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Fiscal deduction in Italy for energy efficiency in residential buildings

Chiara Martini, Domenico Prisinzano, Alessandro Federici, Amalia Martelli, Gabriella Azzolini, Roberto Moneta; ENEA, Italian National Energy Efficiency Agency

ABSTRACT

After more than 10 years since its introduction, the fiscal deduction scheme of 55-65% for energy renovation of existing buildings has represented a veritable break in the Italian energy efficiency world. Such incentives have allowed to limit the serious economic crisis faced by the Italian building sector, at the same time implying the valorization of buildings and improving life quality of Italian people.

In this article, the EU and national regulatory context where the 55-65% tax deduction scheme operates will be briefly summarized, as well as their role relative to the Italian objectives within the implementation of the Energy Efficiency Directive. The savings achieved by different types of interventions will be described, together with the associated investments. The trends on the market of incentivized technologies will be finally identified, also estimating employment impacts on the construction sector and developing other economic considerations and policy implications in order to untap a huge energy saving potential.

The tax deduction scheme

Directive 2012/27/UE set indicative national energy efficiency targets: such targets, as defined in the National Energy Strategy (NES) (Ministry of Economic Development, 2013), are monitored yearly in the Annual Report prepared for the European Commission, as envisaged by article 3 of the Directive. In particular, from 2011 to 2020, the 2017 National Energy Efficiency Action Plan (NEEAP) indicated that Italy should save 15.5 Mtoe of final energy consumption (20 Mtoe of primary energy), reducing its consumption by around 24% relative to the value projected for 2020 by the European reference scenario, based on a business as usual evolution of the system (Ministry of Economic Development, 2014a and 2017a). More specifically, Italy is expected to comply with article 7 of the Energy Efficiency Directive with the White Certificates obligation scheme, combined with the alternative measures of Fiscal Deductions, Thermal Account[1], National energy efficiency fund and National Industry 4.0 Plan[2] (Ministry of Economic Development, 2018).

The scheme is a tax credit with an incentive of 65% (55% till 2013) of the up-front cost borne by the household for the energy upgrading of buildings. It was introduced in Italy by the Budget Law for 2007,

[1] The Renewable energy for heating and cooling support scheme (so-called Thermal Accont or Conto Termico) supports thermal energy production from renewables and energy efficiency interventions in Public Administration.
[2] The Plan provides for a wide array of measures promoting investment in innovation and competitiveness, under a "4.0" logic: http://www.mise.gov.it/images/stories/documenti/investimenti_impresa_40_eng.pdf.

and then renewed every year through the related Budget or Stability Law, resulting in a key driver of energy efficiency improvements in the housing sector, with more than 3 million of actions implemented by 31 December 2017, that is with an average of 300,000 refurbishment/year.

The 65% tax deductions can be claimed by all taxpayers: individuals, including persons pursuing trades or professions; taxpayers with income from business activities (individuals, partnerships, limited liability companies); professional associations; public and private entities not pursuing business activities. For individuals, the incentive may also be claimed by: the holders of a right in rem on the property; co-owners, for actions on common parts of the buildings; tenants; those holding the property in loan for use. The tax deductions for energy efficiency improvement actions are granted to existing buildings of both residential and services sector, parts thereof or any real estate units of any cadastral category, including rural buildings, owned or otherwise held. The incentive consists of a ten-year reduction of IRPEF (personal income tax) or IRES (corporate income tax) granted for expenses incurred to (Table 1):

- reduce heating demand by means of overall upgrading of the building's energy performance (Paragraph 344);
- improve the building's thermal insulation (replacement of windows, including blinds or shutters, and insulation of roofs, walls and floors) (Paragraph 345);
- install solar thermal panels (Paragraph 346);
- replace heating systems with condensing boilers or heat pumps, replace electrical water heaters with heat pump water heaters (Paragraph 347);
- installation of building automation system (BA).

Table 1. Characterization of the tax deductions for energy renovation

Measure	Description	Associated technologies
Paragraph 344	Reduction of energy demand for heating the whole building	Biomass boilers; overall renovation
Paragraph 345a	Improvement of thermal performance of buildings opaque structures	Thermal insulation of vertical walls, roofs, slabs
Paragraph 345b		Replacement of windows and shutters
Paragraph 345c		Solar shading
Paragraph 346	Installation of solar panels	Solar panel for sanitary hot water
Paragraph 347	Replacement of space heating systems	Condensing boilers; heat pumps; biomass boilers; heat pump boilers for sanitary hot water
B.A.	Installation of building automation system	
Condominium 70%	Intervention on common parts of apartment blocks involving the envelope for more than 25% building outer surface and, for interventions called *Condominium 75%*, achieving the average quality for winter and summer performances.	
Condominium 75%		

Source: Stability Law 2017

More recently, the 2017 Italian Stability Law extended fiscal deductions for all the interventions already incentivized with previous regulations. Relative to the energy renovation of common parts of apartment blocks, the mechanism has been extended for five years, for interventions involving the envelope with an incidence higher than 25% on the gross building outer surface, with a deduction equal to 70%; if such interventions achieve at least the "average quality" for winter and summer energy performance[3], the deduction increases to 75%. The main innovation is that, in both cases, the

[3] Interministerial Decree 26 June 2015, guidelines for the energy performance certificate of buildings: http://www.sviluppoeconomico.gov.it/images/stories/normativa/DM_Linee_guida_APE_allegato1.pdf (in Italian).

beneficiaries could choose the transfer of receivables to the suppliers implementing the interventions or to other private actors, with the aim to attract new capitals in this segment of the market and to overcome the issue of families or companies without tax capacity as well, boosting this way the number of such more incentivized actions (Italian Parliament, 2016).

In addition to the tax deduction for energy renovation, since the Nineties tax deductions (currently 50% of the up-front cost) for "common refurbishment" of buildings are in force[4]: implemented measures are not specifically addressed to the energy performance of buildings or dwellings, but energy related technologies also may be embodied within the implemented actions (i.e. replacement of windows, boilers, heat pumps). For this reason, every year an assessment of energy savings from this incentive scheme is also carried out (see Tables 2 and 3, and section 4 for further information).

The trend observed for the number of actions incentivized every year within 50% scheme has not been affected by the introduction of the 65% tax deduction specifically addressed to energy efficiency renovation (Chamber of Deputies and CRESME, 2017), whose implemented actions can be then considered fully additional, that is with only a marginal risk of free rider.

Achieved energy savings

Relative to the 2011-2020 target as set in 2014 NEEAP (Ministry of Economic Development, 2014b) and consistent with 2013 NES, energy savings achieved in 2016 amounted to slightly more than 6.4 Mtoe/year of final energy, equivalent to more than 40% of the target (Table 2). Around one quarter of such savings derives from fiscal deductions for energy renovation of existing buildings (ENEA, 2017a). it is worthy of note that some measures are eligible to two or more scheme (e.g. White Certificates and tax deduction): incentives cannot be cumulated and, notwithstanding a potential (marginal) overlap between schemes, double counting is avoided through a conservative cut from the total amount of achieved savings of that amount potentially stemming from "duplicated" measures[5].

Table 2. Achieved energy saving by sector, years 2011-2016, and expected saving for 2020 (final energy, Mtoe/year), according to 2014 NEEAP

Sector	White Certificates	Fiscal Deductions for existing buildings*	Thermal Account (for Public Administration)	Other measures**	Energy saving		Achieved target (%)
					Achieved 2016***	Expected for 2020	
Residential	0.59	1.56	-	0.94	3.09	3.67	84.2%
Services	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	-	-	-	1.17	1.18	5.50	21.4%
Total	2.56	1.60	0.003	2.35	6.41	15.50	41.4%

* 65% tax deduction for energy renovation; 50% tax deduction for refurbishment; Bonus Mobili. ** Legislative Decree 192/05 for new buildings; Ecoincentives for new vehicles, EU Regulations and High-Speed railways in the transport sector; replacement of big appliances in the residential sector. *** Net of duplications

Source: ENEA elaboration based on data from Ministry of Economic Development, Gestore dei Servizi Energetici S.p.A., ENEA, ISTAT, FIAIP, GFK

[4] General retrofit of the building/dwelling, whose actions have not to be necessarily addressed to energy efficiency. "Common refurbishment" deductions cannot be cumulated with the energy renovation deductions.

[5] For example, in the 3.09 Mtep of total savings achieved in the residential sector at 2016 (Table 2), (few) savings from energy certificates for condensing boilers are not considered.

According to the transposition of the art.7 of the Directive, a cumulative energy saving target of 25.8 Mtoe of final energy is also set over the 2014-2020 period by the 2014 Italy's NEEAP. Table 3 shows the results achieved in 2014, 2015 and 2016 (estimated with regards to fiscal deductions) for each of the measures notified to the European Commission. Figures are on track of expected trend towards the 2020 target: of the almost 7.5 Mtoe of cumulated energy saving obtained in the period 2014-2017, around 40% derives from the fiscal deductions (Ministry of Economic Development, 2018).

Table 3. Achieved energy saving by notified measure, according to EED Article 7 (final energy, Mtoe), years 2014, 2015, 2016 and 2017

Notified policy measures	New achieved savings 2014	New achieved savings 2015	New achieved savings 2016	New achieved savings 2017	Cumulated savings: achieved 2014-2017	Cumulated savings: expected at 2020
White Certificates	0,872	0,859	1,101	1,341	4,174	12,51
Thermal Account	0,003	0,008	0,019	0,045	0,075	0,43
Fiscal Deductions	0,306	0,597	0,873	1,164	2,940	8,39
Energy Efficiency Fund	0,000	0,000	0,000	0,000	0,000	0,18
Industry 4.0 Plan	0,000	0,000	0,000	0,300	0,300	4,00
Total savings	1,181	1,465	1,993	2,850	7,489	25,50

Source: Ministry of Economic Development

Concerning the 65% tax deduction scheme, in the 2014-2016 period approximately a million of interventions were realized (Table 4), and more than 420,000 in 2017, when half involved the replacement of windows and shutters, and 20% the replacement of space heating systems and the installation of solar shading. The investments activated in the 2014-2016 period equaled around 9.5 billion euros: more than 40% of resources were allocated to the replacement of windows and shutters; 25% to the thermal insulation of slabs and roofs; slightly more than 9% to the reduction of energy demand for heating the whole building (ENEA, 2017b). The total investments activated in 2017 were equal to more than 3.8 billion euros, whose maximum potential of fiscal deduction which could be claimed by beneficiaries in the next ten years is around 2.5 billion euros (Ministry of Economic Development, 2018).

Table 4. Number of realized interventions (n) and activated investments (M€) by measure for the tax deduction scheme, year 2017 and total of years 2014-2016

	Interventions 2017*		Investments 2017*		Interventions 2014-2016		Investments 2014-2016	
Measure	n.	%	M€	%	%	n.	M€	%
Overall renovation	4,276	1.0%	369.5	9.7%	9.2%	10,578	862.9	9.1%
Envelope insulation	21,862	5.2%	771.3	20.3%	23.1%	72,755	2,401.6	25.4%
Windows and shutters	212,731	50.4%	1,551.1	40.8%	41.0%	552,629	3,997.0	42.2%
Solar shading	84,953	20.1%	180.4	4.7%	4.5%	117,548	248.8	2.6%
Solar panels	8,236	2.0%	52.3	1.4%	1.7%	34,842	222.6	2.4%
Space heating system	86,319	20.5%	830.3	21.8%	20.3%	196,663	1,721.3	18.2%
Building automation	3,614	0.9%	50.3	1.3%	0.3%	661	9.2	0.1%
Total	421,991	100%	3,805.1	100%	100%	985,676	9,463.3	100%

* Preliminary estimate

Source: ENEA

An analysis of the ratio between implemented investments and net disposable income of households at regional level shows an average value equal to 0.3% (more than 3,300€ per household), with peaks equal to around 0.7% in the northern regions of Aosta Valley and Trentino South Tyrol, and lower values in Southern Italy. This is only partially due to the fact that 65% tax deduction scheme is addressed to the heating of existing buildings. Indeed, the distribution of per capita investments at municipal level for energy renovation measures mirrors the typical North-South differences for the regional distribution of per capita net disposable income, with the result of a two-speed country for incentivized energy saving investments, as observed for investments in other sectors of the national economy (Figure 1). Indeed, notwithstanding that willingness to pay for energy efficiency should be higher in the cold north area that in the south one, pictures like Figure 1 can be derived for investments in solar panels and solar shadings. Such overview provides useful information for the monitoring of Sustainable Energy (and Climate) Action Plans submitted under the Covenant of Mayor initiative.

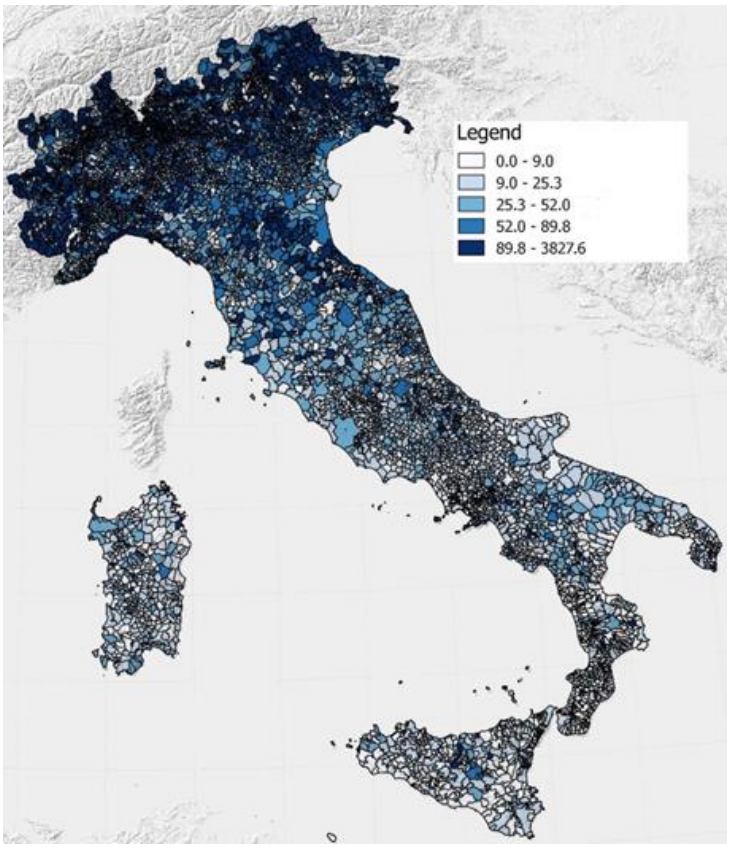

Figure 1. Investments per capita (€ per capita) at municipal level, year 2016. *Source*: ENEA

The achieved deemed energy savings corresponding to these investments are equal, over the period 2014-2016, to around 3,300 GWh/year, equivalent to slightly more than 0.28 Mtoe/year (Table 5). In terms of energy saving achieved in the 2014-2016 period also, the main contribution derives from the replacement of windows and shutters (46.6% of the total), followed by the insulation of slabs and roofs (18.4%), and walls (10.7%), as well as on the installation of condensing boilers (13%).

The interventions realized in 2017 allowed to reach a saving of almost 1,275 GWh/year, more than 41% of which is associated to the replacement of windows and shutters. Almost one third of the saving was achieved thanks to intervention on building's envelope (almost 400 GWh/year), with a main contribution of slabs and roofs (Ministry of Economic Development, 2018).

Table 5. Savings (GWh/year) by technology, year 2016 and total of years 2014-2016

Year	2017*		2014-2016	
Technology/intervention	GWh/year	%	GWh/year	%
Walls	398.9	31.3%	351	10.7%
Slabs and roofs			603	18.4%
Windows and shutters	524.5	41.2%	1,531	46.6%
Solar thermal	37.2	2.9%	160	4.9%
Solar shading	24.4	1.9%	33	1.0%
Condensing boilers	260.5	20.4%	428	13.0%
Geothermal plants			3	0.1%
Heat pumps			138	4.2%
Hot water heat pumps			16	0.5%
Building automation	29	2.3%	5	0.2%
Other	n.a		13	0.4%
Total	1274.5	100%	3,282	100%

* Preliminary estimate

Source: ENEA

The thermal insulation of slabs and roofs, together with the reduction of energy demand for heating the whole building, are characterized by the best cost-effectiveness of the total up-front investment, with an associated cost in the 9-12 eurocent range for each kWh of energy saved during the whole useful life of intervention[6] (Table 6), to be compared with an average of 20 eurocent/kWh payed by end-users in the energy bill.

Table 6. Cost-effectiveness by paragraph (€/kWh), average of years 2014-2017

Measure	Useful life	€/kWh
Overall renovation	30	0.12 €
Envelope insulation	30	0.09 €
Windows and shutters	30	0.10 €
Solar shading	30	0.15 €
Solar panels	15	0.09 €
Space heating system	15	0.21 €
B.A.	10	0.17 €

Source: ENEA

Table 7 shows the investments, both for 2016 and the 2014-2016 period, broken down by technology or by type of intervention: in the three-year period, the main share of resources - around 4.36 billion euros - was allocated to the replacement of 1.9 million windows and shutters (which could be incentivized not only by para 345b, but also by paras 344 and 345a in the case of multiple interventions); more than 1.7 billion euros were instead allocated to more than 52,000 interventions on horizontal walls.

The distribution of investments in 2016 mirrors the one observed in the three-year period, with around 1.5 billion euros for 647,000 replaced windows and shutters, more than 650 million euros for around 16,000 interventions on slabs and roofs, and more than 300 million for around 16,000 interventions on walls.

[6] No discount rate is applied in the calculation.

Table 7. Investments (M€) by technology , year 2016 and total of years 2014-2016

Year	2016		2014-2016	
Technology/Intervention	M€	%	M€	%
Walls	301.1	9.1%	1,074	11.4%
Slabs and roofs	651.2	19.7%	1,734	18.3%
Windows and shutters	1,447.9	43.8%	4,357	46.0%
Solar thermal	56.4	1.7%	223	2.4%
Solar shading	148.4	4.5%	249	2.6%
Condensing boilers	543.3	16.4%	1,412	14.9%
Geothermal plants	4.1	0.1%	11	0.1%
Heat pumps	110.3	3.3%	297	3.1%
Hot water heat pumps	20.7	0.6%	59	0.6%
Building automation	9.2	0.3%	9	0.1%
Other	16.1	0.5%	39	0.4%
Total	3,308.7	100%	9,463	100%

Source: ENEA

Around 80% of investments activated in 2016 (2.6 billion euros out of 3.3) were devoted to buildings built before the '80s[7]; in particular, around one fourth of total resources (more than 810 million euros) was spent on buildings built in the '60s. The main market segments of energy renovation identifiable in 2016 are the buildings with more than three floors of the '60s (45,000 interventions for more than 330 million euros invested) and the detached houses of the post-war period (around 19,000 interventions, around 250 million euros of investments), in '60s (around 25,000 interventions, around 320 million euros of investments) and in '70s (more than 23,000 interventions, around 280 million euros of investments). The allocation of resources observed for years 2014 and 2015 is very similar to the one observed in 2016, shown in Table 8.

Table 8. Investments (M€) by building period and typology, year 2016

	Detached house	Block of flats with less than 3 floors	Block of flats with more than 3 floors	Other	Total	Total (M€)
< 1919	3.4%	1.8%	2.2%	0.4%	7.8%	258.3
1919-1945	3.2%	1.5%	2.2%	0.3%	7.2%	239.6
1946-1960	7.5%	3.2%	6.4%	1.0%	18.0%	596.6
1961-1970	9.6%	3.5%	10.0%	1.5%	24.5%	811.5
1971-1980	8.4%	4.3%	6.1%	2.5%	21.3%	706.1
1981-1990	3.6%	2.9%	2.3%	1.7%	10.4%	344.9
1991-2000	1.8%	1.6%	0.8%	1.0%	5.3%	175.0
2001-2005	0.5%	0.5%	0.2%	0.2%	1.5%	50.3
> 2006	1.9%	1.0%	0.6%	0.2%	3.8%	125.8
Total (%)	39.8%	20.3%	31.1%	8.8%	100%	
Total (M€)	1,317	672	1,028	291		3,308

Source: ENEA

[7] More than 60% of the Italian building stock was built before 1976, the year of Law no. 373 that introduced technical performances to regulate energy performances. Moreover, when Law no 10 of 1991 entered into force, aimed at limiting energy consumption for thermal uses in buildings, 82% of buildings in Italy had already been built.

The saving distribution (Table 9) mirrors the allocation of resources: 36% of total savings (400 GWh/year) is achieved in the four segments previously mentioned.

Table 9. Savings (GWh/year) by building period and typology, year 2016

	Detached house	Block of flats with less than 3 floors	Block of flats with more than 3 floors	Other	Total	Total (M€)
< 1919	3.3%	1.8%	2.0%	0.4%	7.4%	82.8
1919-1945	3.1%	1.5%	2.0%	0.3%	6.9%	77.2
1946-1960	7.4%	3.2%	6.3%	1.2%	18.2%	201.9
1961-1970	9.7%	3.6%	10.2%	2.0%	25.6%	284.3
1971-1980	8.5%	4.3%	6.2%	3.1%	22.0%	244.7
1981-1990	3.4%	2.5%	2.1%	2.5%	10.5%	117.0
1991-2000	1.7%	1.3%	0.7%	1.4%	5.1%	57.0
2001-2005	0.5%	0.4%	0.2%	0.2%	1.3%	14.5
> 2006	1.6%	0.7%	0.4%	0.2%	3.0%	33.0
Total (%)	39.3%	19.2%	30.1%	11.5%	100%	
Total (M€)	436.9	213.6	334.4	127.6		1,112

Source: ENEA

Interventions to reduce energy demand for heating the whole building (para 344) and to thermal insulation of slabs and roofs (para 345a) covered around one third of total investment (1.07 billion euros) and achieved more than one third of total saving observed in 2016 (378 GWh/year, equivalent to 0.032 Mtoe). In particular, around 80% of such resources were devoted to interventions on buildings built before the '80s and, more in detail, more than 40% concentrated on an envelope dating '60s and '70s (Table 10).

Table 10. Investments (M€) and savings (GWh/year) for interventions on the building envelope, year 2016

	Investments		Savings	
	M€	%	GWh/y	%
< 1919	108.6	10.2%	34.8	9.2%
1919-1945	89.6	8.4%	29.2	7.7%
1946-1960	194.8	18.2%	66.9	17.7%
1961-1970	237.5	22.2%	84.8	22.4%
1971-1980	216.4	20.3%	78.5	20.8%
1981-1990	104.7	9.8%	42.5	11.2%
1991-2000	56.1	5.3%	21.9	5.8%
2001-2005	13.2	1.2%	4.7	1.2%
> 2006	47.2	4.4%	14.7	3.9%
Total (%)	1,068.1	100%	378.2	100%

Source: ENEA

Table 11 shows the distribution of investments in windows and shutters that have been replaced. In 2016 more than half of frames of the new windows have been in PVC[8] (53%); while glazing was more

[8] Polyvinylchloride.

than 70% of low emission type[9]. In particular, PVC windows with low-emission glazing cover more than 38% of the market (more than 550 million euros of investments), to which corresponds around 45% of achieved savings (214 GWh/year) by this intervention type.

Table 11. Distribution of investments in windows by frame and glazing typology (%), year 2016

Glazing type	Wood	Metal, thermal cut	PVC	Mixed	Total
Double	3.8%	3.8%	11.2%	1.9%	20.7%
Triple	1.2%	0.9%	2.8%	1.3%	6.1%
Low emission	11.3%	13.2%	38.3%	7.8%	70.6%
Other	0.3%	0.4%	0.7%	1.3%	2.7%
Total	16.5%	18.2%	53.0%	12.3%	100.0%

Source: ENEA

The market of incentivized technologies

In recent years the market for technologies incentivized by fiscal deductions has changed considerably: the products and services offered combine innovation and limited costs, as joint result of incentives and regulation. For example, with the entrance into force of the Ecodesign Directive in September 2015 all heating devices can be sold only if they satisfy minimum energy efficiency requirements and pursue environmental protection. For instance, this implies that at least only devices with efficiencies equivalent or higher than condensing boilers can now be sold[10].

In 2016, more than 540,000 condensing boilers fueled by gas were sold, an 86% share of the total number of boilers sold and an increase by around 70% relative to 2015 even if in a declining overall market (Table 12).

Table 12. Boilers sold on the national market, years 2010-2016

	Traditional boilers	Condensing boilers	Total
2010	668,000	325,500	993,500
2011	650,000	302,000	952,000
2012	601,500	269,000	870,500
2013	513,000	301,000	814,000
2014	466,500	277,800	744,300
2015	446,000	340,000	786,000
2016	85,600	540,600	626,200
Total	3,430,600	2,355,900	5,786,500

Source: Assotermica

The introduction, in 2014, of a new electricity experimental tariff for the heat pumps used as primary heating device in the residential sector (named "D1"), the possibility to obtain different incentives at national level, and the climatic conditions in the last few years, all together have contributed remarkably and in a synergic way to the growth of the heat pumps market. The new tariff seems to have reached the objective: in December 2016, the heat pumps benefitting of D1 tariff were 16,000, three

[9] For technical requirements please refer to: http://efficienzaenergetica.acs.enea.it/doc/dm_11-03-08_coordinato_%20con_dm_26-1-10.pdf.

[10] Until available, stocks of traditional boilers can be sold.

fourths of which installed between 2014 and 2016, during the experimental phase of the tariff[11]. Moreover, around 60% of users who installed heat pumps and applied for D1 tariff have, at the same time, combined the plant with a photovoltaic net-metering system (the so-called "scambio sul posto"). D1 tariff has then contributed to the increase in heat pumps sales, or better, given its characteristics, to the increase in the sales of appliances for the residential sector (Autorità di Regolazione per Energia Reti e Ambiente, 2014).

The national market in 2016 of the heat pumps used as primary heating device in the residential sector can be estimated in around 180,000 units, of which almost 150,000 with split and multi-split, given the ease of application. Air cooled chillers also, conceived for use in the service sector and now commonly used also in the residential multifamily buildings, in 2016 had a good increase in their sales: for those with capacity up to 17 kW, the increase was 25% relative to previous year, and the increase in turnover equaled 27% (Table 13).

Table 13. Heat pumps used as primary heating device in the residential sold on the national market (million units), year 2016

	N.	%
Heat pumps with split and multisplit	147,500	80.1%
Air cooled chillers (capacity lower than 17 kW)	19,000	8.6%
Air cooled chillers (capacity between 18 and 50 kW)	4,000	1.8%
Air cooled chillers (capacity higher than 50 kW)	2,700	1.2%
Variable refrigerant flow (VRF) systems	4,000	8.2%
Total	177,200	100.0%

Source: Assoclima

As regards prices of heating and cooling appliances, in the last five years the price of split and multi-split heat pumps decreased, whereas in 2016 a yearly increase equal to 2% for reversible chillers and a decrease equal to 3% for variable refrigerant flow systems (VRF) were observed (Assoclima, 2017).

In 2016 the overall demand for windows, shutters and curtain wall in the Italian market reached a value equal to about 4.27 billion euros, 2.75 of which in the residential sector and 1.52 in the non-residential, including 485 million euros of continuous facades (UNICMI, 2017). In particular, in the last three years the sales of windows in the residential sector for renovation remained stable, around 4.5 million units per year, with a slight increase in the sales in 2016 (4.53 million units), which allows to foresee a sale of 4.59 million units in 2017. On the contrary, the sales of windows in new buildings have undergone a severe reduction, showing a first weak reversal in this trend (1.24 million units) only in 2016, with a further increase in the sales (1.25 million units) foreseen for 2017 (Table 14). Between 2008 and 2016 a gradual change was observed in the market shares of the three main materials used to produce windows: the most significant increase concerned those in PVC, moving from a market share equal to 16% in 2008 to one equal to 26% in 2016, to the detriment of wood windows; aluminium windows did not undergo significant changes in time. In 2016 the market value equaled 990 million euros for PVC windows, 1,420 million euros for wood windows and 1,400 million euros for metallic ones. An increase in market shares of PVC windows has been observed in recent years, and it is clearly attributable to their good quality-price ratio which, for the same thermal performance required to access fiscal incentives, has a lower sale price relative to other technologies.

[11] For further information, please see: https://www.arera.it/it/inglese/techprofile/16/782-16st.htm.

Table 14. Windows sold in the residential sector for new buildings and renovation of existing ones (million units), years 2004-2017

	New	Renovation	Total
2004	4.02	4.24	8.26
2005	4.42	4.31	8.73
2006	4.71	4.49	9.20
2007	4.66	4.62	9.28
2008	4.27	4.52	8.79
2009	3.34	4.50	7.84
2010	2.82	4.66	7.48
2011	2.63	5.36	7.99
2012	2.27	5.09	7.36
2013	1.97	5.04	7.01
2014	1.35	4.48	5.83
2015	1.23	4.49	5.72
2016	1.24	4.53	5.77
2017*	1.25	4.59	5.84
Total	22.37	47.26	69.63

* Estimated

Source: UNICMI

Fiscal incentives for "common renovation" (50% tax deduction) and for energy renovation (65% tax deduction) caused between 1998 and 2016 more than 14.2 million interventions, carried out by 55% of total Italian households. The investments corresponding to these interventions are equal to 237 billion euros, 205 billion of which concerned "common" refurbishment and slightly less than 32 billion energy renovation.

In terms of estimation of employment impacts, in the last four years (2013-2016) the incentivized investments generated slightly less than 270,000 full-time equivalent (FTE) direct jobs every year, whilst considering also indirect jobs the total is greater than 400,000 FTE employees per year: only in 2016, 419,000 jobs have been created. Fiscal incentives have been an important tool against the crisis and fundamental to the recovery, as shown by the fact that overall, between 2008 and 2016, 600,000 jobs have been lost in the sector (Chamber of Deputies and CRESME, 2017).

The Stability Law 2017 favors global efficiency interventions of the whole building (both envelope and heating system) and of envelope insulation, in particular for medium-large buildings, showing the highest energy efficiency potential. from a qualitative point of view, 30% of building blocks is currently in mediocre or very bad conservation conditions (Italian National Institute of Statistics, 2011). Moreover, in more than 400,000 of analyzed buildings (around one third of the total) having central heating systems, around two thirds were installed more than 15 years ago and would need renovation interventions, aimed at improving energy efficiency and living comfort (ENEA, 2017b).

Such types of interventions ensure the greatest energy savings, but at the same time require the highest financial contribution from the owners. This constitutes a relevant barrier to the realization of interventions, since the incentive is conceived as ex-post reimbursement, split on 10 years: then, the burden of financial contribution to realize the interventions is borne entirely by the owners, who should pay for the works before getting the incentive. Another obstacle to the use of the incentive as a deduction on income tax is the uncertainty on future recovery capacity, since the fiscal coverage of tax payer could change consistently due to reasons not depending on the intervention itself (job loss, retirement, etc.)

and/or due to the access to other fiscal deductions (for example, deductions for dependent family members or retirement incomes). Especially in the case of global renovation interventions that are the most expensive and imply a potentially higher incentive amount, the actual fiscal deduction could turn out to be lower than 65% of incurred cost. Indeed, during the ten years in which the incentive is provided, the tax owed by the beneficiary could prove to be lower than the deductions he is entitled to, nullifying in this way, completely or partly, the possibility to enjoy the fiscal benefit.

When a building consists of many apartments with different owners such economic and fiscal issues could make it difficult to reach the majority in the condominium assembly to approve the renovation works. Indeed, the approval phase has always represented the weakest link to implement whatever activity at building block level. Moreover, reaching the ordinary quorum in the assembly is not enough to get the works started in the case of global renovation.

For these reasons also, the Stability Law 2017 introduced the possibility, in the case of energy renovation of common parts of buildings, to transfer the corresponding credit to the suppliers who realized the interventions, or to other private actors having an adequate fiscal coverage. This allows to make the amount of the incentive certain, and in the case of transfer to the suppliers, to consistently reduce the initial payment for the co-owners, condition which could turn out to be crucial to the approval of works in the condominium assembly. The lack of any possibility to transfer the credit to financial institutions and intermediaries does not impede virtuous mechanisms to arise, which could make it possible to take out a condominium loan for the expenditure share not transferred as tax credit, relying on the lower amount required and, more in general, on the higher solvency of single co-owners.

Conclusions and policy implications

Tax deductions for the energy renovation of buildings are an effective policy for the improvement of the energy efficiency of the Italian building stock, adopted by Italy as an alternative measure to fully comply with article 7 of the Energy Efficiency Directive, and recognized as a best practice at international level also (International Energy Agency, 2014).

More in general, energy efficiency renovation of buildings is a priority in the Italian political agenda, as witnessed by the 2013 and 2017 Italian National Energy Strategy. Indeed, more than two thirds of the stock was built before 1976, the year of the first Italian law on energy performance of buildings. More specifically, the Italian Strategy for the energy renovation of the national building stock assesses an energy saving potential of almost 5.7 Mtoe/year in the 2014-2020 period. 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 (Ministry of Economic Development, 2017c).

Energy saving potential is wide yet, and often achievable through interventions characterized by a short payback period if supported by the incentive[12]. Implemented actions are mainly at single-dwelling level yet: in order to exploit the huge and untapped energy saving potential, end-user demand must by shifted to the more cost-effective overall renovation of (big) buildings. Most recent dispositions foreseen by the 2017 Budget Law pave the way towards this direction, thanks to higher deduction rates for condominiums and the possibility of credit transfer. This should imply higher investments from private stakeholders, allowing larger volumes of energy savings as well, resulting in an important business opportunity.

[12] For example, condensing boilers combined with photovoltaic (2-3 years). For further study cases, please see: http://www.quotidianocondominio.ilsole24ore.com/docs/Editrice/ILSOLE24ORE/QUOTIDIANO_CONDOMINIO/Online/_Oggetti_Correlati/Documenti/2018/04/21/Calabrese.pdf?uuid=AE1LZOcE.

Indeed, 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. 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, together with the adoption of new products and evolution of systems and components (for instance 3D printing, development of robotics, so-called Internet of things), and 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 (ENEA, 2016).

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