ITALY'S ENERGY EFFICIENCY ANNUAL REPORT

2016

EXECUTIVE SUMMARY

ENEA

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2016 ENEA – www.enea.it
Italian National Agency for New Technologies,
Energy and Sustainable Economic Development

Foreword

As tradition has it, at the end of the spring ENEA publishes the Energy Efficiency Annual Report.

It is a great honour to close these first five years that saw its creation, growth and development into a leading reference publication for the analysis of the Italian energy efficiency market and its link with the economic and technological contexts.

Energy efficiency is now a priority in all national political agendas. The number of countries that, ideally deserting the Paris appointment last December, do not set targets to reduce their energy intensity, consumption and CO_2 emissions is very low.

Nevertheless, very often good intentions are not followed by concrete actions. Notwithstanding the broad consensus on the need to save energy through the improvement of energy efficiency and a growing availability of technologies, sometimes figures show a different trend.

Several reasons explain this "energy efficiency gap". I believe a major cause is the lack of data for building suitable indicators.

In this regard, I would like to remember a Galileo's maxim: 'Measure what is measurable, and make measurable what is not so'. It is a statement so true and effective to be at the root of the action of many decision makers, managers and entrepreneurs.

Also Peter Drucker, the father of modern management, always highlighted the importance of setting clear and measurable targets in the realization of different activities, considering in each case the deviations from the goal.

Indicators cannot be built without data. Without indicators, it is very hard to develop a robust strategy for the evaluation of achieved results. As a consequence, both optimization of policies and measures, and monitoring of progresses and failures are affected by lack of information.

Without false modesty I can say that, although there is still room for improvement Italy has done a good job in this direction, setting up a yearly monitoring tool with a twofold value. On the one side, this Report helps Italy to align with European policies, and to monitor the current contribution to the 2020 target. On the other side, it allows to check the implementation status of our policies and measures, quantifying their achievements and, if needed, correcting the trend.

Yet, a third characteristic makes the Report truly innovative and effective: a "shared monitoring", that is the support of many different high-level experts, establishing a network of 'sensors' all over the Italian territory.

The challenge to reduce energy consumption is ambitious, and very stimulating at the same time. It can be successfully addressed only by acting together, sharing practices and experiences. This is why I am particularly grateful to my colleagues of the Technical Unit for Energy Efficiency, editors of the Report, and above all to our "sensors", who alternate every year and kindly agree to share this path with us.

Thank you all.

Federico Testa

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Introduction. The international and national contexts

At the end of 2015, the first ever global climate agreement, the *Paris Agreement*, was adopted by 195 countries. It set the ambitious global target to hold the increase in the global average temperature to well below 2°C above pre-industrial levels, and to pursue efforts to limit the temperature increase to 1.5°C.

Countries will adopt gradual commitments, through the review every five years of the *Intended Nationally Determined Contributions* (INDCs). The agreement is a clear signal both to market participants, relative to the consolidation of an already underway transition process, and to policy makers, relative to the development of national decarbonisation strategies. Already in the short term the countries will have to boost infrastructural and technological innovation, supporting the investments needed to place themselves on a long-term decarbonisation path.

Together with the decarbonisation of electricity generation and energy consumption, energy efficiency is one of the key strategic actions, in very different countries in terms of economic structure and energy mix. According to the *Deep Decarbonization Pathways Project*, in 16 participating countries the consumed energy per unit of Gross Domestic Product (GDP) would decrease by 64% on average in 2050, thanks to a combination of technological innovation and behavioural change. In decarbonisation pathways, energy efficiency is the prevalent strategic action until 2030, and reduction in energy intensity provides a relevant contribution in achieving national goals. Building construction techniques, more energy efficient industrial production processes, optimised urban transport and logistic chains are examples of key elements at sectoral level.

The European Union has been one of the main proponents of the Paris Agreement, confirming its role as the forerunner in emission reduction and energy efficiency policies. In early 2015, the Commission published the *European Union strategy*, a very important step in the transition to a low-carbon economy based on secure, sustainable and competitive energy. The five dimensions of the *Energy Union* are interrelated and mutually reinforcing. For example, with respect to the energy security dimension, the European Union currently imports 53% of the energy it consumes: lowering energy demand through energy efficiency, which is another dimension, represents an opportunity to reduce energy dependence, enhancing security. Lowering demand is possible through innovative technologies, the use of which could increase industrial competitiveness. The other dimensions are internal market, decarbonisation of economy and research, innovation and competitiveness.

The proposed revision of Directive 30/2010 as well as the actions planned on Ecodesign and Directive 27/2012 are targeted to radically rethink the role of energy efficiency for achieving the 2030 indicative objective. A particular focus in this process is placed on the

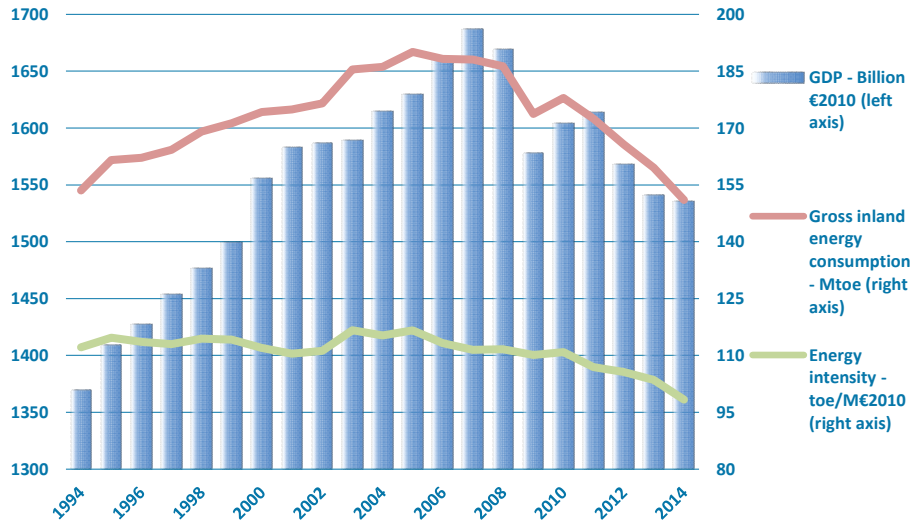
building sector, which accounts for about 40% of final energy consumption in the EU. The energy efficiency potential is huge: only a small proportion of buildings is subject to major renovation and it is expected that more than two-thirds of the total will still be in use in 2050.

Thanks to the adoption of the so-called *Minimum Requirements Decree* (Interministerial Decree 26 June 2015), Italy has focused more attention on the energy performance of buildings. Nevertheless, there are still barriers, many of which are outside the regulatory framework and, as in other sectors, prevent the energy efficient potential to be fully exploited. Better information and improved conditions to access financial instruments should play a key role in favouring the massive investments needed to achieve the 2020 objectives.

1. Energy demand and consumption

Consistently with the decreasing trend observed since 2010, in 2014 gross inland consumption decreased by 5.3%, reaching 151 Mtoe. The GDP scored almost the same value as in 2013 (-0.3%). Primary energy intensity well summarises these two trends: since 2008 it has decreased by 17.3% (Figure 1) and in 2014 it was equal to 98.4 toe/M€$_{2010}$, decreasing by 5% relative to 2013.

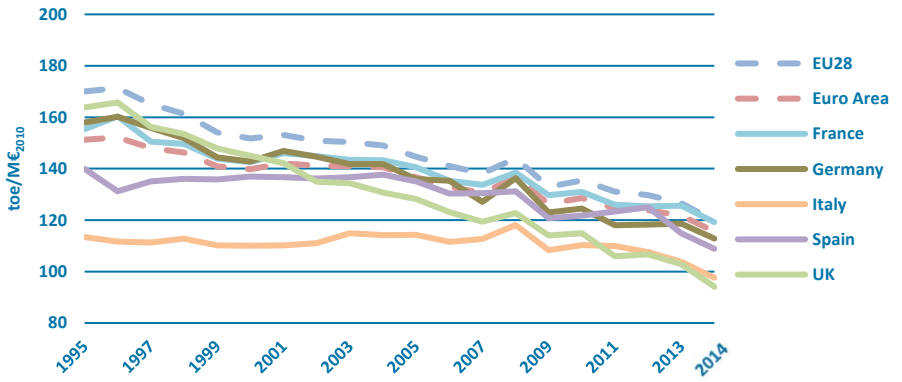
Figure 1 – Italian gross inland energy consumption, GDP, primary energy intensity



Source: ENEA elaboration on data from Ministry of Economic Development and ISTAT

A decreasing trend in the primary energy intensity is observed in Italy, consistently with other EU countries (Figure 2). In Italy, the primary energy intensity is lower than the average in EU28 (-18.5%) and in Eurozone countries (-15%).

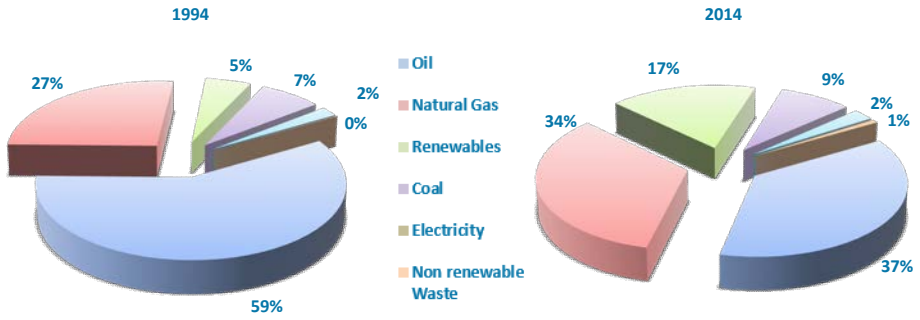
Figure 2 – Primary energy intensity in UE28 (toe/M€$_{2010}$), years 1995-2014



Source: EUROSTAT

In 2014, the primary energy consumption reached the level of the early Nineties but with a different energy mix (Figure 3). Fossil energy sources still represent the main energy source, although their share has continued to decrease: in 2014, around 80% of gross inland consumption was covered by fossil fuels, against a 92.4% share in 1994. Renewables have been steadily growing, with a share on the total increased from 5.4% in 1994 to 17.6% in 2014.

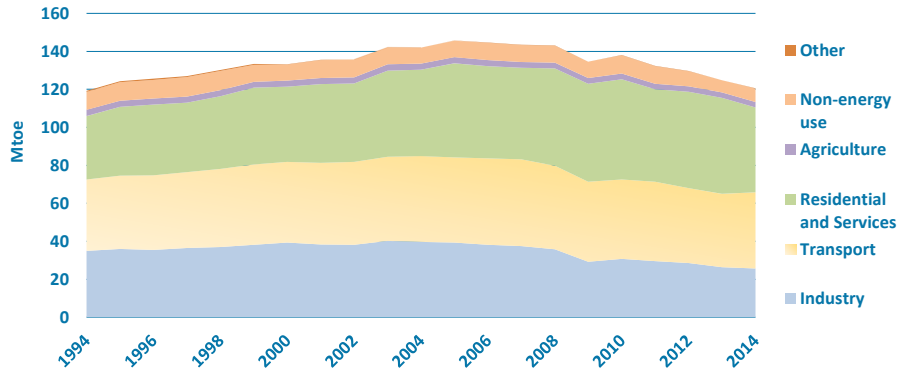
Figure 3 – Primary energy consumption by energy source (%), comparison between 1994 and 2014



Source: EUROSTAT

In absolute terms, in 2014 consumption was equal to 55.8 Mtoe for oil (-2.8% relative to 2013), 50.7 Mtoe for natural gas (-11.6%) and 26.5 Mtoe for renewables (+0,5%). In 2014 the decreasing trend in final energy consumption is confirmed: final consumption was equal to 120.5 Mtoe, with a reduction of 3.4% relative to 2013, reaching the 1994 consumption level (Figure 4).

Figure 4 – Final energy use by sector (Mtoe), years 1994-2014



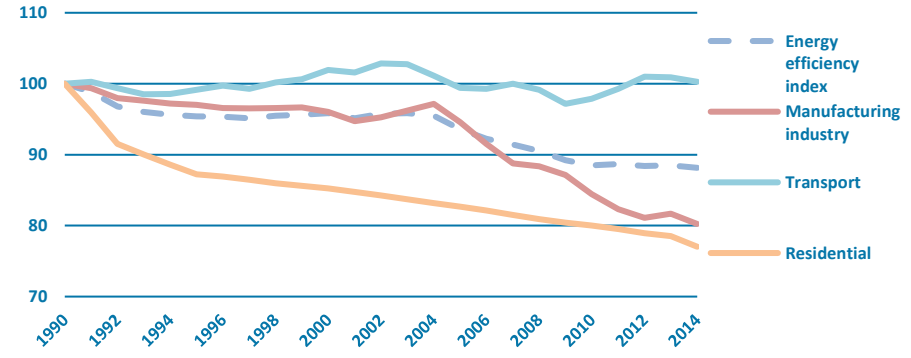
Source: EUROSTAT

Except transport (+3.6%), the other sectors showed a consumption reduction: -11.6% for residential and services (mainly driven by natural gas) and -2.4% for industry.

In spite of the decrease observed in 2014, the highest consumption share corresponds to the civil sector (37.1%), followed by transport (33.3%) and industry (21.3%). Such a distribution is determined by the steady growth in the civil sector over the 1994-2014 period, which implied an energy consumption higher than the 1994 level (+33.8%). By contrast, the industrial sector lowered its consumption (-26.5%), in particular starting from 2000. A reduction is also observed also in the agricultural sector (-14.6%). In the transport sector, a slight increase (6.6%) is observed in the 1994-2004 period.

The ODEX energy efficiency index, developed in the European project ODYSSEE-MURE, can be used for an overall evaluation of energy efficiency improvements in different sectors. It provides a more reliable assessment than energy intensity figures, since it does not include structural changes and other factors not associated to efficiency (Figure 5).

Figure 5 – ODEX energy efficiency index (1990=100), years 1990-2014



Source: ODYSSEE

In 2014, the ODEX index (lower the value, better the performance) for the whole Italian economy was 88.1, slightly decreasing after the constant trend observed in the last three years and the steady improvements until 2010. Sectors have contributed to this trend in a different way: the residential sector registered regular and constant progresses over the 1990-2014 period, with main progresses in the early Nineties; the industrial sector has obtained significant improvements starting from 2005, with a negative result in 2013 associated to a slight efficiency loss in non-metallic minerals (excluded cement) and textile. The transport sector has the greatest difficulties in achieving energy efficiency improvements due to the characteristics of the freight transport system, almost exclusively based on road transport. In particular, both number of travels and energy consumption are growing, although with a lower load factor.

2. Achieved energy savings

Quantitative evaluation of achieved savings has been made both with reference to National Energy Efficiency Action Plan 2011 (2011 NEEAP) objectives, relative to the 2005-2016 period, and to the Italian National Energy Strategy objectives, relative to the 2011-2020 period, further revised in 2014 NEEAP. Besides, energy savings and information for the mandatory targets of Energy Efficiency Directive (EED) article 7 are also provided. The methodology for the quantification of energy savings has been revised in 2015, in order to take a broader set of available data and information into account.

In particular, the following measures were analysed:

- Energy efficiency obligation scheme or White Certificates (Table 1): the energy saving from projects implemented since 2005 through standard sheets (ex-ante estimation based on algorithms), and analytical and final balance sheets (ex-post measure) was equal to more than 4.75 Mtoe/year of primary energy (equivalent to more than 4.38 Mtoe/year of final energy).

Table 1 – Savings from White Certificates (primary energy, Mtoe/year), years 2005-2015

	Total 2005-2010	2011	2012	2013	2014	2015	Total 2005-2015
Total	2.62	0.07	0.30	0.79	0.53	0.44	4.75

Source: Ministry of Economic Development elaboration on Gestore Servizi Energetici (GSE) data

- Fiscal deductions for energy renovation of existing buildings: until September 2016 it is still possible to modify data relative to interventions implemented in 2015. The energy saving for 2015 has then been estimated on the basis of preliminary data and was equal to 0.24 Mtoe/year of primary and final energy. The overall energy saving in primary and final energy was equal to 1.89 Mtoe/year (Table 2). In the 2007-2015 period more than 2.5 million interventions were incentivised, with more than 28 billion euros invested by households.

Table 2 – Savings from fiscal deductions for energy renovation (primary energy, Mtoe/year), years 2007-2015

Intervention	2007	2008	2009	2010	2011	2012	2013	2014	2015*	Total
Overall renovation	0.006	0.014	0.01	0.004	0.003	0.003	0.003	0.003	0.003	0.049
Thermal insulation of the envelope	0.016	0.043	0.043	0.066	0.052	0.047	0.064	0.065	0.06	0.456
Efficient heating systems installation	0.096	0.162	0.136	0.138	0.146	0.129	0.174	0.175	0.18	1.347
Multiple actions	0.015	0.034	-	-	-	-	-	-	-	0.049
Total	**0.133**	**0.253**	**0.189**	**0.208**	**0.201**	**0.179**	**0.241**	**0.243**	**0.243**	**1.890**

* Estimates

Source: ENEA

- Renewable Energy for Heating & Cooling Support Scheme (so-called *Thermal Account*): Table 3 shows achieved energy savings in 2014 and 2015 by Public Administration. The total amount is equal to almost 0.78 ktoe/year of primary and final energy.

Table 3 – Savings from *Thermal Account* (primary energy, Mtoe/year), years 2014 and 2015

Intervention	2014	2015
Opaque envelope	na	0.000266
Windows and shutters	na	0.000140
Condensation boilers	na	0.000366
Total	**0.000005**	**0.000773**

Source: Gestore Servizi Energetici (GSE)

- Transposition of Directive 2002/91/CE and implementation of Legislative Decree 192/05 with reference to the Minimum Energy Efficiency Requirements for buildings: the overall primary energy saving was 2.03 Mtoe/year, mainly deriving from the substitution of heating systems in residential buildings (Table 4).

Table 4 – Savings from the implementation of Legislative Decree 192/05 (primary energy, Mtoe/year), years 2005-2015

Intervention	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015*	Total
New buildings - Residential	0.008	0.037	0.040	0.034	0.028	0.026	0.027	0.021	0.017	0.015	0.013	0.266
New buildings - Non residential		0.019	0.019	0.041	0.031	0.040	0.035	0.027	0.018	0.017	0.015	0.262
Heating system replacement		0.226	0.179	0.161	0.168	0.178	0.166	0.155	0.100	0.091	0.08	1.504
Total	**0.008**	**0.282**	**0.238**	**0.236**	**0.227**	**0.244**	**0.228**	**0.203**	**0.135**	**0.123**	**0.108**	**2.032**

* Estimates

Source: ENEA elaboration

- Transport sector (Table 5): a primary energy saving equal to 1.44 Mtoe/year (equal to 1.33 Mtoe/year of final energy) was achieved by applying incentives to the purchase of more efficient vehicles; implementing EC Regulations; and

commissioning high speed railways, which implied a demand reduction on the corresponding flight and road routes.

Table 5 – Savings from measures in transport sector (primary energy, Mtoe/year), years 2005-2015

Measure	2007	2008	2009	2010	2011	2012	2013	2014	2015*	Total
2007-2009 incentives for new cars	0.03	0.04	0.14	0	0	0	0	0	0	0.21
EC Regulation 443/2009				0.16	0.17	0.16	0.21	0.22	0.2	1.12
EC Regulation 510/2011							0.003	0.01	0.01	0.023
Incentives for low emission vehicles							0.0002	0	0	0.0002
High speed railways		0.01	0.04	0	0.01	0	0.004	0.014	0.01	0.088
Total	**0.03**	**0.05**	**0.18**	**0.16**	**0.18**	**0.16**	**0.217**	**0.244**	**0.22**	**1.441**

* Estimates

Source: ENEA elaboration

For the 2005-2016 time horizon, as in the 2011 NEEAP, total final energy saving deriving from analysed measures amounts to almost 10 Mtoe/year, that is 91.2% of 2016 target (Table 6).

Table 6 – Achieved energy savings by sector, years 2005-2015, and expected for 2016 (final energy, Mtoe/year), according to 2011 NEEAP

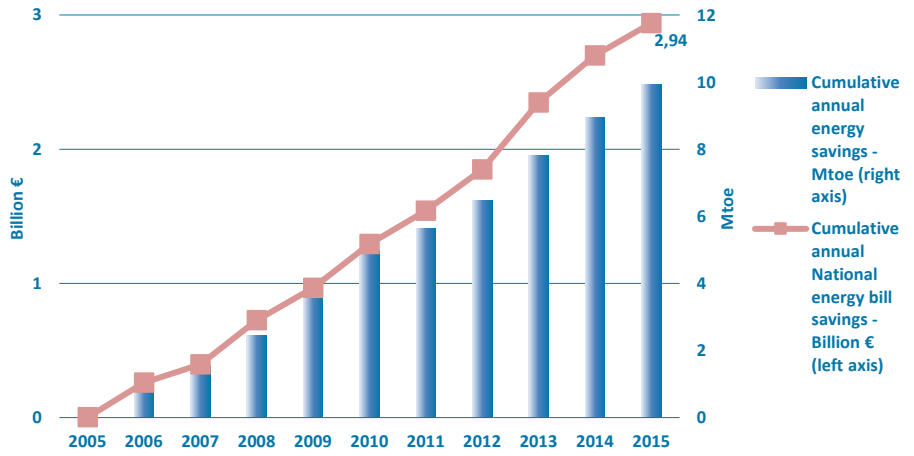
	White Certificates	Tax Deductions *	Thermal Account	Legislative Decree 192/05*	Measures in transport sector *	Other measures*	Energy savings		Achieved target (%)
							Achieved in 2015**	Expected for 2016	
Residential	1.697	1.822	-	1.77	-	0.095	5.38	5.16	104.3%
Services	0.206	0.026	0.0008	0.084	-	-	0.32	2.11	15.0%
Industry	2.476	0.049	-	0.178	-	-	2.70	1.73	156.3%
Transport	-	-	-	-	1.42	0.088	1.51	1.87	80.9%
Total	**4.379**	**1.897**	**0.0008**	**2.032**	**1.42**	**0.183**	**9.92**	**10.87**	**91.2%**

* Estimates for 2015
** Net of duplications

Source: ENEA elaboration

Figures provided in Table 6 imply an annual cumulative saving of about 3 billion euros of avoided oil and natural gas imports (Figure 6).

Figure 6 – Saving in the Italian energy bill and energy saving, years 2005-2015



Source: ENEA elaboration

Relative to the objective for 2011-2020 period, as set in 2014 NEEAP, energy savings achieved in 2015 amounted to slightly more than 5 Mtoe/year of final energy, equivalent to around one third of the target (Table 7). 40% of such savings derives from the White Certificates scheme. At sectoral level, the residential sector has already achieved almost two thirds of the expected 2020 target.

Table 7 – Achieved energy savings by sector, years 2011-2015, and expected for 2020 (final energy, Mtoe/year), according to 2014 NEEAP

	White Certificates	Tax Deductions *	Thermal Account	Legislative Decree 192/05*	Measures in transport sector *	Other measures*	Energy saving		Achieved target (%)
							Achieved in 2015**	Expected for 2020	
Residential	0.471	1.066	-	0.685	-	0.019	2.24	3.67	61.1%
Services	0.101	0.013	0.0008	0.036	-	-	0.15	1.23	12.2%
Industry	1.468	0.025	-	0.076	-	-	1.57	5.1	30.8%
Transport	-	-	-	-	1.01	0.038	1.05	5.5	19.1%
Total	2.040	1.104	0.0008	0.797	1.01	0.057	5.01	15.5	32.3%

* Estimates for 2015
** Net of duplications

Source: ENEA elaboration

Concerning the cumulative energy saving target of 25.8 Mtoe of final energy over the 2014-2020 period, according to EED Article 7, Table 8 shows achieved results in 2014 and

2015 for each of the measures notified to European Commission. Figures are on track of expected trend towards the 2020 target.

Table 8 – Achieved energy savings by notified measure, according to EED Article 7 (final energy, Mtoe), years 2014 and 2015

Policy measure	Achieved savings 2014	Achieved savings 2015	Total savings 2014-2015	Expected total savings 2020
Obligation scheme – White Certificates	1.004	0.801	1.805	16.00
Alternative measure 1 – Thermal Account	0.000005	0.000778	0.000783	5.88
Alternative measure 2 – Fiscal Deduction	0.228	0.456*	0.684	3.92
Total saving	**1.232**	**1.257**	**2.490**	**25.80**

* Estimates

Source: ENEA elaboration

As regards the renovation of 3% of the total floor area of heated and/or cooled buildings owned and occupied by Italian central government, interventions on 120 buildings are planned, in the pipeline, or completed during the 2014-2015 period. More specifically, a total floor area of 855,235 m^2 is involved (468,000 m^2 in 2015, when the 3% target was largely overtaken), as shown in Table 9.

Table 9 – Energy renovation of Italian central government buildings, years 2014 and 2015

	2014	2015
Total floor area of buildings with a total useful floor area over 500 m^2 owned and occupied by the central government of the Member State concerned that, on 1 January of each year, do not meet the national minimum energy performance requirements set in application of Article 4 of Directive 2010/31/EU	12,985,228 m^2	12,598,236 m^2
Total floor area of buildings with a total useful floor area over 250 m^2 owned and occupied by the central government of the Member State concerned that, on 1 January of each year, do not meet the national minimum energy performance requirements set in application of Article 4 of Directive 2010/31/EU	Not under obligation	305,334 m^2
Total renovated (or planned or in the pipeline) floor area	386,992 m^2	468,243 m^2
%	**2.98 %**	**3.63 %**

Source: Ministry of Economic Development

3. The industrial sector

In accordance to article 8 of the Legislative Decree 102/2014 (EED transposition), large industrial consumers should undergo energy audits by the deadline of December 5, 2015. Table 12 shows the sectoral breakdown of the approximately 11,000 audits transmitted to ENEA, 47% of which came from the manufacturing sector (Table 10).

Table 10 – Energy audits undergone according to article 8 Legislative Decree 102/2014

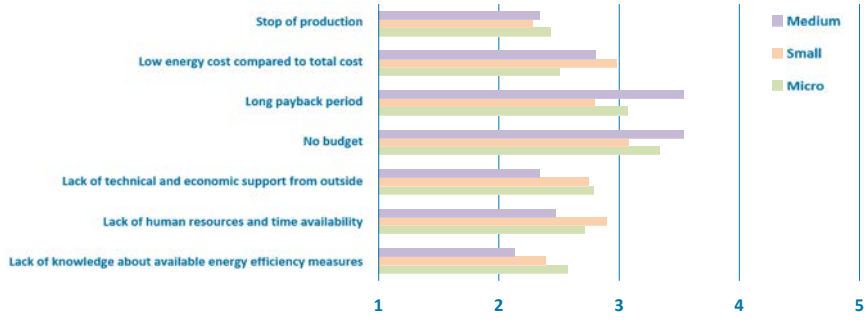
NACE classification	N°	%
C - Manufacturing	5,089	47.0%
D - Electricity, gas, steam and air conditioning supply	462	4.3%
E - Water supply, sewerage, waste management and remediation activities	690	6.4%
G - Wholesale and retail trade, repair of motor vehicles and motorcycles	1,766	16.3%
H - Transportation and storage	578	5.4%
J - Information and communication	501	4.6%
K - Financial and insurance activities	599	5.5%
Other sectors	1,138	10.5%
Total	**10,823**	**100%**

Source: ENEA

Legislation specifies that the obligation does not apply to large enterprises that have adopted management systems compliant with European or international standards, such as EN ISO 50001, EMAS, and EN ISO 14001, provided that they include an energy audit. In 2015 slightly more than 450 sites were ISO 50001 certified. The enterprises having appointed an energy manager (whether obliged or not to do so) and being at the same time ISO 50001 certified were 115, 51 of which in the industrial sector and 32 in the energy and network services ones.

Concerning SMEs, the weight of energy efficiency investments varies according to the size of the firm and the industry sector, and the same is true for the perception of barriers. Figure 7 shows, according to the firm size, survey answers regarding the internal barriers to the implementation of energy efficiency measures.

Figure 7 – Energy efficiency investment barriers by firm size (multiple choice, score from 1 - Not relevant to 5 - Very relevant)



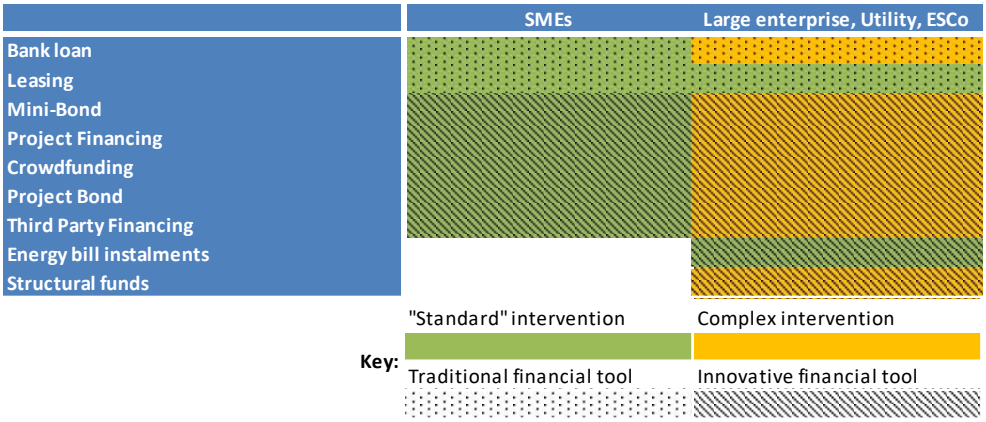
Source: ENEA

The financial component, linked both to the absence of dedicated budget and long payback times, is considered the most important among the respondents. The network contract, a legal instrument introduced in 2009, can be a valuable tool to overcome the investment barriers associated to the firm dimension and, in this way, enhance energy

innovation. Together, SMEs can join efforts, share the risk, take advantage of the skill synergies and successfully implement new R&D projects.

The bank loan is the main financial instrument employed by SMEs for financing energy efficiency projects, possibly together with the incentive mechanisms mentioned above. For large enterprises and ESCOs (including also utilities) the range of options is wider, both relative to available financial instruments and the complexity of financeable interventions. Figure 8 is a matrix listing a number of financial instruments in order of innovativeness (and complexity of use) which SMEs and large companies can choose according to the type of intervention, whether "standard", as those set by White Certificates sheets, or more complex, such as those related to the industrial production process.

Figure 8 – Investment matrix: financial tools, firms and interventions



Source: ENEA

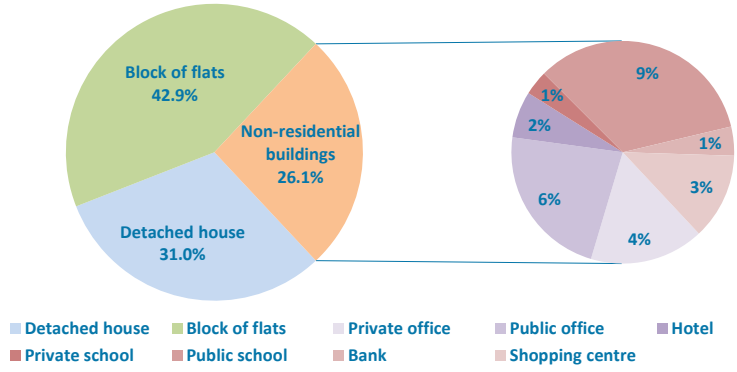
The proposed matrix is a first attempt to provide a method for the choice of successful combinations of the key financial and economic elements involved in the decision process of an energy efficiency project. Of course, it must be further and deeply disaggregated for each of its dimensions, so that it can provide reliable “solutions”. They may constitute the bulk of all the information needed to aggregate similar energy efficiency projects and eventually replicate them, thus facilitating their bankability and, more in general, improving their attractiveness for big and new market players.

4. Renovation of the building stock

Energy efficiency renovation of buildings is a priority for Italy. More than two thirds of the stock was built before 1976, the year of the first Italian law on energy performance of buildings. Energy saving potential is wide and often achievable through interventions characterised by a short payback period.

The Italian *Strategy for the energy renovation of the national building stock* assesses an energy saving potential of almost 5.7 Mtoe/year at 2020 (Figure 9). The corresponding level of investments in the residential sector is about 13.6 billion euros per year for interventions aimed at the overall renovation of buildings, and 10.5 billion euros per year for partial interventions (roof, facade, windows, heating system). Concerning the services sector, the amount of necessary investments is about 17.5 billion euros per year.

Figure 9 – Italian building renovation strategy: expected energy saving for 2020 (%)



Source: Ministry of Economic Development

The Italian *National Plan for Nearly Zero Energy Buildings* provides an evaluation of the energy performance of some different typologies of reference buildings for different climatic zones. Additional costs for new NZEBs are provided in Table 11.

Table 11 – Average additional cost for a new NZEB, compared to current minimum energy performance requirements (€/m²)

	Envelope	Heating system
Office – Climatic Zone B	13	21
Office – Climatic Zone E	31	24
Block of flats – Climatic Zone B	7	51
Block of flats – Climatic Zone E	14	53
Detached house – Climatic Zone B	12	68
Detached house – Climatic Zone E	23	68

Source: Ministry of Economic Development

For NZEB renovations of existing buildings, additional costs are relevant for interventions on the heating system, especially in the case of a detached house (Table 12).

Table 12 – Average additional cost for NZEB renovation of existing buildings, compared to current minimum energy performance requirements (%)

	Detached house	Block of flats	Office
Envelope	+4.2%	+4.6%	+5.3%
Heating system	+50.2%	+27.4%	+28.1%

Source: Ministry of Economic Development

Thanks to an immediate application of NZEB parameters to both new buildings and deep renovations, a 10 ktoe energy saving is assessed for the period 2015-2020, compared to current minimum energy performance requirements.

The Italian construction sector is taking a new and evolutionary phase, reshaping strategic visions, processes and products, thus supporting the implementation of the aforementioned strategies. Indeed, some mature technologies are already available, though not so common in the market yet. This is mainly due to a lack of expertise of practitioners and/or higher costs compared to the market average.

But innovation is only one of the different factors guiding the process. To mention a few:

- The crisis of traditional market areas and new emerging fields, with the gains of the latter already able to offset the losses of the former. For example: plant engineering; facility management; integration of building services.
- The adoption of new products and evolution of systems and components. For example: 3D printing; development of robotics; so-called *Internet of things*.
- The development and spread of information technologies within three different and interrelated fields: intercooperation among all the players of the chain; interoperability of models to support improvements of processes, design systems, building management and maintenance; adoption of *Building Information Modeling* (BIM) for the reduction of design errors and rework in construction and engineering projects.
- New processes resulting from the integration of different operative levels, able to (re)activate and radically improve the productivity of the construction sector, opening it to the future: new contract standards, also integrated with BIM application and/or *Lean Production* principles; evolution of the materials potential and building equipment.

Albeit not yet completed, all of these phenomena are already ongoing, clearly depicting the evolutionary process taken, at least within three domains:

- The use of data and BIM, reducing the risk of changes and delays to a minimum. Indeed, BIM allows controlling expenditure and additional costs during and after the construction. More in general, thanks to facility management informative systems, sharing design and construction data allows a more effective work management.
- The use of prefabricated components heavily simplifies building site procedures, reducing labour need in the site itself.
- Industrialization of supply to meet micro-demand: thanks to new technologies, innovative models are reshaping traditional ways to meet the micro-demand for building maintenance/renovation, integrating products and services.

The Italian construction sector is then characterized by the beginning of deep transformations, able to modify the whole design, operative and management process, both in terms of productivity improvement and reduction of error costs.

In 2015, the production value of the Italian construction sector was equal to 165.5 billion euros, of which 119 (72%) due to maintenance of the existing stock, ordinary (36 billion) but mainly extraordinary (83 billion). More specifically, the importance of extraordinary maintenance has remarkably grown during the last years: in 2007, it embodied 47% of construction investments whereas, 66% in 2015, with a peak of 76.7% in the residential sector. Job creation implications are noteworthy, with almost 60.000 employees associated every year to an average of € 3 billion investments through the tax deduction scheme.

5. The transport sector

The European and National 2020 energy strategies identify in the deployment of electric vehicles a pivotal element for decarbonising road transport and, more generally, improving energy efficiency and reducing emissions. In 2015, the sales of plug-in electric and hybrid cars have reached 193,000 units, doubling relative to the previous year and exceeding 1% of the total European market. In Italy electric vehicles still represent a niche market almost exclusively dominated by foreign manufacturers.

The development of electrical mobility and charging stations are, at this early stage, necessarily affected by the level of car manufacturer investments and the incentives put in place by governments and/or local authorities, as shown by the successful experiences of some European countries. Forecasts for the electric vehicle market in Europe indicate a steady growth of sales in the coming years, with prospects up to 8% per year by 2025.

From a technological point of view, the recent years have witnessed huge steps forward, in two main fields: batteries, with higher capacity and autonomy and lower cost; charging stations, not only with the creation of systems more efficient and tailored to the user needs, but also with the standardization and improved compatibility between the different systems on the national territory. The development of storage systems based on the Li-ion technology has constituted a technological breakthrough both for electric vehicles market and charging infrastructures: in fact, the accumulation capacity of these batteries allows a 120-200 km autonomy, according to the road profile and driving style.

Although it would likely decrease in the future, one of the main obstacles to the deployment of electric mobility is the high vehicle purchase cost. A possible solution could come from the electric conversion of existing vehicles with internal combustion engine. Conversion kits are available on the market and in Italy it is currently possible converting to electric vehicles in M and N1 categories as well as buses and light commercial vehicles.

The conversion cost, however, can be substantial (over 10,000 euros), being directly connected to the required autonomy, and then to the battery cost.

The charging systems market, as mentioned, has seen deep changes, with the increasing availability of more powerful systems for on-the-road charging with shorter times. In fact, the rapid charging allows reducing the size of the storage system, and ensures a greater autonomy at the same time: using a rapid charging system of around 50 kW size, a capacity of 24 kWh can be recharged up to 80% in 30 minutes.

Faster charging systems are now on the market also for local public transport. They could be automatic and, once installed on the vehicle roof, allow electric buses to theoretically work 24/7. The local public transport companies, however, are facing significant obstacles for electric conversion of their fleet. In particular, these include: compatibility of electric traction with service requirements; need for major initial investments, related to the construction of the charging infrastructure; additional cost of the electric vehicle compared to a conventional one; the necessary technological and organizational integration of the offered service. Car manufacturers, together with rental companies, have a relatively high interest in promoting electric mobility. In recent years, trade associations and private companies have signed agreements with Public Administration for the supply of electric vehicle fleets, also as a result of green procurement legislation.

More generally, thanks to the slow development of electric mobility, in recent years urban mobility habits have started changing, and this process would likely be associated with high positive effects in terms of energy, environmental and land use impacts. In particular, the attitude of individuals and companies towards the car is changing, shifting from ownership to shared use. A car sharing boom is observed in metropolitan areas, thanks to the “free floating” service: it allows covering the so-called *last mile* of a travel, which may have been mostly carried out by public transport.

Bike sharing services are also spreading out: approximately 130 systems exist in 58 Italian cities, with over 1,000 supply points and almost 10,000 bicycles. Sharing is possible not only for the passenger mobility, although this is currently the most popular service, but also for good transport in an urban context. In van sharing, a vehicle fleet is shared by multiple logistic operators who can rent a low environmental-impact vehicle and load and unload even within the Limited Traffic Zones. The undisputed advantages of such services are the reduction of vehicles circulating within cities and the mitigation of associated energy and environmental impacts.

Finally, car-pooling is also increasing, implying the reduction of circulating vehicles through an increased load factor. The service is offered through web platforms and smartphone applications that allow connecting people willing to offer or ask for a ride to make the same journey.

Significant savings can also be obtained by strengthening the rail infrastructure, both at urban and suburban level, partly in order to (re)orient the commuting flows into large cities to this transport mode. According to the latest surveys, the demand for short-haul rail services is increasing: this positive trend results not only from the gradual relocation process from urban areas to the suburbs, but also from the policies to limit the use of private vehicles implemented in the major cities, such as parking charges and limits to circulation.

6. Three-Year Training and Information Program

The above-mentioned energy efficiency measures and their monitoring show a positive strategic approach towards energy saving and energy efficiency. Nevertheless, there is still unexploited energy efficiency potential, especially in some sectors. This seems to be due to both asymmetric information and inadequate training of some stakeholders, on subjects such as: benefits to be obtained through interventions on goods and services; difficult access to capital for the initial investment; high risk perceived in investments and lack of instruments and information on the payback time; high transaction costs associated to small-sized projects.

In order to fill this gap, the Italian Ministry of Economic Development has assigned a specific role to the communication and training as key drivers in generating and strengthening the attention given to energy saving and efficiency, through a full involvement of consumers to make them aware on the importance of orienting their choices towards a more efficient use of resources, even changing their behaviour.

To this aim, the aforementioned Legislative Decree 102/2014 sets out that a Three-Year Training and Information Program should be developed by ENEA, involving key stakeholders such as Regions, consumers' associations, ESCO associations and energy services suppliers.

The slogan of the Program is *Italia in Classe A* (*Italy in A Class*, (here the logo on the left). It has been structured taking into account the innovative and complex features of the actions needed for its implementation, and it would be carried out step by step, flexibly, continuously monitoring the results, in order to achieve the present objectives.

The Program and the strategies were identified and structured on the basis of a deep analysis of the economic, social and legal contexts, with a systemic approach which, according to the law, is aimed to promote and support the efficient energy use and to involve the highest number of end-users. This is often considered as a technical and specialist subject, and communication has to face a lack of "appeal" from the media, lack

of knowledge, fragmentation, discontinuity of initiatives, loss of synergies and lack of an interdisciplinary perspective.

For this purpose, the main aims of the *Italia in Classe A* campaign are the following:

- To support awareness raising actions and to encourage large enterprises and SMEs to carry out energy audits.
- To stimulate the Public Administration employees' behaviour to reduce energy consumption.
- To inform enterprises, administrations and households on existing incentives.
- To educate students in efficient energy use.
- To raise households' awareness on the benefits of energy audits, energy performance certificate and efficient energy use.
- To encourage the participation of banks and other financial institutions in financing energy efficiency measures.
- To promote training programs for energy services operators' qualification.
- To train Public Administration technicians in the planning of building refurbishment projects.

In order to achieve the foreseen objectives of policies implementation, the main constrains for each target were identified, which can be tackled through a structured communication action:

- SMEs: lack of specific expertise in the smallest companies; limited financing capacity; energy audits less frequent than in large companies; rare systematic energy management; scarce control of energy consumption.
- Public administration employees: scarce participation in the organizational process; inadequate information sharing about energy consumption; inadequate knowledge/awareness on energy efficiency.
- Schools: lack of integration of the energy topics in the curricular framework; few operational activities; use of language not always suitable to young people; problems of motivation and inadequate knowledge/awareness on the subject.
- Households: lack of information on energy consumptions and on the payback time of the building refurbishment investment, and even on the available incentive mechanisms; cultural aspects related to housing; bureaucratic and administrative aspects in the selection of operators to involve in the project.
- Banks and financing institutions: lack of expertise for the technical evaluation of the foreseen interventions and, consequently, difficulties in quantifying the investments payback; regulation uncertainty.
- ESCo, EGE and services companies: financing weakness (inadequate capitalization and insufficient turnover) to operate through third-party financing and

guarantees; excessive bureaucracy; high cost and complexity of documenting and measuring climate features and end-users' behaviour.

Three phases of the Program are foreseen:

- Phase 1 – Start up (first year): massive information/communication activities on energy saving and energy efficiency topics, to ensure initial basic knowledge.
- Phase 2 – Tailored targets (second year): central phase of the Program, maximizing information coverage and starting the tailored actions.
- Phase 3 – Monitoring and consolidation (third year): consolidating the initiatives; dissemination of results and analysis of the communication impacts, with evaluation and control of achieved results.

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