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IMPROVING THE ENERGY EFFICIENCY OF HOMES IN ITALY: THE STATE OF THE ART AND SOME CONSIDERATIONS FOR PUBLIC INTERVENTION

by Guido de Blasio*, Roberta Fiori†, Luciano Lavecchia‡, Michele Loberto§, Valentina Michelangeli**, Elena Padovani††, Elena Pisano††, Maria Lisa Rodano‡‡, Giacomo Roma§§, Tiziana Rosolin*** and Pietro Tommasino†††

Abstract

The European energy efficiency (EE) regulations for housing impose significant obligations on households within a limited time frame. This paper describes the background to the regulatory framework, housing and occupants' characteristics, the economic literature on the costs and benefits of EE investment, and the role of the public sector, financial intermediaries and the private sector. Some considerations for designing measures aimed at increasing investments in EE are then proposed. A critical issue is the poor availability of data on housing energy efficiency, energy consumption and past incentive measures, which would need to be improved to both develop market solutions (the contribution of banks and the private sector to EE investment) and correctly design public policy measures. In addition, in light of public finance constraints, public intervention should focus on less well-off households, which are more likely to live in inefficient housing and to be subject to liquidity constraints, and concentrate on the measures best suited to improving energy efficiency. Our findings also suggest supplementing tax incentives with other instruments and providing adequate and reliable coverage.

JEL Classification: Q4, Q5.

Keywords: energy-efficiency, buildings, environmental policy, energy poverty, EPC, energy performance certificates, tax incentives, public expenditure.

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1. Introduction[1]

Energy efficiency (EE) of buildings is one of the tools envisaged at European level to support the green transition. The new Energy Performance of Buildings Directive (EPBD), which is part of the "Fit for 55" package, sets targets for energy consumption of buildings, with the provision of a zero emissions requirement for new buildings from 2030. This work focuses on residential buildings.

From a general point of view, and in order to better contextualise the debate on the European directive in the broader one on the modalities of the transition, it should be noted that the decarbonisation commitment does not necessarily have to materialise through mandatory targets on the EE of the residential sector, even if the latter is responsible for a significant share of emissions. Other forms of intervention could be more cost-efficient, i.e. achieve a greater reduction of greenhouse gases (Gillingham and Stock, 2018) for the same expenditure. For example, with reference to the choices made in the Italian National Recovery and Resilience Plan (NRRP), taking into account engineering estimates of the effectiveness of the interventions, Alpino et al. (2022) show that spending on 'Superbonus' (a specific and most recent tax incentive for EE in Italy), has resulted in a reduction in emissions far below what could have been achieved by alternative measures. Another aspect relates to the increasing electrification of energy use[2] and the increased availability of clean energy sources, which would make energy savings less relevant for the objectives of decarbonisation (Auffhammer, 2021)[3]. In the work it is assumed that the policy maker is called on by European standards to take action to increase housing EE. Given this choice, possible desirability criteria are identified for the concrete design of the interventions.

The provisions of the new Directive could have a significant impact on Italy's real estate stock, which consists of 36 million dwellings (out of around 77 million building units), characterized by a significant presence of poor energy performance houses. The Italian real estate market is characterised by the large share of property occupied by the owners while the rental share is relevant only for poorer households. In order to properly assess the costs and benefits that could arise from EE's obligations linked to the update of the European Directive, it should be borne in mind that the shares of buildings of architectural or historical value and of buildings unoccupied or used for limited periods could be significant; in this respect, it will be crucial to examine the way in which the directive is implemented at national level and the extent of the exceptions it provides for. Moreover, demographic trends could further increase the number of unused housing units (according to the latest estimates released by National Statistical institute (ISTAT), the resident population would decrease from the current 59 million to around 54 million in 2050 and to around 46 million in 2080)[4].

[1] The authors thank Paolo Angelini, Alessio De Vincenzo, Alberto Felettigh, Maura Francese, Patrizio Pagano, Giacomo Ricotti and Paolo Sestito for their comments.

[2] For example, for the heating of environments, food cocking and the production of health hot water, the shift from technologies using fossil sources to those based on the use of the electricity carrier (such as heat pumps and induction plates), which are significantly more efficient, could in itself be sufficient to significantly reduce total consumption (Eyre, 2021).

[3] It should also be borne in mind that while having quantitative targets helps to achieve coordination between countries (Bård, 2016), overly ambitious and/or costly targets may not be credible.

[4] Another aspect relevant to the Italian case relates to seismic and hydrogeological risk, which, for the sake of simplicity, is not taken into account in this work. This is a highly interrelated aspect, as the costs and benefits of investments for EE need to be assessed taking into account all risk profiles.

The economic analysis identified two types of 'market failure' that could justify public intervention to support investments in housing EE. First, energy prices do not internalise the environmental costs of greenhouse gas emissions, thus leading to excessive energy consumption compared to socially optimal energy consumption. Second, there may be frictions that distort the choices of households and firms. For example, agents may not have perfect information about the potential benefits of EE in terms of energy cost savings. Or, they may face liquidity constraints and, while aware of the benefits, may not be able to borrow in order to bear the costs of investment.

As described by Alcott and Greenstone (2012), interventions should address each type of market failure as directly as possible; for example, by facilitating access to finance for those facing liquidity constraints, or by addressing imperfect or asymmetric information problems with policies that increase transparency, such as mandatory energy certification of buildings, or by raising awareness of potential energy savings. In the case of externalities of energy consumption not embedded in prices, the optimal policy is the introduction of a pigouvian tax (carbon tax). However, there are significant problems of social acceptability (Dechezlepretre et al., 2023) resulting from the introduction of this type of tax, given the greater share of energy consumption for poorer households (for Italy see Faiella and Lavecchia, 2021), unless the resulting revenues are redistributed (see, for example, Besley and Persson, 2023; for Italy, Caprioli and Caracciolo, 2022). These difficulties suggest that more indirect policies, such as incentives and obligations, may be more likely to be implemented.

In practice, it is difficult to identify *ex ante* which market failures are relevant; this makes it necessary to base policy measures on rigorous quantitative analyses, mainly *ex post*, which may suggest the most effective ways of achieving the emission reduction targets at the lowest cost. For Italy, these analyses are constrained by the limited availability of data on housing energy efficiency, energy consumption and past incentive measures. Given this limitation, at an early stage, experimental forms of intervention are desirable, so as to provide for an immediate assessment of the effects and allow data collection. Actions to increase households' awareness of the costs and benefits of efficiency would, for example, be desirable. As experienced in other countries, advice to households on technical options, savings in terms of reduced electricity consumption and lower emissions, and financing possibilities and incentives could stimulate interest from individuals.

Greater availability of information would also support market developments in favour of EE investments. The supply of green mortgages by banks, for example, is currently also constrained by a lack of information on the energy performance of buildings. Investments in EE could also be supported by the development of innovative financial instruments, such as on-bill debit schemes (see 2.6), which imply a joint action between, on the one hand, energy suppliers and companies carrying out efficiency works, and, on the other, financial and public operators; these schemes have recently been tested in some EU countries.

An increased data availability would also allow a better design of public policy measures.

In Italy, the first tax incentives aimed at energy retrofitting residential buildings were introduced in 2007. The most recent one, Superbonus, has given rise to significant problems relating, *inter alia*, to its cost to

the State coffers and the ability to generate additional investments and energy savings. On the basis of past and other countries' experiences, for the future it seems desirable to redesign the measures financed by the public budget in such a way as to target those households and buildings most exposed to market failures. In particular, interventions should focus on low-income households, who are more likely to reside in inefficient housing and to be subject to liquidity constraints. Action should be taken through a mix of instruments that not only include tax reliefs but also other measures (to modulate aid according to the characteristics of the different households); risks of moral hazard should be countered and fiscal balances should be preserved.

The work is structured as follows. Section 2 describes the relevant context. Section 3 provides guidance on possible policy measures. Section 4 concludes.

2. The state of play

In order to provide a useful background to the formulation of policy proposals, this section describes the background in relation to the regulatory framework (paragraph 2.1), the energy performance characteristics of dwellings and residents (2.2), the economic literature on the costs and benefits of investments in EE (2.3), and the role of financial intermediaries (2.4), the public sector (2.5) and the private sector through innovative financial methods (2.6).

2.1 Legal framework

The energy efficiency of buildings is one of the tools envisaged at European level to foster the ecological transition and reduce the impact of human activities on the environment, as part of the overall energy efficiency targets, with respect to which, most recently, Directive 2023/1791 of 13 September 2023 required Member States to collectively ensure a reduction in energy consumption of at least 11.7% in 2030 compared to the projections in the EU 2020 baseline. With regard to the EE, Directive 2010/31/EU on the energy performance of buildings (EPBD), which was amended in 2018, contains the common general framework within which Member States must establish the methodology for calculating the energy performance of buildings, requires Member States to apply minimum requirements to the energy performance of new and existing buildings and sets out the principles relating to the energy certification of buildings (see Box 1).

BOX 1. DIRECTIVE 2010/31/EU

The energy performance of a building shall be determined on the basis of the calculated or actual energy consumption and shall reflect the normal energy use of the building for heating and cooling and the production of hot water for household use. The methodology must take into account different dimensions, such as thermal characteristics of the building (thermal capacity, insulation, passive heating, etc.), heating, cooling, hot water production, lighting and ventilation. The Directive sets out the general

principles which have been reflected in the methodologies of the individual Member States; the latter may therefore not be fully homogeneous and lead to diverging assessments across countries.

The minimum energy performance requirements must be set by the Member States in such a way as to achieve cost-optimal levels, with the possibility of distinguishing between existing and new buildings. A number of exceptions may be made, for example for buildings of architectural or historical value, places of worship, temporary buildings, residential buildings used for a limited period of the year and small buildings.

The purpose of the Energy Performance Certificate (EPC) is to enable the owners or tenants of the building or building unit to assess and compare the energy performance. To this end, it shall indicate the energy performance of a building and some reference values such as minimum energy performance requirements; it may also provide additional optional information (such as the share of renewable energy in total energy consumption). The EPC is mandatory in the case of a new construction, purchase or lease of an existing building.

On the basis of Directive 2010/31/EU, Member States have in place their certification systems. In Italy, following a first phase with the 'Attestato di certificazione energetica' (ACE), national guidelines for the energy certification of buildings were adopted (interministerial decree of 26 June 2015). The current energy certification system includes ten classes, from A4 (most efficient) to G (the least efficient). The energy class of the building shall be determined on the basis of the overall non-renewable energy performance index (EPgl) which expresses the annual amount of non-renewable primary energy needed to meet the various needs related to standard use of the building, divided by the relevant surface area. This index takes into account energy needs for winter and summer air conditioning, ventilation, health hot water production, lighting and the transport of persons or goods, as well as ancillary energy to the plant systems, including cogeneration, district heating and renewable use systems.

In April 2024 the new EPBD was adopted[5]. It forms part of the "Fit for 55" package, in which the European institutions aim to reduce greenhouse gas emissions by 2030 by 55 per cent compared with 1990 levels. This target was set by the European Council of 10 and 11 December 2020 and subsequently reflected in several legislative proposals presented by the Commission.

The Directive sets deadlines by which all new buildings must be zero-emissions (from 2028 for public buildings and from 2030 for all others). For existing buildings, the Directive provides for 'national trajectories' to reduce energy consumption. The national trajectory shall be expressed as a decline in the average primary energy consumption of the whole housing stock, with the aim of reducing it by 16% by 2030 and by 20-22% by 2035, provided that at least 55% of the savings result from the renovation of the worst-performing buildings. In the text initially proposed by the Commission and examined by the

[5] Agreement on the text was reached between the Council and the European Parliament in December 2023. The two institutions adopted it on March 12, 2024 and April 12, 2024 respectively.

Council and Parliament, a mandatory improvement of the energy classification for all buildings was proposed[6], while in the final version more discretion is left to the Member States.

The Directive provides, like the European legislation currently in force, for certain exceptions to efficiency requirements, such as historic buildings and those used only in certain periods of the year.

In addition, a category 'A0' for zero-emission and 'A+' buildings is introduced in energy performance certificates for buildings which, in addition to being zero-emissions, contribute to the on-site renewable energy grid. Finally, the Directive sets targets for the installation of renewable energy production facilities and provides for their gradual entry into force.

The Directive requires Member States to put in place funding, support measures and other instruments to address market barriers and stimulate the necessary investments in energy restructuring, including by removing non-economic barriers (e.g. rules of procedure for condominium meetings where they require reinforced majorities or do not allow to counter the inertia of condominiums). In particular, enabling investment and financing instruments, such as energy efficiency loans and mortgages for building renovation, energy performance contracts, tax incentives, tax and on-bill systems, guarantee funds and renovation funds are promoted. In addition, technical assistance structures shall be set up for all actors involved in the restructuring (one stop shops) and measures shall be put in place to promote education and training to ensure a sufficient workforce with an adequate level of skills. According to the Directive, financial incentives shall be prioritised for vulnerable households, people in energy poverty and people living in social housing.

2.2 Households and residential real estate

In 2022, there were around 36 million homes in Italy. Based on Istat' Household budget survey (HBS), 73 per cent of households live in owner-occupied dwellings, 17 per cent are rented (which rises to around 40 per cent for households belonging to the first decile of the distribution of equivalent expenditure) and the remaining 10 per cent live in usufruct or free-of-charge housing. The owners of rented households (4.6 million) are 78% of individuals and 15% of public housing institutions (in Italian *Edilizia residenziale popolare* – ERPs, also known as IACP, IPAB). Around 60% of households in the poorest fifth live in public housing.

As regards the energy efficiency characteristics of Italian dwellings, around half of Italian households live in buildings built before the introduction of the first regulation on energy efficiency standards, which provided mandatory indications on thermal insulation of buildings (Law 373 1976). Finally, in Italy it is mandatory to produce an Energy performance certificate (EPC) in the case of rental, sale or renovation of a building (see Box 2).

[6] By 2033 all buildings were expected to reach the energy performance class D and by 2040 consumption should have been equivalent to a nationally determined value resulting from a gradual decrease in average primary energy consumption from 2033 to 2050 in line with the final goal of transforming the residential building stock into a zero-emission building stock. Parliament proposed a further deadline, in 2030, by which buildings should reach class E as a minimum.

BOX 2. THE ENERGY PERFORMANCE CERTIFICATE

A certification of the status of the energy efficiency of a building is envisaged in the Italian legisaltion since 2009: *Attestato di certificazione energetica* or ACE (Energy certification certificate) from 2009 to 2015, *Attestato di prestazione energetica* or APE (Energy Performance Certificate) since 2015 onwards. The EPC is drawn up by technicians registered in specific regional registers; the EPCs are submitted to regional archives, most of which are now integrated with the national cadastre managed by ENEA (SIAPE)[7].

The EPC envisages consumption simulation, based on an engineering model, for six energy services: space heating and cooling, water heating, lighting, mechanical ventilation and transport of persons (the latter two are assessed only in the case of non-residential buildings). Following an on-the-spot visit, the technician, who will also have acquired data on heating and cooling systems, on the windows, building's insulation and other information, will use a certified software to estimate the overall energy performance index (EPgl), expressed in kWh per m², as the sum of two components, non-renewable energy (EPgl, nren) and renewable energy (EPgl, rn). The ratio of the estimated non-renewable component to the index of a reference building with similar characteristics establishes the energy efficiency class: values below 1 imply more efficient buildings than the reference building (from A1 to A4 class), while values above 1 less efficient buildings (up to class G). To date, buildings are classified in 10 classes, from the least efficient (class G) to the most efficient (class A4).

The methodology for comparison with the reference building appears to be less used compared with other European countries, which assign the energy class solely on the basis of the performance of the property concerned. Since 2015, there have been national guidelines, annexed to the Ministerial Decree of 26 June 2015, to which regional differentiations apply, which may complicate the comparison of the EPCs in different regions.

As of 22 January 2024, SIAPE had 5.3 million EPCs (4.6 residential and 0.7 non-residential). According to the latest information available, around 54 per cent of residential property in SIAPE has very low energy efficiency (class F and G), compared with about 11 per cent, which instead shows excellent energy performance (classes A1 to A4; figure 1). The distribution of the energy classes that SIAPE can obtain is unlikely to reflect that of the entire housing stock, as it is derived from a selected sample (it is in fact envisaged only for rental, sale or renovation of the property, thus inducing a positive bias in the SIAPE's representation[8]). Bragiotti et al. (2023) perform a simulation of the entire Italian housing stock and show a gap, with regard to residential dwellings, which is particularly significant in the F and G class, the least efficient, with a difference of more than 26 percentage points, equal to around 9 million more inefficient houses, compared with what can be inferred from the SIAPE.

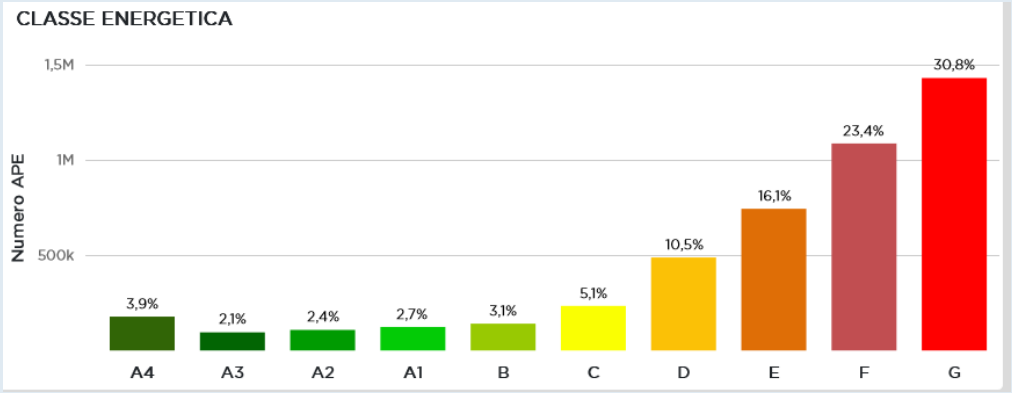
[7] The provinces of Trento and Bolzano have a separate cadaster. By September 2023, only Sardinia and Campania had not yet joined the SIAPE.

[8] The selling houses belonging to the most efficient energy classes are more valued by the market than the least efficient ones (Loberto et al. 2023).

Figure 1

Energy efficiency of Italian houses

(percentage shares)



Source: SIAPE, last updated 22 January 2024.

Italy's housing stock could have specific characteristics that are relevant for the exceptions provided for in terms of efficiency requirements (paragraph 2.1). One aspect relates to buildings with architectural or historical value, for which the available evidence does not allow to accurately identify the age of the properties. Data for the decade of construction of the real estate unit are available only from 1919 onwards. Based on the latest European Population and Housing Census (2011), around 11 per cent of the homes in Italy were constructed before 1919, slightly above the European average (9 per cent), but significantly lower than the shares of Belgium, the United Kingdom and France (23, 21 and 18 per cent respectively).

Another aspect relates to buildings that are not inhabited or are used for limited periods only. According to Istat's Permanent Population Census, 27 per cent of the dwellings in 2021 were empty or only partially used. Finally, demographic trends may further increase the number of unused housing units. According to Istat's latest forecast of the demographic future of Italy, the resident population will decline from today's 59 million to around 54 million in 2050 and around 46 million in 2080.

The energy characteristics of housing are, together with household' income and energy price developments, among the drivers of energy poverty[9]. At the end of 2022, there were 2 million households in energy poverty in Italy, 7.7% of the total, down 0.8 p.p. compared with 2021 (OIPE, 2024). Households in energy poverty that rent their house are around 600 thousand, about one third of the total, distributed equally between private rented sector and public housing entities.

Energy is a merit good and the share of households' energy expenditure (for the house and transportation) decreases as income grows (Figure 2). This implies that energy price shocks (Faiella et al., 2022;

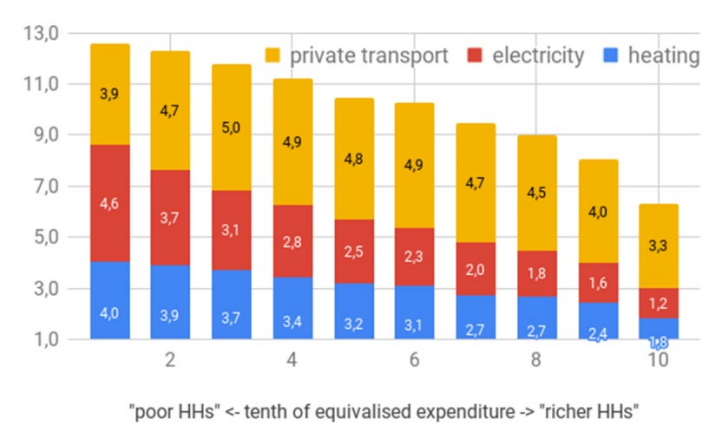
[9]In our country, energy poverty is defined as difficulties in purchasing a minimum basket of energy goods and services or, alternatively, access to energy services, implying a diversion of resources, in terms of expenditure or income, above a "normal value" (source National Energy Strategy, 2017 and National Energy and Climate Plan, 2019).

Colabella et al., 2023) particularly impact poorer and financially vulnerable households. Poorer households also exhibit lower energy demand price elasticity (Faiella and Lavecchia, 2021).

Figure 2

Households' energy expenditure share by equivalent expenditure decile (2021)

(percentage shares)



Source: Faiella e Lavecchia (2021).

2.3 The returns of energy efficiency investments

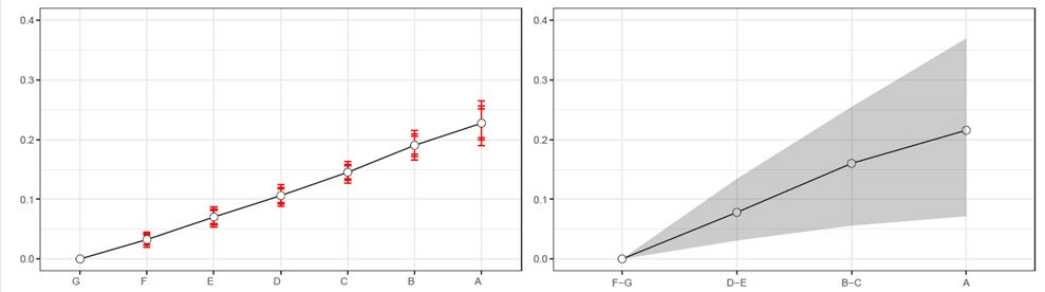
According to empirical evidence, house prices reflect the benefits of higher energy efficiency of buildings because buyers discount future lower energy consumption: private investment in energy efficiency of housing would thus benefit from a market return.[10] However, the estimates from different countries are not comparable, as the energy classification is based on national standards that are not harmonised across countries.[11] It is therefore difficult to extrapolate the international evidence to the Italian case.

[10] Aydin et al. (2020) estimate that in the Netherlands a 10% increase in the energy efficiency of housing causes a house appreciation of 2.2%. Eichholtz et al. (2023) analyse a dataset of non-residential buildings in the United States and find that higher energy efficiency is fully capitalised in prices. Other work confirming the presence of a market premium associated with increased energy efficiency includes Brounen and Kok (2011) for the Netherlands, Fuerst et al. (2015) for Great Britain, Taruttis and Weber (2017) for Germany, de Ayala et al. (2016) for Spain.

[11] As discussed above, Directive 2010/31/EU sets out principles on the basis of which Member States have adopted their methodologies. The harmonisation of the standards for measuring the energy performance of buildings, which is one of the objectives of the recent proposal for a directive on this subject, would improve comparability between EU countries.

Figure 3

The impact of energy label on house prices



Source: Loberto et al. (2023), estimates based on Immobiliare.it data. The charts report the results from the linear regression of the log price per square meter of dwellings on a categorical variable for the energy label, controlling for several house characteristics and the location. Values greater than zero imply the existence of a price differential with respect to a house with label G. The left-hand chart shows the estimates for the whole country. The right-hand chart shows the distribution of the estimates of the province-level regressions. The solid line represents the median estimate, while the grey area includes estimates between the 5th and 95th percentiles of the distribution.

Loberto et al. (2023) show that in Italy the average price differential between a house with energy label A1-A4 (the most efficient) and G (the least efficient) is about 25 per cent (ceteris paribus). However, this price differential is heterogeneous across provinces and may vary between 7 and 35 per cent (Figure 3), partly due to the heterogeneity of the buildings' energy efficiency classification between regions. This heterogeneity is due to differences in regional regulations and large climate variations.[12] The energy efficiency premium is higher in the cold climate areas, probably reflecting the higher retrofitting costs to be incurred to reduce energy consumption compared to warmer zones.[13]

However, the evidence of positive returns does not ensure that the cost-benefit ratio of energy efficiency investments is positive. Some studies based on engineering estimates have shown that the benefits of energy savings outweigh the costs. This has sparked a broad debate on why only a small proportion of individuals undertake investments in energy efficiency (*energy efficiency gap)*. Indeed, the economic literature looking at the actual savings generated by investments in energy efficiency has called into question the existence of *an energy efficiency gap* (Alcott and Greenstone, 2012; Gillingham and Palmer, 2014).[14] Some studies for the US show that efficiency costs are, on average, higher than the benefits,

[12] Due to regulatory differences between regions (and differences in data sources), there is no well-defined relationship at the national level between the energy label and energy performance, which is the theoretical energy consumption of the house measured in kWh/sqm. Therefore, Loberto et al. (2023) cannot identify the contribution to the house price of a change in the energy performance index. Indeed, the price premium associated with a unit reduction in energy performance may be homogeneous at the national level. Still, the spatially heterogeneous relationship between prices and energy labels depends on the different distributions of the energy performance index for the same label.

[13] However, other socio-economic factors may also play a role. Kahn and Kok (2014) show that in the United States the premium associated with the energy performance certificate is higher in areas where the sensitivity of the population to environmental issues is most widespread.

[14] There are several reasons why the net benefits of energy efficiency measures may be overestimated. First, engineering models do not take into account any unobservable costs associated with the investment (e.g. the opportunity cost of alternative investments or the costs of moving out of the house while the retrofitting interventions are being carried out), the heterogeneity of consumers and the uncertainty of the benefits (which depend on future energy price developments) that would discourage

even considering the positive externalities associated with reducing greenhouse gas emissions. Generally, engineering models overestimate consumption savings, and these studies argue that better targeting of retrofitting interventions based on housing characteristics may restore a positive balance between benefits and costs.[15] Another important dimension of heterogeneity relates to the characteristics of homeowners. Usually, incentives are more effective when they trigger new investments in energy efficiency that would not be made without public intervention (Alcott and Greenstone, 2012). That may happen because, for example, homeowners do not have initial capital and credit-market rationed.

In general, there is no clear evidence from the literature that the energy efficiency gap is due to inefficiencies holding back private investment (Alcott and Greenstone, 2012). However, several studies have investigated the role of information inefficiencies and the inattention and assessed some of the most common policies to correct this type of inefficiency.[16] Myers et al. (2022) show that the mandatory disclosure of the energy performance of a dwelling has a positive effect on the price premium for the most efficient homes and incentivises investments in energy savings. Gosh et al. (2023) also find a positive effect of this kind of policy on the prices of more efficient houses. Other work shows that auditing programmes that provide suggestions on potential energy efficiency measures have a positive impact on firms' willingness to undertake such investments (Anderson and Newell, 2004). Finally, other studies show that providing agents with information on energy consumption of individuals or companies with comparable characteristics, e.g. households in the same neighbourhood or companies in the same sector, together with suggestions for reducing energy use or on specific interventions in energy efficiency, leads to an effective reduction in energy expenditure (Schultz et al., 2008; Alcott, 2011; Ayres et al., 2013).

2.4 Banks, buildings and energy efficiency

Information on significant Italian banks referring to 2022 shows that the distribution by energy class of the properties used as collateral for loans is, on average, lower than that of other European countries, but it is quite consistent with the distribution by energy classes of the national real estate properties for which data are available (paragraph 2.2). Most intermediaries declare that they do not have energy performance certification (EPC) of buildings, but use estimated data.

investment decisions. Finally, engineering models do not take into account the *"rebound effect*", i.e. that, faced with lower energy costs, households increase their consumption, thereby reducing the benefits of energy efficiency investments (Aydin et al., 2017).

[15] For example, Fowley et al. (2018) analyse the case of *the Weatherisation Assistance Program* in the United States and show that efficiency costs are higher than the benefits, as estimated savings through engineering models are systematically higher than the actual savings of households. Even if the social benefits associated with reducing greenhouse gas emissions are taken into account, the cost-benefit assessment would be negative. Fowlie et al. (2018) do not find evidence of *a rebound effect* and argue that the overestimation of the benefits could be due to forecast errors in the engineering models in use. Evidence in Christensen et al. (2023) is consistent with this view: the overestimation of engineering models would mainly affect thermal isolation of housing walls. Christensen et al. (2022) show that there would be ample scope for designing the most effective programmes: using machine learning techniques would make it possible to target intervention programmes only on houses with specific characteristics, which are typically associated with significant energy savings as a result of efficiency gains.

[16] Information inefficiencies may be due to the ignorance of the possible benefits of energy efficiency investments and the difficulty in assessing the degree of energy efficiency of an asset.

Several initiatives at national and international level have been launched to involve banks in the transition to a sustainable economy. Financial institutions could channel financial flows using credit, bond, equity and derivatives instruments. At the same time, banks could benefit from the lower credit risk associated with the transition to efficient mortgage collateral, as well as from the reputational effects for their action in favour of the transition.

Credit instruments include green mortgages, i.e. loans with favourable conditions for the purchase of energy-efficient buildings or renovations aimed at increasing energy efficiency. These mortgages are characterised, on average, by a lower default rate (EC, 2021a; Guin and Korhonen, 2020; Billio et al., 2020; Billio et al., 2021; An and Pivo, 2018; Zancanella et al., 2018; Kaza et al. 2014) and a lower loss in case of bankruptcy thanks to the more limited reduction of house prices (EC, 2021; Reusen et al., 2023; Kahn et al., 2014). Data from *the Regional Bank Lending Survey* referring to the end of 2022 show 29 banks provided accurate data on green mortgages granted. These banks represent 54 percent of the total assets of the RBLS sample, and in 2022, they granted green mortgages amounting to approximately 3.5 billion euros, equivalent to 12 percent of their total new mortgage loans and 6 percent of the overall mortgages disbursed that same year by banks participating in the survey section (Figure 4, panel a). On the basis of the data on loan offers to households made available by the main Italian broker online (Mutuionline) and relating to loans granted under the *Energy Efficient Mortgages Initiative* (EEMI, a market initiative involving various entities, such as banks, investors, rating agencies, academics, insurance companies, etc.), it appears that, all other things being equal, the discount rate on green loans with respect to other loans offered by banks working with the platform[17] would be around 7 basis points in the period September 2022-June 2023 (Figure 4, panel b; Abate, Lionetti and Michelangeli, 2024). The market practices of banks in the provision of green loans and/or mortgages are currently being addressed by the European Commission, which is considering introducing a common definition or a European voluntary standard based on taxonomy (similar to green bonds) in order to increase citizens and SMEs' access to these products and stimulate their provision by credit institutions (see Box 3).

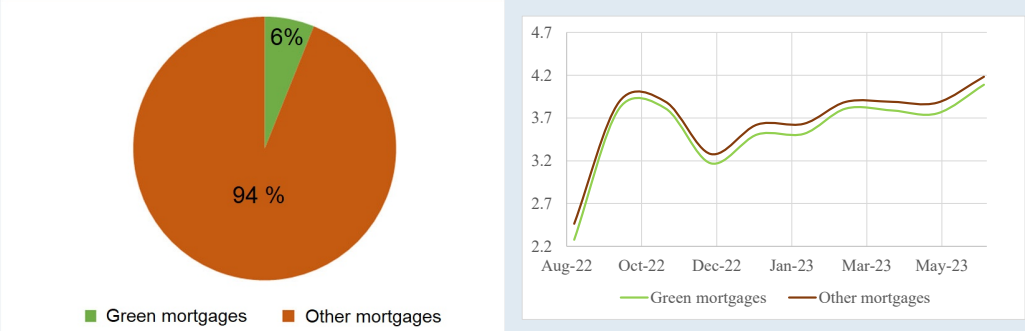
[17] On the basis of an agreement with MutuiOnline, the Bank of Italy has access to monthly loan offers to rented customers who submitted applications via the portal. Customers differ by age, geographical area, type of work, income, type of loan required, type of loan required, type of loan required and loan-to-value. All affiliated banks receive the same questions via the portal and may decide whether or not to grant a loan, indicating the contractual conditions if they do so. The dataset is monthly, in line with the updated bank models and the monthly observations are around 285.000. For the description of the dataset, see Carella et al (2020).

Figure 4

Green mortgages: estimated market share and interest rate

(percentage shares)

(a) mortgages granted in 2022 (b) average interest rate



Source: Panel (a): *Regional Bank Lending Survey. Data refers to the total mortgages granted by banks in the RBLS sample; green mortgages refer to information provided by 29 banks, representing 54 percent of the total assets of the sample.* Panel (b): Mutuionline.

On the funding side, companies and banks could issue green bonds to raise capital to finance energy efficiency projects. Green bonds could provide capital at lower costs and with less restrictive covenants than bank loans, thus representing an attractive source of support (Azhgaliyeva et al., 2020). However, the green bond label itself may not be sufficient to raise funds at a lower cost because it is difficult for investors to distinguish issuers seriously engaged in environmentally friendly projects from those seeking to mislead the consumer through "greenwashing" (Fatica et al., 2021). The European voluntary standard on green bonds seeks to address this problem by imposing a number of requirements on issuers (EU and non-EU) wishing to join, including the drafting of disclosures before, during and after the issuance and review of these disclosures by external verifiers registered with and supervised by the European Securities and Markets Authority (ESMA). Banks and companies could also issue green equity or derivatives to support energy-efficient projects. However, due to the complexity of derivatives and shares, the most popular green financial instruments are bank loans and corporate bonds (Gilchrist et al., 2021).

BOX 3. REGULATORY INITIATIVES ON GREEN LOANS AND MORTGAGES

As part of its Sustainable Finance Strategy, the European Commission published last year a *Call for Advice*[18] addressed to the European Banking Authority (EBA) to gather information on banks' market practices in the provision of green loans and mortgages. The aim of the European Commission is to assess the appropriateness of introducing a common definition or a voluntary European standard based

[18] See: https://www.eba.europa.eu/sites/default/documents/files/document_library/About%20Us/Missions%20and%20tasks/Call%20for%20Advice/2022/CfA%20on%20green%20loans%20and%20mortgages/1043881/EBA%20Call%20for%20Advice%20Green%20Loans%20and%20Mortgages_Clean.pdf

on the EU Taxonomy (similar to the EU green bond standard) and the potential for (legislative and non-legislative) measures to increase access for citizens and SMEs to these products and to stimulate their provision by credit institutions.

In order to respond to the Commission's request for an opinion, the EBA conducted a *voluntary* survey, to[19] which around 80 European banks representing 50 per cent of the total assets of the European banking system (including five Italian banks) participated**.** Based on the information collected, the uptake of green loans would still be limited (around 5 per cent of total loans with significant differences between the banks participating in the survey). The bulk of these loans appear to have been driven by households' real estate financing. Banks mainly use energy classification (EPC) or gain from energy classes/energy savings to classify loans, although this information would not always be available. Alternatively, banks use private standards and/or the EU Taxonomy criteria (although not easy to apply, especially for retail counterparties). The survey would confirm the heterogeneity of banks' criteria for identifying and classifying green loans.

In the short term, the EBA's approach would be to introduce a common definition based on current market practices and EU Taxonomy criteria, which is also proposed in the context of the revision of the *Mortgage Credit Directive* (MCD), in order to ensure adequate comparability of practices while ensuring adequate protection of borrowers. The EBA also proposed to supplement *Annex II* of the MCD (the *European standardised information sheet*) to collect information on the energy class of residential property (EPC) and the sustainability of the related green loan.

Only in the medium term would the EBA consider the introduction of a voluntary standard, in relation to the degree of market development. Among the main obstacles to its development, banks highlight the difficulties in applying the EU Taxonomy criteria, especially in relation to retail counterparties (households and SMEs), the lack of consumer attractiveness due to presumably a lack of awareness or knowledge on the subject; higher costs of investigation and monitoring. In the face of these difficulties, banks are offering better financing conditions to encourage the take-up of green loans. lower fixed investigation costs or notarial costs and energy certificates.

Regulatory interventions that increase the profitability of bank financing for EE investments must be carefully assessed on the basis of a robust analysis of the risk spread between green lending and other lending. The lack of empirical evidence in this regard and the lack of sufficiently robust data and methodologies have so far discouraged regulators from intervening on prudential capital requirements (i.e. Pillar I measures), favouring measures to strengthen the governance of risks (Pillar II) and disclosure requirements to the public (i.e. Pillar III).

In this regard, the Bank of Italy drew up, in the first few months of 2022, a first set of "supervisory expectations" addressed to banks on the integration of climate-related and environmental risks into their corporate strategies, governance and control systems, and risk management systems, which is used as the basis for an initial discussion (with the intermediaries) on the degree of compliance with the expectations and the adjustment plans. Following this initial discussion, the management bodies of all less significant banks were made aware of drawing up action plans that make it possible, over the next three years, to fully integrate climate risks into the ordinary governance and risk management framework. These action plans will serve as a reference for the subsequent supervisory dialogue, which will focus on verifying the progressive alignment of business practices with "expectations". The efficiency and effectiveness of a risk management system *is closely* linked to the availability of an adequate and comprehensive information set. In this regard, intermediaries are called upon to support a substantial effort to collect and store data, including through the establishment of constructive dialogue with

[19] See: https://www.eba.europa.eu/eba-seeks-input-credit-institutions-green-loans-and-mortgages

counterparties. It also notes the relationship with data providers, in respect of which the systematic assessment of the data provided (including through comparisons with aggregated institutional sources) is essential, in order to test their robustness and integrity, as well as the regular performance of data gap analyses to identify any information gaps.

2.5 Public intervention

In Italy, the first tax incentives aimed at energy retrofitting of residential buildings were introduced in 2007, as a deduction (*detrazione*)[20] of a share of the expenditure, to be used over several years (usually 10). The reliefs, initially temporary, were subsequently extended - albeit with changes to the amount of the benefit (i.e. percentage of deductible expenses and ceilings to the eligible expenditure) – and in some cases made permanent. Currently[21], the incentive scheme includes basically two measures (see Table 1 in Appendix for details):

- the 'Ecobonus', in force until the end of 2024[22], which provides for a 10-year deduction from personal income tax[23] of energy retrofitting expenditure[24] on housing units and on buildings (including those not used as main dwellings) incurred by the owner or occupier (tenant). The tax relief is granted on a differentiated basis (both in terms of rates and limits to eligible expenditure) depending on the type of building involved (single units, condominiums) and interventions carried out: the basic rate is 65%, reduced to 50% on some works (e.g. windows), and increased to 70-75% for certain works on condominiums improving energy performances (further increased to 80-85% if coupled with a certain reduction in seismic risk is achieved);
- the 'Superbonus' introduced in 2020, which is an enhancement of the Ecobonus through an increase in the personal income tax deduction, to be used over four years, of the expenses for thermal insulation of building envelopes and replacement of winter air conditioning systems (so-called "towing interventions") carried out on the common parts and on single or multi-family houses, provided that they lead to a significant improvement of energy efficiency (i.e. a reduction of two classes in the energy performance)[25]. Eligible expenditure ceilings are differentiated according to type of intervention and building. The enhanced deduction also covers other energy retrofitting works ("towed works") when coupled with at least one of the so-called 'towing interventions. The allowance, initially at 110%, was subject to successive amendments aimed at reducing the benefit for expenditure incurred from 2023 onwards: for condominiums and

[20] By deduction in this paper we mean a relief on the taxes due rather than an abatement of the tax base.
[21] Tax laws in this paper is updated to 31.12.2023.
[22]In case of no extensions, starting from 2025 energy-saving interventions are subsidized with the same ordinary rate of building renovation works (36 per cent of the expenditures).
[23] The deduction can also apply for corporate tax purposes (i.e. it is also granted to firms and companies). In any case, the benefit can be used only within the limits of the beneficiary's tax liability of each year.
[24] These include, for example, aimed at reducing energy needs for heating, improving the energy performance of the building (insulations, roofs, floors, windows), replacing winter air conditioning systems, etc.
[25] Superbonus also applies to certain anti-seismic measures.

buildings from 2 to 4 units (single or multi-family), a *decalage* of 90% in 2023, 70% in 2024 and 65% in 2025 was provided; for single building units, the 90% deduction has been in place only until 2023 and subject to the economic condition of the beneficiary (see Table 1 in Appendix).

Until 17 February 2023, in the case of Ecobonus and Superbonus (as well as other building incentives), as an alternative to deduction from tax liability, it was possible to opt for an equivalent discount granted by the suppliers of the goods or services (invoice discount) or for the transformation of the deduction into a transferable tax credit. The latter could be used by the buyer to offset his own taxes through annual instalments, according to the same rules set for the deduction (10 or 4 years)[26]. The disposals, initially possible in favor of any person and with no limit in the number of transfers, have been subject to numerous legislative measures aimed at limiting the circulation of the credits (see Table 2 in the Appendix). To date, for credits relating to expenses incurred before 17 February 2023, only one transfer is allowed to any person, while following ones can only be made to supervised entities (financial intermediaries and insurance companies); they, in turn, are entitled to a maximum of 4 additional transfers to other supervised entities or, in the case of banks, to their current account holders (that may only use the credits to offset their own liabilities, but cannot dispose of them further)[27].

The deduction from personal income tax over 10 years of 50 per cent of the VAT paid for the purchase of real estate units for residential use (even if not intended as main dwelling) of energy class A or B was not extended beyond 2023; the allowance only applied if the seller was an OICR or the building company.

Lastly, as regards indirect taxation, in Italy there is no specific provision for energy retrofitting of buildings; however, the 10% reduced VAT rate applies in the event that the interventions are part of more general works for the recovery or renovation of the building.[28] The same reduced rate is granted for district heating plants and those producing electricity from solar-photovoltaic and wind power.

In addition to tax expenditures, a contribution (so-called 'Conto termico') up to 65% of expenditure is provided for interventions to increase energy efficiency and production of heat power from renewable sources for small plants.[29]

Public incentives for energy efficiency in the form of deductions, tax credits or subsidies are currently granted in several other countries. Box 4 summarizes the experiences of other main EU countries (France and Germany) and two jurisdictions (the United States and the United Kingdom) that stand out for the importance of this type of provisions.

[26] Any portion not used in the relevant year was lost, not being possible to carry forward it to the following year; the only possibility to use it was to transfer to a third party, that, in turn had to use it by the end of the year.
[27] In addition, for financial intermediaries and insurance companies have been given the option to convert 10% of the credits not used for offsetting taxes in a given year into ten-year BTPs, from 2028 onwards, provided that in that year they had exhausted their fiscal capacity. Finally, credits not used as of 31 March 2023, could be used in 10 annual instalments, instead of the original instalment scheme.
[28] The reduced rate applies to the provision of services and, to a certain extent, to "significant" goods supplied by the firm carrying out the works.
[29] https://www.gse.it/servizi-per-te/efficienza-energetica/conto-termico.

BOX 4. TAX INCENTIVES AND SUBSIDIES FOR ENERGY RETROFITTING ABROAD

In Germany, under the *Climate Action Programme 2030*[30], a tax deduction was introduced in 2020 (20% of the costs of the works over three years); in addition, no VAT is charged on the installation of solar panels. Since the beginning of the 2000s, there have also been subsidies to improve the energy efficiency of domestic heating and cooling systems (enhanced since 2016).

In France, the energy transition tax credit (15-30% on certain works)[31], in force until 2020, was fully replaced in 2021 by a subsidy-based incentive scheme (*Ma Prime Renov*); a 5.5% VAT rate on energy retrofitting measures (on dwellings owned for at least two years) is also granted. An interesting feature of *Ma Prime Renov* is that, in order to obtain the subsidy, an asseveration – also *ex post* - has to be released by independent experts in order to certify the actual impact of the energy efficiency intervention. The amount of the subsidy is EUR 1,000 for heating systems and EUR 8,000 for the installation of solar panels.

In the United States, there is a tax allowance for energy efficiency and a tax credit (both at a rate of 30%) for installations producing renewable energy, with limits varying depending on the type of work[32]. The *Weatherisation Assistance Program* (WAP) has also been in place for many years (although its funds have decreased over time): a system of subsidies aimed at boosting the energy efficiency of housing targeting poorer households, funded by the federal budget but managed by the States.

In the United Kingdom, as regards income taxes there are no major energy-improvement-related tax advantages; until 2027, a 0% VAT rate will be applied on specific materials and energy retrofitting interventions on buildings. Instead, there is a subsidy of GBP 5,000 per household, which is doubled in the case of low-income ones (see Table 3 below for details of tax incentives related to income taxes).

Compared with the main countries, in Italy the system of tax incentives, even without considering Superbonus, appears particularly generous, both as regards the extent of the benefit (deduction percentages and ceilings) as well as the scope of subsidized buildings and interventions. In particular, in foreign countries tax deductions and tax credits are less common and, in most cases, they are limited to main dwellings and granted to owners only. On the opposite, in Italy, this kind of incentive is granted for all types of accommodation and to anyone who is entitled to occupy them (thus, including tenants). On the other hand, in the field of VAT, Italy provides more limited incentives than those in other countries. Finally, while in Italy direct monetary transfers are less common, in other countries these seems to be the prevalent means of provision of the benefits. The reason for this difference may be largely due to the greater importance attached in foreign jurisdictions to the aim of targeting the poorest households, a limited range of beneficiaries which makes administratively easier to grant the benefits in the form of subsidies.

The rate of 110% granted under the 'Superbonus' has been an *unicum* in the international landscape. Together with the option to convert the deduction into an invoice discount or a transferrable credit,

[30] https://www.bundesregierung.de/breg-en/issues/climate-action/klimaschutzprogramm-2030-1674080.
[31] https://www.ecologie.gouv.fr/credit-dimpot-transition-energetique-cite.
[32] https://www.irs.gov/credits-deductions/energy-efficient-home-improvement-credit; https://www.irs.gov/credits-deductions/residential-clean-energy-credit.

undoubtedly it has been an unprecedented driving force for energy requalification works, stimulating additional investments, with non-negligible macroeconomic impacts; however, it also generated critical issues in many respects, first and foremost on public finances (see Box 5).

BOX 5. THE 'SUPERBONUS'

Impact on public finances. — The cost of Superbonus for public finances was significantly high and much higher than initially estimated: based on available data, the tax credits accrued up to the end of 2022, together with those related to the 'Bonus Facciate'[33], should amount in total to around EUR 90 billion. For 2023, the amount of credits accrued should be slightly lower than EUR 80 billion.

Cost-effectiveness of the measure. — With regard to the aim of reducing climate-related emissions - although rigorous assessments of the environmental impact of the measure are not yet available - the interventions incentivized with the Superbonus do not appear to be among the most effective ones and would achieve modest results in terms of reducing CO2 emissions[34]. Therefore, the Superbonus would have low *cost-effectiveness*: according to the early evidence, in the best scenario, the environmental benefits of Superbonus would repay the financial costs in about 40 years[35]. Other estimates suggest that the return time is longer than the expected life of the specific interventions, even assuming particularly penalizing *social cost of carbon* (OIPE, 2023).

Macroeconomic impact. — Concerning the ability to boost investments, according to preliminary analyses[36], in 2021-22 the additional expenditure due to bonuses was about two thirds of the value of the investments that benefited from the aid. Indeed, besides additional expenditure, there is a share of the expenditure that households would incur even in the absence of subsidies (for instance on works already planned and on interventions that replaced others of a similar amount). Moreover, the "bonus Facciate" and the Superbonus may have led, in some cases, to a rearrangement of households' investment plans, with an advance to 2021-2022 of expenditure planned for the following years[37].

Distributional aspects. — From a distributional point of view, as other building incentives, the Superbonus – being granted irrespective of the income condition of the individual (and of the household) – is a regressive measure; however, the option for an invoice discount or a credit transfer has mitigated that feature[38].

[33] The "bonus Facciate" introduced by the 2020 budget law was an incentive equal to 90% of the expenditure for the refurbishment or renovation of the external façade of the building; it was first reduced in 2022 and then eliminated in 2023. In fact, spending on the "bonus Facciate" was concentrated in 2021, when it accounted for more than half of total resources.
[34] See "Relazione sullo stato della green economy 2022" by Fondazione per lo sviluppo sostenibile.
[35] See Alpino et al. (2022). This is achieved by assuming a discount rate slightly below 2 per cent, in line with some recent contributions in the literature on the topic, and assigning a relatively greater weight to the damages that will occur in low-income countries. By taking higher discount rates or weighting damages evenly across countries, the monetary value of environmental benefits would be lower than the costs.
[36] See Accetturo et al. (2024).
[37] See "Audizione nell'ambito dell'indagine conoscitiva sugli effetti macroeconomici e di finanza pubblica derivanti dagli incentivi fiscali in materia edilizia", testimony by Pietro Tommasino from the Bank of Italy Structural Economic Analysis Directorate, Chamber of Deputies, Rome, 29 March 2023.
[38] There is a link between the intensity of the use of the *bonus* and GDP per capita on a municipal basis; this relationship is much less strong for Superbonus than for the Ecobonus (see "Audizione nell'ambito dell'indagine conoscitiva sugli strumenti di incentivazione fiscale con particolare riferimento ai crediti d'imposta" the 6th Committee of the Senate of the Republic, 2 March 2023 and "Audizione sugli effetti macroeconomici e di finanza pubblica derivanti dagli incentivi fiscali in materia edilizia", the V Committee of the Chamber of Deputies, 16 March 2023, testimonies by the President of the Parliamentary Budget Office Lilia Cavallari).

The issue of transferability. — With regard to the transformation of the deduction into a transferable credit, it should be noticed that this instrument was not new in the Italian tax law. This possibility existed even before 2020 for incentives such as Ecobonus, but the transfer was allowed only in respect of parties linked to the relationship that gave rise to the deduction (e.g. the companies carrying out the works), with the explicit exclusion of public administrations and banks[39]. The reason for that exclusion was in the public accounting rules, according to which the transferability to those entities may result in the classification of such instruments as *payable*, with a different impact on the time allocation of the burden for the purposes of public finance calculation rules of the net borrowing[40].

The extension of the transferability option to all building bonuses and the inclusion of the banks among the possible transferees – together with the 110% rate of and simple initial rules for disposal[41] – created a genuine market for these credits, which soon absorbed almost all of the tax capacity of financial institutions. This led the statistical authorities to re-classify Superbonus credits[42] as *payable* and to include them in the public net borrowing, causing an upward revision of the government deficit (by almost 3 points of GDP in 2022).

By mid-2024, the statistical authorities will re-assess the accounting treatment of the incentives, taking into account the significant changes made to the usability of credits[43] and the developments in the market for transferable credits (in particular, the difficulties in the actual disposal).

Overall, these uncertainties inherent in the accounting of the tax incentives contribute to a less transparent assessment of such items and more difficult budgetary planning.

Other critical aspects. — 1) In the case of Superbonus, the 110% rate eliminated any form of beneficiaries' participation to the cost, contributing to the increase in building sector prices (also due to the excess demand for goods and labour over the available supply) in a period of exit from the pandemic crisis, which already suffered from significant bottlenecks and tensions on the markets for several raw materials and products; 2) Insufficient anti-avoidance rules led to high amounts of fraud (largely attributable to the "Bonus Facciate")[44]. In order to counter these effects measures have been taken, *inter alia*, aimed at strengthening *ex-ante* controls, introducing price caps and restrictions on the credits circulation. However, the latter resulted in an 'constrained' market of credits, which could no longer easily be disposed of. This has led the policy maker to review the restrictions by broadening the range of options for using credit; these solutions, however, have not been sufficient to eliminate the problem.

[39] The banks were among the possible transferees only in the case of the 'Ecobonus' owed to individuals with no sufficient tax liabilities for benefiting of the deduction.

[40] According to the rules of the Manual on Government Deficit and Debt (MGDD, drafted by Eurostat), if a tax incentive is *payable* (i.e. the possibility that it may be fully benefited is high) it has to be imputed on an accrual basis in the accruing year; otherwise, its impact is diluted over time based on its actual use. In the former case, the budgetary impact is more visible and immediate (at least on the deficit; the evolution of government debt, on the other hand, is not affected).

[41] Originally, credits could be sold without any limit, by simply notifying the sale to the tax administration through a platform created for this purpose. There were no *a priori* checks or, in cases other than Superbonus, certificates of any kind.

[42] The change also concerned the "Bonus Facciate".

[43] See "Audizione preliminare all'esame della Nota di aggiornamento del Documento di economia e finanza 2023", testimony by the Head of the Directorate General for Economics, Statistics and Research of the Bank of Italy, S. Nicoletti Altimari, Chamber of Deputies, Rome, 9 October 2023.

[44] According to the data published at the hearing of the Tax Administration in March 2023, the overall fraud would amount to EUR 9 billion, of which 58% relating to the "Bonus Facciate", 23% to the Ecobonus and 5% to the Superbonus; more than EUR 12 billion was reported at the Council of Ministers on 28 August 2023, of which EUR 7,2 billion were seized.

More recently, in addition to the traditional instruments, governments have started to use so-called *green bonds* to finance EE-related public expenditure. Box 6 analyses the weight of the incentive programmes for the energy efficiency of housing in the issuance of Italian Treasury green government bonds.

BOX 6. GREEN BONDS AND ENERGY EFFICIENCY EXPENDITURE

Green *bonds* are debt instruments used to finance projects that deliver environmental benefits. In particular, the issuer undertakes to report on the expenses incurred, including an assessment of the environmental benefits achieved.

In recent years, several countries have started issuing green securities (Doronzo et al., 2021). In addition to being seen as an innovative financial instrument to finance expenditure on the energy transition, the issuance of this type of bond allows other benefits to be achieved, such as: positive spillovers to private industry by stimulating private emissions; reputational, as an indication of a country's long-term investment strategy; on the composition of sovereign debt, attracting – compared with conventional securities issuances – a larger and long-term investor base. At the same time, the issuance of green government bonds needs to be assessed in the light of the higher costs associated with the reporting burden.

The costs that may be reported include those associated with subsidies or tax deductions granted for the energy efficiency of private property assets. The Italian Treasury has already made extensive use of this option, including the amount relating to Ecobonus for the BTP issued in 2021 (12% of the expenditure reported) and, to an even greater extent, for that issued in 2022 (47% of the reported expenditure, see Figure 5).

Looking at the main euro area issuers, France has also followed a similar strategy by accounting for charges for tax deductions, VAT reduction on works and direct subsidies expenditure in amounts between 28% and 46% of annual issuances. By contrast, Germany did not include these charges to a significant extent in green government bonds, as these programmes were mainly financed by Kreditanstalt für Wiederaufbau (KfW) – the promotional bank of the Federal Republic of Germany – and thus related to green bonds issued by KfW itself[45]. At European level, the European Commission, which is active in the issuance of green bonds (NGEU Green Bonds), points out that a significant proportion of eligible expenditure to finance NGEU Green Bonds is included in the category of energy efficiency[46].

As stated above, tax incentives aimed at energy efficiency can be accounted for against the issuance of green government bonds. However, the conditions for their inclusion should be specified and communicated to the market prior to the issue itself. In this regard, the Italian reference framework currently provides that only 'investment costs contributing to at least two levels of improvement on the Italian scale of energy efficiency' can be included, i.e. measures with the characteristics of Superbonus 110%. However, in the past, this specification has not precluded the reporting of other costs such as those for Ecobonus due to the inclusion of appropriate justifications in the green bonds allocation report – i.e. the report explaining the allocation of resources to the projects financed.

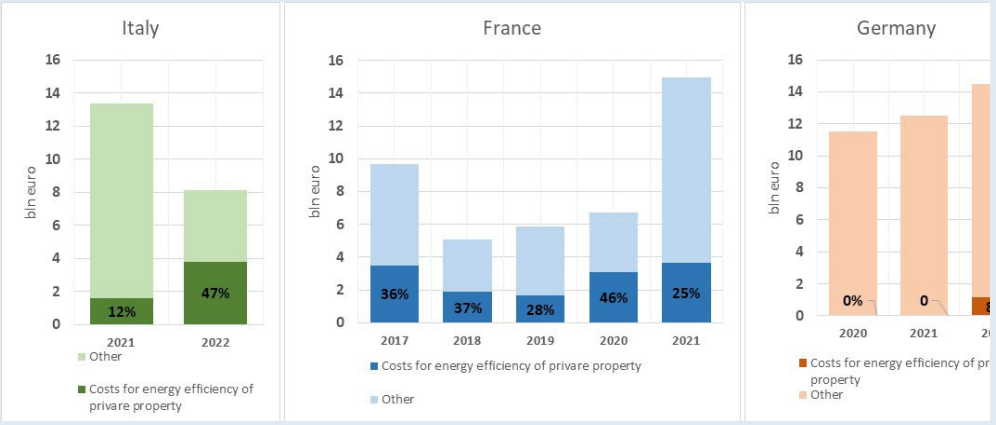
[45] KfW's green bond issuance in 2022, around EUR 10.5 billion, was allocated 52.8% to energy efficiency measures in residential buildings.

[46] Against NGEU Green Bonds issued for EUR 44.2 billion as of 1 August 2023, eligible financing expenditures of EUR 21 billion were reported, of which 47% were allocated to the housing energy efficiency category (see European Commission, 2023).

Figure 5

Green government bonds by country and year of issue: composition of the costs reported

(EUR billions and percentages)



Source: based on MEF, Agence France Trésor and Bundesministerium der Finanzen data.

2.6 Innovative financial instruments

In addition to the provision of subsidies or incentives to achieve energy efficiency goals, innovative projects involving the private sector have also been launched in the EU. These aim, on the one hand, to stimulate demand by facilitating the financing of works and sometimes providing technical support, and, on the other hand, to channel investments in the sector. In particular, on-bill debit schemes have been tested in Europe, which, thanks to the intervention of the energy provider, enable consumers to finance efficiency works with the savings on supply[47]. This experiment has also involved Italy. Similarly, a financing model with repayment of the loan has been tested in Spain, which affects the payment of the property tax, and thus with the involvement of the local government acting as a collector. The implementation of this model, which is based on a public-private partnership, may be complex due to the need for specific regulatory revisions to modify the property tax and to deal with non-payments. The EU also funded projects that aim to develop specific energy efficiency loans (see 2.4). Table 4 in the Appendix outlines some features of the main innovative financial instruments.

3. **Possible areas for action**

Government interventions can be useful to correct possible market failures. However, in the case of EE investments, the economic literature does not agree on the size and nature of imperfections (see para.

[47] Conceptually, the mechanism can be designed in such a way that the loan is less than the expected savings, possibly adjusting the repayment period. However, a reliable forecast of energy prices is needed to ensure effective neutrality (see Bianco and Sonvilla, 2023).

2.3). In addition, there is a serious lack of data and analysis in Italy, leading to difficulties in designing the interventions, particularly as regards quantitative aspects.

Difficulties in identifying relevant market imperfections have two main implications: first of all, rigorous analyses must be prepared within a short period of time so as to make it possible to understand which obstacles to EE are relevant to the Italian case and what the measures already tested in the past have been effective. From this point of view, the critical issue relates to the availability of data. Micro information on the energy efficiency of housing, energy consumption and incentive measures already held by various agencies and ministries should be made available for empirical analysis[48].

Secondly, a variety of instruments should be used as there are potentially multiple reasons for holding back investments in EE. In any case, uncertainty about the nature of market imperfections and the effect of incentives suggests that the effects of the measures should be carefully and regularly monitored.

Also on the basis of these considerations, some proposals for (re)design of public policies are made later in this section.

3.1 Transparency of the EE market.

Some information imperfections may hinder investments in EE (para. 2.3). These imperfections may relate to difficulties in assessing the degree of energy efficiency of a dwelling and the possible benefits of investing in EE. It would be desirable for EPAs to be available for more housing and to contain reliable[49] and territorially homogeneous information, allowing for comparisons between different regions (para. 2.2). As experienced in other countries, forms of advice to citizens on technical options for EE, returns in terms of lower electricity consumption and lower emissions, and financing and facilitation arrangements could facilitate interest on the part of households (see, for example, the experience of *one-stop shops in* some northern European countries, France and the Benelux countries: Box 7). This type of advice could make it easier to overcome the bureaucratic obstacles that may arise for more complex operations. These information centres need not necessarily be public, given the interest of private operators in investing in EE. Other ways could relate to simple comparison elements that energy service companies could propose (e.g. in their bills) to show savings that would be achieved after investing in EE (e.g. by providing average consumption of similar dwellings for housing and household characteristics but belonging to better performing energy classes).

BOX 7. THE ONE STOP SHOPS

The EPBD (EU) 2018/844 introduced the concept of a *one stop shop* (OSS). In particular, the Directive calls on Member States to provide accessible and transparent advisory tools, such as one stop shops, to inform and assist consumers on energy efficiency and with regard to the relevant financial instruments.

The OSS can be defined as advisory tools that facilitate access to financial mechanisms, assist consumers

[48] The project of the National Portal on Building Energtic Prestation (PNPE2), managed by ENEA, should collect all this information, but it is necessary to proceed with agreements with the individual authorities holding these datasets. Unfortunately, at present, these agreements have not been implemented.
[49] To date, around one sixth of the EPAs deposited with SIAPE are filtered out by ENEA.

on technical and financial issues and guide them through a number of key steps in the restructuring process. The OSS are customer-transparent advisory tools and new business models from a supplier perspective (Boza-Kiss and Bertoldi, 2018).

According to the European Commission (Economidou et al, 2019), assistance through the OSS can help address a number of barriers, such as difficult access to financial incentives, fragmentation of energy efficiency interventions, high transaction costs due to the small scale of investments, insufficient understanding of the complexity of interventions, lack of reliable and credible information on costs and benefits.

While homeowners often act on the replacement of household appliances, or modernisation projects aimed at improving comfort or aesthetics, the OSS promote, where possible, integrated energy renewal solutions and represent a building-related service that facilitates dialogue between users/owners and suppliers, in order to identify solutions at all stages of the renovation process. The role of the OSS can then be defined as facilitator or intermediate contact point.

From a practical point of view, OSS can also help customers to select suitable contractors and suppliers, taking into account their previous experiences. The OSS often ensure quality of service and have some basic packages tailored to specific cases. These include detailed information on what each restructuring proposal entails, including possible interventions, solutions and benefits. At the same time, from the supplier's perspective (architects, engineers, installers, producers, finance partners), the OSS help the supplier to simplify interactions with individual private clients, as the OSS guide customers through visits, decision-making and other complex procedures.

The OSS overcome market fragmentation on both the demand and the supply side, offering solutions for the entire value chain (Boza-Kiss and Bertoldi, 2019).

OSS service providers are usually independent organisations, experts or consultants dealing with technical assistance, structuring and providing financial support, helping the client to apply for public funding. In Europe, several examples of OSS have been identified in the Nordic countries, France and the Benelux countries (Boza-Kiss and Bertoldi, 2018). Some significant examples of OSS are the Rhodoshop Development Unit in Bulgaria, the Småland-Blekinge SDO pilot in Sweden, Ile-de-France Energies for residential buildings in France and the Energy Investment Unit of the Cambridges Council of Cambridgeshire public buildings in the United Kingdom. The EU Horizon 2020 programme supports the creation of OSS, recognising their value in mobilising funding for energy efficiency.

3.2 Measures charged to the public budget.

Before any tax policy decisions, a technical/engineering assessment should be carried out to identify the type of investment deserving public support, recognizing those likely to bring significant benefits in terms of reducing energy consumption and climate-altering gas emissions compared to cost (i.e. the most cost-effective ones).[50]

[50] As mentioned above (para. 2.3) *ex-ante* engineering assessments are often more optimistic than *ex-post* assessments, that take into account the behavioural reactions of incentivised individuals (and, in particular, the "rebound effect"), but they are useful for identifying sub-optimal interventions (for example because they use technologies leading to energy consumption and GHG reductions lower than other available technologies).

The design of incentives should tackle some issues: (1) the selection of beneficiaries and buildings; 2) the type of instrument used for providing the benefit; 3) the measure of the incentive; 4) the impact on the public finances; 5) law certainty and stability over time.

1) Selection of beneficiaries and building to be incentivized. Concerning beneficiaries, resources should be channelled mainly towards households in the left-hand tail of the income and wealth distribution, also in the light of empirical evidence suggesting that incentives for green technologies are more often caught by the wealthiest households (Davis, 2023). This targeting would allow to reconcile fairness and efficiency (minimizing the deadweight loss), as these households are more likely to face liquidity constraints and to live in energy inefficient dwellings. It is important to select beneficiaries using indicators that refers to the household (and not the individual) – which are more representative of the actual economic situation – and that also include wealth, being more robust to tax evasion than those based on income only (e.g. ISEE[51]).

Directing public resources for EE towards low-income and liquidity-constrained households - which, as noted above, are more likely to live in inefficient houses mostly needing retrofitting measures - would also be appropriate to maximize macroeconomic effects of the incentives. This option would reduce the likelihood of public resources being used to finance previously planned investments ("poor addictiveness") and, therefore, that public funds would replace private ones (see Box 8).

All other beneficiaries' characteristics being equal, priority should be given to the least efficient building and, more generally, to the most cost-effective measures. In addition, benefits should be granted only for dwellings that are occupied for most of the time.

The use of public resources could be particularly desirable for households living in rented dwellings, although in Italy they are a minority (4.6 million)[52]. Indeed, in this case incentives to invest in EE are particularly low for both the tenant – who may not stay in that dwelling enough to benefit from returns on the investment – and for the owner – who may face difficulties in ensuring that the rent reflects the energy savings stemming from the EE investment (split-incentive problem)[53]. For private rented sector (PRS), in order to reduce the effects of the split-incentive problem, it would be preferable to target the interventions on owners, with different means[54]. One could be to provide for enhanced tax incentives conditional on achieving certain levels of EE, also through a reduced taxation of the rent; for instance, as already provided for by some territorial agreements in Italy, an increase of the "*canone*

[51] The ISEE is an indicator in Italy of the economic condition accounting for both income and assets of the family and it is used for social transfers by the national social security institute.
[52] As previously documented (para. 2.2) rental is more widespread among less well-off households. However, tenants living in energy poverty conditions are only about one third of the total, evenly distributed between dwellings owned by a private owners or public housing entities.
[53] To address this problem, in Germany the building heating tax (introduced in 2021) was split between tenants and owners according to the energy performance of the building: the lower the latter, the higher the owner's share (Hoeller et al., 2023). However, this scheme is not applicable to tax incentives which, by definition, are voluntary.
[54] However, current tax incentives already granted to owners could remain unaffected (but they should be targeted towards the less well-off).

concordato"[55] – which benefits from preferential taxation – could be granted according to the energy performance of the building, or a specific (lower) rate could be introduced. Alternatively, as in other countries, such as France and the United Kingdom (see OECD, 2024), consideration could be given to allowing the possibility to rent the house conditional on meeting some minimum energy standards[56], coupled with the granting of tax incentives (always subject to an appropriate ISEE threshold[57]). For public housing entities (*Edilizia Residenziale pubblica – ERP*), in view of the precarious financial conditions of the institutions and their shareholders, it would be appropriate to set up a state fund to co-finance retrofitting measures, including design costs. Moreover, public ownership would make it possible to easily solve the coordination problems that often arise in case of interventions on common parts of the building (e.g. thermal insulation, installation of solar panels on the roof) in condominiums with numerous owners.

2) Choice of the instrument for providing the benefit. — In general, as regards the choice between direct subsidies and tax expenditures, account must be taken of several aspects, relating to *compliance* and administrative burden, possible distortions, transparency/accountability and control of the expenditure, as well as fairness (Villela, Lemgruber and Jorratt, 2010).[58] Tax incentives are more certain, administrative simpler and ensure a faster take-up than direct subsidies. They are generally not subject to budgetary constraints and can be automatically used upon meeting the requirements set by the law, with no need for *ex-ante* requests and administrative or evaluation procedures; this leads to a lower compliance burden.[59] The tax credits are even faster since they can also be set-off against a number of taxes and social contributions. However, this tool has two main limitations: first, it benefits only those with sufficient tax liabilities and therefore tends to be regressive. Second, precisely because of the automatic nature and absence of 'upstream' controls, the lower revenue from tax expenditures is more difficult to predict and to monitor; thus, it may the actual use of incentives by taxpayers may diverge from the allocated resources.[60]

Based on Italian past experience, the transferability of credits appears to have limited the typical regressive nature of this type of incentives and mitigated liquidity constraints[61]. However, the problems that emerged with the Superbonus (large cost, rapid market saturation and widespread fraud: see para. 2.5) seem to advise against re-introducing such transferability in the future on a large scale; eventually,

[55] They are contracts where the fee is established in territorial agreements between tenants' and owners' organizations according to some parameters linked to house characteristics. The rent perceived by the landlord benefit of a reduced taxation.
[56] This measure should be accompanied by strengthened controls in order to counter increased incentives to rent evasion.
[57] The threshold for accessing the benefits should not be too low so as to include households with the enough economic capacity to support the investment.
[58] See, *inter alia*, "Audizione nell'ambito dell'indagine conoscitiva sugli strumenti di incentivazione fiscale con particolare riferimento ai crediti di imposta", testimony by the Head of the Tax Directorate of the Bank of Italy, G. Ricotti, Senate of the Republic, Rome, 21 February 2023.
[59] Simplicity and automatic features must be balanced by appropriate anti-elusive rules. For example, in the case of Superbonus, the corrective measures concerned: certifications by independent technicians, heavier penalties for false certifications and the adoption of lists setting caps on prices by type of intervention.
[60] It should be also noticed that tax reductions are typically diluted over a longer time horizon, which may interfere with their correct perception by the citizens.
[61] See hearings of the Ufficio parlamentare di bilancio (cit.) of 16 March 2023 and 2 March 2023.

it could be granted in limited cases to given categories of individuals (such as those with insufficient tax liabilities or elderly) or for interventions on common parts of condominiums (in order to facilitate reaching the decision, made more difficult by coordination problems). Moreover, it should be subject to strict anti-avoidance rules and the disposal should be allowed in favor of supervised entities (banking, insurance) only. As an alternative to transferability, a direct cash transfer could be used in such cases[62], always coupled with a monitoring system of the actual progresses of planned works.

Another form of incentive could be to facilitate the access to credit market for financing EE works (i.e. energy efficiency mortgages or green mortgages), through the recognition of tax reliefs or public guarantees. In particular, these schemes could be useful in cases of investments that require high spending, for those who do not have a completely impaired creditworthiness. Compared with more traditional policies the advantage is that there is still an incentive for the investor for the expected savings to actually materialize, and that there is an assessment of the profitability of the investment by an intermediary specialized in this type of analysis, which is, in turn, also interested in the repayment of the loan. In the case of the guarantee (that should be only partial in order to preserve the abovementioned incentives for monitoring) public resources could be used using the logic of the revolving fund: as the guaranteed loans are repaid, new loans can be guaranteed using the public resources initially allocated.

As noted above (para. 2.5), many jurisdictions adopt a multi-tool approach (subsidies, tax incentives, soft loans). On the other hand, Italy is characterized by a strong preference for the tax incentive instrument. This may be due to a variety of factors, such as the greater political appeal of tax incentives over expenditure increases, and the lack of a means-testing indicator in the past, as well as the inadequacy of the administrative system. In recent years, Italy has adopted too a reliable tool for assessing family economic conditions (ISEE) and there has been an improvement in digital administrative procedures. This could allow to gradually introduce, alongside tax reliefs, some forms of selective subsidies, as is the case in other countries. Policy interventions could therefore consist of a balanced mix of instruments tailored to the characteristics of the different target groups.

3) Measure of incentive. As regards the measure of the incentive, participation to the cost of the intervention by the beneficiary is always necessary to avoid moral hazard problems. In general, the generosity of the benefit should be modulated to balance several issues; in particular, the measure could be enhanced in relation to the expected energy performance improvement resulting from the intervention, its cost (which is relevant for the severity of liquidity constraints) and the recipients' characteristics (primarily the economic condition).

4) Fiscal impacts. An issue that deserves particular attention concerns fiscal impacts. Should the public resources for promoting the energy efficiency be increased compared to those before the Superbonus adoption, the high public debt and the strict constraints on the budget (European rules, scrutiny of financial markets) require appropriate and reliable coverage to be identified so as to neutralize, as far as possible, the impact on public budget. Among the cover measures, priority consideration should be given

[62] The provision in Decree Law 212/2023, seems going in this direction, granting a contribution to individuals with household incomes lower than EUR 15.000 who incur expenditure for Superbonus works in condominium buildings by October 2024.

to expenditure cuts (primarily environmentally harmful ones,[63] in line with the European "Do Not Significant Harm" principle)[64]and the introduction of a carbon pricing system, in addition to the EU-ETS, affecting the consumption of fossil fuels or other environmentally harmful processes[65].

5) Certainty and stability. A desirable feature of the policies that drives behaviour is the (perceived) stability of the benefits over a time horizon proportionate to the type and size of the investment. Therefore, an adequate certainty has to be ensured to investors. The stability and certainty of the incentive over time depends in turn on the cost: only financially sustainable instruments can credibly be of permanent.

3.3 Possible role of banks.

Banks could contribute to the transition to a sustainable economy through the provision of green mortgages. For this type of loans, however, financial institutions face a number of difficulties that may limit their ability to offer products on competitive terms (Ranieri et al. 2022). The main issue relates to the lack of information on the energy performance of buildings[66], which could lead to higher administrative costs associated with energy efficiency certification for both banks and borrowers. In the Italian case, the difficulties associated with a lack of data could be overcome by involving a multitude of actors (such as manufacturers, investors, residents, financial companies and public entities that help to estimate the efficiency of the building) and there are institutional initiatives in this regard[67]. In addition, statistical methodologies could be used to estimate variables of interest on the basis of a limited set of dwellings for which they are available (e.g. public datasets referring to buildings with similar characteristics in terms of geographical area, quality and year of construction). In some cases, these methodologies also make it possible to estimate the evolution of energy performance over time, thus allowing the monitoring of housing energy costs and the quantification of the benefits of EE in terms of energy savings. Some companies already offer such solutions. In addition to the use of external data, banks could collect detailed data on green loans granted, compiling pre-defined and homogeneous templates (including characteristics of the property, contract and borrower, as well as mortgage-related costs and energy savings). These surveys could feed into a dataset including green mortgage disbursements (para. 2.4). Information on housing EE is also requested by larger banks for disclosure

[63] Some of these are not classified from an accounting point of view as expenditure in the strict sense, but nevertheless fall within the category of 'tax expenditure'.

[64] Do No Significant Harm (DNSH) states that the interventions provided for in the national NRRPs do not cause any significant damage to the environment: compliance with this principle is key to accessing Recovery and Resilience Facility funding.

[65] As recalled in para. 2.5, since the choice of form of payment of the benefit affects the way in which the burden is accounted for in the public budget (cash vs accrual) – and therefore has a different impact on the deficit-, these issues must also be taken into account properly when designing the incentive.

[66] This difficulty is further exacerbated in Italy, unlike other jurisdictions such as United Kingdom, France and Spain, due to the lack of access to administrative information already available at ENEA SIAPE, creating a competitive disadvantage for the Italian financial system.

[67] The MEF's Sustainable Finance Table, in which the Bank of Italy participates, along with other authorities, is involved in developing a proposal for solutions aimed, inter alia, at reducing the sustainable data gap (Lavecchia et al., 2022), including through greater accessibility to public databases such as SIAPE and SII, in accordance with the applicable rules on privacy (where applicable).

purposes under Pillar 3[68] and could also be used for the valuation of real estate collateral for loans granted by banks.

More information on energy savings (and therefore on the additional disposable income for households) and the value of collateral could facilitate the differentiation of the rates offered by banks on green mortgages, with benefits for final consumers. Such information would allow banks to integrate energy efficiency information into the credit granting process for an adjustment of product *pricing* and a proper assessment of the counterparty's creditworthiness. As more and more customers take into account the sustainability orientation of suppliers in their choices, banks offering green products could more easily expand their market share. Finally, the development of the green bond market on the one hand and the green mortgage market on the other would create a virtuous circle for *the green economy* with reputational benefits for banks.

3.4 Innovative arrangements involving joint public and private sector involvement.

Innovative financial instruments, such as on-bill debit schemes, are interesting because they attract private capital into the industry and could help stimulate demand. However, these initiatives are currently limited to projects and the development of robust, innovative business models would be needed to support their implementation (Bianco et al., 2022).

BOX 8. ISSUES ON THE MACROECONOMIC EFFECTIVENESS

In the Bank of Italy's quarterly model, which is based on aggregated relationships that do not involve the heterogeneity of agents, the transmission channels and the macroeconomic effects of a public measure aimed at stimulating investment in EE – such as a tax credit or alternatively a subsidy – are in principle, and for the same amount of resources, equivalent. Assuming that there is no private cost sharing and that the resources will finance unplanned investments only, inasmuch as they reach the same target group, the effects of both types of measures are similar to those typical of a reduction in the cost of capital, characterized by a fiscal multiplier that is gradually increasing over time and slightly above unity.

From the point of view of macroeconomic effectiveness, in discriminating between different measures, it is therefore important to assess other factors relating to: (I) how the impulse is transmitted over time, (ii) how much public measures crowd out private resources, and (iii) how the distributional implications are reflected in the overall effectiveness of the intervention. The following considerations highlight some characteristics that can increase the effectiveness of public intervention in terms of its effects on output, limiting its net cost and thus its impact on public finances.

From a temporal perspective, an incentive for private investment in the form of a tax credit, which typically has a pre-defined validity period, affects the choices of agents, determining the anticipation of decisions over time, in a less predictable way than other measures, such as subsidies. Moreover, absent a ceiling on the availability of public resources, a measure, whose benefit can be enjoyed in a limited period of time, may in principle lead to a greater crowding-out of private resources than other forms of intervention, whose time profile and total amount of resources can be determined a priori. This suggests that the expected effects of a fiscal stimulus may be characterized by a strong non-linearity, both in the impulse and in the ensuing 'technical rebound'.

[68] See template 2, EBA ITS ESG P3.

In determining the macroeconomic effects, the crowding-out of private resources is a key issue: if the measure – whether it be an incentive or a subsidy – intervenes to finance investments that have already been planned, it effectively becomes akin to a transfer to households. This is because – all other things equal in terms of investment decision – it frees up private funds that can then be used for alternative purposes. In this case, however, it would be associated to a significantly lower multiplier, which, according to the regularities shown in the Banca d'Italia's econometric model, reaches 0.5 three years after the impulse, less than half of what would be if the funds were entirely directed to a 'new' investment. The average multiplier of the measure therefore depends on the percentage, which is difficult to identify in advance, of resources that finance already planned investment plans [69].

An intervention basically akin to a transfer of resources produces stronger macroeconomic results the higher the propensity to consume associated with the recipients; all other things equal, this is more typical when the measure benefits low-income and liquidity-constrained households. In the context of distributional considerations, it is more likely that public resources crowd-out public investments, when they are directed towards households that are relatively richer and less credit-constrained, as they are already in a position to develop an autonomous decision to invest in energy retrofitting. In other words, the measure may be more easily 'additional' – i.e. capable to finance 'new' investments – if it benefits relatively low-income households, for which the capital to be used for efficiency investment is absent and/or inaccessible. In these circumstances, facilitating access to credit, including by providing for the sale of tax benefits, could be decisive for the actual realization of the desired investment.

4. Conclusions

The European standards on housing EE being approved could have a significant impact on Italy's housing stock, which is characterised by a significant presence of housing with poor energy performance characteristics. This work illustrates the regulatory framework, the characteristics of housing and residents, the economic literature on the costs and benefits of EE investments, and the role of the public sector, financial intermediaries and the private sector. Some considerations for the design of interventions aimed at increasing investments in EE are proposed. In the current situation, a critical issue relates to the scarcity of data on energy efficiency of housing, energy consumption and past incentive measures. Greater availability of this information would favour transparency and market developments (e.g. action by banks and the private sector for EE investments). This could also contribute to the provision of advice (e.g. on savings related to electricity consumption, emissions, investment financing arrangements) such as those granted in other countries through the *one-stop-shops*. It could be useful for companies providing energy services to show the savings that would be achieved after investing in EE (e.g. by indicating average consumption of similar dwellings by housing and household characteristics in bills, belonging to better performing energy classes).

[69] Based on the elasticities of the econometric model, if this percentage exceeds 80%, then the average multiplier associated with the measure is lower than that of a monetary transfer to the poorest households.

As regards tax policies, five issues are relevant:

1) The **selection of beneficiaries and buildings to be incentivized** should **be designed so as to channel resources mainly toward neediest households** (e.g. identified on the basis of the ISEE indicator) and, other conditions being equal, **on less energy-efficient houses,** provided that they are occupied for most of the time. In the case of **privately rented dwellings**, consideration could be given to granting enhanced tax incentives (e.g. reduced rent taxation for owners) conditional on the achievement of certain levels of EE, or to allow the rental subject to minimum energy standards (as in other countries), providing in any case for tax reliefs. For **public residential housing**, the cost of investment could be fully or largely borne directly by public owners through a state fund co-financing retrofitting measures, including design expenses.
2) As for **policy instruments,** as is the case in other countries, **a more balanced *mix* of tools could be used,** taking into account the **characteristics of the different target groups**: deductions and tax credits (currently prevalent in Italy) could be accompanied by direct subsidies and support to credit access.
3) The measure of the incentive should always entail a participation to the **cost by the beneficiary** in order to limit moral hazard risks and be **modulated** in relation to the expected **energy savings**, the cost of the intervention and the **income and wealth condition** of the recipients.
4) With regard to **public finance,** if resources are to be increased in the future compared with the situation prior to Superbonus, **proper and certain financing coverage** should be identified**.** This could result, for example, from selected **cuts to environmentally harmful subsidies** and from the introduction of a **carbon pricing system** complementary to the EU-ETS.
5) Finally, it would be necessary to provide **adequate stability and certainty of the incentive.**

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6. Appendix

Table 1. The tax reliefs in force in Italy (updated to 31.12.2023)

Facilitation	Date interval	Maximum limit	Target and range	Subsidised works/purchases
"Ecobonus" (Article 14 of the DL. 63/2013): personal income tax or corporate income tax deduction over 10 years: - Interventions on single units: **65% or 50%**[80] - Interventions on condominiums: **65%, 70%-75%**[81]**, 80%-85%**[82] Invoice discount or **transferable tax credit** until 17/2/2023.	Until 2024[83]	Maximum deduction of EUR 100,000 (with sub-caps for some works)[84]. For interventions on buildings at 70-75%, maximum eligible expenditure: EUR 40,000 x n. of units of the building. For interventions on condominiums at 80-85%, maximum eligible expenditure: EUR 136,000 x n. of units of the building	All dwellings (not only main dwellings), single units or condominiums[85]. Recipients: individuals, firms and companies owning or holding the property (including tenants).	— reducing energy needs for heating; — thermal improvement of the building (insulations, coverings, floors, windows); — installation of solar panels for the production of hot water for domestic or industrial purposes; — replacement of winter air conditioning systems with condensing boilers and development of the distribution system, with high-efficiency heat pumps or low- enthalpy geothermal systems; — replacement of traditional water heaters by pump boilers dedicated to the production of hot water; — purchase and installation of solar screens; — purchase and installation of winter air conditioning systems with heat biomass fuelled generators; — purchase, installation and implementation of multi-media devices for remote control of heating or hot water production and air conditioning systems; — purchase and installation of micro co-generators in place of existing systems;

[80] The 50% deduction is due on the purchase and setting up of:
– windows;
– solar screens;
– winter air conditioning systems with heat generators powered by biomass fuels;
– replacement of winter air conditioning systems with boilers with efficiency at least equal to Class A or with heat generators powered by biomass fuels (the deduction, however, is more than 65% if boilers, in addition to being at least in class A, also have advanced thermal regulation systems).

[81] The works must concern the building envelope with an impact of more than 25% of the gross dispersant surface; the benefit increases to 75% if the interventions improve the winter and summer energy performance and reach at least the average quality referred to in the Ministerial Decree for Economic Development of 26 June 2015.

[82] The rates of 80%-85% apply to measures aimed at jointly reducing seismic risk: 80% if they lead to a lower risk class, 85% to two lower risk classes.

[83] In the absence of extensions, since 2025, measures aimed at achieving energy savings will be incentivized at the standard rate of 36% provided for renovation and refurbishment works.

[84] The maximum deduction is EUR 60,000 for works on envelopes, walls, windows, roofs and floors, installation of solar panels for the production of hot water and solar screens; EUR 30,000 to replace traditional water heaters with heat pumps ones, winter air conditioning systems with heat pumps ones and with heat generators powered by biomass fuels.

[85] Requirements: APE certification from a qualified technician (not required for operations such as the replacement of windows, installation of solar panels, replacement of winter air conditioning systems, etc.) and a descriptive sheet containing the annual energy savings achieved by the intervention.

				— replacement of winter air conditioning systemswith hybrid ones (heat pumps integrated with condensation boilers); — purchase and installation of condensing warm air heaters.
"Superbonus" (Article 119 of the DL. 34/2020) IRPEF deduction[86] over 4 years. Interventions on condominiums or on buildings with 2 to 4 units (one or more households)[87]: 90% until 2023[88], 70% until 2024, 65% until 2025. Interventions on single real estate units (e.g. single-family	Until 2025	For thermal insulation of surfaces: • EUR 50,000 for single-family buildings and independent units[91] in multi-family buildings; • EUR 40,000 x n. of units, for buildings with 2 to 8 units; • EUR 30,000 x n. of building units, for buildings with more than 8 units. To replace the air conditioning system:	Residential properties: common parts of condominiums, single-family buildings or functionally independent units within multi-family buildings.[92] Recipients: individuals owning or holding the property (including tenants)[93].	**"Towing interventions"[94]:** — Thermal insulation of vertical, horizontal and sloped opaque surfaces on buildings, accounting for more than 25% of the gross dispersing surface. — replacement of existing winter air conditioning by centralized heating, cooling or hot water systems with efficiency at least equal to class A, heat pumps (including hybrid or geothermal systems), or micro- cogenerators or solar collectors. **"Towed interventions":** Other energy efficiency interventions (see Ecobonus)[95], photovoltaic solar and accumulation systems[96], infrastructures

[86] IRES entities are among the beneficiaries of Superbonus only in the event of participation in the costs of "towing" measures carried out on the common parts of condominiums.

[87] For each individual, the concession is granted on a maximum of two units, in addition to that on common parts of buildings.

[88] The rate remains at 110% for the condominiums with works resolutions approved before 18 November 2022 and building permit (CILAS) submitted by 31 December 2022, or approvals adopted between 18 and 24 November 2022 and CILAS submitted by 25 November 2022; buildings composed of two to four units with CILAS submitted by 25 November 2022.

[91] The unit must be "functionally independent", i.e. it must have at least three of the following facilities: water supply; gas; electricity; winter air conditioning. In addition, it must have one or more independent external accesses.

[92] Necessary, *inter alia*: pre- and post-intervention APE, *ex-ante* analysis and feasibility study, data and transmittance certificates of replaced doors and windows, certification of new ones, data and certificates on new curtains, technical data sheets relating to materials purchased.

[93] IRES entities are among the beneficiaries of Superbonus only in the event of participation in the costs of "towing" measures carried out on the common parts of condominiums.

[94] Superbonus also included anti-seismic measures; the reconstruction of dwellings in areas affected by seismic events benefits from the rate of 110% until 2025.

[95] The "towed" interventions can also be carried out on individual units within condominium. In the case of buildings subject to at least one of the constraints set by the cultural goods and landscape Code, or if structural interventions are prohibited under building, planning and environmental regulations, 110% applies to all energy retrofitting measures provided for by the Ecobonus, even if they are not carried out with "towing" works, subject to the condition that such interventions lead to a minimum improvement of two energy classes or to the achievement of the highest energy class.

[96] For these measures, interventions to reduce seismic risk are also considered to be as "towing". The benefit is granted up to a total amount of expenditure not exceeding EUR 48,000 and, in any case, within the limit of expenditure of EUR 2,400 for each kW of nominal power per solar photovoltaic system and EUR 1,000 for each kWh of capacity for accumulation systems. The deduction is subject to the supply to the energy service management entity (GSE) of the non-self-consumed energy, and cannot be combined with other public incentives or other forms of grants provided for by European, national and regional legislation.

detached houses made up of one unit) or carried out by the public houses associations (IACP): 90% until 2023[89]; for detached houses, limited to homeowners, per main residence and with reference income < EUR 15,000[90].		• EUR 30,000 for single-family buildings or independent units within multi-family buildings; • EUR 20,000 x n. building units, for buildings of up to 8 units; • EUR 15,000 x n. of units, for buildings with more than 8 units.		for recharging electric vehicles[97] and removal of architectural barriers when carried out with one of the 'towing' interventions. All the "towing" measures must lead to an improvement of at least two energy classes[98].
IRPEF deduction of 50% of VAT paid (Budget Law 2023)	Until 2023	No restriction	Residential properties in A and B energy class (not only main dwellings)[99]. Recipients: individuals only (not entrepreneurs).	Purchase of real estate units intended for residential purposes in energy class A or B from collective investment entities (OICR) or construction companies.

[89] The rate of 110% is confirmed for 2023 for: expenditure incurred by 31 December 2023 by individuals on single units if at least 30% of the total intervention has been carried out as of 30 September 2022 (including also works non-incentivized with Superbonus); expenditure by 31 December 2023 by IACP and housing cooperatives carrying out at least 60% of the work as of 30 June 2023.

[90] The reference income is calculated by dividing the household income by an equivalence scale based on household composition.

[97] Up to EUR 2,000 for single-family buildings or independent units in multi-family buildings; EUR 1,500 for multi-family buildings or condominiums installing a maximum of 8 charging infrastructures; EUR 1,200 for multi-family buildings or condominiums that install more than 8 infrastructures.

[98] To this end, the towed interventions of photovoltaic and accumulation systems are also considered.

[99] Necessary proof of energy performance (APE).

Table 2. Provisions on the credit transfers (updated to 31.12.2023)

Provision	Scope of transferees	Number of possible disposals	Notes
Decree Law 34/2020 (so called DL "Rilancio")	All	Unlimited	
Decree Law 157/2021 (so-called DL "Anti-Frode") then repealed but absorbed by the 2022 Budget Law	All	Unlimited	The measure operated 'upstream', extending the compliance and certification requirements, introducing a price list, strengthening the *ex-ante* controls by the tax administration and requiring entities subject to anti-money laundering law not to purchase loans in cases of suspicious transaction .
Decree Law 4/2022 (the so-called DL "Sostegni-ter")	All	Only one (by the beneficiary or the firm that granted the invoice discount)	Transitional rule for previous credits: possibility of a further (last) disposal to anyone
Decree Law 13/2022 subsequently repealed by the Law converting DL 4/2022 which absorbed its provisions	Banks, financial intermediaries (Art. 106 of the TUB[100]), companies belonging to a banking group, insurance companies	Two additional disposals possible after the first one (i.e. the one made by the beneficiary or the company that granted the invoice discount)	A ban on the disposal of splitted credits was introduced.
Decree Law 17/2022 (the so-called DL "Bollette")	Banks, financial intermediaries (Art. 106 of the TUB),, companies belonging to a banking group, insurance companies + their current account holders	Introduction of the possibility of a fourth and final sale to current bank customers	

[100] TUB stands for "*Testo Unico Bancario*", i.e. Consolidated Banking Act.

Decree Law 50/2022 (so-called DL "Aiuti") first version	Banks, financial intermediaries (Art. 106 of the TUB),, companies belonging to a banking group, insurance companies and their current account holders (private professional customers referred to in Art. 6(2)-quinquies, TUF[101])	Four (three + the first one made by the beneficiary or the firm which granted the invoice discount). However, when the sale to the current accountant occurs, no further disposals can be made.	The provision introduced by the DL "Bollette" was amended, stipulating that the sale by banks to their customers may take place even before the fourth sale and, at the same time, limiting the scope of customers to private professional account holders only.
Decree Law 50/2022 (so-called DL "Aiuti") final version	Banks, financial intermediaries (Art. 106 of the TUB),, companies belonging to a banking group, insurance companies + their current account holders (customers with a VAT number, i.e. customers other than consumers or users, as defined in Article 3 of the Consumer Code)	As above	The provision applies to credits notified to tax administration from 1 May 2022 (see Art. 57(3) of Decree-Law n. 50/2022).
Law converting Decree Law 73/2022 (the so-called DL "Semplificazioni")	As above	As above	It allows to transfer the credits notified to tax administration before 1 May 2022 to current account holders with a VAT number.

[101] TUF stands for "*Testo Unico della Finanza*", i.e. Consolidated Law on Finance.

Law converting Decree Law 115/2022 (the so-called DL "Aiuti-bis")	As above	As above	It relaxes conditions for responsibility of the purchaser with reference to transfers arising after November 2021..
Decree Law 176/2022 (the so-called DL "Aiuti-quarter")	As above	As above	Transferees can smooth the purchased unused credits (not reported to the tax administration by 31.10.22) over 10 years (annual fees of equal amount), instead of the original instalment. The option applies only to the interventions incentivized at 110% .
Law converting Decree Law 176/2022 (the so-called DL "Aiuti-quarter")	As above	Five (four more than the first one made by the beneficiary or the firm that granted the invoice discount). However, when the sale to the current accountant occurs, the latter is always the last one, and no further supplies can be made.	Increase the number of sales possible within the supervised entities from two to three. This also applies to disposals notified to the tax administration before the entry into force of the conversion law.

DL 11/2023	None	None	Since 17 February 2023 the building interventions no longer give rise to credit but only to deductions over some years, since the option of invoice discount and of transforming the tax deduction into a transferable credit are no longer available. Under certain conditions, the measures already in place on the date of entry into force of the decree are not affected. It also provides for a set of documents having which intentional and serious misconduct is excluded for the transferee in any event.
Law 38/2023 converting Decree Law 11/2023	Pre-DL 11/2023 rules are maintained for some interventions (e.g. removal of architectural barriers, works on properties damaged by seismic events, on social houses or by non-profit organizations). Introduced the possibility for financial intermediaries and insurance companies to convert 10% of unused credits in a given year into ten-year BTPs from 2028 onwards, provided that in that year the transferee had exhausted its tax capacity. In addition, for Superbonus, Sismabonus and architectural barriers bonus , the unused tax credits resulting from sales or invoice discount notifications sent to the tax administration by 31 March 2023 can be deployed in 10 equal annual instalments, instead of the original instalments(similarly, it has been provided for the possibility for Superbonus beneficiaries to smooth the deduction in 10 years, starting with the 2024 tax return for the 2023 period, in relation to the expenditure incurred in 2022).		

Table 3. Tax incentives for energy efficiency in major countries (updated to 31 December 2023)

Country	Facilitation	Limit of eligible expenditure	Target	Subsidised works/purchases
France	'*Crédit d'impôt pour la transition énergétique*'. Abolished in 2021. Until 2019: deduction of 30%-15%of costs. In 2020: amount determined on a flat-rate basis for each intervention up to a maximum of 75% of the expenditure.	Until 2019: expenditure limits specific to each type of intervention. Maximum eligible expenditure: EUR 8,000 for single person, EUR 16,000 for couple, increase of EUR 400fordependant. In 2020: ceilings of eligible expenditures reduced to EUR 2,400 for individual person, EUR 4,800 for couples , increase of EUR 120 for dependant.	Main dwelling. Owners, tenants and occupiers free of charge. In 2020 limited to low-income taxpayers.	Energy-saving heating systems, energy production equipment, thermal insulation.
Germany	From 2020 to 2029. Deduction of 40% of expenditure over 3 years (7% in the first 2 years and 6% in the third).	Ceiling of eligible expenditure EUR 40,000 (up to EUR 14.,000 in the first two years, up to EUR 12,000 in the third year)	Owner-occupied dwellings (excluding rented dwellings). Buildings older than 10 years.	Thermal insulation, replacement or renewal of heating and ventilation systems, installation of new doors and windows, installation of digital systems to optimize energy consumption.
United States	"*Energy Efficient Home Improvement Credit*" From 2023 to 2032 Deduction of 30% of expenditure	Annual maximum of $1,200 ($500 for doors, $600 windows and $150 for energy certifications, $2,000 forstoves and biomass boilers).	Owner-occupiers for main residence.	External doors, windows, skylights and insulating materials, stoves and boilers. Centralized conditioners, water heaters, ovens, boilers and heat pumps. Biomass stoves and boilers. Energy certification and consultancy
	"*Residential Clean Energy Credit*" Tax credit: 2022-2032: 30% 2033: 26% of expenditure2034: 22%	No maximum expenditure limits (except fuel cells)	Owners on all dwellings.	Solar, wind and geothermal energy systems Solar water heaters Fuel cells Battery storage (from 2023 onwards)

Sources: IBFD; laws and institutional sites of the countries.

France: https://www.ecologie.gouv.fr/credit-dimpot-transition-energetique-cite; https://www.economie.gouv.fr/particuliers/credit-impot-transition-energetique-cite;
Germany: https://www.bundesregierung.de/breg-en/issues/climate-action/klimaschutzprogramm-2030-1674080; United States: https://www.irs.gov/credits-deductions/energy-efficient-home-improvement-credit; https://www.irs.gov/credits-deductions/residential-clean-energy-credit.

Table 4. Characteristics of some innovative financial instruments

Type of financing	Description	Projects/Applications	Advantages/disadvantages
On-bill finance schemes	Loan for energy efficiency works that are repaid on the energy bill. The financing for the initial cost of the works is provided by either the utility (onbill financing) or a third party while the company providing the energy is an intermediary for payment (on-bill repayment). The loan can be paid by the owner (on-bill loan) or be attached to the property meter (on-bill tariff). In order to be an attractive scheme, the bill including financing should not exceed the previous renewal works. This should be achieved through the energy savings generated by the works.	Those programmes are deployed in the US and were applied in 2013 in UK, where it was closed due to the application of uncompetitive interest rates. The EU conduced a experimentation in the period 2018-21 with the REN-on_bill programme (funded by Horizon 2020) which also involved Italy (BluEnergy with a programme for codomini e Universities and University of Genova for evaluation tool).	(+) Useful for blocks or rented houses to overcome liquidity problems or split-incentives (cost can be divided with the tenant). It facilitates the attraction of investments into a "package" of customers. (−) Impact on utility financing. Complexity for the utility business model. Energy evaluation is difficult.
Property assessment clean energy (PACE)	Loan for energy efficiency works with a repayment model on property taxation and secured by the property. Payments are collected by the local government, which directs them to the financiers, thus engaging in a public-private partnership. This mechanism facilitates the raising of long-term private financing. Energy service providers are used as sellers to stimulate demand for renewal.	Programmes implemented in the United States since 2007. EU experimentation in 2018-21 with the EuroPACE programme (funded by Horizon 2020) carried out in Spain.	(+) Overcomes liquidity problems thanks to the monthly payment; overcomes solvency problems thanks to the guarantee on the property; it allows for the combination of technical assistance and other fiscal benefits/benefits. (−) It works only if it is compatible with property taxation. Specific legislation is needed to justify collection with taxation and to deal with non-payments. Involve the government in the collection without increasing the issuance of debt.
Energy efficiency mortgages	Loans to finance efficiency works. The advantage for the owner is to overcome the initial liquidity problem and finance the payment of the instalment with the savings bill. Financial institutions can benefit from demand for green loan-backed securities.	In the EU since 2016, the Energy Efficient Mortgage Initiative (EEMI) has been launched, comprising three projects funded by Horizon 2020 Projects and coordinated by the European mortgage Federation-European covered bond council (EMF-ECBC): Energy efficient Mortgages Action Plan (EeMAP), Energy efficient Data Protocol and Portal (EeDaPP), Energy efficient Mortgage	(+) Reduce the initial payment; attracting investment. (−) Expensive mortgages for small projects. Lack of specific regulation.

		Market Implementation Plan (EeMMIP). The Energy Efficient Mortgage (EEM) Label was launched in 2021, with the support of the European Commission. This initiative should support transparency for consumers, lenders and investors.	
Crowdfunding	Private crowdfunding initiatives to finance efficiency projects.	There are some platforms with projects also in Italy.	(+) Catalysing investments. (−) Risks due to lack of regulation.
Energy efficiency feed-in tariffs	This concept is similar to the concept of mandatory energy efficiency schemes. Whereas the latter set the amount of savings to be achieved, the tariff incentive mechanisms set the price associated with a unit of savings leaving the market fixed the quantity of such savings.	There are no concrete applications.	(+) Incentives for efficiency similar to that to stimulate energy production from alternative sources. (−) It does not ensure the level of attainment. Complexity of measuring savings and pricing