Italian Energy Efficiency Action Plan

June 2017

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1 Introduction

The Italian Energy Efficiency Action Plan (EEAP) 2017, prepared on the basis of an ENEA proposal under Article 17(1) of Legislative Decree No 102/2014, contains a brief summary of the energy efficiency targets set by Italy for 2020. This is followed by a description of the results achieved as at 2016, in addition to the main measures implemented and planned in order to achieve the energy efficiency targets by 2020.

Chapter 2 of the EEAP, in line with European Commission compilation guidelines, describes the national targets for the reduction of primary and final energy consumption in Italy. It also quantifies the end-use energy savings expected by 2020 for each economic sector and for each main instrument used to promote energy efficiency. The chapter also presents the results achieved by 31 December 2016 as a result of policy measures already operational in Italy.

The third chapter of the document explains in more detail the measures introduced by the decree transposing Directive 2012/27/EU and those currently in the pipeline. It estimates the expected impact in terms of energy savings for each economic sector.

More specifically, Section 3.1 outlines the cross-cutting measures adopted, such as the white certificates energy efficiency obligation scheme, tax relief on renovations to improve the energy efficiency of existing buildings, and the thermal energy account. It also provides an update on the current status and the measures planned for the energy services sector and metering and billing, as well as for energy audit and management tools, expert qualification and accreditation, and consumer information and training programmes.

Section 3.2 examines the energy efficiency of the national building stock in the public and private sectors. This section outlines the regulatory and financial measures designed to support the energy efficiency of buildings. More detailed information can be found in the annexes, which describe the national building stock through an estimate of the potential for energy improvement in the civil sector and an assessment of the potential for growth in nearly zero-energy buildings.

The promotion of energy efficiency in government buildings, particularly those of central government, is covered in Section 3.3. More specifically, this describes the renovation programme for central government buildings (PREPAC), the method used to identify buildings that could benefit from energy performance enhancements, the instruments put in place to achieve the targets, and the results achieved in the first few years. There is a particular focus on the current state of Green Public Procurement (GPP) and Environmental Minimum Requirements (EMRs), as well as the mechanisms for promoting them.

Section 3.4 describes the measures promoting energy efficiency in industry. Here the focus is on the National Industry Plan 4.0 and subsidies to support and encourage companies that invest in capital assets.

With regard to the transport sector, Section 3.5 contains an in-depth review of the transposition of the DAFI Directive. It describes the energy savings expected from the main measures/programmes, composed of projects aimed at upgrading the road vehicle fleet, encouraging sustainable mobility, and developing rail infrastructure and advanced logistics management systems.

Section 3.6 focuses on heating and cooling efficiency. As well as giving an overview of the development potential of high-efficiency cogeneration (HE CHP) and district heating (DH), it describes the measures that support investment in those technologies.

Section 3.7 tackles the subject of energy efficiency in energy transformation, transmission and distribution. It outlines the energy efficiency criteria to be introduced or expanded within the framework of energy and grid tariffs and in electricity sector regulation, in addition to measures to boost effective demand-side participation in the energy market and new forms of clustering and the provision of services.

Lastly, Section 3.8 provides an overview of the available resources from the Structural Funds for the 2014-2020 programming cycle.

2 Overview of national energy efficiency and savings targets

2.1 National energy efficiency targets for 2020

The national energy efficiency targets for 2020 (as stated in the EEAP 2014) include an energy efficiency improvement programme that proposes to save 20 Mtoe/year of primary energy and 15.5 Mtoe/year of final energy.

Table 2.1 shows the expected savings by 2020 for final and primary energy by sector and intervention measure.

Table 2.1 – Final and primary energy efficiency targets for 2020 (Mtoe/year)

Sector	Measures planned in the period 2011-2020					Expected saving by 2020	
	White certificates	Tax relief	Thermal energy account	Regulatory standards	Mobility investments	Final energy	Primary energy
Residential	0.15	1.38	0.54	1.60		**3.67**	**5.14**
Tertiary	0.10		0.93	0.20		**1.23**	**1.72**
Public authorities	0.04		0.43	0.10		**0.57**	**0.80**
Private	0.06		0.50	0.10		**0.66**	**0.92**
Industry	5.10					**5.10**	**7.14**
Transport	0.10			3.43	1.97	**5.50**	**6.05**
Total	**5.45**	**1.38**	**1.47**	**5.23**	**1.97**	**15.50**	**20.05**

Source: EEAP 2014

To achieve these objectives, Legislative Decree No 102 of 4 July 2014[1] was enacted, implementing those provisions of Directive 2012/27/EU not already transposed into Italian law in accordance with the National Energy Strategy guidelines.

This is accompanied by the binding target laid down in Article 7 of Directive 2012/27/EU, which for the period 2014-2020 imposes a cumulative end-use energy savings target of 25.8 Mtoe through energy efficiency measures. Specifically, under EU legislation, the white certificates mechanism (national obligation scheme) must meet 60 % of the target, while the remaining 40 % will be achieved through alternative measures that meet the criteria under Directive 2012/27/EU.

In quantitative terms, through the white certificates mechanism, final energy savings are expected of around 5.5 Mtoe/year (4.3 Mtoe/year from 2014). To comply with Article 7, two alternative measures are also used: tax relief (1.38 Mtoe/year, of which 0.98 Mtoe/year from 2014) and the thermal energy account (1.47 Mtoe/year from 2014). Figure 2.1 gives an overview of the energy savings targets in relation to each of the mechanisms proposed for the period 2014-2020.

Figure 2.1 – Expected energy savings in the period 2014-2020 (Mtoe/year of final energy)

[1] Implementation o /EC and 2010/30/EU and re

Source: Ministry of Economic Development

Mtep	Mtoe
Conto Termico	Thermal energy account
Detrazioni Fiscali	Tax relief
Certificati Bianchi	White certificates
Totale	Total

2.2 Primary and final energy savings

2.2.1 EEAP 2011 targets and results achieved

For the period 2005-2016 provided for in the EEAP 2011, the overall final energy savings resulting from the measures analysed amount to around 11.6 Mtoe/year as at 2016: the target set was therefore exceeded by 0.7 Mtoe/year, due in large part to the contribution from industry and the residential sector (Table 2.2).

Table 2.2 – Annual energy savings achieved by sector in the period 2005-2016 and expected by 2016 under the EEAP 2011 (final energy, Mtoe/year)

Sector	White certificates	Tax relief*	Thermal energy account	Legislative Decree No 192/ 2005*	Eco-incentives and EU regulations*	Other measures **	Energy savings		Target achieved
							Achieved by 2016	Expected by 2016	
Residential	1.86	2.77	-	1.99	-	0.10	**6.72**	**5.16**	**130.2 %**
Tertiary	0.23	0.03	0.003	0.09	-	-	**0.35**	**2.11**	**16.4 %**
Industry	2.71	0.05	-	0.20	-	-	**2.95**	**1.73**	**170.8 %**
Transport	-	-	-	-	1.47	0.09	**1.56**	**1.87**	**83.4 %**
Total	**4.79**	**2.85**	**0.003**	**2.28**	**1.47**	**0.19**	**11.58**	**10.87**	**106.5 %**

* Estimate for 2016.
** The residential sector includes savings from replacing large domestic appliances. The transport sector includes savings from high-speed transportation.
Source: ENEA processing of data from the Ministry of Economic Development, ISTAT, Gestore dei Servizi Energetici SpA, ENEA, FIAIP and GFK.

2.2.2 EEAP 2014 targets and results achieved

Compared with the target set for the period 2011-2020 in the EEAP 2014 and in line with the 2013 NES, the energy savings targets achieved by 2016 were approximately 7.4 Mtoe/year, which is equivalent to approximately 37 % of the target for 2020 (Table 2.3).

Table 2.3 – Annual energy savings achieved by sector in the period 2011-2016 and expected by 2020 under the EEAP 2014 (primary energy, Mtoe/year)

Sector	White certificates	Tax relief*	Thermal energy account	Legislative Decree No 192/ 2005*	Eco-incentives and EU regulations*	Other measures **	Energy savings		Target achieved
							Achieved by 2016	Expected by 2020	
Residential	0.69	1.56	-	0.91	-	0.02	**3.19**	**5.14**	**62.1 %**
Tertiary	0.15	0.02	0.003	0.05	-	-	**0.21**	**1.72**	**12.3 %**
Industry	2.16	0.03	-	0.09	-	-	**2.28**	**7.14**	**31.9 %**
Transport	-	-	-	-	1.61	0.10	**1.71**	**6.05**	**28.3 %**
Total	**3.01**	**1.60**	**0.003**	**1.05**	**1.61**	**0.12**	**7.40**	**20.05**	**36.9 %**

* Estimate for 2016.
** The residential sector includes savings from replacing large domestic appliances. The transport sector includes savings from high-speed transportation.
Source: ENEA processing of data from the Ministry of Economic Development, ISTAT, Gestore dei Servizi Energetici SpA,

ENEA, FIAIP and GFK.

In final energy terms, the total saving as at 2016 is just over 6.4 Mtoe/year, equivalent to more than 40 % of the end target (Table 2.4). At sector level, the residential sector has already achieved 84 % of the target set for 2020, whereas the tertiary and transport sectors still have a long way to go.

Table 2.4 – Annual energy savings achieved by sector in the period 2011-2016 and expected by 2020 under the EEAP 2014 (final energy, Mtoe/year)

Sector	White certificates	Tax relief*	Thermal energy account	Legislative Decree No 192/ 2005*	Eco-incentives and EU regulations*	Other measures **	Energy savings		Target achieved
							Achieved by 2016	Expected by 2020	
Residential	0.59	1.56	-	0.91	-	0.02	**3.09**	**3.67**	**84.2 %**
Tertiary	0.13	0.02	0.003	0.05	-	-	**0.19**	**1.23**	**15.4 %**
Industry	1.84	0.03	-	0.09	-	-	**1.95**	**5.10**	**38.3 %**
Transport	-	-	-	-	1.13	0.04	**1.18**	**5.50**	**21.4 %**
Total	**2.56**	**1.60**	**0.003**	**1.05**	**1.13**	**0.07**	**6.41**	**15.50**	**41.4 %**

* Estimate for 2016.

** The residential sector includes savings from replacing large domestic appliances. The transport sector includes savings from high-speed transportation.

Source: ENEA processing of data from the Ministry of Economic Development, ISTAT, Gestore dei Servizi Energetici SpA, ENEA, FIAIP and GFK.

2.2.3 Aims of the Energy Efficiency Directive and results achieved

As regards the minimum energy savings target of 25.8 Mtoe of cumulative final energy to be achieved between 2014 and 2020 in accordance with Article 7 of the Energy Efficiency Directive, Table 2.5 below shows the savings achieved in 2014 and 2015 and estimated for 2016 by means of the measures notified. The results achieved are essentially in line with the savings trends provided for in order to meet the target for 2020. However, the table does not show the reduction in energy consumption resulting from other measures to promote energy efficiency, especially at regional level. In this regard, detailed monitoring has been introduced of the above measures, which will be notified to the Commission during the current year.

Table 2.5 – Mandatory savings (Mtoe) in accordance with Article 7 of the EED – 2014-2016

Policy measures notified	New savings achieved	New savings achieved	New savings achieved (estimated)	Cumulative savings	Cumulative savings anticipated by 2020
	2014	**2015**	**2016**	**2014-2016**	
Obligation scheme – White certificates	1.050	0.896	1.135	**3.081**	**16.00**
Alternative measure 1 – Thermal energy account	0.000004	0.001	0.002	**0.003**	**5.88**
Alternative measure 2 – Tax relief	0.248	0.502	0.731	**1.481**	**3.92**
Total savings	**1.298**	**1.399**	**1.868**	**4.564**	**25.80**

Source: GSE and ENEA data processed by ENEA.

As the following table shows, consumption in 2020 as forecast under current policies would be around 118 Mtoe of final energy and 154 Mtoe of primary energy, down 26 % compared with 2007 forecasts.

Table 2.6 – Energy production and consumption in 2015 and 2020 estimates (Mtoe)

Consumption	2015 (Mtoe)	2020 estimate (Mtoe)
Total primary energy	156.17	153.57
Electricity transformation inputs	46.77	42.48
Electricity production	22.14	16.76
Cogeneration transformation inputs	16.75	19
Cogeneration production – heat	5.09	4.38
Cogeneration production – power	8.24	8.71
Distribution losses	1.98	1.94
Total final consumption	116.44	117.97
Final consumption – industry	26.02	27.16

Final consumption – transport	39.54	40.4
Final consumption – residential	32.49	31.89
Final consumption – services and agriculture	18.05	18.51

Source: ENEA

3 Policy measures implementing the Energy Efficiency Directive

3.1 Horizontal measures

3.1.1 Energy efficiency obligation schemes and alternative policy measures

To achieve the minimum cumulative final energy savings of 25.58 Mtoe targeted in the period 2014-2020, Italy mainly relies on the white certificates obligation scheme. This is accompanied by two other support instruments for energy efficiency improvement projects: tax relief on renovations to improve the energy efficiency of buildings, and the thermal energy account. All of these measures are already operational at national level. For further information on the methodology used to determine the savings achieved, useful life, eligible projects, types of obligated parties or parties eligible for alternative measures, please refer to the official documents already submitted to the European Commission[2].

3.1.1.1 White certificates

Brief description of the mechanism, recent legislation and 2020 targets

White certificates, also known as 'Energy Efficiency Certificates' (EECs), are negotiable securities that certify the achievement of energy savings in energy end-use through measures and projects to improve energy efficiency. The white certificates mechanism is based on the creation of an obligated market for these certificates[3]. Each year, Gestore Servizi Energetici SpA (GSE) notifies each electricity and gas distributor of its mandatory quota[4].

With regard to white certificates, Legislative Decree No 102 of 4 July 2014, which transposed Directive 2012/27/EU in Italy, lays down that:

- the mechanism must ensure that at least 60 % of the cumulative national energy savings target is achieved by 31 December 2020;
- eligibility for the mechanism is restricted to persons and companies certified according to UNI CEI 11339 and UNI CEI 11352 respectively as of July 2016.

The Decree of 11 January 2017[5] quantifies the national energy savings targets to be achieved in

[2] Implementation of Article 7 of Directive 2012/27/EU on energy efficiency obligation schemes. Notification of methodology, 4 December 2013.

[3] The obligation scheme was introduced by the Legislative Decrees that liberalised the electricity and natural gas markets (Ministerial Decrees of 20 July 2004). The mechanism was updated by Legislative Decrees Nos 115 of 30 May 2008 and 28 of 3 March 2011, implementing Directive 2006/32/EC on energy end-use efficiency and energy services, and Directive 2009/28/EC on the promotion of the use of energy from renewable sources. The Ministerial Decree of 28 December 2012, implementing Legislative Decree No 28 of 3 March 2011, and EEN Guidelines 9/11 introduced significant changes both in terms of scope and operational instruments for the certification of savings and the recognition of certificates.

[4] By way of example, the Appendix contains a list of obligated distributors for 2016: Table A.1 relates to electricity distributors; Table A.2 to gas distributors.

[5] Determination of quantitative national energy savings targets to be pursued by electricity and gas distribution companies in the period 2017-2020 and approval of new guidelines for the preparation, execution and evaluation of energy efficiency projects.

the period 2017-2020 and redefines the criteria and procedures for accessing the Energy Efficiency Certificates mechanism. In particular, the new Decree:

- determines the national quantitative energy savings targets to be achieved in the period 2017-2020 through the white certificates mechanism, in line with national energy efficiency targets and in conjunction with other instruments designed to support and promote energy efficiency;
- determines the annual requirements to increase energy end-use efficiency for electricity and gas distributors in the period 2017-2020;
- lays down new guidelines for the preparation, execution and evaluation of energy efficiency projects and the definition of criteria and procedures for issuing white certificates;
- defines the methodology for evaluating and certifying the savings achieved and the procedures for recognising white certificates;
- identifies the parties eligible for the white certificates mechanism and the procedures for accessing it;
- introduces measures to enhance the overall effectiveness of the white certificates mechanism, including by means of administrative simplification;
- introduces measures to facilitate compliance with the obligations set;
- updates the provisions on monitoring and verification of the technical and administrative implementation of projects accepted for the white certificates mechanism, and the related penalties.

In addition, the Decree quantifies the annual national energy savings targets to be achieved in the period 2017-2020 through the white certificates mechanism (Table 3.1).

Table 3.1 – Quantitative national energy savings targets 2017-2020 (Mtoe)

	2017	2018	2019	2020
Primary energy savings	7.14	8.32	9.71	11.19

Source: Ministry of Economic Development

Projects implemented and savings achieved

In terms of the number of projects, energy service companies remained the most active operators in 2016, accounting for 11 980 of the 12 500 or so projects submitted.

The volume of primary energy savings certified in 2016 for new energy efficiency projects came to a total of around 0.27 Mtoe:

- 34 % relates to primary energy savings achieved through energy efficiency projects to reduce electricity consumption (Type I);
- 51 % relates to primary energy savings achieved through energy efficiency projects to reduce natural gas consumption (Type II);
- around 15 % relates to primary energy savings (other than electricity and natural gas) achieved in the transport sector (Type III).

Following investigations carried out in the baseline year relating to production in 2015, GSE recognised 718 538 Type II CHP certificates.

As regards negotiable certificates, in 2016 the GSE recognised a volume of Energy Efficiency Certificates equivalent to 667 996 Type II CHP certificates.

Most Energy Efficiency Certificates were obtained in 2016 by means of projects carried out in the industrial sector (approximately 56 % of all Energy Efficiency Certificates), with particular reference to energy efficiency projects for optimising production processes in the most energy-intensive

sectors. The residential sector represents some 40 % of Energy Efficiency Certificates recognised in 2016, about 2.2 million certificates, mainly concerning projects relating to air conditioning and hot water production. Table 3.2 lists the savings certified for each type of measure over the last four years.

Table 3.2 – White certificates: certified savings by type of measure (toe), 2013-2016

TYPE OF RVC (REQUESTS FOR VERIFICATION AND CERTIFICATION)[6]	2013	2014	2015	2016
RVC-S + RVC-A	**676 266**	**590 714**	**695 698**	**1 055 038**
RVC-C of which:	**1 772 004**	**2 103 858**	**1 037 743**	**877 249**
Industry				
IND-T	948 739	942 708	504 077	536 116
IND-FF	535 884	883 153	313 098	189 534
IND-E	134 583	103 402	58 178	32 022
IND-GEN	86 270	53 601	49 779	19 164
Industry subtotal	**1 705 476**	**1 982 864**	**925 131**	**776 836**
Civil				
CIV-INF	20 787	62 897	47 271	56 655
CIV-T	27 413	34 053	19 039	14 973
CIV-GEN	2 556	3 681	956	2 632
CIV-ELET	360	744	2 024	828
CIV-FC	-	60	165	51
CIV-ICT	674	1 207	1 098	33
Civil subtotal	**51 790**	**102 642**	**70 553**	**75 172**
Lighting				
IPRIV-NEW	9 397	7 394	7 620	7 463
IPRIV-RET	4 531	3 969	5 394	4 571
IPUB-RET	810	650	774	426
Lighting subtotal	**14 738**	**12 013**	**13 788**	**12 461**
Networks and Transport				
TRANSP.	-	6 085	28 000	12 521
NETWORKS	-	254	270	260
Networks and Transport subtotal	**-**	**6 339**	**28 270**	**12 781**
Total savings certified (toe)	**2 448 270**	**2 694 572**	**1 733 441**	**1 932 287**

Source: GSE

Mechanism trend

The overall capacity of the mechanism to catalyse primary energy savings to be achieved in the short to medium term can be represented by two key indicators:

- the ratio between the number of new projects and the annual volume of projects and RVCs[7] submitted overall, analysed by type of project;
- the volume of EECs that can be generated over the useful life on the basis of the nominal capacity of the project proposals and programmes of measures (PPPM) approved annually.

Based on the data and information contained in this paragraph, it is clear that:

- the overall volume of projects submitted in 2015 and 2016 has risen sharply compared with the previous period, reaching a two-year peak with some 12 500 projects submitted in

[6] RVC: Request for Verification and Certification of savings. The request may take place through the use of the standardised (RVC-S), analytical (RVC-A) or final (RVC-C) evaluation method.

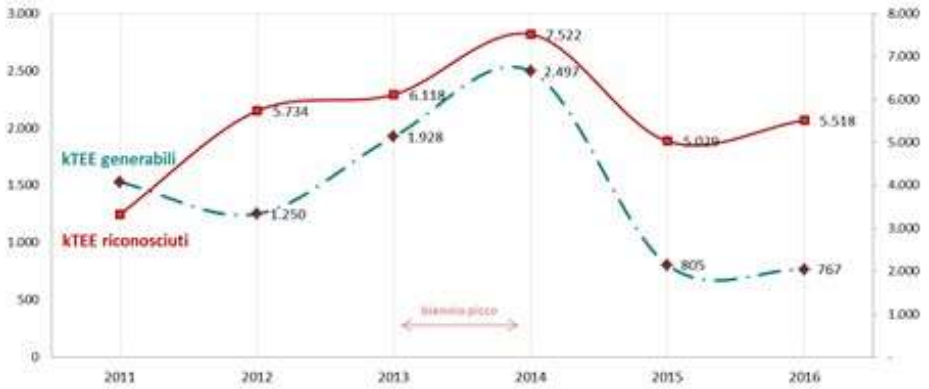
[7] The annual volume of certificates recognised for RVCs is not an indicator of the actual distribution of the savings made during the year, since it provides an indication of the distribution of reports submitted for the verification of savings, according to timeframes (half-yearly, annual or five-yearly) that vary significantly depending on the measurement programmes.

2016, or three times the volume in 2012 (around 4 600); a 6 % increase was also recorded in the number of projects submitted in 2016 compared with 2015;

- the number of new projects submitted by operators each year has risen: in 2015 just over half of the projects and RVCs related to new projects (PPPM and RVC-S, RVC-A and RVC-C), whereas in 2016 this climbed to 68 %.

As to the volume of EECs that can be generated over the project lifetime on the basis of PPPM approved annually, taking into account the combined effect of the procedure defined for reporting savings according to the type of project and the introduction of exclusive eligibility for new projects, the 2016 figures confirm the trend recorded in 2015. In analysing the data, the growing volume of annual certificates recognised in the last two years, amounting to 5 million EECs in 2015 and 5.5 million EECs in 2016 (Figure 3.1) should be added to the potential volume of certificates that will be recognised in the coming years due to approved PPPM.

Figure 3.1 – White certificates: projects submitted and EECs recognised (thousands of certificates), 2011-2016



Source: GSE

kTEE generabili	EECs that can be generated (’000)
kTEE riconisciuti	EECs recognised (’000)
Biennio picco	Two-year peak

Assuming that most of the PPPM approved in 2014 are already reporting savings through RVC-C, based on the PPPM approved in the period 2015-2016, the potential EECs that can be generated during the project lifetime is around 8 million EECs. Of this total, the industrial sector accounts for more than 6 million EECs.

Therefore, the reduction in energy consumption obtainable through the white certificates mechanism between now and 2020 is considered to be broadly in line with expectations.

3.1.1.2 Tax relief on refurbishment and energy efficiency renovation of the existing building stock

Brief description of the mechanisms and recent legislation

Tax relief on projects designed to upgrade the energy efficiency of buildings was introduced in Italy by the 2007 Finance Act and still applies to date.

The 2016 Stability Law expanded the incentive to include the costs of buying, installing and implementing 'multimedia systems for remote control of residential heating, hot water and air-conditioning systems'. Another major change is that for work carried out in common areas of multi-apartment buildings, the tax relief can be transferred to the companies doing the work in return for a discount. This allows tenants to benefit from the tax relief, even if they would otherwise be unable to take advantage of it. Finally, independent social housing associations (IACP) are also now eligible for tax relief on expenditure incurred from 1 January to 31 December 2016, for work carried out on public housing they own.

The Law of 11 December 2016 extended the tax relief of 65 % for projects designed to upgrade the energy efficiency of buildings to include expenditure incurred before 31 December 2017, confirming the possibility of access to the mechanism for IACP. For energy efficiency improvements to common areas of multi-apartment buildings, the rate is increased to 70 % for improvements carried out on at least 25 % of the building envelope, and to 75 % for projects designed to boost winter and summer energy performance that ensure 'average quality' for the building envelope[8], subject to a ceiling of EUR 40 000 for each building unit. In this case, the incentives will be valid for expenditure incurred from 1 January 2017 to 31 December 2021.

All taxpayers, individuals, professionals, companies and businesses that incur costs for energy efficient renovations are eligible for tax relief on existing buildings or parts thereof or existing building units in any cadastral category (including rural buildings) that they own or hold, provided they are heated.

Conversely, tax relief on building 'refurbishment' projects was introduced by Article 1(5) and (6) of Law No 449 of 27 December 1997. Refurbishment projects include condensing boilers and doors and windows, with the incentive of tax relief for energy efficiency improvements.

The total cost of energy efficient renovation projects as at 2016 was more than EUR 29 billion. Table 3.3 contains data on applications submitted to the Revenue Agency for tax relief (50 % as at 26 June 2012, compared with 36 % previously, except for a few years when it was 41 %) on building refurbishment. It is estimated that around 1.4 million applications were submitted in 2016, for a total cost of more than EUR 25.7 billion in subsidised projects.

Table 3.3 – Comparison of tax relief for building refurbishment and energy efficiency renovation, 1998-2016

	Building refurbishment				Energy efficiency renovation			
	Applications submitted	Expenditure (€m)	Amounts deductible (€m)	Tax relief applied	Applications submitted	Expenditure (€m)	Amounts deductible (€m)	Tax relief applied
1998	240 413	3 385	1 388	41 %				
1999	254 989	3 590	1 472	41 %				
2000	273 909	4 392	1 581	36 %				

[8] For more details, see the Decree of the Ministry of Economic Development of 26 June 2016 (Minimum Requirements Decree). Regarding the winter energy performance of the building envelope, the average quality indicator is defined according to the value of the thermal performance index for the heating of the reference building ($EP_{H,nd,limit\ (2019/21)}$). This is calculated in accordance with Annex 1, Chapter 3 of the Decree, assuming, as indicated by the subscript, that building elements are installed in it that meet the minimum legal requirements in force from 1 January 2019 for public buildings, and from 1 January 2021 for all others. This value is defined as the separation limit between high quality and average quality building envelopes.

As to the summer energy performance of the building envelope, the average quality indicator is defined according to the periodic thermal transmittance $Y_{IE}e$ and the summer equivalent solar area per unit of useful floor area ($A_{sol,est}/A_{sup}$), as referred to in Annex 1, Chapter 3 and Appendix A of the Decree.

2001	319 249	5 119	1 843	36 %				
2002	358 647	5 750	2 070	36 %				
2003	313 537	5 666	2 040	36 %				
2004	349 272	4 888	1 760	36 %				
2005	342 396	6 848	2 465	36 %				
2006	371 084	6 313	2 588	41 %				
2007	402 811	7 938	2 858	36 %	106 000	1 453	799	55 %
2008	391 688	7 365	2 651	36 %	247 800	3 500	1 925	55 %
2009	447 728	8 070	2 905	36 %	236 700	2 563	1 410	55 %
2010	494 006	8 705	3 134	36 %	405 600	4 608	2 534	55 %
2011	779 400	14 400	5 184	36 %	280 700	3 099	1 704	55 %
2012	883 600	16 325	7 279	36 % / 50 %	245 234	2 891	1 590	55 %
2013	1 317 627	24 345	12 172	50 %	355 961	3 849	2 260	55 % / 65 %
2014	1 366 416	25 246	12 623	50 %	299 795	3 056	1 987	65 %
2015	1 195 438	22 087	11 043	50 %	335 960	2 839	1 845	65 %
2016*	1 392 705	25 732	12 866	50 %	408 032	3 355	2 181	65 %
Total	**11 494 914**	**205 272**	**89 928**		**2 921 782**	**31 213**	**18 235**	

* Estimate

Source: CRESME[9] for building refurbishment; ENEA for energy efficiency renovation.

Measures implemented and savings achieved

Since the launch in 2007, ENEA – the body responsible for managing the mechanism – has received some 3 million applications for tax relief of 55 % or 65 % for upgrading the energy efficiency of existing buildings.

Table 3.4 contains details of the 336 000 or so projects carried out in 2015, broken down by type. Together these represent more than EUR 2.8 billion in active investments, resulting in total primary energy savings of more than 0.084 Mtoe/year. If we exclude measures relating to renewable energy sources from the calculation, the savings achieved in 2015 are approximately 0.08 Mtoe/year of primary and final energy.

Table 3.4 – Projects implemented, expenditure incurred and savings generated through tax relief, 2015

	No of cases	Expenditure (€)	Savings (Mtoe)
Section 344 – Complete renovation	3 551	185 486 874	0.0058
Section 345a – Works on the building envelope	22 591	701 760 542	0.0248
Section 345b – Replacement of doors and windows	181 414	1 297 548 416	0.0368
Section 345c – Solar shading systems	47 673	97 944 267	0.0011
Section 346 – Solar panels for hot water	10 611	69 006 588	0.0038
Section 347 – Winter heating systems	70 120	487 685 104	0.0119
Total	**335 960**	**2 839 431 790**	**0.0842**

Source: ENEA

More than 408 000 applications were recorded in 2016. These are added to the 2.5 million applications received in 2015, to give a total of almost 3 million applications as at 2016 (Table 3.5).

Table 3.5 – Tax relief applications received by type of project, 2007-2016

Type of project	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016*	Total
Section 344	3 180	5 700	5 600	1 917	1 450	3 579	3 566	5 843	3 551	4 839	**39 225**

[9] Chamber of Deputies, Environment Department Research Unit and CRESME, *Il recupero e la riqualificazione energetica del patrimonio, edilizio: una stima dell'impatto delle misure di incentivazione* [Refurbishment and energy efficient renovation of the building stock: an estimate of the impact of incentive measures], Fourth Edition, No 83/3, 2016.

Sections 345a and 345b	39 220	112 600	127 800	226 720	170 400	135 283	244 421	214 963	204 005	231 502	**1 706 914**
Section 345c									47 673	76 448	**124 121**
Section 346	20 140	37 100	35 300	47 106	29 350	33 801	26 851	15 347	10 611	9 978	**265 584**
Section 347	27 560	57 700	68 000	129 883	79 500	72 571	81 123	63 500	70 120	84 509	**734 466**
Building automation										756	**756**
Multiselect	15 900	34 700	-	-	-	-	-				**50 600**
Total	**106 000**	**247 800**	**236 700**	**405 626**	**280 700**	**245 234**	**355 961**	**299 653**	**335 960**	**408 032**	**2 921 666**

* Provisional

Source: ENEA

The number of boilers eligible for tax relief for energy efficiency renovation (just over 60 000 in 2015) is far lower than the number of boilers sold on the market, on average equivalent to 300 000 in recent years (Figure 3.2). Since October 2015, it has no longer been possible for manufacturers to place non-condensing boilers on the market[10]. This explains the growth in sales of condensing boilers observed in 2016, and the simultaneous decline of conventional boilers.

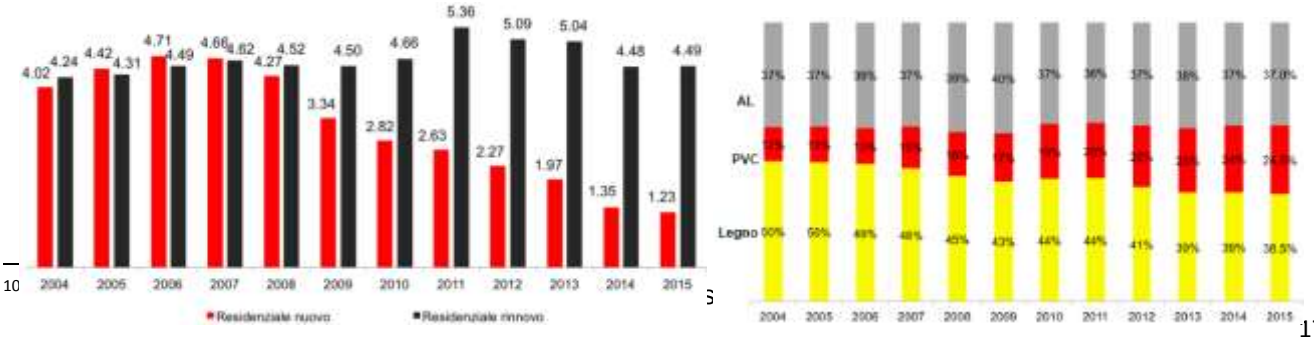
Figure 3.2 – Boilers sold in the domestic market, 2010-2016

Source: Assotermica

Caldaie tradizionali	Conventional boilers
Caldaie a condensazione	Condensing boilers
Totale	Total

The same applies for the replacement of doors and windows: of the 580 000 or so doors and windows eligible for tax relief for energy efficiency renovation, 5.7 million windows were installed in 2015 in the residential sector, of which 4.5 million in existing buildings and 1.2 million in new buildings (Figure 3.3). The number of windows sold in the non-residential sector is estimated to be about 2.2 million units.

Figure 3.3 – Windows sold in the residential sector, new vs replacement (million units, left) and material (%, right)



Source: UNICMI processing of ISTAT data

Residenziale nuovo	New residential
Residenziale rinnovo	Replacement residential
AL	Al
PVC	PVC
Legno	Timber

Given the large number of renovations monitored in recent years with tax relief for building refurbishment, it is reasonable to assume that the remaining market share of condensing boilers and doors and windows not accounted for by tax relief for energy efficiency renovation is covered by tax relief for building refurbishment. Based on the unitary energy saving that can be inferred from tax relief for energy efficiency renovation, for condensing boilers, and the savings resulting from the replacement of single glazing with double glazing, for doors and windows, the reduction in consumption achieved in 2015 by the installation of condensing boilers and the replacement of doors and windows, for which incentives were provided through tax relief for building refurbishment, is 0.18 Mtoe/year, net of the energy savings certified by means of white certificates for the same types of project.

Therefore, the energy savings achieved in 2015 through the two types of tax relief described comes to a total of 0.26 Mtoe/year.

Table 3.6 shows the overall savings achieved in the period 2006-2016, net of savings already counted with white certificates for projects of this type: in total, 2.85 Mtoe/year has been saved since 2006.

Table 3.6 – Savings from tax relief on energy efficiency renovation and building refurbishment (Mtoe/year), 2006-2016

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016*	Total
Energy efficiency renovation		0.060	0.144	0.107	0.153	0.110	0.097	0.123	0.088	0.079	0.093	**1.055**
Building refurbishment	0.023	0.204	0.197	0.185	0.173	0.213	0.191	0.132	0.162	0.180	0.135	**1.796**
Total	**0.023**	**0.264**	**0.341**	**0.292**	**0.326**	**0.323**	**0.288**	**0.255**	**0.250**	**0.260**	**0.228**	**2.850**

* Estimate
Source: ENEA

The recent amendments to the legislation on tax relief for energy efficiency renovation are designed to boost demand for projects with a higher cost/benefit ratio. In addition, for improvements to common areas of multi-apartment buildings, the mechanism will remain in place at least until 2020. Therefore, if both mechanisms described remain in place until then, the reduction in energy consumption achievable by 2020 through tax relief should be in line with expectations.

3.1.1.3 Thermal energy account

Brief description of the mechanism and recent legislation

The Ministerial Decree of 28 December 2012 introduced a new incentive system for actions to improve energy efficiency and generate thermal energy from renewable sources. This incentive

mechanism, dubbed the Thermal Energy Account, is the first nationwide direct incentive scheme for the generation of renewable thermal energy, as well as being the first scheme encouraging public administrations to implement energy efficiency improvement actions in buildings and technical installations. The Thermal Energy Account became operational in July 2013.

The Ministerial Decree of 16 February 2016 (Thermal Energy Account 2.0) amended the earlier Decree from 2012, increasing access to funding for businesses, households and public authorities, and transposing the legislative provisions adopted in recent years, which have an impact on the types of investment eligible for incentives[11]. It also significantly enhanced the incentive through the addition of new eligible measures. For some of these (such as the transformation of public buildings into NZEB), the eligible expenditure includes costs incurred for seismic improvements, which contribute to thermal insulation. The maximum size of the projects eligible for incentives has been increased. At the same time, the range of eligible beneficiaries has been extended, allowing social cooperatives and 100 % publicly owned companies (which are responsible for managing local services and networks in the public interest) to qualify for incentives for projects reserved for public authorities. Lastly, the payment procedures have been revised: under the new rules, the grant will be disbursed in one, two or five annual instalments, depending on the size and type of the project. For applications submitted by individuals, lump-sum payments have been introduced for amounts up to EUR 5 000, while for public authorities, lump-sum payments may be made for amounts above this threshold.

Measures implemented and savings achieved

At the end of 2016, nearly 26 000 applications were approved for the incentive, constituting a total spending commitment of around EUR 92 million, EUR 18 million of which related to energy efficiency in the public administration.

An upward trend was observed during the period of operation of the thermal energy account. The first significant results of the new structure of the mechanism were recorded in 2016, with an 81 % increase from 2015, or an 80 % increase in the incentives requested. For the same period, it can be seen that the number of applications for contractual incentives account for 78 % of those received[12]. Of the EUR 90.4 million paid through direct access, 10 % relates to works carried out on school buildings.

Table 3.7 – Contractual applications in the period 2013-2016

	DIRECT ACCESS		RESERVATION		REGISTERS		TOTAL	
PERIOD	**No of applications**	**Incentive paid [€m]**	**No of applications**	**Incentive paid [€m]**	**No of applications**	**Incentive paid [€m]**	**No of applications**	**Incentive paid [€m]**
2013-2014	7 720	23.8	15	0.2	29	4.8	**7 764**	**28.8**
2015	7 842	31.6	4	0.2	17	3.3	**7 863**	**35.1**
2016	9 861	35.0	53	8.0	*	*	**9 914**	**43.0**
2013-2016	**25 423**	**90.4**	**72**	**8.4**	**46**	**8.1**	**25 541**	**106.8**

Source: GSE

Analysing the trend for 2016 by type of responsible party, the new reservation system appears to

[11] In particular, the Ministerial Decree of 26 June 2015, which updated national guidelines for the energy certification of buildings in 2009, and Law No 164/2014 extended to social housing bodies and residents associations the possibility of applying for incentives for the same categories of projects previously reserved for public authorities.

[12] The remaining 22 % consists of approved applications where the contract has not yet been signed by the responsible party, applications being processed and rejected applications. Rejected applications only make up 5 % of those received in the period 2013-2016.

be of growing interest to the public administration. In the first few months of Thermal Energy Account 2.0, an average of 1 300 applications were submitted each month; in December 2016, some 2 600 applications were received for the incentive, a 300 % increase compared with the average for the first four months of 2016 (around 830 applications a month). In particular, in 2016 around 950 applications were received for energy efficiency measures for the public administration, with over EUR 32 million of incentives requested.

For a comparison between the old and new mechanism, the introduction of the new Thermal Energy Account led to a significant rise in the number of applications received each month, together with an increase in the average monthly amount of the incentives requested.

Table 3.8 – Comparison of the trend between Thermal Energy Account 1.0 and Thermal Energy Account 2.0

Thermal energy account	No of applications submitted	No of projects submitted	Average monthly requests	Incentives requested [€m]	Average project incentive [€]	Average project incentive – public administration [€]	Average project incentive – private individuals [€]
1.0 (January 2013 to May 2016)	23 369	24 067	570	95	3 938	20 584	3 150
2.0 (June 2016 to December 2016)	9 626	9 973	1 375	45	4 516	31 830	2 285

Source: GSE

The average amount of projects submitted by the public administration has grown significantly. This is due to the increased availability of the reservation mechanism, with Thermal Energy Account 2.0 already usable from the building energy audit stage. As a result, the public administration is able to carry out larger projects, as reflected in the higher average amount of the incentives requested.

In 2016, energy efficiency measures for the public administration generated overall primary energy savings of around 1 800 toe/year, with more than EUR 32.5 million of incentives requested.

Table 3.9 – Thermal Energy Account: applications by type of project and energy savings achieved, 2016

Type of project	No of projects	Incentives requested per project [€m]	Amount of primary fossil energy saved (toe/year)
1.A – Opaque building envelope	175	9.09	653
1.B – Transparent closures	71	9.89	295
1.C – Condensing generators	548	2.21	781
1.D – Shading	23	0.17	
1.E – NZEB	21	9.66	45
1.F – Lighting	67	1.13	
1.G – Building automation	40	0.45	
Total	**945**	**32.6**	**1 774**

Source: GSE

Due to the changes introduced with Thermal Energy Account 2.0, the results reported for 2016 indicate a change in the trend for energy savings achieved through the mechanism. Therefore, assuming that the funding available to the public administration remains at the same level until 2016, the annual energy savings in the period 2017-2020 are expected to be at least equal to the energy savings for 2016.

3.1.2 Energy audits and energy management systems

Article 8(1) and (3) of Legislative Decree No 102/2014 identifies the parties obligated to conduct an energy audit by 5 December each year as from 2015 as large enterprises (paragraph 1) and

'energy-intensive' enterprises (paragraph 3)[13].

To educate businesses on how to present documentation, special stakeholder forums were organised with the help of ENEA to identify effective, efficient and replicable solutions in accordance with the Decree. This initiative resulted in a set of proposed clarifications, transposed in the two clarification documents issued by the Ministry of Economic Development in May and October 2015 and in November 2016.

In parallel with the discussion forums, and in a bid to standardise reporting, ENEA produced a series of documents on behalf of the Ministry of Economic Development containing operational recommendations for stakeholders on the subject of energy audits required under Article 8. A logical approach was proposed towards structuring and compartmentalising the energy audit, together with a model for analysing the energy structure of the site being audited. In addition, guidelines were drawn up with various industry bodies[14] specifically for their members, providing businesses and other interested parties with the information required to meet the requirements of Article 8.

This provision (Article 8(6)) also requires ENEA to check the conformity of audits with the requirements of the Article. Acting on the instructions of the Ministry of Economic Development, ENEA initially performed checks on obligated parties who had failed to submit the necessary documentation. By consulting the Equalisation Fund list and through direct contact with its departments, energy-intensive enterprises were identified that had not fulfilled this obligation. For large enterprises, the defaulting parties were identified from lists provided by the Ministry of Economic Development.

Following the discovery of numerous errors, each submission via the website was thoroughly checked. At the end of this process, which involved dialogue with stakeholders, the errors and anomalies were addressed to ensure the correct use of the documents received.

Similar checks are currently under way in relation to obligated parties as at 5 December 2016. The Ministry of Economic Development is taking the necessary measures in accordance with Article 6(1). Guidelines have also been drawn up for the substantive review of audits, which assessors must follow to meet the requirements of Article 8(6).

As a result of the preliminary activities described above and following the checks carried out, by April 2017 ENEA had received 15 152 audits relating to 8 128 enterprises. This number is set to grow as a result of monitoring and checks carried out by the Ministry of Economic Development, and the entry in the same database of audits performed on SMEs participating in regional calls. Table 3.10 provides a breakdown by sector: around 45 % of audits were carried out in the manufacturing sector and more than 10 % in the retail sector, mainly among large-scale retail outlets.

Table 3.10 – Energy audits carried out in accordance with Article 8 of Legislative Decree No 102/2014

[13] For energy-intensive enterprises subject to the energy audit obligation, it was clarified that this obligation only applies to enterprises receiving incentives for energy-intensive users. This means all enterprises on the list held by the Electricity Industry Equalisation Fund (Cassa Conguaglio per il Settore Elettrico) pursuant to the Interministerial Decree of 5 April 2013.

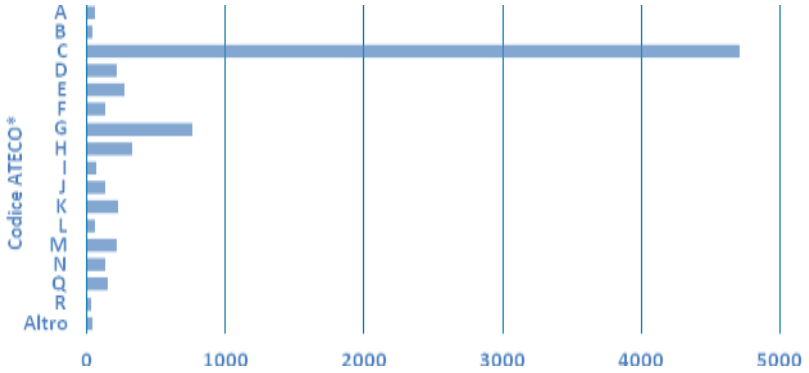
[14] ABI Lab for banks, CONFINDUSTRIA Ceramica, ASSOCARTA, ASSOTELECOMUNICAZIONI-ASSTEL, FEDERDISTRIBUZIONE, ASSOIMMOBILIARE, ASSOVETRO, ASSOFOND. For more information and details, see: .http://www.agenziaefficienzaenergetica.it/per-le-imprese/diagnosi-energetiche.

ATECO sector	No of enterprises [15]	Sites audited	ISO 50001 enterprises	Large enterprises	Large energy-intensive enterprises	Other energy-intensive enterprises
A – Agriculture, forestry and fishing	58	97	2	55	1	0
B – Mining and quarrying of minerals	37	53	2	22	2	10
C – Manufacturing	4 825	6 792	97	2 490	722	1 528
D – Electricity, gas, steam and air conditioning supply	226	507	8	191	3	6
E – Water supply, sewerage, waste management and remediation activities	302	890	12	246	17	14
F – Construction	159	346	9	144	2	1
G – Wholesale and retail trade, repair of motor vehicles and motorcycles	837	2 287	4	728	24	11
H – Transportation and storage	392	942	10	320	27	9
I – Accommodation and food service activities	93	258	2	81	4	0
J – Information and communication	150	596	4	130	4	3
K – Financial and insurance activities	238	684	6	220	2	0
L – Real estate activities	57	95	1	46	2	1
M – Professional, scientific and technical activities	229	472	4	197	3	3
N – Rental, travel agency and business-support services	222	471	2	196	5	3
Q – Human health and social work activities	208	451	2	184	12	4
R – Arts, sport, entertainment and recreation	43	118	0	32	4	1
Other	52	93	1	37	2	3
Total	**8 128**	**15 152**	**166**	**5 319**	**836**	**1 597**

Source: ENEA

Figure 3.4 shows the number of enterprises that have fulfilled the obligation, by ATECO code.

Figure 3.4 – Energy audits in accordance with Article 8 of Legislative Decree No 102/2014: enterprises that have fulfilled the obligation, by ATECO code



* For a description of the ATECO code, see Table 3.10

Source: ENEA

Codice ATECO*	ATECO code*
Altro	Other

By analysing the energy audits, it is possible to gain an insight into the potential measures to improve the energy efficiency of the production process. Table 3.11 provides a cumulative total for

[15] Note that the total number of enterprises does not match the sum of the subsequent columns, which only show the most representative types (for example, the first column also contains audits carried out on SMEs participating in regional calls). In addition, some enterprises appear in more than one column (such as energy-intensive enterprises or large enterprises that are ISO 50001 certified).

suggested projects according to their payback period. This will determine investments in the construction sector and the production of high-efficiency systems and components, mainly supplied by Italian industry. The total potential saving exceeds 1.5 Mtoe, of which more than 1.1 Mtoe is achievable through over 14 000 projects with a payback period of five years or less.

Table 3.11 – Payback periods of energy efficiency projects described in energy audits performed in accordance with Article 8 of Legislative Decree No 102/2014

Payback period (years)	Projects	Savings (toe)	Investments (€)
≤ 3	8 364	779 560	646 335 323
≤ 5	14 193	1 168 814	1 631 881 852
≤ 10	21 923	1 414 719	2 657 662 287
≤ 20	25 698	1 501 881	3 341 674 298
≤ 30	26 284	1 509 606	3 449 551 432

Source: ENEA

Under the three-year information and training programme provided for by Article 13(1) of Legislative Decree No 102/2014, ENEA has organised, developed and implemented a communication, training and information plan to share awareness of the obligations under Article 8 to all stakeholders, particularly large and energy-intensive enterprises. A collaboration agreement was therefore signed with Confindustria to organise training and information conferences and seminars hosted by Confindustria and other industry bodies. To that end, two training courses were organised for businesses planning to conduct audits under Article 8 using their own staff.

The legislation further specifies that this obligation does not apply to large enterprises that have adopted management systems in compliance with EMAS and ISO 50001 or EN ISO 14001, provided that the management system in question includes an energy audit. Around 350 Italian organisations were ISO 50001 certified as at 2016, making a total of some 750 certified sites. The uptake of EMS[16] reinforces the role of the energy manager, associating it with a cohesive business commitment and increased collaboration among all corporate functions. One of the factors behind this growth was the obligation imposed by Article 8 of Legislative Decree No 102/2014 on large and energy-intensive enterprises, encouraging them to have a certified EMS rather than carry out an energy audit every four years. Added to this is the significant growth in the number of certified EMS. This is due to the requirement, introduced by Article 12 of the Decree, for parties intending to participate in the white certificates mechanism and to carry out mandatory energy audits to demonstrate their professionalism by obtaining UNI CEI 11339 certification.

Article 7(8) of Legislative Decree No 102/2014 also laid down the possibility of notifying ENEA of energy savings from energy efficiency improvements made in previous years and for which no Energy Efficiency Certificates were recognised. Table 3.12 gives a sector breakdown of the 2.2 Mtoe reported by businesses for improvements carried out from 2014 to 2016: 1.8 Mtoe (about 83 % of the total) was reported by manufacturing firms.

Table 3.12 – Energy savings (toe) achieved in the period 2014-2016, as reported by businesses in accordance with Article 7(8) of Legislative Decree No 102/2014

ATECO section or division	toe 2014-2015	toe 2016	Total toe 2014-2016	%
C – Manufacturing, of which	1 158 594	641 492	1 800 086	82.7 %
10 – Food manufacturing	400 118	25 370	425 488	19.5 %
19 – Manufacture of coke and refined petroleum products	469 203	60 207	529 410	24.3 %
23 – Manufacture of other non-metallic mineral products	118 261	24 938	143 199	6.6 %
29 – Manufacture of motor vehicles, trailers and semi-trailers	55 195	244 490	299 685	13.8 %
Other manufacturing activities	115 817	286 487	402 304	18.5 %

[16] The number of parties that have appointed an energy manager as well as setting up an ISO 50001 certified EMS rose from 115 in 2015 to 186 in 2016 (source: FIRE).

D – Electricity, gas, steam and air conditioning supply	103 895	42 184	146 079	6.7 %
H – Transportation and storage	132 230	6 007	138 237	6.4 %
Other sectors	51 556	40 823	92 379	4.2 %
Total	**1 446 275**	**730 506**	**2 176 781**	**100.0 %**

Source: ENEA

The Decree of the Ministry of Economic Development and the Ministry of the Environment of 12 May 2015 initiated the process designed to help small and medium-sized enterprises with their energy efficiency improvements. According to the Decree, the Regions and Autonomous Provinces may submit programmes aimed at supporting energy audits carried out at SMEs. In 2015, EUR 15 million was available for the co-financing of regional incentive programmes for the energy audits of SMEs or the adoption of energy management systems conforming to ISO 50001. A further EUR 15 million is provided by the Regions. Altogether the funding covers 50 % of the energy audit costs. The same Decree also approved certification and accreditation schemes. It is estimated that no fewer than 15 000 SMEs a year could be involved in this initiative, and that energy audits will lead to just as many energy efficiency projects. The initiative was repeated in 2016 and is expected to take place annually, with similar resources available until 2020. However, the Interregional Energy Coordination Unit has reported a lack of interest in the measure, so it will be crucial to assess its effectiveness and recommend changes where appropriate.

Table 3.13 lists the Regions that have issued calls for applications for the co-financing of regional programmes. Regarding the call for 2015, six Regions have set aside more than EUR 11.5 million for the co-financing of energy audits of SMEs and for the adoption of energy management systems in accordance with ISO 50001.

Table 3.13 – Support programmes for energy audits in SMEs and the adoption of energy management systems in accordance with ISO 50001, following the calls of 12 May 2015 and 4 August 2016

Programme	Eligible programmes – Executive Decree of 21 December 2015		Eligible programmes – Executive Decree of 21 December 2016	
Region/Autonomous Province	Resources allocated under the call	Total resources available	Resources allocated under the call	Total resources available
Abruzzo Region	EUR 298 500		EUR 298 500	
Basilicata Region	EUR 149 250			
Calabria Region			EUR 298 500	
Campania Region			EUR 1 194 000	EUR 1 194 000
Emilia-Romagna Region[17]	EUR 1 194 000	EUR 2 388 000		
Friuli-Venezia Giulia Region[18]	EUR 298 500	EUR 597 000	EUR 298 500	
Liguria Region	EUR 402 975			
Lombardy Region[19]	EUR 2 686 500	EUR 5 373 000	EUR 2 686 500	
Marche Region	EUR 447 500		EUR 447 750	
Piedmont Region[20]	EUR 1 194 000	EUR 2 388 000	EUR 1 194 000	
Sardinia Region[21]	EUR 298 500	EUR 597 000	EUR 298 500	
Sicily Region	EUR 895 500		EUR 895 500	
Umbria Region	EUR 298 500		EUR 298 500	
Valle d'Aosta Region	EUR 149 250			
Veneto Region	EUR 1 343 250			
Autonomous Province of Trento	EUR 149 250		EUR 149 250	
Total	EUR 9 805 475	EUR 11 343 000	EUR 8 059 500	EUR 1 194 000

Source: Ministry of Economic Development

As a result of the audits carried out by energy-intensive and large enterprises and the campaign to promote energy audits in SMEs, a significant increase is expected in the coming years in the number of energy efficiency projects implemented by businesses. These projects will mainly focus on the production process. As a result, they will be more complex in terms of implementation (with longer payback periods) and offer a better cost/benefit ratio. Some of the costs could be subsidised by means of the white certificates obligation mechanism, through ESCOs where necessary.

[17] Decision of the Regional Executive No 344 of 20 March 2017 'Approval of the call for procedures and criteria for the granting of aid for energy audits or the adoption of energy management systems in accordance with ISO 50001 by small and medium-sized enterprises under the regional programme approved by Decisions of the Regional Executive Nos 776/2015 and 1897/2016', published in Regional Gazette No 89 of 3 April 2017.

[18] Decision of the Regional Executive No 2341 of 2 December 2016: 'Call for the implementation of the programme referred to in the call for the co-financing of programmes presented by the Regions, and designed to support the implementation of energy audits in small and medium-sized enterprises or the adoption, by them, of energy management systems conforming to ISO 50001 under Article 8(9) of Legislative Decree No 102 of 4 July 2014 (pursuant to Article 5(2) of the Interdepartmental Decree of 12 May 2015)'.

[19] Directorial Decree of the Operational Unit No 8675 of 8 September 2016, 'Regional programme for the energy efficiency of small and medium-sized enterprises, approved by Decision of the Regional Executive No 4256 of 30 October 2015: approval of the call for incentives to carry out energy audits or the adoption of an energy management system in accordance with ISO 50001', published in Regional Official Gazette No 37 of 13 September 2016.

[20] Decision No 536/A1904A of 21 September 2016 of the Head of the Sustainable Energy Development Unit: 'Call to support the implementation of energy audits in SMEs or the adoption of energy management systems (EMS) in accordance with ISO 50001', published in the Official Gazette of the Piedmont Region No 39S1 of 29 September 2016.

[21] Decision No 34236/482 of 27 October 2016 of the Head of the Energy and Green Economy Unit: 'Efficient small and medium-sized enterprises – Improving energy efficiency in SMEs in Sardinia', published on the official website of the Autonomous Region of Sardinia and in the Official Gazette of the Sardinia Region (BURAS) No 51 of 10 November 2016.

3.1.3 Metering and billing

3.1.3.1 Bill 2.0

By means of Decision No 501/2014/R/com of 16 October 2014, the Electricity, Gas and Water Authority (AEEGSI) approved new requirements for the transparency of bills for electricity and/or gas distributed via urban networks, in a bid to harmonise, rationalise and simplify billing information[22]. By means of Decision No 200/2015/R/com, the Authority postponed the entry into force of the new transparency requirements, initially scheduled for 1 September 2015, until 1 January 2016, to coincide with the reform of network tariffs and tariff components covering the general system costs for domestic electricity customers[23].

The features and content of the bill to be issued for tax purposes are defined (summary bill), together with other information about quantities and unit prices applied for billing purposes (itemised elements). These must be made available to electricity and gas customers on request, for customers on a protected tariff, or according to the terms of the contract, for customers on a market tariff[24].

Suppliers are also expected to publish a guide on how to read energy bills on their websites, which must include a complete description of the items contained in the bill. The aim of the guide is to provide customers with a key to reading energy bills and understanding the link between the aggregated items contained in the summary bill and the charges defined in the contract. The guide to protected tariffs was compiled by the Authority[25], and is published on the Authority's website, as well as on the websites of companies offering protected tariffs. The Authority has also devoted a section of its website to the new 'Bill 2.0'[26]. In the deregulated market, each supplier must publish a guide to each of the available tariffs on its website. Customers must be given information on how to access the guide, together with the contractual documents, when they sign the contract. As well as the information provided online, it is important that a printed version is also available for users who do not use the internet, such as the elderly.

A review by the Authority of the information provided online by the main market operators to explain the content of energy bills, while not exhaustive, revealed a marked preference for the use of graphics. These often consisted of an image of a bill from which, by clicking on text boxes or

[22] http://www.autorita.energia.it/allegati/docs/14/501-14all_ti.pdf. The new transparency requirements apply to bills issued to electricity customers on a low voltage supply (excluding public lighting) and to gas customers. It excludes gas customers who use more than 200 000 SCM/year. For both utilities, bills issued to public authorities are also excluded. These are covered by the requirements on electronic invoicing laid down by Law No 244 of 24 December 2007, for multi-site electricity and gas customers for whom specific criteria apply.

[23] The transparency requirements approved by means of Decision No 501/2014 lay down, inter alia, the minimum information that must be contained in summary electricity and gas bills. More information should be given on a periodic basis (such as detailed consumption data for the previous 12 months) or when certain events occur (such as information about any price changes). In addition to the itemised summary and additional information, summary bills must also include the elements used to calculate the amount billed. These include: consumption data and meter readings (actual, estimated and billed); the set-off period, estimated consumption and the relevant amounts previously billed and deducted from the current bill, if the bill offsets the amounts billed in previous bills for estimated consumption; and annual consumption.

[24] Information about the average unit cost of the bill (ratio between the total amount due and billed consumption) and the average unit cost of the electricity/gas (ratio between the amount of expenditure on electricity and gas and billed consumption) also makes the bill easier to understand. The same applies (albeit indirectly) for consumption data for the previous 12 months, which must be provided at least once a year, and information on periodic changes to the terms of protected tariffs. Customers on a protected tariff can ask their supplier to include details on how the amounts billed are calculated, with an indication of the unit prices applied to each item and the related quantities.

[25] http://www.autorita.energia.it/allegati/docs/15/201-15.pdf

[26] https://bolletta.autorita.energia.it/bolletta20/

using interactive tools, users are able to access descriptive content and information for the various sections of the bill. In some cases, video guides are also available where a sample bill is dynamically illustrated with audio content.

3.1.3.2 Smart meters

Second-generation electricity smart meters

In Italy, the process of installing the first smart meters neared completion in 2006 for the main distribution company (about 85 % of end customers). It was completed five years later, in 2011, for the other distribution companies.

Legislative Decree No 102/2014 tasked the Authority with defining the functional specifications of second-generation (2G) smart meters by July 2016, but did not set a start date for the obligation to put 2G smart metering systems into service.

By means of Decision No 87/2016/R/EEL, the AEEGSI defined the functional requirements or specifications for 2G meters and the expected performance and timetable for the rollout of 2G smart metering systems[27]. It also defined the expected performance levels, for example in relation to the daily availability of 15-minute curves or large-scale centralised reprogramming, which were to be available as soon as possible.

For the roll-out of 2G meters, distribution companies with more than 100 000 points will have to propose and publish their own 15-year plan containing a forecast of meter volumes and related expenses, distinguishing between the 'bulk phase' and the 'user management' phase. The plan must describe the actual performance and weaknesses of the 1G system and the expected performance of the 2G system, explaining how users will be informed and indicating the possible impacts of the new system on users. The distribution company must also publish detailed six-monthly schedules for the large-scale roll-out of 2G meters, indicating the timetable for each area (usually a town, or a smaller area in the case of large cities) and providing information on the actual progress from the third detailed schedule.

The Authority reimburses the costs according to a conventional installation plan based on the estimated useful life (15 years) of 1G meters. If the actual rate of installation is faster than the conventional plan, the 2G costs are still reimbursed based on the conventional plan. Distributors are discouraged from replacing 1G meters much sooner than the end of their useful life, unless this is offset by expectations of higher cost savings. This is because there is no immediate reimbursement, resulting in lower returns[28].

Gas smart meters

The Authority initiated the replacement of conventional gas meters with smart meters. This began

[27] The Decision also required incentive mechanisms to be defined, following a consultation process, to cover the costs of replacing first-generation (1G) equipment and meters with new smart metering systems, the main aim being to ensure the timely, effective and gradual deployment of 2G smart metering systems with the associated benefits. Furthermore, by means of consultation document No 468/2016/R/EEL, the Authority identified various improvements to the existing electrical service and system processes, as well as potential new services enabled by the uptake of 2G smart metering systems, outlining the benefits for the electrical system and highlighting areas where regulations would need to be updated to harness such benefits.

[28] As an added incentive to reduce service costs, the Authority has exceeded the criterion for the reimbursement of final costs for 2G systems, instead using a standard cost to define projected annual investment expenditure over 15 years. The standard cost takes into account companies' forecasts: on the one hand, the company has an incentive to make reasonable and accurate forecasts due to the penalty for incorrect forecasts; on the other, the company retains up to 25 % of the profits if it spends less than expected. The remainder of the profits will be passed on immediately to consumers.

with the highest rated meters (G40 class and above) and was gradually extended to intermediate meters and, from 2013, smaller gas meters for domestic use (G4-G6 class).

While transposing Legislative Decree No 102/2014, the Authority issued Decision No 117/2015/R/GAS to overhaul the rules on gas metering. This will increase the amount of actual data available to suppliers and end customers. To that end, the Authority gradually updated the replacement plan for gas meters, taking into account the technical challenges concerning implementation. The current target is 50 % of G4-G6 class gas smart meters in service by 2018 (for distribution companies with more than 200 000 end customers at 31 December 2013), by which time the installation of higher-rated gas smart meters will be complete[29].

By means of Decision No 393/2013/R/GAS, the Authority began testing whether the communications infrastructure for smart metering could be shared on a multi-utility basis, particularly for gas metering (see next paragraph). It then extended the trial to other utilities, considering the potential cost effectiveness and social benefits that these innovative implementation models might offer.

Multi-utility smart meters

In late 2014, the AEEGSI approved eight pilot schemes involving remote meter management for various public services in nine Italian cities (Turin, Reggio Emilia, Parma, Modena, Genoa, Verona, Bari, Salerno and Catania) and several smaller towns, involving a total of around 60 000 supply points[30]. The call was open to all gas distribution companies. The approved projects were funded with a mini-contribution of around 10 cents per year for consumers throughout the country, levied through the tariff component for gas distribution in their gas bill.

The incentive for the owners of the pilot projects is structured as follows:

- for capital expenditure on gas metering units located at the remotely managed points concerned, provided these were brought into operation in 2014, coverage of up to 150 % of the standard costs set by the Authority for 2012 is guaranteed;
- capital expenditure on any other utility meters regulated by the Authority is reimbursed by the relevant tariff regulation, including any special features or mechanisms intended for the trial;
- a grant is paid to cover some of the other costs (operating costs or capital expenditure) that cannot be reimbursed through the applicable tariff regulation.

The approved projects are all aimed at testing the ability to use a single shared network to transfer consumption data from electricity, gas and water meters to different suppliers within a notional smart city. Gas and water distribution are included in each of the projects selected, as well as other utilities that vary from project to project. Examples of the various services being trialled include public lighting, noise sensors, sensors to detect water leakage from public supply pipes, and sensors to detect when waste containers are full. The data are relayed by meters or sensors via communications infrastructure built and operated by third parties, and shared among the operators of the various services involved. It is thus possible to provide customers with information on their multi-utility consumption via a single website, despite there being separate meters for the different

[29] The Authority asked the Italian Gas Committee to define the technical rules for gas smart metering systems. Particular emphasis was placed on the issues of interchangeability – or the ability of a smart metering system to operate identically with equipment from different manufacturers – and interoperability; i.e. the ability of a system to exchange data with the systems of other utilities. The architecture of gas smart metering systems can either be point-to-point (generally with communication over the public telecommunications network) or point-to-multipoint, with a concentrator; in these cases communication is conducted via a radio frequency of 169 MHz.

[30] The list of projects can be found in the Appendix in Table A.3.

utilities.

According to the timetable drawn up by the AEEGSI, the roll-out phase will last one year. The operational phase should be completed within three years from the project approval date. Preliminary project reports were compiled in March 2015, while progress reports are to be submitted to the AEEGSI at regular intervals.

3.1.3.3 Conclusion

The various activities described in the area of metering point to a growing consumer focus: the amount of information that is and can be made available in real time, if properly supported by adequate training and information on the use of smart meters (via the three-year information and training programme[31] already under way), will form the basis of the behavioural change that needs to take place among end users. Although difficult to quantify, this phenomenon will unquestionably lead to a significant increase in energy efficiency projects carried out in various end-use sectors. The added contribution in terms of energy savings achieved, which will count towards the 2020 targets, will at least be incorporated within the results achieved by the main incentive mechanisms available, as previously described.

3.1.4 Consumer information and training programmes

Article 13 of Legislative Decree No 102/2014 made provision for a specific three-year information and training programme (PIF)[32]. This was designed by ENEA involving various parties such as Regions, consumer associations, ESCOs and ESCO associations. They are also the stakeholders for the implementation of the programme, coordinated by ENEA. The information and training programme and the strategies identified were organised following an in-depth analysis of the economic, social and regulatory climate: Table 3.14 identifies the main issues that hamper the implementation of policies and that can be addressed through appropriate communication targeting the parties concerned.

Table 3.14 – Target groups for the three-year information and training programme and key issues

Addressees	Key issues
SMEs	• Lack of energy expertise in smaller firms • Reducing costs is the biggest incentive for energy efficiency, although financial capacity is the main barrier to investment • Energy audits in SMEs less frequent than in large companies • Energy management rarely systematic • Energy consumption rarely monitored
Government employees	• Low participation of government employees in business dynamics • Lack of incentives and target-based performance assessments • Lack of information-sharing about energy consumption • Routines • Lack of motivation and insufficient knowledge/awareness of energy efficiency issues
Schools	• Curriculum does not cover the subject of energy • Too much theory and few practical exercises • Use of language that it is too out of touch with young people • Lack of motivation and insufficient knowledge/awareness of energy efficiency issues
Households (multi-apartment buildings)	• Mostly occupants of existing buildings with poor energy efficiency • Lack of information on energy consumption and returns on investment in building upgrades • Cultural aspects of housing (choice of projects according to how invasive they are, intangibility of energy efficiency compared with aesthetic criteria and visibility, etc.). • Financial aspects (despite suitable mechanisms such as tax relief and the thermal energy account) • Bureaucratic and procedural aspects in the choice of operators who can design and carry out projects

[31] Cf. paragraph 3.1.4.

[32] For more information about the information and training programme, visit www.italiainclassea.enea.it.

Banks and financial institutions	• ROI difficult to quantify • Technical assessment of the projects proposed • Guaranteed continuity of the business benefiting from the energy saving • Regulatory framework • Regulatory uncertainty
ESCOs, energy management experts (EMEs) and service providers	• Too weak financially (e.g. inadequate capitalisation, insufficient turnover, etc.) to be able to operate through third-party financing and performance guarantees • Bureaucratic obstacles (planning permission and operating permits, connections to energy networks, emissions limits, etc.) • Measurement and documentation of climate conditions and occupant behaviour, which can prove complex and expensive. Resources do not always exist to overcome these difficulties, or there is a lack of interest and care on the part of the public administration/individual

Source: ENEA

The programme is divided into three different stages, each lasting one year:

- Stage 1. Start-up (first year): involves mass information/communication to provide a basic introduction to energy efficiency and energy savings. Targeted actions are planned for selected recipients;
- Stage 2. Specific targets (second year): the midpoint of the programme, which involves maximising information coverage and launching targeted actions for the recipients identified under Article 13 of Legislative Decree No 102/2014;
- Stage 3. Consolidation and testing (third year): consolidation of initiatives, communication of results and analysis of the communication impact.

The main actions taken during the first year involved raising public awareness of energy efficiency through prime-time television broadcasts, as well as public information films produced in association with the Prime Minister's Office. During the planning phase, a minimum target was set of 500 000 viewers for each of the 14 public information films, reaching an estimated target audience of about 7 million. Each film was to last for a minimum of three minutes and be broadcast during programmes or time slots with an average audience per episode at least equal to the target audience. The campaign aired for two months, involving 29 television programmes and reaching an average audience of more than 500 000 viewers. Overall, it generated 55 million gross contacts.

The Ministry of Economic Development has declared November to be 'Energy Efficiency Month'. Throughout the month, businesses, industry bodies, public authorities and schools are encouraged to organise events, promotions and seminars of varying lengths to foster a more environmentally conscious use of energy. The target for the first year was to have 300 organisers and event promoters take part, reaching an audience of between 15 000 and 20 000 participants[33]. More than 400 participants took part in the initiative by organising around 270 events nationwide[34]. Considering the vast target market of some of the stakeholders involved (e.g. Italo, ACEA, ENEL), the overall impact of the initiative was estimated at about 12 million end users, reached through live events and online via websites and social media (Facebook, Twitter, Instagram). In view of its success, the Energy Efficiency Month shall become an annual event.

During the first year of the information and training programme, awareness-raising campaigns were also carried out aimed at[35]:

[33] During the initial planning phase, the EU Sustainable Energy Week was used as a baseline for calculating the scope of the initiative, since on average it involves around 30 000 second-level participants each year.

[34] The main user categories were financial institutions, schools and local, provincial and regional authorities, alongside SMEs, communication networks, trade associations and economic entities outside the energy sector. Regarding the types of initiatives organised, the majority were information and awareness-raising events (53 %), followed by promotions of goods and services directly or indirectly related to energy efficiency (25 %), and lastly training aimed at students and pupils and industry professionals.

[35] In this respect, training courses were organised for the public administration, building managers, energy service companies, journalists, estate agents and school teachers at all levels to encourage behavioural

- developing guidelines and producing an information pack and guide to the relevant legislation (Presidential Decree No 74/2013 on air-conditioning systems and the Decree of 26 June 2015 on minimum requirements and the energy performance certificate).
- organising awareness-raising campaigns for public sector and other employees on the implementation of programmes aimed at upgrading the energy efficiency of public buildings (PREPAC), on the use of tools for effective service contract management (e.g. model energy performance certificates, guidelines for the preparation of energy audits, guidelines for the Energy Performance Contract), on the existence of support measures for carrying out works (e.g. National Energy Efficiency Fund, scheme promoting energy audits in SMEs) and the availability of technical support materials.
- joint activities with environmental and consumer associations, trade unions and enterprises (e.g. dissemination of the guide to thermal installations, model energy performance certificates, Ecobonus scheme, etc.).

An initial general impact assessment of the actions taken during the first year of the information and training programme was carried out by analysing big data obtained from web searches by users using commercial browsers[36]. A comparative analysis shows that between September and December 2016, there was a significant increase in the number of searches for all keywords, suggesting that the campaign had an impact on awareness and interest in certain topics. In some cases, by analysing these trends over a two-year period, it emerged that there was a renewed interest in certain technologies (such as heat pumps and condensing boilers) and in incentive mechanisms such as the Thermal Energy Account, as well as specific instruments such as the energy performance certificate.

The second year is the midpoint of the training and information programme, with maximum information coverage together with the launch and implementation of actions targeted at different audiences: enterprises (especially SMEs), government employees, students and pupils, households, banks and financial institutions, businesses and residential customers, and energy service companies[37]. The programme for 2017 mainly focuses on the configuration, implementation and promotion of macro-projects able to facilitate and boost communication around energy savings and efficiency, thus overcoming the main problems and meeting the information needs of the different target groups (Table 3.15).

Table 3.15 – Three-year information and training programme: specific goals in the second year

Objective	Description
Objective 1 – Large enterprises and SMEs	Support, raise awareness and encourage large enterprises and SMEs to perform energy audits and use incentives for the installation of energy-efficient technologies (co-financing programme for energy audits).

change. Of particular interest is the MAEnergy initiative, a pilot project for testing behavioural change models to save energy, intended for staff at the Ministry of Foreign Affairs. Lastly, numerous training courses are organised for central and local government, building managers, energy service companies, journalists (in association with the industry body), estate agents, teachers and the armed forces.

[36] Google Trends was used for the analysis to assess whether, following the public awareness-raising actions carried out between October and December 2016, reaching some 55 million people through the radio and TV campaign and Energy Efficiency Month, there had been increased interest in certain topics and technologies, as inferred from internet searches using specific keywords.

[37] To encourage widespread involvement in the planning of the second year of the information and training programme, the open workshop #ClasseA-LAB was held to maximise contributions and define actions and initiatives for the dissemination and promotion of best practices, instruments and technologies, opportunities for incentives and funding to achieve the energy efficiency targets.

Objective 2 – Public administration	Encourage employees to change their behaviour to help reduce the energy consumption of the public administration; inform government employees of support programmes for upgrading the energy efficiency of public buildings (PREPAC).
Objective 3 – Incentives and support instruments	Inform enterprises, ESCOs and residential customers about the features of existing incentive mechanisms (tax relief, thermal energy account, etc.) to encourage their widespread use.
Objective 4 – Pupils and students	Educate pupils and students on environmentally conscious energy use.
Objective 5 – Households	Raise awareness among households, particularly in multi-apartment buildings, of the benefits of energy audits, the energy performance certificate (EPC) and environmentally conscious energy use.
Objective 6 – Banks	Encourage banks and financial institutions to become involved in financing energy efficiency improvement projects, particularly by sharing data and experiences of public-private partnerships.
Objective 7 – Training	Promote training programmes for the qualification of operators in the energy services sector, with particular reference to energy auditors and installers; training for government technicians to design projects to upgrade the energy efficiency of buildings.

Source: ENEA

For each of the objectives identified in Table 3.15, a pilot action is planned to develop systems for measuring the effectiveness of the information and awareness actions on the energy savings achievable.

More generally, the activities carried out and planned under the information and training programme are intended to foster widespread and shared awareness among end users in the various end-use sectors. Ultimately, this process will also have the effect of funnelling demand towards energy efficiency measures that, although characterised by a level of complexity and longer payback periods than those previously seen, will still deliver higher energy savings on a per-unit basis. It is hard to quantify the additional impact that the information and training programme has had on the energy savings achieved: in any case, the phenomenon will be indirectly quantified at least on the basis of the results achieved by the main incentive mechanisms, which will act as a conduit for the measures initiated under the programme.

3.1.5 Availability of qualification, accreditation and certification schemes

Italy is mindful of the requirements of Directive 2006/32/EC regarding qualification and certification schemes, calling for European and international standards to be set and devising national standards for issues on which European and international standard-setters are still to reach a consensus[38]. Legislative Decree No 102/2014 reinforces the issue of the qualification and certification of industry operators, introducing certain obligations while the decision of whether to gain certification generally remains at their discretion[39].

In Italy the standardisation bodies are UNI and, in the field of electrotechnics, electronics and telecommunications, CEI. In general, the standards issued by UNI are only recognised in Italy[40]. ACCREDIA is the organisation responsible in Italy for dealing with accreditation requests, and the conformity assessment bodies are not required to consult other EU bodies. Table 3.16 shows the certification currently available for industry operators in Italy and relating to energy efficiency, in addition to the relevant standards that the certification bodies must comply with in order to obtain accreditation from ACCREDIA.

[38] This decision is largely dependent on the standard UNI CEI 11339 for the certification of energy management experts, issued in 2009, and the standard UNI CEI 11352 for the certification of ESCOs, published the following year.

[39] Cf. Section 3.1.2 for enterprises subject to the energy audit obligation under Article 8 of Legislative Decree No 102/2014.

[40] Regulation (EC) No 765/2008, identifying the international technical standards for the operation of accreditation bodies, harmonises the conformity guarantee model at European level. Member States have the task of designating a single accreditation body that governments have the option of using. A key aspect of the Regulation is the requirement for accreditation bodies to join European and international mutual recognition agreements (MLA-MRA), managed by international accreditation networks (EA, IAF, ILAC).

Table 3.16 – Energy efficiency certification available in Italy

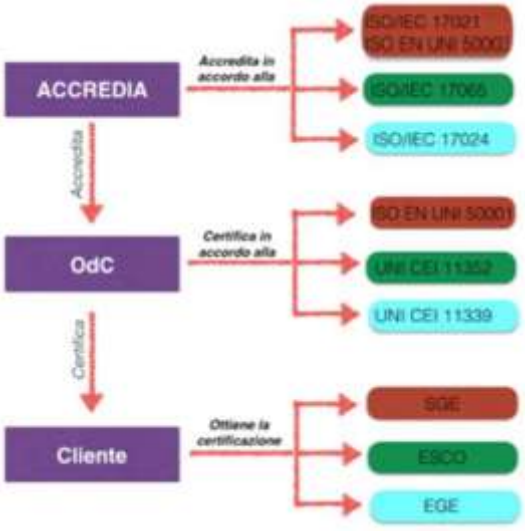
Certification	Regulatory framework for businesses or professionals	Regulatory framework for certification bodies	Accreditation scheme	European Directive or Regulation
Energy management system	UNI CEI EN ISO 50001:2011	UNI CEI EN ISO/IEC 17021 UNI ISO 50003	Interdepartmental Decree of the Ministry of Economic Development and Ministry of the Environment of 12.5.2015	
Environmental management systems	UNI CEI EN ISO 14001:2015	UNI CEI EN ISO/IEC 17021		
EMAS		UNI CEI EN ISO/IEC 17021		1221/2009
ESCO certification	UNI CEI 11352:2014	UNI CEI EN ISO/IEC 17065	Interdepartmental Decree of the Ministry of Economic Development and Ministry of the Environment of 12.5.2015	
EME certification	UNI CEI 11339:2009	UNI CEI EN ISO/IEC 17024	Interdepartmental Decree of the Ministry of Economic Development and Ministry of the Environment of 12.5.2015	
Certification of energy auditors	UNI CEI 16247-5: 2015	UNI CEI EN ISO/IEC 17024	Awaiting approval	

Source: ISNOVA

In addition to the accreditation of certification bodies, ACCREDIA manages the databases of certified parties[41]. This includes the accreditation of EMEs, ESCOs and organisations with ISO 50001 certification for EMS.

Certification in the energy sector is mostly voluntary, such as ISO 50001 for enterprises. Although this is usually the case, some certification is compulsory for specific activities, such as UNI CEI 11352 and UNI CEI 11339, which from 18 July 2016 are required for access to the white certificates mechanism or to perform mandatory energy audits for large enterprises in accordance with Article 8 of Legislative Decree No 102/2014. This legislative provision, introduced with the Ministerial Decree of 28 December 2012 and Legislative Decree No 102/2014, has dramatically increased the level of certification of EMEs and ESCOs in the last three years. Figure 3.5 contains a summary of the different parties and reference standards for accreditation in Italy[42].

Figure 3.5 – Summary of accreditation and certification standards



[41] The certification bodies that iss ata to ACCREDIA for inclusion in its database.

[42] The Appendix lists the certificat certification bodies – Table A.4), UNI CEI 113396 (16 certification ertification bodies – Table A.6).

ACCREDIA	ACCREDIA
OdC	Certification body
Cliente	Client
Accredita	Accreditation
Certifica	Certification
Accredita in accordo alla	Issues accreditation in accordance with
Certifica in accordo alla	Issues certification in accordance with
Ottiene la certificazione	Obtains certification
ISO/IEC 17021	ISO/IEC 17021
ISO EN UNI 50003	ISO EN UNI 50003
ISO/IEC 17024	ISO/IEC 17024
ISO EN UNI 50001	ISO EN UNI 50001
UNI CEI 11352	UNI CEI 11352
UNI CEI 11339	UNI CEI 11339
SGE	EMS
ESCO	ESCO
EGE	EME

3.1.6 Energy services

As previously explained, ESCOs play a key part in the context of the measures implemented[43].

For an assessment of the level of development of ESCOs for energy efficiency in the public sector, the results of the 'Integrated Energy Service'[44] can be used as a reference. This is an integrated set of services provided by CONSIP to public authorities covering the management, maintenance and energy efficiency of thermal and electrical installations for government buildings. Under the first two agreements, now concluded, more than 600 contracts worth more than EUR 2 billion were activated, servicing 13 000 government buildings and delivering a total saving of around 12 ktoe/year (Table 3.17).

Table 3.17 – Integrated energy service: results achieved

Issue	No of contracts	Contract value (€m)	No of buildings managed	Energy savings (toe/year)
1 (2009-2013)	324	803	5 800	2 761
2 (2011-2016)	298	1 367	7 200	9 158
Total	622	2 170	13 000	11 919

Source: CONSIP

The Energy Service is a results-based contract aimed at ensuring the right level of comfort (heat and electricity) for users through the integrated management of the building system/installation. Under the terms of the contract, the supplier must conduct an energy audit of the entire building/installation no later than the first heating season, depending on the building's volume and thermophysical characteristics. The aim is to estimate energy consumption and identify any possible areas of improvement. To encourage rational energy use and to measure the results obtained, the Integrated Energy Service requires the supplier – according to the commitment made in the technical bid – to implement energy-saving projects for the benefit of participating public administrations. The results are certified by AEEGSI: upon reaching a predefined order level under the agreement, the supplier must take steps to reduce primary energy demand. For every EUR 10 million in orders, the primary energy savings generated by the project had to be at least 5 toe under the first agreement (887 installation projects) and at least 300 toe under the second (1 938 building/installation projects). Under the third agreement, the commitment offered is equal to 25 % of baseline thermal energy and 20 % of historical power consumption.

CONSIP also provides public authorities with a public lighting service: the Lighting Service is a results-based contract aimed at ensuring the efficiency and quality of public lighting, through incentives for service management geared towards energy conservation, safety, public comfort and respect for the environment. For the second version of the initiative, the supplier was expected to carry out works that reduced primary energy demand for every EUR 10 million in orders: 500 toe for the second version, and 4 500 toe for the third version, currently under way. Through energy efficiency improvements and rationalisation, the initiative yielded savings of around 18.7 GWh/year, which equates to 0.0016 Mtoe/year.

Regarding the turnover generated by ESCOs from industry, recent surveys suggest that ESCOs are only responsible for 20 % of investments in key sectors[45]. Paper, building products, glass and

[43] Cf. paragraphs 3.1.1, 3.1.2, 3.1.4 and 3.1.5.

[44] In 2005, the Integrated Energy Service initiative won the award for 'Best Practice for Public Assets' in the category 'Regional Asset Management'. In 2014, it won the 'European Energy Service Award (EESA)' in the category 'Best European Energy Service Promoter', showcasing the energy efficiency obtained for participating public authorities. The initiative is now in its fourth year (the tender is currently at the adjudication stage).

[45] Source: Milan Polytechnic – Energy & Strategy Group, Energy Efficiency Report: *Le filiere dell'efficienza energetica in Italia*. The study analysed the following sectors: food, paper, building products, mechanical engineering, metallurgy, glass and ceramics, large-scale retail distribution and hotels, representing total investments of EUR 1.42 billion.

ceramics and metallurgy seem to be 'self-driven' sectors, with a medium-high propensity towards efficiency, but still relying on ESCOs to a limited extent. In contrast, mechanical engineering, hotels, large-scale retail distribution and food are 'ESCO-driven' segments, where the momentum for energy efficiency is still low.

An estimate of the total turnover of ESCOs in 2015 is around EUR 1.5 billion, demonstrating the growth of the industry, in part resulting from the legislative changes recently introduced through the white certificates mechanism. The Italian market has tripled in three years, as shown in Table 3.18.

Table 3.18 – ESCO market in Italy

Year	ESCO turnover (€m)
2008	275
2009	387
2011	500
2015	1 500

Source: JRC for 2008, 2009 and 2011; Milan Polytechnic – Energy & Strategy Group for 2015

ACCREDIA continually updates the information on certified ESCOs[46].

A recent phenomenon is the increase in the proportion of utilities in the energy efficiency services offering. As highlighted in the Energy Efficiency Report 2017 by the Energy & Strategy Group, of the top 22 utilities in Italy, as many as 18 have an internal division that deals with energy efficiency services ranked as first or second level within the organisation; moreover, among the utilities that have set up a dedicated business unit, half have their own certified ESCO. Utilities can leverage their available capital and energy distribution networks to target both the industrial and residential sectors effectively. However, they have not yet developed specific expertise in energy efficiency. Consequently, if ESCOs and utilities were to join forces, this could allow both to operate more effectively, leading to further investment and market consolidation.

3.1.7 Other horizontal energy efficiency measures

3.1.7.1 New guidelines for energy performance contracts for buildings

The guidelines for preparing the Energy Performance Contract (EPC) were recently revised in the light of new legislative changes, notably Legislative Decree No 50/2016 on the New Public Procurement Code[47], which fully repealed Legislative Decree No 163/2006, the previous legislative reference for public procurement. The final revision is awaiting the enactment of decrees implementing Legislative Decree No 50/2016 issued by the Ministry of Infrastructure and Transport, and the National Anti-Corruption Agency guidelines.

The EPC contractual model proposed for public authorities encourages the involvement of private operators (ESCOs, banks, etc.) to create economies of scale. This will ensure that the results achieved are transparent and reliable, in compliance both with the procedures for awarding contracts under existing laws, and with the new legislation on energy efficiency in buildings.

More specifically, the proposed EPC is extremely technical in terms of its content. In addition to the legal clauses (warranties, jurisdiction, safety standards, etc.), it includes financial content (financing arrangements, calculation of performance, etc.) and engineering content (energy audits, projects aimed at improving the energy efficiency of the building envelope and installations). This meant

[46] http://www.accredia.it/context.jsp?ID_LINK=1700&area=7

[47] Implementing Directive 2014/23/EU on the award of concession contracts, Directive 2014/24/EU on public procurement and Directive 2014/25/EU on procurement by entities operating in the water, energy, transport and postal services sectors, with the revision of existing legislation on public contracts for works, services and supplies.

that various difficulties had to be overcome to simplify the proposed contractual format and reconcile the needs of the contracting authority/client administration, which has to achieve the 'mandatory energy efficiency targets', with those of the contractor who has to finance, build and operate projects under the EPC.

The energy audit is the cornerstone of the entire approach. It is vital therefore that it should be the contracting authority/client administration who performs it, because the energy audit determines the baseline data, the necessary energy upgrade works and the minimum energy saving targets that the contractor has to guarantee for the duration of the contract. In addition, the data will be used during the performance of the contract by third-party verifiers (e.g. the Joint Supervisory Committee) to ascertain that the minimum energy savings required under the contract have been achieved. The verification will determine whether the contractor receives a bonus or a penalty, potentially leading to the termination of the contract in the event of material non-compliance[48].

The precise definition of the minimum guaranteed savings, fees, bonuses, penalties and, in severe cases, automatic termination of the contract, should encourage the contractor to achieve or even exceed the contractual targets and assure the contracting authority/client administration of the outcome of the energy efficiency projects carried out.

3.1.7.2 Split incentives

To foster the development and uptake in the residential sector of energy efficiency projects delivered by ESCOs, the EPC model must offer solutions for sharing the costs and benefits between the user, the building owner and the ESCO, with a triple-win approach that satisfies all stakeholders.

The solutions currently being examined[49] involve the following cases:

- owner and tenant sign a contract with the ESCO (option for public bodies in rented facilities, commercial properties and the residential sector);
- owner signs the contract with the ESCO:
  - EPC with the transfer of the savings (option for residential and commercial office buildings);
  - EPC with the owner covering the costs (option for residential and commercial office buildings);
  - progressive redevelopment of neighbourhoods (option for social housing in large neighbourhoods);
- user/tenant signs the contract with the ESCO: EPC with the owner's consent (option for government departments and long-term leases).

The tax relief mechanism for energy efficiency renovation also allows tenants to take advantage of

[48] For the same reason, in order to offer an additional guarantee both for the economic operators participating in the tender and the contracting authority/client administration, the methodology adopted by the technician in charge of the energy audit should contain the minimum elements indicated in the technical specifications. The verification is crucial for payments based on the energy savings required under the contract. Therefore, the guidelines stipulate that the contracting authority/client administration should pay the contractor's 'fee' once the works commence, with subsequent payment being contingent on the outcome of the verification. In other words, once the renovated building is brought into service, allowing sufficient time for the retrieval of all data from the monitoring system (a year, for example), the contracting authority/client administration, either directly or through a committee of experts established for that purpose (Joint Supervisory Committee), verifies that the works carried out guarantee the minimum savings required under the contract and awards a bonus (a higher fee in proportion to the additional savings achieved compared with the minimum guaranteed savings) or imposes a penalty (a reduced fee in proportion to the lower savings achieved). In severe cases, the contract may be terminated automatically.

[49] For further details, please refer to the project GuarantEE – Building energy services in Europe.

the incentive.

3.1.8 Financing of horizontal measures

3.1.8.1 National Energy Efficiency Fund

The Legislative Decree transposing Directive 2012/27/EU on energy efficiency provides for the establishment of a National Energy Efficiency Fund at the Ministry of Economic Development. The aim of the fund is to support energy efficiency measures carried out by public authorities, ESCOs and businesses to increase the energy efficiency of their own buildings, systems and production processes. The Fund is used to support measures aimed at upgrading the energy efficiency of buildings owned by public authorities, creating district heating and/or cooling networks, streamlining public services and infrastructure (including public lighting), upgrading the energy efficiency of whole buildings (including social housing) and reducing the energy consumption of industrial processes.

The Fund is revolving in nature and is divided into two sections for the purpose of:

- issuing guarantees for individual transactions and/or portfolios for loans granted to firms for the implementation of energy efficiency measures;
- lending, either directly or through banks and financial institutions, including the European Investment Bank, if necessary by subscribing for units of closed-end mutual funds whose investment objective is to subscribe for newly issued debt securities, or the arrangement of new finance, in any of the forms permitted by law, as well as by subscribing for securities issued in accordance with Law No 130 of 30 April 1999 in the context of securitisation transactions involving private loans to small and medium-sized enterprises and ESCOs for investing in energy efficiency.

The Fund is intended to prioritise projects and programmes aimed at:

- creating new jobs;
- upgrading the energy efficiency of the whole building;
- promoting new nearly zero-energy buildings (NZEB);
- installing earthquake protection measures in addition to upgrading energy efficiency.

An estimated total of EUR 490 million will be paid into the Fund for the period 2014-2020. The Fund is expected to be operational by the end of this year.

3.1.8.2 Structural Funds 2007-2013 programming period

Table A.7 in the Appendix illustrates the current status of projects relating to the different EU programmes: some are still in progress and, as mentioned, for those that began after 2014, a detailed assessment will be carried out of the energy savings achieved. Overall, more than 800 projects have been financed, representing total public funding of more than EUR 500 million.

3.2 Energy efficiency in buildings

3.2.1 State of implementation of the EPBD recast

This section examines compliance with various specific requirements of the EPBD recast (Directive 2010/31/EU).

With regard to Article 5, the Italian cost-optimal methodology[50] was presented to the European

[50] *Application of the methodology for the calculation of cost-optimal levels of minimum energy performance requirements*, produced by a working group coordinated by the Ministry of Economic Development and composed of ENEA, RSE and CTI. The methodology is available on the website

Commission in July 2013. A review of the methodology is planned in time for the five-year review of the minimum energy performance requirements, as provided for in Article 4 of the Directive.

Article 10 requires that a list of measures and instruments to support the achievement of the EPBD targets is provided, associated with catalysing the energy performance of buildings and the transition to nearly zero-energy buildings. An initial list of existing and proposed measures and instruments was sent to the European Commission in 2012. An update is required every three years. The list may be submitted to the Commission by including it in the EEAP; Italy has chosen to make use of this option[51].

Below is a list of the measures and instruments adopted in Italy:

- white certificates;
- tax relief at 65 %;
- thermal energy account;
- reduction in construction costs at regional and national level for NZEB;
- PREPAC programme for central government buildings;
- structural Funds (e.g. financing of energy efficiency improvement projects in public buildings owned by the local municipality or for refurbishment projects);
- awareness-raising campaigns on current incentives, the information and training programme (Article 13 of Legislative Decree No 102/2014) and the one-stop shop for energy efficiency in existing buildings;
- awareness-raising campaigns organised by the Prime Minister's Office (CIRIESCO, ITALIASICURA);
- awareness-raising campaigns organised by the Regions and Autonomous Provinces (e.g. CasaClima Bolzano);
- Kyoto Fund;
- National Energy Efficiency Fund;
- financial instruments for schools, social housing and hotels;
- Plafond casa;
- development and circulation of model energy performance contracts;
- measures promoted by the Regions.

Lastly, with regard to Articles 14 and 15, Italy has introduced periodic inspection schemes for accessible parts of heating and air conditioning systems. Therefore, it is not required to report on alternative measures.

3.2.2 Upgrading the energy efficiency of the national building stock

The detailed document on upgrading the energy efficiency of the national building stock contained in Annex 1 gives an overview of the national building stock, identifies the project criteria on the basis of the optimisation of the cost/benefit ratio, and analyses the technical, economic and financial barriers that hamper the implementation of energy efficiency improvements. The document also assesses the potential savings within the sector and estimates the expected energy savings by 2020 as a result of the measures put in place.

https://ec.europa.eu/energy/en/topics/energy-efficiency/buildings

[51] For Member States that do not include the list of measures and instruments in the EEAP, the following link is available: https: //ec.europa.eu/energy/en/topics/energy-efficiency/buildings/financing-renovations

3.2.3 Measures for energy efficiency in buildings and installations

3.2.3.1 National action plan for increasing the number of nearly zero-energy buildings

This document, required under Article 4-*bis*(2) of Legislative Decree No 192/2005, clarifies the definition of NZEB and examines the energy performance of the various types of NZEB in different end-use sectors and climate zones. It estimates the additional costs – relative to current levels – necessary to construct new NZEB or transform existing buildings into NZEB. It also outlines the national development framework and policies for increasing the number of NZEB through the regulatory and incentive measures available. Based on the estimates made, from the early adoption of NZEB standards ahead of the entry into force of the new building requirements laid down in Legislative Decree No 102/2014, and from incentives for deep renovations to encourage the transformation of existing buildings into NZEB, the savings estimated for the period 2015-2020 (for the residential and non-residential sector combined) total approximately 10 200 toe (cf. Annex 2). The Decree ratifying the plan is in the process of being enacted.

3.2.3.2 Legislative Decrees of 26 June 2015

Legislative Decree No 63 of 4 June 2013 transposed Directive 2010/31/EU, amending Legislative Decree No 192/2005 transposing Directive 2002/91/EC (the Energy Performance of Buildings Directive, EPBD).

To complete the transposition, the Interministerial Decree of 26 June 2015 was published, composed of three separate Decrees. The first concerns the 'Application of energy performance calculation methods and the definition of the rules and minimum requirements for buildings'; the second 'Reference procedures and framework for compiling the project technical report for the application of rules and minimum energy performance requirements for buildings'; and the third 'Adaptation of national guidelines for the energy certification of buildings'.

The first Decree:

- defined the criteria for nearly zero-energy buildings and set new minimum standards, in force since 1 October 2015;
- introduced a new method for calculating a building's energy performance;
- amended the services to be taken into account when evaluating the building's performance;
- laid down a new method for determining the energy classification of buildings using a predefined scale;
- split the redevelopment of existing buildings into two levels, depending on the extent of the work.

The second Decree provided three outlines for project technical reports, relating to:

- new buildings, major renovations and nearly zero-energy buildings (Annex 1);
- work on upgrading the energy efficiency of existing buildings and secondary major renovations, by improving the building envelope and heating systems (Annex 2);
- upgrading the energy efficiency of technical installations (Annex 3).

The third Decree:

- described the guidelines, transitional measures, consultation and cooperation between the State and the Regions for the preparation of energy performance certificates (EPCs);
- introduced an information system for managing a national register of energy performance certificates and heating systems (SIAPE), developed by ENEA jointly with the Regions and launched at the end of 2015;
- stipulated that by 31 March each year, the Regions and the Autonomous Provinces must

submit data on certificates issued in the previous year;

- introduced an obligation for the Regions and the Provinces to draw up inspection plans and procedures in order to analyse a minimum of 2 % per annum of the EPCs in their territory.

The format of the EPC and energy qualification certificate are defined in the Annex to this Decree.

3.2.3.3 Building code

The draft building code[52] approved in November 2016 lays down the general principles and criteria for simplifying and harmonising local building regulations throughout Italy. The building code is divided into two parts:

- general building principles and rules: these lay down the standard building practices to apply at a national and regional level;
- local building regulations: these define the regulatory framework for construction under local authority jurisdiction, which, again to ensure the simplification and harmonisation of building standards nationwide, must follow a uniform general structure.

3.2.4 Financing

3.2.4.1 Fund for the purchase and/or restructuring of buildings (Plafond casa)

In order to support housing policies, Article 6(1)(a) of the Decree-Law of 31 August 2013 (converted into Law No 124 of 28 October 2013) allocates EUR 2 billion to facilitate access to credit in the residential sector. This amount was increased to EUR 3 billion in April 2016.

The Fund is intended to finance home purchases through mortgage-backed loans. Priority is given to properties that are the main residence, preferably within energy categories A, B or C, and/or renovations and energy efficiency improvements, with priority given to young couples, households with at least one disabled person and large families.

The practical arrangements for the scheme are defined in a specific agreement between Cassa Depositi e Prestiti and the Italian Banking Association. For the banks, access to the credit line is set to a first-come-first-served basis, provided that resources have not been exhausted. Recipients contact one of the participating banks, which use the funds made available by Cassa Depositi e Prestiti to grant mortgages for purchase and/or restructuring:

- up to EUR 100 000 for restructuring with a view to increasing energy efficiency;
- up to EUR 250 000 for the purchase of residential real estate;
- up to EUR 350 000 for measures involving both purchase and restructuring, involving an increase in the property's energy efficiency.

3.2.4.2 Structural Funds 2007-2013 programming period

Table A.8 in the Appendix illustrates the current status of projects relating to the different EU programmes: some are still in progress and, as mentioned, for those that began after 2014, a detailed assessment will be carried out of the energy savings achieved. Overall, around 80 projects have been financed, representing total public funding of more than EUR 14 million.

[52] Agreement, under Article 8(6) of Law No 131 of 5 June 2003, between the Government, Regions and municipalities concerning the adoption of the building code referred to in Article 4(1-*sexies*) of Presidential Decree No 380 of 6 June 2001.

3.3 Energy efficiency measures in the public sector

3.3.1 Central government buildings

In early 2013, the Ministry of Economic Development, working with the State Property Agency, began compiling an inventory of buildings owned and used by public authorities. The buildings had to meet the following criteria:

- have a useful floor area (air-conditioned in summer and heated in winter) of over 250 m^2;
- not be subject to official protection owing to their special architectural or historical merit;
- not be owned by the armed forces or public authorities and serving national defence purposes, apart from single living quarters or office buildings for the armed forces and other staff employed by national defence authorities;
- not be a building used as a place of worship or for religious activities.

The inventory includes information on the useful floor area in square metres and energy usage data (including the energy performance certificate, if applicable)[53].

The inventory currently identifies 4 102 buildings[54] occupied by the government, with a gross floor area of over 250 m^2 (for a total of 15 190 344 m^2) and for which – albeit incomplete – information is available on gross floor area, annual fuel and electricity consumption and related costs.

The Interministerial Decree of 16 September 2016 defined the procedures for implementing the energy renovation programme for central government buildings (PREPAC), particularly in relation to the identification and selection of projects eligible for funding and the necessary information and technical support activities. To access the funding, public authorities must draw up, either separately or jointly, proposals for the energy efficiency renovation of the buildings they occupy. By means of the Interministerial Decree of 5 December 2016, 68 projects submitted in 2014-2015 were approved, totalling around EUR 73 million in approved funding.

For 2016, 32 projects have currently been approved (3 of which are considered exemplary), totalling more than EUR 60 million in requested funding.

During the three-year period between 2014 and 2016, works were carried out or planned on an additional 150 buildings, amounting to a total surface area of 1 414 972 m^2. The figure is largely attributable (both in terms of works and floor area renovated) to the programme for upgrading the energy performance of central government buildings (PREPAC). The remainder is due to other specific incentive measures (Interregional Operational Programmes – Energy) and works carried out by the State Property Agency under the centralised maintenance system (or 'Single Maintenance Provider') pursuant to Decree-Law No 98/2011.

Table 3.19 shows the total area to be upgraded and the floor area of the buildings concerned.

[53] The authorities concerned upload the data to a website run by the State Property Agency. With the entry into force of Article 12 of Decree-Law No 98/2011 (converted with amendments by Law No 111/2011), the State Property Agency was given responsibility for decisions regarding spending on maintenance work for properties owned and used by the public administration. It was also assigned the role of central purchasing body when selecting operators to carry out the work.

[54] The generic term 'building' has been used to cover cases where only certain parts of the building are intended for government use. Compared with the previous year, the revised data resulted in the number of buildings actually owned and occupied by the central government being amended, with a consequent reduction in the total gross area used as the basis for calculating the 3 % per annum that must be upgraded.

Table 3.19 – Upgrading the energy efficiency of central government buildings – 2014 and 2015 results and 2016 estimates

	2014	2015	2016
Total floor area of the buildings with a useful floor area exceeding 500 m^2, owned and occupied by central government and not meeting the energy performance requirements laid down in Article 5(1) of the EED	14 828 984	14 441 992	13 973 749
Total floor area of the buildings with a useful floor area exceeding 250 m^2, owned and occupied by central government and not meeting the energy performance requirements laid down in Article 5(1) of the EED	Not monitored as not mandatory	361 360	361 360
Total surface area of heated and/or cooled buildings owned and occupied by central government, upgraded or scheduled to be so during the year	386 992	468 243	559 737
Percentage of surface area that is subject to the upgrading requirement	2.61 %	3.16 %	3.90 %

Source: ENEA, based on data from the Italian State Property Agency, MISE (Ministry of Economic Development) and MATTM (Ministry of the Environment)

3.3.2 Other public buildings

3.3.2.1 Regional and local energy and environmental plans

Around half of Italian Regions recently introduced an energy and environmental plan in line with Legislative Decree No 102/2014[55].

There are currently 106 applications under the new Covenant of Mayors for Climate and Energy. With support from area coordinators[56], the new signatories plan to reduce CO_2 emissions by at least 40 % by 2030, and to adopt an integrated approach towards climate change adaptation and mitigation[57].

Among the main provincial cities, between 2012 and 2015, 78 authorities committed to the energy efficiency renovation of municipal buildings. This included nearly 90 % of authorities in Northern Italy, 70 % of authorities in Central Italy, and 50 % of authorities in Southern Italy. Nearly half of the upgrades concern the heating system, followed by the replacement of doors and windows and the installation of renewable energy plants. In addition, there is widespread awareness of investments aimed at increasing the energy efficiency of public lighting: in 2015, 81 towns implemented at least one measure in this regard.

Among the public bodies that have adopted a specific energy efficiency plan, the Ministry of Defence has developed guidelines for energy conservation, for the reduction and optimisation of consumption, and for improving the energy efficiency of technical and administrative buildings and facilities[58].

[55] Table A.9 in the Appendix lists the Regions that have recently implemented an energy and environmental plan.
[56] There are 101 coordinators for the Covenant: the national coordinator, ENEA, is joined by 11 Regions, 54 provinces, 31 groups of municipalities of various types (for example, associations of municipalities and Mountain Communities) and four metropolitan areas (Rome, Turin, Venice and Genoa).
[57] Of these, 18 had joined the previous Covenant of Mayors. Almost all of the signatories that accepted the commitment by 2020 under the previous version of the Covenant of Mayors have prepared an action plan (3 057 out of 3 117). However, the number that monitor results has fallen to 740.
[58] The document is available via the following link: http://www.difesa.it/Amministrazionetrasparente/segredifesa/Documents/LineeGuidaRisparmioEnergetico.pdf. A summary of the planned actions can be found at: http://www.difesa.it/Content/Documents/manifesto_progetto_energia.pdf.

3.3.3 Purchasing by public bodies

The National Action Plan for Green Public Procurement (NAP GPP) was launched in 2008. In 2013 it was updated to improve its overall approach and to modify various operational aspects, particularly with regard to Environmental Minimum Requirements (EMRs). In 2012, under the Plan, EMRs for building energy services were published. These were followed in 2016 by EMRs for the outsourcing of design services and works for construction, renovations and maintenance of buildings for government construction site management ('construction EMRs'), updated in January 2017[59].

The building EMRs state that in the case of projects involving the renovation or maintenance of existing buildings, an energy audit must be performed or commissioned to determine the building's energy performance and the measures to be taken to reduce the building's energy demand[60]. For new builds[61], however, and for major renovations, notwithstanding the more restrictive standards and regulations (e.g. local planning and building regulations, etc.) and the provisions of the 'energy services' EMR (Ministerial Decree of 7 March 2012, as amended), projects must ensure that the total energy demand of the building is met by renewable energy systems or alternative high-efficiency systems (high-efficiency cogeneration/trigeneration, centralised heat pumps, low-enthalpy geothermal energy, etc.). These must generate an additional 10 % of energy on site compared with the amount required under Legislative Decree No 28/2011, Annex 3(1), within the timeframe specified therein. The design of the building should also include technical specifications for water saving and internal environmental quality[62].

Lastly, the maintenance plan for the structure and its parts must include the verification of qualitative and quantitative performance levels, based on a programme for monitoring and regulating air quality inside the building: clearly this programme is only identifiable once the installation is operational, by staff professionally qualified for this purpose.

As regards the technical specifications of building components, in order to reduce the environmental impact on natural resources, the EMRs provide for greater use of recycled materials, and hence encourage the recovery of waste, particularly in terms of demolition and construction (consistent with the target of recovering and recycling at least 70 % of non-hazardous waste from construction and demolition by 2020). To this end, when working on a building project a designer must make technical design choices, specify the environmental information relating to the products selected and provide the technical documentation meeting those criteria, and must also stipulate that during the procurement phase the contractor shall ensure compliance with these common criteria by means of the documentation indicated when verifying each criterion. This documentation must be submitted to the contracting authority at the implementation stage of the works, in the manner defined in the specifications. Lastly, specific criteria exist for the building components[63].

[59] Adoption of minimum environmental requirements for buildings, furniture and textile products.
[60] Cf. also Sections 3.1.6 and 3.1.7.
[61] Including demolition and reconstruction works and extensions of existing buildings that have a gross air-conditioned volume that is 15 % (or 500 m^3) more than the existing building.
[62] In terms of: natural lighting; natural ventilation and controlled mechanical ventilation; solar protection systems; indoor electromagnetic pollution; indoor materials emissions; acoustic comfort; thermo-hygrometric comfort; and radon.
[63] All of the following materials must be produced with a given recycled content: concrete (and related component materials) mixed on site, premixed and prefabricated; bricks; timber products and wood-based materials; cast iron, iron and steel; plastic components; stone and mixed masonry; interior partitions and suspended ceilings; thermal and acoustic insulation; floors and walls; paints and varnishes; interior and exterior lighting; heating and air conditioning systems; plumbing systems.

3.3.4 Financing

3.3.4.1 Kyoto Fund for the energy efficiency of educational buildings

The Kyoto Fund for Schools provides funding at a preferential rate (0.25 %) for the purposes of carrying out energy efficiency measures in publicly owned school and university buildings. The Fund is governed by Interministerial Decree No 66 of 14 April 2015, implementing Article 9 of Decree-Law No 91 of 24 June 2014, and enables public bodies to borrow up to EUR 2 million for a maximum of 20 years. The financing covers the replacement of systems and work on building envelopes, as well as drawing up energy audits for structures. One of the requirements of the call for applications is that the energy efficiency of the buildings concerned improves by at least two categories. This improvement is certified by comparing the building's previous energy certification, required at the time of participation in the call for applications, and its certification after the work, required upon completion of the work.

In addition to energy efficiency, it is also possible to request funding for works to make buildings safe and works necessary in order to comply with earthquake prevention rules. In such cases, a maximum of 49 % of a project's total amount may be obtained.

The resources allocated amount to EUR 350 million and the admission procedure is on a first-come-first-served basis (resources are distributed according to the chronological order of the receipt of applications, until the funds have run out). The Ministry of the Environment is responsible for examining applications, verifying that the documentation is complete and has been prepared correctly, as well as compliance with the technical requirements set out in the call.

The Fund is managed by Cassa Depositi e Prestiti SpA, which deals with all economic and financial aspects of the loans, after eligibility for financing has been established (drawing up of the contract, disbursement of amounts and payment of instalments).

An initial call for applications for the Kyoto Fund for Schools was launched between June and September 2015. Following this, 120 energy efficiency projects were considered eligible, for a total value of approximately EUR 66 million. In most cases, work is due to commence in the second half of 2017. Residual resources have been made available by means of a second call, which was launched in April 2016 and is still ongoing (with a deadline of 30 June 2017). To date, 92 energy efficiency projects have been funded, for a total value of approximately EUR 38 million.

3.3.4.2 La Buona Scuola

Law No 107 of 13 July 2015 on the reform of the national education and training system and recasting of existing legislative provisions, which came into effect on 16 July 2015, defines, inter alia, the architecture, building systems, technology, energy efficiency and structural and seismic safety for the construction of new schools. Under this law, the State Schools Fund is increased by EUR 123.9 million in 2016 and EUR 126 million annually from 2017 to 2021. The estimate of revenue and expenditure of the Ministry of Education, Universities and Research includes a cash fund under the heading '"La Buona Scuola" Fund for the improvement and enhancement of school education', with a budget of EUR 83 000 for 2015. By means of the subsequent Decree No 594 of 7 August 2015, on the allocation of resources and the definition of criteria for the construction of new schools, the Minister for Education, Universities and Research defined how EUR 300 million would be shared between the Regions on the basis of population and school density.

3.3.4.3 Structural Funds

ERDF ROP 2014-2020 programming

Table A.10 in the Appendix lists the 23 regional calls issued to date. In total, more than EUR 300 million has been set aside.

2007-2013 programming

Tables A.11 and A.12 in the Appendix show the current status of projects relating to the various European programmes; some are still in progress and, as mentioned, for those launched from 2014 a detailed assessment of the energy savings achieved will be carried out. Overall, about 640 public building projects have been financed, representing around EUR 400 million in public funding. Around 940 public lighting projects have been financed, representing more than EUR 200 million in public funding.

3.4 Energy efficiency measures in industry

3.4.1. Main measures[64]

3.4.1.1 National Plan for Industry 4.0

The Plan sets out concrete measures based on three main guidelines:

- applying technological neutrality;
- implementing horizontal rather than vertical or sectoral measures;
- leveraging enablers.

There are four strategic guidelines:

- innovative investments: catalyse private investment in the adoption of technologies enabling Industry 4.0 and increase spending on research, development and innovation;
- enabling infrastructure: ensure adequate network infrastructure, data security and protection, and collaborate on the definition of international standards for interoperability;
- expertise and research: develop competencies and encourage research through ad hoc training courses;
- awareness and governance: disseminate knowledge and showcase the potential applications of Industry 4.0 technologies, and guarantee public/private governance to achieve the targets set.

The goal for 2017 is to increase private investment from EUR 80 billion to EUR 90 billion; in the period 2017-2020, the aim is to increase private investment in R&D&I by more than EUR 11 billion, with more focus on Industry 4.0 technologies.

3.4.2 Financing

3.4.2.1 Super-amortisation and hyper-amortisation

To support and encourage businesses that invest in new capital assets and tangible and intangible assets (software and IT systems) necessary for the digital and technological transformation of production processes, there are two forms of amortisation:

- super-amortisation: overvaluation of 140 % of investments in new capital assets purchased

[64] For a description of the energy efficiency measures for industry described above, in addition to their results and prospects, please refer to the sections on the white certifications obligation mechanism (Section 3.1.1), energy audits under Article 8 of Decree No 102/2014 (Section 3.1.2), and information and training programmes (Section 3.1.4).

or leased;

- hyper-amortisation: overvaluation of 250 % of investments in new purchased or leased tangible assets, equipment and technologies enabling Industry 4.0 transformation.

3.4.2.2 Capital assets – Nuova Sabatini

The subsidy introduced by Article 2 of Decree-Law No 69/2013[65] seeks to enhance the competitiveness of Italian manufacturing and improve access to credit for micro, small and medium-sized enterprises for purchasing new machinery, plant and equipment. This involves a contribution towards some of the interest paid by the enterprise on bank loans of between EUR 20 000 and EUR 2 million, arranged with banks approved by the Ministry of Economic Development, which either meet the credit limit set by Cassa Depositi e Prestiti, or constitute ordinary lending. The contribution is calculated on the basis of a five-year repayment plan with an interest rate of 2.75 % per annum. It is increased by 30 % for investments in Industry 4.0 technologies.

3.4.2.3 R&D tax credit

The 2015 Stability Law introduced a tax credit for enterprises investing in R&D, regardless of the legal form of the enterprise, the sector in which it operates, its accounting regime or its size. Investments must be made between the next tax year after the year ended 31 December 2014 and the tax year in progress at 31 December 2019. The activities include basic research, industrial research, experimental development and the production and testing of products, processes and services.

3.4.2.4 Structural Funds

ERDF ROP 2014-2020 programming

Table A.13 in the Appendix lists the 38 regional calls issued to date. In total, more than EUR 400 million has been set aside.

2007-2013 programming

Table A.14 in the Appendix illustrates the current status of projects relating to the different EU programmes: some are still in progress and, as mentioned, for those that began after 2014, a detailed assessment will be carried out of the energy savings achieved. Overall, 250 projects have been financed, involving public funding totalling more than EUR 41 million.

3.5 Energy efficiency measures in the transport sector

3.5.1 Main energy efficiency measures in the transport sector

3.5.1.1 Transposition of Directive 2014/94/EU

By means of Legislative Decree No 257/2016[66], Italy transposed Directive 2014/94/EU on the deployment of alternative fuels infrastructure. In order to reduce dependence on oil and mitigate the environmental impact in the transport sector, the measure lays down minimum requirements for the construction of alternative fuels infrastructure, including recharging points for electric vehicles and fuelling points for compressed and liquefied natural gas, hydrogen and liquefied petroleum gas

[65] Article 2 of Decree-Law No 69/2013.

[66] Regulation implementing Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels infrastructure.

as well as common technical specifications for charging points and refuelling, and requirements regarding user information. In particular, the Decree adopts the National Strategic Framework (NSF), which contains the following sections:

- electricity supply for transport;
- hydrogen supply for road transport;
- natural gas supply for other uses;
- supply of liquefied petroleum gas (LPG) for transport.

The Framework contains national targets for ensuring an infrastructure for alternative fuel.

- **Electricity supply for transport.** An appropriate number of recharging points accessible to the public are to be put in place by 31 December 2020, in order to ensure interoperability between existing points and those to be installed, and, depending on the needs of the market, to ensure electric vehicles can circulate at least in urban/suburban agglomerations, in other densely populated areas and in other networks and according to other areas progressively identified.
- **Hydrogen supply for road transport.** By 31 December 2025, an adequate number of hydrogen supply points accessible to the public are to be made available, to be developed gradually, taking into account current demand and development in the short term in order to allow the circulation of hydrogen-powered vehicles, including fuel cell vehicles, in the networks identified by the National Strategic Framework, including possible cross-border links.
- **Natural gas supply for transport.** An appropriate number of refuelling points for LNG are to be put in place at maritime ports, to enable LNG inland waterway vessels or seagoing ships to circulate throughout the TEN-T Core Network by 31 December 2025. Cooperation with neighbouring Member States may be required to ensure adequate coverage of the TEN-T Core Network. This measure also applies to inland ports, but by 31 December 2030. By 31 December 2025, the appropriate number of refuelling points for LNG are to be made available to the public, even if combined with CNG refuelling points, at least along the Italian sections of the TEN-T network to ensure circulation in connection with the EU network of heavy-duty LNG vehicles. By 31 December 2020, additional CNG refuelling points accessible to the public are to be put in place in order to ensure, according to market requirements, that CNG motor vehicles can circulate throughout the country, especially in areas with insufficient infrastructure. By 31 December 2025, an appropriate number of CNG refuelling points accessible to the public are to be put in place, at least along the Italian sections of the existing TEN-T Core Network, to ensure that CNG motor vehicles can circulate throughout the Union.

In cases of authorisations for the construction of new fuel distribution plants and the complete restructuring of existing fuel distribution plants, the Regions undertake to provide high-speed, high-power infrastructure for charging electric vehicles and to ensure the supply of CNG or LNG, even in an exclusively self-service mode.

3.5.1.2 Other measures

Decree of 1 December 2015[67]. The Decree lays down the technical and administrative procedures that will allow cars, buses and light vehicles under 3.5 tonnes, originally fitted with a petrol or diesel engine, to be converted into an electric vehicle.

[67] Regulation on the electric regeneration system to be fitted to category M and N1 vehicles.

3.5.1.3 Measures in the provincial capitals

In 2015, electric vehicle recharging points were present in 55 provincial cities[68] (compared with 46 in 2014), mostly concentrated in northern cities (7 out of 10). Of these recharging points, 6.5 % are powered entirely or partially by renewable energy. In 2015, an average of 8 % of alternative fuel vehicles were methane (out of a total of nearly 17 500), 5 % were LPG and 4 % were electric or hybrid.

3.5.2 Financing

3.5.2.1 Legislation

Decree of 7 November 2014[69]. Under the Fund for the implementation of the national infrastructure plan for electric vehicle charging (PNIRE), in July 2013 a call was published for Regions with a budget of more than EUR 4.5 million. At the end of the process, 19 projects from Regions and Autonomous Provinces were selected.

Departmental Decree No 503 of 22 December 2015 issued by the Head of the Department of Regional Development and Planning at the Ministry of Infrastructure and Transport. Coinciding with the annual update of the PNIRE, the Departmental Decree informed the Regions that a funding programme had been laid down to promote the nationwide development of an electric vehicle recharging network for a total of EUR 28 671 680. The programme, due to take effect after the annual update of the PNIRE in 2015, would be covered by the Fund referred to in Article 17-*septies*(8) of Chapter IV-*bis* of Law No 134 of 7 August 2012. It was approved by the Prime Minister with the Decree of 26 September 2014 following a proposal from the Ministry of Infrastructure and Transport.

Decree of 10 June 2015[70]. The Decree of the Ministry of Infrastructure and Transport on 'Criteria and procedures for awarding grants for projects in the marine sector' defines the eligibility criteria for the 20-year, EUR 5 million budget available from 2015 under the 2015 Stability Law. The funding is intended for research and development projects designed to improve products and processes launched or in the process of being launched in the marine sector.

2016 Stability Law and Environmental Attachment. The Stability Law[71] for 2016 introduced measures for maritime and rail intermodality, with contributions to combined road-sea transport (EUR 138.4 million in total, 2016-2018), contributions to combined road-rail transport (EUR 60 million in total, 2016-2018), resources for tourist cycle paths (EUR 91 million, 2016-2018) and to upgrade the local public transport fleet for 2019-2022 (EUR 430 million), in addition to incentives for purchasing goods vehicles for road transport.

The 'Environmental Attachment'[72] lays down measures for sustainable mobility by introducing a national pilot scheme for sustainable mobility to and from school and work with a budget of EUR 35 million. Under the law, project funding will be available for municipalities with a population of more than 100 000 inhabitants. There are also plans to convert a disused railway line in Emilia-

[68] The cities with the highest number of electric vehicle recharging points are Milan (390, mostly within the car-sharing network), Rome (112), Florence (50), Pisa (47), Brescia (36) and Siena (33); all of them apart from Rome (due to its size) have a recharging point every 10 km^2.

[69] Allocation of resources to Regions and Autonomous Provinces from the Fund referred to in Article 17-*septies*(8) of Decree-Law No 83 of 22 June 2012, on 'Urgent measures for national growth', converted into Law No 134 of 7 August 2012.

[70] Criteria and procedures for awarding grants for projects in the marine sector.

[71] Law No 208 of 28 December 2015, Provisions for drawing up the annual and multiannual state budget.

[72] Law No 221 of 28 December 2015 on Environmental provisions to promote green economy measures and curb the excessive use of natural resources.

Romagna into a walking and cycling route (which received EUR 5 million in 2016) and to appoint mobility managers in all schools.

2017 Stability Law

By means of the 2017 Stability Law, the Government launched a large-scale financing plan to upgrade the fleet of road vehicles used for local public transport for the period 2019-2033. The fund's budget was increased to allow the purchasing, electrical retrofitting or chartering of local and regional public transport vehicles. A total of EUR 3.7 billion was set aside for this purpose.

This was in addition to the resources previously set aside in the Stability Laws for 2015 and 2016, representing a total of around EUR 4.2 billion.

3.5.2.2 Structural Funds

Infrastructure Operating Plan 2014-2020 (Development and Cohesion Fund)

The Infrastructure Operating Plan was approved in April 2017. It includes six areas of intervention, which together total around EUR 11.5 billion. The following resources have been earmarked for sustainable mobility:

- EUR 2 billion for rail sector projects;
- EUR 1.2 billion for the metropolitan plan aimed at the construction and completion of new subway and rapid mass transport lines and improvements to services and vehicles (21 projects, from Piedmont to the Islands).

ERDF ROP 2014-2020 programming

Table A.15 in the Appendix lists the six regional calls issued to date. In total, more than EUR 78 million has been set aside.

2007-2013 programming

Table A.16 in the Appendix illustrates the current status of projects relating to the different EU programmes: some are still in progress and, as mentioned, a detailed assessment will be carried out of the energy savings achieved for those that began after 2014. In total, 419 projects have been financed, involving public funding totalling more than EUR 7.7 billion.

3.5.3 Energy savings achieved

Eco-incentives 2007-2009. Vehicles registered in the period 2007-2009, with lower average CO_2 emissions than the prevailing trend due to eco-incentives and covering almost 100 000 km in 2014, yielded final energy savings of 0.19 Mtoe (0.21 Mtoe of primary energy).

Regulation No 443 In 2014, vehicle sales began to recover (1.36 million, +4 % on 2013, which had the lowest number of vehicle registrations in the last three decades), followed by steady growth in 2015 (1.57 million, +15.75 % on 2014) and 2016 (1.82 million, +15.82 % on 2015).

The weighted average carbon dioxide emissions of vehicles registered in Italy has fallen steadily in recent years. The target of 130 g/km set for 2015 was reached in 2011: in 2016, the average declined even further, to 112.7 g/km[73]. This reduction is mainly due to more efficient diesel engines, rather than the increased penetration of electric vehicles or vehicles with lower CO_2 emissions (methane gas and LPG).

[73] UNRAE, UNRAE Book 2016.

After falling sharply from the 2000s onwards, the decline in average driving distances levelled out in 2015: 9 800 km/year for petrol cars, 18 300 km/year for diesel cars[74].

All these factors result in overall savings due to vehicles registered from 2010 to 2016 (more than 11 million) of 1.24 Mtoe of primary energy (1.36 Mtoe of primary energy).

Regulation No 510 After falling to a record low in 2013 (92 000 vehicles), registrations of light commercial vehicles recovered in 2014 (107 000), followed by 2015 (125 000 vehicles) and 2016 (190 000 vehicles). With an assumed average distance of 25 000 km per vehicle per year, the final energy savings linked to vehicles registered in 2014 and 2015 amount to 11.47 ktoe (12.85 ktoe of primary energy). For 2016, these are estimated at 13.4 ktoe (15 ktoe of primary energy).

High-speed rail To estimate the energy savings generated by the introduction of high-speed rail services, traffic trends on competing air routes and motorway sections were examined, comparing them against the equivalent trend for rail traffic.

The analysis showed that since 2009, high-speed rail has been effective in capturing demand from the Rome to Milan, Naples to Milan and Naples to Turin air routes. The impact on the Rome to Bari, Rome to Bologna, Rome to Turin and Rome to Venice routes only became apparent later. However, the trend fluctuated as a result of countermeasures taken by the airlines to compete with rail transport, coupled with the economic crisis that weighed on demand for transport in general. In 2012-2013, these various factors meant that routes facing competition from high-speed rail were in line with the trend for other air traffic. In 2014, however, when there was a general upturn in air travel, high-speed rail *slowed* the recovery of competing services.

The effects of high-speed rail on motorway traffic are less apparent than those on air traffic. Compared with other routes, the sections of the A1 between Naples and Bologna have seen a more visible decline in traffic (from 2008 for the Naples-Rome section and from 2010 for the Rome-Bologna section). Yet this is not the case for traffic on the Bologna to Turin and Padua to Mestre sections, which seem more resistant to competition from the rail sector.

By combining the effects of modal transfer from air and road, the overall energy saving as at 2016 due to high-speed rail (calculated at the primary source) can be estimated at around 100 ktoe. Despite the gradual acquisition of traffic over time, the energy-saving benefits of high-speed rail are only increasing slowly because of ongoing efforts to improve the energy efficiency of air and road transport.

Overall summary In short, primary energy savings as at 2016 amount to more than 1.7 Mtoe/year, or around 1.56 Mtoe/year of final energy (Table 3.20).

Table 3.20 – Energy savings in the transport sector (primary energy, Mtoe/year), 2007-2016

Measure	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016*	Total
Vehicle eco-incentives 2007-2009	0.030	0.040	0.140	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.210**
Regulation (EC) No 443/2009				0.160	0.170	0.160	0.210	0.220	0.220	0.220	**1.360**
Regulation (EC) No 510/2011							0.003	0.013	0.013	0.015	**0.044**
High-speed rail		0.010	0.040	0.000	0.010	0.000	0.004	0.014	0.010	0.010	**0.098**
Total	**0.030**	**0.050**	**0.180**	**0.160**	**0.180**	**0.160**	**0.217**	**0.247**	**0.243**	**0.245**	**1.712**

* Estimate

Source: ENEA processing

[74] UNRAE, ibidem.

3.6 Promotion of efficient heating and cooling

3.6.1 Progress made in the implementation of the comprehensive assessment[75]

The development potential of high-efficiency cogeneration (HE CHP) and district heating (DH) was analysed by Region and Autonomous Province and is a benchmark for the integration and updating of regional energy and environmental plans (REEP).

The economic potential of high-efficiency CHP was found to be, given the current market and regulatory conditions, 49.1 TWh (4 224 ktoe) of useful heat. Compared with the overall production of useful heat from high-efficiency CHP in 2013, equivalent to 31.3 TWh (2 694 ktoe), the potential increase is 17.8 TWh (1 529 ktoe). Of this increase in useful heat from high-efficiency CHP, 61 % is linked to self-producing high-efficiency CHP plants in the industrial sector (10.8 TWh), 32 % from high-efficiency CHP plants in the service sector (5.8 TWh), and 6 % (1.2 TWh) from high-efficiency CHP plants operated by energy utilities involved in district heating. The residential sector has no economic potential under the current market conditions and technology costs (Figure 3.6).

Figure 3.6 – Comparison of the current level of useful heat production from HE CHP (2013) and its technical and economic potential (GWh) by end-use sector

Source: GSE

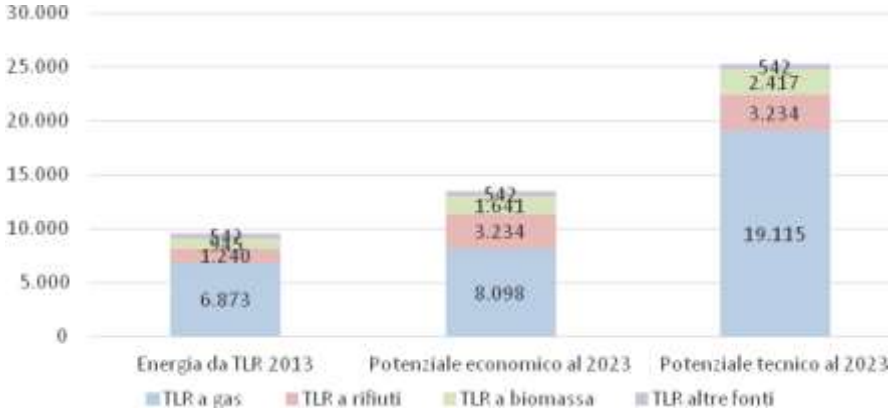
Calore CAR 2013	HE CHP heat 2013
Potenziale economico	Economic potential
Potenziale tecnico	Technical potential
Industria	Industry
Terziario	Tertiary
Residenziale	Residential
Utilities TLR e altro	Utilities, DH and other

In the district heating sector (Figure 3.7), the economic potential was determined to be 13.5 TWh (1 160 ktoe). Compared with the heat supplied by DH in 2013, which amounted to 825 ktoe, the potential increase through efficient district heating is estimated to be 335 ktoe. This potential

[75] The preparation of the comprehensive assessment was entrusted to GSE, as provided for in Article 10(1) of Legislative Decree No 102/2014 and according to the strategic policies of the Ministry of Economic Development. GSE worked closely with the Regions to share data and results at a local level, and other collaborations were also necessary to deepen various aspects of the sectors analysed (including RSE, ENEA, AIRU and AEEGSI).

increase in energy from district heating is based on the production of heat from natural gas, which contributes 1 225 GWh (or 105 ktoe, of which 84 ktoe from cogeneration), biomass exploitation, which contributes 696 GWh (60 ktoe), and waste-to-energy, which contributes a further 1 994 GWh (171 ktoe).

Figure 3.7 – Comparison of the current level of energy from DH (2013) and its technical and economic potential (GWh) by source



Source: GSE

Energia da TLR 2013	Energy from DH 2013
Potenziale economico al 2023	Economic potential by 2023
Potenziale tecnico al 2023	Technical potential by 2023
TLR a gas	Gas DH
TLR a rifiuti	Waste DH
TLR a biomassa	Biomass DH
TLR altre fonti	DH – other sources

3.6.1.1 Support measures for high-efficiency cogeneration

Owners of a cogeneration unit may apply for HE CHP certification, in accordance with Legislative Decree No 20/2007 as supplemented by the Ministerial Decree of 4 August 2011, and for access to the white certificates support scheme if necessary, as provided for by the Ministerial Decree of 5 September 2011[76].

[76] Legislative Decree No 20 of 8 February 2007 implementing Directive 2004/8/EC introduced the criteria for the definition of high-efficiency cogeneration, based on the thresholds of the Primary Energy Saving parameter (PES>10 % for installations >=1 MWe, PES>0 for installations <1 MWe). The operational procedures for HE CHP certification and the data needed to calculate the PES are described in the Ministerial Decree of 4 August 2011, which incorporates Legislative Decree No 20 of 8 February 2007 and explains the necessary calculation parameters and methodologies. The Ministerial Decree of 4 August 2011 was partially updated by Commission Delegated Regulation (EU) 2015/2402 of 12 October 2015, both in terms of calculation methodology and efficiency reference values for calculating PES. This update took effect on 1 January 2016. Article 10(15) of Legislative Decree No 102 of 4 July 2014 implementing Directive 2012/27/EU on energy efficiency states that 'any form of public support for cogeneration is subject to the electricity produced originating from high-efficiency cogeneration and the waste heat being effectively used to meet an economically justifiable demand'.

The main benefits of high-efficiency cogeneration under current legislation are:

- priority dispatch of electricity from cogeneration compared with electricity produced by conventional sources[77];
- the ability to access the net metering service for electricity produced by high-efficiency cogeneration plants with a rated power of up to 200 kW[78];
- the possibility of applying simplified economic and technical conditions for connection to the electricity grid[79];
- the possibility of obtaining a higher tariff for plants using renewable energy sources[80];
- the possibility of incentives for net electricity produced in high-efficiency cogeneration, fed into the grid from biomethane power plants.

Certified high-efficiency cogeneration units are also eligible for the white certificates mechanism[81]: there was a 73 % increase in the number of applications submitted in the period 2013-2016, rising from just over 900 to more than 1 500. The phenomenon is mainly due to:

- existing plants that have taken advantage of the opportunity to access benefits for cogeneration plants;
- new plants that have become operational;
- entry into force of legislation for the recognition of subsidised tariffs for the variable portion of general system charges (SEU and SEESEU).

Table 3.21 gives a breakdown of the savings achieved during the period 2013-2015.

Table 3.21 – Savings achieved by HE CHP through the white certificates mechanism

	Generation capacity [MW]	Gross electricity [GWh]	High-efficiency E / Gross E [%]	Useful heat [GWh]	Savings [Mtoe]	Savings [%]
2013	13 087	55 019	47.5	31 331	1.23	-10.3
2014	13 155	51 937	48.6	31 551	1.2	-9.9
2015	13 309	55 055	57.4	35 061	1.56	-11.8

Source: GSE

3.6.1.2 National incentive measures for district heating

The regulatory, tax and incentive measures specifically for district heating (DH) are as follows.

- Article 22(4) of Legislative Decree No 28/2011 laid down the guarantee fund to support the implementation of district heating networks: the fund is endowed by a special levy (a percentage of RE and RET charges) applied to natural gas consumption, charged to end customers and paid bimonthly by distribution companies. Article 5(12) of Legislative Decree No 102/2014 broadened the fund's remit, extending its use to the promotion and implementation of energy services and energy efficiency improvements in publicly owned buildings.
- In accordance with the Ministerial Decree of 6 July 2012 on incentives for electricity from

[77] Legislative Decree No 79 of 16 March 1999, Article 11(4).
[78] Decision of the Authority No ARG/elt 74/08 of 3 June 2008, as amended.
[79] Decision of the Authority No ARG/elt 99/08.
[80] Premiums provided for by the Ministerial Decree of 6 July 2012, no longer present in the Ministerial Decree of 23 June 2016.
[81] In accordance with Article 6 of Legislative Decree No 20 of 8 February 2007, and in the manner specified by the Ministerial Decree of 5 September 2011. For more details on GSE's certification criteria for high-efficiency cogeneration plants, please use the following link: http://www.gse.it/it/Qualifiche%20e%20certificati/Certificati%20Bianchi%20e%20CAR/Riconoscimento%20CAR/Pages/default.aspx. Under the Ministerial Decree of 4 August 2016, sustainable bioliquid plants converted into high-efficiency cogeneration units are also eligible for this mechanism.

non-photovoltaic renewable energy sources, the production of energy by cogeneration plants connected to district heating and that entered into service before 31 December 2012, entitled to green certificates, is eligible for an incentive on net production for the remaining period of entitlement to green certificates after 2015, in addition to the revenues arising from optimal energy use[82].

- The aims of the National Energy Efficiency Fund laid down under Article 15 of Legislative Decree No 102/2014 and in the process of being issued include the implementation of district heating and cooling networks.
- DH qualifies for various tax benefits for heat production at civilian end users: the consumption of fuels used in cogeneration systems and in supplementary boilers directly connected to the same district heating network benefit from a lower rate of excise duty for industrial use (and the related share of the subsidised rate for electrical use)[83].
- The electricity produced by cogeneration plants serving district heating networks qualifies for priority dispatch in the national grid.
- DH heating networks are eligible for the white certificates incentive mechanism[84].

3.6.1.3 The role of HE CHP and DH in regional energy planning

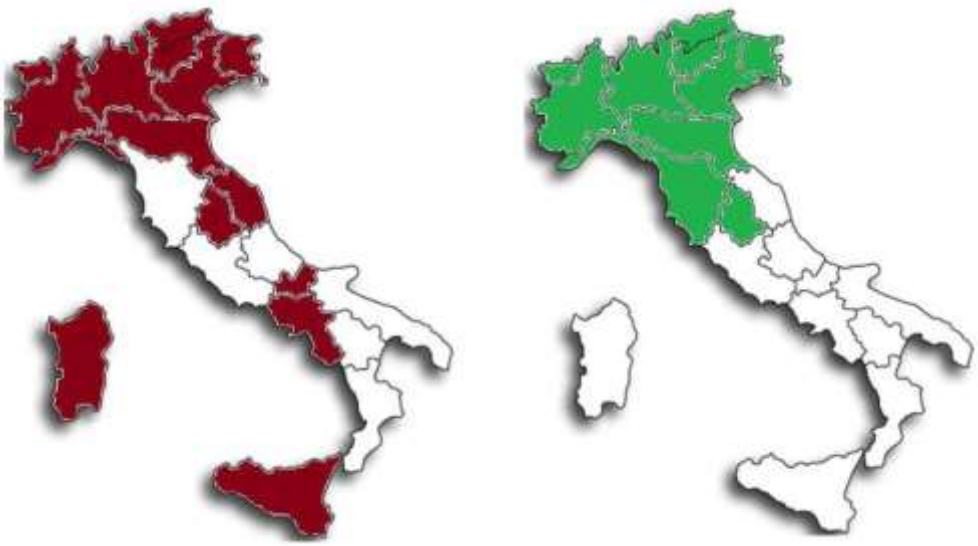
The measures taken by the various Regions – mainly the Regional Energy and Environmental Plans (PEAR), some of which have received the final approval from the Regional Assemblies, while others have been approved by the Regional Executives and opened for public consultation – show a broad distinction between those Regions that in recent years have significantly pushed forward the theme of cogeneration and district heating and those that have given a more marginal role to development scenarios for those technologies, or have outright failed to issue specific measures and guidelines on this issue (Figure 3.8).

[82] Green Certificates, as well as the premium for cogeneration associated with district heating, cannot be cumulated with incentives for energy efficiency and heat production (e.g. white certificates). The Ministerial Decree of 6 July 2012 also provides that the tariff applying to biomass systems using specific types of by-products, listed in the Decree, is to be increased by a premium of EUR 40/MWh if the cogenerated heat is used for district heating. Until the mid-2000s, some cogeneration plants were also eligible for a grant per kWh produced, in accordance with Decisions 15/89 and 34/90 of the Interministerial Committee on Prices. Other plants were eligible for CIP 6/92 grants.

[83] The subsidy is subject to certain conditions (high-efficiency cogeneration and electricity/heat ratio >10 %): if the criteria are not met, the consumption is subject to excise duty at the rate applicable for civil use.

[84] The certificates available to DH networks linked to HE CHP installations are calculated in the manner set out in the Ministerial Decree of 5 September 2011, which lays down the support scheme for high-efficiency cogeneration. As to the white certificates available to DH networks linked to non-CHP plants or to plants not considered in the Ministerial Decree, the applicable rules are those of Technical Sheet 22T: 'Application in the civil sector of district heating systems for space conditioning and domestic hot water production'.

Figure 3.8 – Regions for which the official documents include assessments of the potential for HE CHP (left) and DH (right)



Source: GSE

In particular, mapping the main regional data concerning this benchmark shows a clear propensity of northern regions to see HE CHP and especially DH as useful contributors to the diversification of energy supply, in particular in the residential and industrial sectors. This is clearly due to the specific climatic and socioeconomic characteristics of the northern regions, including the demand for heating and the existence of particular energy districts and hubs, coupled with the availability of the fuels used. In this respect, the report on the potential of HE CHP and DH is a valuable reference that the Regions and Autonomous Provinces can use to update and supplement existing energy and environmental plans[85].

3.6.2 Individual installations: results

Italy transposed the provisions of Article 14(5) and Part 2 of Annex IX to Directive 2012/27/EU in Article 10(7) and Annex 4 to Legislative Decree No 102/2014, by imposing the obligation to perform a cost/benefit analysis for operators proposing projects with requirements in compliance with those indicated in the Directive and not covered by the exemptions notified to the Commission. Thus far, the conditions for the application of this provision do not appear to have been met.

3.6.3 Individual installations: exemptions

In accordance with Article 14(6) of Directive 2012/27/EU, the Ministry of Economic Development has notified the European Commission of exemption from the cost/benefit analysis for the following types of individual installations:

- peak load and back-up electricity generating installations that are planned to operate under 1 500 operating hours per year as a rolling average over a period of five years;
- installations that need to be located close to a geological storage site approved in

[85] In the Regional Energy Plan to 2030 for Emilia-Romagna, approved by the Decision of the Regional Executive No 111 of 1 March 2017, the promotion of HE CHP and DH is also carried out on the basis of the potential application of high-efficiency cogeneration and efficient district heating, evaluated by the GSE under Legislative Decree No 102/2014.

accordance with Directive 2009/31/EC.

3.7 Energy transformation, transmission, distribution and demand response

3.7.1 Energy efficiency criteria in network tariffs and network regulation

To encourage the use of more efficient electrotechnology, the domestic electricity tariff is undergoing a review in a bid to reform the progressive consumption-based tariff.

AEEGSI Decision No 582/2015/R/EEL stipulates, inter alia, that the reform of network tariffs and tariff components covering general system charges for domestic electricity customers should be phased in gradually, in accordance with Article 11(3) of Legislative Decree No 102/2014. More specifically, it proposes a three-year transition period (2016-2018) with clearly defined stages[86].

On 1 January 2016, nearly 30 million Italian households began to be transferred to the new electricity tariff. This process will be completed on 1 January 2018. Thereafter, the tariff for energy transmission and meter management and for system charges – or around 40 % of the customer's bill – will be identical for each consumption level. The 'progressive structure', where prices per kWh increase with higher consumption, has been abolished. As a result, domestic electricity customers in Italy will more or less pay for the actual costs of the service they use. For example, the total cost shown on the bill for a residential customer on the Better Protection tariff – which will be available from 2018, once the reform becomes fully operational – will on average be composed 75 % of variable charges (i.e. the amount of electricity used) and 25 % of standing charges (per point and per kW of contract demand).

The difference compared with the previous progressive structure is that the proportion of standing charges on the electricity bill – i.e. charges not related to energy consumption – has increased for some customers. This is essentially because, until 2015, these standing charges were heavily subsidised for all households. For domestic residential customers, only the standing charge for electricity transmission and meter management will go up (on average 15 % of the total bill); this is one of the four main items that make up the bill.

For domestic non-residential customers, the increase in standing charges will be higher because it will cover two of the four main items on the bill: not only the tariff for electricity transmission and meter management, but also system charges (which on average make up 40 % of the total bill). Standing charges will also be proportionally higher for second homes, which are used less frequently and therefore have lower annual energy consumption than other vacant homes (for example, people travelling on business or living in student accommodation).

Conversely, the tariff reform only has a marginal impact on energy costs, which are mainly consumption-related and on average represent around 50 % of the bill. In this case, the percentage of the total bill made up of standing charges depends on both the level of consumption and the terms of the customer's contract.

The tariff reform will help to unlock the installation potential of energy-efficient electrical devices (such as heat pumps, electric cars and induction plates). Until 2015, these were hampered by

[86] Decision No 654/2015/R/EEL introduced contractually binding consumption levels with effect from 1 January 2017. These were more detailed than the previous consumption levels, enabling end customers to choose the right level for their personal needs. In addition, Decision No 782/2016/R/EEL (ratifying the 'Consolidated provisions for electricity transmission, distribution and metering services'), during the update for the first quarter of 2017, laid down the values of tariff components applied to low-voltage domestic customers to cover general system charges.

excessive usage charges due to the progressive nature of the tariff, with electricity consumption possibly replacing other energy carriers (gas, LPG or similar).

For low-income families, the Authority has designed a buffer to mitigate any negative impact of the reform. This instrument, which is already in force, is a discount on the bill guaranteed by the 'social bonus'[87].

3.7.2 Facilitating and promoting demand response

With 2G smart meters, 'Chain 1' is reinforced from the customer's meter to the supplier, which uses data validated by the distributor for billing purposes. 'Chain 2' is created from the meter installed directly with the customer (or third parties), with non-validated data that can be used by the supplier or other parties designated by the customer for information or energy efficiency services. The main purpose of the first part of the chain is to improve the performance of commercial activities and billing; for the second part of the chain, the aim is to monitor the energy footprint and offer innovative solutions (integrated with other services) where possible.

The benefits can be summarised as follows:

- increased billing accuracy (reduction of tail estimates) and therefore fewer complaints: the availability of validated 15-minute data that is closer to the point of consumption and available to the supplier daily allows prompt and continuous billing that is also more accurate, relying less on estimates and adjustments (except in an emergency, e.g. a malfunction);
- growth in sales opportunities (billing plans with time bands more suited to the needs of each end customer) and increased customer engagement; with 2G smart meters, it is possible:
  - for the seller to configure certain aspects of the meter (via the smart metering system managed by the distributor)[88];
  - to simplify reprogramming and changing of the time band structure;
- reduction in switching times and in the time it takes to issue a final invoice, improved customer satisfaction, verifiable data and fewer disputes:
  - option of switching mid-month based on actual data;
  - immediate availability of meter readings for the final invoice;
  - prolonged availability on the meter display of the meter reading corresponding to the switching date;
- more customer control over spending (residual kWh display); option of choosing specific billing plans (e.g. for second homes or consumption during particular periods);
- lower consumption, changes in electricity usage patterns, greater awareness of the range of products and services; this is possible due to:
  - non-validated data available in real time (via Chain 2);
  - real-time direct feedback (using special devices, websites or smartphones) and indirect feedback (consumption analysis);
  - choice of new service plans based on an analysis of meter readings (products and services with carbon footprint measurement);
  - interest among end customers and other actors (third parties or service providers).

[87] This was introduced by the Government and implemented by the Authority in partnership with local municipalities, lowering energy costs for large families and families facing financial and physical hardship. For more information, see: http://www.autorita.energia.it/it/bonus_sociale.htm.

[88] More specifically, the supplier can define up to six daily differentiated price bands (with the aggregate total displayed on the screen) and adjust the contractual parameters (e.g. data confidentiality or access to data 'frozen' at the billing date to make bills easier to check).

Ultimately, due to the simplification of system processes and the consequent reduction in costs passed on to the customer, the role of the consumer is more important (as is quality of service). The growth in active demand is linked to increased observability of the network, unexpected changes in demand curves and voltage events (such as outages), the efficiency of processes involving different actors (such as dispatching and settlement) and, in the future, both the uptake of home automation systems and the activation of demand response contracts, with the possibility of fast remote load shedding and the ability for offtake customers to offer balancing resources.

3.7.3 Energy efficiency in network design and regulation

3.7.3.1 Electricity network

The electricity network development plan plays an increasingly important role, particularly when it comes to energy efficiency. This is mainly due to:

- the reduction in network losses;
- better use of generation resources by shifting production quotas from less efficient plants (necessary to meet network constraints) to more efficient plants that run on cleaner energy (such as gas).

The reduction of transmission system losses leads to lower electricity production at Italy's power plants, with a consequent reduction in CO_2 emissions from thermoelectric generation. The entry into service of the main development measures set out in the TERNA annual development plan will reduce network losses. By estimating the percentage of losses from primary sources (including renewables), and based on specific emission coefficients, the decrease in CO_2 emissions due to the reduction in network losses can be calculated[89]. Table 3.22 contains TERNA estimates of the impact of loss reduction (GWh/year and tCO_2/year).

Table 3.22 – Energy savings from the reduction of network losses (GWh/year and tCO_2/year)

Year	Savings from reduced losses (GWh/year)	Savings from reduced losses (tCO_2/year)
2014	1 100	400-500 000
2015	1 100	400-500 000
2016	1 650	600-700 000
2017	830	500-600 000

Source: TERNA

3.7.3.2 Natural gas network

Through continuous monitoring and specialised gas recovery measures, such as using specific technology to reduce losses from pneumatic equipment, significant quantities of natural gas can be recovered, leading to lower greenhouse gas emissions from plants. Table 3.23 shows the natural gas recovered by Snam through improvements to its network.

Table 3.23 – Energy savings and emissions avoided due to improvements carried out on

[89] The increased efficiency in thermoelectric plant operation resulting from the main measures to improve the national grid is calculated from results obtained in operational simulations of the electrical system. The main technical constraints modelled in this analysis include, in addition to the system's energy balance and the characteristic limits of generation units, exchange limits between market zones. The network modelling thus allows scenarios to be simulated that represent different stages of completion of network development measures. Specifically, it compares the dispatching obtained in two situations, one characterised by the higher exchange limits expected due to the completion of the measures planned, and the other characterised by current exchange limits. Based on this analysis, TERNA has calculated that reducing congestion within zones will lead to less efficient installations being replaced by more efficient production plants.

the gas network (Mmc, toe and tCO_2eq)

Year	Natural gas recovered (Mmc)	Natural gas recovered (toe)	Emissions avoided (tCO_{2eq})
2014	3.0	2 457	52 500
2015	3.6	2 948	63 600
2016	4.5	3 685	77 780

Source: Snam

3.7.4 Financing

3.7.4.1 Structural Funds

ERDF NOP and ROP 2014-2020 programming

Table A.17 in the Appendix lists the two regional calls issued to date. In total, more than EUR 84 million has been set aside.

2007-2013 programming

Table A.18 in the Appendix illustrates the current status of projects relating to the different EU programmes: some are still in progress and, as mentioned, for those that began after 2014, a detailed assessment will be carried out of the energy savings achieved. Overall, 155 projects have been financed, involving public funding totalling around EUR 336 million.

3.8 Overview of resources available from the Structural Funds

Between December 2014 and December 2015, the European Commission adopted all ROPs submitted by Italy, both at the national and regional level. As a result, the 2014-2020 programming was fully operational from 1 January 2016. A Steering Committee was set up within the Prime Minister's Office[90] for the purpose of programming the Development and Cohesion Fund 2014-2020.

For the 2014-2020 programming cycle, of a total budget of EUR 26 billion, it is estimated that the Regional Operational Programmes of the European Regional Development Fund (ERDF-ROP) have allocated approximately EUR 2.5 billion in total for energy savings and energy efficiency measures, sustainable urban development, decarbonisation and intelligent transport systems[91]. Table 3.24 gives details of the two calls issued to date: as at April 2017, 69 calls had been launched, involving around EUR 900 million of allocated resources, most of which was earmarked for businesses (approximately half of resources) and measures taken for public buildings (more than one third).

[90] Prime Ministerial Decree of 25 February 2016 laying down a Steering Committee pursuant to Article 1(703)(c)of Law No 190 of 23 December 2014 (Stability Law 2015) The Steering Committee acts as a discussion forum for the State, Regions, Autonomous Provinces of Trento and Bolzano and Metropolitan Cities, in order to define operational plans for each national thematic area. The operational plans must contain an indication of the expected results and actions and the individual measures needed to achieve them, the related financial estimate, the national and regional implementing bodies, the time frame for implementation and the monitoring arrangements, as well as the annual statement of financial requirements, for the three years following the 2014-2020 programming period, in line with the equivalent budget decided for each national thematic area.

[91] Table A.19 in the Appendix provides a summary of the resources allocated at the regional level. Table A.20 lists, for each Region, the ERDF priority axes approved by the European Commission in relation to energy efficiency and the corresponding actions and funding. Lastly, Tables A.21-A.28 detail the progress of projects financed during the 2007-2013 programming cycle under each funding programme.

Table 3.24 – 2014-2020 Structural Funds: calls issued and resources allocated (EUR), by sector

Sector	No of calls	Amount awarded (EUR)	Amount awarded (EUR)
Public sector	23	316 790 791	35 %
Industry	38	416 369 257	47 %
Smart grid	2	83 900 000	9 %
Transport	6	78 257 294	9 %
Total	**69**	**895 317 343**	**100 %**

Source: Regions and Autonomous Provinces

Table 3.25 provides an overview of the situation for the 2007-2013 programming cycle, with more than EUR 9.2 billion of public funding allocated to 3 250 projects involving energy efficiency measures.

Table 3.25 – National, Interregional and Regional Operational Programmes: projects funded and completed and related resources available, 2007-2013 programming cycle

Programme	No of projects	Public funding (€)	Commitments (€)	Total payments (€)
ERDF 'Networks & Mobility' Convergence NOP	14	428 409 631	341 015 811	254 571 554
DCF Special Implementation Programmes – Rail Routes	6	2 754 000 000	168 315 540	134 744 637
Cohesion and Action Plan (CAP) Programme	131	299 994 383	150 636 648	99 714 987
DCF Regional Implementation Programme (PAR)	161	976 306 221	980 310 895	646 545 658
DCF Regional Implementation Programme (PAR)	5	143 167 338	120 344 763	8 710 786
ERDF Convergence ROP	652	3 036 968 059	2 547 629 523	1 597 008 888
ERDF ROP – Regional Competitiveness and Employment	2 025	965 450 323	930 283 238	855 481 293
Interregional Operational Programme (IOP) for 'Renewable energy and energy saving'	256	626 062 537	608 381 031	562 676 841
Total	**3 250**	**9 230 358 492**	**5 846 917 449**	**4 159 454 644**

Source: ENEA processing of data from the Prime Minister's Office (www.opencoesione.gov.it/)

To reduce energy consumption by 2020, for the 2007-2013 programming cycle, the energy savings achieved from the 1 300 or so projects launched since 2014 will be estimated. For the 2014-2020 programming cycle, the results of the various calls issued locally will be monitored; for these, the current status as at April 2017 is shown.

APPENDIX

Table A.1 – White certificates: electricity distributors subject to the obligation in 2016

Distributor (company name)	GWh distributed in 2014	Mandatory quota (%)	EECs
AIM Servizi a Rete Srl	446.38	0.20 %	10 534
A2A Reti Elettriche SpA	8 876 91	4.01 %	209 480
ACEA Distribuzione SpA	10 294.13	4.64 %	242 924
AcegasApsAmga SpA	817.01	0.37 %	19 280
AEM Torino Distribuzione SpA	3 700.83	1.67 %	87 333
AGSM Distribuzione SpA	1 141.27	0.51 %	26 932
ASM Terni SpA	326.77	0.15 %	7 711
Azienda Energetica Reti SpA	1 009.18	0.46 %	23 815
Deval SpA	574.72	0.26 %	13 562
Enel Distribuzione SpA	189 430.03	85.47 %	4 470 225
Hera SpA	2 130.54	0.96 %	50 277
Selnet Srl	962.04	0.43 %	22 703
Set Distribuzione SpA	1 916.4	0.86 %	45 224
Total	**221 626.21**		**5 230 000**

Source: GSE

Table A.2 – White certificates: gas distributors subject to the obligation in 2016

Distributor (company name)	GJ distributed in 2014	Mandatory quota (%)	EECs
2i RETE GAS SpA	192 869 515.04	19.56 %	837 090
AIM SERVIZI A RETE Srl	5 981 459.44	0.61 %	25 961
ASA - AZIENDA SERVIZI AMBIENTALI SpA	3 042 244.00	0.31 %	13 204
A2A RETI GAS SpA	63 457 014.55	6.43 %	275 415
ACAM GAS SpA	3 619 975.24	0.37 %	15 711
ACEGASAPSAMGA SpA	27 406 944.56	2.78 %	118 951
ACSM-AGAM RETI GAS-ACQUA SpA	12 555 954.82	1.27 %	54 495
AEMME LINEA DISTRIBUZIONE Srl	7 065 383.00	0.72 %	30 665
AGSM DISTRIBUZIONE SpA	12 138 932.59	1.23 %	52 685
AMG ENERGIA SpA	3 193 924.00	0.32 %	13 862
AMGAS SpA	1 464 807.28	0.15 %	6 358
AS RETIGAS Srl	8 741 596.94	0.89 %	37 940
ASCOPIAVE SpA	23 964 940.01	2.43 %	104 012
AZIENDA MUNICIPALE DEL GAS SpA	3 530 826.71	0.36 %	15 324
Centria Srl	25 163 954.35	2.55 %	109 216
DOLOMITI RETI SpA	9 873 333.00	1.00 %	42 852
EDISON DG SpA	9 658 110.24	0.98 %	41 918
EDMA RETI GAS Srl	5 846 564.37	0.59 %	25 375
EGEA ENTE GESTIONE ENERGIA E AMBIENTE SpA	3 800 344.37	0.39 %	16 494
EROGASMET SpA	12 024 447.27	1.22 %	52 188
GEI GESTIONE ENERGETICA IMPIANTI SpA	10 684 564.03	1.08 %	46 373
GAS NATURAL DISTRIBUZIONE ITALIA SpA	11 671 172.87	1.18 %	50 655
GAS PLUS RETI Srl	5 156 716.08	0.52 %	22 381
GENOVA RETI GAS	12 789 094.04	1.30 %	55 507
GESAM SpA	5 419 898.59	0.55 %	23 523
GRITTI GAS RETE Srl	6 349 545.70	0.64 %	27 558
HERA SpA	70 981 152.34	7.20 %	308 071
IRETI SpA	30 317 950.77	3.07 %	131 585
LARIO RETI GAS Srl	6 088 719.15	0.62 %	26 426
LINEA DISTRIBUZIONE Srl	22 403 072.14	2.27 %	97 233
MARCHE MULTISERVIZI SpA	4 748 219.61	0.48 %	20 608
MEDITERRANEA ENERGIA	1 513 167.75	0.15 %	6 567
NAPOLETANA GAS SpA	20 128 392.22	2.04 %	87 361
NUOVENERGIE DISTRIBUZIONE Srl	3 777 229.00	0.38 %	16 394
PASUBIO DISTRIBUZIONE GAS Srl UNIPERS.	3 810 615.14	0.39 %	16 539
PESCARA DISTRIBUZIONE GAS Srl	2 278 474.06	0.23 %	9 889
PREALPI GAS Srl	4 412 920.00	0.45 %	19 153
RETIPIU' Srl	11 784 024.53	1.19 %	51 145
SIDIGAS SpA	2 750 641.90	0.28 %	11 938
SIME SpA	7 052 855.70	0.72 %	30 611
SALERNO ENERGIA DISTRIBUZIONE	1 638 958.00	0.17 %	7 113
SGR RETI SpA	9 680 815.00	0.98 %	42 016
SOCIETA' ITALIANA PER IL GAS PA - ITALGAS	249 607 929.50	25.31 %	1 083 345
TEA SEI Srl	4 330 684.70	0.44 %	18 796
TOSCANA ENERGIA SpA	34 255 712.00	3.47 %	148 676
UMBRIA DISTRIBUZIONE GAS SpA	1 862 573.00	0.19 %	8 084
UNIGAS DISTRIBUZIONE Srl	5 238 698.58	0.53 %	22 737
Total	986 134 068.18		4 280 000

Source: GSE

Table A.3 – Summary of key project data for approved multi-utility smart meters

Proponent	Area	Total metering points	Third-party operator	Other partners	AEEGSI regulated services	AEEGSI unregulated services
AES Torino SpA	Turin	4 002	• Iren Servizi • Innovazione SpA	• AEM Torino Distribuzione SpA • SMAT Torino SpA	• Gas distribution • Electricity distribution • Water services	• District heating • Environmental sensors • Public lighting • Fire hydrants
AGSM Distribuzione SpA	Verona	4 710	AGSM Lighting Srl	• AGSM Verona SpA • Acque Veronesi Scarl • Digicom SpA • Terranova Srl • Aragon Partners Srl	• Gas distribution • Electricity distribution • Water services	• District heating • Public order • Public lighting • Fire hydrants
AM GAS SpA	Bari	10 297	Enel Distribuzione SpA	• Acquedotto pugliese SpA • Municipality of Bari	• Gas distribution • Electricity distribution • Water services	• District heating • Water smart grid • Public lighting • Energy management
ASEC	Catania	9 390	• Telereading • Telecom Italia • Hewlett Packard	• Sidra • Acoset • Municipality of Catania	• Gas distribution • Electricity distribution • Water services	• Public lighting • Disabled parking • Landfill sites
Hera SpA	Modena	13 364	Acantho SpA (Hera Group)		• Gas distribution • Electricity distribution • Water services	• District heating • Environmental health – Waste collection
IREN Emilia Genova Reti Gas	Reggio Emilia Scandiano Parma Genoa	16 126	Telecom Italia	• Mediterranea delle Acque • Iren Energia • RE: Lab • DQuid • Interuniversity Consortium ICOOR	• Gas distribution • Electricity distribution • Water services	• District heating • Environmental health – Waste collection • Public lighting
ISERA Srl	Isera and six small mountain villages	3 607	CPL CONCORDIA	CEDIS	• Gas distribution • Electricity distribution • Water services	• Remote control of hydrogen production plant • Remote control of photovoltaic installation • Remote control of public lighting system • Home display
SEDs	Salerno	2 520	Business solution	• Salerno sistemi • Sinergia • Salerno Mobilità • Salerno Solidale	• Gas distribution • Water services	• Remote control of municipal heating systems and electric sub-metering • Remote management of public car parks • Helpline

Source: AEEGSI

Table A.4 – ISO/IEC 17021 accredited certification bodies issuing ISO 50001

Accredited certification bodies	Year of accreditation
ANCIS Srl	2014
Bureau Veritas Italia SpA	2013
CERTIQUALITY Srl	2010
CSQA Certificazioni Srl	2014
DNV GL Business Assurance Italia Srl	2011
ICIM SpA	2011
IMQ SpA	2011
KIWA CERMET Italia SpA	2011
RINA Services SpA	2013
SGS Italia SpA	2011
SQS	2013
TÜV Italia Srl	2016
IGQ	2016

Source: ISNOVA

Table A.5 – ISO/IEC 17024 accredited certification bodies issuing UNI CEI 11339

Accredited certification bodies	Year of accreditation	Year of accreditation (energy management expert)
AICQ SICEV Srl	1994	2015
AJA Registrars Europe Srl	2013	2015
APAVE ITALIA CPM Srl	2012	2016
Bureau Veritas Italia SpA	2010	2015
CEPAS Srl	1996	2015
DEKRA Testing and Certification Srl	2013	2016
ENIC Srl	2013	2013
FIRE-SECEM	2012	2012
ICIM SpA	2012	2014
ICMQ SpA	2012	2015
KHC – Know How Certification Srl	2003	2013
KIWA CERMET Italia SpA	2013	2014
RICEC	2015	2015
RINA Services SpA	2001	2015
SACERT	2009	2015
TÜV Italia Srl	2012	2013

Source: ISNOVA

Table A.6 – ISO/IEC 17065 accredited certification bodies issuing UNI CEI 11352

Accredited certification bodies	Year of accreditation	Year of accreditation (energy management expert)
ABICERTSas di Bianco Antonio & C.	2016	2016
AJA Registrars Europe Srl	2013	2016
ANCIS Srl	2015	2016
Bureau Veritas Italia SpA	1999	2015
CERTIQUALITY Srl	2002	2016
CSQA Certificazioni Srl	1998	2016
DASA RAGISTER SpA	2015	2016
DEKRA Testing and Certification Srl	2013	2016
DIMITTO Italia Srl	2015	2016
DNV GL Business Assurance Italia Srl	2000	2016
IAS Register AG	2016	2016
ICIM SpA	1999	2015
ICMQ SpA	1997	2016
IMQ SpA	1993	2016
KHC – Know How Certification Srl	2015	2016
KIWA CERMET Italia SpA	2003	2016
NEXOS Srl	2007	2016
RINA Services SpA	1991	2016
SGS Italia SpA	2000	2015
SQS – Swiss Association for Quality and Management	2016	2016
TÜV Italia Srl	2012	2016
TÜV NORD Italia Srl	2014	2016
TÜV Rheinland Italia Srl	2015	2016

Source: ISNOVA

Table A.7 – Financing of horizontal measures: Structural Funds 2007-2013 programming period, current status by programme and type

Programme	Type	Project status	No of projects	Total public funding	Commitments	Total payments
Cohesion and Action Plan (CAP) Programme	Horizontal measures in the public sector	Ongoing	22	6 553 548	6 553 548	3 925 386
		Liquidated	1	153 963	153 963	148 831
ERDF ROP – Convergence	Horizontal measures in the public sector	Ongoing	42	23 137 117	13 833 614	9 403 423
		Concluded	3	2 317 002	1 941 007	1 923 461
		Liquidated	7	2 763 211	2 742 196	2 733 737
	Jessica Fund	Concluded	9	106 706 954	106 706 954	106 706 954
		Liquidated	2	120 711 984	120 711 984	120 711 984
ERDF ROP – Regional Competitiveness and Employment	Horizontal measures in the public sector	Ongoing	39	42 262 032	19 290 172	14 222 999
		Concluded	145	9 024 972	9 582 815	8 743 315
		Liquidated	8	1 844 647	1 852 767	1 717 302
	Horizontal measures in the private sector	Ongoing	1	16 173	12 378	12 378
		Concluded	14	649 599	626 559	626 454
	Horizontal measures in industry	Ongoing	20	4 215 044	3 215 244	3 106 735
		Concluded	39	5 516 113	5 562 060	5 561 566
	Incentives for businesses and individuals	Ongoing	34	1 633 099	1 633 099	1 242 599
		Concluded	154	9 502 893	9 563 854	9 487 916
		Liquidated	101	27 065 419	26 985 419	26 950 738
	Incentives for public bodies	Ongoing	3	56 431	22 708	22 708
		Concluded	23	347 432	267 721	257 345
		Liquidated	48	5 999 188	5 645 938	5 637 589
	Revolving energy efficiency fund	Liquidated	1	1 918 972	1 918 972	1 918 972
	Jessica Fund	Liquidated	2	80 100 000	80 100 000	80 100 000
	Information and training	Concluded	12	48 092	48 092	48 092
		Liquidated	25	443 494	473 744	473 710
Interregional Operational Programme (IOP) 'Renewable energy and energy saving'	Business incentives	Concluded	1	67 000 000	67 000 000	67 000 000
	SME guarantee fund	Ongoing	1	52 000 000	34 000 000	34 000 000
	Communicating on energy efficiency	Ongoing	2	30 887 326	30 887 326	23 234 035
	Horizontal measures in the public sector	Ongoing	2	1 096 696	1 096 696	948 635
		Concluded	25	13 181 692	13 181 692	13 116 646
		Liquidated	16	2 054 483	2 054 483	2 028 581
		Total	**802**	**619 207 576**	**567 665 005**	**546 012 091**

Source: ENEA processing of data from the Prime Minister's Office (www.opencoesione.gov.it/)

Table A.8 – Financing of building measures: Structural Funds 2007-2013 programming period, current status by programme and type

Programme	Type	Project status	No of projects	Total public funding	Commitments	Total payments
DCF Regional Implementation Programme (PAR)	Residential	Ongoing	1	820 000	820 000	524 638
ERDF ROP – Regional Competitiveness and Employment	Industrials	Ongoing	1	195 692	195 692	178 508
		Concluded	14	1 375 366	1 375 366	1 375 366
	Residential	Ongoing	17	7 810 062	7 134 786	6 266 400
		Concluded	1	306 079	306 079	309 892
		Liquidated	3	622 800	622 800	609 046
	Commercial	Concluded	15	783 751	774 641	774 641
		Total	**52**	**11 913 751**	**11 229 364**	**10 038 491**

Source: ENEA processing of data from the Prime Minister's Office (www.opencoesione.gov.it/)

Table A.9 – Recently approved regional energy and environmental plans

Region	Description	Objectives	Strategies	Type of measure/financing	Funds
Emilia-Romagna	Regional energy plan and summary document	Axis IV – Building, urban and territorial status	- Exemplary role of the public sector - Upgrading of schools - Sustainable procurement	- Grant - Guarantee - Subsidised-rate loans - Regulation	ERDF ROP 2014-2020
Friuli-Venezia Giulia	Regional Environmental and Energy Plan	Fiche 10 – Increasing energy efficiency in the public sector	- Creation of an energy register of public buildings - Establish an order of priority for funding for local councils and public authorities in the energy savings and efficiency sector - Obligatory three-year plan for the public administration for the refurbishment of public buildings	- Public lighting projects - Energy efficiency in public buildings	- National Energy Efficiency Fund - Structural Funds - ESCOs - White certificates
Friuli-Venezia Giulia	Regional Environmental and Energy Plan	Fiche 12: ESCOs (Energy Service Companies)	12c Provide incentives through tax relief, cumulable with EECs, for the replacement of industrial machinery (motors and inverters) with the minimum performance requirements	Incentives through tax relief, cumulable with EECs	Regional funding
Friuli-Venezia Giulia	Regional Environmental and Energy Plan	Fiche 20: Encourage the most efficient use of energy outputs in cogeneration (thermal, electrical and cooling)	20A Use forms of subsidised credit to foster the development of small cogeneration plants to make maximum use of local resources (biomass) and maximise plant efficiency with the recovery of process heat	Subsidised credit	Regional funding
Friuli-Venezia Giulia	Regional Environmental and Energy Plan	Fiche 24: Help to reduce greenhouse gases in the sector	– 24a Introduce the energy audit for existing buildings by establishing registers of professionals at professional bodies, or of ESCOs accredited for their operational and financial viability, which perform an initial assessment free of charge or at subsidised rates, financed by the relevant regional fund, with the audit results entered in regional energy archives – 24b Introduce incentives for new and existing buildings to enhance energy performance, install renewable installations and micro-installations, or make greater use of renewable energy sources, in view of the required minimum threshold laid down in national legislation. In	Special regional fund and planning and building incentives	Regional funding

			addition, introduce an incentive mechanism for the conversion for residential purposes of former factories located within residential development zones. These may be planning and building incentives or targeted financial incentives. This measure would encourage the use of buildings that are currently empty, with a twofold benefit in terms of reducing land use and improving energy efficiency.		
Friuli-Venezia Giulia	Regional Environmental and Energy Plan	Fiche 30: Funding for credit guarantee consortia to improve energy efficiency in various sectors	30a Funding for credit guarantee consortia to facilitate energy efficiency improvements and to set up a working group composed of credit guarantee consortia and economic actors, with a view to optimising resources and guarantee procedures and developing the Region's renewable energy sector. Funding may also be extended to individuals and buying groups.	Funding for credit guarantee consortia to facilitate energy efficiency improvements	Regional funding
Lombardy	Regional Environmental and Energy Programme	Energy efficiency renovation of public buildings	- Accompanying actions for municipalities - Technical support - Financial support	- Grant - Subsidised loan - EPC - PPPs - ESCOs - Third-party financing - Regional energy efficiency fund	ERDF ROP 2014-2020
Marche	Regional Environmental and Energy Plan	13.1.2 Energy efficiency improvements in public buildings and public lighting	- Combined heat and power production - Public lighting - Energy efficiency in government buildings	Creation of revolving funds and/or regional guarantee funds	- ERDF ROP 2014-2020 - Thermal Energy Account 2.0 - White certificates
Marche	Regional Environmental and Energy Plan – PEAR 2020 (Administrative Decision of the Regional Legislative Assembly No 42/2016)	Reduce final energy consumption by 20 % by 2020	Energy efficiency renovation of public buildings and public lighting. Energy efficiency in production processes (industry, agriculture and fisheries) and services (transport, tourism and trade).	Non-repayable grant Revolving and/or guarantee funds	ERDF ROP 2014-2020 - Regional Development Plan 2014/2020
Apulia	Regional Environmental and Energy Plan - Update	Results for the period 2008-2012	-	-	-

Sardinia	Regional Environmental and Energy Plan 2015-2030	General objective 3 – Priority 3: energy efficiency of public buildings, including the use of natural and sustainable building materials and development of energy services (ESCOs)	- Promotion and incentivisation of systemic actions to improve the energy efficiency of government buildings - Coverage by 2020 of at least 15 % of heat consumption with renewable energy sources	- Energy audits of public buildings, schools, universities, hospitals - Regional energy data collection system for public buildings, to plan future actions	-
Tuscany	Regional Environmental and Energy Plan, Plan Attachments, Overview 1, Overview 2, Environmental Report	Objective A – Specific objective 2: to rationalise and reduce energy consumption	- Actions to increase the energy efficiency of public buildings (municipalities, provinces, local health authorities, hospitals) - Public lighting	- Tax relief - Structural Funds - Energy certification - Agreement with CET - Memorandum of understanding between the Region and GSE	- ERDF ROP – Regional Competitiveness and Employment - Underutilised Areas Fund - European Investment Bank
Umbria	Regional Environmental and Energy Strategy 2014-2020	Reduction of energy consumption in public buildings to improve efficiency	- Energy efficiency in public buildings - Lighting - Energy audits	- Incentives for public sector measures - Regional programme for improving the energy efficiency of public buildings - Partnership agreement between the Region, municipalities, ARPA and universities to implement municipal plans	- ERDF ROP - EAFRD - SEAP
Veneto	Regional Energy Plan	'Energy status of the public sector'	- Identification of provincial schools to undergo energy-saving improvements - Energy audits - Energy efficiency of public lighting	- Building envelope - Efficient air conditioning systems - Energy-efficient light bulbs - Lighting control and regulation systems - Low-flow dispensers	- SEAP - Economic contributions

Source: Regions and Autonomous Provinces

Table A.10 – Financing of public sector measures: Structural Funds 2014-2020 programming period, calls issued and amounts allocated by Region and Autonomous Province

Region	Description	Financial arrangements	Amount awarded (€)
Calabria	ERDF ROP 2014-2020. Call to encourage municipalities to adopt high-efficiency technological solutions to reduce energy consumption in public lighting networks.	Grant covering 100 % of eligible costs.	35 000 000
Emilia-Romagna	ERDF ROP 2014-2020, Axis IV, Investment priority 4c, Specific objective 4.1, Actions 4.1.1 and 4.1.2. Decision of the Regional Executive No 610 of 28 April 2016 laying down the procedures and criteria for the granting of aid to implement projects to upgrade the energy efficiency of public buildings and public housing.	Capital co-financing for a maximum of 30 % of eligible costs.	28 000 000
Friuli-Venezia Giulia	ERDF ROP 2014-2020 Invitation Line 3.1.B.1 Energy efficiency improvements to the Pordenone hospital district	Non-repayable grant for up to 100 % of eligible costs	9 000 000
Friuli-Venezia Giulia	ERDF ROP 2014-2020, Axis III. Line 3.1.A.1 Call for funding to reduce primary energy consumption in schools.	The minimum eligible cost may not be less than EUR 1 million and the maximum cost may not exceed EUR 3 000 000. Non-repayable grant for 100 % of eligible costs.	12 1333 397
Friuli-Venezia Giulia	ERDF ROP 2014-2020 Invitation Line 3.1.B.1 Invitation Energy efficiency improvements to the Trieste hospital district	Non-repayable grant for up to 100 % of eligible costs	6 000 000

Friuli-Venezia Giulia	ERDF ROP 2014-2020. Line 3.1.B.2 Invitation for the reduction of primary energy consumption in residential facilities for dependent elderly people in mountain areas	Non-repayable aid for 100 %, up to a maximum of EUR 1 million.	8 000 000
Friuli-Venezia Giulia	ERDF ROP 2014-2020, Axis III. Line 3.1.B.2 Call for the granting of funding to reduce primary energy consumption in residential facilities for dependent elderly people not located in mountain areas.	Non-repayable grant for 100 % of eligible costs, subject to a maximum of EUR 240 000 per facility with fewer than 20 beds and a maximum of EUR 12 000 per bed for 20 beds or more.	5 107 698
Lombardy	ERDF ROP 2014-2020, Axis IV, Action IV.4.C.1.1. Decision of the Regional Executive No X/3904 ratifying the initiative to upgrade the energy efficiency of public buildings owned by small municipalities, associations of municipalities, merged municipalities and Mountain Communities.	Non-repayable grant for up to 90 % of the project costs, subject to a maximum of EUR 250 000, payable in two instalments.	7 000 000
Lombardy	ERDF ROP 2014-2020. Call for improvements to the energy efficiency of public buildings owned by small municipalities, associations of municipalities, merged municipalities and Mountain Communities.	Non-repayable government grant for 90 % of the total eligible cost, in a maximum of two instalments. Maximum ceiling EUR 250 000.	11 087 787
Lombardy	ERDF ROP 2014-2020. Call for the granting of subsidies for the energy upgrade of public buildings (Regional Energy Efficiency Fund).	Minimum project size EUR 1 million. Subsidy composed of a non-repayable amount (30 % of costs) and a repayable amount (40 %), up to a maximum of EUR 4 900 000.	30 750 000
Lombardy	ERDF ROP 2014-2020, Axis IV. Decision of the Regional Executive No X/5737 of 24 October 2016 issuing a call for the incentivisation of measures for energy efficiency improvements to public lighting installations and the uptake of integrated technology services.	Non-repayable grant for 30 % of eligible costs. Maximum grant available of EUR 7 million, with a minimum project cost of EUR 500 000.	20 000 000
Marche	ERDF ROP 2014-2020 Axis IV 13.1.1A – 'Energy efficiency measures in healthcare facilities'	13.1.1A – 'Energy efficiency measures in healthcare facilities' Non-repayable grant for 39 % Revolving fund (40 %)	4 379 000.29 4 620 999.71
Marche	ERDF ROP 2014-2020 Axis IV Action 13.1.2.A – 'Energy efficiency measures in public buildings'	Non-repayable grant for 75 %	4 200 000.00
Marche	ERDF ROP 2014-2020 Axis IV Action 13.1.2.B – 'Energy efficiency measures in public buildings used for sport'	Non-repayable grant for 50 %	800 000.00
Marche	ERDF ROP 2014-2020 Axis IV Action 13.2.1 – 'Energy efficiency measures and use of renewable energy in public lighting'	Non-repayable grant for 75 %	1 385 006.40
Piedmont	ERDF ROP 2014-2020 Investment priority IV.4c, Objective IV.4c.1 Decision of the Regional Executive No 12/4568 of 16 January 2017 ratifying the measure fiche to reduce energy consumption in properties owned or used by the Piedmont Region.	Capital grant for 100 % of eligible costs.	10 000 000
Piedmont	ERDF ROP 2014-2020 Investment priority IV.4c, Objective IV.4c.1 Decision of the Regional Executive No 11/4567 of 16 January 2017 ratifying the measure fiche to reduce energy consumption in public facilities of local authorities in the Piedmont Region.	Capital grant for 80 % of eligible costs for municipalities or associations of municipalities in towns with a population of 5 000 or less and 40 % for those with a population of 5 000 or more. In addition, subsidised credit for 50 % of eligible costs.	10 000 000
Piedmont	ERDF ROP 2014-2020 Investment priority IV.4c, Objective IV.4c.1 Decision of the Regional Executive No 12/4588 of 23 January 2017 ratifying the measure fiche to support the reduction of energy consumption in public buildings and facilities owned by the regional health authority.	Capital grant for 40 % of eligible costs and subsidised credit for 60 % of eligible costs.	16 000 000
Piedmont	ERDF ROP 2014-2020 Investment priority IV.4c, Objective IV.4c.1 Decision of the Regional Executive No 11/4567 of 16 January 2017 ratifying the measure fiche to reduce energy consumption in public facilities of local authorities in the Piedmont Region.	Capital grant for 80 % of eligible costs for municipalities or associations of municipalities in towns with a population of 5 000 or less and 40 % for those with a population of 5 000 or more. In addition, subsidised credit for 50 % of eligible costs.	40 000 000
Piedmont	ERDF ROP 2014-2020 Investment priority IV.4c, Objective IV.4c.1 Decision of the Regional Executive No 12/4569 of 16 January 2017 ratifying the measure fiche to support the reduction of energy consumption in the public social housing sector, managed by regional housing agencies in the Piedmont Region.	Capital grant for 90 % of eligible costs.	10 000 000
Autonomo	ERDF ROP 2014-2020 Axis III – Call 2015 'Sustainable	The grant covers 100 % of the costs for	10 000 000

us Province of Bolzano	environment' call for energy-related renovation of public buildings	provincial services and 85 % for other entities.	
Autonomous Province of Bolzano	ERDF ROP 2014-2020 Axis III – 2017 'Sustainable environment' call for energy-related renovation of public buildings	The grant covers 100 % of the costs for provincial services and 85 % for other entities.	12 000 000
Umbria	ERDF ROP 2014-2020 Axis IV Action 4.1.1 – Public call for granting aid to public bodies for energy audits and certification of public buildings to promote energy efficiency improvements	Maximum grant available of EUR 6 000, or EUR 12 000 in the case of buildings or hospitals	996 000
Umbria	ERDF ROP 2014-2020 Axis IV Action 4.2.1 – Public call for granting aid to public bodies for minor projects to improve the energy efficiency of buildings.	This finances 35 % of eligible costs. Together with the Thermal Energy Account 2.0, a government incentive that covers 40 % to 55 %, up to 90 % of the costs may be covered. For improvements to NZEB, the Thermal Energy Account finances a maximum of 65 % and the regional call 25 % (again totalling 90 %).	2 500 000 (recalculated from 800 000)
Umbria	ERDF ROP 2014-2020 Axis IV Action 4.2.1 – Public call for granting aid for energy efficiency improvements to public or public-use buildings	Maximum grant of between 50 % and 100 % of eligible costs, depending on the type of public body and the building undergoing the work (grants for 100 % are available to transform existing buildings into NZEB)	4 200 000
Valle d'Aosta	ERDF ROP 2014-2020. Regional Council Decision No 1255 of 23 September 2016 ratifying the strategic project for improving the energy efficiency of public buildings.	-	11 252 000
Valle d'Aosta	Call for the creation and development of a research unit. Thematic areas: Energy, Sustainable Construction and Green Building.	The incentives range between 50 % and 100 % for industrial research and 25 % and 100 % for experimental development.	4 097 307
Veneto	ERDF ROP 2014-2020. Call for financial support on a first come, first served basis for local authority projects to improve the energy efficiency of publicly owned non-residential buildings.	Financial support for 80 % of eligible expenditure. For buildings that can be classified as nearly zero-energy buildings, the financial support covers 100 % of expenditure.	20 000 000

Source: Regions and Autonomous Provinces

Table A.11 – Financing of public building measures: Structural Funds 2007-2013 programming period, current status by programme and type

Programme	Project status	No of projects	Total public funding	Commitments	Total payments
Cohesion and Action Plan (CAP) Programme	Ongoing	36	19 546 458	19 546 458	11 670 462
	Concluded	2	285 660	302 800	285 660
	Liquidated	1	270 203	270 203	270 203
DCF Regional Implementation Programme (PAR)	Ongoing	33	28 468 291	23 888 207	4 959 550
	Concluded	5	2 037 992	1 891 994	2 023 939
ERDF ROP – Convergence	Ongoing	42	32 183 319	25 637 620	18 311 657
	Concluded	4	1 703 893	1 620 409	1 660 633
	Liquidated	15	8 750 797	7 872 410	8 317 499
ERDF ROP – Regional Competitiveness and Employment	Ongoing	71	42 880 586	38 689 459	30 355 909
	Concluded	246	136 949 135	133 564 952	133 578 012
	Liquidated	65	16 802 954	17 474 835	17 149 675
Interregional Operational Programme (IOP) for 'Renewable energy and energy saving'	Ongoing	66	83 546 664	83 546 664	70 486 365
	Concluded	43	44 313 934	44 632 428	43 905 464
	Liquidated	24	3 000 533	3 000 533	2 961 142
	Total	**653**	**420 740 419**	**401 938 972**	**345 936 170**

Source: ENEA processing of data from the Prime Minister's Office (www.opencoesione.gov.it/)

Table A.12 – Financing of public lighting measures: Structural Funds 2007-2013 programming period, current status by programme and type

Programme	Project status	No of projects	Total public funding	Commitments	Total payments
Cohesion and Action Plan (CAP) Programme	Ongoing	48	12 134 785	12 134 785	9 729 017
DCF Regional Implementation Programme (PAR)	Ongoing	10	8 783 724	7 472 338	2 098 032
	Concluded	1	79 472	34 994	79 472
	Liquidated	1	1 175 000	1 175 000	1 122 176
ERDF ROP – Convergence	Ongoing	193	36 561 731	31 307 831	25 322 474

	Concluded	189	19 266 249	18 903 841	18 859 888
	Liquidated	37	5 457 466	4 942 011	5 065 982
ERDF ROP – Regional Competitiveness and Employment	Ongoing	101	23 082 038	21 838 905	18 562 098
	Concluded	182	28 450 169	27 148 984	26 545 424
	Liquidated	117	19 199 851	19 764 098	18 987 059
Interregional Operational Programme (IOP) for 'Renewable energy and energy saving'	Ongoing	13	43 939 180	43 939 180	33 553 145
	Concluded	30	3 150 079	3 150 079	3 149 273
	Liquidated	15	1 278 438	1 278 438	1 274 850
	Total	**937**	**202 558 182**	**193 090 484**	**164 348 890**

Source: ENEA processing of data from the Office of the Prime Minister (www.opencoesione.gov.it/)

Table A.13 – Financing of industry measures: Structural Funds 2014-2020 programming period, calls issued and amounts allocated by Region and Autonomous Province

Region	Description	Financial arrangements	Amount awarded (€)
Calabria	ERDF ROP 2014-2020 Axis I Action 1.1.2 – Call for the purchase of services for technological and production innovation	Capital grant for a maximum of 75 % of the costs eligible for the subsidy. The maximum subsidy is EUR 100 000.	3 935 650
Calabria	ERDF ROP 2014-2020 Axis III Action 3.1.1 Public call for financial support for business reorganisation and restructuring	Maximum amount of EUR 200 000, up to a maximum intensity of 70 % of eligible costs	10 000 000
Calabria	ERDF ROP 2014-2020 Axis III Action 3.5.2 Public call for financial support for the adoption of information technology in SMEs	Maximum amount of EUR 200 000 for consortia and EUR 100 000 for individual SMEs, up to a maximum intensity of 70 % of eligible costs	7 000 000
Campania	ERDF ROP 2014-2020 and regional co-financing. Regional programme to support the implementation of energy audits or the adoption of energy management systems conforming to ISO 50001 by SMEs.	The grant covers 50 % of eligible costs, subject to a maximum of EUR 5 000 for each energy audit and EUR 10 000 for the adoption of energy management systems.	5 000 000
Emilia-Romagna	ERDF ROP 2014-2020. Call for strategic industrial research projects aimed at innovation in the energy sector.	For research organisations and non-economic entities, the grant is 70 % for industrial research and experimental development, while for other public and private entities it is 50 % for industrial research, 25 % for experimental development and 100 % for promotion and development.	2 000 000
Emilia-Romagna	ERDF ROP 2014-2020 Axis I Action 1.1.2 – Call for projects for product or service diversification and innovation for SMEs	Minimum grant of 35 % and a maximum percentage of 45 % of eligible costs.	8 000 000
Lazio	ERDF ROP 2014-2020, Action 4.1.1. Decision No G12962 of 28 October 2015 issued a call for proposals entitled 'Sustainable energy 2.0'.	The grant covers 100 % of the project cost, which must be between EUR 200 000 and EUR 700 000. The project must be completed within two years.	13 200 000
Lazio	ERDF ROP 2014-2020, Axis III. Call for Green Building and Smart Building. Potential applicants: micro, small and medium-sized enterprises	-	11 000 000
Liguria	ERDF ROP 2014-2020, Thematic objective 4. Decision of the Regional Executive No 1189 of 26 October 2015 ratifying the regional programme supporting the implementation of energy audits in SMEs or the adoption of energy management systems for 2014.	EUR 44 775 for awareness-raising activities targeting SMEs and carried out by the Region. EUR 402 975 allocated to measures to support SMEs.	447 750
Lombardy	ERDF ROP 2014-2020 Axis I Action I.1.b.1.3 – Call for the launch of an experimental approach towards defining agreements for research, development and innovation.	Aid intensity of 60 % for micro/small, medium and large enterprises and research organisations, and 40 % for experimental development activities. Non-repayable grants for up to EUR 4.5 million each	40 000 000
Lombardy	ERDF ROP 2014-2020 Action III. 3.c.1.1. Decision of the Regional Executive No X/4256 of 30 October 2015 concerning the energy efficiency programme for SMEs, based on energy audits or energy management systems conforming to ISO 50001.	ERDF ROP funds cover EUR 1 550 933.78 of the regional contribution. 50 % of eligible costs, subject to a maximum of EUR 10 000 for energy audits and a maximum of EUR 20 000 for management systems.	5 373 000

Marche	ERDF ROP 2014-2020 Axis I Action 1.1 – Support for collaborative R&D for the development of new sustainable technologies, new products and services. 1.1.A 'Promotion of research and development in the areas of smart specialisation'	Non-repayable grant for between 25 % and 80 %	21 351 258 76
Marche	ERDF ROP 2014-2020 Axis IV Action 12.1.1 'Energy efficiency and development of the use of renewables in enterprises and production'	Non-repayable grant for a maximum of 40 % small and micro enterprises Revolving fund for a maximum of 40 %	4 386 267.20
Piedmont	ERDF ROP 2014-2020: Thematic objective I Action I.1.b.1.2 – MANUNET 2016 call	Contribution for up to 50 % of eligible costs	2 000 000
Piedmont	ERDF ROP 2014-2020: Thematic objective I Action I.1.b.1.2 – MANUNET 2017 call	Contribution for up to 50 % of eligible costs	2 000 000
Piedmont	ERDF ROP 2014-2020, Axis IV, Action IV.4b.2.1. Decision of the Regional Executive No 24/2725 of 30 December 2015 on incentives aimed at reducing energy consumption and greenhouse gas emissions of businesses and manufacturing areas, including the installation of renewable power plants for their own energy consumption.	The incentive may cover up to 100 % of eligible costs. It consists of a subsidised loan for at least 80 % of the project value, and a non-repayable amount for up to 20 %.	50 000 000
Piedmont	ERDF ROP 2014-2020, Axis III. Call for access to the SME Fund to support projects and investments targeting innovation, environmental sustainability, energy efficiency and workplace safety, developed by micro, small and medium-sized enterprises.	Subsidised loan for up to 100 % of eligible expenditure, disbursed as follows: 50 % regional interest-free loan for up to EUR 750 000; 50 % bank financing.	60 000 000
Piedmont	ERDF ROP 2014-2020. Call for energy efficiency and renewable energy in businesses. Subsidies for enterprises for investments to improve energy efficiency through the use of renewable energy sources. Recipients: non-energy intensive SMEs and energy-intensive large enterprises.	The incentive may cover up to 100 % of eligible costs. The financial contribution breaks down as follows: finance for at least 80 % of the project value; non-repayable grant for up to 20 % of the project value.	50 000 000
Piedmont	ERDF ROP 2014-2020, Axis I. Call to support regional innovation cluster development programmes.	Contribution towards 50 % of the costs incurred.	5 000 000
Piedmont	ERDF ROP 2014-2020, Thematic objective I, Action I.1.b.1.2 – Call for access to subsidies for experimental industrial research and development projects in the field of electromobility.	Contribution towards eligible costs: up to 55 % for micro and small enterprises; up to 45 % for medium-sized enterprises; up to 35 % for large enterprises.	1 500 000
Piedmont	ERDF ROP 2014-2020, Axis IV, Action IV.4b.2.1. Direct call to support the implementation of energy audits in SMEs or the adoption of energy management systems conforming to ISO 50001.	50 % of the financing is covered by the Ministry of Economic Development and the remaining EUR 1 194 000 by the ERDF ROP 2014-2020, Axis IV, Action 4b.2.1. Non-repayable grant for 50 % of eligible costs.	2 388 000
Apulia	ERDF ROP-ESF 2014-2020 Axis 1 Action 1.4.b – INNOLABS call for grants in support of innovative solutions targeting key social issues	Equipment grants for projects submitted by individual enterprises, equal to: 45 % for micro/small enterprises; 35 % for medium-sized enterprises; and 25 % for large enterprises. For projects submitted by consortia, the aid intensity is increased by 15 % under specific conditions.	10 000 000
Apulia	ERDF-ESF ROP 2014-2020 Axis 1 Action 1.6 – INNONETWORK call to support R&D for new sustainable technologies, products and services.	The aid intensity is equal to: a) for industrial research activities, 80 % for micro and small enterprises, 75 % for medium-sized enterprises and 65 % for large enterprises; b) for experimental development activities, 60 % for micro and small enterprises, 50 % for medium-sized enterprises and 40 % for large enterprises.	30 000 000
Sardinia	ERDF ROP 2014-2020 Actions 1.1.3, 3.3.1, 3.7.1 – Integrated measures between local participatory development and employment in the green and blue economy as part of the regional project to obtain funding under the national infrastructure plan for electric vehicle charging (PNIRE)	The maximum project value is EUR 500 000.00 for Line 2 and EUR 300 000.00 for Line 3	11 666 857

Sardinia	ERDF ROP 2014-2020 Axis III Action 3.6.1 – Business start-up and development aid	Two financing arrangements: 1) Competitiveness Fund: direct public financing, on market terms, for up to 75 % of the value of the business start-up or development plan; 2) Non-repayable grant for 50 % of the value of the approved plan, rising by a further 10 % in the case of a loan from a bank or any other private financial intermediary	15 000 000
Sardinia	ERDF ROP Sardinia 2014-2020 Axis III Action 3.3.1. Call to promote the uptake of energy audits and the implementation of energy management systems conforming to ISO 50001 in SMEs.	Maximum financial incentive of EUR 5 000 for energy audits (50 % of the costs), EUR 15 000 for ISO 50001 certification (50 % of the costs) and EUR 40 000 for energy efficiency actions (from 40 % to 65 %).	2 458 000
Tuscany	ERDF ROP 2014-2020 Axis 4 – Call for aid for energy efficiency projects in buildings	Aid intensity, under de minimis rules, is equal to 40 %, 30 % and 20 % of the eligible costs for micro, small, medium-sized and large enterprises respectively	1 500 000
Tuscany	ERDF ROP 2014-2020 Axis 4 – Call for aid for energy efficiency projects in production processes	Aid intensity, under de minimis rules, is equal to 40 %, 30 % and 20 % of the eligible costs for micro, small, medium-sized and large enterprises respectively	1 500 000
Tuscany	ERDF ROP 2014-2020. Decision of the Regional Executive No 1040 of 11 November 2015 ratifying a call for the selection of projects to improve the energy efficiency of non-domestic buildings, with priority for enterprises affected by natural disasters.	The maximum aid intensity by size of enterprise ranges from 20 % to 40 %, in the form of a capital grant.	3 000 000
Tuscany	ERDF ROP 2014-2020, Axis IV, Action 4.2.1, Sub-action a1. Call of the Regional Executive No 383 of 3 May 2016 to improve energy efficiency at manufacturing sites, aimed at promoting investment projects for the energy efficiency of non-domestic buildings.	The maximum aid intensity in relation to the eligible cost ranges from 20 % to 40 % depending on the size of the enterprise, in the form of a capital grant.	8 000 000
Tuscany	ERDF ROP 2014-2010 Axis I Action 1.1.2 – Call for support for micro, small and medium-sized enterprises to purchase innovation services	Different aid intensities depending on the project	10 400 000
Tuscany	ERDF ROP 2014-2010 Axis I Actions 1.1.2 and 1.1.3 – Call for support for innovative strategic or experimental projects	Aid intensity of 60 % for medium-sized enterprises, 70 % for small enterprises and 80 % for micro-enterprises, and maximum eligible expenditure of EUR 100 000.	14 000 000
Umbria	ERDF ROP 2014-2020 Axis I. Call for support for the creation and consolidation of innovative start-ups with knowledge-intensive applications and spin-off research initiatives.	Non-repayable grant for 40 % of the expenditure deemed eligible.	2 000 000
Umbria	ERDF ROP 2014-2020, Axis IV (2015). Call for support for investment in energy efficiency and use of renewable energy sources by non-agricultural small, medium-sized and large enterprises.	Aid intensity of 50 %, 40 % and 30 % for small, medium-sized and large enterprises respectively.	2 000 000
Umbria	ERDF ROP 2014-2020, Axis IV (2016). Call for support for investment in energy efficiency and use of renewable energy sources by non-agricultural small, medium-sized and large enterprises.	Aid intensity of 50 %, 40 % and 30 % for small, medium-sized and large enterprises respectively.	2 000 000
Umbria	ERDF ROP 2014-2020 Axis I Action 1.1.1 – Call for support for industrial research projects and the experimental development of enterprises	Non-repayable grant of 35 % for SMEs and 25 % for large enterprises for experimental development; 60 % for SMEs and 50 % for large enterprises for industrial research.	8 000 000
Veneto	ERDF ROP 2014-2020 Axis I Action 1.4.1 – Call for financial contributions for innovative start-ups	Capital grant for 80 % of eligible costs	5 000 000
Veneto	ERDF ROP 2014-2020 Axis III Action 3.3.1 – Call for financial aid for investments in machinery, plant and intangible assets and support for business reorganisation and restructuring processes – Manufacturing sector sub-action	Non-repayable grant for 45 % of eligible costs	5 000 000

Veneto	ERDF ROP 2014-2020 Axis III Action 3.3.1 – Call for financial aid for investments in machinery, plant and intangible assets and support for business reorganisation and restructuring processes – Retail sector sub-action	Non-repayable grant for 50 % of the amount of eligible costs	3 000 000
Veneto	ERDF ROP 2014-2020 Axis III Action 3.3.1 – Call for financial aid for investments in machinery, plant and intangible assets and support for business reorganisation and restructuring processes – Cultural sector sub-action	Non-repayable grant for up to 70 % of costs, subject to a maximum of EUR 200 000.00	3 000 000

Source: Regions and Autonomous Provinces

Table A.14 – Financing of industry measures: Structural Funds 2007-2013 programming period, current status by programme and type

Programme	Project status	No of projects	Total public funding	Commitments	Total payments
ERDF ROP – Convergence	Ongoing	1	1 400 000	1 400 000	730 738
ERDF ROP – Regional Competitiveness and Employment	Ongoing	55	12 891 673	8 281 168	8 835 659
	Concluded	186	26 439 374	25 549 366	25 377 781
	Liquidated	8	330 505	325 990	325 989
	Total	**250**	**41 061 552**	**35 556 524**	**35 270 167**

Source: ENEA processing of data from the Prime Minister's Office (www.opencoesione.gov.it/)

Table A.15 – Financing of transport sector measures: Structural Funds 2014-2020 programming period, calls issued and amounts allocated by Region and Autonomous Province

Region	Description	Financial arrangements	Amount awarded (€)
Calabria	ERDF ROP 2014-2020, Axis VII, Action 7.2.2 Call for ports	The eligible costs cover necessary expenditure during the entire construction period of the public infrastructure. Maximum of EUR 5 million for each infrastructure	21 044 794
Lazio	ERDF ROP 2014-2020 Axes 1 and 3. Call for incentives for sustainable and smart mobility. Sectors: automotive, logistics and transport.	Non-repayable grants	16 500 000
Lombardy	ERDF ROP 2014-2020 Axis 4 Action IV.4.E.1.1 – Call for expressions of interest regarding project proposals for cycling	The maximum percentage of the non-repayable grant is 70 %, subject to a maximum amount of EUR 1 500 000	20 000 000
Marche	Action 14.1.1 Replacement of the bus fleet for the local public transport service	Non-repayable grant for a maximum of 50 % Revolving fund 35 %	18 172 579.40
Marche	ERDF ROP 2014-2020 Axis IV Action 14.2.1 Purchase and installation of AVM signs and Action 14.2.2 Purchase of automatic ticketing devices	Non-repayable grant for a maximum of 75 %	2 126 132.51
Marche	ERDF ROP 2014-2020 Axis IV Action 14.3.1 – Purchase and installation of electric vehicle recharging points (public and private), including those powered by alternative sources;	Non-repayable grant for a maximum of 75 %	730 500.00
Marche	ERDF ROP 2014-2020 Axis IV 14.4.1 – 'Cycling development projects'; Action 14.4.2 – 'Creation of parking areas for park and ride schemes'; 14.4.3 – 'Bikesharing'.	Non-repayable grant for a maximum of 75 %	7 258 274.34
Autonomous Province of Bolzano	ERDF ROP 2014-2020 Call for the submission of projects under Axis 3 'Sustainable environment (mobility)'		16 300 000
Sardinia	ERDF ROP 2014-2020 Axis IV Action 4.6.4 – Exploratory notice for the recognition of private initiatives aimed at constructing electric vehicle recharging infrastructure in Sardinia, to be promoted as part of the regional project to obtain grants under the PNIRE		1 600 000

Tuscany	ERDF ROP 2014-2020 Axis IV Action 4.6.4.A – Call for financial support for sustainable urban mobility projects: increase in soft mobility (urban cycle paths)	Maximum capital grant of EUR 600 000, covering a maximum of 80 % of the actual costs incurred for the implementation of individual projects (operations) eligible for funding	2 812 500

Source: Regions and Autonomous Provinces

Table A.16 – Financing of transport sector measures: Structural Funds 2007-2013 programming period, current status by programme and type

Programme	Project status	No of projects	Total public funding	Commitments	Total payments
ERDF 'Networks & Mobility' Convergence NOP	Ongoing	6	351 501 639	264 188 203	177 743 946
	Concluded	5	46 563 992	46 483 608	46 483 608
	Liquidated	3	30 344 000	30 344 000	30 344 000
DCF Special Implementation Programmes – Rail Routes	Ongoing	6	2 754 000 000	168 315 540	134 744 637
Cohesion and Action Plan (CAP) Programme	Ongoing	14	256 706 258	107 331 383	70 066 618
	Concluded	3	2 390 476	2 390 476	2 369 797
DCF Regional Implementation Programme (PAR)	Ongoing	44	448 735 065	450 666 168	144 695 260
	Concluded	49	391 511 120	395 640 482	392 792 860
	Liquidated	17	94 502 615	98 626 706	98 067 259
DCF Regional Implementation Programme (PAR)	Ongoing	5	143 167 338	120 344 763	8 710 786
ERDF ROP – Convergence	Ongoing	72	2 554 350 301	2 087 765 900	1 164 383 781
	Concluded	8	38 866 124	39 714 312	37 324 329
	Liquidated	10	61 499 426	65 741 748	60 150 932
ERDF ROP – Regional Competitiveness and Employment	Ongoing	49	183 959 030	172 949 999	127 771 417
	Concluded	92	109 030 364	109 285 932	107 170 725
	Liquidated	36	235 295 295	249 954 807	242 996 532
	Total	**419**	**7 702 423 043**	**4 409 744 027**	**2 845 816 487**

Source: ENEA processing of data from the Prime Minister's Office (www.opencoesione.gov.it/)

Table A.17 – Financing of measures aimed at energy transformation, transmission and distribution: Structural Funds 2014-2020 programming period, calls issued and amounts allocated by Region and Autonomous Province

Region	Description	Financial arrangements	Amount awarded (€)
Sardinia	ERDF ROP Axis IV. Decision of the Regional Executive No 63/19 of 25 November 2016 ratifying the call for the development of experimental intelligent network projects in municipalities in Sardinia.	Non-repayable grant for 100 % of the eligible costs, subject to a maximum of EUR 150 000.	3 900 000
Basilicata, Calabria, Campania, Apulia	ERDF Enterprises and Competitiveness NOP 2014-2020, Axis IV, Action 4.3.1. Call for electrical infrastructure incentives for the construction of smart grids.	Aid granted in the form of a direct subsidy for up to 100 % of eligible costs. For each enterprise, the subsidy may not be less than EUR 1 million or more than EUR 50 million for each project.	80 000 000

Source: Regions and Autonomous Provinces

Table A.18 – Financing of measures aimed at energy transformation, transmission and distribution: Structural Funds 2007-2013 programming period, current status by programme and type

Programme	Project status	No of projects	Total public funding	Commitments	Total payments
Cohesion and Action Plan (CAP) Programme	Ongoing	3	1 210 553	1 210 553	771 060
	Concluded	1	742 479	742 479	477 954
ERDF ROP – Convergence	Ongoing	27	40 150 235	34 166 335	24 811 681
	Liquidated	9	6 800 000	7 158 000	7 619 632
ERDF ROP – Regional Competitiveness and Employment	Ongoing	14	1 189 211	1 043 051	992 155
	Concluded	74	4 672 970	4 662 018	4 650 913
	Liquidated	8	450 750	449 702	448 608

Interregional Operational Programme (IOP) for 'Renewable energy and energy saving'	Ongoing	9	106 781 227	106 781 227	93 473 997
	Concluded	6	82 282 285	82 282 285	82 282 285
	Liquidated	3	91 550 000	91 550 000	91 262 423
	Total	**154**	**335 829 710**	**330 045 650**	**306 790 707**

Source: ENEA processing of data from the Prime Minister's Office (www.opencoesione.gov.it/)

Table A.19 – ERDF ROP 2014-2020 programming period: resources dedicated to energy efficiency (€)

Region	Resources dedicated to energy saving and efficiency (€)	Overall programme budget (€)	%
Piedmont	160 625 000	965 844 740	16.6 %
Valle d'Aosta	14 252 000	64 350 950	22.1 %
Lombardy	203 100 000	970 474 516	20.9 %
Autonomous Province of Trento	21 734 048	108 668 094	20.0 %
Autonomous Province of Bolzano	24 788 552	136 621 198	18.1 %
Veneto	105 558 512	600 310 716	17.6 %
Friuli-Venezia Giulia	57 276 180	230 779 184	24.8 %
Liguria	45 000 000	392 545 240	11.5 %
Emilia-Romagna	78 926 880	481 895 272	16.4 %
Tuscany	216 371 778	792 454 508	27.3 %
Marche	65 449 928.00	337 383 288	19.0 %
Umbria	49 926 820	342 042 004	14.6 %
Lazio	91 000 000	913 065 194	10.0 %
Abruzzo	25 400 000	231 509 780	11.0 %
Molise	10 997 314	153 607 454	7.2 %
Campania	222 629 484	4 113 545 843	5.4 %
Apulia	305 891 208	6 896 281 414	4.4 %
Basilicata	91 624 000	793 031 332	11.6 %
Calabria	166 099 512	2 039 837 007	8.1 %
Sicily	412 145 061	4 557 908 024	9.0 %
Sardinia	94 819 600	930 979 082	10.2 %
Total	**2 432 315 908**	**26 043 001 192**	**9.3 %**

Source: ENEA processing of data from the Regions and Autonomous Provinces

Table A.20 – ERDF ROP 2014-2020 programming period: energy and related funding

Region	Energy axis	Energy efficiency actions within the axis	EU funding	National or regional grant	Total funding
PIEDMONT	**Axis IV – Sustainable energy and quality of life (OT4)**	Energy efficiency renovation of public infrastructure, demonstration projects and supporting measures	43 500 000	43 500 000	87 000 000
		Energy efficiency and demonstration projects in SMEs and supporting measures	16 200 000	16 200 000	32 400 000
		Promotion of energy efficiency in large enterprises	15 862 500	15 862 500	31 725 000
	Axis VI – Sustainable urban development (OT2/4/6)	Energy efficiency renovation of public infrastructure, demonstration projects and supporting measures	4 750 000	4 750 000	9 500 000
	TOTAL ENERGY EFFICIENCY		**80 312 500**	**80 312 500**	**160 625 000**
	OVERALL PROGRAMME BUDGET		**482 922 370**	**482 922 370**	**965 844 740**
	% RESOURCES ALLOCATED TO ENERGY EFFICIENCY				**16.63 %**
VALLE D'AOSTA	**Axis IV – Supporting the shift towards a low-carbon economy in all sectors (OT4)**	Energy efficiency renovation of public infrastructure, demonstration projects and supporting measures	5 626 000	5 626 000	11 252 000
		Cycle tracks and footpaths	1 500 000	1 500 000	3 000 000
	TOTAL ENERGY EFFICIENCY		**7 126 000**	**7 126 000**	**14 252 000**
	OVERALL PROGRAMME BUDGET		**32 175 475**	**32 175 475**	**64 350 950**
	% RESOURCES ALLOCATED TO ENERGY EFFICIENCY				**22.15 %**

LIGURIA	**Axis IV – Supporting the shift towards a low-carbon economy in all sectors (OT4)**	Support to environmentally friendly production processes and resource efficiency in SMEs	6 000 000	6 000 000	12 000 000
		Energy efficiency renovation of public infrastructure, demonstration projects and supporting measures	15 000 000	15 000 000	30 000 000
		Intelligent transport systems (including the introduction of demand management, tolling systems, IT monitoring control and information systems)	1 500 000	1 500 000	3 000 000
	TOTAL ENERGY EFFICIENCY		**22 500 000**	**22 500 000**	**45 000 000**
	OVERALL PROGRAMME BUDGET		**196 272 620**	**196 272 620**	**392 545 240**
	% RESOURCES ALLOCATED TO ENERGY EFFICIENCY				**11.46 %**
LOMBARDY	**Axis IV – Supporting the shift towards a low-carbon economy in all sectors (OT4)**	Energy efficiency renovation of public infrastructure, demonstration projects and supporting measures	67 300 000	67 300 000	134 600 000
		Clean urban transport infrastructure and promotion (including equipment and rolling stock)	20 000 000	20 000 000	40 000 000
	Axis V – Sustainable urban development	Cycle tracks and footpaths	10 000 000	10 000 000	20 000 000
		Energy efficiency renovation of public infrastructure, demonstration projects and supporting measures	4 250 000	4 250 000	8 500 000
	TOTAL ENERGY EFFICIENCY		**101 550 000**	**101 550 000**	**203 100 000**
	OVERALL PROGRAMME BUDGET		**485 237 258**	**485 237 258**	**970 474 516**
	% RESOURCES ALLOCATED TO ENERGY EFFICIENCY				**20.93 %**
MARCHE	**Axis 4 – Supporting the shift towards a low-carbon economy in all sectors**	Energy efficiency renovation of public buildings	13 437 476	13 437 476	26 874 951.75
		Biomass demonstration projects – internal areas	250 000 4 893 745	250 000 4 893 745	500 000 9 787 490.00
		Energy efficiency of sustainable mobility firms	14 143 743	14 143 743	28 287 486.25
	TOTAL ENERGY EFFICIENCY		**32 724 964**	**32 724 964**	**65 449 928.00**
	OVERALL PROGRAMME BUDGET				**337 383 288.00**
	% RESOURCES ALLOCATED TO ENERGY EFFICIENCY				**19.0 %**
AUTONOMOUS PROVINCE OF TRENTO	**Axis 3 – Supporting the shift towards a low-carbon economy in all sectors**	Energy efficiency renovation of public infrastructure, demonstration projects and supporting measures	5 700 000	5 700 000	11 400 000
		Environmental measures aimed at reducing and/or avoiding greenhouse gas emissions (including treatment and storage of methane gas and composting)	5 167 024	5 167 024	10 334 048
	TOTAL ENERGY EFFICIENCY		**10 867 024**	**10 867 024**	**21 734 048**
	OVERALL PROGRAMME BUDGET		**54 334 047**	**54 334 047**	**108 668 094**
	% RESOURCES ALLOCATED TO ENERGY EFFICIENCY				**20.00 %**
AUTONOMOUS PROVINCE OF BOLZANO	**Axis 3 – Sustainable energy**	Energy efficiency renovation of public infrastructure, demonstration projects and supporting measures	11 017 134	11 017 134	22 034 268
		Intelligent transport systems (including the introduction of demand response, tolling systems, electronic monitoring and information and control systems)	1 377 142	1 377 142	2 754 284
	TOTAL ENERGY EFFICIENCY		**12 394 276**	**12 394 276**	**24 788 552**
	OVERALL PROGRAMME BUDGET		**68 310 599**	**68 310 599**	**136 621 198**
	% RESOURCES ALLOCATED TO ENERGY EFFICIENCY				**18.14 %**
	Axis 3 – Supporting the shift towards a low-carbon economy in all sectors	Energy efficiency renovation of public infrastructure, demonstration projects and supporting measures	28 472 756	28 472 756	56 945 512

FRIULI-VENEZIA GIULIA	**Axis 4 – Urban development**	Intelligent transport systems (including the introduction of demand response, tolling systems, electronic monitoring and information and control systems)	165 334	135 334	330 668
	TOTAL ENERGY EFFICIENCY		**28 638 090**	**28 638 090**	**57 276 180**
	OVERALL PROGRAMME BUDGET		**115 389 592**	**115 389 592**	**230 779 184**
	% RESOURCES ALLOCATED TO ENERGY EFFICIENCY				**24.82 %**
VENETO	**Axis 4 – Energy sustainability and environmental quality**	Energy efficiency renovation of public infrastructure, demonstration projects and supporting measures	29 279 256	29 279 256	58 558 512
		Intelligent energy distribution systems at medium and low voltage levels (including smart grids and ICT systems)	5 000 000	5 000 000	10 000 000
		Energy efficiency and demonstration projects in SMEs and supporting measures	12 000 000	12 000 000	24 000 000
	Axis 6 – Sustainable urban development	Intelligent transport systems (including the introduction of demand management, tolling systems, IT monitoring control and information systems)	6 500 000	6 500 000	13 000 000
	TOTAL ENERGY EFFICIENCY		**52 779 256**	**52 779 256**	**105 558 512**
	OVERALL PROGRAMME BUDGET		**300 155 358**	**300 155 358**	**600 310 716**
	% RESOURCES ALLOCATED TO ENERGY EFFICIENCY				**17.58 %**
EMILIA-ROMAGNA	**Axis 4 – Promoting the low-carbon economy locally and in manufacturing**	Energy efficiency and demonstration projects in SMEs and supporting measures	18 215 641	18 215 641	36 431 282
		Promotion of energy efficiency in large enterprises	2 023 960	3 023 960	4 047 920
		Energy efficiency renovation of public infrastructure, demonstration projects and supporting measures	8 085 933	8 085 933	16 171 866
		Energy efficiency renovation of existing housing stock, demonstration projects and supporting measures	4 000 000	4 000 000	8 000 000
		Intelligent transport systems (including the introduction of demand response, tolling systems, electronic monitoring and information and control systems)	3 000 000	3 000 000	6 000 000
		Cycle tracks and footpaths	4 137 906	4 137 906	8 275 812
	TOTAL ENERGY EFFICIENCY		**39 463 440**	**39 463 440**	**78 926 880**
	OVERALL PROGRAMME BUDGET		**240 947 636**	**240 947 636**	**481 895 272**
	% RESOURCES ALLOCATED TO ENERGY EFFICIENCY				**16.38 %**
TUSCANY	**Axis 4 – Supporting the shift towards a low-carbon economy in all sectors**	Clean urban transport infrastructure and promotion (including equipment and rolling stock)	19 652 871	19 652 871	39 305 743
		Energy efficiency and demonstration projects in SMEs and supporting measures	51 160 863	51 160 863	102 321 726
		Promotion of energy efficiency in large enterprises	27 529 870	27 529 870	55 059 739
	Axis 6 – Urban	Energy efficiency renovation of public infrastructure, demonstration projects and supporting measures	4 921 143	4 921 143	9 842 285
		Clean urban transport infrastructure and promotion (including equipment and rolling stock)	4 921 142	4 921 142	9 842 285
	TOTAL ENERGY EFFICIENCY		**108 185 889**	**108 185 889**	**216 371 778**
	OVERALL PROGRAMME BUDGET		**396 227 254**	**396 227 254**	**792 454 508**
	% RESOURCES ALLOCATED TO ENERGY EFFICIENCY				**27.30 %**
MARCHE	**Axis 4 – Supporting the shift towards a low-carbon economy in all sectors**	Energy efficiency renovation of public infrastructure, demonstration projects and supporting measures	10 549 986	10 549 986	21 099 972
		Intelligent transport systems (including the introduction of demand management, tolling systems, IT monitoring control and information systems)	1 631 248	1 631 248	3 262 496

		Energy efficiency and demonstration projects in SMEs and supporting measures	4 893 745	4 893 745	9 787 490
	TOTAL ENERGY EFFICIENCY		**17 074 979**	**17 074 979**	**34 149 958**
	OVERALL PROGRAMME BUDGET		**163 624 820**	**163 624 820**	**327 249 640**
	% RESOURCES ALLOCATED TO ENERGY EFFICIENCY				**10.44 %**
UMBRIA	**Axis 4 – Sustainable energy**	Energy efficiency renovation of public infrastructure, demonstration projects and supporting measures	7 660 020	7 660 020	15 320 040
		Energy efficiency renovation of existing housing stock, demonstration projects and supporting measures	2 553 340	2 553 340	5 106 680
		Intelligent energy distribution systems at medium and low voltage levels (including smart grids and ICT systems)	1 000 000	1 000 000	2 000 000
		Energy efficiency and demonstration projects in SMEs and supporting measures	6 000 000	6 000 000	12 000 000
		Promotion of energy efficiency in large enterprises	1 660 020	1 660 020	3 320 040
	Axis 6 – Sustainable urban development	Energy efficiency renovation of public infrastructure, demonstration projects and supporting measures	4 000 000	4 000 000	8 000 000
		Intelligent transport systems (including the introduction of demand management, tolling systems, IT monitoring control and information systems)	2 090 030	2 090 030	4 180 060
	TOTAL ENERGY EFFICIENCY		**24 963 410**	**24 963 410**	**49 926 820**
	OVERALL PROGRAMME BUDGET		**171 021 002**	**171 021 002**	**342 042 004**
	% RESOURCES ALLOCATED TO ENERGY EFFICIENCY				**14.60 %**
LAZIO	**Axis 4 – Sustainable energy and mobility**	Energy efficiency renovation of public infrastructure, demonstration projects and supporting measures	10 000 000	10 000 000	20 000 000
		Energy efficiency renovation of existing housing stock, demonstration projects and supporting measures	9 000 000	9 000 000	18 000 000
		Intelligent Energy Distribution Systems at medium and low voltage levels (including smart grids and ICT systems)	1 000 000	1 000 000	2 000 000
		High-efficiency cogeneration and district heating	1 000 000	1 000 000	2 000 000
		Intelligent transport systems (including the introduction of demand management, tolling systems, IT monitoring control and information systems)	9 500 000	9 500 000	19 000 000
		Energy efficiency and demonstration projects in SMEs and supporting measures	15 000 000	15 000 000	30 000 000
	TOTAL ENERGY EFFICIENCY		**45 500 000**	**45 500 000**	**91 000 000**
	OVERALL PROGRAMME BUDGET		**456 532 597**	**456 532 597**	**913 065 194**
	% RESOURCES ALLOCATED TO ENERGY EFFICIENCY				**9.97 %**
ABRUZZO	**Axis IV – Promoting a low carbon economy**	Energy efficiency renovation of public infrastructure, demonstration projects and supporting measures	3 500 000	3 500 000	7 000 000
		Energy efficiency and demonstration projects in SMEs and supporting measures	8 000 000	8 000 000	16 000 000
	Axis VII – Sustainable urban development	Intelligent transport systems (including the introduction of demand management, tolling systems, IT monitoring control and information systems)	1 200 000	1 200 000	2 400 000
	TOTAL ENERGY EFFICIENCY		**12 700 000**	**12 700 000**	**25 400 000**
	OVERALL PROGRAMME BUDGET		**115 754 890**	**115 754 890**	**231 509 780**
	% RESOURCES ALLOCATED TO ENERGY EFFICIENCY				**10.97 %**
		Energy efficiency renovation of public infrastructure, demonstration projects and supporting measures	1 545 556	1 545 556	3 091 112

MOLISE	**Axis 4 – Sustainable energy**	Intelligent Energy Distribution Systems at medium and low voltage levels (including smart grids and ICT systems)	1 242 996	1 242 996	2 485 992
		High-efficiency cogeneration and district heating	1 674 699	1 674 699	3 349 398
		Intelligent transport systems (including the introduction of demand management, tolling systems, IT monitoring control and information systems)	400 000	400 000	800 000
		Energy efficiency and demonstration projects in SMEs and supporting measures	635 406	635 406	1 270 812
	TOTAL ENERGY EFFICIENCY		**5 498 657**	**5 498 657**	**10 997 314**
	OVERALL PROGRAMME BUDGET		**76 803 727**	**76 803 727**	**153 607 454**
	% RESOURCES ALLOCATED TO ENERGY EFFICIENCY				**7.16 %**
CAMPANIA	**Axis 4 – Sustainable energy**	Energy efficiency renovation of public infrastructure, demonstration projects and supporting measures	37 484 687	12 494 896	49 979 583
		Intelligent Energy Distribution Systems at medium and low voltage levels (including smart grids and ICT systems)	55 532 869	18 510 956	74 043 825
		Intelligent transport systems (including the introduction of demand management, tolling systems, IT monitoring control and information systems)	7 021 912	2 340 637	9 362 549
		Energy efficiency and demonstration projects in SMEs and supporting measures	23 000 000	7 666 667	30 666 667
		Promotion of energy efficiency in large enterprises	14 021 912	4 673 971	18 695 883
	Axis 7 – Transport	Intelligent transport systems (including the introduction of demand management, tolling systems, IT monitoring control and information systems)	11 862 551	3 954 184	15 816 735
	Axis 10 – Sustainable urban development	Energy efficiency renovation of public infrastructure, demonstration projects and supporting measures	18 048 182	6 016 061	24 064 243
	TOTAL ENERGY EFFICIENCY		**166 972 113**	**55 657 371**	**222 629 484**
	OVERALL PROGRAMME BUDGET		**3 085 159 382**	**1 028 386 461**	**4 113 545 843**
	% RESOURCES ALLOCATED TO ENERGY EFFICIENCY				**5.41 %**
APULIA	**Axis IV – Sustainable energy and quality of life**	Energy efficiency renovation of public infrastructure, demonstration projects and supporting measures	101 945 604	101 945 604	203 891 208
		Intelligent Energy Distribution Systems at medium and low voltage levels (including smart grids and ICT systems)	15 000 000	15 000 000	30 000 000
		Intelligent transport systems (including the introduction of demand management, tolling systems, IT monitoring control and information systems)	3 000 000	3 000 000	6 000 000
		Energy efficiency and demonstration projects in SMEs and supporting measures	20 000 000	20 000 000	40 000 000
	Axis XII – Sustainable urban development	Energy efficiency renovation of public infrastructure, demonstration projects and supporting measures	13 000 000	13 000 000	26 000 000
		Cycle tracks and footpaths	5 500 000		
	TOTAL ENERGY EFFICIENCY		**158 445 604**	**152 945 604**	**305 891 208**
	OVERALL PROGRAMME BUDGET		**3 448 140 707**	**3 448 140 707**	**6 896 281 414**
	% RESOURCES ALLOCATED TO ENERGY EFFICIENCY				**4.44 %**
BASILICATA	**Axis 4 – Energy and urban mobility**	Energy efficiency renovation of public infrastructure, demonstration projects and supporting measures	5 550 000	5 550 000	11 100 000
		Energy efficiency renovation of existing housing stock, demonstration projects and supporting measures	4 300 000	4 300 000	8 600 000

		Intelligent Energy Distribution Systems at medium and low voltage levels (including smart grids and ICT systems)	8 000 000	8 000 000	16 000 000
		High-efficiency cogeneration and district heating	6 000 000	6 000 000	12 000 000
		Intelligent transport systems (including the introduction of demand management, tolling systems, IT monitoring control and information systems)	5 000 000	5 000 000	10 000 000
		Energy efficiency and demonstration projects in SMEs and supporting measures	11 873 400	11 873 400	23 746 800
		Promotion of energy efficiency in large enterprises	5 088 600	5 088 600	10 177 200
	TOTAL ENERGY EFFICIENCY		**45 812 000**	**45 812 000**	**91 624 000**
	OVERALL PROGRAMME BUDGET		**396 515 666**	**396 515 666**	**793 031 332**
	% RESOURCES ALLOCATED TO ENERGY EFFICIENCY				**11.55 %**
CALABRIA	**Axis 4 – Energy efficiency**	Energy efficiency renovation of public infrastructure, demonstration projects and supporting measures	108 237 258	36 079 086	144 316 344
	Axis 7 – Development of sustainable mobility networks	Multimodal transport	16 337 376	5 445 792	21 783 168
	TOTAL ENERGY EFFICIENCY		**124 574 634**	**41 524 878**	**166 099 512**
	OVERALL PROGRAMME BUDGET		**1 529 877 755**	**509 959 252**	**2 039 837 007**
	% RESOURCES ALLOCATED TO ENERGY EFFICIENCY				**8.14 %**
SICILY	**Axis 4 – Sustainable energy and quality of life**	Energy efficiency renovation of public infrastructure, demonstration projects and supporting measures	239 589 614	79 863 205	319 452 819
		Energy efficiency renovation of existing housing stock, demonstration projects and supporting measures	7 068 046	2 356 015	9 424 061
		Intelligent Energy Distribution Systems at medium and low voltage levels (including smart grids and ICT systems)	8 000 000	2 666 667	10 666 667
		Intelligent transport systems (including the introduction of demand management, tolling systems, IT monitoring control and information systems)	3 750 000	1 250 000	5 000 000
		Energy efficiency and demonstration projects in SMEs and supporting measures	20 812 500	6 937 500	27 750 000
		Promotion of energy efficiency in large enterprises	6 937 500	2 312 500	9 250 000
		Cycle tracks and footpaths	22 951 136	7 650 379	30 601 515
	TOTAL ENERGY EFFICIENCY		**309 108 796**	**103 036 265**	**412 145 061**
	OVERALL PROGRAMME BUDGET		**3 418 431 018**	**1 139 477 006**	**4 557 908 024**
	% RESOURCES ALLOCATED TO ENERGY EFFICIENCY				**9.04 %**
SARDINIA	**Axis IV – Sustainable energy and quality of life**	Energy efficiency renovation of public infrastructure, demonstration projects and supporting measures	9 412 900	9 412 900	18 825 800
		Energy efficiency renovation of existing housing stock, demonstration projects and supporting measures	9 412 900	9 412 900	18 825 800
		Intelligent Energy Distribution Systems at medium and low voltage levels (including smart grids and ICT systems)	20 084 000	20 084 000	40 168 000
		Intelligent transport systems (including the introduction of demand management, tolling systems, IT monitoring control and information systems)	5 000 000	5 000 000	10 000 000
		Cycle tracks and footpaths	3 500 000	3 500 000	7 000 000
	TOTAL ENERGY EFFICIENCY		**47 409 800**	**47 409 800**	**94 819 600**
	OVERALL PROGRAMME BUDGET		**465 489 541**	**465 489 541**	**930 979 082**
	% RESOURCES ALLOCATED TO ENERGY EFFICIENCY				**10.18 %**

Source: Regions and Autonomous Provinces

Table A.21 – ERDF 'Networks & Mobility' Convergence NOP, 2007-2013 programming cycle

	Project status	No of projects	EU funding	State funding (Revolving Fund)	State funding (CAP – Cohesion and Action Plan)	State funding (Other measures)	Total public funding	EU reportable cost	Commitments	Total payments	Total EU reportable payments
Sustainable mobility	Ongoing	6	133 569 429	44 523 143	30 247 828	143 161 240	351 501 639	178 092 572	264 188 203	177 743 946	174 116 099
	Concluded	5	34 922 994	11 640 998	0	0	46 563 992	46 563 992	46 483 608	46 483 608	46 483 608
	Liquidated	3	22 758 000	7 586 000	0	0	30 344 000	30 344 000	30 344 000	30 344 000	30 344 000
TOTAL		**14**	**191 250 423**	**63 750 141**	**30 247 828**	**143 161 240**	**428 409 631**	**255 000 564**	**341 015 811**	**254 571 554**	**250 943 707**

Source: ENEA processing of data from the Prime Minister's Office (www.opencoesione.gov.it/)

Table A.22 – Special Implementation Programmes (DCF) on rail routes, 2007-2013 programming cycle

	Project status	No of projects	State funding (DCF – Cohesion and Development Fund)	State funding (CAP – Cohesion and Action Plan)	State funding (Other measures)	Other public funding	Total public funding	Commitments	Total payments
Sustainable mobility	Ongoing	6	401 000 000	1 085 000 000	1 267 000 000	1 000 000	2 754 000 000	168 315 540	134 744 637

Source: ENEA processing of data from the Prime Minister's Office (www.opencoesione.gov.it/)

Table A.23 – Cohesion Action Plan (CAP) programme, 2007-2013 programming cycle

	Project status	No of projects	EU funding	State funding (DCF – Cohesion and Development Fund)	State funding (CAP – Cohesion and Action Plan)	State funding (Other measures)	Municipal funding	Total public funding	EU reportable cost	Commitments	Total payments	Total EU reportable payments
Public buildings	Ongoing	36	311 325	0	19 235 133	0	0	19 546 458	311 325	19 546 458	11 670 462	311 325
	Concluded	2	0	0	285 442	0	218	285 660	0	302 800	285 660	285 442
	Liquidated	1	0	0	264 598	0	5 606	270 203	0	270 203	270 203	264 598
Lighting	Ongoing	48	9 582 017	0	2 552 768	0	0	12 134 785	9 582 017	12 134 785	9 729 017	9 529 384
Horizontal measures in the public sector	Ongoing	22	3 666 638	0	2 886 910	0	0	6 553 548	3 666 638	6 553 548	3 925 386	3 382 123
	Liquidated	1	148 831	0	5 132	0	0	153 963	148 831	153 963	148 831	148 831
Energy distribution	Ongoing	3	0	0	1 210 553	0	0	1 210 553	0	1 210 553	771 060	0
	Concluded	1	0	0	742 479	0	0	742 479	0	742 479	477 954	0
Sustainable mobility	Ongoing	14	0	38 388 983	105 972 541	111 286 605	1 058 130	256 706 258	0	107 331 383	70 066 618	3 626 130
	Concluded	3	0	0	2 390 476	0	0	2 390 476	0	2 390 476	2 369 797	0
TOTAL		**131**	**13 708 811**	**38 388 983**	**135 546 032**	**111 286 605**	**1 063 954**	**299 994 383**	**13 708 811**	**150 636 648**	**99 714 987**	**17 547 833**

Source: ENEA processing of data from the Prime Minister's Office (www.opencoesione.gov.it/)

Table A.24 – Development and Cohesion Fund (DCF) Regional Implementation Programme (PAR), 2007-2013 programming cycle

	Project status	No of projects	State funding (DCF – Cohesion and Development Fund)	State funding (Other measures)	Regional funding	Provincial funding	Municipal funding	Other public funding	Private funding	Total public funding	Commitments	Total payments
Public buildings	Ongoing	33	23 257 092	0	22 681	340 000	4 702 517	146 000	0	28 468 291	23 888 207	4 959 550
	Concluded	5	1 643 235	0	45 188	0	118 424	231 146	0	2 037 992	1 891 994	2 023 939
Lighting	Ongoing	10	5 291 544	0	0	0	3 492 181	0	0	8 783 724	7 472 338	2 098 032
	Concluded	1	22 830	0	12 164	0	0	44 478	0	79 472	34 994	79 472
	Liquidated	1	705 000	0	0	0	470 000	0	0	1 175 000	1 175 000	1 122 176
Residential buildings	Ongoing	1	157 208	0	0	0	0	662 792	0	820 000	820 000	524 638
Sustainable mobility	Ongoing	44	345 850 935	43 155 281	26 890 827	689 917	15 414 547	16 733 557	21 929 472	448 735 065	450 666 168	144 695 260
	Concluded	49	327 694 623	31 751 642	6 886 385	7 196 796	14 369 528	3 612 146	4 726 558	391 511 120	395 640 482	392 792 860
	Liquidated	17	71 022 139	15 199 235	792 446	0	0	7 488 795	9 015 815	94 502 615	98 626 706	98 067 259
	TOTAL	**161**	**775 644 606**	**90 106 158**	**34 649 691**	**8 226 713**	**38 567 197**	**28 918 914**	**35 671 845**	**976 113 279**	**980 215 889**	**646 363 186**

Source: ENEA processing of data from the Prime Minister's Office (www.opencoesione.gov.it/)

Table A.25 – Development and Cohesion Fund (DCF) Regional Implementation Programme (PAR), 2007-2013 programming cycle

	Project status	No of projects	State funding (Cohesion and Development Fund – DCF)	Total public funding	Commitments	Total payments
Sustainable mobility	Ongoing	5	143 167 338	143 167 338	120 344 763	8 710 786

Source: ENEA processing of data from the Prime Minister's Office (www.opencoesione.gov.it/)

Table A.26 – ERDF Convergence ROP, 2007-2013 programming cycle

	Project status	No of projects	EU funding	State funding (Revolving Fund)	State funding (DCF – Cohesion and Development Fund)	State funding (other)	Regional funding	Municipal funding	Other public funding	Private funding	Total public funding	EU reportable cost	Commitments	Total payments	Total EU reportable payments
Public buildings	Ongoing	42	22 831 202	5 086 044	0	0	4 063 829	202 244	0	0	32 183 319	31 981 075	25 637 620	18 311 657	18 228 907
	Concluded	4	815 918	646 942	0	0	241 033	0	0	0	1 703 893	1 703 893	1 620 409	1 660 633	1 660 633
	Liquidated	15	4 341 360	3 180 170	0	0	1 229 267	0	0	0	8 750 797	8 750 797	7 872 410	8 317 499	8 169 575
Lighting	Ongoing	193	23 190 853	6 375 167	0	51 150	4 763 759	359 552	1 821 250	795 671	36 561 731	36 441 463	31 307 831	25 322 474	24 859 192
	Concluded	189	10 858 414	2 150 676	0	0	2 014 817	83 236	4 159 106	0	19 266 249	19 266 249	18 903 841	18 859 888	18 787 734
	Liquidated	37	2 635 218	1 563 459	0	0	649 337	276 324	333 127	0	5 457 466	5 457 466	4 942 011	5 065 982	4 761 275
Horizontal	Ongoing	42	14 987 167	2 936 408	0	2 153 916	3 025 571	34 054	0	0	23 137 117	23 124 970	13 833 614	9 403 423	9 388 474
	Concluded	3	791 813	10 969	0	1 031 800	453 169	0	29 250	0	2 317 002	2 317 002	1 941 007	1 923 461	1 923 461

measures in the public sector	Liquidated	7	2 054 409	53 882	0	0	630 921	23 998	0	0	2 763 211	2 760 648	2 742 196	2 733 737	2 731 175
Industry	Ongoing	1	560 000	672 000	0	0	168 000	0	0	0	1 400 000	1 400 000	1 400 000	730 738	730 738
Energy distribution	Ongoing	27	27 707 171	6 979 701	0	875 000	4 588 363	0	0	5 179 854	40 150 235	40 150 235	34 166 335	24 811 681	24 811 681
	Concluded	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Liquidated	9	5 100 000	850 000	0	0	850 000	0	0	0	6 800 000	6 800 000	7 158 000	7 619 632	6 750 013
Sustainable mobility	Ongoing	72	910 350 430	62 012 120	6 058 609	29 476 313	261 410 064	269 595 998	1 015 446 765	12 863 675	2 554 350 301	1 221 800 863	2 087 765 900	1 164 383 781	892 954 048
	Concluded	8	28 318 242	5 119 457	0	962 972	4 465 452	0	0	0	38 866 124	38 720 261	39 714 312	37 324 329	36 521 186
	Liquidated	10	45 398 699	9 572 295	0	0	6 378 431	0	150 000	0	61 499 426	61 474 066	65 741 748	60 150 932	60 068 499
Jessica Fund	Concluded	9	69 603 477	0	0	16 922 809	20 180 668	0	0	0	106 706 954	106 706 954	106 706 954	106 706 954	106 706 954
	Liquidated	2	85 355 992	2 500 000	0	7 249 194	25 606 798	0	0	0	120 711 984	120 711 984	120 711 984	120 711 984	120 711 984
	Total	**670**	**1 254 824 959**	**109 696 723**	**6 058 609**	**58 723 154**	**340 706 911**	**270 575 406**	**1 021 939 498**	**18 839 200**	**3 062 525 268**	**1 729 467 385**	**2 572 078 613**	**1 613 951 226**	**1 339 677 971**

Source: ENEA processing of data from the Prime Minister's Office (www.opencoesione.gov.it/)

Table A.27 – ERDF ROP (Regional Competitiveness and Employment), 2007-2013 programming cycle

	Project status	No of projects	EU funding	State funding (Revolving Fund)	State funding (CAP – Cohesion and Action Plan)	State funding (other)	Regional funding	Provincial funding	Municipal funding	Other public funding	Private funding	Total public funding	EU reportable cost	Commitments	Total payments	Total EU reportable payments
Public buildings	Ongoing	71	15 566 607	15 161 039	30 431	851 568	2 699 686	0	248 561	8 322 695	0	42 880 586	40 914 530	38 689 459	30 355 909	29 960 365
	Concluded	246	43 846 879	40 758 454	0	3 714 454	13 947 977	98 681	8 998 469	25 584 221	0	136 949 135	126 730 235	133 564 952	133 578 012	124 820 224
	Liquidated	65	5 054 279	5 264 907	0	0	1 154 593	0	3 861 410	1 467 764	0	16 802 954	13 573 054	17 474 835	17 149 675	13 370 130
Industrial buildings	Ongoing	1	77 433	90 983	0	0	27 276	0	0	0	35 935	195 692	195 692	195 692	178 508	178 508
	Concluded	14	503 100	604 617	0	0	267 649	0	0	0	789 352	1 375 366	1 375 366	1 375 366	1 375 366	1 375 366
	Liquidated	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residential buildings	Ongoing	17	3 295 470	3 450 652	0	0	428 692	0	0	635 248	0	7 810 062	7 174 814	7 134 786	6 266 400	5 982 047
	Concluded	1	140 585	147 206	0	0	18 288	0	0	0	0	306 079	306 079	306 079	309 892	297 167
	Liquidated	3	286 059	299 529	0	0	37 212	0	0	0	0	622 800	622 800	622 800	609 046	569 412
Commercial buildings	Ongoing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Concluded	15	281 723	345 851	0	0	156 177	0	0	0	1 084 825	783 751	774 641	774 641	774 641	774 641
	Liquidated	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lighting	Ongoing	101	13 861 919	832 519	2 565 216	4 121 396	218 636	0	1 482 352	0	0	23 082 038	19 893 503	21 838 905	18 562 098	18 229 670
	Concluded	182	11 398 110	10 024 829	0	0	2 947 309	0	4 058 222	21 700	399 013	28 450 169	26 278 894	27 148 984	26 545 424	24 829 473
	Liquidated	117	6 781 810	2 228 310	0	7 351 611	416 706	0	2 421 415	0	0	19 199 851	17 131 955	19 764 098	18 987 059	16 960 797
Horizontal measures in the public sector	Ongoing	39	8 853 071	5 982 483	2 199 480	0	1 158 637	0	12 177 107	11 891 254	0	42 262 032	17 237 776	19 290 172	14 222 999	13 965 188
	Concluded	145	3 551 921	3 555 781	0	0	1 032 148	0	759 339	125 783	0	9 024 972	7 999 674	9 582 815	8 743 315	7 789 240
	Liquidated	8	581 614	549 566	5 132	0	175 872	0	532 464	0	0	1 844 647	1 754 736	1 852 767	1 717 302	1 634 838
Horizontal measures in the private sector	Ongoing	1	8 087	8 087	0	0	0	0	0	0	43 583	16 173	16 173	12 378	12 378	12 378
	Concluded	14	303 600	317 852	0	0	28 147	0	0	0	741 890	649 599	627 737	626 559	626 454	626 454
Horizont	Ongoing	20	1 980 537	2 068 093	0	0	166 414	0	0	0	6 862 658	4 215 044	4 215 394	3 215 244	3 106 735	3 106 735

al measures in the industrial sector	Concluded	39	2 218 455	2 791 265	0	0	506 392	0	0	0	6 247 275	5 516 113	5 591 408	5 562 060	5 561 566	5 561 566
Industry	Ongoing	55	5 331 422	6 058 965	13 488	0	1 487 797	0	0	0	14 494 655	12 891 673	12 377 926	8 281 168	8 835 659	8 560 662
	Concluded	186	10 316 659	12 857 729	0	0	3 264 985	0	0	0	42 365 308	26 439 374	25 762 443	25 549 366	25 377 781	25 377 781
	Liquidated	8	163 341	146 649	0	0	20 514	0	0	0	388 092	330 505	330 505	325 990	325 989	325 989
Energy distribution	Ongoing	14	539 391	583 044	0	0	66 776	0	0	0	0	1 189 211	1 189 211	1 043 051	992 155	992 155
	Concluded	74	1 874 616	2 719 442	0	78 650	261	0	0	0	0	4 672 970	4 672 970	4 662 018	4 650 913	4 650 913
	Liquidated	8	182 419	268 332	0	0	0	0	0	0	0	450 750	450 750	449 702	448 608	448 608
Sustainable mobility	Ongoing	49	56 270 084	52 768 934	3 590 451	0	12 102 289	2 160 000	56 577 377	489 895	0	183 959 030	168 097 993	172 949 999	127 771 417	121 232 279
	Concluded	92	44 024 448	30 526 539	96 323	11 732 065	8 612 486	0	5 379 500	8 659 004	2 712 500	109 030 364	98 706 148	109 285 932	107 170 725	96 146 584
	Liquidated	36	35 180 093	32 519 918	0	7 956 060	13 624 108	0	136 428 881	9 586 235	2 312 143	235 295 295	192 499 403	249 954 807	242 996 532	191 992 239
Incentives for businesses and individuals	Ongoing	34	620 431	1 012 668	0	0	0	0	0	0	2 503 775	1 633 099	1 633 099	1 633 099	1 242 599	1 242 599
	Concluded	154	4 238 622	5 021 933	0	0	242 338	0	0	0	20 176 869	9 502 893	9 502 893	9 563 854	9 487 916	9 487 916
	Liquidated	101	12 237 805	13 592 457	0	0	1 235 158	0	0	0	8 776 039	27 065 419	26 985 419	26 985 419	26 950 738	26 950 738
Incentives for public bodies	Ongoing	3	22 572	23 701	0	0	10 158	0	0	0	0	56 431	56 431	22 708	22 708	22 708
	Concluded	23	138 973	145 921	0	0	62 538	0	0	0	0	347 432	347 432	267 721	257 345	257 345
	Liquidated	48	925 667	971 950	0	0	4 101 571	0	0	0	0	5 999 188	5 999 188	5 645 938	5 637 589	5 637 589
Revolving energy efficiency fund	Liquidated	1	1 918 972	0	0	0	0	0	0	0	0	1 918 972	1 918 972	1 918 972	1 918 972	1 918 972
Jessica Fund	Liquidated	2	43 162 777	24 750 884	0	0	12 186 339	0	0	0	0	80 100 000	80 100 000	80 100 000	80 100 000	80 100 000
Information and training	Concluded	12	24 046	24 046	0	0	0	0	0	0	0	48 092	48 092	48 092	48 092	48 092
	Liquidated	25	221 747	221 747	0	0	0	0	0	0	0	443 494	443 494	473 744	473 710	443 460
	Total	**2 024**	**335 985 344**	**278 696 883**	**8 500 520**	**35 805 803**	**82 405 127**	**2 258 681**	**232 925 098**	**66 783 797**	**109 933 912**	**1 043 361 254**	**923 536 830**	**1 008 194 171**	**933 392 225**	**845 880 827**

Source: ENEA processing of data from the Prime Minister's Office (www.opencoesione.gov.it/)

Table A.28 – Interregional Operational Programme (IOP) 'Renewable energy and energy savings', Axis II 'Energy efficiency and optimisation of the energy system', by action, 2007-2013 programming cycle

Sector	Project status	No of projects	EU funding	State funding (Revolving Fund)	Municipal funding	Other public funding	Total public funding	EU reportable cost	Commitments	Total payments	Total EU reportable payments
2.1 – Measures to support entrepreneurship linked to energy savings with particular reference to business start-up and networks											
Business incentives	Concluded	1	50 250 000	16 750 000	0	0	67 000 000	67 000 000	67 000 000	67 000 000	67 000 000

2.2 – Energy efficiency projects for public or public-use buildings and energy users											
Public buildings	Ongoing	25	45 690 861	15 230 287	0	0	60 921 148	60 921 148	60 921 148	52 133 211	52 133 211
	Concluded	18	23 190 459	7 730 153	1 274 064	2 732 572	34 927 248	30 914 540	35 245 753	34 600 845	30 594 209
2.3 – Measures for the promotion and uptake of energy efficiency in protected natural areas and in the smaller islands linked to actions for the development of local networks and Sustainable Communities											
Public buildings	Ongoing	21	5 572 971	1 857 657	0	0	7 430 628	7 430 628	7 430 628	6 476 942	6 476 942
	Concluded	4	979 994	326 665	0	0	1 306 659	1 306 659	1 306 659	1 251 064	1 251 064
2.4 – Measures for developing and upgrading transport networks to increase the use of renewable energy sources and small and micro-cogeneration											
Energy distribution	Ongoing	8	78 989 046	26 329 682	0	0	105 318 727	105 318 727	105 318 727	92 342 607	92 342 607
	Concluded	6	61 711 713	20 570 571	0	0	82 282 285	82 282 285	82 282 285	82 282 285	82 282 285
	Liquidated	3	68 662 500	22 887 500	0	0	91 550 000	91 550 000	91 550 000	91 262 423	91 262 423
2.5 – Measures for heat distribution networks, particularly for cogeneration and district heating and cooling											
SME guarantee fund Public buildings	Ongoing	1	39 000 000	13 000 000	0	0	52 000 000	52 000 000	34 000 000	34 000 000	52 000 000
	Concluded	2	2 140 143	713 381	0	0	2 853 523	2 853 523	2 853 512	2 843 692	2 843 692
2.6 – Leadership, awareness and training actions											
Training and information	Ongoing	2	23 165 495	7 721 832	0	0	30 887 326	30 887 326	30 887 326	23 234 035	23 234 035
2.7 – Energy efficiency measures implemented primarily in the context of sustainable urban development actions or which are consistent with local or national planning											
Public buildings	Ongoing	20	11 396 166	3 798 722	0	0	15 194 888	15 194 888	15 194 888	11 876 212	11 876 212
	Concluded	19	2 452 397	817 466	0	1 956 641	5 226 504	3 269 863	5 226 504	5 209 863	3 253 223
	Liquidated	24	2 250 400	750 133	0	0	3 000 533	3 000 533	3 000 533	2 961 142	2 961 142
Lighting	Ongoing	13	11 936 332	3 978 777	28 024 071	0	43 939 180	15 915 109	43 939 180	33 553 145	12 000 237
	Concluded	30	1 202 940	400 980	1 546 159	0	3 150 079	1 603 920	3 150 079	3 149 273	1 603 115
	Liquidated	15	958 828	319 609	0	0	1 278 438	1 278 438	1 278 438	1 274 850	1 274 850
Distribution of energy	Ongoing	1	1 096 875	365 625	0	0	1 462 500	1 462 500	1 462 500	1 131 390	1 131 390
Horizontal measures in the public sector	Ongoing	2	750 000	250 000	96 696	0	1 096 696	1 000 000	1 096 696	948 635	869 545
	Concluded	25	2 852 505	950 835	8 081 624	1 296 728	13 181 692	3 803 340	13 181 692	13 116 646	3 738 295
	Liquidated	16	1 540 862	513 621	0	0	2 054 483	2 054 483	2 054 483	2 028 581	2 028 581
	TOTAL	**256**	**435 790 487**	**145 263 496**	**39 022 614**	**5 985 941**	**626 062 537**	**581 047 910**	**608 381 031**	**562 676 841**	**542 157 058**

Source: ENEA processing of data from the Prime Minister's Office (www.opencoesione.gov.it/) and Interregional Operational Programme (www.poienergia.gov.it/)

Annex 1 – Strategy for the energy efficiency renovation of building stock

Annex 2 – NZEB action plan

ANNEX 1 – Upgrading the energy efficiency of the national building stock

1 Preamble

In accordance with Article 4 of Directive 2012/27/EU, this document provides an overview of the national building stock in Italy. It identifies the intervention criteria on the basis of the optimisation of the cost/benefit ratio. It then examines the technical, economic and financial barriers that hinder the implementation of energy efficiency measures in buildings, recommending actions aimed at improving the effectiveness of supporting instruments. Lastly, it estimates the expected energy savings by 2020 in the civil sector.

2 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 (where temperatures can exceed 40 °C in summer), 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 for Ahrntal (Province of Bolzano) to 1 679 kWh/m^2 for Pachino (Province of Syracuse), 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. The design and implementation of the measures must therefore be carefully thought out by specialists. Furthermore, all stakeholders, including end users, must be involved in the process to achieve the energy saving targets prescribed by law.

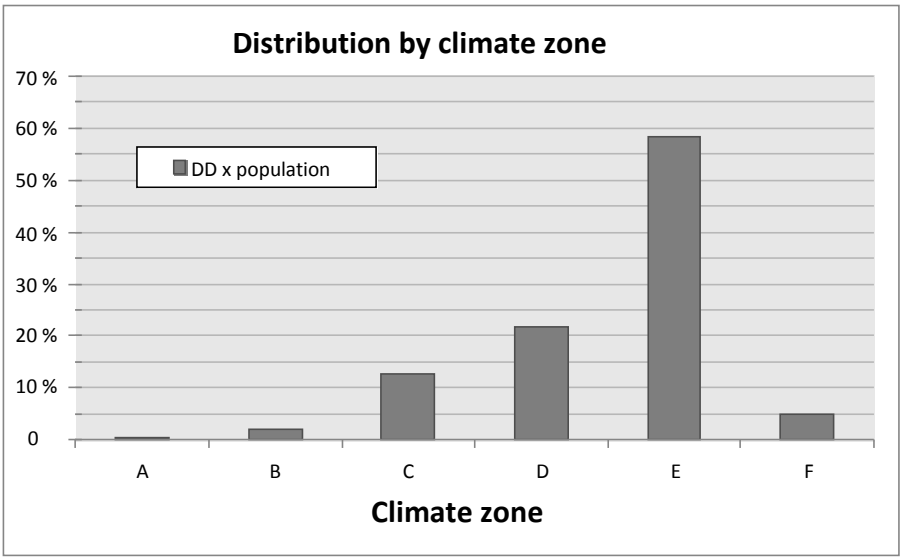
Table 1 lists Italy's climate zones and the number of municipalities in each one.

Table 1: Number of Italian municipalities by climate zone and 'degree days'

CLIMATE ZONE	DEGREE DAY (DD)	NUMBER OF MUNICIPALITIES	RESIDENT POPULATION	% RESIDENT POPULATION
A	DD ≤ 600	2	22 989	0.04 %
B	600 < DD ≤ 900	157	3 176 382	5.33 %
C	900 < DD ≤ 1 400	989	12 657 407	21.25 %
D	1 400 < DD ≤ 2 100	1 611	14 970 952	25.13 %
E	2 100 < DD ≤ 3 000	4 271	27 123 848	45.53 %
F	DD > 3 000	1 071	1 619 003	2.72 %

For the 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. Climate zone A, where only 0.04 % of the population lives (represented by only two municipalities), is excluded.

Figure 1: Distribution of population by climate zone



In 2015, final energy consumption totalled 116.4 Mtoe (excluding non-energy use), a 2.7 % increase on 2014. This was mainly due to the residential sector (+10 %) and tertiary sector (+4.9 %), which recorded consumption of 32.5 Mtoe and 15.4 Mtoe respectively. In the residential sector, this phenomenon was due to the climate factor[1], whereas in the tertiary sector, it was linked to the economic growth recorded in that sector. The structure of final energy consumption in 2015 illustrates the impact of the civil sector: this accounts for 41.1 % of total final consumption, up from 2014. The residential sector represents 27.9 % of this total, the service sector 13.2 %.

To conclude, the existing building stock is the sector with the highest potential for energy savings. However, the high investment costs pose a problem both for the government and the private sector.

For data on residential building stock, reference is made to the ISTAT 2011 census; for the non-residential sector, reference is made to the data contained in the CRESME and ENEA reports compiled during research into the national electrical system[2].

[1] Interestingly, 1 809 degree days were recorded in 2015, compared with 1 632 in 2014.
[2] Annual Implementation Plan (AIP) 2014 for the Programme Agreement between the Ministry of Economic Development and ENEA for research and development of general interest for the national electricity system.

2.1 Residential buildings

Italy has 12.2 million buildings intended for residential use, with more than 31 million dwellings. Over 60 % of this building stock is more than 45 years old (i.e. it predates Law No 373/1976[3], the first law on energy saving). Of these buildings, more than 25 % have annual consumption ranging from a minimum of 160 kWh/m^2 per year to over 220 kWh/m^2.

The current state of residential building stock is shown below by period of construction (Table 2) and climate zone (Table 3).

Building period	***Number of buildings***	***%***
Pre-1918	1 832 504	15.0
1919-1945	1 327 007	10.9
1946-1960	1 700 836	14.0
1961-1970	2 050 833	16.8
1971-1980	2 117 651	17.4
1981-1990	1 462 767	12.0
1991-2000	871 017	7.1
Post-2001	825 083	6.8
Total buildings	*12 187 698*	*100*

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

Table 2 – Residential buildings in 2011 by period of construction

Table 3 – Residential buildings in 2011 by climate zone

Climate zone	***Number of buildings***	***%***
Climate zone A	*4 875*	*0.04*
Climate zone B	*699 573*	*5.74*
Climate zone C	*2 710 544*	*22.24*
Climate zone D	*2 858 016*	*23.45*
Climatic zone E	*5 191 960*	*42.60*
Climate zone F	*722 730*	*5.93*
Total	*12 187 698*	*100*

2.2 Non-residential buildings

Non-residential buildings have been grouped into the most widespread categories: schools, offices, shopping centres, hotels and banks.

Schools: nationwide, there are about 51 000 buildings entirely or partly reserved for use as schools. A total of 30 % of school buildings are concentrated in 10 provinces (the top three being Rome, Milan and Naples). More than half (51 %) are located in 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 73.2 million m^2 and their total volume is about 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 as follows: 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).

Offices: nationwide, there are about 65 000 buildings entirely or mainly for office use. A total of 30 % of office buildings are concentrated in 12 provinces (the top three being Milan, Rome and Turin), and 50 % are located in 26 provinces. About half (53 %) of schools are located in small and medium-sized municipalities (up to 20 000 inhabitants). Office buildings have a total floor area of 56.7 million m^2 and their volume is just under 200 million m^3. Most buildings are of a small size: about half do not exceed 350 m^2. A share of 32 % of the total floor area and volume (about 62 million m^3) is made up of just under than 1 200 large buildings (more than 5 000 m^2), mainly concentrated in Northern Italy.

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[4] amounts to around 165 million m^2, divided between shops and boutiques (99 million m^2 between 876 300 businesses), restaurants, pizzerias and bars (44 million m^2 and 261 600 businesses) and supermarkets (22 million m^2 and around 20 100 companies). The latter category can be divided into five sub-types, as detailed in **Error. Reference source not found.**

The percentage distribution of consumption varies according to the market sector, particularly outside the food industry. In shopping centres that sell electronics, for example, electrical consumption is higher than for other products.

In terms of energy end use, the most common energy carrier is electricity (about 70 %), as shown by national and European studies[5].

Table 4 – Distribution of the floor area of large supermarket chains and specific consumption

Type	Number of companies	Size	Specific consumption
Minimarket	5 636	1.6 million m^2	535 kWh/m^2/year
Supermarket	10 108	9.3 million m^2	585 kWh/m^2/year
Hypermarket	610	3.7 million m^2	525 kWh/m^2/year
Department store	2 067	2.7 million m^2	255 kWh/m^2/year
Large specialist store	1 685	5.1 million m^2	219 kWh/m^2/year

Hotels: nationwide, there are about 25 800 buildings entirely or mainly for use as hotels. Of these, 30 % are concentrated in six provinces, in order: Rimini, Bolzano, Venice, Naples, Trento and Rome. The top 17 provinces account for 50 % of all hotels in Italy. Moreover, 30 % of hotels are located in municipalities with a low population (up to 5 000 inhabitants) and 64 % in municipalities with up to 20 000 inhabitants.

[4] Information on the retail and hotel sectors was obtained from Nomisma Energia data processed by RSE SpA.
[5] EU Project CommONEnergy 2014.

In the last eight years, the average annual addition of new hotel buildings has been around 1.4 % of the existing stock.

Just over 1 in 5 buildings was built before 1919; the past 20 years have seen a decline in new buildings compared with earlier periods. The buildings have a total floor area of 48.6 million m^2 and a volume of more than 140 million m^3. The largest share of buildings is medium-large in size: almost 60 % are over 1 000 m^2. However, 43 % of floor areas and volumes (about 61 million m^3) are made up of 13 % of hotel buildings, i.e. 3 300 large buildings (more than 3 000 m^2). These are mainly concentrated in Northern Italy.

Banks: Italy has 76 banking groups, comprising 33 727 branches across the country. Many of these branches occupy portions of buildings, usually on the ground floor.

Buildings wholly or mainly for bank use number 1 469. Geographical concentration is fairly high: just over 30 % of those buildings are concentrated in only four provinces (Milan, Rome, Turin and Florence), while 50 % are distributed across the top 14 provinces. Also in terms of large geographical areas, distribution is not proportionate to the population: 58.2 % of buildings are located in Northern Italy, 22.2 % in Central Italy and 19.6 % in Southern Italy.

The buildings have a total floor area of 5.48 million m^2 and a volume of just over 18.5 million m^3. About half the buildings are medium-large in size: 48 % are over 1 000 m^2. However, 62 % of floor area and volume (about 11.5 million m^3) is made up of just 16 % of bank-use buildings, i.e. 236 large buildings (each with floor area over 5 000 m^2), almost exclusively concentrated in Central and Northern Italy.

2.3 Estimating consumption

The estimates for calculating average consumption for the different intended uses were based on 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. Unoccupied residential buildings (which account for some 22 % of the total) and partially used non-residential buildings were not included in the assessment of buildings and their useful floor area. Table 5 contains the average annual consumption indicators for each intended use[6].

Table 5 – Summary of intended use and average annual consumption indicator weighted by climate zone

Intended use	Electricity consumption [kWh/m^2 year]	Thermal consumption [kWh/m^2 year]
Single-family building	38	142
Multi-dwelling building	35	125
Schools	20	130
Offices	95	170
Hotels	110	150

[6] For the analysis, data from ISTAT, the Ministry of Economic Development, CRESME and ENEA were used.

3 Cost-effective measures and national savings potential

3.1 Assessment methodology for the cost-benefit ratio

Based on Directive 2010/31/EU (EPBD recast), Delegated Regulation (EU) No 244/2012[7] for the application of the comparative methodology, and the Commission Guidelines of 19 April 2012[8] accompanying the Regulation, the methodological framework was defined to determine the optimal energy requirements of buildings from a technical and economic viewpoint. The Member States are required to define the energy efficiency measures to be applied to residential and non-residential buildings by making reference to the results of applying that methodology (cf. Annex 1).

Regarding the provisions of Article 5 and Annex III of Directive 2010/31/EU, to define these measures a comparative methodology was applied for calculating the cost-optimal energy efficiency requirements. Measures that interact with each other (for example, the insulation of the building envelope affects the output and size of the technical installations) were combined in packages and/or variants.

The energy assessment was carried out by applying a simplified methodology in accordance with the technical specifications UNI/TS 11300:1-4. This was used to estimate the overall energy consumption for each building in the sample; to estimate the overall cost in the context of a new build or major renovation, the economic assessment was carried out in accordance with the standard UNI EN 15459.

For the assessments, reference was made to a conventional user and reference climate zone, so as to eliminate the effect of user behaviour or climate conditions on the final result. To that end, UNI/TS 11300 was used to define the 'standard' boundary conditions[9]. Regarding the thermal conditions of adjacent buildings or building units, UNI/TS 11300-1 requires, for all building categories (except for categories E.6(1) swimming pools, saunas and similar, E.6(2) gyms and similar and E.8 buildings used for industrial and craft activities and similar), a temperature of 20 °C in winter and 26 °C in summer. With regard to the management of a building installation system, a 'conventional' user is defined[10].

The energy efficiency measures taken into account made reference to various intended uses, as required by the recast Energy Performance of Buildings Directive (EPBD) and Directive 2012/27/EU. For the public and private sector, these concerned the 'residential, schools and offices' category; for the private sector only, hotels and shopping centres were also considered. For each intended use, the measures were assumed to have different efficiency levels:

- the first level indicated failure to meet the energy requirements in force;
- the second level indicated compliance with the energy requirements laid down in Legislative Decree No 192/2005, prior to the legislative amendments that entered into force on 1 October 2015;

[7] Commission Delegated Regulation (EU) No 244/2012 of 16 January 2012 supplementing Directive 2010/31/EU of the European Parliament and of the Council on the energy performance of buildings by establishing a comparative methodology framework for calculating cost-optimal levels of minimum energy performance requirements for buildings and building elements.

[8] Guidelines accompanying Commission Delegated Regulation (EU) No 244/2012 of 16 January 2012.

[9] With regard to climate data, UNI/TS 11300 refers to the standard UNI 10349 and Presidential Decree No 412/1993 (degree days).

[10] Annex E to UNI/TS 11300-1 reports the average daily factor of presence in air-conditioned premises, the correction factor for ventilation under reference conditions, and the overall average gains per unit of floor area.

- the subsequent levels indicated an improvement on the performance required by law.

For example, for measures to upgrade the energy efficiency of the building envelope, the first level considers a higher (i.e. worse) thermal transmittance value than the one prescribed by Annex C to Legislative Decree No 192/2005; the second level upgrades the building envelope to the standards prescribed by the Annex; and subsequent levels introduce further improvements.

For the application of the optimisation procedure, the following factors were defined:

- the energy efficiency measures to be considered;
- the energy saving options based on different solutions and/or several simultaneous measures;
- the energy savings achievable;
- the optimal costs of the measures[11].

Once the energy demand of the buildings was established, the package of measures was defined through an iterative calculation, which gave the cost-optimal level for that particular building category. More details on the methodology used can be found in Annex 1.

3.1.1 Building clustering model

The existing building stock is extremely varied in terms of type, construction, technical installations, geographical location, climate, etc. In order to establish a meaningful representation for this population, a method had to be found that would describe it according its various characteristics. Building categories were therefore defined, based on which a clustering model could then be generated. This model was then used to define additional models, parameters and criteria, as described below.

By defining a clustering model, the building stock could be presented in a meaningful and representative manner. Below are some of the aspects that informed the choice of criteria for creating a reference framework with which to assess the buildings and define the measures, together with the related priorities.

- The housing stock consists of a large number of buildings constructed before the Second World War (30.1 % of buildings). From the post-war period until the late 1990s, Italian building construction saw a sharp increase (around 70 % of buildings). During the last property cycle (post-2001), taller multi-storey buildings with larger plan dimensions were built (4.5 %). In general, the building stock was constructed at different times, and around 60 % consists of buildings constructed prior to the enactment of the first law on energy saving (Law No 373/1976). Many are subject to architectural and planning constraints.
- Because they were built at different times, the buildings have different construction techniques: stone-built with iron or timber floors; entirely stone-built; stone- and brick-built; built from reinforced concrete and brick; built from reinforced concrete with prefabricated curtain walls; entirely built from reinforced concrete; timber construction; steel and glass construction; glass and steel curtain walls.
- Two main types of use have been identified: residential and non-residential. Residential buildings include detached and semi-detached houses, terraced houses,

[11] For the lifecycle assessment of building elements, reference is made to Annex 1 to EN 15459:2007.

blocks, high-rise buildings, etc.; non-residential buildings, in addition to their various configurations, encompass a wide range of uses with specific user profiles and needs (schools, offices, farm buildings, hotels, shopping centres, sports centres, etc.).

- The buildings are located in different climate zones and geographical regions, and so require specific energy efficiency measures.

Defining packages of standard measures to be carried out on the building envelope, installations or entire building (deep renovations) is therefore extremely difficult. Consequently, the first step of the methodology consisted of estimating:

- the number of residential and non-residential buildings to be refurbished;
- the provincial or sub-provincial geographical distribution;
- the size classes of these buildings;
- the representative types of building;
- the types of heating and lighting systems and the energy source used.

The model therefore consists of the following steps:

- definition of the reference buildings;
- definition of the energy efficiency measures to be applied to the reference buildings;
- calculation of the energy demand of the reference buildings, as modified by each of the energy efficiency measures considered;
- calculation of the overall cost[12] of the measures;
- sensitivity analysis;
- calculation of the cost-optimal levels.

3.1.2 Results of the application of the comparative methodology

By applying the comparative methodology[13], the optimal value of the primary energy (PE) performance index can be assessed for new and existing residential buildings (Table 6) and office buildings (Table 7) in climate zones B and E, taking into account the energy performance and costs of the measures[14]. This procedure defines the optimal energy performance requirements of the energy efficiency measures implemented, considering the investment costs for energy installations, maintenance and operating costs and any disposal costs. In addition, the potential[15] reduction in related consumption can also be calculated.

For climate zones B (climate with mainly summer demand) and E (mainly winter demand), the following types of buildings were selected:

- RMF: single-family house;
- RPC: small multi-apartment building;

[12] The term 'overall cost' means the cost associated with a new build or deep renovation, divided into various cost components: initial investment; maintenance; replacement; sale; residual cost.
[13] Application of the methodology for the calculation of cost-optimal levels of minimum energy performance requirements (Directive 2010/31/EU, Article 5), July 2013.
[14] To determine the population of buildings to be considered, the main criterion was current energy consumption.
[15] 'Potential' means the performance theoretically achievable, regardless of the current trend observed for renovations.

- RGC: large multi-apartment building;
- UFF: office buildings.

For each type, both the new building (NB) and renovations of two different existing buildings (E1 and E2) were considered. The results are given in Table 6 (residential) and Table 7 (offices). The optimal values are determined through the technical and economical optimisation of the various possible configurations. Annex 1 contains a flow chart for the optimisation procedure and the methodology employed. Note 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 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 Tables 6 and 7.

	BUILDING CODE	Overall cost [€/m^2]	PE optimal value [kWh/m^2]
CLIMATE ZONE E	RMF_E1	566	69.4
	RMF_E2	464	54.17
	RMF_N0	512	58.42
	RPC_E1	612	115.57
	RPC_E2	520	63.27
	RPC_N0	510	61.06
	RGC_E1	676	116.13
	RGC_E2	493	81.72
	RGC_N0	429	68.25
CLIMATE ZONE B	RMF_E1	420	46.14
	RMF_E2	374	43.1
	RMF_N0	359	31.3
	RPC_E1	466	93.41
	RPC_E2	418	54.1
	RPC_N0	419	50.81
	RGC_E1	541	81.22
	RGC_E2	439	69.13
	RGC_N0	346	46.97

Table 6 – Minimum overall cost and related optimal annual primary energy value of reference residential buildings

Table 7 – Minimum overall cost and related optimal annual primary energy value of reference office buildings

	BUILDING CODE	Overall cost [€/m^2]	PE optimal value [kWh/m^2]
CLIMATE ZONE E	UFF_E1	752	115
	UFF_E2	454	87
	UFF_N0	608	112
CLIMATE ZONE B	UFF_E1	669	79
	UFF_E2	406	116
	UFF_N0	502	68

3.2 Potential savings in the civil sector

This section summarises the results of the study on the potential savings in the civil sector. 'Potential savings' means the savings that would be achieved if all energy efficiency improvement measures having a favourable cost/benefit ratio and not yet implemented were carried out, irrespective of the spending capacity of the executing parties and the financial resources available under the energy efficiency promotion schemes, over a seven-year period. Clearly this potential is only theoretical, since the decision to execute the works does not depend on the cost/benefit ratio alone.

To assess the potential savings, the category of buildings was considered in relation to the distribution by climate zone and intended use (residential and non-residential). For data on residential building stock, reference is made to the ISTAT 2011 census; for the non-residential sector, reference is made to the data contained in the CRESME and ENEA reports compiled during research into the national electrical system[16].

As previously mentioned, the analysis of these subsets of buildings focused on those having the poorest energy performance.

Table 8 – Distribution by climate zone of residential and non-residential buildings

Type of building	Climate zone	Number of buildings	Values %
Residential	abc	3 412 000	28
	d	2 803 000	23
	ef	5 972 000	49
	Total	12 187 000	**100**
Non-residential			
Offices	abc	18 525	28
	d	18 265	28
	ef	28 210	44
	Total	**65 000**	**100**
Schools	abc	14 014	27
	d	12 976	25
	ef	24 914	48
	Total	**51 904**	**100**

3.2.1 Residential buildings

For the residential sector, the assessment concerned the existing building stock built between 1946 and 2005 (both single-family and multi-dwelling buildings), and included two types of renovation (complete and partial).

Potential consumption reduction was estimated taking into account the performance standards in force, the cost/benefit ratio and the feasibility of the following type of works:

[16] Annual Implementation Plan (AIP) 2014 for the Programme Agreement between the Ministry of Economic Development and ENEA for research and development of general interest for the national electricity system.

- 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 elements);
- upgrading of the heating/cooling system controls (thermostatic valves, etc.);
- replacement of the heat generator (with condensing boilers or heat pumps, including geothermal pumps);
- installation of a home automation system;
- replacement or refurbishing of the lighting system (high-efficiency luminaries);
- use of renewable sources (thermal solar panels, photovoltaics).

The types of measures considered are as follows.

- Complete renovation: this concerns about 3.5 % of the buildings built in the period from 1946 to 2005 for single-family buildings and about 3 % of multi-dwelling buildings, for an annual floor area of about 51.6 million m^2. The potential for energy efficiency improvements in this category of buildings is greater in those built between 1946 and 1980, which have the poorest energy performance.
- Partial renovation: this mainly concerns individual apartments and common areas and technical systems of multi-dwelling buildings. It is estimated that effective action can be taken on about 4 % of buildings, for an annual floor area of some 118.5 million m^2. To estimate the achievable savings the various projects have been broken down by single-family and multi-dwelling buildings built between 1946 and 2005, with different consumption reduction percentages according to type of project.

The evaluations made lead to the potential energy savings achievable over a seven-year period (2014-2020), as illustrated in Table 9.

Table 9 – Consumption reduction potential by 2020 from works on residential buildings carried out from 2014

Type of building	**Renovation scenarios on the building stock**		**Energy saving by type of project***					**Total energy savings by 2020[17]**	**Total energy savings by 2020[24]**
	Floor area covered	**Floor area covered by renovation each year**	Roof	External walls	Windows and external doors	Technical systems	Complete renovation		
		m^2	**GWh/year**					**GWh/year**	**Mtoe/year**
Single-family buildings	**Partial renovation**	39 407 808	221	132	83	265		4 907	0.43
	Complete renovation	26 551 030					2 230	15 610	1.34
Multi-dwelling buildings	**Partial renovation**	79 141 300	253	475	253	658		11 473	0.98
	Complete renovation	25 142 222					2 414	16 898	1.45

[17] The energy saving values given for the projects should be considered in isolation, since they cannot be aggregated.

Total	**170 242 360**		**48 888**	**4.20**

The estimated investments to achieve these potential savings amount to EUR 13.6 billion per year for complete renovation projects and EUR 10.5 billion per year for partial renovation projects. To estimate the investment costs to be incurred, a technical and economic assessment was carried out taking into account the different types of residential building located in climate zones A to F. This resulted in different assessments from the comparative methodology, based on 'typical' reference buildings located in two climate zones, B and E.

3.2.2 Non-residential buildings

For the non-residential sector, the analysis took into account buildings with specific uses (offices, schools, hotels, banks and shopping centres) for which the average energy consumption is 50 % higher than the benchmark. The potential savings achievable by 2020 were assessed based on that analysis.

The measures taken into account in assessing consumption reduction relate to:

- thermal roof insulation;
- thermal insulation of stilt floors or floors/ceilings bordering on unheated spaces and of heat-dispersing external walls (portion of wall below the window);
- replacement of existing windows with high-energy performance windows;
- upgrading of the heating/cooling system controls (thermostatic valves, etc.);
- replacement of the heat generator (especially for those still using diesel);
- use of high-efficiency heat recovery systems;
- installation of a home automation system or a BEMS (Building Energy Management System);
- replacement/refurbishing of the lighting system (high-efficiency luminaries);
- external solar screens, especially on south-facing sides of the building.

Complete renovations involve different combinations of the above-mentioned individual measures, depending on the climate characteristics of the zone in which the building is situated, the intended use and the cost/benefit ratio.

The floor area of the public and private buildings that can effectively be renovated each year has been estimated to be:

- 5.5 million m^2 for office use (about 2 000 buildings);
- 6.0 million m^2 for school use (about 3 800 buildings);
- 1.4 million m^2 for hotels (about 500 buildings);
- 2.3 million m^2 for shopping centres;
- 0.8 million m^2 for banks.

On this stock of buildings, several measures have been applied, differentiated by climate zone and applicability of the solutions, to achieve energy savings of 60 % in the public sector (offices and schools), 45 % in the private sector (offices, hotels, schools and banks) and 35 % in shopping centres. The difference in energy saving percentages between the public and private sector stems from the fact that public buildings were mainly constructed prior to 1980, and their baseline energy performance is therefore poorer. For shopping centres, the conservative estimates of 35 % savings is due to the fact that, on account of the type of building envelope, upgrading actions are mainly restricted to the technical systems.

The estimated investments for these projects amount to EUR 17.5 billion per annum, and should

yield potential energy savings by 2020 of some 17 229 GWh/year, equivalent to 1.48 Mtoe/year (Table 10). To estimate the investments, given the widespread use of asbestos in buildings between the mid-1960s and the late 1970s, consideration was also given to remediation costs and costs of measures involving stabilisation works, such as the alteration of flat roofs for the installation of renewable energy sources. The percentage of these costs is estimated at about 20 %.

Table 10 – Consumption reduction potential by 2020 from complete renovation of non-residential buildings carried out from 2014

Buildings	Floor area covered by renovation each year	Total energy savings by 2020	Total energy savings by 2020
Type	**m^2**	**GWh/year**	**Mtoe/year**
Private offices	2 880 000	2 858	0.25
Public offices	2 640 000	3 881	0.33
Hotels	1 425 000	1 167	0.10
Private schools	1 000 000	617	0.05
Public schools	4 950 000	5 821	0.50
Banks	782 811	726	0.06
Shopping centres	2 289 163	2 159	0.19
Total	**15 966 974**	**17 229**	**1.49**

3.2.3 Total potential reduction in consumption by 2020

Table 11 summarises the total theoretical potential to reduce consumption by 2020 for works on residential and non-residential buildings. Overall, this amounts to 5.69 Mtoe/year. The total amount of resources to be mobilised over a seven-year period is more than EUR 290 billion.

Table 11 – Consumption reduction potential by 2020 from partial renovation of residential buildings and complete renovation of non-residential buildings carried out from 2014

Buildings	Floor area covered by renovation each year	Total energy savings by 2020	Total energy savings by 2020
Type	**m^2**	**GWh/year**	**Mtoe/year**
Residential	170 242 360	48 888	4.20
Non-residential	15 966 974	17 229	1.49
Total	**186 209 334**	**66 117**	**5.69**

3.3 Barriers to measures to improve the energy performance of buildings

Although the energy efficiency measures described are profitable, there are various impediments to this positive process being instigated voluntarily, especially in the case of minor works. The high initial investment costs, a frequent lack of awareness of the potential savings and difficulty in accessing incentives in many cases deter small-scale consumers. A brief analysis of the main technical and economic/financial barriers is provided below.

3.3.1 Technical and administrative barriers

Technical barriers cover several areas. Crucially, a regional variation exists in the implementation of procedures and requirements laid down in the planning tools that govern and regulate measures aimed at improving the energy efficiency of existing buildings, and the criteria for steering those measures toward innovative solutions.

Other issues concern the following processes:

- the management of the application procedure, which should be handled via websites accessible to individuals and businesses containing information on local planning restrictions;
- supporting documents for applications, which should be standardised and streamlined;
- administrative or preliminary costs, which should not discourage the use of energy efficient technology.

Simplifying the procedures is key, since this represents the bedrock of an environment conducive to investment, innovation and entrepreneurship. Actions to this effect will also speed up the harmonisation of planning tools for the implementation of measures on the ground. In this respect, the government digitisation process currently under way will play a vital role.

A key provision on simplification was introduced in Article 14(5) of Legislative Decree No 102/2014. This provides for the publication of guidelines to simplify and harmonise the application procedure for the setting up of energy efficient technical installations or mechanisms in residential and commercial property and for the use of renewables, and to harmonise the rules on energy performance certificates, accreditation requirements for certifying parties, and the system of checks and penalties. The new guidelines are expected to be issued in the coming months.

3.3.2 Economic and financial barriers

It has become considerably harder in recent years to obtain bank loans, especially for deep renovations. This is mainly due to the complexity of assessment and technical/economic approval of the project, the lengthy payback periods, the timing of payments, and the interest rates charged. In the case of projects implemented via an ESCO, the uncertainty of the future cash flows is another deterrent to the granting of funding. The lending process also remains highly conservative, given the limited experience and reluctance to finance energy efficiency projects based on cash flow, particularly where innovative incentive schemes are involved. This is partly due to the limited financial size of the projects (medium-small), which is of little interest to large financial institutions, but above all to the lack of project ‘models’. Added to this is the perceived high risk among the banks themselves, owing to the difficulty in calculating the actual costs of advanced or innovative technology, assessing unforeseen costs, and factoring in the significant fluctuations in energy costs, which affect the return on investment over time.

On the end-user side, the barriers are mainly access to credit, the interest rates charged and the lack of subsidised funding. In addition, the difficulties in accessing public funding and tax relief are even higher for innovative projects, regardless of the end-use sector.

Another issue is the separation of interests: the economic benefits and investment costs often go to different parties. In the residential sector, this situation typically occurs in the tenant-landlord relationship, where the landlord might make energy efficiency investments without reaping any direct benefit, other than increasing the value of the property, while the tenants could benefit from smaller utility bills, but have no interest in investing in a property they do not own and which they might leave a few years hence, before having recovered their investment.

In the case of works in public and private multi-owner buildings financed by ESCOs, there is a high

risk of payment default, which discourages ESCOs in view of the possible problems in collecting their share of receivables from the energy savings achieved.

As a result of these issues, the bank loans and leasing – which are the most widely used instruments[18] for financing energy efficiency measures – currently available on the market have almost 'traditional' characteristics, hardly compatible with the nature of energy efficiency schemes. For example, banks will rely on the applicant's credit score as a decision-making criterion far more than the technical and economic merits of the project.

Overcoming these barriers is thus a priority for 'capturing' the maximum potential savings available. Some actions have already been taken, such as the extension of tax relief, the launch of the thermal energy account and the introduction of new energy saving targets through the white certificates mechanism. More generally, to overcome the barriers to the adoption of energy efficient solutions, it is crucial that instruments are rationalised and strengthened and that dedicated measures are put in place for each market segment and sector. The existing instruments have been or will be reinforced. In addition, new instruments will be introduced that set targets on the basis of both the potential to increase the energy efficiency of each consumption sector targeted, and the specific cost/benefit ratio of the instrument itself. Other opportunities were provided for in Legislative Decree No 102 of 4 July 2014, transposing Directive 2012/27/EU, which, to overcome the financial barriers described above, introduced the National Energy Efficiency Fund.

4 Assessment of the annual savings achievable by 2020 under existing instruments

While section 3.2 estimated the potential savings resulting from energy efficiency measures in residential and non-residential buildings, this section examines the savings achievable due to the regulatory or incentive-based policy measures currently in force, as covered in the Energy Efficiency Action Plan (EEAP) 2017.

The civil sector's contribution to the national targets is estimated at 4.9 Mtoe/year by 2020, including 3.67 Mtoe/year from the residential sector and 1.23 Mtoe/year from the non-residential sector. This estimate is based on consideration of the following factors:

- application of the new standards required by the EPBD for buildings and by the Ecodesign Directive for heating and cooling systems: the contribution to the total figure is estimated to be in the region of 1.6 Mtoe/year for residential buildings and 0.2 Mtoe/year for non-residential buildings;
- tax relief mechanism: this is estimated to yield a savings of 1.38 Mtoe/year of final energy in the residential sector;
- thermal energy account: this is estimated to save 1.47 Mtoe/year of final energy use, including 0.54 Mtoe/year in the residential sector and 0.93 Mtoe in the tertiary sector, both public and private;

[18] Over EUR 600 million disbursed during the period 2007-2013 (source: Energy Strategy Group, Milan Polytechnic).

- white certificates: while this scheme was designed with the industrial sector and infrastructure in mind, based on historical data white certificates are estimated to generate savings in the civil sector of 0.25 Mtoe/year of final energy, including 0.15 Mtoe/year in the residential sector and 0.1 Mtoe/year in the tertiary sector.

Table 13 illustrates the savings achieved during the period 2011-2016 for each economic sector as a result of the main policy measures in force: the comparison with the 2020 targets shows that the residential sector has nearly reached the target set, while there is a significant gap between the results obtained and the targets for the tertiary sector.

Table 13 – Annual energy savings achieved by sector during the period 2011-2016 and expected by 2020 (final energy, Mtoe/year)

Sector	White certificates	Tax relief*	Thermal energy account	Legislative Decree No 192/2005*	Eco-incentives and EU regulations*	Other measures**	Energy savings		Target achieved
							Achieved 2016	Expected by 2020	
Residential	0.59	1.56	-	0.91	-	0.02	**3.09**	**3.67**	**84.2 %**
Tertiary	0.13	0.02	0.003	0.05	-	-	**0.19**	**1.23**	**15.4 %**
Industry	1.84	0.03	-	0.09	-	-	**1.95**	**5.10**	**38.3 %**
Transport	-	-	-	-	1.13	0.04	**1.18**	**5.50**	**21.4 %**
Total	**2.56**	**1.60**	**0.003**	**1.05**	**1.13**	**0.07**	**6.41**	**15.50**	**41.4 %**

* Estimate for 2016.

** The residential sector includes savings from replacing large domestic appliances. The transport sector includes savings resulting from high-speed transport.

Source: ENEA processing of data from the Ministry of Economic Development, ISTAT, Gestore dei Servizi Energetici SpA, ENEA, FIAIP, GFK.

5 Conclusions

Italy already has a broad set of measures for the promotion of energy efficiency in buildings, described in detail in the EEAP 2017. By 2016, these measures had already achieved over 80 % of the savings target for 2020, particularly in the residential sector.

However, there are still potential savings to be tapped by implementing measures to overcome the barriers that limit investment in the energy-efficient renovation of buildings. This process is already under way, as evidenced by last year's updates to the main instruments used to promote energy efficiency, including, for example, maintaining tax relief for energy efficiency improvements to common areas of multi-apartment buildings until 2021.

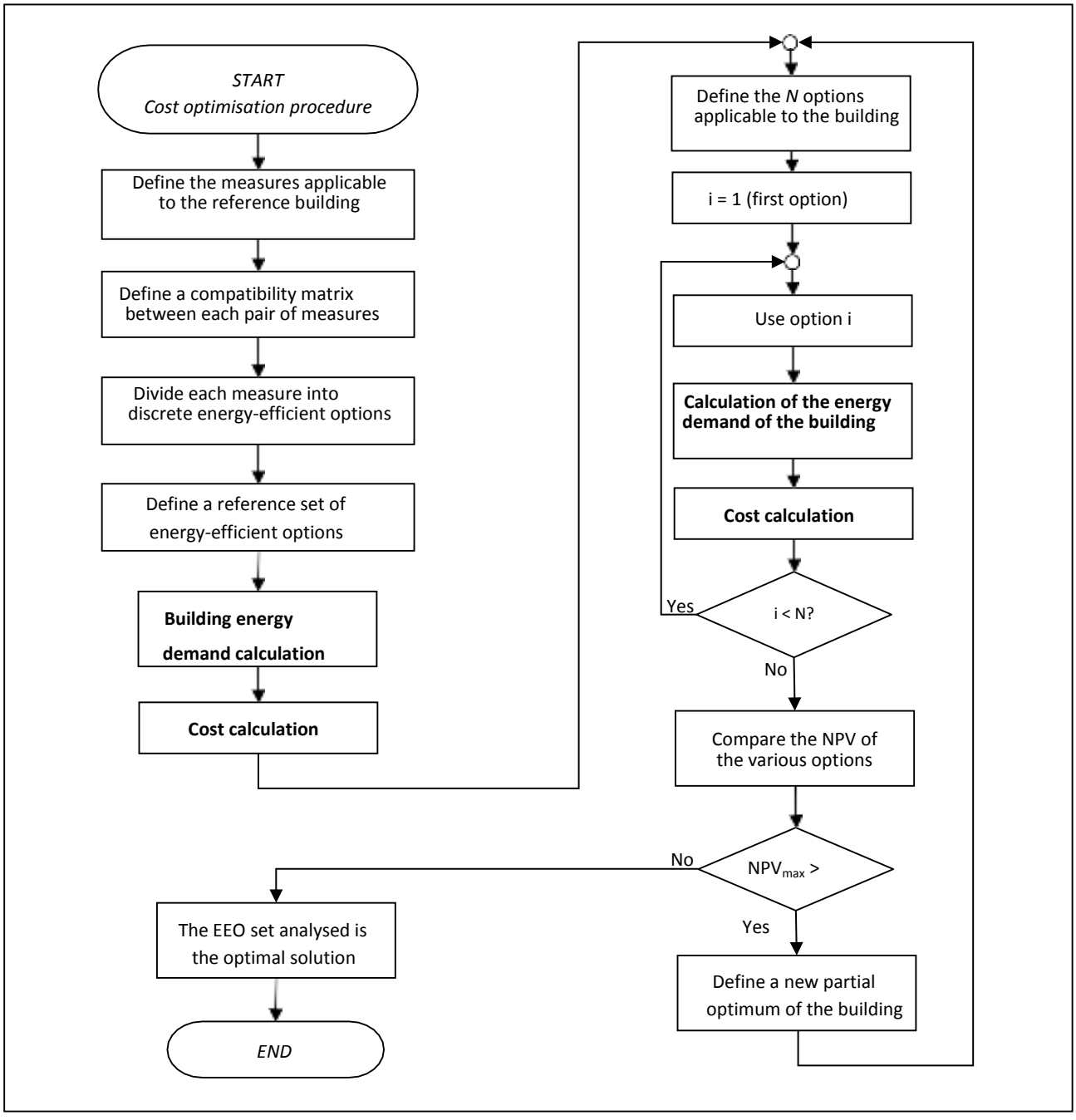
Together with new schemes, Italy remains committed to developing and refining its existing instruments for promoting energy efficiency in buildings.

To that end, revising the National Energy Strategy will be crucial ahead of the preparation of the Climate and Energy Plan, which will leverage the potential energy savings in the civil sector as a key to achieving the environmental targets by 2030.

Appendix 1 – Optimisation methodology

An optimisation macro has been developed that interfaces with spreadsheets for the calculation of energy demand (UNI/S 11300-1, 2, 3, 4) and overall cost. An auxiliary spreadsheet links each package of measures identified by the optimisation procedure to all input data necessary to describe the reference building and perform the calculations.

Optimisation procedure flow chart



The optimisation methodology considers discrete energy efficient options (for example, different levels of thermal insulation), applied one at a time to obtain a new partial 'optimised building' for each calculation step.

The starting point of the iterative optimisation calculation is a reference package of energy-efficient options; the present value of each series of energy-efficient options is defined in relation to the reference set. Next, the procedure identifies a series of configurations (packages of measures) that represent 'partial optimums'. To progress from one partial optimum to the next, all the parameters that characterise the levels of each energy-efficient measure will be changed one at a time. Of all the configurations tested, the next partial optimum is the one that offers the greatest reduction in overall cost.

Classification of packages of measures to be applied to various building clusters

For an estimate of the measure, consideration was given to the actual applicability of the energy-efficient measures, the cost/benefit ratios and the modularity of operations concerning:

a. the building envelope: reference was made to the standard parameters prescribed by Legislative Decree No 192/2005, as amended, which involve the insulation of the building envelope, the replacement of doors and windows, screening elements, etc.;

b. thermal and electrical installations: integrated projects were considered such as the replacement of the existing thermal installation with a new high efficiency system, where necessary, and the implementation of a BEMS to manage the entire electrical system of the building, with the integration and installation of renewable energy sources.

The following measures were assessed for their potential to reduce consumption:

- thermal insulation of the building envelope;
- thermal insulation of the roof;
- thermal insulation of stilt floors or floors/ceilings bordering on unheated spaces and of heat-dispersing external walls (portion of wall below the window, roller blind boxes, etc.);
- replacement of existing windows with high-energy performance windows;
- upgrading of the heating/cooling system controls (thermostatic valves, etc.);
- replacement of the heat generator (especially of those still using diesel);
- installation of a home automation system or a BEMS;
- replacement/refurbishing of the lighting system (high-efficiency luminaries);
- external solar screens, especially on south-facing sides of the building.

The projects considered are defined as a mix of combinations that take into account both the climate characteristics at the building's location, and the type and intended use***.***

For this assessment, considering the interaction between the different measures (such as the insulation of the building envelope, which affects the output and size of technical systems), the measures were combined into 'packages'. The aim was to create synergy in order to achieve more realistic results (in terms of cost and energy performance) than would be achievable with individual measures.

The energy efficiency projects considered were divided into different categories depending on the building type. These were then assessed according to the energy efficiency of the measures (EEM) and cost/benefit factor, by reference to the performance standards prescribed by the regulations in force and improvements for the application of Decree-Law No 63/2013.

By way of example, Table A.1 lists the projects considered for the category of 'existing non-residential buildings'.

Table A.1 – Projects for the definition of technology 'packages'

No	Energy efficiency of the measures	Parameter	Symbol
1	External wall insulation (external layer)	Thermal transmittance [W/(m^{2}K)]	U_p
2	Thermal insulation of external walls with blown cavity insulation	Thermal transmittance [W/(m^{2}K)]	U_p
3	Roof insulation	Thermal transmittance [W/(m^{2}K)]	U_r
4	Slab insulation	Thermal transmittance [W/(m^{2}K)]	U_f
5	Doors and windows	Thermal transmittance [W/(m^{2}K)]	U_w
6	Shading systems	Total solar energy transmittance g_{gl}	g_{gl}
7	High-efficiency chiller units	Energy efficiency index in design conditions	EER
8	High-efficiency heating system	Generation efficiency	η_{gn}
9	High-efficiency hot water systems	System performance at 100 % load	$\eta_{gn,Pn,W}$
10	Heating and hot water systems	Generation efficiency	η_{gn}
11	Heat pump for heating system and cooling and hot water production	Coefficient of performance	COP
		Energy efficiency index in design conditions	EER
12	Solar thermal energy	m^2 of solar captors	m^2
13	Solar photovoltaic	Installed peak power	kWp
14	High-efficiency heat exchangers	Heat exchanger efficiency	η_r
15	Intelligent control and management systems	Regulation and control efficiency	η_{ctr}
16	Installed lighting power density	Installed lighting power density (W/m²) (UNI EN 15193)	PN
17	Lighting control systems	Factor of dependency on occupation (UNI EN 15193)	F_o

ANNEX 2

NZEB ACTION PLAN

National plan for increasing the number of nearly zero-energy buildings

December 2016

This document was produced by a working group composed of the Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA), the Italian Thermo-technical Committee (CTI) and RSE SpA, in collaboration with the Ministry of Economic Development.

Contents

1. Introduction

Energy efficiency in buildings is one of the most relevant and strategic issues to have come under the spotlight in recent years, both at a European and international level. Nearly 40 % of final energy consumption (and 36 % of greenhouse gas emissions) comes from homes, offices, shops and other buildings. Improving the energy performance of Europe's building stock is crucial not only for achieving the EU's targets by 2020, but also for meeting the longer-term objectives of our climate strategy, as laid down in the roadmap for moving to a low carbon economy by 2050. The EU has launched a series of projects and programmes and adopted various directives, namely Directives 2002/91/EC and 2010/31/EU on the energy performance of buildings, Directive 2006/32/EC on energy services and Directive 2012/27/EU on energy efficiency. They aim to offer harmonised and shared instruments, criteria and solutions to tackle the issue of increasing energy efficiency in new and existing buildings.

Directive 2010/31/EU on the energy performance of buildings (EPBD) is the EU's main legislative instrument for improving energy efficiency in buildings. A key element of the EPBD is the concept of nearly zero-energy buildings (NZEB).

The EPBD requires Member States to ensure that by 31 December 2020, all new buildings are nearly zero-energy buildings. In addition, from 31 December 2018, all new buildings occupied and owned by public authorities must also be nearly zero-energy buildings.

Energy efficiency is the main priority of the National Energy Strategy (NES). This sets out a roadmap for exceeding EU targets by 2020 and spurs Italian industry to lead the way in exploiting the significant global growth forecast in the energy-efficient technology sector. The NES sets a final energy savings target of 15.5 Mtoe by 2020, equivalent to a 24 % saving compared with the EU baseline.

Given the potential for savings in the civil sector – which accounts for around 39.7 % of national energy end-use demand – Italy considers increasing energy efficiency in buildings and the transition to nearly zero-energy buildings (NZEB) as a primary objective, to be pursued through a wide range of regulatory and incentive measures.

Legislative Decree No 192 of 19 August 2005, transposing Directive 2002/91/EC on energy efficiency in buildings, amended by Decree-Law No 63/2013 transposing Directive 2010/31/EU, Legislative Decree No 102 of 4 July 2014 transposing Directive 2012/27/EU, as amended by Legislative Decree No 141/2016, and Legislative Decrees Nos 115/2008 and 28/2011 transposing Directives 2006/32/EC and 2009/28/EC respectively, are a significant step towards greater energy efficiency in buildings and the promotion of renewable energy in Italy.

New building regulations have now been approved in accordance with Article 4(1-*sexies*) of Presidential Decree No 380/2001. The regulations are intended to simplify and harmonise standards and requirements nationwide. The building regulations lay down the performance requirements for buildings, particularly with regard to safety and energy efficiency, and will be adopted by local municipalities within the statutory timeframe.

As stated in the 2014 Energy Efficiency Action Plan (EEAP), the civil sector will represent 4.9 Mtoe/year of the total national target by 2020, divided between the residential and non-residential sectors.

This document, required under Article 4-*bis*(2) of Legislative Decree No 192/2005, clarifies the definition of NZEB and examines the energy performance of the various types of NZEB

in different end-use sectors and climate zones. It estimates the additional costs – relative to current levels – necessary to construct new NZEB or to transform existing buildings into NZEB. It also outlines the national development framework and policies for increasing the number of NZEB through the regulatory and incentive measures available.

This document is supplemented by the 'Strategy for energy-efficient renovation of the national building stock', provided for by Legislative Decree No 102 of 4 July 2014 and currently in the process of being published. This defines the targets to be achieved, the action lines it intends to focus on to achieve them, the issues to be addressed and possible strategic solutions.

2. NZEB: general framework

2.1 Definition

Decree-Law No 63/2013, converted into Law No 90/2013, lays the groundwork and sets the new criteria for updating and programming performance standards for buildings (envelope, equipment and renewable energy sources) in order to achieve the EU targets under the nearly zero-energy building policy. The minimum performance requirements for buildings will take into due account the winter and summer conditioning period, the climate zone and the other performance standards established by the regulatory framework. In compliance with Directive 2010/31/EU, Decree-Law No 63/2013 also provides that all new buildings should be nearly zero energy by January 2021 (two years earlier for new public buildings).

To that end, the Ministerial Decree referred to in Article 4(1) of Legislative Decree No 192/2005 establishes the procedures for applying the methodology for calculating energy performance and the use of energy from renewable sources in buildings, together with the relevant conditions and requirements.

The energy parameters and minimum thermal characteristics were designed to be more challenging in a bid to improve the energy efficiency of buildings. Minimum transmittance values for building elements were reduced by around 15 % for works carried out after 1 July 2015, and by a further 15 % from 1 January 2021. The minimum performance of technical installations was also expected to improve.

All existing or new buildings will be categorised as 'nearly zero-energy buildings' if they meet the following technical requirements:

(a) all indices listed below, calculated according to the minimum requirements in force from 1 January 2019 for public buildings and from 1 January 2021 for all other buildings, are lower than the values of the corresponding indices calculated for the reference building (a virtual building geometrically identical to the project building but satisfying the minimum thermal characteristics and energy parameters):
   - the total average heat transfer coefficient per transmission per dispersing surface (H'_T);
   - the summer equivalent solar area per unit of useful floor area ($A_{sol,est}/A_{sup\ utile}$) for category E.1 buildings, except for colleges, convents, prisons, barracks, category E.1(3) buildings and all other buildings;
   - the indices $EP_{H,nd}$, $EP_{C,nd}$ and $EP_{gl,tot}$, relating to the effective thermal performance for heating and cooling and the building's total overall energy performance index;
   - the performance of the winter heating (η_H), summer cooling (η_c) and hot water (η_w) system;

(b) the obligations to use energy from renewable sources are fulfilled in compliance with the minimum standards laid down in Annex 3(1)(c) of Legislative Decree No 28 of 3 March 2011.

2.2 Performance of nearly zero-energy buildings

Based on the definition of NZEB given in paragraph 2.1, the energy performance index was calculated for buildings with different building categories, intended use and climate zone, selected from among those used in previous studies [1]. Table 1 shows the year of construction and the main dimensions for those buildings: net heated floor area; gross heated volume; ratio of dispersing surface to gross heated volume; ratio of glazed surface to dispersing surface.

The buildings analysed have thermal transmittance values that comply with those indicated in Appendix A of the Ministerial Decree on 'Minimum Requirements' for 2019/2021 (in accordance with the NZEB definition). As to the type of system, it was assumed that a combined heat pump had been installed for heating, cooling and hot water. If the calculations showed that the minimum percentage of demand covered by renewable energy could not be achieved using the heat pump alone, photovoltaic panels were included. For more information on the technological and system configuration, please refer to Appendix A.

Table 1 also contains the values of the total overall energy performance index (sum of renewable and non-renewable energy) of the buildings concerned for the two climate zones. The total overall energy performance index is also illustrated in Figures 1 and 2 for climate zones B and E. The grey shading denotes the different end-use sectors, while the renewable and non-renewable share is shown in red and green respectively. Lighting energy consumption was only analysed for office buildings, while ventilation was only analysed for newly built offices, which is the only category to have that system.

The results indicate an overall non-renewable energy demand of between 35 and 60 kWh/m^2 per year for both climate zones; the exceptions are single-family residential buildings and existing office buildings in climate zone E, with values of around 80 kWh/m^2 per year.

	Construction period		Useful floor area	Gross volume	Ratio of envelope surface – Gross volume	Ratio of glazed surface – Envelope surface	Total overall energy performance index	
			$A_{floor,n}$ [m^2]	**V_l [m^3]**	**A_{env}/V_l [m^{-1}]**	**A_w/A_{env} [-]**	**$EP_{gl,tot}$ [kWh/m^2]** **Climate zone B**	**Climate zone E**
Residential buildings								
• Single-family	existing	1946-76	162	584	0.75	0.05	113	168
	new	2015	98	371	0.99	0.03	99	120
• Large multi-apartment building	existing	1946-76	1 552	5 949	0.46	0.07	100	114
	new	2015	1 788	6 662	0.43	0.09	99	95
Non-residential buildings								
• Office	existing	1946-76	363	1 339	0.6	0.12	145	160
	new	2015	1 536	6 077	0.35	0.20	131	115

Table 1 – Buildings assessed for energy performance (details in Appendix A).

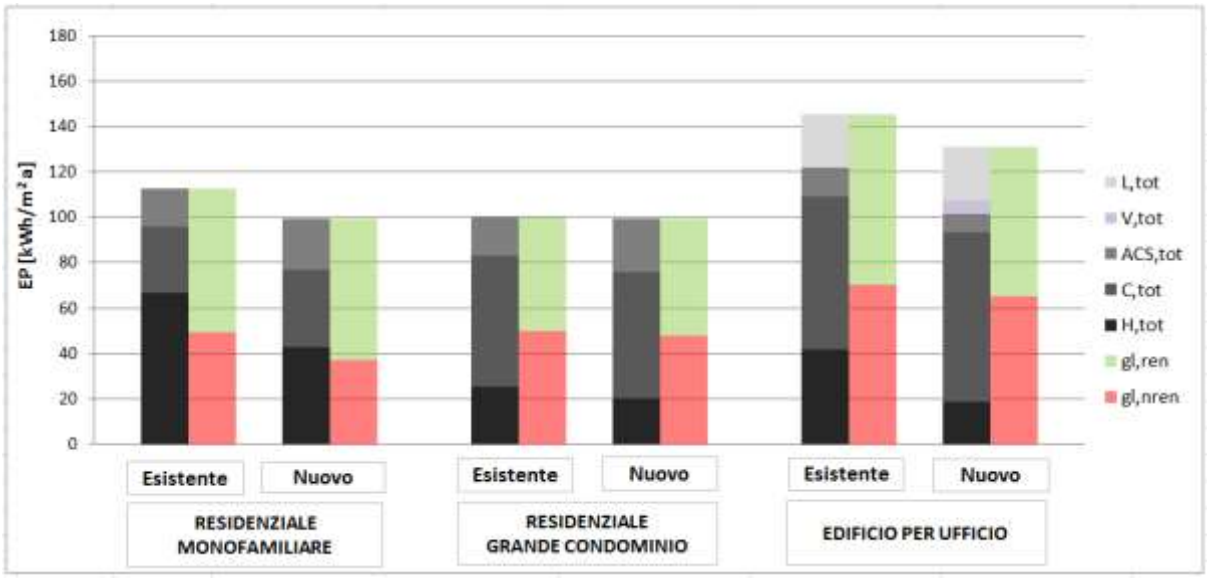


Figure 1 – Climate zone B, energy performance

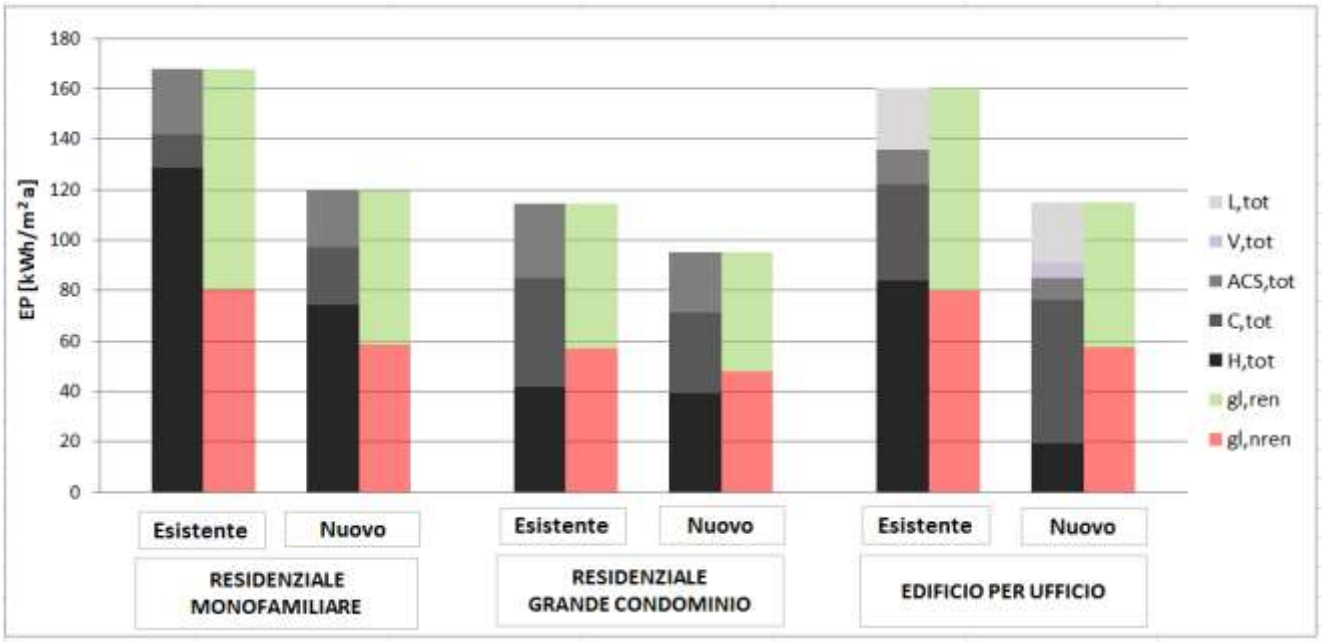


Figure 2 – Climate zone E, energy performance

Esistente	Existing
Nuovo	New
Residenziale monofamiliare	Single-family house
Residenziale Grande condominio	Large multi-apartment building
Edificio per ufficio	Office building
L,tot	L,tot
V,tot	V,tot
ACS,tot	ACS,tot
C,tot	C,tot
H,tot	H,tot
gl,ren	gl,ren
g,nren	g,nren

EP [kWh/m^{2}a]	EP [kWh/m^{2}a]

In order to satisfy the NZEB criteria – particularly the renewable energy requirement – it is essential that the use of the heat pump is assessed. This may be a combined central pump producing thermal energy for heating, hot water and cooling, if necessary supplemented by photovoltaic panels to meet the renewable quota.

Any differences in energy performance between existing buildings being transformed into NZEB and new NZEB are mainly due to the fact that the existing single-family houses and office buildings have a ground-bearing slab floor which cannot be renovated, whereas in new buildings the floor is insulated and ensures better performance. Moreover, in many of the cases analysed, the difference is due to the types of system used. These can vary at times, affecting performance.

2.3 Costs associated with the construction of nearly zero-energy buildings

Fitting out a building with components and technologies that enable it to achieve such a high-performance level inevitably leads to higher investment costs. This section examines the additional investment costs that result from conforming to NZEB criteria, both for new and existing buildings.

As explained in paragraph 2.1, for a building to be classified as an NZEB, various requirements must be met. The first is to improve the thermal insulation of the building envelope. To translate this quantitatively, it should be recalled that for new buildings or buildings undergoing major renovation, several performance indices (including H'_T and $EP_{H,nd}$) must be lower than the values of the corresponding indices calculated for the reference building. The reference building is defined as a building that is identical to the one submitted for design approval in terms of geometry (structural outline, volume, useful floor area, surface area of building elements and components), orientation, location, intended use and boundary situation, with predetermined thermal characteristics and energy parameters. However, for a building to be classified as an NZEB, the thermal characteristics and energy parameters of the reference building are more selective, anticipating the requirements planned for new buildings and those undergoing major renovation from 2021 (2019 for public buildings). Specifically, lower thermal transmittance values are required for the following elements: vertical and horizontal opaque structures and those inclined to the outside or unheated areas, and technical closures that are opaque and transparent to the outside or to unheated environments.

In practical terms, one solution for opaque structures that could meet this requirement would be to use thicker insulating layers than required under current regulations. Assuming that materials such as expanded or extruded polystyrene are used (thermal conductivity of 0.034 W/m·K), the additional thickness would have to increase by about 3 cm. This value would be less in warmer climates (the overall thickness of the insulating layer is generally less than 15-20 cm in cooler climates and less than 10 cm in warmer ones). If other materials such as cork are used (thermal conductivity of 0.05 w/m·K), the additional thickness may need to increase slightly. For the most common materials, the cost of the extra insulating layer is between EUR 1.5 and EUR 3/cm per square metre of insulated surface. Insulating layers can be applied to the outside, to limit the effect of thermal bridges, in cavity walls or from the inside. For new buildings, other solutions exist for achieving the desired level of heat insulation, such as thermal bricks or thermal plaster. In renovations, however, a much more economical solution is to fill any existing air gap with insulating material, although this may not be sufficient to achieve the required thermal transmittance.

Various technical solutions exist for doors and windows (double or triple glazing, injecting gas into the cavity or surface treatments), depending on the climate zone. On average, the

additional cost for an NZEB is in the region of EUR 40 per square metre of opening, although it may rise to EUR 70 per square metre. As to screening, a building may be classified as nearly zero energy provided that it meets the existing requirements for new builds and major renovations. However, in general the performance indices that need to be audited are interrelated, and therefore, depending on the designers' technical and architectural choices, even more efficient solutions may have to be used: not only better thermal insulation, but controlled mechanical ventilation, for example.

Another basic requirement that a building must meet in order to be classified as an NZEB concerns thermal installations. These must be designed and built so that 50 % of the estimated demand for hot water, heating and cooling is covered by energy generated by systems using renewable sources. For new buildings and major renovations[1], as defined by Legislative Decree No 28/2011, a requirement is already in force concerning the use of renewable energy. Specifically, this must cover 35 % of the estimated demand for hot water, heating and cooling and 50 % of the estimated demand for hot water only. Under Annex 3 of Legislative Decree No 28/2011, the obligation to use renewable energy to meet the estimated demand for energy services rose from 35 % to 50 % with effect from 1 January 2017. Furthermore, a minimum electrical output is required for renewable energy systems that have to be installed on or inside the building or its appurtenances[2].

Various types of renewable energy systems exist on the market: aerothermal, hydrothermal or geothermal gas or electric heat pumps; biomass-fired boilers or co-generators; micro/mini wind turbines; solar cooling systems; solar thermal and photovoltaic systems; and medium- and high-enthalpy geothermal installations. There is no simple formula for choosing the right solution; this will depend on the local climate and availability of particular energy resources, or the services provided in the building (heating, cooling, humidification, dehumidification, hot water production, ventilation, lighting) and the resulting loads. In renovations, this is often constrained by the existing situation, which effectively limits the range of possible solutions. For example, in a multi-apartment building with separate systems, some solutions are unfeasible without a radical transformation of the building, which is highly invasive and costly. Regarding the cost, significant differences are observed between the various technologies, depending on both the performance and the level of maturity and uptake.

To illustrate this, the extra cost needed to construct an NZEB (new or existing) was estimated for several buildings representative of the national situation, as defined in Table 1. Appendix B contains a note on methodology that lists the cost items taken into account. These values are indicative and ignore any constraints that might limit designers' options and/or give rise to additional costs in general (for example, building in shade, which affects the performance or feasibility of installing solar energy installations; a relatively inaccessible work site or one at a significant distance from supply centres, etc.).

As to the construction of a new building that could be classified as an NZEB, the results are shown in Figure 3 (expressed in euros per square metre of useful floor area of the building). For residential buildings, the higher costs are more due to the technical solutions adopted rather than measures aimed at insulating the building envelope. In office buildings, however, there is a higher percentage of glazed surfaces (which are more expensive than the opaque

[1] A renovation is defined as 'major' if it falls into one of the following categories: existing building with a useful floor area of more than 1 000 square metres, subject to full renovation of the building elements making up the envelope; or existing building subject to demolition and reconstruction, including as part of supplementary maintenance. In the cases examined to calculate the additional cost of transforming an existing building into an NZEB compared with a large-scale renovation under current legislation, it was assumed that this was not classified as 'major'.

[2] The minimum output (in kW) is currently equal to one 65^{th} of the building plan area at ground level (in m^2). From 2017, this value will be increased to one 50^{th}.

envelope). Conversely, solutions such as heat pumps may be considered as standard and therefore are not an additional cost.

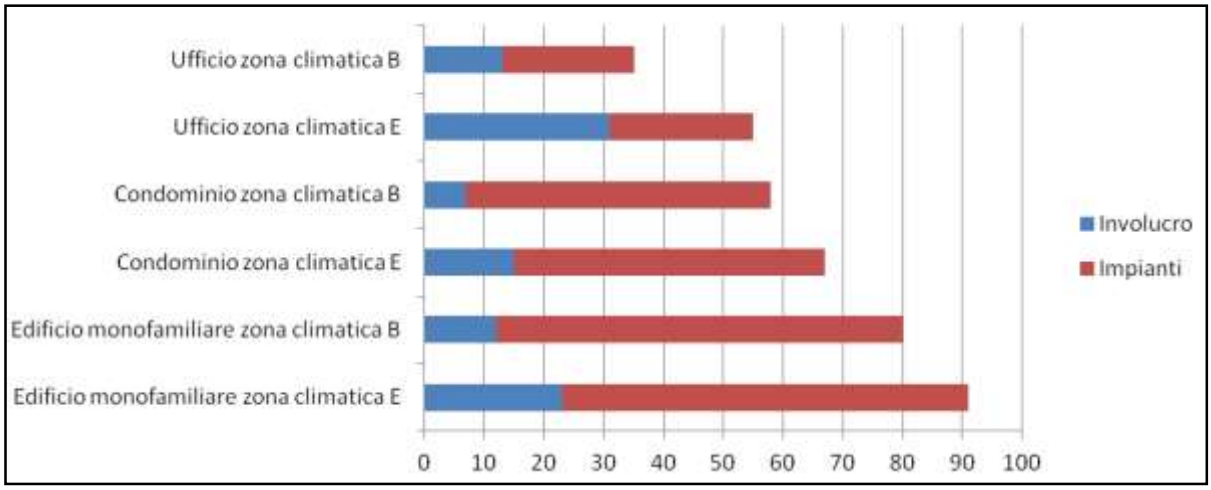


Figure 3 – Additional cost for constructing a new nearly zero-energy building compared with a new building that only needs to comply with applicable legislation (€/m^2)

Ufficio zona climatica B	Office building climate zone B
Ufficio zona climatica E	Office building climate zone E
Condominio zona climatica B	Multi-apartment building climate zone B
Condominio zona climatica E	Multi-apartment building climate zone E
Edificio monofamiliare zona climatica B	Single-family building climate zone B
Edificio monofamiliare zona climatica E	Single-family building climate zone E
Involucro	Envelope
Impianti	Systems

Table 2 shows the estimated additional cost of transforming existing buildings into NZEB, compared with a major renovation. It can be seen that, in general, the cost of an 'energy' upgrade largely consists of expenditure on associated or indirect works, such as scaffolding hire, the replacement of window ledges, the upgrading or refurbishment of flues, and modifications to the distribution system. On the whole, in the cases examined, the cost of transforming an existing building into an NZEB involves a minimum spend of between about EUR 500 and EUR 600/m^2.

Type	Single-family building	Multi-apartment building	Office building
Envelope	+ 4.2 %	+ 4.6 %	+ 5.3 %
Systems	+ 50.2 %	+ 27.4 %	+ 28.1 %
Total	+ 22.0 %	+ 14.6 %	+ 14.0 %

Table 2 – Average additional cost to transform an existing building into an NZEB compared with a major renovation

Lastly, it is important to note that the current energy performance requirements stem from the optimisation of energy consumption and costs (in accordance with Commission Delegated Regulation (EU) No 244/2012). In general, exceeding the current minimum requirements by constructing or transforming an existing building into an NZEB entails

additional costs that are not fully recovered through the energy savings achieved[3]. Until market developments result in lower costs, these aspects can be mitigated by offering suitable incentives and through the intelligent scheduling of upgrades (for example, to coincide with other renovations).

3. National context

3.1 National building stock

3.1.1 Residential buildings

There are 12 million residential buildings in Italy comprising 31 million dwellings in total, 77 % of which are occupied by residents (24 million people)[4]. Most of these buildings are single-family (61.5 %), and as can be seen from Figure 4, buildings with more than 9 dwellings are a minority (4.3 %). According to the data, the average number of dwellings per building is fairly low, at around 2.6. The oldest buildings contain relatively fewer dwellings, while the period between 1961 and 1970 saw the highest number of dwellings per building (around 3), owing to an increase in the number of medium and large multi-apartment buildings.

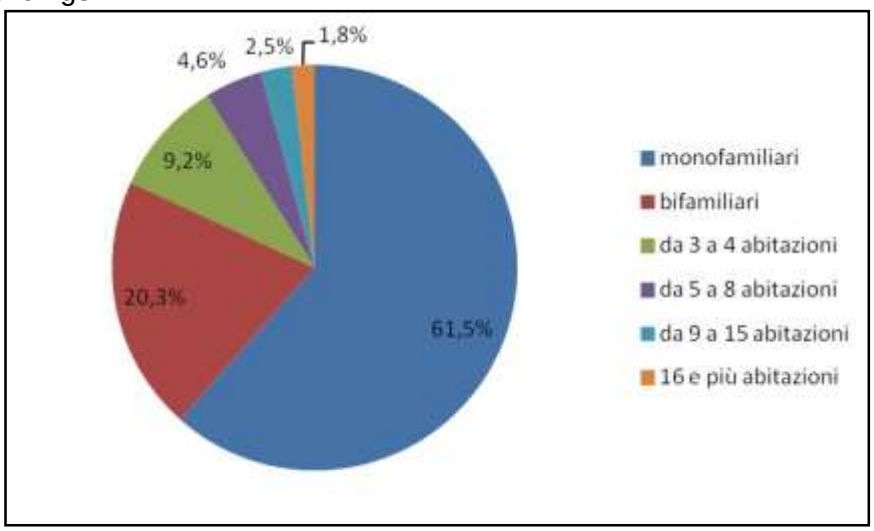


Figure 4 – Residential buildings by number of dwellings

monofamiliari	Single-family
bifamiliari	Two-family
Da 3 a 4 abitazioni	From 3 to 4 dwellings
Da 5 a 8 abitazioni	From 5 to 8 dwellings
Da 9 a 15 abitazioni	From 9 to 15 dwellings
16 e più abitazioni	16 or more dwellings

Table 3 gives a detailed breakdown of the building stock by construction period.

[3] Note that in some cases, where the market is already reasonably well developed, the construction of new NZEB could already be cost-effective.

[4] The size of the housing stock was calculated by processing data compiled and published by ISTAT in its 'Population and Housing Censuses' [2][3].

	Building Residential	Dwellings	Dwellings with residents
Pre-1918	1 832 504	3 656 542	2 453 037
1919-1945	1 327 007	2 799 407	2 033 438
1946-1960	1 700 836	4 268 838	3 382 138
1961-1970	2 050 833	5 986 048	4 829 923
1971-1980	2 117 651	5 770 951	4 494 257
1981-1990	1 462 767	3 874 961	3 044 874
1991-2000	871 017	2 311 576	1 870 661
2001-2010	825 083	2 469 955	1 956 966
Total	12 187 698	31 138 278	24 065 294

Table 3 – Italian housing stock in 2011 by construction period

Overall, dwellings with residents had a total floor area of 2 396 million m^2, corresponding to an average of around 99 m^2 per dwelling.

According to EUROSTAT reports for 2013 [4], final consumption in Italy totals 119 Mtoe. In quantitative and percentage terms, this is distributed by end-use sector as shown in Figure 5. It can be seen, therefore, that the residential sector accounts for around one quarter of final consumption (34.2 Mtoe). In this sector, natural gas is by far the most widely used energy product (57 %), followed by electricity (19 %), renewable sources (12 %), petroleum products (10 %) and heat (2 %).

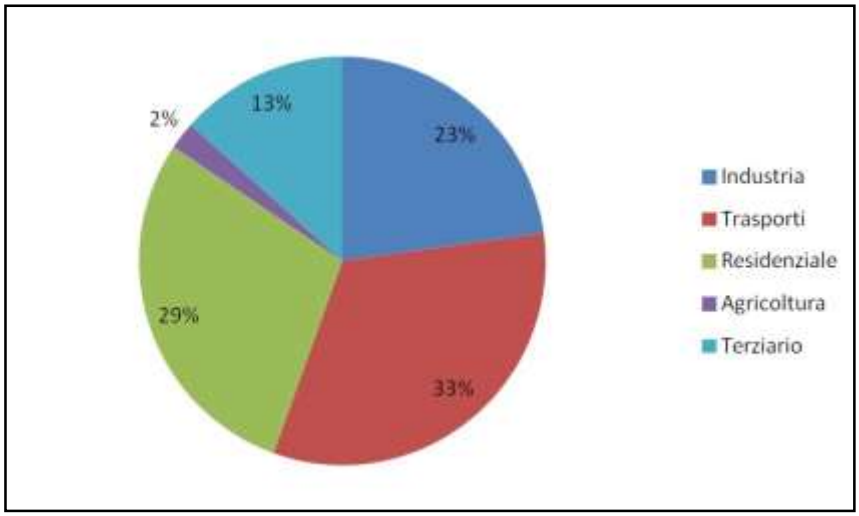


Figure 5 – Final energy consumption in 2013 by end-use sector

Industria	Industry
Trasporti	Transport
Residenziale	Residential
Agricoltura	Agriculture
Terziario	Tertiary

In terms of service provided, ENEA provides a breakdown according to which heating covers more than two thirds of total consumption; this is followed by cooking and hot water with 16.5 % and lighting and electrical appliances with 13.5 %. Average consumption per household is 1.3 toe, with an average spend of EUR 1 635 [6]. On average, final energy

consumption comes to around 150 kWh/m^2 per year; heating alone accounts for just over 100 kWh/m^2 per year. In terms of non-renewable primary energy, the total average consumption of residential buildings is more than 180 kWh/m^2 per year.

3.1.2 Non-residential buildings

Given the wide variety of commercial buildings, a distinction is made between the following sectors: retail, hotels, banks, offices, schools and hospitals. The total floor area of buildings in the retail sector[5] amounts to some 165 million m^2, divided between shops and boutiques (99 million m^2 between 876 300 businesses), restaurants, pizzerias and bars (44 million m^2 and 261 600 businesses) and large-scale retail outlets (22 million m^2 and around 20 100 companies). The latter category can be divided into five sub-types, as detailed in Table 4.

Type	Number of companies	Size	Specific consumption
Minimarket	5 636	1.6 million m^2	535 kWh/m^2/year
Supermarket	10 108	9.3 million m^2	585 kWh/m^2/year
Hypermarket	610	3.7 million m^2	525 kWh/m^2/year
Department store	2 067	2.7 million m^2	255 kWh/m^2/year
Large specialist store	1 685	5.1 million m^2	219 kWh/m^2/year

Table 4 – Distribution of the floor area of large-scale retail outlets and related specific consumption

The hotel sector is also extremely diverse in terms of the type of buildings, the services provided and the seasonal nature of these. However, the hotel categories and number of stars are a useful index for classifying the sector. There are 150 280 businesses, which as shown in Figure 6 predominantly consist of rental accommodation (48 %), followed by three-star hotels (18 %) and agritourism (12 %). There are approximately 3.2 million beds, distributed between three-star hotels (30 %), four-star hotels (23 %), and rental accommodation (18 %). This difference is clearly due to the average size of the facility: on average, the higher the category, the more hotel beds there are; rental accommodation, agritourism and B&Bs tend to be fairly small, with a maximum of 15 beds. For hotels and guesthouses alone, the total floor area is 45 million m^2.

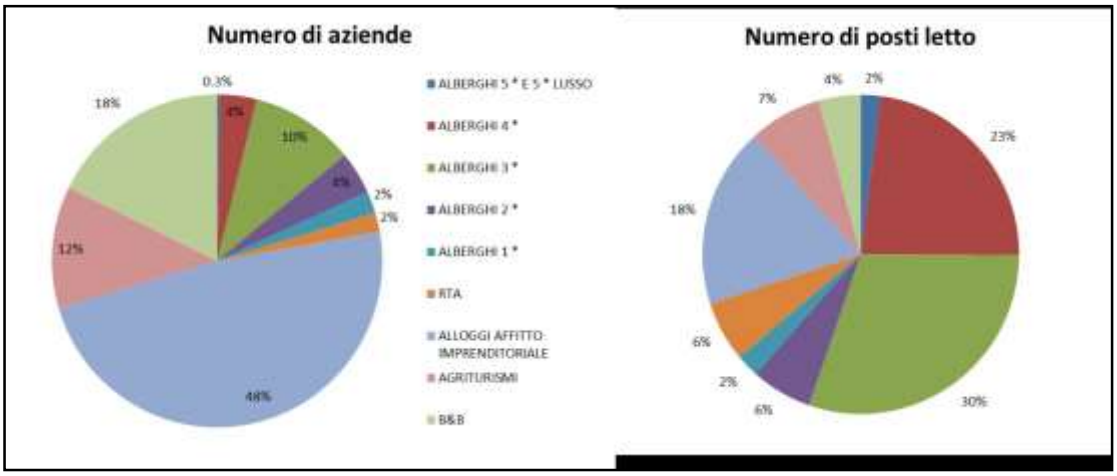


Figure 6 – Distribution of the number of businesses and beds between the different accommodation categories

[5] The information on the retail and hotel sectors was obtained from RSE processing of Nomisma Energia data [7].

Numero di aziende	Number of businesses
Alberghi 5* E 5* Lusso	Five-star and luxury five-star hotels
Alberghi	Hotels
RTA	Aparthotels
Allogi affitto imprenditoriale	Business rental accommodation
Agriturismi	Agritourism
B&B	B&Bs
Numero di posti letto	Number of beds

Italy has 76 banking groups, comprising 33 727 branches across the country. Many of these branches occupy portions of buildings, mostly on the ground floor. Buildings entirely or mainly for bank use number 1 469. The buildings have a total floor area of 5.5 million m^2 and a volume of more than 18.5 million m^3.

Around 51 000 buildings are used exclusively or predominantly by schools, comprising a total floor area of 73 million m^2 and a volume of 256 million m^3. The majority of buildings (39 %) are between 1 000 and 3 000 m^2 in size, with an average floor area of 1 819 m^2. Around 43 % of the buildings can be divided into three categories of floor area: 16 % have a floor area of 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).

Nationwide, there are about 65 000 buildings entirely or mainly for office use. Office buildings have a total floor area of 56.7 million m^2 and a volume of just under 200 million m^3. Most buildings are small: about half do not exceed 350 m^2. A share of 32 % of the total floor space and of volume (about 62 million m^3) is made up of just under 1 200 large buildings (more than 5 000 m^2).

Table 5 summarises the data on hotels, schools, offices and hospitals.

Intended use	Size	Specific electrical consumption	Specific heat consumption
Hotels	45.2 million m^2	110 kWh/m^2/year	150 kWh/m^2/year
Schools [8]	73.2 million m^2	50 kWh/m^2/year	130 kWh/m^2/year
Offices [8]	56.7 million m^2	95 kWh/m^2/year	170 kWh/m^2/year
Hospitals and nursing homes	148.8 million m^3	253 kWh/m^2/year	385 kWh/m^2/year

Table 5 – Summary by sector: hotels, schools, offices and hospitals

3.2 National market trend for buildings and NZEB targets

The construction sector was significantly impacted by the economic crisis, recording a sharp fall in both investments and new building/renovation projects during the period 2007-2013. However, during the last quarter of 2014 and in early 2015, the market appeared to show signs of recovery, especially in the sector for renovations of existing building stock.

More than 70 % of the existing building stock was constructed pre-1980s, before specific energy efficiency requirements applied. Considering that the average lifespan of a building is estimated to be about 60 years and that energy bills represent an increasingly significant share of the costs, the number of energy-efficient and major renovations carried out on existing buildings can be expected to grow.

As to the construction of new buildings, including demolition and reconstruction and deep renovation works, it can be assumed that a certain percentage of these were built to NZEB standards and requirements, even before these became mandatory.

This section estimates the potential savings achievable during the period 2015-2020, assuming that 1 % per year of existing buildings subject to energy-efficient or major renovations or new buildings conform to NZEB standards.

3.2.1 New buildings

RESIDENTIAL

The most recent census data published by ISTAT (2011) indicate growth in the new-build residential sector of approximately 825 000 buildings, compared with the previous census from 2001.

The corresponding new floor area (2001-2011) totals around 190 million m^2, for an average percentage of new-build construction compared with existing buildings of about 1.1 % in terms of new floor area.

Considering the construction market trend, according to the 2011 ISTAT census data and those estimated by other sector operators (ANCE, CRESME, ENEA and others), the trend in new building development (2015-2020) is estimated at approximately 7.2 million m^2 per year, of which about 60 % consists of single-family buildings and approximately 40 % multi-family buildings.

The following estimates were based on the assumption that during the period 2015-2020, 1 % of the total floor area of new residential buildings (7.2 million m^2 per year) will be in buildings constructed to NZEB standards, representing a total floor area of around 0.432 million m^2 by 2020. Table 6 shows the total floor area by single-family and multi-family residential buildings in different climate zones. The savings achievable have been estimated from the difference in energy savings between those prescribed under applicable legislation and those necessary to achieve the energy performance required for NZEB.

RESIDENTIAL BUILDINGS		**Total floor area**	**Assumed % NZEB**	**Floor area of NZEB/ year**	**Estimated specific savings compared with buildings constructed to existing standards**	**NZEB floor area generating savings during the period 2015-2020***	**Estimated savings by 2020**
Type	**Climate zone**	**m^2**	**%**	**m^2/year**	**kWh/m^2/year**	**m^2**	**Toe**
Single-family	A-B-C	936 000	1	9 360	7	56 160	126
	D	1 404 000	1	14 040	15	84 240	378
	E-F	2 340 000	1	23 400	22	140 400	945
Subtotal		**4 680 000**		**46 800**		**280 800**	**1 448**
Multi-family	A-B-C	504 000	1	5 040	6	30 240	52
	D	756 000	1	7 560	11	45 360	155
	E-F	1 260 000	1	12 600	17	75 600	387
Subtotal		**2 520 000**		**25 200**		**151 200**	593
Total		**7 200 000**		**72 000**		**432 000**	**2 042**

Table 6 – Estimated construction of new NZEB by 2020: residential

(*) Cumulative value for the years from 2015 to 2020.

NON-RESIDENTIAL

There are fewer data for this sector than for the residential sector. The following estimates were based on data available from the 2011 ISTAT census, ANCE reports on the construction market, industry studies and analyses carried out by CRESME, a study by Milan Polytechnic and ENEA data.

For these buildings also, the following estimates assume that 1 % of the total floor area of new buildings during the period 2015-2020 will conform to NZEB standards. For the public sector, the reference period for estimates to 2020 includes the period from 2015 to 2017, as provided for by Legislative Decree No 102/2014.

Given the market trend, taking into account the 2011 ISTAT census and ANCE, CRESME and ENEA data available, the floor area per year of new buildings intended for use as public and private offices totals around 2.8 million m^2. Assuming that 1 % will be NZEB, this equates to a floor area of approximately 28 000 m^2, of which 5 900 m^2 will be public and 22 132 m^2 private.

For schools, the floor area of new buildings is around 3.3 million m^2 per year. Assuming that 1 % are NZEB, this equates to a floor area of approximately 33 800 m^2, of which 30 492 m^2 will be public and 3 388 m^2 private.

The estimated percentages for public- and private-sector buildings are consistent with those for the existing building stock.

Table 7 shows the total floor area for buildings used as offices and schools in different climate zones. The savings achievable have been estimated from the potential increase in savings for buildings conforming to NZEB standards, rather than existing legal requirements.

			PUBLIC			**PRIVATE**			**TOTAL**
NON-RESIDENTIAL BUILDINGS		**Estimated specific savings from NZEB standards**	**1 % Floor area to be upgraded each year**	**NZEB floor area generating savings during the period 2015-2018****	**Estimated savings**	**1 % Floor area to be upgraded each year**	**NZEB floor area generating savings during the period 2015-2020***	**Estimated savings**	**Total estimated savings by 2020**
Type	**Climate zone a**	**kWh/ m^2/year**	**m^2/year**	**m^2**	**Toe**	**m^2/year**	**m^2**	**Toe**	**Toe**
Offices	A-B-C	9	1 525	6 099	20	5 720	34 323	88	108
	D	19	2 050	8 199	61	7 690	46 139	265	325
	E-F	31	2 325	9 299	111	8 721	52 328	487	598
Subtotal			**5 900**	**23 598**	**192**	**22 131**	**132 791**	**839**	**1 031**
Schools	A-B-C	6	9 587	38 349	85	1 065	6 392	11	96
	D	13	6 019	24 076	120	669	4 013	16	136
	E-F	21	14 886	59 544	481	1 654	9 924	62	544
Subtotal			**30 492**	**121 968**	**687**	**3 388**	**20 328**	**89**	**776**
Total			**36 392**	**145 566**	**879**	**25 519**	**153 119**	**928**	**1 807**

Table 7 – Estimated construction of new NZEB by 2020: offices and schools

(*) Cumulative value for the years from 2015 to 2020.

(**) Cumulative value for the years from 2015 to 2018.

3.2.2 Existing buildings

RESIDENTIAL

For projects aimed at reducing energy consumption and increasing the energy efficiency of existing buildings, the most widely used support measures are the 65 % tax relief and the Thermal Energy Account.

Tax relief for the energy-efficient renovation of existing buildings provides an overview of the projects carried out on residential buildings under current legislation. As at 2013, the number of energy-efficient renovations was approximately 1.8 million, of which some 355 000 were carried out in 2013, with a percentage increase of around 35 %.

The Thermal Energy Account, which is less widely used, is an innovative measure that was introduced in July 2013. This could yield significant results in the short to medium term, partly as a result of the current simplification and improvement programme.

By analysing the trend for these mechanisms, it can be estimated that each year, the floor area of residential buildings that have been upgraded will total around 11.2 million m^2. This equates to approximately 0.5 % per year of existing buildings potentially suitable for upgrading (source: ISTAT-CRESME). According to the percentage distribution of the building population (source: ISTAT 2011), around 65 % of these are single-family buildings, while around 35 % are multi-family buildings.

Assuming that 1 % of these upgrades will render the floor area compliant with NZEB standards, the following can be estimated.

Table 8 shows the total floor area for single-family and multi-family buildings in different climate zones. The savings achievable from NZEB have been estimated by comparison with upgrading in accordance with existing minimum legal requirements.

RESIDENTIAL BUILDINGS		**Total floor area**	**Assumed % NZEB**	**Floor area of NZEB/ year**	**Specific savings compared with buildings constructed to existing standards**	**NZEB floor area generating savings during the period 2015-2020***	**Estimated savings by 2020**
Type	**Climate zone**	**m^2**	**%**	**m^2/year**	**kWh/m^2/ year**	**m^2**	**Toe**
Single-family	A-B-C	1 469 000	1	14 690	7	88 140	183
	D	2 203 000	1	22 030	14	132 180	549
	E-F	3 672 000	1	36 720	21	220 320	1 373
	Subtotal	**7 344 000**		**73 440**		**440 640**	**2 104**
Multi-family	A-B-C	791 000	1	7 910	6	47 460	81
	D	1 186 000	1	11 860	11	71 160	243
	E-F	1 938 000	1	19 380	17	116 280	595
	Subtotal	3 915 000		**39 150**		**124 900**	**919**
	Total	**11 259 000**		**112 590**		**675 540**	**3 024**

Table 8 – Estimated transformation of existing buildings to NZEB by 2020: residential

(*) Cumulative value for the years from 2015 to 2020.

NON-RESIDENTIAL

As mentioned earlier, the analysis of the non-residential sector took into account the ISTAT 2011 data and data processed by CRESME, ENEA and ANCE relating to market trends in recent years. It can be estimated that, prior to 2020, energy upgrades will be carried out each year on around 12.5 million m^2 in the public and private sectors.

In view of the market trend, and considering the ISTAT 2011 and ANCE, CRESME and ENEA data available, the floor area subject to energy-efficient renovation each year in existing buildings is estimated as follows for each end-use category:

- approximately 4 million m^2 for offices in the public and private sector;
- approximately 8.5 million m^2 for schools in the public and private sector.

To estimate the distribution of floor area by climate zone, reference was made to the analysis contained in the RSE report entitled 'Calculation of energy consumption and demand from building systems/installations – Characterisation of the building stock for RESIDENTIAL use' (RdS/2012/109).

The estimated percentages for public- and private-sector buildings are consistent with those for the existing building stock.

Assuming, as mentioned above, that 1 % of these upgrades will render the floor area compliant with NZEB standards, the following can be estimated.

Table 9 shows the total floor area for buildings used as offices and schools in different climate zones. The savings achievable have been estimated from the potential increase in savings for buildings conforming to NZEB standards, rather than existing legal requirements.

			PUBLIC			**PRIVATE**			**TOTAL**
NON-RESIDENTIAL BUILDINGS		**Estimated specific savings from NZEB standards**	**1 %Floor area to be upgraded each year**	**NZEB floor area generating savings during the period 2015-2018****	**Estimated savings**	**1 % Floor area to be upgraded each year**	**NZEB floor area generating savings during the period 2015-2020***	**Estimated savings**	**Total estimated savings by 2020**
Type	**Climate zone**	**kWh/m^2/ year**	**m^2/year**	**m^2**	**Toe**	**m^2/year**	**m^2**	**Toe**	**Toe**
Offices	A-B-C	12	2 153	8 612	41	8 232	49 394	185	226
	D	28	2 894	11 576	125	11 067	66 399	557	682
	E-F	45	3 283	13 132	229	12 551	75 306	1 023	1 252
Subtotal			**8 330**	**33 320**	**395**	**31 850**	**191 100**	**1 764**	**2 160**
Schools	A-B-C	9	23 968	95 872	321	2 663	15 979	42	362
	D	19	15 048	6 192	451	1 672	10 032	59	510
	E-F	31	37 214	148 856	1 808	4 135	24 809	234	2 043
Subtotal			**76 230**	**304 920**	**2 580**	**8 470**	**50 820**	**334**	**2 914**
Total			**84 560**	**338 240**	**2 975**	**40 320**	**241 920**	**2 099**	**5 074**

Table 9 – Estimated transformation of existing buildings to NZEB by 2020: offices and schools

(*) Cumulative value for the years from 2015 to 2020.

(**) Cumulative value for the years from 2015 to 2018.

Based on the estimates made, from the early adoption of NZEB standards ahead of the

entry into force of the new building requirements laid down in Legislative Decree No 102/2014, and from incentives for deep renovations to encourage the transformation of existing buildings to NZEB, the cumulative savings estimated for the period 2015-2020 (for the residential and non-residential sectors combined) total approximately 11 947 Toe.

3.2.3 Current situation

This section describes various regional best practices in terms of low-impact buildings (similar to NZEB) that have already been constructed in Italy.

Emilia-Romagna Region

The Region enacted Regional Law No 26/2004, as amended by Regional Law No 7/2015, which anticipates by two years the national deadlines (2017 for public buildings and 2019 for all other buildings) for the conformity of new buildings with NZEB requirements.

Lombardy Region

The Lombardy Region decided to pursue its goal of reducing building energy consumption by adopting Regional Law No 7/2012anticipating the provisions of Directive 2010/31/EU at 31 December 2015, the date from which all new public- or private-sector buildings must be classified as NZEB.
By 2020, according to estimates contained in the Regional Environmental Energy Plan (PEAR) ratified by the Regional Executive by means of its Decision No X/3706 of 12 June 2015, the early adoption of NZEB legislation will save about 80 000 toe/year in a best-case scenario and 70 in an average scenario. This was calculated by forecasting that the growth in NZEB construction will replace new buildings with average energy performance. A key variable is the rate of demolition and reconstruction that determines the replacement of buildings. A conservative building replacement rate of between 0.8 % and 1 % per year was considered: in this scenario, building replacement would account for 5 % of the contribution calculated. Any policy that encourages demolition and reconstruction (including urban planning policies and the fight against land take) will impact significantly on the energy performance of buildings in Lombardy.
Lastly, a regional law was ratified (Article 10 of Regional Law No 38/2015) to enable the entire volume represented by the external envelope to be deducted if the renovation work reduces by at least 10 % the primary energy demand required by regional legislation, since as at 2016 this had already anticipated the requirements imposed by national legislation and due to enter into force at a later date.

Piedmont Region

The Piedmont Region has produced two publications entitled ‘Buone pratiche in campo energetico finanziate dalla Regione Piemonte’ (Best practices in the energy sector funded by the Piedmont Region), which describes in detail major projects carried out to improve the energy efficiency of existing buildings and the construction of new nearly zero-energy buildings.
These publications are available to download from the website http://www.regione.piemonte.it/energia/documentazione.htm.

Umbria Region

In 2014, the Umbria Region, as a MARIE (Mediterranean Building Rethinking for Energy Efficiency Improvement) project partner that receives funding under the Med 2007-2013 Programme, and given the need to reduce energy consumption in buildings to achieve the targets set by the ‘Europe 2020’ strategy, produced a ‘Catalogue of best practices for

improving the energy efficiency of buildings'. To facilitate knowledge transfer, a call was published at regional level to compile best practices in energy efficiency. Designers were invited to share their professional experience of projects carried out in the region to improve the energy efficiency of existing or new buildings. The projects received in response to the call were compiled in the above-mentioned publication, which catalogues examples of how consumption can be reduced significantly through building practices.

In March 2015, the Umbria Region published the 'Guide to energy efficiency in the Umbria Region. National and international instruments and financial incentives to promote energy efficiency', which aims to provide an overview of the patchwork of laws that exist nationwide on the subject of energy efficiency, while describing the financial and contractual instruments that can be used to carry out energy efficiency projects. This user-friendly guide offers all stakeholders – whether from the public or private sector – an overview of the main instruments available at the regulatory, administrative and financial levels, as well as the most effective ways of making the most out of them. It seeks to promote the use of existing incentives and to encourage the implementation of energy efficiency projects throughout the Region, and is designed to be an awareness-raising tool. As such, the guide borrows from regional energy policies covered by the 2014-2020 Regional Environmental Energy Strategy (SEAR), adopted by means of Decision of the Regional Executive No 1281 of 9 November 2015. Since its fundamental purpose is to improve energy efficiency, it identifies energy savings as the means of achieving the main EU targets set by the Climate and Energy Package.

Autonomous Province of Bolzano

Since 2002, the ClimateHouse agency has held the ClimateHouse Awards, recognising the new-build and renovation projects that have been the most successful in applying energy efficiency and sustainability criteria. Since 2008, these awards have been joined by the Klimaenergy Award, a sounding board for best environmental practices designed and implemented by local and provincial municipalities in Italy.

4. Existing instruments and new proposals

As already mentioned, the construction sector will be key to achieving the targets set by Italy for 2020. The National Energy Strategy (NES) intends to reach its ambitious energy saving targets by strengthening existing instruments and possibly by introducing new measures. In particular, the following actions are planned:

- reinforcing the minimum energy standards for the construction of new buildings and the renovation of existing buildings, to progressively increase the number of nearly zero-energy buildings in line with the provisions of Directive 2010/31/EU (EPBD recast);
- consolidation of the tax relief system, especially in the civil renovations sector, which must be updated to boost its effectiveness and cost/benefit ratio;
- strengthening of incentives for the renovation of government buildings, which should set the example for the entire sector for energy efficiency in buildings;
- strengthening of the targets of the White Certificates scheme, which is mainly designed for the industrial sector but can play a major role in raising awareness of energy efficiency issues among economic operators.

This chapter sets out the national framework of actions to implement the energy efficiency targets in buildings laid down in the NES and in Directives 2010/31/EU and 2012/27/EU, with particular reference to measures that promote the transition of the existing building

stock towards nearly zero-energy buildings.

4.1. Regulatory instruments

Over the past decade, energy policies have evolved significantly: new legislation and methodologies have introduced technical-regulatory measures to promote the rational use of energy and assess the effectiveness of policies. Directive 2002/91/EC, also known as the EPBD (Energy Performance of Buildings Directive), was issued to improve energy performance in the civil sector, which for many years has been the greatest consumer of end-use energy and the largest source of greenhouse gases in Europe and Italy. The Directive was transposed in Italy by means of Legislative Decree No 192/2005, as amended.

Directive 2010/31/EU (EPBD recast) updated the principles relating to the improvement of the energy performance of buildings. The Directive was transposed in Italy by Decree-Law No 63/2013, converted by Law No 90/2013.

Among other changes, the EPBD recast introduced a comparative methodology framework for calculating cost-optimal levels of minimum energy performance requirements for buildings. Under the Directive, Member States must establish minimum energy performance requirements for buildings or building elements, with a view to achieving optimal cost/benefit ratios.

The national legislative framework for increasing the energy efficiency of buildings is quite varied. The decrees implementing Legislative Decree No 192/2005 and Decree-Law No 63/2013, converted into law by Decree No 90/2013, are key acts that updated the regulatory framework and established criteria and procedures for nearly zero-energy buildings (NZEB). Other relevant measures are Legislative Decree No 115/2008 on energy services and Legislative Decree No 28/2011 on renewable energy sources.

Details are provided below on the key decrees for the energy efficiency of buildings issued in 2013, and on Legislative Decree No 28/2011, which transposed Directive 2009/28/EC on the promotion of the use of energy from renewable sources.

Among the main changes introduced are the concepts of nearly zero-energy buildings, system boundary, energy produced on site (energy produced or collected within the boundaries of the system) and the cost-optimal level.

With regard to NZEB, the Decree stipulates that starting from 1 January 2019 new buildings owned or occupied by public authorities must be NZEB. All other new buildings must be NZEB from 1 January 2021.

Ministerial Decree on minimum requirements

With the publication of the Ministerial Decree of 26 June 2015 (the ‘Minimum Requirements Decree’), the methodology for calculating energy performance was updated in line with the standard UNI TS 11300, parts 1, 2, 3 and 4, and CTI Recommendation 14. At the same time, with a view to optimising the cost/benefit ratio of projects, the minimum energy standards were strengthened for the construction of new buildings and for the renovation of existing buildings, leading to a gradual increase in nearly zero-energy buildings in accordance with Directive 2010/31/EU. The same Decree defines the minimum energy requirements for new buildings and buildings undergoing major renovations and energy-efficient renovations. It also defines the requirements for NZEB. The minimum requirements comply with technical and economic cost-effectiveness assessments, based on the cost/benefit analysis of the economic lifecycle of the buildings; for new buildings and major renovations, the requirements are established by using the reference building, on the basis of the type of building and climate zones; to assess compliance with energy performance requirements, specific building parameters are established (thermal

performance and transmittance indices) as well as overall parameters (total overall energy performance indices). The aim of the Decree is to promote, with immediate effect, the uniform and coordinated application of

energy efficiency standards in buildings throughout Italy, where standards are currently extremely varied owing to the considerable autonomy given to the regions in transposing Directive 2002/91/EC.

New energy certification guidelines

Decree-Law No 63/2013 on the energy performance certificate (EPC) introduces the requirement when selling or letting a property to enclose the EPC with the sales or letting agreement.

The Decree for the new EPC guidelines, enacted on 26 June 2015, includes the following:

- recommendation for simplified calculation methods to be applied to smaller buildings, to reduce the costs incurred by individuals;
- definition of an energy performance certificate that includes all data relating to the building's energy efficiency, such as the overall energy performance and energy rating, to enable individuals to assess and compare different buildings;
- definition of a standard advertisement to be displayed by estate agents when selling or letting a property, containing regulatory information on the energy performance of the building intended for individuals;
- definition of the overall energy performance of the building in terms of total primary energy and non-renewable primary energy using the respective indices;
- definition of the energy rating calculated by means of the building's overall energy performance index, expressed in non-renewable primary energy;
- minimum energy efficiency requirements under the law;
- calculation of CO_2 emissions;
- calculation of exported energy;
- recommendations for improving the building's energy efficiency with proposals for the most significant and cost-effective actions;
- information such as energy audits and financial incentives;
- definition of a common information system for the entire country, the use of which is mandatory for the Regions and Autonomous Provinces, including the management of a building land register, energy performance certificates and the relevant public inspections.

Evidently the information contained in the EPC must include the building classification and an indication of whether it is a nearly zero-energy building.

Like the Minimum Requirements Decree, the Decree for the EPC guidelines is aimed at promoting, with immediate effect, the uniform and coordinated application of energy efficiency standards in buildings throughout Italy, where standards are currently extremely varied owing to the considerable autonomy given to the regions in transposing Directive 2002/91/EC.

Presidential Decree No 74/2013

Presidential Decree No 74 of 16 April 2013 established the new rules concerning the operation, management, control, maintenance and inspection of heating, cooling and hot water systems in buildings.

The Decree lays down a set of obligations and criteria applicable to public and private buildings. They include in particular:

- new ambient temperature limit values for cooling and heating in all buildings;
- changes in the periods and duration of operation of winter heating systems;
- revised general criteria, requirements and responsible parties for the operation, management, control and maintenance of heating and cooling systems;
- the procedures and criteria for performing checks and maintenance on the systems, which can only be conducted by authorised firms in accordance with Ministerial Decree No 37/2008;
- the competent regional authorities, in cooperation with the local authorities, shall be responsible for performing energy efficiency checks, verifications and inspections on heating and cooling systems, and for establishing the criteria to be used for those checks;
- the regions, in cooperation with local authorities, shall set up registers of technical systems; they will also establish regional databases of energy performance certificates, ensuring that these are compatible with other regional databases.
- programmes will be implemented for the professional qualification and updating of heating and cooling system inspectors, as well as programmes for the annual conformity check of inspection reports;
- the organisation of information and awareness-raising campaigns aimed at the general public.

Presidential Decree No 75/2013

Presidential Decree No 75 of 16 April 2013 lays down the professional requirements and accreditation criteria to ensure the qualification and independence of the experts and bodies to be tasked with the energy certification of buildings.

The Decree identifies the following approved certifying parties:

- approved technicians holding the appropriate educational qualification (for details see Article 2 of the Decree) as well as the professional qualification;
- public entities and bodies governed by public law operating in the energy and building sectors, which run the certification service via one or more qualified in-house technicians;
- public and private bodies duly authorised to perform inspections in the sector for building, general civil engineering works and associated technical systems, approved by the Italian National Accreditation Body (ACCREDIA) or other equivalent European body (provided they operate with qualified technicians);
- the energy services companies (ESCOs) operating in accordance with the provisions implementing Directive 2006/32/EU on energy end-use efficiency and energy services, which deliver this service via qualified technicians.

The Decree provides for training courses leading to professional qualifications, to be offered at national level by universities, research and advisory bodies and agencies, and professional bodies and councils authorised by the Ministry of Economic Development, and at regional level by the Regions and Autonomous Provinces, or by other regional-level authorised bodies.

The Decree also defines the minimum course content and establishes the criteria for checking the quality of service. These include document checks on the Energy Performance Certificates, and assessment of the correspondence of project data or energy audits with the findings of building inspections.

Lastly, simplification measures are introduced for updating the EPCs when the renovation works concern only the technical systems.

Legislative Decree No 28/2011

Legislative Decree No 28/2011 transposes Directive 2009/28/EC on the promotion of the use of energy from renewable sources.

The Decree contains the following provisions on the energy efficiency of buildings:

- it establishes the obligation to include renewable energy sources in new buildings and buildings undergoing major renovations;
- it requires property sales or letting agreements to include a clause confirming that the purchaser or lessee received the information and documents on the building's energy certification;
- it requires all sales advertisements from 1 January 2012 to state the energy performance index contained in the building's energy performance certificate;
- it provides that new building construction and major renovation projects must include the use of renewable energy sources to cover heat, electricity and cooling requirements in compliance with the minimum integration principles and start dates set out in Annex 3; failure to comply with the obligation shall lead to denial of the building licence.

It is important to mention that under the above-mentioned Minimum Requirements Decree, for a building to be classified as nearly zero energy, it must meet the renewable energy requirements laid down in Annex 3 of Legislative Decree No 28/2011. These provide that at least 50 % of the demand for hot water, heating and cooling must be met using renewable energy sources.

Furthermore, the Decree sets out the installer qualification rules for the installation and supplementary maintenance of renewable power sources.

4.2 Incentives

Various incentive-based instruments exist at national level to promote energy efficiency in buildings. All of them are aimed at tapping the significant potential for energy savings that exists within the civil sector, seeking to unlock these savings by upgrading existing buildings. This section will look briefly at the instruments that are most effective in fostering the transition of the national building stock towards nearly zero-energy buildings.

Thermal energy account

Incentives for small-scale thermal energy production from renewable sources and for energy efficiency improvements stem from Article 28 of Legislative Decree No 28 of 3 March 2011. This refers to a Decree of the Minister for Economic Development, in consultation with the Ministers for the Environment and Protection of Land and Sea and for Agricultural, Food and Forestry Policy, for the definition of the implementing procedures of the 'conto termico' (thermal energy account) mechanism. These procedures were defined by the Ministerial Decree of 28 December 2012 containing 'incentives for small-scale thermal energy production from renewable sources and for energy efficiency improvements', which rendered this incentive mechanism fully operative.

Legislative Decree No 102 of 4 July 2014, transposing Directive 2012/27/EU on energy efficiency, made several changes to the original mechanism. These included increasing the number of eligible persons, establishing specific procedures enabling public authorities to opt for the payment of the incentive in the form of an advance followed by progress payments, and setting a ceiling on the amount of aid of 65 % of the cost incurred.

The recent legislative provisions contained in Article 1(154) of Law No 147 of 27 December 2013 (2014 Stability Law) and Article 22 of Decree-Law No 212 of 12 September 2014 ('Unlock Italy') update the incentive system in the interests of diversification, technological innovation and procedural simplification. The changes include the use of predefined forms to maximise access to funding for businesses, households and public stakeholders.

Through constant monitoring of the mechanism and ongoing dialogue with industry bodies, it has been possible to identify and analyse the issues that emerged in the first few months of implementation. This has given an insight into the needs of operators and enabled the right measures to be defined in order to simplify and improve the thermal energy account.

Updating the incentive mechanism first required a simplification of the access procedures.

In order to develop and share with operators the know-how acquired by GSE regarding the technical appraisal of installations, the Decree compiles a list of 'eligible products' with a thermal output of up to 35 kW (50 m^2 for solar captors), which is accessible to the public and updated regularly. The disbursement procedure would be semi-automatic, thereby lowering administrative costs for beneficiaries and improving the chances of a positive outcome to the appraisal. By purchasing one of the products listed, operators may make use of a streamlined application process, meaning that they no longer have to submit a description of their installation since GSE has already approved its conformity with the eligibility requirements.

The legislative changes contained in Legislative Decree No 102/2014 introduce a new government procedure for awarding the incentive in relation to the Thermal Energy Account, including the disbursement of an advance and, if necessary, progress payments.

In accordance with the provisions laid down in Legislative Decree No 102/2014, the Decree of the Ministry of Economic Development of 14 February 2016 updating the Thermal Energy Account ('Thermal Energy Account 2.0') provides, for all projects eligible for the Thermal Energy Account, through direct access (public authorities and private individuals), for the release of the amount payable in a single instalment, provided the value does not exceed EUR 5 000.

In the interests of further simplification, the Decree also extends the payment procedures currently in place to certify the costs incurred, including online and/or credit card payments, with a contractual description of the payment.

Among the measures aimed at developing the Thermal Energy Account, with reference to small-scale energy efficiency improvement projects, intended solely for public authorities, the Decree extends the Thermal Energy Account to energy efficiency improvements

concerning internal and external lighting of government buildings (or their appurtenances) and the adoption of efficient building automation systems, in view of their relevance for calculating the building's energy performance rating.

Regarding the incentives for thermal energy production from renewable sources, to ensure that the mechanism covers projects carried out in larger buildings (offices, shopping centres, hospitals), the Decree raises the eligibility threshold from the current 1 000 kW to 2 000 kW for heating and cooling systems using electric or gas heat pumps and biomass-fired boilers, and from the current 1 000 m^2 to 2 500 m^2 for solar thermal installations. Furthermore, the Decree grants access to the incentive for efficient hybrid systems and for thermal energy production from renewable sources (e.g. heat pumps combined with condensing boilers), both for public and private entities.

In order to overcome the barriers, often economic, which limit the uptake of the instrument in this context, and to facilitate the implementation of structural works, promoting the deep renovation of government buildings and fostering their transition to 'nearly zero-energy buildings', the Decree raises the incentive as described below:

- equal to 50 % of the investment cost incurred for projects involving the thermal insulation of opaque surfaces acting as a boundary for the heated or cooled volume of the government buildings referred to in Article 4(1)(a) of the Decree, carried out in climate zones E and F;
- equal to 55 % of the investment cost incurred for integrated building and installation projects carried out in climate zones E and F;
- equal to 65 % of the investment cost incurred for projects to transform the property into a 'nearly zero-energy' building in accordance with the Decrees referred to in Article 4 of Legislative Decree No 192/2005, as amended.

At 1 December 2016, since the start of Thermal Energy Account 2.0 (31 May 2016), GSE had received 7 033 applications for a total of 34 million in incentives. Of these, 20 million were through direct-access applications (private individuals and public authorities) and 14 million through reservations (public authorities only).

Since the mechanism was launched on 1 December 2016, more than 24 400 applications have been approved and have benefited from the incentive. This equates to a total of around 89 million in committed incentives, 71 million of which concern projects carried out by private individuals, and the remaining 18 million relating to projects executed by public authorities.

Tax relief for the energy-efficient renovation of building stock

Tax relief on projects designed to upgrade the energy efficiency of buildings was introduced in Italy by the 2007 Finance Act and still applies to this day. This has played a vital role in improving energy efficiency in the residential sector. Overall, the projects carried out (around 1.85 million at 31 December 2013) have contributed to a final energy saving currently in excess of 1.16 Mtoe/year. This has had a positive environmental effect, resulting in CO_2 emissions avoided of more than 3 million tonnes per year.

All taxpayers, individuals, professionals, companies and businesses that incur costs for energy-efficient renovations are eligible for tax relief on existing buildings or parts thereof or existing building units in any cadastral category (including rural buildings) that they own or hold.

If the works are carried out under finance leases, the user is entitled to claim tax relief, which is then calculated on the basis of the cost incurred by the leasing company. The following in particular are eligible for the subsidy:

- individuals, including skilled tradespeople and professionals;
- taxpayers who earn business income (individuals, partnerships, corporations);
- professional associations;
- non-profit public and private organisations.

The following individuals may also take advantage of the subsidy:

- holders of a right in rem over immovable property;
- tenants' associations, for works on common areas of a multi-apartment building;
- tenants;
- anyone who has use of the property.

At an operational level, the parties involved are qualified engineers enrolled with a professional body or association. They are responsible for certifying that the work carried out conforms to the dispersion limits and technical specifications. If the work is straightforward, the certification may be replaced by a declaration by the manufacturer of the item installed.

ENEA (the Italian National Agency for New Technologies, Energy and Sustainable Economic Development) is the body responsible for assessing the energy savings achieved as a result of the work, while the Revenue Agency handles tax-related matters.

Tax relief for energy efficiency projects is available for both residential and commercial buildings, and consists of reductions in IRPEF (personal income tax) and IRES (corporate income tax). It is granted for projects that improve the energy efficiency of existing buildings, particularly where costs are incurred to:

- reduce heating demand by upgrading the overall energy performance of the building;
- improve the building's thermal insulation (replacement of doors and windows and insulation of roofs, walls and floors);
- install solar thermal panels;
- replace winter heating systems (with condensing boilers or heat pumps);
- replace electrical water heaters with heat-pump water heaters.

A prerequisite for qualifying for tax relief is that the works are carried out on existing residential buildings and building units (or parts of buildings), in any cadastral category, rural or otherwise, including those used for business or professional purposes. Furthermore, for some types of works, the buildings must have specific characteristics. For example:

- a heating system must already be present in the rooms being renovated (unless solar panels are installed);
- in renovations on multi-occupancy buildings where the number of building units is set to increase, the benefit is only compatible with the installation of a central heating system serving those units;
- for renovations involving demolition and rebuilding, the incentive is only available in the case of like-for-like reconstruction; extension works are therefore excluded.

All works must meet certain minimum requirements, as laid down in the Ministerial Decree of 19 February 2007, as amended, and in the Ministerial Decree of 11 March 2008, harmonised with the Ministerial Decree of 26 January 2010. For example, new windows or walls must provide the building with sufficient insulation capacity, which varies according to the climate zone where the building is located. In practice, the works must conform to the dispersion limits for the entire building or for the individual building element being renovated. In the case of solar panel installation or replacement of the heating system, the new equipment installed must also meet the technical specifications laid down in the decrees. Deep renovation projects are also eligible, although in this case the overall energy performance upon completion of the works is assessed for the entire building.

As provided for by Decree-Law No 63/2013, as amended, the selective and structural measures and incentives will need to be defined. In this context, as already required for the Thermal Energy Account, the tax relief eligibility criteria will need to be aligned with the new minimum requirements for NZEB introduced by the Ministerial Decree of 26 June 2015. This will encourage more major renovation and deep renovation projects, resulting in a higher percentage of nearly zero-energy buildings in the national building stock.

When examining proposals, consideration should be given to amending the current rates of tax relief, reducing the rates for individual projects (such as new boilers or the replacement of doors and windows) and increasing the rates for major renovation projects, so as to meet the NZEB requirements. It is also worth considering specific social measures to tackle the problem of energy poverty, where households are unable to meet basic energy costs.

Structural funds: 2007-2013 programming and 2014-2020 programming

During the 2007-2013 programming period, EU funds, and specifically the European Regional Development Fund (ERDF), supported the development of renewable energy sources and projects to improve energy efficiency in buildings and public lighting, as well as energy-saving initiatives in SMEs.

At 30 June 2016, the OpenCoesione website – which publishes data from the Unit Monitoring System operated by IGRUE-MEF (Inspectorate General for financial relations with the EU at the Ministry of Economic Affairs and Finance) – listed active projects with an overall value of around EUR 2.4 billion, compared with a total amount programmed of some EUR 2.8 billion (including national co-financing). Of this, approximately EUR 187 million related to financial engineering instruments (e.g. guarantee funds, mortgages, etc.).

Following an assessment by ENEA of the types of projects carried out, the overall energy saving attributable to the ERDF contribution was estimated to be 0.3 Mtoe, with 1 159 $MtCO_2$/year in emissions avoided.

The total EU funding for Italy under the 2014-2020 programming comes to just under EUR 32 billion, including almost EUR 23 billion for less developed regions (Campania, Apulia, Calabria, Sicily and Basilicata), EUR 1.1 billion for transition regions (Abruzzo, Molise and Sardinia), and the remaining EUR 7.8 billion for more developed regions. This funding is supplemented by national co-financing, for which reference is made to the minimum percentages laid down in the Regulation: 50 % for more developed regions; 40 % for transition regions; and 25 % for less developed regions.

In the Partnership Agreement adopted on 29 October 2014, the theme of energy efficiency is covered by thematic objective 4 ‘supporting the transition towards a low-carbon economy in all sectors’, with around EUR 4 billion in funding allocated.

The main areas of this objective are:

1. energy efficiency and energy saving actions in public or public-use buildings and facilities, both residential and non-residential,

2. network initiatives: upgrading of smart networks mainly as part of smart cities and smart communities projects, in synergy with the actions financed by axes 1 and 2 on research and innovation and information and communication technologies, especially through tools supporting collective sustainable mobility and infomobility services;
3. increased sustainable mobility in urban areas.

Reducing energy consumption in public or public-use buildings and facilities, residential or otherwise, is therefore a priority under European guidelines, given the significance of primary energy consumption in the civil sector. To maximise the benefits in terms of overall energy saving based on the cost-optimal level, these actions should target the types of buildings with higher energy consumption and thus greater potential for energy savings relative to the investment required. They should be based on the findings of energy audits and seek to set an example, including by using the latest technology. Public housing projects should mainly be implemented using financial instruments that rely on private funding, thereby maximising investment leverage.

Advanced financial models will therefore be used for the buildings selected. These will include capital and third-party financing, if necessary through energy performance contracting, to carry out works such as:

- insulation of the building envelope;
- improvements in the energy efficiency of technical systems (heating, cooling, hot water production and lighting);
- other works compatible with the climate zones in which the buildings are located.

In each case, the cost/benefit ratio, the timeline for implementation and the transferability of the projects will be assessed. Renewable energy systems may also be installed, but only for self-consumption.
This could lead to the development of an effective and transferable technical, economic and financial model for selecting and executing energy improvement projects in existing public buildings. If structural funds are used for upgrading the building stock, it will be essential to give priority to major renovation projects covering both the building structure and installations, so to increase the number of nearly zero-energy buildings.

4.3. Financial instruments

Since energy efficiency projects are often profitable, in a purely rational scenario one would expect these projects and investments to occur spontaneously, driven by economic and market considerations. However, this positive mechanism is hindered by several barriers to the deployment of energy efficiency technologies, which vary according to sector. In the civil sector, the high initial investment often discourages small consumers from taking action (residential, offices). This is often compounded by limited awareness of the potential savings and a difficulty in accessing the incentives. Since the barriers are linked to the initial investment and agency problem, financial measures are becoming increasingly important.
Furthermore, the value of energy-efficient buildings is still not fully recognised by the market. To overcome these barriers, it is important to consider forms of support for the building as a whole, as well as measures to promote specific actions.
With this in mind, careful consideration should be given to the possibility of introducing financing mechanisms for the civil sector, based around subsidised eco-loans for energy-efficient renovations. This type of instrument could be aimed primarily at deep renovations,

adjusting the rate according to the expected results of the project.
An alternative might be to set up a real estate fund to guarantee long-term funding granted by banks for projects upgrading the energy efficiency of existing buildings. This type of fund would make it easier for private individuals – collectively if necessary (through tenants' associations) – to secure long-term loans repaid solely out of the savings obtained from the energy efficiency measures implemented.
This section lists the financial instruments that exist for upgrading the national building stock.

National Energy Efficiency Fund

The Legislative Decree transposing Directive 2012/27/EU on energy efficiency provides for the establishment of a National Energy Efficiency Fund at the Ministry of Economic Development. The Fund is designed to support energy efficiency measures implemented by the Government, ESCOs and firms to improve the energy efficiency of buildings, installations and production processes. The Fund is used to support measures aimed at upgrading the energy efficiency of buildings owned by public authorities, creating district heating and/or cooling networks, streamlining public services and infrastructure (including public lighting), upgrading the energy efficiency of entire buildings (including social housing) and reducing the energy consumption of industrial processes.

The Fund, which will be launched following the enactment of the planned implementing decree, is revolving and is divided into two sections that are designed:

- to issue guarantees for individual transactions and/or portfolios for loans granted to firms for the implementation of energy efficiency measures;
- to provide financing, either directly or through banks and financial institutions, including the European Investment Bank, if necessary by subscribing for units of closed-end mutual funds for which the investment objective is to subscribe for newly issued debt securities, or the arrangement of new financing, in any of the forms permitted by law, as well as by subscribing for securities issued under Law; No 130 of 30 April 1999 in the context of securitisation transactions involving private loans to small and medium-sized enterprises and ESCOs for investing in energy efficiency.

The Fund is intended to prioritise projects and programmes aimed at:

- creating new jobs;
- upgrading the energy efficiency of entire buildings;
- promoting new NZEB;
- installing earthquake protection measures in addition to upgrading energy efficiency.

A total of EUR 490 million will be paid into the Fund for the period 2014-2020. Further steps are still needed to identify the lending criteria, conditions and procedures for the Fund and the person appointed to manage it. It should be operational in the first few months of 2017, following the forthcoming implementing decree.

Fund for energy efficiency in educational buildings (Kyoto Fund).

The 2007 Finance Act (Article 1(1110)) set up a revolving fund at Cassa Depositi e Prestiti to finance measures to reduce greenhouse gas emissions under the Kyoto Protocol. The total amount of the Fund is around EUR 600 million.

Article 9 of Decree-Law No 91/2014 (converted by Law No 116 of 11 August 2014)

provides emergency measures for the energy efficiency of state-owned buildings used for school and university education, as well as buildings used for higher education in art, music and dance, and authorises the revolving fund, as laid down in Article 1(1110) of Law No 296 of 27 December 2006 on the financing of measures to reduce greenhouse gas emissions. In accordance with the above-mentioned Decree-Law, a Ministerial Decree was enacted on 14 April 2015 by the Ministry of the Environment and Protection of Land and Sea. The provision is designed to concentrate the residual assets of the Kyoto Fund (approximately EUR 350 million) on measures to improve the end-use energy efficiency of school and university buildings, calling on Cassa Depositi e Prestiti SpA as the existing manager of the Fund. The subsidised loans granted under this measure, eligible for the 50 % reduction in the interest rate referred to in the Decree of the Ministry of Economic Affairs and Finance of 17 November 2009, are granted by way of derogation from Article 204 of Legislative Decree No 267 of 18 August 2000, as amended. Access to funding is on the basis of energy audits that include energy certification, and the measures must improve the building's energy efficiency classification by at least two categories over a maximum of three years, as certified by an independent technical expert. The maximum funding period is 20 years, while for energy efficiency measures solely consisting of analysis, monitoring, audits, diagnostics, certification and design, the maximum funding period is 10 years.

Fund for the purchase and/or restructuring of buildings (Plafond casa)

In support of national housing policies, Article 6(1)(a) of the Decree-Law of 31 August 2013 (converted into Law No 124 of 28 October 2013) makes provision for EUR 2 billion to facilitate lending to homebuyers.

This Fund is intended to finance home purchases through mortgage-backed loans. Priority is given to properties that are the main residence, preferably within energy categories A, B or C, and/or renovations and energy efficiency improvements, with priority given to young couples, households with at least one disabled person and large families.

The practical arrangements for the scheme are defined in a specific agreement between Cassa Depositi e Prestiti and the Italian Banking Association.

4.4 Eligibility factors

In order to fully tap the potential for energy savings that exists within the civil sector, the impact of instruments that support and promote energy efficiency will need to be constantly monitored to identify improvement measures.

The strategies for implementing those measures should be directed mainly towards projects that involve major or deep renovations, in a bid to adopt the nearly zero-energy building concept by upgrading both the building envelope and installations to optimise their interaction. This approach can be summarised in three objectives:

- maximising the energy savings achieved;
- achieving greater cost effectiveness to make the best use of the financial resources available;
- increasing the number of NZEB.

In addition, support schemes should encourage technical solutions in proportion to their respective potential. A policy will have to be defined to boost the uptake of energy-efficient technologies. The policy will need to be both dynamic and flexible, adapting to new technologies in order to encourage their development.

To that end, it is essential that the performance, cost and market penetration of energy-efficient technologies are constantly monitored. It is important that technology appraisal systems are adopted that not only look at energy savings and reducing CO_2 emissions, but consider the system-wide benefits (reduction in the raw materials used, recyclability of the product, local reduction in polluting emissions, operational safety, possibility of creating local industrial sectors with a significant socioeconomic impact).

Lastly, the end user's role is central to public support for NZEB. Buyer satisfaction is crucial for the uptake of NZEB: improved thermal and acoustic comfort and lower energy bills must outweigh the higher percentage cost incurred. To ensure this outcome, the focus must be on constructing quality buildings that appeal to end users, if necessary through specific training for construction firms and designers. This is easier if end users are trained on how to manage the building properly, so that actual performance is consistent with expected performance.

This section analyses the eligibility factors necessary to enhance the energy performance of buildings and to increase the uptake of energy-efficient renovations.

Research and development

The construction of new buildings or the transformation of existing buildings into NZEB requires innovative solutions to be used for the components and systems of both the building envelope and the technical installations.

Key to this is research and development into technological innovations that pursue the following goals:

1. maximising the performance of individual components and appliances;
2. developing dynamic solutions for the building envelope to adapt to changes in the internal and external environment;
3. facilitating integration with renewable energy systems;
4. promoting home automation (regulation and control);
5. developing technological solutions to prevent and monitor the build-up of harmful pollutants in enclosed environments.

Some of the most interesting solutions include:

New thermal insulation products which, even with a modest thickness, give cladding and roofing low thermal transmittance values (which is especially significant for renovations of existing buildings). 'Super-insulating' materials are already being produced, such as insulation panels with aerogel that can achieve thermal conductivity of 0.013 W/m·K, or vacuum insulation panels that obtain up to 0.007 W/m·K. Similarly, efficient products are also being developed using nanotechnologies, such as polyurethane nanofoams, which are currently in development. The planting of green roofs and walls should also be mentioned, for which a specific standard exists: UNI 11235: 2007, 'Criteria for the design, execution, testing and maintenance of green roofs'. While not compulsory, its implementation generally leads to reliable and high-quality green roofs, yielding considerable benefits in terms of energy saving and microclimate regeneration. Green roofs and walls come under the concept of 'climate-proof' buildings, as part of the broader strategy of climate change adaptation.

Cool material: enhancing the summer performance of opaque components increasingly relies on solar control, achievable using high solar reflectance materials (cool materials). Elastomeric coatings and membranes can now achieve 90 % reflectance levels, with solutions capable of a chromatic response and enabling the architectural integration of the

envelope. Highly selective materials with high near-infrared reflectance are now on the market and are able to compete with conventional products on cost.

Thermochromic materials, which change colour depending on the surface temperature: they turn white when the temperature exceeds a certain value, and return to their original colour when they cool down. Other solutions being investigated include the use of phase change and photochromic materials.

Phase change materials: these improve the thermal inertia of the structure and could be of interest during the summer. They are used in external and internal plasterwork and in other layers of the building envelope. However, the complexity and cost of these solutions limit the effective market penetration of the technology, which has been around for several decades.

With regard to the transparent envelope, researchers are looking at how to boost thermal insulation by moving towards multiple glazing in cooler climates and improving the selectivity of the glazed component in warmer climates (increasing the ratio between light transmittance and solar factor from the current value of around two to up to three). Significant improvements in thermal insulation have also been achieved for timber, aluminium and PVC doors and windows, where a reduction in thermal transmittance of up to 1 W/m^2K is forecast. Electrochromic glass is a high-tech material that has been on the market for several years, although its use remains confined to niche applications owing to its still-prohibitive cost. Transparent photovoltaics have proved more popular, with a growing number of applications that harness conventional technologies (silicon) or advanced technologies (thin film, dye-sensitised solar cells (DSSC), organic PV with different deposition technologies). The solutions currently under investigation include: transparent phase change materials for stratified glass; thermochromic and thermotropic windows; and daylighting systems with complex-geometry reflective screens.

For some time, research into building installations has been developing increasingly efficient systems. These include hybrid systems which, although still based on methane combustion (such as existing heating boilers and the condensing boilers mentioned earlier), couple combined heat and power (CHP) micro-generation systems to heat pumps (HP) driven by the CHP system, resulting in a more efficient heating performance than conventional systems and delivering energy consumption that is more in line with the NZEB standard.

For solar protection, the latest advances consist of architectural integration with increasingly inventive high-tech solutions (metal and plastic grids with two- and three-dimensional frames). Dynamic screening systems are attracting considerable interest, with growing demand for control based on different strategies and with management systems linked to the various building energy services. Research is focusing on solutions activated by the external climate. The use of shape memory materials for opening and closing solar protection systems is of particular interest.

As for heat pumps, research efforts are being directed towards the use of new coolants with a low environmental impact, new compressors (possibly fitted with inverters), innovative cooling circuits, multi-function appliances, the reduction and optimisation of defrosting cycles, and hybrid (hydronic/direct expansion) systems.

When it comes to solar energy, one innovative solution already on the market is a thermo-photovoltaic hybrid system that can generate both power and heat, with a smaller footprint than an installation with separate thermal and photovoltaic panels.

Double-flow controlled mechanical ventilation can be used to recover some of the heat in the exhaust air from the building's ventilation system. Thermodynamic controlled mechanical ventilation recovers energy from exhaust air from the building's ventilation system through an active thermodynamic process with a reversible heat pump circuit, boosting the cooling or heating capability of the ventilation system. Some of the most advanced solutions are mechanical ventilation systems with heat recovery and a CO_2 sensor that regulates air flow according to the building's population.

Other recent technological developments include:

- daylighting;
- integration of renewable energy sources into the building façade (e.g. multifunctional façades with building-integrated solar thermal (BIST) and building-integrated photovoltaic (BIPV) systems);
- electricity storage to optimise the consumption of photovoltaic energy.

Further developments are also expected in regulation and control systems (building automation). These analyse the external and internal conditions of the building in real time and optimise the management of both the envelope and the installations.

The technological solutions implemented for the building envelope and the technical installations must not compromise the health and well-being of the building's occupants. Therefore, the building materials and technologies used must always be weighed against their impact on health.

Strategy and local governance

In order to communicate policies at the local level, maximising their effectiveness and ensuring that rational energy use plays an active role in local government policy, consideration should be given to setting up an enlarged, multi-level steering committee on energy efficiency, as a forum/instrument for optimising the coordination of energy efficiency actions and measures in government buildings.

Monitoring and availability of data

The data gathered from various channels (tax relief, energy performance certificates, heating system efficiency, etc.) should be more easily accessible to local authorities. The spatial and temporal processing of specific data effectively underpins the new analytical dimension of local authority planning, to define indicators that measure the effectiveness of policies. These indicators may be used for key policies, for example in the definition of overarching initiatives (calls or concerted distribution of economic resources), or as a regional benchmark.

Soft policy measures

Unlike energy system management, efficient energy use relies on the actions of individuals. Binding legislative measures (obligations) or incentives should therefore focus more on encouraging individuals to alter their behaviour. Galvanising, empowering and supporting this socioeconomic fabric through planning, policy measures and administrative actions is therefore key.

Reliable confirmation of this approach can be found in the latest annual energy efficiency report from ENEA, which reads: 'empirical evidence from psychology and behavioural economics shows that consumer choices and actions often deviate from the neoclassical economic assumptions of rationality, and that several fundamental and entrenched prejudices exist in the human decision-making process which frequently cause irrational behaviour'.

It is therefore appropriate to define specific measures to overcome non-economic barriers to the uptake of energy efficiency in buildings.

5. Regional NZEB programmes[6]

Emilia-Romagna Region

The Region has published the following call: 'Granting of aid for the implementation of measures aimed at upgrading the energy efficiency of public buildings and public housing in accordance with axis 4 – investment priority 4c – objective 4.1 – actions 4.1.1 and 4.1.2 of ERDF ROP 2014-2020', referred to in Decision of the Regional Executive No 610/916, which provides for specific measures (Article 4.12(e) – Transformation of existing buildings into nearly zero-energy buildings) for the uptake of NZEB buildings.

Lombardy Region

In 2012, the Lombardy Region, with the support of Cestec's Energy Division (now Infrastrutture Lombarde), produced a catalogue of major projects involving buildings with A and A+ ratings ('Volume LOMBARDIA+ – L'edilizia a consumo quasi zero in Lombardia'). The catalogue is available on the downloads page of the website www.cened.it. The catalogue contains a curated selection of energy-efficient buildings constructed in Lombardy, including 29 exemplary buildings with A+ and A ratings, produced by the accreditation body with a contribution from the BEST Department at Milan Polytechnic.
In 2010, the Lombardy Region published a call for the construction of 'zero-energy' buildings (ref. Decree of the General Director No 10652/2010 'Approval of calls for the uptake of solar thermal installations and rational energy use in public or public-use buildings').

The Region has also published a call for the 'Granting of subsidies aimed at increasing the energy efficiency of buildings', allocating more than EUR 30.75 million to make local government building stock more efficient and compatible with NZEB requirements. The call proposes a subsidy equal to 70 % of the costs (comprising a non-repayable grant for 30 % and a repayment loan for 40 %), subject to a maximum of EUR 4.9 million.

Piedmont Region

Since 2004, the Piedmont Region has launched and funded incentive schemes for demonstration projects. These must feature innovative technical and/or operational solutions and be able to form pilot schemes that can be replicated throughout the Region. The priorities included the adoption of advanced building technologies for the construction of buildings with very low energy consumption. Following the calls, various types of buildings were constructed (single-family houses, multi-apartment buildings, industrial buildings, research centres, etc.) with high energy performance levels, and various examples were featured in publications produced by the Region and found on the website: http://www.regione.piemonte.it/energia/documentazione.htm.
In 2011, the Piedmont Region published a call for NZEB in the private sector to grant aid for the construction of nearly zero-energy buildings, approved in accordance with Decision of the Regional Executive No 41/2373 of 22 July 2011. The authority fully funded this incentive measure under Regional Law No 23 of 7 October 2002, as amended ('Provisions in the energy sector. Procedures for drawing up the energy and environmental plan').
Private individuals were eligible for aid as owners of the property or as holders of rights in rem or rights of possession. The capital financing available was equal to 25 % of the eligible costs of the work.

[6] Given the recent entry into force of national legislation, and since regional initiatives are now out of date, there may be a slight misalignment with the definition of nearly zero-energy buildings.

The grant applied to nearly zero-energy buildings designed and built so as to have an extremely low thermal energy demand both for heating and cooling.
Buildings that met the following minimum requirements – according to the results of energy calculations performed in 'design rating' conditions – were considered eligible:

(a)

$$\frac{Q_{H,ND}}{S_U} \leq 15 \frac{kWh}{m^2 \cdot a}$$

where:

$Q_{H,ND}$ = ideal energy demand of the building for heating (cf. UNI TS 11300-1);

S_u = usable floor area of the building;

(b) $\frac{Q_{C,ND}}{S_u} \leq 10 \frac{kWh}{m^2 a}$

where:
$Q_{C,ND}$ = ideal energy demand of the building for cooling (cf. UNI TS 11300-1);
S_u = usable floor area of the building;

(c)

$$\frac{EP_{tot,RINN}}{EP_{tot}} \geq 50\%$$

where:
EP_{tot} = total primary energy demand of the building (considering the following energy services: heating, cooling, hot water and lighting);
$EP_{tot,RINN}$ = primary energy produced from renewable energy sources by installations located in the building or on its appurtenances.
A total of 94 funding applications were received in response to the call. Following the preliminary phase, 36 applications were accepted, absorbing EUR 2 195 428.32 of the funding available as at 18 December 2013, the closing date of the call.
The following table shows the average, total and unit values of the projects examined in relation to the total project cost, the requested amount and the amount eligible for funding, relative to the total funding available for the call.

	Project cost	**Requested amount**	**Eligible amount**	**Total**
	100 %	67 %	45 %	11 %
Average	EUR 470 352	EUR 314 567	EUR 211 703	EUR 52 647
Total	EUR 16 932 666	EUR 11 324 412	EUR 7 621 322	EUR 1 895 304
Unit	EUR 3 563	EUR 2 383	EUR 1 604	EUR 399

Each project funded had to include – as a requirement of the call – systems for monitoring energy consumption for five years following the completion of the project.
On average, the design of NZEB, particularly new builds, was more orientated towards technical components rather than the building envelope. All the buildings financed involved

the installation of an aerothermal heat pump to meet the demand for thermal energy for heating and of solar thermal installations for hot water. The windows were all low-emissions triple glazing with external screening. To achieve the objectives of the call, all works included the installation of controlled mechanical ventilation with active thermodynamic recovery. The first 10 of the 25 buildings to be built and put into service were monitored.
The main issues detected during the preliminary phase are listed below:

- use of the technical method provided by the standard UNI TS 11300 for the design of NZEB;
- the design often ignored or underestimated the thermal bridges present in the building envelope;
- the installed system ratings were often incompatible with the project's sustainability, both financially and with regard to energy;
- the mild climate discourages the construction of NZEB;
- the problem of high construction costs should not be underestimated in the decision to design and build NZEB.

For the latter incentive, a list of best practices is in the process of being compiled and will also be published on the website.

Lastly, Decision of the Regional Executive No 5/4929 of 19 November 2012 approved the 2012-2013 Energy Action Plan for initial implementation of the regional energy planning guidelines. Under Strategic Axis 2 (Promoting energy efficiency and energy saving), the call was approved for the 'Construction of nearly zero-energy buildings'. The aim was to encourage construction firms in Piedmont to specialise in the construction of new NZEB, in accordance with Directive 2010/31/EU (EPBD 'Recast'). At the same time, buildings with very high energy performance would be constructed in which the low energy demand would be met predominantly from renewable energy sources.

The beneficiaries were individual businesses and/or consortia operating in the construction sector (sector F – ATECO 2007). The amount of EUR 1 million – met entirely by the regional budget – was initially set aside to finance this call.
The eligibility criteria were the same as those used for the above-mentioned call for NZEB in the private sector.

Apulia Region

The Region shortly plans to publish the following call: 'Measures to improve the energy efficiency of public buildings', in accordance with Action 4.1 – Priority Axis IV 'Sustainable energy and quality of life' under the ERDF operational programme 2014-2020, and for the purpose of achieving objective RA 4.1 'Reducing energy consumption in public buildings and facilities, for residential or other use, and the integration of renewable sources', to expedite the transition towards nearly zero-energy buildings laid down in Directive 2010/31/EU and transposed by Law No 90 of 4 July 2013.

Umbria Region

The Region plans to publish the call: 'ERDF ROP 2014-2020 Axis IV Key Action 4.2.1. Public call for the granting of aid to public bodies for the implementation of (minor) works to improve energy efficiency in buildings', as defined in Executive Decree No 2201 of 21 March 2016. This call awards non-repayable grants to public bodies, supplementing the government incentives under the Ministerial Decree of 16 February 2016 (Thermal Energy Account 2.0). It provides access to funding that could potentially cover 90 % of the costs incurred to improve the energy efficiency of buildings and/or of heating and/or cooling systems or to transform existing buildings into NZEB. For the transformation into NZEB in

particular, the contribution referred to in the regional call equates to 25 % of the costs incurred, supplementing the government incentive of 65 %. The budget is currently EUR 2.5 million.
To facilitate access to the government incentives under Thermal Energy Account 2.0 and the above-mentioned EU funding, and to facilitate the implementation of energy efficiency measures, the call was preceded by systemic actions which included, *inter alia*, grants to assist public bodies in performing energy audits on public buildings. In the call referred to in Executive Decree No 4924 of 13 July 2015, which set aside EUR 996 000 with funding under Axis IV of ERDF ROP 2014-2020, 94 applicants entered with 262 public buildings and/or facilities to be subjected to energy audits. These included 139 schools, 39 municipal offices, 26 sports centres, 14 hospitals, 12 cultural centres, 4 healthcare facilities and 9 buildings with another intended use.

Valle d'Aosta Region

The Region has published the following call: 'First public notice for the awarding of loans to carry out building conversion and engineering works in the housing sector involving an improvement in energy efficiency, if possible using renewable energy sources, as laid down in Article 44 of Regional Law No 13 of 25 May 2015 – measure for private individuals', ratified by Decision of the Regional Executive No 489 of 15 April 2016.

This notice applies to subsidised loans granted for building conversion and engineering works in the housing sector, if possible using renewable energy sources, which lead to an improvement in energy efficiency. The total amount of eligible expenditure for the execution of the works must be between a minimum of EUR 10 000 and a maximum of EUR 400 000, net of taxes (such as VAT). Loans are available for up to 100 % of the eligible expenditure, net of taxes (such as VAT).

According to the notice, works carried out on existing residential buildings in the region are eligible for funding. The works may include the following:

(a) complete demolition and reconstruction;
(b) major renovation;
(c) minor renovation;
(d) energy-efficient renovation.

To promote NZEB, the notice recognises the eligibility of demolition and reconstruction works only if intended for the transformation into 'nearly zero-energy buildings'.

Autonomous Province of Bolzano

The Autonomous Province of Bolzano promotes NZEB through the Decision on the overall efficiency of buildings (No 362 of 4 March 2013, as amended). New buildings must meet the ClimateHouse A rating from 1 January 2017. In addition, the Energy Bonus offers a volume bonus of 15 % for the 'ClimateHouse A rating' and 20 % for buildings that meet the 'ClimateHouse A nature' standard.

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APPENDIX A:

Configuration and performance of NZEB and buildings that meet the 'minimum requirements' for 2015

Each building as defined in Table 1 of section 2.2 has been analysed on the basis of one or two of the most common technical configurations, depending on whether the building concerned is existing or new, and assuming – in the case of existing buildings – that the works aimed at upgrading the energy efficiency have different levels of invasiveness. Other than solar energy, renewable energy sources (e.g. biomass, wind, etc.) were not taken into account here as they do not apply in most cases.

For the building envelope, the thermal transmittance values adopted are consistent with those stated in Appendix A of the 'Minimum Requirements' Decree for 2015 and 2019/2021 respectively (required by the NZEB definition).

In general terms:

- in the case of an existing building,
    - configuration 1 requires more invasive work (e.g. replacement of heaters for separate hot water systems in each building unit and central heating with a combined central system) and the use of more efficient technological solutions, such as a combined heat pump for heating, cooling and hot water;
    - configuration 2 requires less invasive work (for example, separate generators are maintained for heating and hot water if the system is so configured) and the use of more conventional technology, such as condensing boilers, which may be combined with solar and/or photovoltaic panels to meet the necessary requirement for renewable energy;
- in the case of a new building,
    - configuration 1 considers a central heat pump for heating, cooling and hot water as the core technology;
    - configuration 2 is designed to test the feasibility of attaining the legal requirements using conventional technology, such as condensing boilers with solar panels and, where necessary, photovoltaic panels for hot water production.

The coverage of 50 % for NZEB or 35 % for buildings conforming to the requirements for 2015, coupled with the technical constraints in the case of work on existing buildings, often limited the technological options.

Large multi-apartment buildings, for example, have central heating with separate hot water systems for each building unit; in this case, the use of solar panels to produce hot water is not technically feasible, therefore a heat pump is used to heat the water in each building unit, with another central heat pump for the heating, while cooling uses individual split units for each apartment. In these cases, if the minimum percentage of demand met by renewable energy sources is not reached, photovoltaic panels are installed. In energy terms, photovoltaic panels produce electricity to run individual systems (e.g. heat pump for hot water and cooling) as well as central systems (e.g. heat pump for heating) each month.

Single-family buildings have a combination system for heating and hot water; this configuration allows solar panels to be used to meet the demand for hot water from

renewable energy sources, with PV panels for auxiliary electrical systems and heat pumps for cooling and potentially heating, if the condensing boiler is not sufficient. The results show that the condensing boiler can only be used in climate zone B and to meet the 35 % renewable energy requirement in the case of buildings that conform to the standards expected for 2015.

Existing office buildings are configured with a central heating system, separate hot water system with electric storage heater and split cooling for each individual environment. As with residential buildings, in the case of non-invasive work, it is necessary to keep the three applications separate and to replace existing generators with separate heat pumps, supplemented by PV panels to meet the NZEB requirements. In the case of new office buildings, the applications are designed to be centralised and a single heat pump installed, again supplemented by PV to meet the NZEB requirements.

Regarding the distribution of heating fluid and environmental emissions, the most economical solution has been chosen from among those that are technically feasible for each building type. In existing residential buildings transformed into NZEB, due to the insulation of the building envelope with the resulting drop in heat load, it is estimated that even where heat pumps are used, the existing radiators are sufficient to maintain the correct temperature.

From these assessments, it emerges that the difference between configurations 1 and 2 is not that significant. In other words, there is no noticeable impact on energy performance if an individual heat pump is used rather than a central heat pump.

It can be concluded therefore that the conditions imposed by the NZEB definition, and particularly the renewable energy requirement, entails the predominant use of a heat pump (possibly centralised and combined to produce thermal energy for heating, cooling and hot water), supplemented by photovoltaic panels where necessary to achieve the required coverage from renewable energy sources. This conclusion is also confirmed by the results of the calculations contained in Appendix A. For example, in the case of an existing or new single-family house and for both climate zones, configuration 2 (combination and split condensing boiler) offers the best energy performance. However, it does not meet the requirement for 50 % coverage from renewable energy sources, and therefore cannot be considered suitable for NZEB.

APPENDIX B:

Methodological note on costings

Prices in the building sector depend on various factors, such as the size of the construction site, proximity to the source of building materials, the local market and the uptake of certain technologies. To provide trackable information that is, as much as possible, valid for all of Italy, national price lists are used as the main source [9] [10]. In addition, the information has been supplemented and validated with data from industry bodies and from the energy efficiency measures actually implemented [11]. Lastly, for advanced technology for which there is no price list as yet, manufacturers' catalogues were used. Where applicable, professional fees were also included (e.g. design, construction supervision, site safety coordination, energy certification and contributions to the national pension and social security fund for engineers and architects). For renovations only, both the costs directly attributable to the works carried out and those associated with auxiliary works are taken into account. A description can be found in Table 10.

Measure	Costs considered
External insulation	Supply and installation of insulation, scaffolding hire (including assembly and disassembly), replacement of downpipes, alteration of window sills, transportation and landfilling of demolition material.
Soffit insulation	Supply and installation of insulation, construction of plasterboard suspended ceiling and painting.
Insulation of the top floor	Supply and installation of insulation, construction of mineral fibre suspended ceiling and painting.
Insulation of the ground floor	Supply and installation of insulation and construction of concrete slab.
Replacement of windows and doors	Supply and installation of doors and windows and removal, transport and landfilling of old doors and windows.
Condensing boiler in single-family buildings	Supply and installation of the generator (heating and hot water) and thermostatic radiator valves, removal, transportation and landfilling of old generator and upgrading of flue (pipework).
Condensing boiler in multi-apartment buildings with central system	Supply and installation of the generator (heating only), expansion tank and thermostatic valves, masonry and electrical works for the heating plant, removal, transportation and landfilling of the old generator, upgrading of the flue (pipework).
Condensing boiler in multi-apartment buildings with separate systems	Supply and installation of the generators (heating and hot water), removal, transportation and landfilling of old generators, construction of external steel flue(s) and scaffolding.
Thermal solar energy	Supply and installation of separate forced-circulation solar systems with flat panels, masonry and electrical works.
Photovoltaic system	Supply and installation of polycrystalline silicon photovoltaic modules, inverters, masonry and electrical works.
Electric hydronic type heat pump	Supply and installation of air-water heat pump, masonry and electrical works at the power plant.
Air conditioning system with direct expansion	Supply and installation of external condensing unit and internal units.
Hybrid heat pump (direct expansion and hydronic)	Supply and installation of external condensing unit, split internal units and hydrotank (tank with exchanger), masonry and electrical works at the power plant.
Heat pump water heaters	Supply and installation of water heater.

Fan coil emission system	Supply and installation of fan coils, distribution construction (copper pipes with insulation), masonry accessories.
Thermostatic valves	Supply and installation of thermostatic valves for each heating element.
Distribution blocks	Supply and installation of distribution blocks for each heating element.

Table 10 – Description of the renovation works