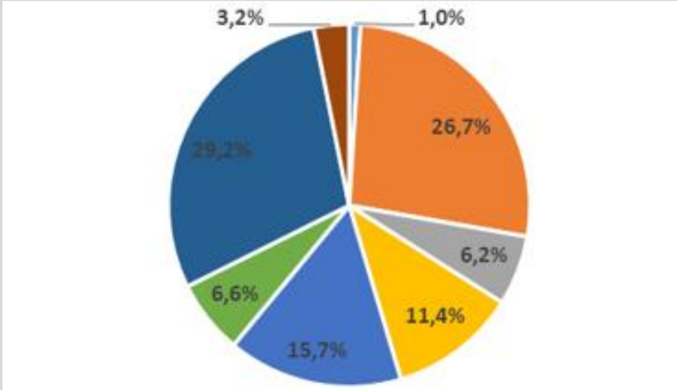
Figure 1 – Distribution of energy performance certificates relating to public property issued in the period 2016-2019, according to the intended use as categorised by Presidential Decree 412/1993



E.1(1) Dwellings used as residences on a continuous basis, such as civil and rural dwellings, colleges, convents, penal institutions and barracks

E.1(2) Dwellings used as occasional residences, such as holiday homes, weekend homes and the like

a. **Residential**



E.1(3) Buildings used as hotels, guest houses and similar purposes

E.2 Buildings used as offices and the like

E.3 Buildings used as hospitals, clinics or nursing homes and the like

E.4 Buildings used for recreation, association activities, worship or the like

E.5 Buildings used for commercial activities and the like

E.6 Buildings used for sporting activities

E.7 Buildings used for educational activities at all levels and the like

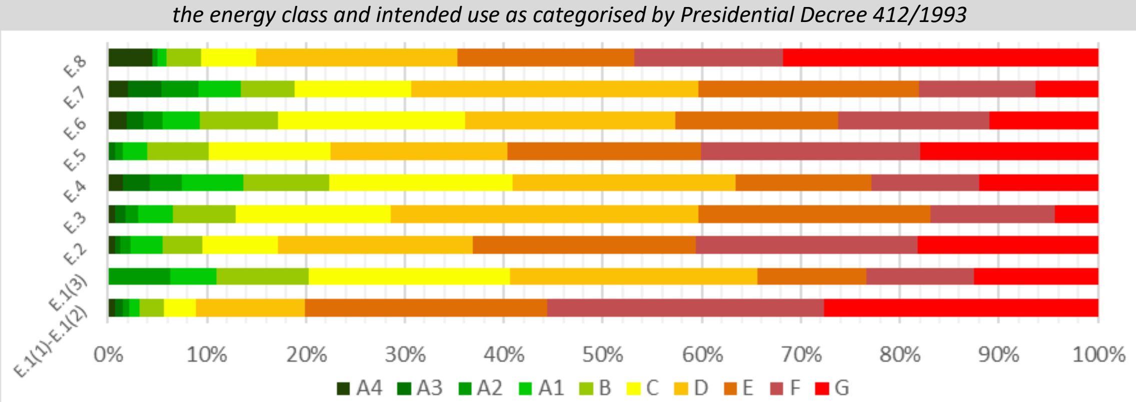
E.8 Buildings used for industrial and craft activities and the like

b. **Non-residential**

Source: Processing of SIAPE data by ENEA.

The distribution of energy classes (Figure 2) across the residential sector (E.1(1)-E.1(2)) shows an increasing trend from the most efficient to the least efficient classes, in line with the national trend. However, it is interesting to note that non-residential uses show a greater number of properties in the intermediate energy classes (D-E). In particular, the most energy efficient properties, with around 20% of energy performance certificates in energy classes A4-B, are those used for recreational activities, association activities and worship (E.4) and hotels and guest houses (E.1(3)), followed by those used for educational activities (E.7) and sporting activities (E.6).

Figure 2 – Distribution of energy performance certificates relating to public property issued in the period 2016-2019, according to the energy class and intended use as categorised by Presidential Decree 412/1993



Source: Processing of SIAPE data by ENEA.

As regards the overall results, property transfers have halved (23.8%), while rentals (39.3%) and energy retrofitting (8.1%) have increased; major renovations (3.2%) and new buildings (2.1%) remain stable. The percentage of cases in the 'Other' category has increased (23.5%) as a result of it being necessary to draw up a certificate in order to access tender procedures or incentives from the government or to meet regulatory obligations.

Commercial sector: This sector refers to various commercial activities. It covers a wide range of building types, such as entire buildings (supermarkets, department stores, etc.), complexes (shopping centres, etc.), and building units (shops, boutiques, workshops, etc.). The total floor area in the commercial sector[8] amounts to over 287 million m^2, distributed across the various climate zones as shown in Table 13:

Table 13 – Buildings for commercial use and corresponding floor area per climate zone

	Number of buildings for commercial use	m^2
Zone A	80	54 300
Zone B	11 297	10 874 400
Zone C	50 282	44 823 800
Zone D	60 050	58 983 600
Zone E	129 693	164 838 300
Zone F	8 549	7 565 800
Total	259 951	287 140 200

Source: Processing of various data by Cresme.

Italy has 876 300 businesses classified as shops and boutiques, including 261 600 catering businesses (restaurants, pizzerias and bars) covering around 44 million m^2, 22 300 large-scale retail businesses covering almost 25 million m^2 and the remainder relating to retail trade of various kinds. The large-scale retail trade category can be divided into five sub-types, detailed in the table below.

Table 14 – Breakdown of floor area of large-scale retail businesses

Sub-type	Number of businesses	m^2
Mini-market	5 724	1 654 028
Supermarket	10 781	10 124 147
Hypermarket	692	3 973 374
Department store	3 263	3 578 382
Large specialised store	1 847	5 653 377
Total	22 307	24 983 308

Source: Processing of various data by ENEA.

[8] Information on the general commerce sector comes from Cresme, while that on large-scale retail trade is taken from the National Trade Observatory (http://osservatoriocommercio.sviluppoeconomico.gov.it/Indice_GDO.html)

There are 1 162 263 commercial property units located in buildings with a different primary use, corresponding to a floor area of 82 651 700 m^2. In this case too the majority of these buildings are in climate zone E (42% of the total). There are 270 176 catering units located in buildings with another primary use, covering a floor area of 32 560 200 m^2; 45% of these units are in climate zone E.

Hotels: nationwide, there are about 27 000 buildings used entirely or primarily as hotels.

Just over 20% of buildings were constructed before 1919; the last twenty years have seen a drop in construction compared to previous periods. Hotel buildings cover a total floor area of over 36.5 million m^2. Table 15 shows the number of hotel buildings and corresponding floor area per climate zone.

Table 15 – Breakdown of floor area of buildings for hotel use by climate zone

	Number of buildings for hotel use	m²
Zone A	25	48 400
Zone B	906	1 591 500
Zone C	3 759	5 374 800
Zone D	5 464	7 482 400
Zone E	11 406	15 661 800
Zone F	5 583	6 391 500
Total	27 143	36 550 400

Source: Processing of various data by Cresme.

Hospitals: According to the Statistical Yearbook of the Italian Health Service, in 2017 there were more than 27 000 public and private accredited health facilities in Italy, divided by sub-type in the table below. In total, there are 165 260 beds used for ordinary hospitalisation, day hospital and day surgery in public facilities and 43 897 in accredited private facilities.

Table 16 – Number of facilities by type of care provided and beds, year 2017

Care	Type of facility		
	Public facility	Private accredited facility	Total
In-hospital patient care	518	482	1 000
Specialist outpatient care	3 514	5 353	8 867
Local residential care	1 302	6 070	7 372
Local semi-residential care	968	2 118	3 086
Other non-hospital care	4 862	724	5 586
Rehabilitation (pursuant to Article 26)	248	874	1 122
Total	11 412	15 621	27 033

Source: Ministry of Health.

Penal institutions: there are 198 penal institutions in Italy, the floor area of which is broken down by climate zone in Table 17; Table 18 shows the number of buildings by period of construction and climate zone.[9]

[9] The information reported here has been processed by Cresme using data from the Ministry of Justice.

Table 17 – Breakdown of floor area of buildings used as penal institutions

	Number of buildings used as penal institutions	m²
Zone A	-	-
Zone B	19	193 364
Zone C	41	723 273
Zone D	64	876 732
Zone E	70	1 296 793
Zone F	4	48 095
Total	198	3 138 257

Source: Processing of various data by Cresme.

Table 18 – Breakdown of the number of buildings used as penal institutions by period of construction and climate zone

Period of construction	Zone A	Zone B	Zone C	Zone D	Zone E	Zone F	Total
pre-1900	-	3	8	10	11		32
1900-1945	-	5	7	14	9	1	36
1946-1975	-		2	10	5	1	18
1976-1990	-	4	6	18	22	2	52
1990-2000	-	4	13	6	9		32
post-2000	-	3	3	2	5		13
not specified	-		2	4	9		15
Total	-	19	41	64	70	4	198

Source: Processing of various data by Cresme.

Barracks: in Italy there are 7 351 buildings and property units used as barracks, the floor area of which is broken down by geographical area in Table 19. The table also includes building complexes, which can represent a group of buildings, a single building or even a single property unit.

Table 19 – Breakdown of floor area of buildings and property units used as barracks

Geographical area	Declared gross floor area	Number of buildings / property units	Number of building complexes
North-west	2 855 234	1 507	477
North-east	2 694 446	1 535	571
Centre	4 012 037	2 029	548
South	2 579 698	1 531	617
Islands	1 823 950	749	276
ITALY	13 965 365	7 351	2 489

Source: Processing of various data by Cresme.

Table 22 summarises the composition of the building stock for the different sectors looked at in this chapter.

Table 20 – Composition of the building stock by sector[10] (Source: Processing of various data by ENEA.)

[10] Excluding property units located within buildings with a different primary use

Intended use	Number of buildings/facilities	Floor area
Single-family or two-family	9 298 410	1 347 849 624
Multi-family residential	3 121 993	1 701 956 558
Government offices	17 229	27 845 573
Hospitals	27 103	49 600 000
Schools	56 049	84 338 970
Private offices	57 129	35 167 597
Hotels	27 143	36 550 400
Penal institutions	198	3 138 257
Barracks	2 489	13 965 365
Commercial:	**Number of**	**Floor area**
Mini-market	5 724	1 654 028
Supermarket	10 781	10 124 147
Hypermarket	692	3 973 374
Department store	3 263	3 578 382
Large specialised store	1 847	5 653 377
Other	853 993	262 156 892

Source: Processing of various data by ENEA.

<u>The databases of the State Property Office</u>

As part of the drive to limit expenses related to the use of real estate by the Italian government, the State Property Office (Agenzia del demanio) implemented a process aimed at developing the knowledge base needed by the public authorities in order to determine their intervention plans. The strategic objective is to help the public authorities to create a virtuous circle by optimising the management and utilisation of buildings in use in line with an approach that includes proper maintenance planning, a rational use of the space available in relation to work processes and a rational use of the resources intended to ensure the functioning of the buildings. In this regard, particular attention was given to the need for a property management system that takes into account the total cost of managing the entire building, i.e. including all facility costs, including energy costs, in addition to the rent. Measures to optimise the use of real estate can be diverse and should be implemented with a systemic approach and from a planning perspective. The PA portal is the IT tool introduced by the State Property Office which public authorities can use to communicate a series of data/information providing details about the activities proposed to render real estate more efficient. Through the **RATIO** application, public authorities provide information about the composition of building stock (floor area, according to the different intended uses), the human resources allocated and the rents paid. They also communicate their space requirements for the years to come, so that the Office can arrange for the provision of buildings to the authorities that need them (or to divest of properties that are no longer needed). On the other hand, **the app IPer** (performance indicator) was created to measure the energy efficiency of government-owned property or property owned by other parties and used by public authorities. This tool, developed entirely in-house, enables the management of a considerable amount of data, both physical and technological, by measuring the energy performance of public buildings based on reference benchmarks developed directly by the system. Since the project began, the Office has already processed millions of pieces of information based on the behaviour of **20 central government authorities** occupying some 22 000 properties: a real and proper database designed to promote responsible behaviour in the use of public assets by identifying gold standards with which public authorities must conform. This information is then shared with the Ministry of Ecological Transition in order to plan energy efficiency measures that help to achieve EU targets.

2.3. Estimating consumption

The average consumption for the different intended uses was calculated on the basis of the distribution of buildings by climate zone and period of construction, as referred to in this chapter, as well as consumption data taken from statistical surveys on a representative set of buildings. This set was determined using a study that defined the representative sample of buildings for each intended use and the most common building type. As an energy consumption indicator, kWh/m^2/year was used in relation to the useful floor area of the building. The indicator was harmonised by referencing the climate zone, intended use and building type. The following table contains the average annual final consumption indicators for each intended use.

Table 21 – Intended use and average annual consumption indicator weighted by climate zone

Intended use	Electric energy consumption (kWh/m^2/year)	Thermal consumption (kWh/m^2/year)	Total consumption (kWh/m^2/year)
Single-family residential properties	38	142	180
Multi-family residential properties	35	125	160
Government properties	50	114	164
Hospitals	211	185	396
Schools	20	130	150
Offices	67	130	197
Hotels	92	139	231
Penal institutions	50	191	241
Commercial:			
Mini-market			535
Supermarket			598
Hypermarket			527
Department store			255
Large specialised store			219
Other			388

Source: Processing of various data by ENEA.

The analysis developed by ENEA and Assoimmobiliare (National Real Estate Association), on the basis of the data reported in the energy audits[11] carried out on 120 buildings entirely for office use, has become a useful point of comparison for supplementing the information available for estimating the consumption of private offices.

The consumption values for the residential sector and for offices and schools in the tertiary sector show predominantly thermal uses, mainly due to the need to heat rooms in the winter, a service for which electricity is not yet commonly used. However, this difference is less noticeable in relation to hotels, where air conditioning is widely used in the summer.

In terms of energy end-use, national and European studies show that the most widely used energy carrier in the large-scale retail trade is electricity (over 90%). A study of energy audits for the food sector in particular reveals an average percentage of almost 95%, including energy taken from the grid, self-generated energy and self-consumed energy. The average specific consumption values for the various sub-types of large-scale retail trade and the supermarket and hypermarket values are also taken from the study of energy audits.

The specific consumption values for hospitals are taken from the information in the box below, based on a number of assumptions relating to the m^2 per bed at national level. Data collected from the energy audits of

[11] Received by ENEA under Article 8 of the Energy Efficiency Directive.

a sample of hospitals provided a useful point of comparison in this case too. As far as penal institutions are concerned, some energy analyses carried out by ENEA as part of the Energy Retrofitting Programme for Central Government Buildings (PREPAC) have also provided useful supplementary information.

Lastly, a recent survey conducted by Cresme on a sample of 1 430 public housing properties shows an overall level of consumption about 4% higher than the overall value for the housing stock estimated by Cresme for 2018[12]. This discrepancy appears to be driven by electricity consumption, which is about 16% higher, while heating consumption seems more in line (+1%). This figure should be read taking into account various specific circumstances: a lower number of unoccupied dwellings in public housing, more time spent at home (elderly people and fewer workers), and a combination of old heating systems and a low number of energy modernisation works. It should also be noted that, due to the average size of dwellings being smaller, the average consumption per dwelling is lower than that estimated for the total housing stock.

In general terms, Table 21 shows that users in the non-residential sector, particularly in the case of certain uses, have very high energy consumption, and there is therefore a lot of potential for increasing energy efficiency.

2.4. National Portal on the energy performance of buildings

The National Portal on the energy performance of buildings was set up by way of Legislative Decree No 48 of 10 June 2020, which amended Legislative Decree No 192 of 2005 to transpose the EPBD III Directive.

Specifically, the Portal brings together the data from national databases relating to the composition of building stock and its energy consumption into a single database, and also provides citizens, businesses and the government with information about the energy performance of buildings, about best practices for energy retrofitting in terms of cost and about existing promotional tools to improve the energy performance of buildings, including the replacement of fossil-fuelled boilers with more sustainable alternatives and energy performance certificates.

The public consultation in fact revealed that in-depth knowledge of the national building stock needs to be improved in order to better guide strategic choices aimed at achieving decarbonisation and the environmental energy targets for the coming decades.

The Portal will therefore be an important source of knowledge both for policy-makers, who will be able to better adjust regulatory and promotional measures to achieve targets, and for private sector operators and citizens, who can access complete sets of information, and assess and plan energy efficiency measures for buildings, including for subsequent stages.

Thanks to this tool, future versions of this Strategy can be updated and refined, with a more complete data set that is more reflective of the real situation.

Estimating energy consumption in public health facilities

Annex 10 of the Consip Agreement 'Technological integrated multi-services for providing energy for healthcare ed. 2' determines the unit price of a single kWh for winter heating systems powered by natural gas (methane), LPG and other gaseous and solid fuels to be 0.125 EUR/kWh and the unit price of a single kWh for heating appliances integrated with winter heating systems (production systems for domestic hot water, superheated water, steam, domestic water systems and systems for uses other than heating) powered by natural gas (methane), LPG and other gaseous and solid fuels to

[12] The data included in Sections 2.1 and 2.2 were, for the most part, provided by Cresme as part of a contract with ENEA aimed at providing information support for the drafting of this Strategy. The survey of ex-IACP buildings is part of this activity.

be 0.110 EUR/kWh. The average of these costs/kWh was taken as a reference for estimating energy consumption, starting with the cost category referred to as ‘heating’ in the P&L form ‘Form for recording the profit and loss statement’, which is used to record the profit and loss items of local health units, public hospitals, Scientific Institutes for Research, Hospitalisation and Healthcare (IRCCS) and public university hospitals (source: profit and loss statement database of the Ministry of Health as at 18 November 2019). The estimated energy consumption for heating at national level for years 2011-2016 is shown in the table below. The tender specifications of the Consip Agreement ‘Technological integrated multi-services for providing energy for healthcare ed. 2’ determines the unit price of kWh for the supply of electricity net of the spread relating to the consumption from the grid segment and the spread relating to the consumption from renewable sources segment (National Single Price, PUN). It conventionally represents the economic value, expressed in €/kWh, given by the sum of charges relating to the PUN, expenses, point of dispatch, network losses, transport and taxation and has been calculated as 0.162 €/kWh. Applying this unit price/kWh to the cost category ‘electricity’ of the P&L form ‘Form for recording the profit and loss statement’ gives the estimate of electricity consumption on a national scale by public health facilities in the period 2011-2016 (source: profit and loss statement database of the Ministry of Health as at 18 November 2019) as shown in the table below:

Table 20 – Estimated heating and electricity consumption by public health facilities

	Heating			Electricity		
YEAR	**costs (EUR 1000)**	**unit price (EUR/kWh)**	**estimated consumption (MWh)**	**utility costs (EUR 1000)**	**unit price utilities (EUR/kWh)**	**estimated consumption utilities (MWh)**
2011	532 371	0.1175	4 530 817	659 545	0.162	4 071 265
2012	598 296	0.1175	5 091 880	764 650	0.162	4 720 061
2013	666 576	0.1175	5 672 987	803 339	0.162	4 958 882
2014	665 958	0.1175	5 667 727	811 921	0.162	5 011 858
2015	636 798	0.1175	5 419 557	783 939	0.162	4 839 129
2016	619 488	0.1175	5 272 238	749 187	0.162	4 624 611
2017	609 236	0.1175	5 184 987	744 021	0.162	4 592 722
2018	611 452	0.1175	5 203 847	756 639	0.162	4 670 613

Source: Data processing by the National Agency for Regional Health Services (AGENAS).

Based on the data available in the open data section on the Ministry of Health’s website, the public health facilities that are the subject of the previous analyses, their beds, estimated energy consumption and heating and electricity expenditure have been grouped by climate zone for the year 2016 in the table below:

Table 21 – Estimate of consumption of public health facilities by climate zone

Climate zone	Public health facilities	Number of beds	costs electricity (EUR 1000)	costs heating (EUR 1000)	estimated electricity consumption (MWh)	estimated heating consumption (MWh)
A	0	0	0	0	0	0
B	22	5 974	64 101	13 656	395 687	116 228
C	34	10 599	130 795	71 355	807 379	607 284
D	28	13 783	181 768	111 516	1 122 026	949 078

E	37	17 070	364 798	387 572	2 251 840	3 298 491
F	1	735	15 176	27 350	93 679	232 765
Total	122	48 161	756 639	611 452	4 670 613	5 203 847

Source: Data processing by AGENAS.

3. Current status of energy retrofitting

3.1. Legislation on renovations

Commission Recommendation (EU) 2019/786 on building renovation, reiterating Directive 2012/27/EU on energy efficiency, indicates that deep renovations are those leading to refurbishment that reduces the energy consumption of a building by a significant percentage compared with pre-renovation levels, leading to very high energy performance.

In Italy, the concept of major renovation has been defined under Law No 90/2013 and the Ministerial Decree of 26 June 2015 (Minimum Requirements), distinguishing between various types of intervention. Demolition and reconstruction and expansion of existing buildings with a new system (with a gross air-conditioned volume in excess of 15 % of the existing volume or more than 500 m^2) are also included in and are considered to constitute new construction projects. By contrast, 'major renovation' is defined as work on the integrated elements and components making up the building envelope that divide a temperature-controlled volume from the external environment or non-air conditioned rooms, covering more than 25% of the total gross dispersing surface of the building.

Major renovations are divided into first-level and second-level renovations. The former concern measures involving more than 50% of the total gross dispersing surface of the building and, at the same time, the renovation of the winter heating and/or summer air conditioning system serving the building itself. In this case, the requirements apply to the whole building and therefore refer to its energy performance in relation to the service(s) concerned. Second-level major renovations, on the other hand, concern measures involving from 25% to 50% of the total gross dispersing surface of the building and possibly also the refurbishment of the system for heating in winter and air conditioning in summer.

All other energy retrofitting measures fall outside of this classification, if they have an impact on the building's energy performance but involve a surface area equal to or less than 25% of the total gross dispersing surface of the building and/or consist of the new installation or renovation of the heating system serving the building, or of other partial interventions, including replacing the generator. In this case, the energy performance requirements apply only to the components involved in the intervention and refer to their relative technical, physical or efficiency characteristics. Major renovations of course include those with nZEB (nearly Zero Energy Building) objectives, which represent a key challenge in strategic terms. In fact, the European target for 2050 is a decarbonised building stock, which can only be achieved by applying the nZEB standard to existing buildings too.

3.2. Safety issues

In order to optimise the cost-benefit ratio of actions that need to be taken when undertaking the major renovation of a building, it is useful to supplement the objective of energy efficiency with policies and measures which focus on something other than efficiency, such as measures linked to the structural and fire safety of buildings, in order to address the risks relating to earthquakes and fires that affect buildings. Article 2a of the EPBD Directive (2018/844) states that, where possible, energy retrofitting measures should be implemented alongside a trigger point such as a financial transaction (for example, sale, rental, change of use), a deeper renovation not related to energy performance[13] or a disaster/accident (for example, a fire or an earthquake)[14].

The two things are often related. The possibility of a fire following an earthquake is a serious threat in an earthquake fault zone, as is the possibility of a fire during construction or renovation work. The risk of fire is usually greater during the construction of a building than during its active use, due to the greater number of ignition sources and incomplete fire protection measures.
Fire safety objectives are usually achieved through a combination of active and passive fire protection systems. Active systems control the spread of the fire and limit the damage it causes through human intervention or automatic devices; passive systems assume that the structure has been correctly designed, meaning that the building has been constructed such as to prevent the spread of fire and such that specific interventions at the time of the fire are not required. The most important component of passive fire protection is the fire resistance of load-bearing and supported structures, which must be designed to prevent the spread of fire and subsequent structural collapse.
All buildings, both new and existing, are obliged to comply with fire regulations in certain specific ways.

Regarding the seismic safety of buildings, on the other hand, it is very important to have appropriate protection measures in place. These can be implemented using:
1) seismic classification, i.e. identifying the danger posed by seismic activity in the ground (Ordinance 3274/2003);
2) seismic regulations, which require preventive measures to be implemented in buildings depending on the seismic risk of their location, and set out criteria for constructing a building in such a way as to prevent damage, or reduce the likelihood thereof following a seismic event (Ministerial Decree of 14 January 2008 – Technical standards for buildings (NTC) / 17 January 2018 – NTC update).

Under the current rules, seismic assessments must be carried out on strategic buildings, but it is not mandatory for all other existing buildings unless they are undergoing building work that falls into the category of ‘upgrading’. As a result, seismic retrofitting remains optional for most privately owned buildings.

Italy is a country with a high seismic risk and a vulnerable building stock, due to existing structures being unable to withstand seismic shocks, meaning that they often need to be made safe. The conventional definition of seismic risk (in which seismic risk = hazard x exposure x vulnerability) implies that, given the same intended use of the building and focusing on the purposes of this document, the real opportunity to work technically on the existing building stock is to remedy the vulnerability of the buildings by means of technical and structural interventions which improve their performance. However, such interventions involve a very high degree of technical complexity and significant implementation costs. It is therefore clear that in most cases where interventions are carried out on existing building stock, seismic safety is not a priority in comparison with other more urgent and practical aspects, including architectural/functional renovation of space, or ordinary or extraordinary maintenance, or even improving the energy efficiency of structures or systems in order to achieve a tangible reduction in energy costs.
However, it is crucial to adopt a holistic approach to renovating the existing national building stock, which enables an integrated assessment of the technological solutions required to improve construction from an architectural, energy and seismic perspective, which are generally considered separately. If the above

[13] The trigger point, when implementing an energy efficiency measure at the same time as other mandatory or scheduled extraordinary maintenance work, coincides with the ‘window of opportunity’ which is also used in cost-optimal methodology and allows costs to be reduced for energy efficiency measures only.

[14] When planning interventions alongside trigger points, as well as when planning energy retrofitting in order to meet the annual retrofitting rate in line with the 2030 targets (Section 5.1), it may be necessary to temporarily relocate the households affected by the renovation work, creating additional economic and social costs.

approach is taken and energy efficient interventions are carried out at trigger points, seismic retrofitting can provide an opportune moment in the life cycle of a building for also conducting energy retrofitting.

The Italian Government has provided strategic incentives in this regard, such as the 'Ecobonus' and the 'Sismabonus' which are granted for increasing the energy efficiency and improving the seismic risk class, respectively, of existing buildings in Italy. Both measures have recently been upgraded, with a priority focus on more cost-effective measures in apartment buildings.
The stand-alone Sismabonus[15] has been upgraded with more rewarding rates than those granted for simple building renovation, for measures that are more effective in terms of reducing the seismic risk class of the building. The Ecobonus has been paired with the Sismabonus[(16)] specifically for measures carried out on communal areas of apartment buildings, and is an alternative to the deductions 'Ecobonus for apartment buildings' and 'Sismabonus for apartment buildings' which are already provided separately. The idea behind this combined deduction is to exploit the huge potential for improving the efficiency of the building sector while encouraging the seismic retrofitting thereof, using the same 'trigger point' represented by the deep renovation of the building, thanks to the economy of scale that can be achieved.
Thanks to these incentives, currently confirmed to be in place until 2021, a combined seismic and energy retrofitting could entail slightly higher costs, but these are still absolutely comparable to those incurred by a single energy or seismic upgrade carried out independently, with obvious results in terms of improvement of the building in question.
Not to mention the substantial reduction in initial investment that can be obtained by choosing to make use of these incentives while also taking advantage of the option to 'transfer the credit' due for the work carried out, which means that only the remaining portion of the costs owed for the retrofitting work needs to be paid.

In view of these new opportunities, which bring economic benefits not only to the individual user but also to the nation as a whole, it is hoped that the retrofitting of the existing building stock can be integrated with improvements to its earthquake protection and fire safety. As a result, Italy would see a further increase in the indirect benefits of energy efficiency: huge losses would be avoided following an earthquake, not only financially but also in terms of human lives.

3.3. The current rate of retrofitting of the national building stock

In order to best plan the actions needed to achieve the 2030 targets and the longer-term 2050 targets, it is necessary to start with the most accurate possible view of the current situation. After having reviewed the national building stock, it is then useful to develop estimates for the rate of energy retrofitting: this enables us to see how far the current situation is from the energy saving and decarbonisation targets, expressed in terms of the retrofitting rate necessary to achieve them.

As is known, the current incentives not only promote deep renovation, but also encourage individual measures such as simply replacing windows. In order to develop a meaningful and measurable indicator of retrofitting progress, the **virtual deep renovation rate** was created with ENEA, the Institute for Environmental Protection and Research (ISPRA) and the Electrical Systems Research programme (RSE). Such

[15] The Sismabonus is a deduction relating to the adoption of earthquake safety measures (Article 16, paragraph 1-*bis*, Decree Law 63/2013) for expenses incurred for earthquake protection works carried out on structural parts of buildings or building complexes that are structurally connected, located in areas with medium or high seismic risk. Depending on the nature of the measure, deductions are 50-70-80% for houses and 50-75-85% for apartment buildings, applied to a total expenditure of no more than EUR 96 000 per property unit each year. The Sismabonus permits a 70% deduction only if the measure relates to the structure, prefabricated elements, machinery or equipment.

[16] The Ecobonus + Sismabonus combine to create a single deduction of 80% or 85%, if the measures lead to the building dropping one or two seismic risk classes. This deduction is split into 10 equal annual instalments and applies to a total expenditure not exceeding EUR 136,000 multiplied by the number of property units in each building. In order to obtain a greater deduction, in addition to the seismic upgrading (dropping one or two risk classes), the work must also comply with the energy requirements necessary to obtain the Ecobonus 'plus' deduction of 70% or 75%.

an indicator is required because it is not possible to consider a building on which a 'simple' intervention has been carried out to have been retrofitted.

This process – based on the Ecobonus and Bonus casa monitoring data – transforms the real rate of intervention (which takes into account all the properties on which measures have been carried out, even in a minimal way), through the energy savings obtained, into a virtual deep renovation rate. This value thus represents the retrofitting rate as it would be if all savings were achieved through building and system retrofitting. In this way, the contributions of all measures, whatever their nature, can be brought together.

The virtual deep renovation rate of Italy's building stock can be estimated with reference to different types of intervention and technological solutions, starting with the data relating to tax deductions for energy efficiency initiatives (the Ecobonus). Ecobonus estimates indicate that over 1.7 million energy efficiency measures were carried out in 2014-2018, of which over 334 000 took place in 2018. The annual virtual deep renovation rate of the national building stock, estimated using the average energy savings in kWh/m^2 achieved in 2014-2018 through initiatives related to paragraph 344 of the Ecobonus provision (overall retrofitting), is about 0.26%.

The estimate of the virtual deep renovation rate can be supplemented by also taking into account the efficiency measures promoted by way of tax deductions for building renovation (known as 'Bonus Casa'), for which savings of 0.225 Mtoe/year were estimated in 2018. The virtual deep renovation rate linked to the Bonus Casa is 0.59%. Taking into account both existing incentives, Ecobonus and Bonus Casa, the virtual rate of deep renovation would therefore be 0.85%, with energy savings of 0.332 Mtoe/year.

As explained above, this rate reflects how many (virtual) square metres would have been subject to energy upgrading if the measures promoted through the Ecobonus and the Bonus casa (limited to those improving energy efficiency) had all been deep renovations. A renovation rate estimated in this way is thus comparable with the annual rate estimated for the residential sector in Chapter 5 using models based on information about cost-optimal methodology.

4. Cost-effective measures and national savings potential

4.1. Assessment methodology for the cost-benefit ratio

The Energy Performance of Buildings Directive (EPBD) 2002/91/EC and the subsequent Directive 2010/31/EU (EPBD Recast) define the principles for improving the energy performance of buildings. The recast EPBD required the Member States to define the minimum energy performance requirements for buildings on the basis of cost-optimal levels. To this end, the Directive introduced a method of comparative analysis for determining the reference requirements for national standards.

Delegated Regulation (EU) No 244/2012 and the subsequent Commission Guidelines of 19 April 2012 set out a methodology framework for calculating the optimal energy requirements of buildings, from both a technical and an economic point of view.

The application in Italy of the method proposed by the Commission has made it possible to identify minimum energy performance requirements based on cost-optimal levels for new buildings and for existing buildings undergoing major or minor renovation of structures and installations.

The report entitled 'Methodology for calculating cost-optimal levels of minimum energy performance requirements (Article 5 of Directive 2010/31/EU)'[17] sent to the Commission in August 2013 presented the results of these calculations and compared them with the requirements in force. As required by Article 5 of Directive 2010/31/EU, the comparative methodology was updated in 2018, five years after it was drawn up in 2013. The new features introduced in the update are set out in the following section[18], while a detailed description of the comparative methodology can be found in the 2013 report mentioned above.

4.1.1. Main changes and calculation assumptions underlying the 2018 methodology

To better understand the results obtained with the 2018 update of the comparative methodology, it is necessary to highlight some of the main points underlying the approach taken. The main changes in relation to the assessments carried out in 2013 and the main calculation assumptions made when applying the methodology are set out below.

1. **Introduction and assessment of a no-action scenario for existing buildings**. In the technical/economic assessments of energy efficiency measures (EEM), the overall costs of measures have been taken into consideration for existing buildings, not the reduced costs if work were done in a 'window of opportunity'. Therefore, the costs of scaffolding and all ancillary works have also been considered in this updated methodology. When applying the 2013 methodology, only costs related to energy efficiency measures were considered, under the assumption that they were conducted at the same time as extraordinary maintenance works, which had to be carried out anyway. This additional assessment enables a much more realistic estimate of the investment needed and offers costs that are higher but much closer to common practice.
2. **Establishing a new intended use for the reference buildings**. The assessments were carried out for the reference buildings previously examined and also for a school building representative of the period 1946-1976, located in Italian climate zones B (601-900 degree days) and E (2 101-3 000 degree days).

[17] https://ec.europa.eu/energy/en/content/eu-countries-2013-cost-optimal-reports-part-2

[18] More information can be found in the report published by the Commission https://ec.europa.eu/energy/en/content/eu-countries-2018-cost-optimal-reports

3. **Assessment of the energy performance of the reference buildings using the semi-stationary calculation method according to Italian standard UNI/TS 11300**. The 2018 update of the comparative analysis method used the latest technical specifications (for years 2014-16). Some of the main changes are outlined below:
   - the climate data refers to the new technical standard UNI 10349-1:2016;
   - new method for calculating the heating and cooling period;
   - analytical calculation of heat bridges for both new and existing buildings;
   - new methods for calculating the efficiency and losses of generation subsystems for energy carriers other than fossil fuels (introduction of UNI TS 11300-part 4:2016).
4. **Change in levels of energy efficiency measures (EEM).** The types of action/measure considered are the same as those used in the 2013 assessment, although in some cases the number of levels examined and/or their intensity (scale of values) has been changed.
5. **Updating of overall costs:**
   - the main changes concern the cost values of energy carriers (methane gas and electricity) and of investment in energy efficiency measures (EEM);
   - no form of incentive or subsidy is considered due to the continuing evolution of the legislative framework in this field and the short time span of some of the measures, in accordance with the Regulation, which allows the Member States to freely choose.
6. **Use of renewable sources**. Availability of space and optimal positioning was always assumed regarding the installation of photovoltaics on various reference buildings, without considering the potential constraints and obstructions that are often present in real life.

4.1.2. Results obtained from the application of the comparative cost-optimal methodology

Given the varied characteristics of the building stock, it was necessary to find a way of describing it that illustrated its specific features and gave it meaningful representation. Building categories were therefore defined, on the basis of which a clustering model representative of the national building stock was generated.

Specifically, for climate zones B (climate with mainly summer demand) and E (mainly winter demand), the methodology analysed the following types of buildings:

- RMF (single-family house): dating from two periods of construction, 1946-1976 and 1977-1990, consisting of 1- and 2-storey buildings;
- RPC (small multi-apartment building): dating from two periods of construction, 1946-1976 and 1977-1990, consisting of 3-storey buildings;
- RGC (large multi-apartment building): dating from two periods of construction, 1946-1976 and 1977-1990, consisting of buildings of 4, 6 and 8 storeys;
- UFF (office buildings): dating from two periods of construction, 1946-1976 and 1977-1990, consisting of 2-storey buildings and buildings of 4-5 storeys;
- SCU (schools): dating from the period of construction 1946-1976 and consisting of 4 storeys.

For each type, both the new building (NB) and renovations of two different existing buildings (E1 and E2)[19] were considered: the results are given in Table 22 (residential), Table 23 (offices) and Table 24 (schools), which show the cost-optimal values updated to 2018. The optimal values are determined through the technical and economical optimisation of the various possible configurations examined. It should be noted that the building codes also differentiate them by their typological and construction characteristics: for example, the code RPC defines a 'small multi-apartment' residential building, but the buildings RPC E1 and

[19] E1 indicates a building from the period of construction 1946-1976 and E2 a building from the period 1977-1990.

RPC E2 differ by year of construction, floor area/volume ratio, dispersing surface, heated volume and other factors that result in the assessments contained in Table 22, Table 23 and Table 24[20].

Table 22 – Minimum overall cost, related optimal annual primary energy value, CURRENT overall non-renewable primary energy consumption, overall non-renewable primary energy consumption in the COST-OPTIMAL scenario and CO_2 emissions reduction in the COST-OPTIMAL scenario for reference residential buildings

	BUILDING CODE	Overall cost	PE optimal value	CURRENT overall non-renewable primary energy consumption	Overall non-renewable primary energy consumption in the COST-OPTIMAL scenario	COST-OPTIMAL CO_2 emissions reduction
		[€/m²]	[kWh/m²]	[kWh/m²]	[kWh/m²]	[KgCO₂/m²]
CLIMATE ZONE E	RMF_E1	498	90.6	500	79	84.2
	RMF_E2	311	89.5	290	79.2	42.2
	RMF_N0	575	97.7	-	26.9	-
	RPC_E1	335	127	325	106	21
	RPC_E2	243	103	160	55.2	16.2
	RPC_N0	419	102	-	42.6	-
	RGC_E1	355	118	295	101	18.6
	RGC_E2	212	73.5	140	59.6	13.1
	RGC_N0	363	75.3	-	40	-
CLIMATE ZONE B	RMF_E1	310	102	225	90.2	27
	RMF_E2	270	92.8	105	82.2	4.6
	RMF_N0	477	120	-	34.8	-
	RPC_E1	242	79	160	55.2	21
	RPC_E2	185	54.3	118	37.2	16.2
	RPC_N0	359	100	-	43.9	-
	RGC_E1	257	82.8	155	62.2	18.6
	RGC_E2	187	55.2	105	39.3	13.1
	RGC_N0	320	85	-	45.2	-

Source: Ministry of Economic Development

Table 23 – Minimum overall cost, related optimal annual primary energy value, CURRENT overall non-renewable primary energy consumption, overall non-renewable primary energy consumption in the COST-OPTIMAL scenario and CO_2 emissions reduction in the COST-OPTIMAL scenario for reference office buildings

	BUILDING CODE	Overall cost	PE optimal value	CURRENT overall non-renewable primary energy consumption	Overall non-renewable primary energy consumption in the COST-OPTIMAL scenario	COST-OPTIMAL CO_2 emissions reduction

[20] For further details, please see: STREPIN, Annex 1 to the Italian Action Plan for Energy Efficiency June 2017, http://enerweb.casaccia.enea.it/enearegioni/UserFiles/PAEE-2017.pdf

		[€/m²]	[kWh/m²]	[kWh/m²]	[kWh/m²]	[$KgCO_2/m^2$]
CLIMATE ZONE E	**UFF_E1**	452	120	320	93.6	45.3
	UFF_E2	384	94.7	230	76.2	30.8
	UFF_N0	514	89.9	-	55.4	-
CLIMATE ZONE B	**UFF_E1**	394	115	230	85.5	29
	UFF_E2	372	98.1	190	76.8	22.6
	UFF_N0	468	112	-	69.9	-

Source: Ministry of Economic Development

Table 24 – Minimum overall cost, related optimal annual primary energy value, CURRENT non-renewable overall primary energy consumption, non-renewable overall primary energy consumption in the COST-OPTIMAL scenario and CO_2 emissions reduction in the COST-OPTIMAL scenario for reference school buildings

	BUILDING CODE	***Overall cost***	***PE optimal value***	***CURRENT overall non-renewable primary energy consumption***	***Overall non-renewable primary energy consumption in the COST-OPTIMAL scenario***	***COST-OPTIMAL CO_2 emissions reduction***
		[€/m²]	**[kWh/m²]**	**[kWh/m²]**	**[kWh/m²]**	**[$KgCO_2/m^2$]**
CLIMATE ZONE E	**SCU_E1**	330	115	240	101	27.8
CLIMATE ZONE B	**SCU_E1**	190	55.5	95	41.7	10.7

Source: Ministry of Economic Development

Evaluating the results set out in the tables above, several general considerations emerge relating to the building envelope, technical systems and costs associated with the configurations obtained using the cost-optimal methodology.

Considering the building envelope (e.g. external insulation, replacement of windows and doors), depending on the methodology used, intervention is an optimal solution only for new buildings and in only a few cases for existing buildings, generally those constructed in the period between 1946 and 1976. In other cases, given the high costs of the civil works required to build or restore the building envelope, the optimal solution focuses on carrying out other measures, in particular relating to systems.

As far as systems are concerned, the full use of heat pumps for heating and cooling and domestic hot water (Full Electric Building) is optimal only for new single-family homes. For the other building categories, the optimal system solution is the combination of heat pump, gas boiler (condensing and three-star) and multi-split system. Photovoltaic modules are used in all building types. In the residential sector, the percentage of energy consumption from renewable sources ranges from 50-70% for new buildings to 10-20% for existing ones. By contrast, offices have coverage of 40-50% for new buildings and 15-20% for existing ones. Lastly, school buildings have a significantly different consumption profile as they do not require air conditioning in the summer. In this case, all heating and domestic hot water is provided by a condensing boiler, while photovoltaics provide around 20% of energy.

Analysing the cost structure of the cost-optimal solutions, the biggest differences relate to the period of construction of the building (new and existing), whereas the cost discrepancy between climate zones B and E is less significant.

5. Estimating the retrofitting rate: energy savings and wider benefits

5.1. Energy saving and emission reduction targets

Commission Recommendations 2019/786 require the STREPIN (strategy for energy retrofitting of national building stock) to adopt cost-effective approaches to retrofitting (Article 2a(1) of the Directive on the energy performance of buildings), so the report 'Update of the application of the methodology for calculating cost-optimal levels of minimum energy performance requirements (Directive 2010/31/EC Article 5)' sent to the European Commission in June 2018, in which the cost-optimal methodology is described, was used as a reference.

Historic national data on the residential sector has been used to develop a simple modelling tool that solves an optimisation problem related to the need to meet the energy and emissions targets set by the INECP for 2030, and the total decarbonisation of the sector by 2050, by using the data from the cost-optimal methodology to identify the lowest-cost solution for achieving the 2030 energy saving targets. The same approach has been replicated for the non-residential sector, in relation to offices and schools, with reference to the standard buildings identified in the above-mentioned report. For the tertiary sub-sectors not covered by the cost-optimal methodology, calculations were carried out based on the annual energy savings target and the square metres to be retrofitted as reported in STREPIN 2017, in accordance with the 2020 targets set out therein.

The parameters of the cost-optimal methodology, calculated in 2018, have to be updated every 5 years: the assessments conducted here assume that any variations in the different cost parameters considered will fully offset one another, for example in the case of the cost of CO_2 and the costs of new materials for thermal insulation of the buildings, which will presumably increase and decrease respectively. The 2050 targets can be assessed using the data made available by the 2030 modelling tool.

As already mentioned, it should be noted that the model was created with both energy and emission reduction targets for 2030, as set out in the INECP, in mind. The target set for 2050, on the other hand, concerns the decarbonisation of the civil sector and, in line with the Long Term Strategy (LTS), would not lead to energy consumption in the sector dropping to zero (final energy consumption should fall from around 32 Mtoe in 2020 to 13 Mtoe in 2050).

5.1.1. Residential sector

The INECP set a savings target of 0.33 Mtoe/year of final energy for the residential sector, to be achieved in the period 2021-2030. In order to estimate the surface area to be retrofitted in the residential sector in order to reach the 2030 targets outlined in the INECP, the following steps were followed:

- **Step 1: extraction of the relevant data for each standard building from the cost-optimal methodology**, consisting of: cost-optimal overall cost (€/m^2), current non-renewable primary energy (kWh/ m^2), cost-optimal non-renewable primary energy (kWh/ m^2), non-renewable primary energy saving (kWh/ m^2) and CO_2 saving (kg/ m^2).
  These data, which can be viewed in Table 22, Table 23 and Table 24, have been incorporated into the modelling tool. Estimates have had to be made for zones other than B and E and for buildings constructed before 1946, both in terms of costs and energy savings, as these categories are not covered by the standard buildings used in the cost-optimal methodology. It has been assumed that no retrofitting will be carried out on buildings constructed from 1991 onwards, and the decision has been made to focus on older buildings with comparatively weaker energy performance, as

shown by the analyses of the energy performance certificates. Consequently, the post-1990 period has been disregarded.

As regards the climate zones, zones A and C have been merged with zone B and zone F with zone E. Zone D was left separate in order to better represent the buildings it contains and their energy consumption. With regard to savings, it has been assumed that zone D is different from zones A-B-C and E-F, in line with the descriptions in the National Action Plan for nZEBs (PANZEB),[21] while with regard to costs an intermediate level has been proposed for the two zones covered by the cost-optimal methodology.

For the pre-1946 period, information from the Tabula project database[22] was used for savings. As the project information relates to a standard climate zone, the difference in savings has been applied in line with the PANZEB as explained above. As regards costs, an increasing variation has been assumed for the later period.

In addition, three different versions of the model have been created, each based on the cost-optimal methodology: the first is based on the parameters produced by the cost-optimal methodology for existing standard buildings (cost-optimal model), the second is based on values linked in the cost-optimal methodology to compliance with the minimum requirements for standard buildings (RM model), and the third is based on parameters linked to conversion into nZEB (nZEB model).

The parameters of the RM model are linked in the cost-optimal methodology to compliance with the minimum requirements (defined in the Ministerial Decree of 26 June 2015), in particular to the optimal mix of measures identified for new standard buildings; a variation was then applied to the relevant costs of the measures to take into account the fact that they are applied to existing buildings and not new ones. The parameters of the nZEB model were derived by applying a variation to the cost and savings values associated with the minimum requirements, based on information from the PANZEB[23]. The assumptions made in these two further models for climate zones A, C, D and F and the pre-1946 period of construction are similar to those already described.

- **Step 2: input of national data by climate zone and building type in line with the standard buildings from the cost-optimal methodology**, with the necessary three-part breakdown by climate zone, period of construction and number of dwellings.
- **Step 3: setting up the modelling tool** to examine the issue of minimising the overall cost of intervention while respecting the constraint of annual energy savings.
  The savings target must be achieved by encouraging the retrofitting of buildings with the best cost effectiveness (defined in the model as kWh/€), while ensuring that a certain percentage of retrofitting work is carried out across all standard buildings.

- **Step 4: acquiring the relevant information set from the INECP and LTS target scenarios**, developed by ISPRA with the TIMES ITALIA model.
  The indications reproduced in the modelling tool for 2030 reference the INECP target scenario and correspond to an annual energy savings target (0.33 Mtoe/year) and a reduction in CO_2 emissions (1.14 Mton/year). For 2050, the modelling tool takes the Long Term Strategy (LTS) target scenario as a reference, which envisages an almost complete decarbonisation of the civil sector by 2050. In

[21] Table 8.
[22] http://webtool.building-typology.eu/#bm
[23] In particular, see Figure 3 for costs and Table 8 for savings. Studies carried out as part of the Electrical Systems Research programme into nZEB single-family and multi-family residential buildings have provided useful additional information.

both cases, the scenarios also contain indications relating to the evolution in the number of households and relative m^2 to be heated, end-use technologies and related energy sources.

- **Step 5: interpretation of results**, regarding:
  - Checking that the energy and emissions targets have both been achieved;
  - Retrofitting rate per standard building, climate zone and total;
  - Annual and cumulative investments;
  - Cost effectiveness of the solution found, in terms of the mix of m^2 to be retrofitted and related measures.

  The retrofitting rate in this context is understood to be relative to the mix of energy efficiency measures identified by the cost-optimal methodology for each standard building. This mix of measures includes interventions such as, for example:

  - thermal insulation of the building envelope (roof, floor/ceiling with a non-heated space, dispersing boundary opaque walls and reduction in thermal bridges);
  - replacement of windows and doors (high energy performance windows and doors, insulation of roller blind boxes, shading fixtures);
  - replacement of the heat generator (with condensing boilers or heat pumps, including geothermal pumps);
  - replacement or refurbishing of the lighting system (high-efficiency luminaires);
  - use of renewable sources (thermal solar panels, photovoltaics).

More information about the mix of measures chosen for each standard building and the related level of energy efficiency can be found in Table 25 – . For each standard building shown in the columns under the three different categories considered, the measures identified as minimum cost by the cost-optimal methodology (those coloured in grey) and their corresponding level of efficiency, increasing from 1 to 5 (with 1 meaning no intervention), are indicated in rows. The efficiency level is determined using different parameters depending on the measure in question, for example in terms of thermal transmission for the opaque envelope or in terms of power for photovoltaic panels.

Table 25 – Measures and related efficiency levels identified by the cost-optimal methodology for standard residential buildings

		Monofamiliare						Piccolo condominio						Grande condominio					
		RMF_NO_E	RMF_NO_B	RMF_E1_E	RMF_E1_B	RMF_E2_E	RMF_E2_B	RPC_NO_E	RPC_NO_B	RPC_E1_E	RPC_E1_B	RPC_E2_E	RPC_E2_B	RGC_NO_E	RGC_NO_B	RGC_E1_E	RGC_E1_B	RGC_E2_E	RGC_E2_B
1	Isolamento termico della parte esterna: sistema a cappotto	4	1	3	1			3	1		1	1		4	1		1	0	
2	Isolamento termico della parte esterna: isolamento nell'intercapedine					2	1			2			1			2		2	2
3	Isolamento termico della copertura	5	5	2	2	2	2	5	5	5	5	5	5	5	5	5	5	5	5
4	Isolamento termico del pavimento	5	5	5	1	5	5	5	5	5	5	4	4	5	5	1	1	4	5
5	Isolamento termico degli elementi trasparenti	2	3	2	3	1	1	1	3	1	1	1	1	1	3	2	3	1	1
6	Sistemi di schermatura solare	2	2	1	3	1	3	2	2	3	3	1	3	2	2	3	3	3	3
7	Macchina frigorifera ad alta efficienza			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
8	Generatore di energia termica ad alta efficienza per il riscaldamento							2	2	3	3	3	1	2	2	2	3		
9	Generatore di energia termica ad alta efficienza per l'acqua calda sanitaria							1	1	2	2	2	1	1	1	2	2		
10	Generatore di energia termica ad alta efficienza per il riscaldamento e l'acqua calda sanitaria			3	3	3	3											2	2
11	Pompa di calore per riscaldamento, raffrescamento e acqua calda sanitaria	1	1																
12	Impianto solare termico	1	1	1	1	1	1	1	1	3	1	3	3	1	1	2	2	3	3
13	Sistema fotovoltaico	2	3	4	4	4	4	3	3	4	4	4	4	3	3	4	4	4	4
14	Sistema di recupero termico sulla ventilazione	3	2					1	1					3	1				
15	Sistema di regolazione avanzato	3	3	4	4	4	4	3	3	4	4	4	4	3	3	4	4	4	4
16	Riqualificazione impianto di illuminazione																		

Source: Data processing by ENEA.

It should be noted that the INECP scenario envisages a saving of 0.33 Mtoe/year of final energy between 2020 and 2030; CO_2 emissions should drop from 44.1 Mton in 2020 to 32.7 Mton in 2030, with a saving of over 40% in relation to levels in the 1990s. The modelling tool used enables results to be compared in three different ways: Table 26 shows the estimated annual retrofitting rates needed for the period 2020-2030 to meet the 2030 INECP target.

Table 26 – Estimated annual retrofitting rate per climate zone and standard residential building[24]

		Cost-optimal model	RM model	nZEB model
Climate zone A-B-C	RMF_E1	0.84%	0.62%	0.57%
	RMF_E2	0.16%	0.25%	0.24%
	RMF_E3	0.53%	0.37%	0.35%
	RPC_E1	0.83%	0.50%	0.47%
	RPC_E2	0.77%	0.35%	0.33%
	RPC_E3	0.66%	0.41%	0.39%
	RGC_E1	0.69%	0.53%	0.50%
	RGC_E2	0.60%	0.32%	0.30%
	RGC_E3	0.59%	0.42%	0.40%
Climate zone D	RMF_E1	1.34%	0.93%	0.87%
	RMF_E2	0.93%	0.56%	0.54%
	RMF_E3	0.61%	0.60%	0.57%
	RPC_E1	0.95%	0.75%	0.71%
	RPC_E2	0.80%	0.48%	0.47%
	RPC_E3	0.90%	0.73%	0.69%
	RGC_E1	0.79%	0.75%	0.70%
	RGC_E2	0.67%	0.40%	0.39%
	RGC_E3	0.82%	0.70%	0.69%
Climate zone E-F	RMF_E1	1.63%	1.28%	1.20%
	RMF_E2	1.30%	0.78%	0.74%
	RMF_E3	0.75%	0.82%	0.79%
	RPC_E1	1.26%	1.05%	0.99%
	RPC_E2	0.82%	0.60%	0.59%
	RPC_E3	1.20%	1.04%	1.00%
	RGC_E1	1.05%	1.09%	1.02%
	RGC_E2	0.73%	0.47%	0.47%
	RGC_E3	1.09%	0.99%	0.94%
TOTAL		**0.81%**	**0.65%**	**0.62%**

Source: Data processing by ENEA.

As is clear, the target rates identified are different, as each of them is characterised by a different energy and CO_2 saving requirement compared to the *ex ante* situation. The target rate of 0.81% calculated using the

[24] In this table, E3 is used to indicate the pre-1946 period.

cost-optimal model is mostly in line with the virtual renovation rate estimated in Section 3.3. The retrofitting rate indicated here refers to deep renovation measures conducted on the building plant system and summarised in Table 27 in terms of the technologies involved. The other models envisage a reduction in the deep renovation rate. Largely confirming the rate does not make it clear that a cost-optimal mix of measures for the different standard buildings has been identified using the cost-optimal model. The energy savings and emissions reduction targets are greater in the RM and nZEB models than in the cost-optimal model, resulting in a lower retrofitting rate.

The three different models developed can be used to obtain the variations in costs and m^2 to be retrofitted necessary in the period 2020-2030 to achieve the INECP target for 2030. Using the minimum cost parameters from the cost-optimal methodology (cost-optimal model), the cost would be EUR 9.18 billion per year (**Error! Reference source not found.**.), slightly less than the estimated annual investment for the current period, with almost 25 million m^2 to be retrofitted. In this case, however, as mentioned above, the system would focus on a mix of measures that favoured deep renovation, and there would thus be a higher volume of energy savings than at present for the same investment, considering the whole life cycle of the measures. The m^2 to be retrofitted would fall by around 20% if energy retrofitting measures aimed to adapt existing standard buildings to meet the minimum requirements (RM model), with a cost variation that would increase to EUR 11.09 billion per year. From a technological perspective, applying the minimum requirements is consistent with the INECP's predicted trend of a strong increase in air-water heating pumps being used for domestic hot water, heating and cooling systems, both autonomous and centralised. Assuming nZEB renovation (nZEB model), the m^2 to be renovated would be further reduced, with a drop in relation to the cost-optimal value of around 24%, and the necessary investments would increase to EUR 11.9 billion per year. By 2030, in the light of the goal of almost complete decarbonisation by 2050, a growth in the rate of transforming existing buildings into nZEBs can already be assumed, in line with the trend for higher investments described in the nZEB model. As regards nZEB energy retrofitting of existing (public) buildings, the new design solutions show that heat pumps (in particular air-to-water heat pumps) combined with photovoltaic installations are the type of system mostly commonly adopted, in most cases allowing the building to transfer its energy consumption to electricity.

Table 27 – Estimated surface area to be retrofitted and related investments in residential buildings

	Retrofitted floor area (m^2/year)	**Primary energy saving (Mtoe/year)**	**Reduction in emissions (Mt CO_2/year)**	**Investments (EUR billion/year)**
Cost-optimal model	24 699 000	0.33	1.14	9.18
RM model	19 832 600			11.09
nZEB model	18 806 600			11.94

Source: Data processing by ENEA.

By 2050, the LTS target scenario envisages an almost complete decarbonisation of the civil sector, with zero direct emissions from the residential sector and almost zero emissions from the tertiary sector. However, it does not predict that final energy consumption will fall to zero, instead envisaging a reduction from around 32 Mtoe in 2020 to 13 Mtoe by 2050. To achieve this goal, it is first necessary to meet the 2030 targets set by the INECP, with appropriate interventions in the civil sector.

Based on the values provided by the modelling tool for 2030 and considering the minimum cost measures represented in the cost-optimal model, it can be estimated that, given the annual emissions reduction target for the 2030-2050 period, a retrofitting rate of 1.16% should be achieved in the residential sector. The retrofitting rate would fall to 0.93% based on the m^2 retrofitted in 2030 under the RM model and to 0.88% with the nZEB model. In 2040 and 2050, the emissions trajectory indicates energy savings for the residential sector in line with the aspirational targets introduced for the residential sector by the INECP. It is important to note that this rate is lower than the annual retrofitting rate associated with the LTS 2050 scenarios. In fact, the estimates presented here have been obtained by referring solely to modelling of the residential sector, while the TIMES model represents the energy system in its entirety and is thus able to take system effects into account, in particular in relation to indirect emissions and electricity prices. This implies that, in the LTS, a higher retrofitting rate is required to achieve full decarbonisation of the residential sector. In other words, the estimates of the annual retrofitting rate between 1.16% and 0.88% identified by the cost-optimal, RM and nZEB models are to be considered as a lower threshold. Lastly, it is pointed out that the LTS assumes a slight population increase by 2050 and thus that the m^2 to be retrofitted in the residential sector will be substantially unchanged.

Adopting the retrofitting rates indicated above, i.e. 0.8% for the 2020-2030 period and 1.2% for the 2030-2050 period, will ensure that the energy and emission targets for 2050 are met by retrofitting 32% of the national residential floor area. The limited area for energy efficiency upgrading is explained by the large volume of energy savings and emissions reductions linked to deep renovation measures, as revealed when applying the comparative model.

By 2050, consumption by source in the residential sector shows zero consumption of LPG, diesel and natural gas, thanks to virtually nationwide use of air-to-water heat pumps, along with a consistent supply of thermal renewables and district heating. Clearly, this may require a strengthening of existing incentives and/or the introduction of new ones, with particular focus on their ability to facilitate deep renovation measures. Measures should also increasingly be aimed at ensuring cost-optimal solutions, with the technological solutions to be incentivised being adapted depending on the specific context, including in terms of climate zone and the possibility of integration with renewable energy sources, and with the incentive granted being adjusted on the basis of the savings achieved.

District heating

District heating serves about 5% of the Italian population and is particularly widespread in northern Italy, where the need for energy for heating is greatest. The use of urban district heating increased significantly up until 2013, but has since declined. According to the data collected by the Italian Association for Urban Heating (AIRU), at the end of 2017 a total volume of 349.2 million cubic metres was connected to the network (with an annual increase of 3.2%), primarily in urban areas (the 2017 National Energy Strategy reports that 64% of heat supplied by district heating is used in residential properties), although there are significant examples of district heating networks supplying heat to users in the services and industrial sectors, with recovery of a substantial amount of the waste heat produced by high-efficiency cogeneration (HEC) systems.

In Italy, the share of energy consumption from renewable sources in the thermal sector is just under 20%. Efficient district heating can help to increase the use of renewables and the recovery of waste heat. The INECP recognises the economically sustainable development potential of district heating and determines that said potential should be exploited in a manner consistent with environmental policy targets, by upgrading the instruments currently available to promote new construction and expansion of infrastructure for distribution of heat in urban areas, in particular in such a way that the heat generation hubs are close to the consumption sites, and by exploiting synergies between the use of renewables and HEC systems. District heating is one example of the many synergies between the plans to upgrade the energy efficiency of the national building stock and the Renewable Energy Directive II (2018/2001), in particular with regard to monitoring of renewable energy targets. Energy communities are clearly a related and particularly relevant factor in terms of achieving combined energy and emissions targets[25].

With a view to 2030, the INECP recognised the importance of an in-depth analysis of the integration into district heating networks of certain technologies that are currently marginal but have potential, such as, for example, thermal solar energy, centralised heat pumps or the recovery of waste heat from installations located throughout Italy, taking into account the contribution of fourth-generation district heating systems. In terms of incentives, white certificates and the National Energy Efficiency Fund are two support options available to operators. White certificates are issued, among other things, for energy savings as a result of high-efficiency cogeneration installations (including installations using renewable energy sources) and installations linked to district heating networks, while the National Energy Efficiency Fund has an economic reserve to provide guarantees in favour of measures to create and expand district heating and district cooling networks.

In addition, given the importance placed on efficient district heating in the contributions received during the public consultation, after Gestore dei Servizi Energetici S.p.A. (GSE) has finished updating the study on the expansion potential of district heating and high-efficiency cogeneration pursuant to Legislative Decree No 102 of 2014, an extension of promotion measures (e.g. the Conto Termico [Thermal Energy Account], tax deductions) will be assessed.

5.1.2. Tertiary sector

The INECP scenario sets a savings target of 0.24 Mtoe/year of final energy for the tertiary sector, to be achieved in the period 2020 to 2030; CO_2 emissions should drop from 17 Mton in 2020 to 10.9 Mton in 2030.

It is important to note that the annual energy savings target for the tertiary sector is higher in relative terms than for the residential sector: the annual savings correspond to 1.2% of 2018 consumption in the tertiary sector compared to 1% in the residential sector. In addition, in 2018, the tertiary sector achieved 29.4% of the 2020 target assigned to it in the 2017 Annual Energy Efficiency Report[26].

A mixed approach was adopted for estimating the m^2 that needs to be retrofitted in order to meet the energy and emissions targets for 2030. The energy savings target for the tertiary sector has been broken down into different sub-sectors on the basis of the specific consumption reported in Table 22. It was possible to apply the cost-optimal methodology to offices and schools (Table 23 and Table 24), with a mix of measures and the related efficiency level as shown in Table 25. Similar to the plans outlined for the residential sector, the mix of energy efficiency measures includes interventions such as thermal insulation of the roof and of dispersing boundary opaque walls, replacement of heat generators and external solar shading.

[25] Alongside the creation of the first renewable energy communities (defined in Article 2 of RED II), for example in Denmark and Scotland, it should be noted that, by 2050, Zero Energy Communities could play an important role: even in the absence of a definition in the Clean Energy Package Directive, they seem to be a promising tool for ensuring that the long-term objectives relating to energy efficiency, renewable sources and greenhouse gas emissions are achieved.

[26] 2020 Annual Energy Efficiency Report.

Table 28 – Measures and related efficiency levels identified by the cost-optimal methodology for standard school and office buildings

		Uffici						Scuole	
		UFF_NO_E	UFF_NO_B	UFF_E1_E	UFF_E1_B	UFF_E2_E	UFF_E2_B	RPC_NO_E	RPC_NO_B
1	Isolamento termico della parte esterna: sistema a cappotto	2	1						
2	Isolamento termico della parte esterna: isolamento nell'intercapedine			1	1	1	1	1	1
3	Isolamento termico della copertura	2	2	2	1	2	1	5	4
4	Isolamento termico del pavimento	3	2	1	1	1	1	3	1
5	Isolamento termico degli elementi trasparenti	5	1	1	1	1	1	1	1
6	Sistemi di schermatura solare	2	2	3	1	3	3	1	1
7	Macchina frigorifera ad alta efficienza			1	3	1	1		
8	Generatore di energia termica ad alta efficienza per il riscaldamento				1				
9	Generatore di energia termica ad alta efficienza per l'acqua calda sanitaria								
10	Generatore di energia termica ad alta efficienza per il riscaldamento e l'acqua calda sanitaria			2	2	1	2	2	2
11	Pompa di calore per riscaldamento, raffrescamento e acqua calda sanitaria	2	2						
12	Impianto solare termico	1	1	1	1	1	1	2	2
13	Sistema fotovoltaico	3	3	4	4	4	4	4	4
14	Sistema di recupero termico sulla ventilazione	1	1	1	1	2	1	1	1
15	Sistema di regolazione avanzato	3	3	4	1	4	4	4	4
16	Riqualificazione impianto di illuminazione	2	2	3	3	3	3	2	2

Source: Data processing by ENEA.

Similarly to the residential sector, climate zones A and C are merged with zone B, and zone F with zone E. The figures for climate zone D were calculated using cost and saving estimates. In this case, however, the standard school and office buildings were considered to be representative of the national building stock, and the modelling tool thus aims to meet the full target.

Similarly to residential buildings, two further models can be developed for school and office buildings, with parameters comparable to the retrofitting of standard buildings to meet the minimum requirements and the nZEB requirements[27]. Table 29 shows the annual retrofitting rates for the different standard buildings under the cost-optimal model. It is observed that, depending on the accuracy in terms of energy efficiency of the measures carried out (increasing from the cost-optimal model to the RM model and then nZEB), the annual retrofitting rate is in the range of 2.32-2.78% for offices and 1.77-2.28% for schools.

[27] Similarly to the residential sector, the necessary information to create a nZEB model for offices and schools has been identified in the PANZEB (in particular Figure 3 and Table 9), and studies carried out as part of the Electrical Systems Research programme (RSE) have provided useful additional information.

Table 29 – Estimated annual retrofitting rate per climate zone and standard office and school building

		Cost-optimal model	RM model	nZEB model
Climate zone A-B-C	**UFF_E1**	2.63%	2.27%	2.16%
	UFF_E2	2.17%	1.80%	1.72%
Climate zone D	**UFF_E1**	3.14%	2.80%	2.65%
	UFF_E2	2.52%	2.18%	2.07%
Climate zone E-F	**UFF_E1**	3.58%	3.27%	3.08%
	UFF_E2	2.86%	2.54%	2.41%
	TOTAL	2.78%	2.44%	2.32%
Climate zone A-B-C	**SCU_E1**	1.71%	1.47%	1.31%
Climate zone D	**SCU_E1**	2.26%	1.92%	1.75%
Climate zone E-F	**SCU_E1**	2.57%	2.18%	2.01%
	TOTAL	2.28%	1.94%	1.77%

Source: Data processing by ENEA.

The m^2 to be retrofitted and the related costs are shown in Table 30 , which is based on the cost-optimal model. Both schools and offices have recorded the upward trend in investments already observed in residential buildings as energy efficiency requirements become more stringent.

Table 30 –Estimated surface area to be retrofitted and related investments in office and school buildings

	Model	Retrofitted floor area (m^2/year)	Primary energy saving (Mtoe/year)	Reduction in emissions (Mton CO_2/year)	Investments (EUR billion/year)
Offices	**Cost-optimal**	1 751 800	0.01	0.04	0.693
	RM	1 539 800			0.732
	nZEB	1 461 700			0.767
Schools	**Cost-optimal**	1 920 000	0.01	0.03	0.551
	RM	1 635 700			0.562
	nZEB	1 493 700			0.588

Source: Data processing by ENEA.

In contrast, for hotels and the commercial sector, the estimate was made on the basis of assumptions consistent with STREPIN 2017. These assessments were based on the specific consumption levels included in Table 21. The mix of efficiency measures includes measures such as, for example:

- thermal insulation of the roof;
- thermal insulation of floors on stilts or unheated rooms and of dispersing boundary opaque walls (under windows);
- replacing windows and doors with high energy performance types;
- replacing heat generators;
- use of high-efficiency heat recovery units;
- replacement or refurbishing of the lighting system (high-efficiency luminaires);

– external solar shading, in particular for south-facing facades.

Lastly, as far as hospitals are concerned, the specific savings achievable through the mix of energy efficiency measures identified by energy audits were taken as a reference, and the m^2 that needs to be retrofitted in order to achieve the energy target assigned to hospitals was calculated on this basis. The mix of energy efficiency measures consists of: management interventions (Building Energy Management System and monitoring of consumption), high-efficiency cogeneration/trigeneration (new installation or efficiency upgrading of existing systems), lighting, pumps, inverters, AHUs/chillers, thermal power stations, building envelope. Combining these approaches leads to the overall results shown in

Table 31, representative of the 2030 INECP target[28], where the cost-optimal model is used for offices and schools. The overall annual retrofitting rate for the tertiary sector amounts to about 4.1% of the total m^2. Assuming that 20% of the savings are related to electricity, which is used for heating and cooling in the tertiary sector more often than in the residential sector, the final energy target of 0.24 Mtoe/year is consistent with the 2030 emissions target for the tertiary sector.

Table 31 – Energy and emissions targets in the tertiary sector, m^2/year to be retrofitted and estimated annual retrofitting rate

	Energy target (Mtoe/year)	**Emissions target (Mton CO_2/year)**	**m^2/year to be retrofitted**	**Annual rate of retrofitting**
Private offices	0.01	0.02	1 751 800	2.9%
Government offices	0.01	0.02		
Hotels	0.01	0.03	1 251 700	3.4%
Schools	0.01	0.03	1 920 000	2.3%
Commercial	0.17	0.43	14 158 000	4.9%
Hospitals	0.03	0.07	1 993 800	4.0%
Total	0.24	0.61	21 062 039	4.0%

Source: Data processing by ENEA.

In order to achieve the target of almost complete decarbonisation of the tertiary sector by 2050 (but not zero final energy consumption, which should drop from around 15.7 Mtoe in 2020 to 11 Mtoe in 2050), it is necessary to first meet the 2030 energy and emissions targets set out in the INECP. Efforts must continue between 2030 and 2050 to improve energy efficiency and reduce emissions, which need to drop from 10.9 to 0.6 Mton of CO_2. Preliminary estimates show an average annual retrofitting rate of 3.7% for the period 2030-2050. It should be noted that, while this value is lower in absolute terms than that forecast for the period 2020-2030, it may prove more challenging given the growth projections for the added value of the services sector over the period 2030-2050[29].

[28] Penal institutions were excluded from the analysis as they represent a negligible percentage of total consumption in the tertiary sector, less than 0.5% of the total. No specific consumption estimate is available for barracks and it was therefore not possible to include this category in the analysis.

[29] In 2040, the emissions trajectory implies energy savings consistent with the indicative target outlined in the INECP, while savings are slightly lower in 2050. The result may depend on technological factors that will become increasingly important over time and which cannot be properly represented in the approach taken.

As already seen in the residential sector, consumption by source in the tertiary sector shows zero consumption of LPG, diesel and natural gas by 2050, thanks to a trend towards very widespread use of heat pumps and thermal renewables. In this case, too, new incentive measures will have to be introduced and existing measures reinforced to adapt them to the wide variety of contexts within the tertiary sector. In this sense, energy audits can make an important contribution to defining sectoral benchmarks and targeting incentive measures towards the sectors and consumption units with the greatest potential for efficiency gains.

Adopting the retrofitting rates indicated above will ensure that the 2050 energy and emissions targets are met, by retrofitting 114%[30] of the national residential floor area. Such a large figure is explained by the low volume of energy savings and emissions reductions linked to deep renovation measures, as revealed when applying the comparative model.

5.2. Roadmap

The tables below provide a roadmap to 2030, 2040 and 2050 in terms of indicative targets for the annual retrofitting rates in the residential and tertiary sectors, obtained using comparative methodology.

Table 32 – Roadmap of targets for annual retrofitting rates

Indicator	**Period 2020-2030**	**Period 2030-2040**	**Period 2040-2050**
Annual retrofitting rate in the residential sector*	0.8%	1.2%	1.2%
Annual retrofitting rate in the tertiary sector	4.0%	3.7%	3.7%

* The annual retrofitting rates set out here were calculated using the cost-optimal model.

Source: Data processing by ENEA.

As the table shows, the annual retrofitting rate in the residential sector for the period 2020-2030 is confirmed, but promotional tools need to focus in the next period on shifting attention to structural interventions capable of generating savings over a far greater number of years. Once this is done, a major increase in the retrofitting rate will be required in the period after 2030 to ensure that decarbonisation targets are met.

With regard to the non-residential sector, on the other hand, a significant increase in the retrofitting rate in relation to current figures needs to start now, in addition to what has already been mentioned for the residential sector, i.e. the need to focus efforts on deep renovation measures.

Lastly, the calculation of the overall retrofitting rate for the residential and tertiary sectors gives a value of 1.6%, almost double the current virtual retrofitting rate, in line with the estimates of the EU Renovation Wave.

An in-depth look at the annual retrofitting rate

[30] The value exceeds 100% due to the need for multiple interventions on some of the buildings considered.

The estimates set out in Section 5.1 are based on the parameters included in the comparative methodology for the residential sector, offices and schools, and on assumptions in line with STREPIN 2017 for other parts of the tertiary sector and lead to the results set out in Section 5.2. This information box provides additional estimates which aim to consider additional factors, not represented in the parameters included in the methodological approaches detailed above, which impact the effective level of savings achievable in the residential and tertiary sectors and thus the resulting retrofitting rate.

The residential sector has currently achieved the energy savings target for 2020 given in the 2017 Annual Energy Efficiency Report and the representation of the actual possibilities for improving efficiency in the comparative methodology could be optimistic, as a result of the assumptions made in Section 4.1.1 and the focus on the cost-effectiveness of interventions. In addition, the model based on the comparative methodology is designed to identify the lowest cost solution for achieving energy and emissions targets, thus retrofitting the smallest m^2 area possible and providing a lower threshold for the retrofitting rate.

As rigorous as this method is from a modelling point of view, at least three real elements can be identified which, if taken into account, lead to a reduction in the actual savings achievable: the first is of a sociological nature, the second of a technical and financial nature, and the last relates to the monitoring of the Ecobonus, the principal incentive measure in the sector.

Residential sector

As indicated by recent activities carried out as part of the Three-Year Information and Training Plan[31], there is not yet universal willingness among private parties to adopt new technologies and to implement energy saving measures. It must be taken into account that deep renovation measures lead to inconvenience for tenants for a variable period, and in some cases for a long time. Clearly, this aspect, together for example with the need for agreement from the homeowners' association in the case of multi-family buildings, complicates the implementation of deep renovation measures. This also leads into the link between the sociological aspects and those relating to technical and financial obstacles, described in more detail in Section 6.4: there are still significant hurdles to be overcome for private parties wishing to access credit to carry out energy efficiency measures, and deep renovation measures obviously require increased investment and are more difficult to finance, which is also due to a lack of knowledge among credit institutions about the technical parameters. Lastly, the fact that it is difficult to implement deep renovation measures is corroborated by monitoring the historical data concerning access to the Ecobonus, which still show far lower uptake in relation to paragraph 344, regarding overall renovation, than for individual measures, whether relating to systems (paragraph 347) or to the building envelope (paragraph 345a)[32]. On these grounds, it is reasonable to assume that the actual savings in the residential sector are in fact lower than the values set out in the comparative methodology: using a lower threshold value of 70 kWh/m^2 for the average final energy saving (average energy saving of 40% compared to the *ex ante* situation) would give a required annual retrofitting rate of 1.9% for the years up to 2030, increasing to 2.7% for the years between 2030 and 2050. This would mean that around two-thirds of the national building stock would need to be retrofitted by 2050 in order to achieve the decarbonisation targets set.

Non-residential sector

The monitoring data indicate that the tertiary sector is less close than the residential sector to achieving the 2020 targets, meaning that there may still be opportunities for low-cost savings which have not yet been sufficiently exploited. This is confirmed by the analysis of the measures in the energy audits received by ENEA pursuant to Article 8 of Legislative Decree 102/2014 which indicates, both in general and for the economic codes from the tertiary sector, a significant number of measures with payback periods of less than 5 years[33]. Furthermore, the mixed approach applied to the tertiary sector, developed for the purposes of this strategy, only takes the comparative methodology into account for offices and schools, which are not the main categories within the sector either in terms of consumption or in terms of m^2: they are sub-sectors with lower retrofitting rates and, given their lesser importance in relative terms, any overestimation of energy savings associated with the comparative methodology would be minimal. The predominant category, accounting for about half of the sector's m^2, is the commercial sector, which is associated with

[31] Household energy behaviour, 2020.

[32] Annual Report on Tax Deductions 2020.

[33] 2020 Annual Energy Efficiency Report.

particularly high specific final consumption. Access to incentives, which should be reinforced in the coming years, could encourage the implementation of projects with savings potential, including significant savings potential. In this sense, the mathematical calculation suggested might underestimate savings potential, aligning most tertiary sectors with the assumptions made in STREPIN 2017. In this case, a savings correction factor is applied, which seeks to represent reality by better reflecting the trends already present on the market (increase in deep renovation measures) and their growth over the coming years due to the perception of the benefits associated with them. The commercial category includes a wide variety of structures and buildings, from hypermarkets to the residual category, which represents a very high proportion of m^2 and comprises restaurants, boutiques, shops and workshops. It is conceivable that some of these companies are focusing increasingly on their sustainability of their operations, as paying attention to environmental and energy efficiency issues is also an increasingly important factor in retaining customers. In addition, as mentioned above, energy savings in different tertiary sub-sectors, not just the commercial sector but hotels and offices too, leads to economic savings that have a positive impact on company performance and competitiveness. It is thus reasonable to assume that the actual savings in the tertiary sector are in fact higher than the figures generated by the mathematical calculation described above: using a higher threshold value of 190 kWh/m^2 for the average final energy saving (an average energy saving of 60% compared to the *ex ante* situation) would give a required annual retrofitting rate of 2.8% for the 2020-2030 period and of 2.6% for the years between 2030 and 2050. This would mean that around 80% of the national building stock would need to be retrofitted by 2050 in order to achieve the decarbonisation targets set.

Table 32b – Roadmap of targets for accurate annual retrofitting rates

Indicator	Period 2020-2030	Period 2030-2040	Period 2040-2050
Accurate annual retrofitting rate in the residential sector	1.9%	2.7%	2.7%
Accurate annual retrofitting rate in the tertiary sector	2.8%	2.6%	2.6%

Source: Data processing by ENEA.

Taking the specific savings of the residential and tertiary sectors into account in accordance with the trends outlined above, the overall annual retrofitting rate would be 2% in 2030 and 2.6% in 2050, which is about three times higher than the current virtual retrofitting rate set out in Section 3.3 and better represents the need for increased efforts. The overall retrofitting rate would involve measures being carried out on two-thirds of Italy's national building stock.

5.3. Benefits in a broad sense

In addition to the benefits in terms of energy savings and reduced CO_2 emissions, the INECP also estimated the benefits to the national system in terms of investments, employment and added industrial value. Two methods were used to produce these estimates: the input-output matrix (I-O, source: GSE) and the social accounting matrix (SAM, source: ENEA). Table 33 shows the change in investments, the added value and the average number of employees, taken from the 2030 targets in the INECP scenario for the residential and tertiary sectors and estimated as annual values for the 2017-2030 period.

For the I-O matrix, impact is estimated in relation to building retrofitting, heat pumps (heating and cooling), heating and domestic hot water, cooking and electrical equipment in the residential sector, and also in relation to lighting in the tertiary sector; for the SAM matrix, impact is estimated in relation to electrical uses and heat pumps, heating (and cooking, where relevant) and building retrofitting in both sectors. It should be noted that the results shown in the table are not directly comparable, due to the different specificities of the two methodological approaches and also different working hypotheses[34]. The SAM also makes it possible to estimate an increase in revenue of EUR 1.2 billion a year connected with interventions in the residential and tertiary sectors.

[34] For more details, see footnote 48 of the INECP and Chapter 5 in general.

Table 33 – Change in investment, added value and average number of additional jobs by 2030 in the INECP target scenario

	I-O			SAM		
	Investments (EUR billion/year)	**Added value (EUR billion/year)**	**Annual work units (ULA) (thousands of temporary employees/year)**	**Investments (EUR billion/year)**	**Added value (EUR billion/year)**	**Annual work units (ULA) (thousands of full-time employees/year)**
Residential	4.4	2.9	53	4.5	1.2	17.6
Tertiary	2.4	1.8	26	2.5	2.8	28.3
Total	6.8	4.7	79	7	4.0	45.9

The combined effect of the energy efficiency incentive measures in place since 2005 has led to cumulative energy savings of approximately 15.2 Mtoe as of 2018, of which approximately 12.1 Mtoe is related to lower natural gas consumption. In economic terms, the cumulative saving on the national energy bill is around EUR 4.2 billion, of which 2.8 billion is due to lower natural gas imports. The savings achieved over the 2005-2018 period prevented the emission of approximately 38.9 $MtCO^2$ in 201835.

A further macroeconomic evaluation method used in the INECP, in the form of the GDyn-E general economic equilibrium model, confirms the reduction of the energy bill. The INECP target scenario, modelled in GDyn-E, in fact estimated that energy imports would decrease by 14% in physical terms and by 13% in value by 2030 compared to the current policies scenario. Energy dependence would therefore also see a reduction in line with the estimates of this methodological approach[36].

Lastly, the savings in terms of household energy bills can be estimated on the basis of the energy retrofitting measures incentivised by the Ecobonus[37]. For the years 2014-2017, an average saving on customer bills which, due to different price levels, varies from EUR 250 in 2014 to EUR 150 in 2017, can be linked to energy efficiency measures. In fact, energy retrofitting measures can lead to savings of an average of 15% of total annual household expenditure on energy products.

Health impacts of energy retrofitting

In Italy, a significant proportion of the population lives in poor quality buildings, which it is impossible to adequately heat or cool, leading to the use of unhealthy heating systems. As a result, these people are more likely than the rest of the population to experience health problems. In particular, in order to reduce expenses, households experiencing energy poverty often need to keep the heating temperature below the minimum comfort level38, leading to an increased likelihood of contracting respiratory and cardiovascular diseases, and potentially causing the onset or exacerbation of psychiatric illnesses. These effects, in addition to obvious considerations of social justice, have an impact on the state budget as 'social externalities' paid for by the health system and the community in general. For example, a study of the city of Turin confirmed on a local scale that the risk of mortality increases as the quality of place of residence falls, net of other demographic and social determinants.39

Energy retrofitting of buildings is a strategy that can tackle the issue 'at the root', by guaranteeing a reduction in energy costs that enables people to maintain a minimum level of comfort in their homes and reducing the likelihood that they will contract the aforementioned diseases. These measures would, therefore, reduce both the burden of disease and the pressure of its consequences on the health system, in terms of costs and use of facilities, as well as contribute to the urban regeneration of what are often run-down areas.

35 Annual Energy Efficiency Report 2019, https://www.enea.it/it/seguici/pubblicazioni/pdf-volumi/2019/raee-2019.pdf
36 Again, see Section 5 of the INECP for more details.
37 Ecobonus Report 2018, https://www.enea.it/it/seguici/pubblicazioni/pdf-volumi/2018/report-detrazioni-2018.pdf
38 According to the WHO, a comfortable home is one in which a temperature of 21 °C is maintained during the day and 18 °C at night; 20 °C if children or the elderly are present.
39 Costa et al., 'Quarant'anni di salute a Torino' [40 years of health in Turin], Inferenze, Milan 2017.

The 'internalisation' of prevented social costs, in particular in relation to health, are not currently considered when assessing the payback time of retrofitting investments, and could promote the sustainability of retrofitting measures on public housing, creating a virtuous circle of resource utilisation. In turn, 'internalising' marginal costs of non-health policies is strongly recommended by the 'Health in All Policies' strategy adopted in 2008, which is currently being followed up with a special concerted policy action from the Ministry of Health as part of the Joint Action European Health Equity Europe.

In order to estimate the potential social costs of energy poverty and to verify the potential indirect benefits associated with the opposite, RSE and the Epidemiological Observatory of Turin (Local Health Authority TO3 Piedmont) launched a pilot project in the Turin area; the aim of the project is to verify whether it is possible to estimate, for a sample of households classed as living in energy poverty, the greater probability of contracting diseases linked to poor living conditions and the greater tendency to use health services, and to evaluate the economic impact thereof.

The experience of the United Kingdom is significant in this respect, where the correlation between energy efficiency and its effects on health in the dwellings of vulnerable users has been analysed in depth over a period of several years, taking into account other factors such as pollution and environmental conditions. The results show that the annual cost to the UK National Health Service for treating winter illnesses caused by living in dwellings without sufficient heating is approximately GBP 859 million, not including additional expenditure by social services or economic impacts due to job loss. The study also showed that about 42% of the money invested in improving the quality of the housing stock comes back to the State in the form of savings for the National Health Service.

One indicator used by the World Health Organization (WHO) is the 'Excess Winter Mortality index (EWM), calculated by comparing the average daily deaths during the winter season with the average in other periods of the year. EWM is, in fact, strongly linked to the quality of the dwelling a person resides in and their ability to maintain an internal temperature in their home that does not fall below the minimum comfort level. According to WHO data, 20% of homes in Italy are affected by damp problems (22% in the EU), with major inequalities penalising the quartiles with the lowest expenditure (up to 25-28%). In such conditions, there is a general deterioration of lung capacity, which leads to an increase in both acute diseases (bronchitis, colds, rhinitis) and chronic conditions (especially asthma). According to a study by the Marmot Review Team, about 40% of EWM can be attributed to cardiovascular diseases and about 33% to respiratory diseases.

A growing problem, related to climate change, is also the inability to keep dwellings comfortably cool in summer, leading to a risk of dehydration, heat stroke and hospitalisation with respiratory and cardiovascular problems. As well as damage to physical health, problems related to mental health have also been observed, as shown by the EPEE project40. Lastly, there is also an impact on employment: health problems can lead to more days of work due to flu, colds or more serious illnesses.

[40] https://ec.europa.eu/energy/intelligent/projects/en/projects/epee

6. Policies and actions to achieve the targets

6.1. Policies and actions relating to residential buildings

Stringent minimum legal requirements for the energy performance of buildings have been adopted in order to encourage increased energy efficiency. There are also many tools supporting energy efficiency in the residential sector, with specific minimum access requirements that are often even stricter than the legal minimum. Over the years, and most recently with the publication of the INECP, numerous measures have been put in place to provide for, among other things, the consolidation of tax deductions and the increase thereof (the Superbonus), the improvement of the Conto Termico, the enhancing of the White Certificates scheme, the launch of the National Energy Efficiency Fund and of incentives to carry out interventions on government buildings.

Thanks to these measures, the 2020 targets in the civil sector can be deemed to have been met; as regards the residential sector, monitoring indicates that they have already been well exceeded, with savings of 5.67 Mtoe/year in 2019: the target set by the 2017 Annual Energy Efficiency Report was 3.67 Mtoe/year[41]. The residential sector will have to contribute to a further reduction in consumption to match the 2030 baseline scenario, with projected savings of 3.3 Mtoe/year over the next decade.

As stressed by the Clean Energy Package Directives, due attention must be paid to the issue of energy poverty in residential buildings. According to the ad hoc indicator used in the National Energy Strategy and in the INECP[42], the proportion of households in energy poverty in 2017 was over 8.7%, equivalent to 2.2 million families, the highest figure in the last 20 years. It is a far more common problem in the south of Italy, in particular on the islands, and is increasing. According to a different indicator, which correlates energy expenditure to the heating needs of a house, taking into account the type of building, around 3 million families are living in energy poverty (11.7%)[43].

The INECP suggests that energy poverty levels will remain substantially unchanged by 2030, in the range between 7% and 8%. This projection is based on several determinants, included in the INECP scenarios and represented by: trends in residential energy consumption and the mix thereof used; upward price trends for energy products; trends in overall household expenditure; demographic changes, with the reduction in the number of household members and increase in households with an elderly member. The rate of retrofitting building stock, and more specifically the implementation of measures in buildings with lower energy performance levels, is another factor which will determine the incidence of energy poverty in the long term. Indeed, energy expenditure alters the impact of energy costs on total household expenditure.

Promoting energy efficiency is a structural solution to the issue of energy poverty, also as a result of its indirect benefits. Recommendations drawn up by the European Energy Network for the European Commission[44] refer to promoting energy efficiency measures as key solutions to energy poverty, allowing for multiple benefits and structural change, and to the essential role of information and training campaigns in achieving behavioural change and boosting the rate of energy renovation of dwellings of households in energy poverty.

The most suitable measures to mitigate the problem of energy poverty can have different characteristics depending on the context, which may involve public or private housing. However, some common strategies can be developed. Monitoring of energy consumption is undoubtedly key in order to be able to correctly recognise households in energy poverty and thus being able to better intervene, including by identifying

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[41] 2020 Annual Energy Efficiency Report.

[42] Faiella I. and L. Lavecchia (2015), 'La povertà energetica in Italia' [Energy poverty in Italy], Politica economica, Società editrice il Mulino, No 1, pp 27-76.

[43] Faiella I., L. Lavecchia and M. Borgarello (2017), 'Una nuova misura della povertà energetica delle famiglie' [A new measure of household energy poverty], Questioni di economia e finanza No 404, October 2017

[44] http://enr-network.org/wp-content/uploads/ENERGYPOVERTY-EnRPositionPaper-Energypoverty-Jan-2019.pdf

buildings that are a priority for energy retrofitting. In addition, the monitoring can be used as a basis for implementing countermeasures based on savings, such as energy performance certificates or an energy audit. In this sense, the SIAPE is potentially a very useful tool for identifying the buildings with the worst energy performance, which are probably (also) inhabited by households in energy poverty. An analysis of consumption reveals complexities: for example, energy retrofitting measures in buildings occupied by households in energy poverty might not always be optimal in terms of costs and/or might have excessively long payback periods, as they may involve low *ex ante* consumption and thus low savings and/or even an increase in other forms of energy expenditure. However, if the indirect benefits of energy efficiency and related savings are also taken into account, an assessment of costs and payback periods might become more favourable.

Thanks to a research project supported by the Region of Veneto, it has been possible to estimate the expenditure required for heating according to a dwelling's features and its technological equipment[45]. The 2011 census survey and the regional register of energy performance certificates compiled for the Province of Treviso in 2015 were used to help make these estimates. Geo-referenced census information can be used to create maps showing the risk of energy poverty and thus to help in planning policies for combating the issue. The experiment could be extended to other areas, and the information could also be combined with other data sources of a sampling or administrative nature, such as data from the Italian Revenue Agency. An analysis at local level can also help to investigate whether there is a gentrification issue associated with energy retrofitting of buildings inhabited by households in energy poverty, who are not the owners, and might then face an increase in rent.

Lastly, it seems crucial to stress the importance of combining building retrofitting with information campaigns aimed at raising people's awareness of their own energy consumption and the potential savings associated with behavioural changes. A recent sample survey by the Di Vittorio Foundation highlighted the specific characteristics of households in energy poverty compared to the national average, showing the importance of changing behaviour to save energy and the low take-up of energy retrofitting incentives, due to the lack of long-term prospects (older age of occupants) and a high prevalence of renting.

6.1.1. Private housing

The main existing incentives for energy efficiency in private housing, which are well known, are tax deductions for energy efficiency measures (the Ecobonus, now joined by the Superbonus) and renovation of existing building stock (Bonus Casa) and the Conto Termico. The INECP describes development trends for these measures, which can be summarised as follows:

- Ecobonus and Bonus Casa: 1) consolidate the scheme over time and optimise it by integrating the two measures into a single incentive, which will provide a benefit scalable in relation to the expected saving (according to an approach focused on savings-based measures). The aim is to reward the most cost-effective interventions and to increase the trend towards deep renovation, including the earthquake proofing of buildings; 2) introduce provisions to encourage initial interventions, for example extending the transferability of tax credits and launching a fund to provide guarantees on financing.

- Conto Termico: 1) continue the task of simplifying access to the scheme for public bodies also through promotion of the ESCo model and the use of energy performance contracts; 2) focus the

[45] Camboni, R., A. Corsini, R. Miniaci and P. Valbonesi (2019) 'Combining Census and EPCs Data to Map Fuel Poverty in Italy. A Small Scale Analysis', mimeo.

scheme on energy efficient retrofitting and restoration of non-residential buildings, both public and private.

In general, and also in relation to areas of intervention other than private housing, the aim is to promote simplification and speeding up of procedures for accessing measures to incentivise energy retrofitting. This simplification should help to better integrate these measures into the procedures and requirements of regional urban planning tools, and also encourage their inclusion in online portals discussing or providing information about the urban planning framework. One example is the case of listed buildings or buildings identified as being of historical value. At the same time, in order to encourage more widespread implementation of the retrofitting work incentivised by the aforesaid measures, it might also be useful to offer favourable prudential treatment to mortgages secured on buildings with a high level of energy efficiency. These approaches can help to promote energy efficiency and decarbonisation even more effectively at a local level.

As regards households in energy poverty living in private housing, it should be noted that following the 2016 Italian Budget Law, the Ecobonus allows credit for persons within the 'no-tax area' to be transferred to the suppliers carrying out the works, extended with the 2017 Budget Law to banks and credit institutions. This, as indicated in the box above, is also expected to be the case for the new Superbonus measure which, given its profitability, could be crucial in combating this issue. Indeed, as indicated in the 2017 Ecobonus Report[46], there is a correlation between disposable income and the distribution of energy efficiency measures. Even the most recent 2019 data[47] indicates that at a regional level, participation in the scheme is much higher in the regions of northern Italy, which have a higher level of income per capita. Given the distribution of measures, which is skewed towards interventions on the building envelope (paragraph 345) and winter heating systems (paragraph 347), the climate zones in the north of Italy definitely influence uptake of the measure, as there is a greater demand for heating. However, the high incidence of energy poverty in the southern parts of the country must also be taken into account, and thus the high potential for energy retrofitting that has not yet been fully exploited. Investments in energy efficiency, although incentivised by the Ecobonus, are clearly still not within the reach of households living in energy poverty and who live in buildings with poor energy performance, as also highlighted in the INECP. In this context, the aim should also be to overcome Italy's polarities, with a large concentration of low-income households in internal areas that are scarcely populated and at high risk of earthquake. It would be useful here to use funds from the Cohesion Policy to develop a top-down process for retrofitting entire areas, a more coherent approach than a bottom-up process in which a single user carrying out work has difficulty in accessing credit[48].

Enhancing the Ecobonus and introducing the Superbonus

Due to the current health crisis caused by COVID-19, additional tools had to be put in place to allow rapid recovery of the economy. Given the importance of the construction sector to the national economy, and considering the challenging sustainability targets set for the sector in the INECP and in this strategy, the Ecobonus can undoubtedly play an important role in achieving both these goals.

A new scheme, the Superbonus, has therefore been launched alongside the standard Ecobonus, which aims to promote the implementation of structural measures on buildings, to improve both energy performance and earthquake protection. In particular, the Superbonus guarantees, through a tax deduction at a rate of 110%, full remuneration of the expenses incurred for certain types of intervention, including the discounting costs owed for receiving the bonus in five equal annual instalments.

[46] https://www.enea.it/it/seguici/pubblicazioni/pdf-volumi/detrazioni-65-2017.pdf

[47] 2019 Ecobonus Report, https://www.enea.it/it/seguici/pubblicazioni/pdf-volumi/2019/detrazioni-fiscali-2019.pdf

[48] The National Strategy for Inland Areas, developed by the Department for Planning and Coordination of Economic Policy at the Prime Minister's Office, is relevant in this context http://www.programmazioneeconomica.gov.it/2019/05/23/strategia-nazionale-delle-aree-interne/

The measures relate in particular to thermal insulation of facades and/or roofs (such as external cladding) and replacing heating systems, including in combination with the installation of photovoltaic systems or micro-cogeneration systems. These measures have the biggest impact on the building in economic terms and are likely to have the greatest positive effect on the construction sector, which will see demand for numerous construction sites. In addition, these measures also have a substantial impact in terms of reducing energy consumption, and they need to be increased in order to achieve the sustainability targets set out in the Integrated National Energy and Climate Plan.

Beneficiaries of the Superbonus can also carry out additional energy efficiency measures on their building (such as replacing windows and doors or installing a home automation system) which, if carried out at the same time as those described above, will also benefit from the same higher rate.

Lastly, the Superbonus offers the beneficiary the option of transferring the tax credit to a third party (such as the companies carrying out the measure, or to financial intermediaries), which enables energy retrofitting to take place even in cases where the owner is not able to make the initial investment. This makes the Superbonus a really important measure for combating energy poverty.

The scheme, thanks to the issuing of the implementing decrees by the Ministry of Ecological Transition and the implementing circular from the Italian Customs Agency, is already fully operational.

The Superbonus was initially going to cover expenses incurred up to 31 December 2021, but the 2021 Stability Law subsequently extended it by one year. However, the possible further extension of the scheme, through projects funded by Italy's national recovery and resilience plan (NRRP) as part of the NextGenerationEU recovery package set up by the European Union, is already under consideration.

As revealed by the public consultation carried out in relation to this strategy, the introduction of improvements on the basis of experience acquired during the measure's period of implementation will be assessed when deciding whether to extend the scheme. In particular, clarification measures concerning the application of the provisions, as well as measures to simplify access to the scheme, may be introduced. More emphasis may also be placed on promoting deep renovation, including in combination with earthquake protection measures, prioritising the thermal insulation of opaque surfaces and promoting the most efficient system solutions for the buildings with the worst energy performance, in line with the INECP targets for 2030, through electrification of consumption and efficient district heating. In this context, increasing self-consumption could also be considered in relation to technologies other than photovoltaics.

The measures already in place, appropriately updated and coordinated, will have to be confirmed in the medium term, in particular in the period after 2030, when it is expected that there will be a substantial need to increase the rate of retrofitting of residential buildings in order to achieve the decarbonisation targets.

First of all, it should be remembered that substantial work needs to be carried out on the national stock of heating systems, in particular in areas affected by poor air quality. A campaign to replace heating systems that produce higher emissions, such as diesel or obsolete biomass systems, with innovative and low-emission systems is therefore being considered in these areas.

It is also important to mention the evaluation of an approach based on introducing obligations to upgrade the energy efficiency of existing buildings. Obligations could be introduced, for example during 'windows of opportunity', i.e. moments in a building's life cycle when major renovations are planned. This refers, for example, to earthquake protection measures, deep renovation or renovation of facades or roofs. The cost of implementing solutions to improve the building's energy performance (such as insulating opaque surfaces) is in fact substantially reduced at these times. These obligations could still benefit from statutory incentives, which would help to further reduce the payback time of energy efficiency investments.

With a view to continually improving the cost-benefit ratio, including in terms of Life Cycle Assessment (LCA), both for the State and for citizens, the demolition and reconstruction of buildings will be encouraged if the costs of retrofitting do not justify the measure, including in terms of renovating the urban environment.

In this context, the implementation of deep renovation measures will also be encouraged through alternative incentives such as permission to increase the cubic volume of buildings, reduction of property transfer taxes and reduction of municipal taxes.

Reform of tax deductions

In order to maximise the effectiveness of tools for promoting building retrofitting based on tax deductions and to streamline them in relation to the use of public funding, it is essential to reform the tax bonuses currently available, taking an integrated and optimised approach to improving existing buildings.

As also shown in the public consultation, the effectiveness of public spending could be increased while achieving the same results by creating a coordinated and simplified regulatory framework for the sector which puts an end to the current fragmentation of measures (Superbonus, Ecobonus, Sismabonus, Bonus casa, Bonus facciate [facade bonus], Bonus mobili [furniture bonus], Bonus verde [green bonus], Bonus alberghi [hotel bonus]).

An integrated approach would make it possible to optimise the time and cost of upgrading a building by exploiting the 'window of opportunity', i.e. unavoidable or already scheduled extraordinary maintenance works to which energy efficiency or earthquake protection measures could be linked. From this point of view, it is important to promote deep renovation of buildings with a view to sustainability in various areas: the energy aspect, in terms of efficiency, production of energy from renewable sources and electrification of consumption; the technological aspect linked to its digitalisation and dialogue with other infrastructures such as transport; the safety of infrastructure, especially in terms of seismic risk; the environmental aspect relating to green spaces, saving water, the sustainability of the materials used and construction techniques, taking the entire life cycle of the building into account; the social aspect relating to energy poverty.

The reform of the regulatory framework will therefore cover all of the aforementioned aspects, providing various deduction rates depending on the general performance achieved by the building, which can be obtained by carrying out measures with different levels of priority. Measures will also be considered which give a greater impetus to work on buildings with the worst energy performance, such as those built in Italy before 1976, i.e. before the law on restricting heat consumption in buildings. In order to remove one of the principal obstacles to carrying out deep renovation interventions, namely the investment cost, deductions in this case may be accompanied by measures such as the transfer of credit and the invoice discount, with streamlined procedures based on the experience acquired during an initial monitoring period of the scheme currently in place.

The sectors potentially affected by this reform are public and private housing, and the private tertiary sector. The other sectors possessing building stock are already covered by other incentives.

Lastly, it will be important to consider a medium-term time frame for the instrument in question (for example up to 2030) that allows for complex investment decisions which produce effective and integrated measures, potentially in successive steps as set out in the section dedicated to the National Portal on the Energy Performance of Buildings.

In this context, still in line with the general aim of optimising the cost-benefit ratio, it will also be important to promote technological solutions and design methods for the energy retrofitting of buildings that are different to traditional ones and based on green buildings, in order to promote the concept of 'environmental sustainability' across the entire life cycle of materials.

Lastly, as a way of enabling and facilitating the implementation of energy retrofitting measures, planning and consultancy tools will be developed for citizens, which must be accessible and transparent and which will guide users in the process of improving the performance of their property, encouraging phased interventions if necessary in order to optimise the benefit of investments. These tools should be supplemented and supported by database IT systems which incorporate all the information available to the government on the national building stock, such as building, heating system and energy performance certificate registers.

6.1.2. Public housing

SIAPE data for public housing, reported in

Figure 1, often indicate poor energy performance. There should be a particular focus on retrofitting the buildings with the poorest energy performance, which often correspond to those inhabited by households in energy poverty.

The INECP identifies the Ecobonus as a way of combating energy poverty. Public housing is eligible for the Ecobonus following the 2017 Budget Law, but can also access other national measures incentivising energy retrofitting work, such as the new Superbonus, the Conto Termico and the National Energy Efficiency Fund. The credit transfer scheme can certainly be helpful for bodies such as ex-IACP associations, which may not have sufficient liquidity for urgent building works, including those of a different nature to energy performance or earthquake protection works. Several regional initiatives have been implemented through calls for tender to improve the energy efficiency of public housing, financed by the 2007-2013 and 2014-2020 cohesion policy programming cycles and to be funded in the future by the new 2021-2027 cycle[49]. In some regions, 'demonstration' measures, which are used for training purposes or as a template, have been implemented or are under way on social housing managed by the Regional Housing Agency or the IACP. In Sicily, for example, with the support of the Region and ENEA, the energy efficiency programme for 80 dwellings located in the Municipality of Marsala, managed by the IACP of Trapani, uses the legislative framework of the Public-Private Partnership in Finance Projects provided for in Legislative Decree 50/16. The measures are aimed at replacing heating and hot water systems, improving the thermal insulation of the building and providing renewable energy (photovoltaic) systems. The project has been developed in line with the Minimum Requirements Decree: it is expected to generate energy savings of around 80% compared to the existing situation, allowing the building to achieve nZEB classification. The planned interventions are eligible for the Conto Termico incentive scheme.

At a regional level, it should also be noted that the Region of Liguria has joined the Enershift project[50]. In line with the project's innovative approach, a call for tenders for large-scale energy retrofitting using Energy Performance Contracts in public social housing was concluded for the first time, and EUR 15 million was invested, reducing CO_2 emissions by more than 3 500 tonnes.

Other policies relating to energy poverty

Electricity and gas bonuses, which are also identified in the INECP as measures for combating energy poverty, are not useful solutions for energy retrofitting of buildings with poor energy performance, but they can help to free up resources for carrying out measures at different levels, from replacing obsolete household appliances to energy retrofitting measures. The INECP proposed that the two schemes be automated in order to improve uptake. An alternative tool that can help to reduce household energy expenditure is the National Energy Income Fund (reddito energetico), a regional initiative for combating energy poverty and meeting decarbonisation targets, for which GSE has provided technical support. Between 2017 and 2018, the reddito energetico was trialled in the municipality of Porto Torres (Region of Sardinia), where public funds were used to install photovoltaic installations to benefit disadvantaged households, who have reduced their energy bills through self-consumption of the energy produced. The municipality set up a revolving fund into which the proceeds from economic exploitation of electricity are channelled, which can then be used for the construction of new photovoltaic systems. The initiative has also attracted the interest of other local authorities, for example in the Region of Apulia, which are considering launching similar projects.

In Milan, an intervention strategy has been adopted as an alternative to supporting expenditure with the electricity and gas bonus: the private electricity and gas supply company has launched a voluntary fundraising campaign through its customer bills, with the money going towards energy efficiency projects for households in energy poverty. The Fondazione Cariplo, a charitable foundation, is also involved, matching the funds collected

[49] Up-to-date information on regional calls for tender is available from ENEA's Observatory for Regional and Local Energy and Environmental Policies.
[50] https://enershift.eu/

through the bills, and the initiative is currently conducting its second call for projects to be funded. Other utilities are considering replicating this approach in other contexts.

A survey carried out by RSE in collaboration with Metropolitane Milanesi (MM), which manages the public housing owned by the municipality of Milan, highlighted significant differences compared to the national average, for example in terms of very obsolete electric household appliances with extremely high energy consumption or very unusual patterns of use, as a result of social exclusion. The potential for improved energy performance and reduced waste associated with cohousing and greater distribution and use of communal spaces in buildings is clear. In the metropolitan city of Milan, the Sans Papier initiative promoted the maintenance of heating systems in public housing and for households in economic difficulties.

6.2. Policies and actions relating to non-residential buildings

The tertiary sector should contribute projected savings of 2.4 Mtoe/year to the 2030 target. Italy will use existing various instruments/support measures that have the potential to be enhanced in order to achieve the cumulative end-use energy savings in the tertiary sector for the 2021-2030 period pursuant to Article 7 of the Energy Efficiency Directive (EED) as well as almost complete decarbonisation by 2050. In fact, the INECP envisages a number of development trends for instruments dedicated to increasing energy efficiency in the tertiary sector, such as the Conto Termico.

The monitoring shows that, as of 2018, the tertiary sector has achieved savings of 0.31 Mtoe/year, compared to a savings target of 1.23 Mtoe/year. Although the tertiary sector is still lagging behind the 2020 target at present, the 2020 target for the civil sector as a whole can be considered to be achieved.

6.2.1. Private tertiary sector

The main existing incentives for energy efficiency in the private tertiary sector are similar to those already mentioned for the private residential sector: tax deductions for energy efficiency measures and renovation of existing building stock and the Conto Termico. The expected development trends of these instruments in the short term are described in Section 3.2 of the INECP, along with some references to important initiatives relating to financial instruments.

In addition, regarding the promotion of energy efficiency measures in the private tertiary sector, there are several regional calls for tender for promoting energy efficiency in SMEs pursuant to Article 8 of Legislative Decree 102/2014. Emilia-Romagna, Sardinia and Campania, whose regional calls for tender also included funding for energy efficiency work following energy audits, have achieved concrete and satisfactory results. In other cases, these initiatives did not have the desired effect in terms of results achieved, primarily due to the fact that not all the Regions responded to the ministerial call for co-funding (split 50-50 between the individual Region and the Ministry for Economic Development), issued in accordance with the standard for funding energy audits in SMEs or the adoption of an ISO 50001 certified energy management system.

It is worth mentioning that, as part of the obligation for large companies and energy-intensive companies to prepare an energy audit pursuant to Legislative Decree 102/2014, ENEA has set up sector-based technical seminars to provide support to operators, which has led to the production of various sector-based guidelines for preparing energy audits. An energy audit is considered a fundamental prerequisite for carrying out well-designed and structured energy retrofitting measures.

The guidelines for energy audits in the banking sector were drawn up in June 2017 in collaboration with ABI Lab which, through its Green Banking Observatory, has been carrying out an in-depth study into ways of conducting energy audits in the banking sector since the end of 2014. The guidelines provide a methodology for self-regulation within the sector. Banks can therefore choose whether or not to adopt them. The guidelines are based on the documentation proposed by the ENEA working group, in which ABI Lab participates with other trade associations and representatives of companies and auditors, on the results of the work carried out by ABI Lab's Green Banking Observatory and on the feedback received by ENEA in each case about the suggested proposals. The document focuses mainly on office buildings, including data centres with significant consumption, or large agencies (consumption above 100 toe) where applicable[51].

The guidelines for the real estate sector (office buildings) were drawn up in October 2017 in collaboration with Assoimmobiliare[52], also with the aim of defining an approach that would provide operators in the real estate market with tools to assist them in carrying out energy audits, pursuant to Legislative Decree 102/2014. Subsequently, in May 2019, a study was developed to provide a series of benchmark indicators for the energy consumption of office buildings, derived from the analysis of data received by ENEA as part of the energy audits. This project, also conducted in collaboration with Assoimmobiliare, aims to provide operators in the real estate sector with useful tools for assessing the energy consumption of their buildings.

Lastly, guidelines were also drawn up in 2017 for preparing energy audits in the large-scale retail trade, in collaboration with Federdistribuzione[53], and in 2019 guidelines were drawn up for the private health sector, in collaboration with Bambino Gesù Children's Hospital, Università Campus Bio-Medico di Roma, San Raffaele Hospital and Gemelli University Hospital[54].

Given the high rate of retrofitting required to achieve the energy efficiency targets in the tertiary sector compared to the residential sector, it is necessary to consider introducing even more effective measures in the short term. In this case, too, an approach based on introducing obligations to upgrade the energy efficiency of existing buildings in the window of opportunity could be considered, adequately supported by incentives and promotion tools. Encouraging demolition and reconstruction will also be considered in cases where retrofitting is not economically viable, promoting solutions that adopt technologies and design methods based on green building and sustainable architecture, including 'passive' cooling and heating systems.

This should be accompanied by an appropriate training and information programme, aimed at supporting companies in the process of improving the energy performance of their buildings, notably by using the results of energy audits carried out.

6.2.2. Public tertiary sector

The public sector, as also indicated in Article 5 of the EED, has an exemplary role to play in terms of energy retrofitting. The following measures closely associated with public buildings[55] are listed and considered in the INECP:

- The Energy Renovation Programme for the Central Public Administration
- The National Energy Efficiency Fund
- White certificates
- Conto Termico

[51] Documentation about the real estate sector is available at the following link http://www.efficienzaenergetica.enea.it/per-le-imprese/diagnosi-energetiche/normativa-casi-di-applicazione/abi-lab-per-le-banche
[52] Documentation about the real estate sector is available at the following link http://www.efficienzaenergetica.enea.it/per-le-imprese/diagnosi-energetiche/normativa-casi-di-applicazione/assoimmobiliare
[53] Documentation about the real estate sector is available at the following link http://www.efficienzaenergetica.enea.it/per-le-imprese/diagnosi-energetiche/normativa-casi-di-applicazione/federdistribuzione
[54] Documentation about the real estate sector is available at the following link http://www.efficienzaenergetica.enea.it/per-le-imprese/diagnosi-energetiche/normativa-casi-di-applicazione/sanita-privata
[55] In STREPIN, the public buildings sector also includes the categories of buildings exempted by Article 5(2) of Directive 2012/27/EU.

- Minimum environmental criteria
- The Kyoto Fund and its reprogramming for public school buildings
- Cohesion Policy, programming cycles 2007-2013, 2014-2020 and 2021-2027
- Central government investment fund, contributions to municipalities towards investment in the field of energy efficiency and sustainable local development, a fund for investment by municipalities and funds for improving roads and schools in provinces and metropolitan cities
- Integrated energy and electricity service – Consip

Some of the measures listed above are already widely used to finance measures for the energy retrofitting of buildings. Other measures, such as the National Energy Efficiency Fund and the Kyoto Fund for the renovation of school buildings, were launched only recently but over the long term will help to achieve targets relating to reduction of energy consumption and decarbonisation.

The **Energy Renovation Programme for the Central Public Administration** (PREPAC) has been widely used since its launch in 2014 and has promoted measures aimed at annually renovating at least 3% of the floor area of central government buildings, as required by Article 5 of the EED. To date, the Programme has approved 195 energy retrofitting projects in central government buildings, worth EUR 270 million. In view of the importance of the measure, which has been extended to 2030, improvements are planned to speed up the implementation stage.

The **Conto Termico** scheme, introduced by Ministerial Decree of 28 December 2012, is an incentive for promoting the production of renewable thermal energy and to permit access by public sector bodies to energy-efficient building works and installations. The scheme has grown exponentially since it was launched, especially in the last 3 years, with particular interest from public bodies. With its 'dual nature', it encourages both energy efficiency measures and the renovation of heating systems with renewable energy and can, in the long run, make a valuable contribution to achieving the objectives outlined in the INECP and the LTS. There are plans to update the scheme in 2021, enhancing it further to promote the retrofitting of public buildings.

The Conto Termico: a key tool for retrofitting public buildings and buildings in the tertiary sector

The Conto Termico [Thermal Energy Account] is a non-repayable capital contribution granted for implementing small energy efficiency measures and producing thermal energy from renewable sources in existing air-conditioned public buildings registered with the Land Registry.

Energy efficiency measures can involve the building envelope, systems or both, with other benefits for nZEB transformation projects. The grant may cover up to 65% of the costs connected to energy efficiency that meet the technical requirements set out by the Conto Termico decree, including as part of more extensive building retrofitting projects. For schools and health facilities, the grant may cover up to 100% of costs. Design costs are compensated at the same percentage as that set for measures; the costs of energy audits and *post operam* energy performance certificates, which are mandatory in many cases, are fully covered.

The Conto Termico helps public authorities to bring their buildings up to higher energy efficiency levels than those set out in the Minimum Requirements Ministerial Decree and to cover additional costs arising from the Minimum Environmental Criteria for planning and implementing measures on buildings. It is also compatible with any other source of public funding, provided that the sum of the contributions does not exceed the total cost of the measures.

The development of the Conto Termico, in line with the development trends outlined by the INECP for the scheme and the provisions introduced by Legislative Decree No 73/2020, implementing Directive (EU) 2018/2002 amending Directive 2012/27/EU on energy efficiency, may see it focus more specifically on public and private buildings in the non-residential civil sector, by including retrofitting measures for buildings in the private tertiary sector among those eligible for the scheme.

The Action plan for environmental sustainability of consumption in the public administration sector, also known as the National Action Plan on Green Public Procurement (PAN GPP), is an interesting initiative because it combines action on the environment with energy efficiency. The **Minimum Environmental Criteria** for construction state, in particular, that in the case of projects involving the restructuring/maintenance of existing buildings, an energy audit must be performed or acquired in order to identify the building's energy performance and measures to be taken to reduce the building's energy requirements. With regard to new buildings[56] and first-level major renovations, without prejudice to any stricter rules and regulations (for example, urban planning and municipal building regulations) and the provisions of the MEC 'energy services' (Ministerial Decree 7/3/2012 as amended), projects must guarantee that the building's overall energy requirement is met by systems using renewable sources or by alternative high-efficiency systems (high-performance cogeneration/trigeneration, centralised heat pumps, low-enthalpy geothermal energy, etc.) producing energy within the site of the building with a value equal to 10% more than the values stated in Annex 3, point 1 of Legislative Decree No 28 of 2011, in accordance with the deadlines prescribed in that Decree. The building design should include technical specifications for internal environmental quality[57] and the maintenance plan for the work and its parts must include the verification of (qualitative and quantitative) performance levels, using a programme for monitoring and controlling air quality inside the building: such a programme can only be clearly identified once the system is running, with the assistance of staff professionally qualified to carry it out.

The **2020 Budget Law** provides for a series of measures to boost investment and resume public works throughout the country for both central and local government. In particular, a fund has been established for central government, with a total allocation of around EUR 20.8 billion for the years 2020 to 2034, which has the main objective of boosting investment, particularly in reference to environmental sustainability and investment programmes and innovative projects, including those implemented in the form of grants to highly sustainable companies, which take account of social impact.

For the years 2020 to 2024, it has been confirmed that Italian municipalities will be granted financial aid to make their buildings and territory safe; the resources have been increased from EUR 4.9 to 8.8 billion to cover energy efficiency interventions as well as safety measures for the buildings. This financial aid will range from a minimum of EUR 50 000 for the smallest municipalities (with a population of 5 000 or less) to a maximum of EUR 250 000 for the largest municipalities (with a population of over 250 000).

A fund will also be set up for infrastructure investments in municipalities, to be spent in particular on public buildings, including maintenance and safety and energy efficiency measures, maintaining road infrastructure, hydrogeological instability, seismic risk prevention and enhancing cultural and environmental assets. This fund will have a budget of EUR 400 million for each of the years 2025 to 2034.

The other measures set out in the Budget Law regarding investments to be made across the country include the allocation of almost EUR 6.1 billion to finance public works for making roads safe and for extraordinary maintenance and energy efficiency measures to be carried out in schools in provinces and metropolitan cities. The funds will be allocated over the period from 2020 to 2034, with a grant of EUR 100 million for the years 2020 and 2021 and of EUR 250 million for each of the following years.

Under the **Cohesion Policy**, in particular the regional and national operational programmes, the Development and Cohesion Fund and the Action and Cohesion Plan, projects relating to energy efficiency

[56] Including demolition and reconstruction work and the expansion of existing buildings with a gross air-conditioned volume in excess of 15% of the existing volume or more than 500 m^3.

[57] In terms of: natural lighting; natural ventilation and controlled mechanical ventilation; solar protection devices; indoor electromagnetic pollution; emissions of materials indoors; acoustic comfort; thermohygrometric comfort; radon.

were selected for the **2007-2013 and 2014-2020 programming cycles**, starting in 2014 and broken down by area of intervention[58], with the corresponding energy saving being estimated on the basis of the investments made[59].

Of the five EU investment priorities financed by the Cohesion Policy, the ones most closely related to STREPIN are supporting the transition to a low-carbon economy in all sectors, promoting the efficient use of resources and adapting to climate change. It is precisely the focus on energy efficiency and large-scale decarbonisation that makes the Cohesion Policy a measure which, in the long term, can contribute to achieving the INECP and LTS targets.

Cohesion policy programming for the 2021-2027 programming cycle is currently under discussion between the European Commission and all the Member States. The discussion focuses on five separate platforms, one for each of the policy objectives described in the proposal for Regulation (EU) No 2014/240 relating to a smarter, greener, more connected, more social Europe that is closer to its citizens.

At the end of the discussion process for each platform, a summary document will be published, representing the starting point for drawing up the Partnership Agreements between the European Commission and the individual Member States and subsequently the various operational programmes.

In conclusion, it is worth mentioning the publication in 2019 of guidelines for carrying out energy audits in public buildings[60], a document which may be a useful tool for planning the energy retrofitting works necessary to achieve long-term targets. The guidelines focus in particular on schools and offices, with the aim of reinforcing the technical know-how of the Regions and local authorities in relation to energy and environmental matters. The objectives of these guidelines are twofold: to make it easier for the Energy Audits Officer (known as the REDE) to carry out energy audits on public buildings for residential use (public housing) and tertiary buildings and to coordinate the results obtained in databases, useful for any comparisons between the energy requirements of existing buildings and those of the reference buildings used for the same purpose.

It will be necessary to implement tools that increase the retrofitting rate in the medium term in the public tertiary sector too, as the measures in place evolve. The introduction of mandatory energy retrofitting will be considered as an option here, possibly in connection with windows of opportunity opened by other unavoidable extraordinary maintenance works.

In light of the solid experience obtained through the PREPAC programme, the introduction of a ‘burden sharing’ system will be considered for central and local government, which may be required to set up mandatory programmes for annual retrofitting of a certain percentage of the surface area of buildings for which they are responsible. Incorporating retrofitting priorities for buildings with the highest savings potential, such as hospitals, into these programmes could be considered.

An effective system of coordination and spatial planning observation should be developed alongside these programmes, through cooperation between State and local authorities, in order to properly assess the efforts made and share good practices.

[58] Public/tertiary buildings, residential buildings/public housing, public lighting, industry, smart grid, information campaign, urban transport and railways.

[59] As regulations do not provide a definitive process for calculating final energy savings for the different sectors taken into consideration when analysing the projects funded by the Cohesion Policy in the 2007-2013 and 2014-2020 programming cycles, the savings have been calculated by only taking into account projects launched since 2014 and, depending on the different sectors, by dividing the investments made by a specific coefficient derived from the evaluation reports drawn up periodically by the Regions to monitor the projects and from specific incentives. For more details on the savings calculation methodology, please refer to the ‘Update on the implementation of Article 7 of Directive 2012/27/EU on energy efficiency obligation schemes – Notification of the method’, sent to the European Commission by the Ministry of Economic Development. April 2019.

[60] More information can be found at the following link http://www.efficienzaenergetica.enea.it/pubblica-amministrazione/edilizia-pubblica/diagnosi-energetica-di-edifici-pubblici-linee-guida-enea

6.3. Initiatives to promote smart technologies, skills and education

6.3.1. Smart, interconnected buildings and energy communities

One of the main innovations introduced by Directive 2018/844 amending and supplementing the Directive on the energy performance of buildings involves the use of 'Smart Ready Technologies' (SRT). Article 8 provides for the adoption of a delegated act establishing an optional common Union scheme for rating the smart readiness of buildings and the capabilities of a building or building unit to adapt its operation to the needs of the occupant and the grid and to improve its energy efficiency and overall performance. In particular, the Article provides for the definition of a new Smart Readiness Indicator (SRI) and a methodology by which it is to be calculated. The European Commission entrusted the consortium coordinated by the research institute VITO and Waide Strategic Efficiency Europe with the task of carrying out technical studies and coordinating stakeholder meetings to define and consolidate the SRI calculation methodology and the analysis of the related implementation methods. As well as technologies such as smart meters, the methodology takes into account self-regulating devices for indoor air temperature control and other technological solutions, the building automation and control systems described in Articles 14 and 15 of Directive 2018/844, which will be mandatory by 2025 for non-residential buildings with an effective rated output for heating systems or systems for combined space heating and ventilation of over 290 kW. Italy participates in technical expert groups set up by the European Commission and stakeholder meetings and has launched a study to assess the impact of the calculation methodology proposed for the SRI on different types of national buildings. The smart readiness indicator shall cover features for enhanced energy savings, benchmarking and flexibility, enhanced functionalities and capabilities resulting from more interconnected and intelligent devices.

Currently, the Decree of 26 June 2015 sets out the obligation to install systems in line with the UNI EN 15232 standard; specifically, newly constructed non-residential buildings or those subject to major renovation must have a minimum level of automation corresponding to class B as defined in the UNI EN 15232 standard. This standard, entitled 'Energy performance of buildings - Part 1: Impact of Building Automation, Controls and Building Management – Modules M10-4,5,6,7,8,9,10' sets out a structured list of control, building automation and technical building management functions which contribute to the energy performance of buildings; functions have been categorised and structured according to building disciplines and 'Building Automation and Control' (BAC). It is also worth mentioning the technical specification UNI CEI TS 11672:2017, which sets out the knowledge, competence and skill requirements for BAC system installers: 'Unregulated professional activities – Professionals performing installation and maintenance of BACS (Building Automation Control Systems) – Knowledge, skills and competence requirements'.

The following incentives relating to BAC systems have been available since 2016:

Table 34– Incentives for smart technologies

Conto Termico	Enables the installation of technologies for the management and automatic control of heating and electrical systems in buildings, including the installation of thermoregulation and heat metering systems. The incentive is only available for technologies that allow at least class B of the UNI EN 15232 standard to be achieved. This incentive is intended only for existing buildings, in any cadastral category.
Ecobonus	This provides support with the costs incurred through 'purchasing, installing and operating multimedia devices for the remote control of heating, hot water production or air conditioning systems in housing units, aimed at increasing users' awareness of their energy

	consumption and to ensure that the systems are functioning efficiently'. ENEA published an updated version of the vademecum on building automation on 9 May 2019.
White Certificates	As an alternative to the tax deduction of 65%, residential buildings can benefit from the incentives provided for by the White Certificates scheme in relation to installing Building Automation and Control Systems in line with the UNI EN 15232 standard.

Source: Data processing by ENEA.

As revealed by the public consultation, it will be carefully considered whether the SRI indicator defined in the recently published EU regulations[61] should be adopted at national level, and it will also be considered whether the minimum technical requirements for building automation systems should be updated and made more stringent.

In line with the National Energy Strategy and with the provisions of Directive (EU) 2018/2001, the National Energy and Climate Plan, submitted to the European Commission in December 2019, identifies self-consumption as a key measure for small plants, placing a central emphasis on citizens and businesses (in particular SMEs), in such a way that they become key players and beneficiaries of the energy transition and not just the financiers of active policies. Self-consumption and energy communities therefore play an important role in terms of reaching local consensus in authorisation processes.

Article 42-*bis* of Italian Decree-Law No 162 of 30 December 2019 on 'Urgent provisions regarding the extension of legislative deadlines, the organisation of public authorities and technological innovation' (known as 'Milleproroghe' [a thousand extensions]) established methods and conditions for implementing collective self-consumption of renewable energy and creating renewable energy communities. This is an experimental and transitional measure, pending the transposition of Directive 2018/2001 into Italian law, which is accompanied by the provision introduced by Decree-Law No 34/2020 (the 'relaunch') of accumulation with the Superbonus 110%.

At the same time, it is worth highlighting some pilot projects for national implementation, creating the first energy communities, which have been launched at a regional level.

One initiative which combines intelligent systems, smart cities and energy communities is the GECO Green Energy Community project. A neighbourhood energy community involving citizens and about 900 companies is being set up in the Pilastro-Roveri district of Bologna, thanks to a combination of renewable sources, distributed generation, energy storage and optimisation of consumption. The project is sponsored by the AESS (Agency for Energy and Sustainable Development), as coordinator, ENEA and the University of Bologna, with the involvement of Bologna Agri-Food Centre (CAAB)/FICO agri-park and the local development agency for Pilastro and the north east district. Funded with EUR 2.5 million from the European EIT Climate-KIC Fund, the GECO project is linked to Roveri Smart Village, an initiative supported by ENEA since 2017. ENEA will work on developing a blockchain-based platform to manage electricity flows, with the aim of improving consumer awareness.

The Region of Piedmont was the first Italian Region to introduce a law on self-consumption and energy communities, with Regional Law No 12 of 3 August 2018, '*"Promoting the creation of energy communities" and Implementing provisions and approval, for the year 2019, of the criteria for financial support' in Regional Council Decision No 18-8520 of 8 March 2019 (Official Regional Gazette No 11 of 14 March 2019)*, defining the criteria and procedures for regional financial support, with EUR 25 000 for 2018 and 2019 for creating energy communities. The first energy community was set up in the Pinerolo area and consists of 25 municipalities in an area of 1 350 square kilometres, with a population of 150 000.

[61] Commission Delegated Regulation (EU) 2020/2155 of 14 October 2020 and Commission Implementing Regulation (EU) 2020/2156 of 14 October 2020

The Region of Apulia has also taken action in this regard, with *Regional Law No 45 of 9 August 2019, 'Promoting the creation of energy communities'.* In Sardinia, the experience of the municipality of Benetutti (Province of Sassari) is different. As it owns the local electricity distribution grid, it has submitted a preliminary study for creating a smart grid, with the *Complex Project – Intelligent networks for Energy Management* conducted by the Renewable Energy Platform of Sardegna Ricerche [Research for Sardinia] and the University of Cagliari. Thanks to self-consumption from photovoltaic sources, the municipality is already using electricity to generate a proportion of its heat consumption. It is also planning to construct a biogas plant for the production of biogas. Today, the Azienda Elettrica Comunale di Benetutti [Benetutti Municipal Electricity Company] has over 1100 users. In addition, the Region of Sardinia also participated, together with the Region of Lazio, in the European Project ENERSELVES (EUR 1 598 431) from 1 January 2017 to 31 December 2020, part of the Interreg Europe programme 2014-2020. The project focuses on the use of renewable sources for energy self-consumption in buildings and aims to improve regional operational programmes and increase the technical/professional capacity of stakeholders.

The *Complex Project – Intelligent networks for efficient energy management* was developed based on the experience acquired by the Renewable Energy Platform since the ERDF Regional Operational Programme 2007-2014, in particular with the renewable energy cluster project, which had around 40 participants, including companies, research organisations and regional public bodies. It is part of the ERDF Regional Operational Programme 2014-2020 (Action 1.2.2.) and has its own section in the Smart Specialisation Strategy (S3) of the Region of Sardinia.

From the broader perspective of developing new technologies and innovative products and services, the *National Energy Technology Cluster* is worth mentioning, the executive board of which consists of Eni, Enel with e-distribuzione, General Electric-Nuovo Pignone, Terna, CNR, RSE, EnSiEL, Lombardy Energy Cleantech Cluster and ENEA. The Cluster has been recognised by the Ministry of Education, University and Research which, by Decree of 14 March 2019, approved the payment of a contribution aimed at launching the activities set out in the National Research Programme 2015-2020 (NRP 2015-2020) and the National Smart Specialisation Strategy. (Decree No 466/2019).

Lastly, it is worth noting the measures promoted by the Systems Research programme, which are aimed at developing: technological tools and solutions to enhance the energy performance of new and existing buildings; innovative materials for optimising the insulation of the building envelope; components and systems for increasing the use of renewable energy in buildings.

Collective self-consumption and energy communities

With the recent Directive 2018/2001 on the promotion of the use of energy from renewable sources (RED II), which sets a target of 32% of energy from renewable sources in the Union's final consumption of energy by 2030 and was adopted as part of the 'Clean Energy Package', the concepts of 'renewables self-consumers', 'jointly acting renewables self-consumers' and 'renewable energy communities' were introduced for the first time.

'Renewables self-consumer' means a final customer 'operating within its premises located within confined boundaries or, where permitted by a Member State, within other premises, who generates renewable electricity for its own consumption, and who may store or sell self-generated renewable electricity, provided that, for a non-household renewables self-consumer, those activities do not constitute its primary commercial or professional activity'.

The Directive also provides for inhabitants of the same building or apartment building to be granted the status of a group of jointly acting renewables self-consumers; Member States are entitled to differentiate between individual 'renewables self-consumers' and 'jointly acting renewables self-consumers'.

Regarding renewable energy communities, these are defined as a legal entity:

- which, in accordance with the applicable national law, is based on open and voluntary participation;

- which is autonomous, and is effectively controlled by shareholders or members that are located in the proximity of the renewable energy projects that are owned and developed by that legal entity;
- the shareholders or members of which are natural persons, SMEs or local authorities, including municipalities;
- the primary purpose of which is to provide environmental, economic or social community benefits for its shareholders or members or for the local areas where it operates, rather than financial profits.

It is also stipulated that final customers, in particular household customers, are entitled to participate in a renewable energy community while maintaining their rights or obligations as final customers.

Article 42-*bis* of Decree-Law No 162 of 30 December 2019 sets out the terms and conditions for implementing collective self-consumption from renewable sources and creating renewable energy communities, de facto trialling a framework of rules aimed at allowing final customers to 'join together' to 'share' electricity produced locally by new plants powered by renewable energy.

Specifically, the Decree-Law introduces the opportunity, with reference to new plants powered by renewable energy which have a total capacity not exceeding 200 kW and which come into operation within 60 days of the date of entry into force of the decree transposing Directive EU/2018/2001, to implement collective self-consumption from renewable sources or to create renewable energy communities.

The regulatory framework for the transitional implementation into national law of arrangements for setting up collective self-consumption and renewable energy communities has been completed with Decision No 318/2020/R/eel of the Italian Regulatory Authority for Energy, Networks and Environment (ARERA) on procedures and economic regulation relating to shared energy, and by Decree of the Ministry of Economic Development (MiSE) of 16 September 2020, which defines the incentive tariff for using renewable energy systems, included in the aforesaid arrangements.

Under the current implementation framework, GSE is the institution responsible for 'development and promotion of shared electricity' (known as 'shared electricity service') and for applying the incentive tariff for using renewable energy systems included in the arrangements for setting up collective self-consumption and renewable energy communities. To this end, in December 2020, the GSE published, pursuant to Article 11 of Annex A to Decision No 318/2020/R/eel, the Technical Regulations for development and promotion of shared electricity, describing in detail the requirements and application procedures for accessing the service, the standard contract template, the calculation criteria and the time frame for paying the subsidies.

6.3.2. Skills and training

It is necessary to identify professional requirements and build skills for the future of work, to enhance the dissemination of information about skills, to encourage information sharing between ministries, local authorities and all interested parties[62]. It is also necessary to include as many people as possible in the innovation process and its benefits, while taking into account the challenges of continuous learning for adults, especially for less qualified profiles, and the associated risks, which digitalisation and technological innovation threaten to increase[63].

The European initiative BUILD UP Skills focused on the training needs of blue collar workers, i.e. the workers on construction sites. Improving the skills of technicians and operators in the energy performance of the buildings sector requires the development of new methods of designing and delivering training, which address the specific challenges faced by workers in the sector when undertaking traditional training courses. In addition, under the new approach it is of fundamental importance to take the regulatory framework into account, which aims to value skills obtained through all learning, including learning acquired in informal or

[62] *'OECD National Skills Strategy Diagnostic Report 2017 – Italy'*.
[63] OECD report *'Skills Outlook 2019: Thriving in a Digital World'*.

non-formal ways, in reference to the European ECVET and EQF recommendations, to ensure transparency of qualifications and skills.

Table 35 – Regulatory framework of reference for skills and training

Directive (EU) 2018/2001 on the promotion of the use of energy from renewable sources, Articles 52, 53 and 54
Council Recommendation (2017/C 189/03) of 22 May 2017 on the European Qualifications Framework for lifelong learning
European Council Recommendation of 22 May 2018 sets out and approves key competences
Italian Law No 92 of 28 June 2012, as amended, provides for a reform of the labour market with a view to growth, and in particular Article 4, from paragraph 51 to paragraph 68, sets out the principles underlying the reform of professional training.
Legislative Decree No 13 of 16 January 2013 sets out the general rules and essential performance levels for identifying and validating non-formal and informal learning and the minimum service standards for the national system for competences certification, in accordance with Article 4, paragraphs 58 to 68, of Law No 92/2012.
Interministerial Decree (Ministry of Labour and Social Policies in agreement with the Ministry of Education, University and Research) of 30 June 2015 puts in place the 'Operational framework of reference for the recognition at national level of regional qualifications and related skills', as part of the National Directory of Education and Training Certificates and Professional Qualifications pursuant to Article 8 of Legislative Decree 13/2013.

Source: Data processing by ENEA.

The Italian BUILD UP Skills roadmap to 2020 has therefore been developed along several strategic lines: training of trainers; on-the-job training; creating a uniform system for certification of competences. The Roadmap makes reference to the traditional professions included in the qualifications directories of the Regions and Autonomous Provinces, in order to suggest complements and/or adjustments necessary for the renewable energy and energy efficiency market. As regards compliance with the principles of 'neutrality' and independence required by Article 3 of the Ministerial Decree of 16 January, please refer to Law No 4 of 14 January 2013: Provisions for non-regulated professions. The roadmap gives the example of Secem certification for experts in energy management which is based on the national standard UNI CEI 11339.

The roadmap analyses employment in the construction sector up to 2020 for each professional role, estimating that there will be 1 518 456 skilled workers and 1 783 290 non-qualified workers in construction by 2020 (proposals are also set out regarding actions, persons responsible and costs up to 2020).
BUILD UP Skills Pillar II in Italy has funded two projects: I-TOWN *Italian training qualification workforce in building* and *BRICKS Building refurbishment with increased competences*, *knowledge and skills*. BRICKS, coordinated by ENEA, has developed qualification schemes for a dozen professional roles.
With an estimated 21.1 million people employed in the construction sector in 2015[64], the BUILD UP Skills initiative was followed up in Horizon 2020 (Construction Skills). In Italy, the project coordinated by ENEA Net-UBIEP*(Network for using BIM to increase energy performance*) has been running since 2017.
BIM is one of the topics addressed in the training sessions for decision makers, technicians, professionals and SMEs, planned as part of the three-year energy efficiency training and information plan, applying Article 13 of Legislative Decree 102/2014. The summer school for energy efficiency and e-learning discusses the latest technologies and specific aspects relating to energy efficiency in buildings and subjects such as water recovery, indoor comfort, ventilation, bio-materials, green walls and roofs. On the latter issue, UNI 11235 of 2007, updated in 2015, provides support for the construction of green roofs, but not for establishing energy performance. Work is under way to draw up guidelines for designers/operators in the sector and to supplement/update the 11235 standard for green roofs.

[64]European Construction Sector Observatory (ECSO), Analytical Report – Improving the human capital basis, April 2017.

Regarding indoor comfort, it is worth mentioning the REEHUB project, which assesses the comfort and air quality of the indoor environment in schools subject to energy retrofitting (total budget EUR 744 800, co-financing of 85%, duration 2018-2020). The main outputs are: audit methodology; capacity building actions for energy efficiency in buildings; roadshow for key stakeholders.
As revealed by the public consultation, it seems crucial to stress the importance of combining building retrofitting incentives with information campaigns aimed at raising people's awareness of their own energy consumption and the potential savings associated with energy retrofitting and behavioural changes.
This is because the cultural aspect underpins investment decisions and can persist over time and remain effective even in the absence of highly rewarding incentives, such as the Superbonus. In addition, being aware of which measures are most effective at reducing energy consumption and energy bills provides a knowledge base which facilitates decision-making, especially in complex situations such as in apartment buildings.
This knowledge also needs to be accompanied by an appropriate set of professional skills to ensure the best results when implementing the efficient technologies available on the market.
Legislative Decree 102/2014, recently amended to transpose EED II, renewed and upgraded the National Energy Efficiency Information and Training Plan for 2021-2030.
Specific initiatives will thus be developed to fill the information gap for end users in the residential sector, as well as appropriate training activities (both on incentives and the most effective measures) for companies offering energy services, for companies carrying out interventions and for apartment building syndicates.
Initiatives will be developed in the non-residential sector with the aim of raising awareness among businesses about the benefits of undertaking energy retrofitting work following an energy audit.
In view of the professional requirements of operators in the sector, reference is made to Article 4-*ter* of Legislative Decree 192/2005. The provision, introduced by Legislative Decree No 48 of 2020, provides for the issuance of a Presidential Decree setting out the requirements to be met by operators who install building elements and technical building systems, taking into account the need to ensure that such operators are sufficiently skilled and considering, inter alia, the level of professional training, including that achieved through specialised courses and certifications. This is with particular reference to the fact that, 180 days after the date of entry into force of the aforementioned decree, energy retrofitting incentives will be granted on the condition that the aforementioned systems are installed by an operator meeting the prescribed requirements.

6.4. Financial tools

In order to instigate a voluntary and exemplary process that maximises the positive returns of energy efficiency measures, STREPIN 2017 already suggested the removal of impediments, be they technical or administrative, economic or financial, that deter both small and large investments. Financial instruments aimed at facilitating the energy retrofitting of buildings, such as energy performance contracts and public-private partnerships (PPPs), could realise their full potential here. As revealed by the public consultation, in order to further encourage such approaches, and to minimise the risk for contractors, there will need to be greater standardisation of the forms used.

Many impediments are mainly due to high initial investment costs, a frequent lack of awareness of the potential savings and difficulty in accessing incentives, serious issues for both end users and lenders/credit providers. Examples are listed below:

- administrative or preliminary costs, to make carrying out the measure accessible and appealing;
- difficulties in obtaining loans from credit institutions, including via ESCos, due to lending procedures that are still highly conservative and uncertainties about projects based on cash flow or where innovative incentive schemes are involved;
- risk of payment default for measures financed by ESCos;

- perceived high risk, high interest rates and lack of subsidised funding;
- asymmetry of information: barriers to the implementation of energy efficiency measures due to a lack of awareness of the potential benefits of savings and difficulty in accessing incentives;
- split incentives: impediments due to the fact that the economic benefits of efficiency measures are often not experienced by those who have to pay the investment costs.

To overcome the barriers and subsequently increase implementation of energy efficiency measures, existing instruments need to be modified and potentially reinforced to increase their effectiveness and flexibility in the event of combination with non-energy related interventions, and successful initiatives should be transformed into model evaluation procedures/guidelines, as shown in Table 38.

Table 36 – Existing financial mechanisms and their areas of intervention

	a. Aggregation of projects	**b. Reduction of perceived risk**	**c. Public funding**	**d. Guiding investment in an energy-efficient public building stock**	**e. Accessible and transparent advisory tools and energy advisory services**
The National Energy Efficiency Fund		**X**	**X (Invitalia)**	**X**	
Energy efficiency fund for schools				**X**	
Fund for the purchase and/or renovation of real estate ('Plafond casa' initiative – energy retrofitting)[65]	**X**	**X**	**X (CDP)**		
First Home Guarantee Fund (Fondo Garanzia Prima Casa)[66]			**X (MEF)**		
Conto Termico		**X**		**X**	
Ecobonus	**x**			**x**	
Energy Performance Contract	**X**	**X**			
Green bonds[67]	**x**			**x**	**x**
Crowd-funding[68]	**x**			**x**	
Initiatives with structural funds[69]		**X**			**x**
One-stop shop[70]	**X**				
White certificates			**X**		

Source: Data processing by ENEA.

Recent guidelines show that rather than introducing new schemes (introducing innovations that often risk being more complex and consequently less effective because of the longer time required to set them up),

[65] The fund is the result of an agreement between Associazione Bancaria Italia and Cassa Depositi e Prestiti SpA. See the following link for participating banks https://www.cdp.it/resources/cms/documents/PCASA_Elenco%20Banche%20Contraenti_2019.10.23.pdf

[66] The fund is financed by the Ministry of Economy and Finance (MEF) and managed by CONSAP; the possibility of establishing more stringent requirements for energy efficiency measures and including an additional quota for energy efficiency and earthquake protection is being investigated.

[67] Some Italian examples are: Terna for EUR 500 million, Ravenna-Tozzi Green for rural areas in Peru, Hera Group for EUR 500 million for discharges into the sea in Rimini but also for district heating, central cogeneration plants and renewables from organic waste in other provinces of Emilia-Romagna; Ferrovie Stato for purchase of regional trains and electric freight locomotives, green buildings in general, clean transport, renewables. In Italy, there has been a marked increase in the issuance of green bonds, (with EUR 4.25 billion issued since January) compared to EUR 2 billion for the whole of 2018 (Sole24 finance business).

[68] Some Italian examples are: Palayamamay Busto Arsizio sports facility energy efficiency project, Welfare Efficiency Piemonte and support platforms (Ecomill, WeAreStarting, Infinityxhubecc).

[69] For example, the DGR471_2018 – Region of Abruzzo: 100% non-repayable regional funding on condition that the applicant makes use of the Conto Termico and the energy one-stop shop.

[70] Some Italian examples are: IREN Spa and Fratello Sole, Punti Energia Clima per i Comuni [Focus on Energy and Climate for Municipalities, PECC] based on an ongoing collaboration between ENEA and GSE.

the rationalisation of existing instruments should be considered, extending the range of beneficiaries to include, for example, apartment buildings, and extending the scope, where appropriate, to cover the financing of energy retrofitting in residential buildings, including unsecured loans.

Regarding financial mechanisms made available at a European level, such as funding granted by the European Investment Bank, it is worth mentioning how often the same impediments arise as those listed above, relating to high transaction costs, split incentives and difficulties in aggregating projects. It should also be pointed out that loan beneficiaries have limited capacity to design and implement quality projects which meet certain requirements and the high threshold for minimum investment of EUR 30 million[71].

With regard to the banks' willingness to finance energy efficiency projects, it is important to mention the process, implemented by EEFIG and the United Nations Sustainable Finance Agency, aimed at identifying a taxonomy for the building and manufacturing sectors, which are considered priority sectors in terms of energy and emissions, and at defining criteria for tagging energy efficiency loans. This would facilitate the de-risking process, closing the current investment gap and contributing to the achievement of long-term energy emissions targets. Under current practice, major financial institutions have established 'in-house' criteria to identify and assess sustainable economic activities and sustainable investments, in the absence of common terminology and uniform measurement and assessment criteria. The parameters in the proposed taxonomy for buildings submitted to the European Parliament and Council in December 2019 include the building's CO_2 emission levels, the building's primary energy consumption level and the energy performance class to which the building belongs. Meeting these parameters would allow investments to be correctly classified in terms of their eligibility for financing; in this regard, the SIAPE may contain information that could potentially be very useful to financial institutions. The conclusion of this process, with taxonomy and tagging tools being made available to stimulate the supply of capital, must be accompanied by a consolidation of the demand for capital, boosting confidence among final consumers regarding investment in energy retrofitting, which appears to be another aspect still in need of reinforcement.

For the private residential sector – as well as for the private tertiary sector, given its greater difficulty in achieving the energy saving targets for 2020 – it seems particularly important to ensure the availability of appropriate financial instruments which support and complement existing incentives[72].

It is relevant to mention, in this regard, the Fund referred to in Article 1(48)(c) of Law No 147 of 27 December 2013 – managed by Consap Spa – which issues a first demand guarantee for 50% of the mortgage sum, issued only to natural persons for an amount less than EUR 250 000, for the purchase, or purchase and renovation and energy efficiency upgrading, of property to be used as a main residence. The instrument is counter-guaranteed by the State, giving the guaranteed loans a favourable risk weight for banking supervisory regulation purposes. Since it was launched (January 2015), with a budget of around EUR 650 million, as of 15 September 2019, the Fund has achieved the following results:

- 147 029 approved loan transactions, equivalent to a sum of around EUR 16.5 billion;
- 56% of loans involve young people aged between 20 and 35;
- only 35 guarantees were actually enforced, for a sum of around EUR 500 000. The Fund's resources are only actually used in the event that the guarantee is enforced due to default on the guaranteed loan.

The figures show how – with few resources – it is possible to encourage major investments with significant positive returns for the national economy. However, the aforementioned instrument is not explicitly dedicated to the energy retrofitting of buildings.

The 2018 Budget Law therefore established a section of the National Energy Efficiency Fund specifically for issuing guarantees for loans to finance energy efficiency measures, and the related provision is currently

[71]The energy retrofitting of a large apartment building can cost around EUR 1.5 million.

[72] For a more extensive discussion of financial tools, see Chapter 9.

being agreed between the Ministries of Economic Development, Economy and Finance, and the Environment.

However, in order to support and facilitate access to these instruments, it will be important to develop standardised systems for assessing financial risk, with particular reference to financing energy retrofitting measures in buildings (known as 'green mortgages'). To this end, it will therefore be important to:

- use technical standards as tools to reduce risk, as they are based on universal criteria of transferability, essentialness, transparency and sharing, in order to ensure that energy efficiency measures, and consequently the cash flow expected from the initiative, are relevant, transparent, reliable and measurable.
- develop systems that allow processes to be standardised and enable the acquisition of long-term risks, which make it easier to obtain capital for energy performance contracts for residential buildings, in particular for multi-family buildings;
- create national database systems to support assessments.

In addition, with a view to optimising the cost-benefit ratio, schemes could be developed to facilitate or promote the granting of financial subsidies for measures that combine renovation and building safety measures (reinforcing structures to make them more stable and reduce geological/seismic risk) with measures to improve energy performance, including surface installation or installation of renewable energy systems, but also incorporating charging infrastructure for electric vehicles.

In addition to the above, in order to encourage investment in the real estate sector and, in particular, investment to improve energy performance, measures such as restructuring of taxation on buildings with high energy performance, or on which energy retrofitting measures have been carried out alongside safety measures, may be considered.

Lastly, it is worth mentioning three different initiatives that have recently been launched on a national level and may have a positive impact:

1. In February 2019, the Italian Banking Association (ABI) and National Association of Insurance Companies (ANIA) signed a 'Joint Declaration for the valorisation of buildings, to improve energy efficiency and reduce the economic impact of seismic risk', to share a common strategy for the banking and insurance sectors on both the supply and demand sides.

   The main objectives are to:

   a) promote initiatives aimed at improving the management of the energy and environmental aspects of the building stock and minimising the economic impacts of earthquakes by identifying the most suitable financial and insurance products to support energy retrofitting work in private housing;
   b) analyse and make the best use of tools for measuring and verifying performance, in order to calculate the savings obtained from energy efficiency measures, which can be used to design new financial and insurance products;
   c) develop joint information and training initiatives in order to promote and disseminate a culture of prevention, adaptation and mitigation of the risks arising from climate change and earthquakes.
2. The European Commission has planned a series of **Sustainable Energy Investment Forums** as part of the 'Smart Finance for Smart Buildings' project. With reference to Italy, several events have been organised in collaboration with the European Commission, the ABI, the Ministry of Economic Development, ENEA, and UNEP-FI. The first event, in November 2017, brought together some 125 participants interested in the topic of energy efficiency in buildings: the financial sector, national governments, project developers, operators in the building renovation chain and local and regional

agencies. The conference was followed in May 2018 by a 'National round table on financing the energy retrofitting of buildings in Italy' concerning renovation of private housing, de-risking of energy efficiency investments, energy efficiency loans and also public buildings. A 'Second national round table' was then held in February 2019, with the aim of further developing dialogue between key stakeholders on how to improve access and reduce risk for energy retrofitting measures in the construction sector, with a focus on retrofitting residential buildings, de-risking energy efficiency investments and public buildings. The meeting revealed a number of issues that need to be worked on to find common solutions, including identifying methodologies to demonstrate that investments in energy efficiency are in fact low risk, in order to develop an adequate supply of capital, but also a demand that, at the moment, is not high, primarily due to a lack of awareness among building owners about the benefits of energy retrofitting measures.

3. In September 2019, the ABI set up a '**Technical panel to promote energy efficiency in buildings**' in which public and private parties interested in the subject participate, including: the European Commission, the Ministry of Economy and Finance, the Ministry of Economic Development, the Ministry of the Environment and Protection of Land and Sea, the Bank of Italy, ENEA, the ANIA, Consumer Associations, the main property associations (e.g. Confedilizia and National Builders' Association (ANCE)), the European Mortgage Federation, ABI Lab.

   The main objectives of the technical panel are:

   a) creating synergies in order to encourage communication about new legislation, taxation and regulations as well as about European or national initiatives relating to the energy efficiency of the building stock;
   b) to spread a culture of energy efficiency at national level, with a view to increasing demand for energy retrofitting measures;
   c) identify tools that could promote the energy retrofitting of buildings.

   Increasing private capital investment in energy efficiency in buildings, thereby improving leverage and the balance between the costs to the State and benefits, is key to ensuring that the challenging decarbonisation targets for the national building stock are met.