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Tax Policies for Housing Energy Efficiency in Italy: A Risk Analysis Model for Energy Service Companies

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Abstract: The Superbonus is an Italian tax relief policy aimed at encouraging residential buildings' energy and seismic efficiency. Only the energy part of the legislation is analyzed here. The tax deductions of the Superbonus exceed the nominal value of the project, making the interventions convenient even for economically disadvantaged citizens and small construction companies. However, the measure has only found wide diffusion in single-family housing, while it proceeds more slowly for multi-family buildings, where procedural complexities greatly amplify the risk of the financial failure of projects. The purpose of the paper is to analyze how urban planning and technical and administrative problems affect the Return on Investment (ROI) when the Superbonus is applied to multi-unit buildings. Therefore, a financial risk analysis is conducted from the perspective of an ordinary Energy Service Company (ESCo), which assumes the burden of carrying out energy efficiency measures. The property considered has all the requirements of an ordinary multi-family building for which the Superbonus is generally used. The works considered are also those carried out most frequently. The study shows that only three out of five energy interventions are financially sustainable. This result is in line with the data provided by the Italian Revenue Agency.

Keywords: Superbonus 110%; energy efficiency; eco-sustainable construction; fiscal detraction; tax credit; risk analysis; economic evaluation of project

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1. Introduction

In 2015, the United Nations (UN) approved 17 Sustainable Development Goals (SDGs) grouped in the well-known Agenda 2030 [1]. This article addresses issues related to the "Affordable and clean energy" objective (SDG7), and the actions taken by Italy to achieve the targets set in international agreements [2].

The Commission Recommendation (EU) 2019/1658 of 25 September 2019 introduced the possibility for the Member States of the European Union to implement incentive policies for the renovation of buildings thanks to subsidies and subsidized credits in favor of families and small-medium enterprises for the achievement of the EU objectives of reducing energy consumption and polluting emissions. In December 2019, Italy merged these indications into the Integrated National Plan for Energy and Climate—PNIEC [3]. The country is called upon to make investments to reduce final energy consumption by at least 0.8% per year in the period of 2021–2030. Construction is the main sector involved in energy efficiency interventions. The PNIEC assigns the civil sector a target of reducing energy consumption by approximately 5.7 Mtoe (million tons of oil equivalent) compared to the BASIC scenario by 2030. Interventions in the residential sector must guarantee cumulative savings equal to 3.3 Mtoe.

To pursue these objectives, Italy makes use of various support tools for the promotion of interventions to increase energy efficiency, such as White Certificates, the Thermal Account, the National Fund for Energy Efficiency, and tax deductions for energy efficiency interventions.

This article analyzes the latter case, describing an intervention financed through private investments and public contributions in terms of tax deductions and tax credits.

Among the measures cited, the 110% tax deductions (the so-called Superbonus) for interventions aimed at energy saving and the prevention of seismic risk on buildings took on particular importance. The scope of these incentives is to trigger an extensive process of urban regeneration and efficiency of the existing building heritage [4,5]. This heritage is largely outdated and unsuitable for ensuring energy saving and environmental protection objectives as well as the safety of tenants.

The incentive is configured as an integration of the previous Ecobonus and Sismabonus, which brings the value of the tax deduction to 110% of the real cost of the intervention to incentivize the recovery of the sector after the structural crisis that started in 2008 and the most recent one due to the COVID-2019 pandemic. Similar legislative interventions are reported in many European countries such as France and Germany.

The Superbonus mechanism, although a very challenging incentive, had limited application in the first semester of validity (June–December 2020). One of the reasons was the ever-changing legislative landscape and the numerous changes made by the control bodies. Another critical aspect is linked to the timing of the issue of urban planning permits and cadastral checks, which condition the possibility of enjoying the incentives. Today, this deadlock could be partially overcome by the introduction of specific urban planning authorizations for the Superbonus (called CILAS), but the tool is still very controversial and debated regarding its concrete applicability.

Overall, private individuals, companies, and other operators involved in real projects have expressed various concerns related to recurring problems of an urban planning, technical, and administrative nature that characterize the process in question. The extent of these critical issues is investigated in this work to reconcile their impact on the effectiveness of the provision.

The analytical purpose of the paper is to analyze to what extent the urban planning, technical, and administrative problems typical of the Superbonus can condition the Return on Investment (ROI) when the tool is used to carry out energy retrofit interventions on multi-unit buildings. Therefore, a financial risk analysis is conducted from the perspective of an ordinary energy service company (ESCo), which assumes the responsibility of providing all the technical, commercial, and financial services necessary to carry out energy efficiency interventions. It is assumed that these interventions will be carried out on a property that meets all the requirements of the type of multi-family building for which the Superbonus mechanism is generally used. Specifically, the building was selected from a set of thirty projects of which the authors of this paper carried out financial consultancy work for the executing companies. Even the works taken into consideration are those most frequently encountered in the projects analyzed by the study group.

The work represents one of the first attempts to integrate a risk analysis with economic and financial assessments of the Superbonus.

The document is structured as follows: Section 2 analyzes the state of the art on subsidy policies for energy efficiency interventions in residential buildings both internationally and in Italy; Section 3 describes the methodological approach adopted in detail; in Section 4, the results are presented and discussed; finally, in Section 5, the main conclusions and policy implications are reported.

2. State of Art

2.1. Analysis of Tax Relief Policies in the International Arena

In many European countries (France, Germany, Belgium, Denmark, the Netherlands, and Greece), tax incentive policies for the energy renovation of buildings have been used in recent years [6]. The most common form of relief is the tax credit, whereby a percentage of the investment cost can be used to offset taxes. France and Germany have used tax credits to promote housing energy efficiency. Another tool used in Europe to encourage energy efficiency in residential construction is the adoption of a subsidized VAT rate for the purchase of high-energy-performance equipment and systems. However, in particular cases, some measures may instead discourage owners from carrying out interventions aimed at reducing the energy consumption of their homes. For example, in Sweden, the property tax is higher for properties with excellent energy performance. On the other hand, in the Czech Republic, there is tax relief for 5 years for owners who replace the heating system of their home. Similarly, in Bulgaria, a temporary exemption from property tax is foreseen for high-energy performance buildings [7]. In Spain, grants and loans were primarily used to encourage the renovation of existing buildings, while fiscal policy did not significantly contribute to the energy efficiency of the construction sector [8]. Outside the European context, tax credits for residential energy efficiency have already been used in the USA for several years, but they have generated many problems of social inequity [9].

Instead, the African continent is characterized by the lack of reliable and accurate energy data essential to policy makers to apply adequate sustainable energy policy.

In Asia, various policies aimed at the energy transition have recently been implemented in various sectors, including the residential one. However, these policies (agreements, laws, financing and tax incentives, etc.) are highly fragmented and insufficiently regulated [10,11].

There are several studies aimed at evaluating the effectiveness of the tax policies adopted by various countries. Some authors have concluded that tax breaks can incentivize energy efficiency in residential buildings [12–16]. Other authors, on the other hand, underline the ineffectiveness of fiscal incentive policies [8,17,18]. However, most of the literature studies focus on the ability of tax policy to encourage homeowners to make their homes more efficient from an energy perspective. On the other hand, studies aimed at evaluating the financial effectiveness of the tax relief policy for governments, property owners, and executing companies are rare. In this sense, among the few examples is the work of Brown, D. et al. (2019). However, the study focuses more on funding policies than on tax breaks [19]. In addition, there are a few examples of the application of financial risk analysis and assessment approaches in energy redevelopment interventions carried out through tax incentive policies (tax deduction and/or tax credit). Among these rare examples is the work of Yeganeh et al. (2021), which, based on statistical regression analysis, energy simulation, and simulated risk analysis, demonstrates that in the US, the net present value of investments in affordable and zero-energy housing can be positive with low risk [20]. With this study, we try to further fill this gap in the literature, proposing a case study set in Italy.

2.2. Analysis of Tax Relief Policies in Italy

The first form of tax relief established in Italy to promote energy efficiency interventions in buildings is the Ecobonus, originally introduced by Law no. 296. These are tax deductions from 50% to 75% of the expenses incurred recognized for those subjects who have carried out energy efficiency works on existing buildings. The bonus was and still is paid in the form of a reduction in taxes due in ten annual installments of the same amount.

Art. 119 of the "Relaunch" Decree-Law, converted into Law no. 77, changed the scope of the Ecobonus and the Sismabonus (an instrument similar to the Ecobonus but aimed at securing buildings from seismic risk) by raising the deduction to 110% [5]. For energy interventions, the 110% deduction rate applies if they are carried out in conjunction with one of the following interventions (so-called "leading works"):

- Thermal insulation interventions of opaque surfaces affecting the building envelope with an incidence greater than 25% of the gross dispersing surface of the same or of the real estate unit located within multi-family buildings that is functionally independent. The relative deduction is calculated on the following expense amounts: (i) Up to 50,000 euros for single-family buildings or real estate units located within multi-family but functionally independent buildings; (ii) up to 40,000 euros multiplied by the number of real estate units that make up the building for those properties consisting of two to eight units; (iii) up to € 30,000 multiplied by the number of real estate units that make up the building for properties consisting of more than eight units.

- The replacement of existing winter air conditioning systems with centralized systems for heating, cooling, or for the supply of domestic hot water, condensing, with efficiency equal to at least class A. The deduction is calculated on the following expense amounts: (i) Up to 30,000 euros for single-family buildings; (ii) up to 20,000 euros multiplied by the number of real estate units for buildings consisting of up to eight units; (iii) up to 15,000 euros multiplied by the number of real estate units for buildings consisting of more than eight units.

Together with the "leading works", there is further work defined as "additional works", which, if carried out together with one of the previous three, would fall within the scope of the 110% super bonus. They are as follows:

- Energy efficiency interventions pursuant to art. 14, D.L. 63/2013.
- Interventions aimed at eliminating architectural barriers (a spending limit of 96,000 euros).
- Interventions for the installation of photovoltaic systems and integrated storage systems (a spending limit of 48,000 euros for each of the two categories of intervention).
- Installation of infrastructures for recharging electric vehicles in buildings (a variable spending limit depending on the number of real estate units and calculated in echelons).
- Interventions on buildings subject to cultural and landscape constraints if one of the leading works listed above is not possible.

Table 1 shows a summary of the interventions envisaged by the Superbonus legislation.

Table 1. Summary of the interventions admitted to the Superbonus, the related spending limits, and the deductible percentages (parameters relating to the 2020–2022 period).

Leading Works	**Building Type**	**Spending Limits [EUR]**	**Deductions [%]**
Thermal insulation of vertical, horizontal and oblique opaque surfaces with an incidence of more than 25% of the gross dispersing surface	Single-family buildings Buildings from 2 to 8 units Buildings with more than 8 units	50,000 40,000 30,000	110
Replacement of existing winter air conditioning systems with centralized heat pump condensing systems, hybrid or geothermal systems (autonomous systems for multi-family buildings are excluded)	Single-family buildings Buildings from 2 to 8 units Buildings with more than 8 units	30,000 20,000 15,000	110
Additional works	**Number of real estate units**	**Spending limits [EUR]**	**Deductions [%]**
Replacement of fixtures	For each unit	54,545	50 *
Solar screens	For each unit	54,545	50 *
Heating systems common parts: condensing boiler, biomass, PDC water heater	For each unit	27,272	50 *−65 *
Autonomous heating systems (private): condensing boiler, biomass, PDC, PDC water heaters, hybrid systems	For each unit	27,272	50 *−65 *
Microgenerators	For each unit	110,000	65 *
Biomass	For each unit	27,272	65 *
Building automation	For each unit	-	65 *
Solar heating system	For each unit	27,272	65 *
Photovoltaic system	For each unit and max 2400 €/kW peak (max 1600 €/kW peak in case of renovation)	48,000	50 *
Storage for photovoltaics	For each unit and max 1000 €/kW peak	48,000	50 *
Installation of infrastructure for charging electric vehicles	-	3000	50 *

* Deduction that rises to 110% if the intervention is carried out in conjunction with one of the driving interventions.

To access the deduction, the joint interventions must involve the improvement of at least two energy classes (or, where not possible, the achievement of the highest class).

As regards the methods of accessing tax benefits, the following three possibilities are envisaged:

- Tax deduction: This is the option that allows owners to take advantage of the bonus directly if they have the tax capacity. It allows them to take full advantage of the entire amount of the deductions, without reductions in favor of third parties.

- Discount on the invoice: With the discount, the taxpayer benefits from the tax credit by reducing the amount of the invoice to be paid to the supplier. The discount can be up to 100% of the amount to be paid, so the 10% surcharge on the discounted part is up to the company carrying out the work.
- Assignment of credit: The taxpayer pays the invoice to the supplier, but then transforms the deduction into credit by transferring it to a third party, for example, to a bank [5].
- Since property owners are unlikely to have sufficient tax capacity, they usually decide to opt for the discount on the invoice or the assignment of credit, diverting a large part of the financial risk to the company carrying out the interventions. For example, as regards the projects analyzed for the following study, only the invoice discount mechanism was used.

For the interventions for which it is possible to access the credit transfer or the discount on the invoice, it is possible to proceed by Work Progress Status (SAL), so as not to have to wait for the end of the work to be able to monetize the tax credit. Each SAL must refer to at least 30% of the same intervention, as established by art. 121 of the Decree-Law 34/2020.

2.3. Superbonus Criticality

Three types of critical issues characterizing the Superbonus policy are generally identified [21,22]. All the actors involved (owners, design firms, contractors, accountants, general contractors, and credit institutions), albeit to varying degrees, are subject to recurring criticalities that can be classified in the following three ways:

- Urban planning critical issues: To benefit from the building bonus, the buildings must be regular concerning state regulations and the local building and urban planning regulations. The lack of regularity leads to the loss of the tax benefit and, in the case of a practice already initiated and subsequently controlled by the Revenue Agency, severe penalties and blocking of the construction site are envisaged. It is mandatory to present a building permit for all the work that has been conducted over the years since the property was built. Furthermore, it is necessary to verify that the floor plan presented at the land registry conforms to what has been created and what has been authorized. What allows one to verify the presence or absence of building abuse is the building permit deposited in the Municipality of reference. Today, with the introduction of the new CILAS model (Superbonus Certified Work Commencement Notice), this risk appears to have been mitigated but cannot be completely excluded.
- Technical critical issues: This situation occurs if the design requirements are not respected and the costs incurred are not considered adequate. A certification issued by an engineer, an architect, a surveyor (limited to some minor interventions), or other energy certifiers (such as the technicians called to issue the Energy Performance Certificates, necessary before and after the interventions) is required to be sent electronically to ENEA (National Agency for New Technologies, Energy, and Sustainable Economic Development). The certification is necessary to demonstrate the improvement of at least two energy classes or, if this is not possible, the achievement of the higher one.
- Administrative critical issues: Problems related to errors attributable to the persons in charge of issuing the compliance certificate necessary for the assignment of the tax credit or the discount on the invoice. The compliance visa required for the Superbonus is defined as light because the professional who affixes it is not required to enter into the merits of the documents presented, but simply to carry out a formal check on them. The compliance certificate can only be issued by professionals authorized to electronically transmit the tax return (accountants, commercial experts, or labor consultants). They must verify that the applicant has the requisites to be able to benefit from the concession, the property is among the types admitted to the benefit, the interventions are among those admitted, the amounts of the works are within the spending limits, and the technicians have issued the necessary certifications and stipulated the insurance policy required by law. Failure to meet the compliance

requirements precludes the right to deduct even if the subsequent regularization is carried out. In the event of an unfaithful visa, the technician who issued it is punished with an administrative fine ranging from 258 to 2582 euros. In the event of serious or repeated violations, there is also the suspension of the right to issue a visa for a period of 1 to 3 years.

These three criticalities can only be mitigated if one is willing to implement a series of precautionary and protective measures. Measures often have a considerable cost, so the three criticalities can influence the risk of the financial failure of the project. In general, urban planning, technical, and administrative criticalities are mitigated through insurance policies. Alternatively, these critical issues are absorbed by commissioning the verification of the project to high-level professional firms or scientific institutions such as universities. Another way to limit the three critical issues is to purchase the advice of international groups expert in the field (H&D, Ernest & Young, etc.) that perform the function of the General Contractor. Therefore, a good measure of the level of the three criticalities could be represented by the cost of the precautionary and protective actions necessary to mitigate them. When you opt for the invoice discount mechanism, generally the cost of mitigating the recurring criticalities is charged to the company carrying out the interventions (which most often is an Energy Service Company—ESCo). Therefore, in this work, the total cost of the insurance policy, professional consultancy, and the General Contractor is used as a proxy for all the critical issues of an urban planning, technical, and administrative nature found for the project. Starting from the projects analyzed, the probability distribution of this cost was defined, identifying the maximum value, the minimum value, and the most frequent value. The probability of financial failure of the project selected as representative was then estimated as the overall cost of the precautionary and protective measures varies (sensitive variable of the problem). The probability of financial failure is expressed considering the Return on Investment (ROI) as a performance index of the project. Regarding the reasons that led to choosing the ROI as a metric used for risk analysis, we will return to Section 3.5.

The following section defines the logical path followed in detail to analyze the financial performance and the level of risk of the investment.

3. Methods and Application

The methodological approach can be summarized in the operational phases shown in the flowchart in Figure 1.

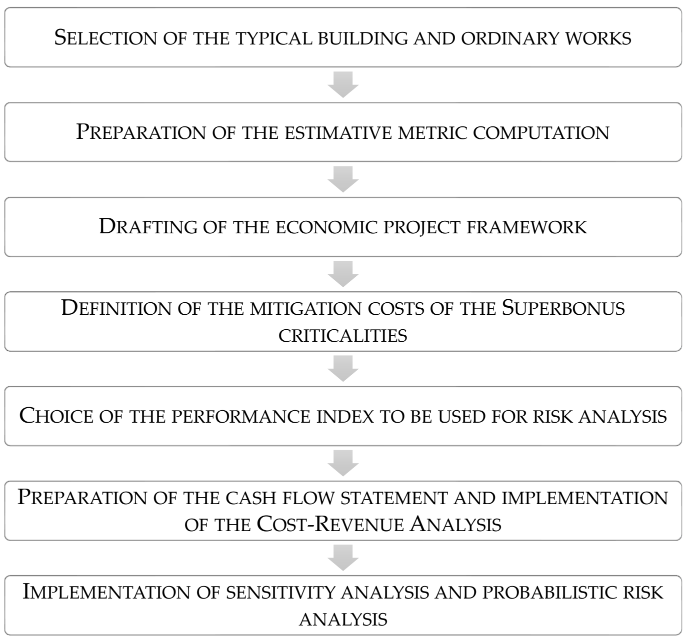

Figure 1. Flowchart of the methodological approach.

3.1. Selection of the Typical Building and Ordinary Works

As anticipated, in this work, we intend to evaluate the convenience that an ordinary Energy Services Company (ESCo) has in carrying out energy retrofit interventions on a structure that possesses all the requirements of the multi-family type building for which one generally uses the Superbonus mechanism. The building was selected from a set of thirty projects, concerning which the authors of this paper have carried out financial consultancy work for the executing companies. Even the works that are supposed to be carried out are those most frequently encountered in the thirty projects analyzed. The representative building was identified based on the data collected in Appendix A (Table A1). First of all, multi-family buildings with the most recurrent characteristics were identified (buildings in Table A1 indicated with the numbers 3, 4, 8, 11, 12, 18, 19, 20, 23, 26, and 29 and highlighted in bold). These buildings total 11 compared to 30 overall. Among these, building 12 was then selected, which presents all the identified characteristics of medium size (or is, in any case, close to the average value). In particular, the residential building selected is of the multi-level type (8 floors in total, 1 of which is underground) and consists of 22 real estate units. The building, built after 1960, is completely isolated from the other adjacent properties and has a framed structure in reinforced concrete without structural joints. It has a regular plan, and the average floor area is 250 m^2. The cover is a heavy non-pushing type.

Similarly, the most recurring works were identified in the event of recourse to the Superbonus (see Table A2 in Appendix B). In the first instance, only the works present in at least half of the projects were considered. Secondly, those projects selected present these works at the same time (projects indicated with numbers 3, 6, 12, 14, 20, 22, 26, 27, 29, and 30 and highlighted in bold in Table A2). The processes considered are therefore the following:

- Insulation of opaque vertical and horizontal structures (leading works).
- Replacement of private and condominium fixtures (additional works).
- Installation of solar shading (additional works).
- Installation of a photovoltaic solar system with a relative storage system serving the common parts (additional works).
- Replacement of boilers for private use (additional works).

3.2. Estimative Metric Computation

The estimative metric computation is the main document that allows the ex ante monetary quantification of the works to be carried out [23–25]. In the case of the Superbonus, according to the Decree of the Ministry of Economic Development of 6 August 2020, a technician must certify that the technical requirements of the intervention comply with those established by the law and the appropriateness of the expenses incurred [26]. At point 13 of Annex A of the aforementioned decree, it is established that it is the responsibility of the technician to assert that the costs by type of intervention are lower than or equal to the average costs of the works carried out as indicated in the Regional or Autonomous Provinces price lists or the guides on the informative prices of the building published by the DEI (Civil Engineering Authority's Typography). If these price lists do not include the items relating to the interventions, it is possible to determine the new prices analytically. Furthermore, Annex I always establishes the cases in which the asseveration of the technician can be replaced by a declaration from the supplier or installer (an example is the simple replacement of the fixtures). If the costs incurred are greater than the maximum costs indicated by the law about one or more types of intervention, the deduction is applied within the maximum limits identified by the decree [27].

For the case study, the costs for each category and macro-category of processing, as shown in Table 2, were estimated by averaging the costs deriving from the estimated metric calculations of the projects listed in Appendix A (Table A1) and Appendix B (Table A2) whose identification number is marked with an asterisk (projects 2, 12, 20, 26, and 29). These projects refer both to buildings with the most recurring characteristics and to the most frequently performed works when using the Superbonus. In addition, for all five selected projects, the building's energy efficiency improvements are as follows:

- Realization of insulation with an EPS thermal coat on all external walls of the building.
- Realization of insulation with a thermal coat in EPS of the horizontal surfaces of the terraces and of the overhangs (balconies and cornices).
- Replacement of all fixtures, including the windows and doors of the stairwell and excluding those pertaining to non-residential premises (garages, boxes, and terraces) with new PVC fixtures and double glazing.
- Replacement of the boxes and the roller shutter system of the windows with thermal break elements.
- Construction of a 6 kW single-phase photovoltaic system with the storage system.

It is found that, for each category and macro-category of processing, the average amounts shown in Table 2 are very close to those estimated for building 12 during the drafting of the preliminary project. For this reason, building 12 can represent, in all respects, the typical property to be taken into consideration for this study.

Resolution No. 60/E of 2020 of the Revenue Agency clarifies the maximum spending limits and the maximum deductible amount for each category of processing [28]. Specifically, those calculated for the case study are shown in Table 3.

Table 2. Works categories and macro-categories.

Categories Summary	Amount [EUR]	Macro-Category Summary	Interested Parties	Amount [EUR]
Plasters Insulations Waterproofing Paintings Landfill charges	46,922.84 238,108.33 18,133.72 32,560.92 3090.00	Building envelope thermal insulation interventions	Condominium	338,815.81
Sills-Thresholds Private Fixtures Condominium fixtures	44,617.76 198,527.20 15,279.10	Energy efficiency interventions—Fixtures	Privates and condominium	258,424.06
Roller shutters	27,702.37	Energy efficiency interventions—Solar screens	Privates	27,702.37
Photovoltaic Storage for photovoltaics	19,104.60 10,946.10	Photovoltaic system installation	Condominium	30,050.70
Boilers and valves	49,227.63	Energy efficiency interventions—Autonomous boilers and radiator valves	Privates	49,227.63
Safety	49,295.44	Security charges	Condominium	49,295.44
Total	753,516.01	Total		753,516.01

Table 3. Spending limits and maximum deductible amount per processing macro-category.

Macro-Category	Spending Limits (100%) [EUR]	Maximum Deductible Amount (110%) [EUR]
Building envelope thermal insulation interventions	600,000	660,000
Energy efficiency interventions—Fixtures	1,200,000	1,320,000
Energy efficiency interventions—Solar screens	1,200,000	1,320,000
Photovoltaic system installation	20,400	22,440
Energy efficiency interventions—Autonomous boilers and radiator valves	600,000	660,000
Total	3,620,400	3,982,440

In the next sub-section, the expense items of the estimative metric computation converge in the economic project framework together with other cost items.

3.3. Economic Project Framework

Starting from the estimative metric computation, it was possible to draw up the economic framework of the project (Table 4). The first row of Table 3 shows the costs for each category of processing including the portion of the safety costs of them. In the second line, the amounts of each category were increased by the portion of technical expenses and overheads directly attributable to the work, as well as VAT and other taxes [29]. The third row shows the maximum deductible amounts (defined in Table 2). The fourth line shows the nominal amounts of the 110% tax credit (including VAT) to be effectively transferred to the ESCo. From the last line, it is possible to read the amounts to be paid by private individuals more than the maximum deductible amount. Specifically, only a portion relating to the installation of the photovoltaic system and the storage system is borne by the tenants.

An important aspect to underline is that the fees paid for the service rendered by the General Contractor, by way of organizational expenses and coordination of the activities entrusted to him for the realization of the works, do not fall among the costs admitted to the Superbonus 110%. The same applies to all other expenses not strictly related to the execution of works, such as those relating to professional consultancy. The exclusion of these charges from the Superbonus is justified by the fact that these are costs not strictly related to the interventions admitted to the tax benefit [30,31]. Therefore, a large part of the costs necessary to mitigate the criticalities of an urban planning, technical, and administrative nature are not subject to any concessions. These costs are therefore borne by the ESCo.

Table 4. Summary of the economic project framework, cost allocation scheme between the ESCo and private individuals, and a statement of the amounts subject to tax deduction within the maximum spending limits.

Categories	Building Envelope (Leading Work)	Fixtures (Additional Work)	Photovoltaic System (Additional Work)	Solar Screens (Additional Work)	Autonomous Boilers (Additional Work)	Total
Amount of work including safety charges [EUR]	348,674.90	268,283.15	39,909.79	37,561.46	59,086.72	753,516.01
Amount of work including technical, general and other expenses [EUR]	482,635.79	371,357.53	55,243.13	51,992.57	81,787.84	1,043,016.86
Maximum deductible amount [EUR]	660,000.00	1,320,000.00	22,440.00	1,320,000.00	660,000.00	3,982,440.00
The nominal amount of tax credit at 110% [EUR]	530,899.37	408,493.29	22,440.00	57,191.83	89,966.62	1,108,991.11
Amount of work to be carried out by private individuals [EUR]	0	0	34,843.13	0	0	34,843.13

3.4. Definition of the Mitigation Costs of the Superbonus Criticalities

As mentioned, in the first instance, one objective of the paper is to measure the critical issues of urban planning, technical, and administrative nature typical of the Superbonus to assess their impact on the project ROI. It is possible to use the cost that the ESCo must incur to mitigate them as a proxy for these three critical issues. To define these costs, two project datasets were analyzed. The first dataset refers to the 30 projects already mentioned (the characteristics of which are shown in Tables A1 and A2), i.e., those carried out on multi-family buildings. The projects of the first dataset are divided into two subgroups: The first subgroup consists of the 10 projects started before the introduction of CILAS (whose model was published on 4 August 2021, on the portal of the Ministry of Public Administration), while the second subgroup it is made up of the remaining 20 projects started following the introduction of CILAS. Similar to that explained in Section 3.1, a second dataset is collected. It is constructed considering properties that are small in size (single-family and semi-detached properties). In particular, 15 properties with similar characteristics in terms of square footage, number of floors, and type of structure are selected.

Starting from the three groups of projects identified (composed of 10, 20, and 15 projects) it was possible for each project to determine the mitigation costs of the critical elements in terms of the ratio of the total amount of energy efficiency works. Table 5 shows how the percentage costs of urban, technical, and administrative criticalities have been quantified compared to the 15 projects carried out on small buildings. The first column shows the identification number of each project. The second column shows the total amount of work for each project. The third, fourth, and fifth columns show the costs of the mitigation of urban, technical, and administrative criticalities, respectively. The sixth column shows the total cost of mitigating the three critical issues. The latter includes the costs of consulting experts in the field and, in the case of more complex projects, the costs for insurance policies, any audits commissioned to scientific institutions, and the services offered by the General Contractor. The total cost of mitigating the criticalities has been a reliable figure from the moment it was deduced from the economic frameworks of the project. The specific costs of each critical issue are less certain. The latter has been defined by sharing, on the basis of the limited information available, the total cost of mitigating the criticalities in the three categories (urban criticality, technical criticality, and administrative criticality). The main difficulty lies in the fact that the three critical issues are strongly interconnected, so the distribution of costs can only take place in a purely indicative way. In the seventh, eighth, ninth, and tenth columns, the costs of urban, technical, administrative, and total criticalities, respectively, were expressed as a percentage of the total amount of the work. It makes sense to express these costs as a percentage of the total amount of work as it is in these terms that they are generally agreed upon when negotiating with professional consultants, contractors, and insurance companies. The last column shows the frequency with which a certain total cost of mitigation of criticalities is found within the dataset, expressed as a percentage of the total amount of work.

Table 5. Definition of the percentage costs of urban, technical, and administrative criticalities as a percentage of the amount of the works for the 15 projects carried out on small buildings (single-family and two-family).

Building	Amount of Work [EUR]	Cost of Mitigation of Urban Planning Criticalities [EUR]	Cost of Mitigation of Technical Criticalities [EUR]	Cost of Mitigation of Administrative Criticalities [EUR]	Total Cost of Mitigating Issues [EUR]	Cost of Mitigation of Urban Planning Criticalities [%] *	Cost of Mitigation of Technical Criticalities [%] *	Cost of Mitigation of Administrative Criticalities [%] *	Total Cost of Mitigating Issues [%] *	Frequency
1	89,332	0	0	0	0	0.0	0.0	0.0	0.0	5
2	100,232	0	0	0	0	0.0	0.0	0.0	0.0	5
3	115,344	0	0	0	0	0.0	0.0	0.0	0.0	5
4	154,900	0	0	0	0	0.0	0.0	0.0	0.0	5
5	164,239	0	0	0	0	0.0	0.0	0.0	0.0	5
6	132,432	530	400	390	1320	0.4	0.3	0.3	1.0	3
7	111,998	450	350	300	1100	0.4	0.3	0.3	1.0	3
8	125,431	500	380	370	1250	0.4	0.3	0.3	1.0	3
9	212,987	1700	1300	1250	4250	0.8	0.6	0.6	2.0	4
10	103,232	830	600	620	2050	0.8	0.6	0.6	2.0	4
11	134,233	1100	800	850	2750	0.8	0.6	0.6	2.0	4
12	189,343	1500	1150	1200	3850	0.8	0.6	0.6	2.0	4
13	91,323	1100	850	800	2750	1.2	0.9	0.9	3.0	2
14	122,875	1500	1100	1080	3680	1.2	0.9	0.9	3.0	2
15	300,212	4900	3550	3490	11,940	1.6	1.2	1.2	4.0	1
Mean value	143,208	941	699	690	2329	0.6	0.4	0.4	1.4	-

* Percentages expressed as a ratio of the costs of urban, technical, administrative, and total criticalities on the amount of the work.

Similarly, Table 6 shows how the percentage costs of urban, technical, and administrative criticalities have been quantified compared to the 10 projects carried out on multi-family buildings that started before the introduction of CILAS.

Table 6. Definition of the percentage costs of urban, technical, and administrative criticalities as a percentage of the amount of the works for the 10 projects carried out on multi-family buildings started before the introduction of CILAS.

Building	Amount of Work [EUR]	Cost of Mitigation of Urban Planning Criticalities [EUR]	Cost of Mitigation of Technical Criticalities [EUR]	Cost of Mitigation of Administrative Criticalities [EUR]	Total Cost of mitigating Issues [EUR]	Cost of Mitigation of Urban Planning Criticalities [%] *	Cost of Mitigation of Technical Criticalities [%] *	Cost of Mitigation of Administrative Criticalities [%] *	Total Cost of Mitigating Issues [%] *	Frequency
1	613,378	18,500	36,500	36,800	92,007	3.0	6.0	6.0	15.0	4
2	1,294,732	38,850	77,700	77,400	194,210	3.0	6.0	6.0	15.0	4
3	1,019,349	30,500	61,000	61,200	152,902	3.0	6.0	6.0	15.0	4
4	978,430	29,000	59,000	58,700	146,765	3.0	6.0	6.0	15.0	4
5	1,019,483	23,000	45,700	45,500	114,692	2.3	4.5	4.5	11.3	3
6	897,540	20,250	40,400	40,200	100,973	2.3	4.5	4.5	11.3	3
7	1,320,199	30,000	60,000	58,000	148,522	2.3	4.5	4.4	11.3	3
8	765,030	11,500	23,000	22,800	57,377	1.5	3.0	3.0	7.5	2
9	1,422,987	21,350	42,600	42,000	106,724	1.5	3.0	3.0	7.5	2
10	1,259,087	9500	18,900	19,350	47,216	0.8	1.5	1.5	3.8	1
Mean value	1,059,022	23,245	46,480	46,195	116,139	2.3	4.5	4.5	11.3	-

* Percentages expressed as a ratio of the costs of urban, technical, administrative, and total criticalities on the amount of the work.

Table 7 shows how the percentage costs of urban, technical, and administrative criticalities have been quantified compared to the 20 projects carried out on multi-family buildings following the introduction of CILAS.

Starting from the last two columns of Tables 5–7, it was possible to construct the graphs shown in Figure 2 where, for each of the three groups of projects, it is possible to read the frequency with which a specific total cost of mitigation of criticalities expressed as a percentage of the amount of work occurs.

Table 7. Definition of the percentage costs of urban, technical, and administrative criticalities as a percentage of the amount of the works for the 21 projects carried out on multi-family buildings following the introduction of CILAS.

Building	Amount of Work [EUR]	Cost of Mitigation of Urban Planning Criticalities [EUR]	Cost of Mitigation of Technical Criticalities [EUR]	Cost of Mitigation of Administrative Criticali-Ties [EUR]	Total Cost of Mitigating Issues [EUR]	Cost of Mitigation of Urban Planning Criticalities [%] *	Cost of Mitigation of Technical Criticalities [%] *	Cost of Mitigation of Adminis-Trative Criticalities [%] *	Total Cost of Mitigating Issues [%]*	Frequency
1	111,998	448	336	333	1117	0.4	0.3	0.3	1.0	5
2	132,432	530	400	380	1310	0.4	0.3	0.3	1.0	5
3	122,875	1500	1100	1110	3710	1.2	0.9	0.9	3.0	3
4	212,987	860	650	630	2140	0.4	0.3	0.3	1.0	5
5	243,924	1000	750	800	2550	0.4	0.3	0.3	1.0	5
6	105,540	1700	1300	1250	4250	1.6	1.2	1.2	4.0	2
7	95,430	1900	1440	1400	4740	2.0	1.5	1.5	5.0	1
8	125,431	500	400	370	1270	0.4	0.3	0.3	1.0	5
9	134,233	1100	800	850	2750	0.8	0.6	0.6	2.0	4
10	189,343	1500	1150	1100	3750	0.8	0.6	0.6	2.0	4
11	89,332	0	0	0	0	0.0	0.0	0.0	0.0	6
12	312,987	2500	1900	1800	6200	0.8	0.6	0.6	2.0	4
13	100,232	0	0	0	0	0.0	0.0	0.0	0.0	6
14	121,433	0	0	0	0	0.0	0.0	0.0	0.0	6
15	91,323	1100	820	850	2770	1.2	0.9	0.9	3.0	3
16	115,344	0	0	0	0	0.0	0.0	0.0	0.0	6
17	103,232	850	620	610	2080	0.8	0.6	0.6	2.0	4
18	143,546	1750	1300	1250	4300	1.2	0.9	0.9	3.0	3
19	154,900	0	0	0	0	0.0	0.0	0.0	0.0	6
20	300,212	4900	3500	3700	12,100	1.6	1.2	1.2	4.0	2
21	164,239	0	0	0	0	0.0	0.0	0.0	0.0	6
Mean value	150,999	1107	823	822	2752	0.7	0.5	0.5	1.8	-

* Percentages expressed as a ratio of the costs of urban, technical, administrative, and total criticalities on the amount of the work.

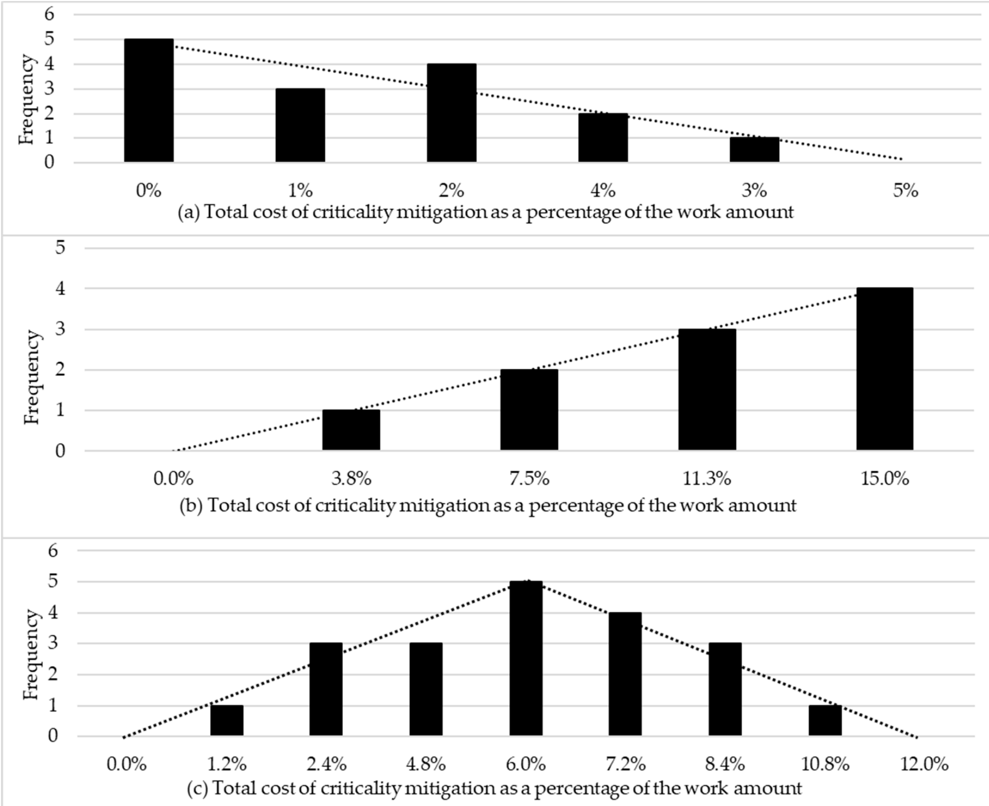

Figure 2. Graphs that relate the total cost of mitigating the criticality of the Superbonus expressed as a percentage of the amount of work and the frequency with which they occur for each project of the three datasets: (**a**) Dataset consisting of 15 projects carried out on small buildings (single-family and two-family); (**b**) dataset consisting of 10 projects carried out on multi-family buildings started before the introduction of CILAS; (**c**) dataset composed of 21 projects carried out on multi-family buildings following the introduction of CILAS.

Subsequently, again starting with the data in Tables 5–7, for the three groups of projects, it was possible to identify the percentages of the minimum, maximum, and most recurring costs for each critical component to be mitigated (see Table 8).

Table 8. Minimum, maximum, and more frequent costs of mitigation of urban planning, technical, and administrative criticalities, as a percentage of the cost of the efficiency intervention, in the case of small buildings (single-family and two-family), multi-family buildings whose projects started before the introduction of CILAS, and multi-family buildings whose projects started after the introduction of CILAS.

Type of Building	Type of Cost	Mitigation Cost of Urban Planning Criticalities [%]	Mitigation Cost of Technical Criticalities [%]	Mitigation Cost of Administrative Criticalities [%]	Total Mitigation Cost of Criticalities [%]
Single-family and duplex	Minimum	0.0	0.0	0.0	0.0
	Most frequent	0.0	0.0	0.0	0.0
	Maximum	2.0	1.5	1.5	5.0
Multi-family pre-CILAS	Minimum	0.0	0.0	0.0	0.0
	Most frequent	3.0	6.0	6.0	15.0
	Maximum	3.0	6.0	6.0	15.0
Multi-family post-CILAS	Minimum	0.0	0.0	0.0	0.0
	Most frequent	0.5	2.8	2.7	6.0
	Maximum	1.0	5.5	5.5	12.0

Starting with the data in Table 8 and the graphs in Figure 2, it was possible to construct the probability distributions of the total costs necessary to mitigate the criticalities of the Superbonus (see Figure 3).

From Figure 3 it can be seen that the probability distribution functions can be assumed to be triangular. In particular, for small-sized buildings (single-family or two-family), the overall cost of mitigating critical issues varies between 0% and 5% of the cost of the efficiency intervention, with the most probable value corresponding to 0% (distribution of rectangular triangular probability). When moving to multi-family buildings, the criticalities increase and, consequently, the costs to mitigate them. The insurance coverage is increased, the technical-accounting control is entrusted to specialized companies, and the administrative control becomes much more complex. Before the introduction of CILAS, the probability distribution function could have been of the rectangular triangular type with the total cost of risk mitigation varying between 0% and 15% of the cost of the efficiency intervention and the most probable value equal to 15%. Following the simplification of the effects of possible building abuse, the function can be assumed as an isosceles triangular between 0% and 12%, with the most probable value of 6%. The reduction in the absolute value of the impact of costs to contain the risk is also connected to the multiple clarifications made on the interpretation of the rules and the greater familiarity that designers and managers have acquired on the subject in the time that has passed since the Superbonus started.

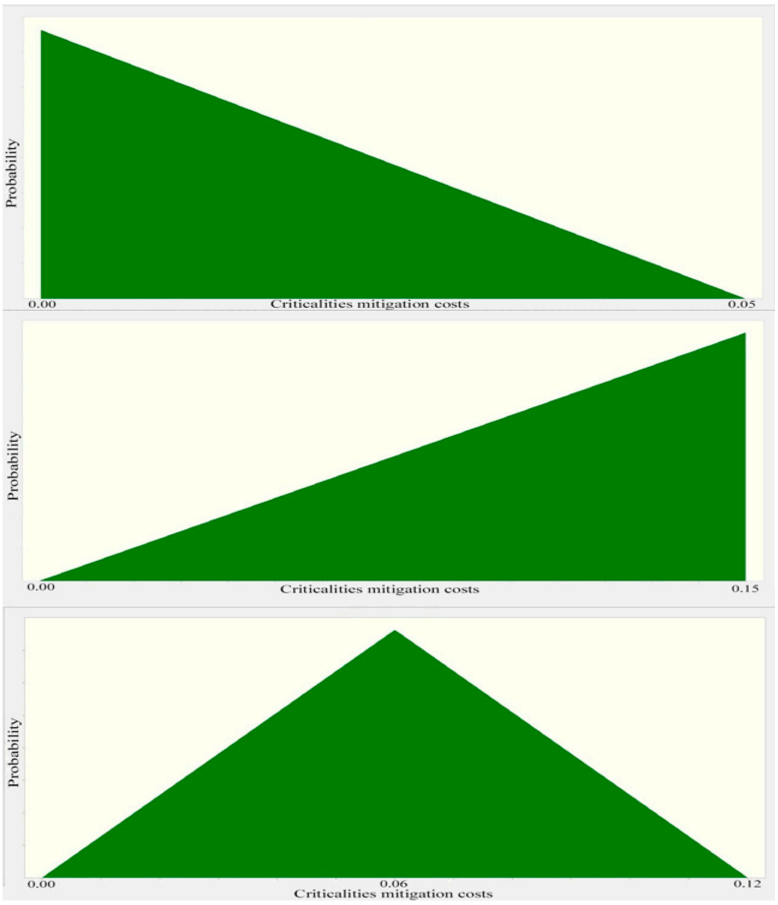

Figure 3. Probability distribution of the cost of mitigating the criticalities of the Superbonus in the case of small residential properties (top image), multi-family buildings renovated before the introduction of CILAS (central image), and multi-family buildings renovated after the introduction of CILAS (bottom image).

3.5. Choice of the Performance Index to Be Used for Risk Analysis

We decided to use ROI (Return on Investment) as a metric for the assessment of a project's financial risk and no other metrics (Net Profit, NPV, IRR, Payback Period, etc.) for several reasons. First of all, it is necessary to explain why we decided not to resort to net profit or NPV (Net Present Value). Recall that the net profit is the set of earnings that a company obtains from its activity and is the value that is reported in the statutory financial statements. It makes it possible to estimate the profitability of an enterprise in a given year. Net profit does not correspond to cash flow, as it is the difference between total revenue and operating costs, regardless of actual receipts or payments (net profit may imply some deferrals in receipts/payments). Conversely, cash flow consists of all the actual cash flow of a firm over a given period, i.e., the difference between the total cash inflows and outflows. The Net Present Value (NPV) corresponds to the sum of a series of expected cash flows discounted on the basis of an appropriate discount rate. Profit is an indicator of the profitability (the difference between revenues and costs) of the company's activity calculated on an annual basis. The NPV, on the other hand, represents an indicator of the financial sustainability of the company (difference between discounted income and expenditure) that considers the entire duration of the project [32]. Both the net profit and NPV can vary significantly depending on the project analyzed. Typically, both increase as the size of the project increases. In the present case, risk analysis shall be carried out against a representative project selected from a set of projects of varying sizes. For this reason, we decided to use a synthetic index that is less influenced by the size of the project as an evaluation metric, so as to be able to extend it to energy retrofit interventions that are not perfectly homogeneous. Secondly, it is necessary to explain why ROI has been preferred to other indices such as ROE (Return on Equity) and IRR (Internal Rate of Return). ROI allows one to define the operating income of an investment compared to the total capital invested (equity and debt capital), unlike ROE, which measures the ability of equity invested in a project to generate profit, the latter is considered the net of interest and taxes [33]. ROI was preferred because this index offers indications of the percentage gain obtained compared to the total capital invested. In the projects analyzed, the equity capital advanced by the ESCo represents only a small part of the total invested capital. As far as the TIR is concerned, it represents the value of the discount rate that renders the NPV null and void. This index is used to understand whether an investment or project will produce a percentage return higher than the unit cost of capital invested. Similar to ROI, it also allows one to compare different projects of varying sizes and choose the most profitable one [32]. However, the TIR, similar to the NPV, becomes important when the project under analysis has a duration of several years. In the case in question, only the construction phase is being analyzed, whose duration assumed on the basis of similar interventions carried out is approximately one year. For this reason, we decided to use ROI as a financial risk assessment metric for the ESCo, as this index, in forecasting analysis, is generally estimated on an annual basis. Nevertheless, net profit, NPV, HGV, and ROE were still estimated in order to obtain detailed information on the project ordinarily carried out.

Finally, it should be remembered that the proposed analysis is financial (not economic) as it is conducted from the point of view of the ESCo and not from that of the owners of the apartments subject to renovation. The goal of ESCo is the simple maximization of profits. For this reason, non-monetary factors were not taken into account in the analysis. The benefits that are not easily monetized (improved thermal comfort, reduction of environmental emissions, etc.) are instead fundamental if we intend to evaluate the effectiveness of the energy retrofit project for property owners or for society. Nevertheless, the analysis carried out here can also offer relevant information for the owners and all other actors involved in the operation. For example, a high probability of financial failure of the project for the ESCo could depend on the high costs of mitigating administrative, technical, and urban planning criticalities. In general, these costs increase when the probability that the aforementioned criticalities will occur, or incur irregularities of various kinds, is perceived as high. Please note that a lack of regularity can lead to the loss of the tax benefit. Thus, the high probability of financial failure for the enterprise can lead to the total compromise of the project, to the detriment of all actors involved (property owners, technicians, general contractors, etc.).

3.6. Cash Flow Statement and Cost-Revenue Analysis

Once the costs of the intervention and the total deductible amount were defined, it was possible to draw up the financial statement of the project from the perspective of an ordinary ESCo. For the projects analyzed, the ESCos dealt with both the design service and the supply and installation service of the energy requalification interventions. In addition, to reduce administrative risks, the companies, being of medium size, decided to resort to General Contractors who took care of the coordination activities (non-deductible accessories and insurance services). Having established the portion of the works subject to deduction and that which directly affects the private individuals, it was possible to define the structure of the economic project frameworks and cash flow statements [34]. In the cases in question, taxpayers have resorted to the discount on the invoice, transferring the tax credit to the ESCos. Consequently, the ESCos advanced the deductible expense to the client, in turn transferring the tax credit accrued at each State of Work Progress (SAL) to banks. The revenues for the ESCos are therefore represented by the tax credit net of the bank cost of assigning the credit. To cover part of the amounts paid in advance in the period between the start date of the works and the achievement of the first SAL, the ESCos resorted to a bridging loan or a temporary loan granted by the bank until the tax credit accrual [35]. A similar inter was therefore also hypothesized for the representative project taken as a reference for the present study. The discount rate to be used for discounting project cash flows was estimated using the Weighted Average Cost of Capital (WACC) method:

$$r = WACC = \frac{E}{E+D} r_E + \frac{D}{E+D} r_D (1-t), \quad (1)$$

where E represents the equity, D is the debt, r_D is the interest rate of the bridge loan, r_E is the expected return on equity estimated through the Capital Asset Pricing Model (CAPM), and t is the marginal tax rate [32,36,37]. The parameters needed to estimate rE have been extrapolated from the Damoradan database (2021) [38]. After obtaining r by (1), the quarterly discount rate was then estimated using the following equation:

$$\bar{r} = (1+r)^{1/3} - 1. \quad (2)$$

In cash flow discounting, the rate $\bar{r}$ was used because the total duration of the works was set at one year (the most frequent duration of the works of the projects analyzed). In addition, each Work Progress Report (SAL), at which the process for the payment of the company is started, takes place approximately every four months. From (1) and (2) we obtain r = 5.07% and $\bar{r}$ = 1.66%, respectively.

Table 9 shows the financial statement built according to the principles that ESCo would have had to apply if it had been a small building. The cost of mitigating critical issues is assumed to be zero (more likely the value in the case of small-sized buildings). Considering this scenario, the ROI is 13.3%.

Table 9. Cash flow statement of the project in the case in which criticality levels similar to those found on small real estate units are assumed (with the most probable cost of mitigation of criticalities).

Cash Flow Statement	Start of Works [EUR]	First SAL [EUR]	Second SAL [EUR]	Closing of Works [EUR]	Totals [EUR]
Tax credit	0	332,697	332,697	443,596	1,108,991
Bank cost of credit assignment	0	−24,196	−24,196	−32,262	−80,654
REVENUES FROM SALES OF TAX CREDIT	0	308,501	308,501	411,335	1,028,337
Risk mitigation cost	0	0	0	0	0
Production factors payment	−226,839	−226,839	−226,839	−226,839	−907,356
COSTS	−226,839	−226,839	−226,839	−226,839	−907,356
EARNINGS BEFORE INTEREST AND TAXES (EBIT)	−226,839	81,662	81,662	184,496	120,981
Notional taxes on the operating result	0	−19,599	−19,599	−44,279	−83,477
NET OPERATING PROFIT AFTER TAXES (NOPAT)	−226,839	62,063	62,063	140,217	37,504
Risk mitigation cost + Production factors payment	226,839	226,839	226,839	226,839	907,356
CASH FLOW FROM CURRENT OPERATIONS (CF)	0	288,902	288,902	367,056	944,860
Debts invested in the project (to cover the works)	−81,662				−81,662
Equity invested in the project (to cover the works)	−54,441				−54,441
Equity invested in the project deriving from current operations cash flow (to cover the works)		−257,084	−257,084	−257,084	−771,253
FREE CASH FLOW FROM OPERATIONS (FCFO)	−136,103	31,818	31,818	109,972	37,504
Bridge financing	81,662				81,662
Capital share		−27,000	−27,387	−27,781	−82,167
Interest share		−1030	−642	−249	−1922
Amount paid by private individuals	10,453	10,453	13,937		34,843
FREE CASH FLOW TO EQUITY (FCFE)	−43,988	14,241	17,726	81,942	69,920
DISCOUNTED CASH FLOW (DCF)	−43,988	14,009	17,151	77,991	65,162
NPV [EUR]			65,162		
IRR [%]			47		
ROE [%]			4.3		
ROI [%]			13.3		

Similarly, the financial statement was constructed, which considers the criticality levels associated with a multi-family building before the introduction of CILAS (see Table 10). In the most probable case, or when the mitigation costs are equal to 15% of the amount of the work, the ROI stands at −3.3%.

Table 10. Cash flow statement of the project in case we consider the levels of criticality associated with multi-family construction before the introduction of CILAS (most likely cost of mitigation of criticalities).

Cash Flow Statement	Start of Works [EUR]	First SAL [EUR]	Second SAL [EUR]	Closing of Works [EUR]	Totals [EUR]
Tax credit	0	332,697	332,697	443,596	1,108,991
Bank cost of credit assignment	0	−24,196	−24,196	−32,262	−80,654
REVENUES FROM SALES OF TAX CREDIT	0	308,501	308,501	411,335	1,028,337
Risk mitigation cost	−23,468	−46,936	−46,936	−39,113	−156,453
Production factors payment	−226,839	−226,839	−226,839	−226,839	−907,356
COSTS	−250,307	−273,775	−273,775	−265,952	−1,063,809
EARNINGS BEFORE INTEREST AND TAXES (EBIT)	−250,307	34,726	34,726	145,383	−35,472
Notional taxes on the operating result	0	−8334	−8334	−34,892	−51,560
NET OPERATING PROFIT AFTER TAXES (NOPAT)	−250,307	26,392	26,392	110,491	−87,032
Risk mitigation cost + Production factors payment	250,307	273,775	273,775	265,952	1,063,809
CASH FLOW FROM CURRENT OPERATIONS (CF)	0	300,167	300,167	376,443	976,777
Debts invested in the project (to cover the works)	−95,743				−95,743
Equity invested in the project (to cover the works)	−63,829				−63,829
Equity invested in the project deriving from current operations cash flow (to cover the works)		−300,167	−300,167	−303,904	−904,238
FREE CASH FLOW FROM OPERATIONS (FCFO)	−159,571	0	0	72,539	−87,032
Bridge financing	95,743				95,743
Capital share		−31,655	−32,110	−32,571	−96,335
Interest share		−1208	−753	−292	−2253
Amount paid by private individuals	10,453	10,453	13,937		34,843
FREE CASH FLOW TO EQUITY (FCFE)	−53,376	−22,410	−18,925	39,676	−55,034
DISCOUNTED CASH FLOW (DCF)	−53,376	−22,044	−18,312	37,763	−55,968
NPV [EUR]			−55,968		
IRR [%]			-		
ROE [%]			−9.2%		
ROI [%]			−3.3%		

In the same way, the financial statement was drawn up, which refers to the critical levels found to date for multi-family buildings, i.e., following the introduction of CILAS (see Table 11). In the most likely case, i.e., when the mitigation costs are equal to 6% of the amount of the work, the ROI is 6%.

Table 11. Cash flow statement of the project in the event that critical levels similar to those found on small real estate units are assumed (most likely criticality mitigation cost).

Cash Flow Statement	Start of Works [EUR]	First SAL [EUR]	Second SAL [EUR]	Closing of Works [EUR]	Totals [EUR]
Tax credit	0	332,697	332,697	443,596	1,108,991
Bank cost of credit assignment	0	−24,196	−24,196	−32,262	−80,654
REVENUES FROM SALES OF TAX CREDIT	0	308,501	308,501	411,335	1,028,337
Risk mitigation cost	−9387	−18,774	−18,774	−15,645	−62,581
Production factors payment	−226,839	−226,839	−226,839	−226,839	−907,356
COSTS	−236,226	−245,613	−245,613	−242,484	−969,937
EARNINGS BEFORE INTEREST AND TAXES (EBIT)	−236,226	62,888	62,888	168,851	58,400
Notional taxes on the operating result	0	−15,093	−15,093	−40,524	−70,710
NET OPERATING PROFIT AFTER TAXES (NOPAT)	−236,226	47,795	47,795	128,326	−12,310
Risk mitigation cost + Production factors payment	236,226	245,613	245,613	242,484	969,937
CASH FLOW FROM CURRENT OPERATIONS (CF)	0	293,408	293,408	370,811	957,627
Debts invested in the project (to cover the works)	−87,294				−87,294
Equity invested in the project (to cover the works)	−58,196				−58,196
Equity invested in the project deriving from current operations cash flow (to cover the works)		−274,816	−274,816	−274,816	−824,447
FREE CASH FLOW FROM OPERATIONS (FCFO)	−145,491	18,593	18,593	95,995	−12,310
Bridge financing	87,294				87,294
Capital share		−28,862	−29,276	−29,697	−87,835
Interest share		−1101	−687	−266	−2054
Amount paid by private individuals	10,453	10,453	13,937		34,843
FREE CASH FLOW TO EQUITY (FCFE)	−47,743	−917	2567	66,032	19,938
DISCOUNTED CASH FLOW (DCF)	−47,743	−902	2484	62,848	16,686
NPV [EUR]			16,686		
IRR [%]			12%		
ROE [%]			−1.6%		
ROI [%]			6.0%		

Once the structure of the financial statements has been established, it is possible to implement risk analysis to verify the financial performance of the project [39]. This verification is conducted through the ROI. The objective of the analysis is to evaluate how the cumulative probability distribution of ROI changes as the mitigation costs of the typical Superbonus criticalities change (these costs are, therefore, assumed to be a critical variable of the problem). The analysis is conducted, through the Monte Carlo simulation, on three scenarios: (i) A project with levels of criticality similar to those found on small real estate units; (ii) a project with critical levels typical of the multi-family buildings before the introduction of CILAS; (iii) a project with critical levels typical of the multi-family buildings after the introduction of CILAS. By implementing the simulation for each of the three scenarios, as the mitigation costs change according to the probability distributions defined in Section 3.4, the cumulative probability distributions of the ROI are obtained. In the subsequent risk assessment phase, the cumulative probabilities of the ROIs of the three scenarios are compared with a threshold value deemed optimal [32,40,41]. At the outset, three possible thresholds were considered. First of all, a reference was made to the Weighted Average Cost of Capital (WACC), which represents the financial discount rate r adopted for the energy efficiency project, equal to 5.07%. Secondly, wd decided to take the average ROI of the construction sector in Italy for the year 2019 as a reference, proposed by the Italian National Foundation of Accountants (2021), equal to 10.6%. Thirdly, it was assumed that the data deriving from the Damodaran database (2021) should be assumed as the threshold value [38]. This figure, equal to 8.9%, is constructed as the average of the ROI of 2754 companies in Europe operating in the year 2020 in the following sectors: Building materials, engineering/construction, environmental services and waste, green and renewable energy, and house construction. In the end, we decided to assume the value of 5.07% as a threshold indicator of the ROI for this study, inferable from the WACC, as the ability to obtain a return on capital higher than its cost (ROI > WACC) is the necessary prerequisite for the creation of intrinsic business value. The intent is to evaluate the effects of the investment consistently with the basic assumption of the neoclassical economy, according to which, in the absence of market imperfections, the company can achieve returns capable, at most, of remunerating only the cost incurred for the factors of production, including the opportunity cost of equity [42,43]. Since the ROI is estimated on an annual basis, it is compared with the annual rate r = WACC and not with the quarterly rate $\bar{r}$. The simulation results and their comparison with the WACC are presented in the next section.

4. Results and Discussion

First of all, reference is made to the cash flow statement built according to the principles that the ESCo would have had to apply if it had been a small building. Obviously, by implementing the Monte Carlo simulation, we obtained a 100% chance of having an ROI above the 5.07% threshold.

In this case, by implementing a sensitivity analysis starting from the parameters of Table 8 relating to single-family and two-family buildings, the results (EBIT, net profit, NPV, TRUCK, ROE, and ROI) shown in Table 12 are obtained. As the risk mitigation cost varied, the bridge financing also varied, keeping the D/E ratio constant.

Table 12. Results of the sensitivity analysis conducted considering levels of criticality similar to those found on small real estate units and assuming critical mitigation costs equal to the minimum, maximum, and most frequent values.

Cost Level	Total Mitigation Cost of Criticalities [%]	EBIT [EUR]	Net Profit [EUR]	NPV [EUR]	IRR [%]	ROE [%]	ROI [%]
Minimum	0	120,981	35,583	65,162	47	4.3	13.3
Most frequent	0	120,981	35,583	65,162	47	4.3	13.3
Maximum	5	68,830	−5930	24,850	17	−0.7	7.2

Obviously, by implementing the Monte Carlo simulation, one obtains, in this first case, a 100% probability of having an ROI above the threshold of 5.07%.

Secondly, a reference is made to the financial statement constructed according to the principles that the ESCo should have applied in the case of multi-family buildings before the introduction of CILAS. By implementing a sensitivity analysis starting from the parameters of Table 8 relating to pre-CILAS multi-family buildings, the results (EBIT, net profit, EV, TIR, ROE, and ROI) shown in Table 13 are obtained.

Table 13. Results of the sensitivity analysis conducted considering critical levels typical of multi-family buildings before the introduction of CILAS and assuming critical mitigation costs equal to the minimum, maximum, and most frequent values.

Cost Level	Total Mitigation Cost of Criticalities [%]	EBIT [EUR]	Net Profit [EUR]	NPV [EUR]	IRR [%]	ROE [%]	ROI [%]
Minimum	5	68,830	−6261	23,807	14	−0.7	7.2
Most frequent	15	−35,472	−89,285	−55,968	-	−9.2	−3.3
Maximum	15	−35,472	−89,285	−55,968	-	−9.2	−3.3

When implementing risk analysis through Monte Carlo simulation considering the typical criticality level for multi-family buildings before the introduction of CILAS, the cumulative probability distribution of ROI in Figure 4 is obtained.

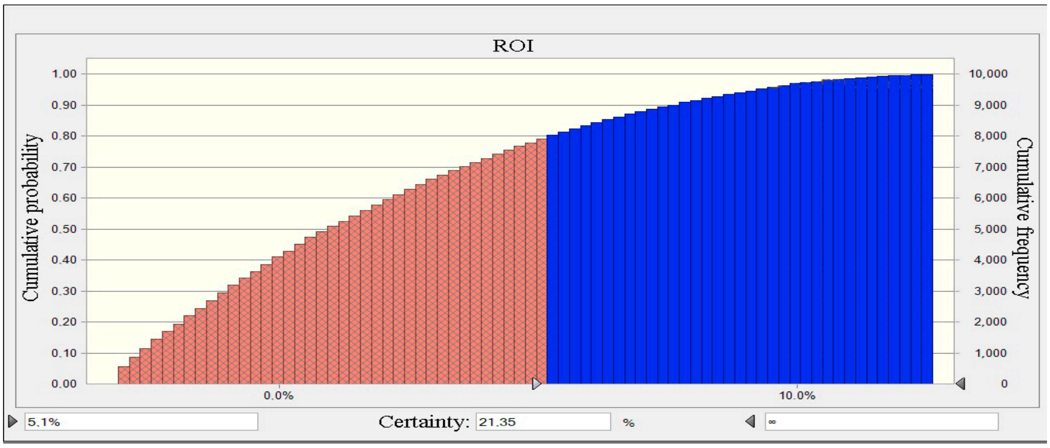

Figure 4. Cumulative probability distribution of ROI if critical levels (urban planning, technical, and administrative) are assumed for multi-family buildings before the introduction of CILAS (own elaboration).

In that case, the probability of having an ROI above the 5.07% threshold is 21.35%. Therefore, the probability of failure is just under 80%. So, until before the introduction of CILAS, only one out of five interventions would have had a good chance of reaching the port with satisfactory results for the company (and, consequently, for all the other actors involved).

Finally, reference is made to the financial statement constructed according to the principles that the ESCo should apply today in the case of multi-family buildings (post-CILAS situation). By implementing a sensitivity analysis starting from the parameters of Table 8 relating to post-CILAS multi-family buildings, the results (EBIT, net profit, VAN, TIR, ROE, and ROI) shown in Table 14 are obtained.

Table 14. Results of the sensitivity analysis conducted considering critical levels typical of multi-family construction after the introduction of CILAS and assuming critical mitigation costs equal to the minimum, maximum, and most frequent values.

Cost Level	Total Mitigation Cost of Criticalities [%]	EBIT [EUR]	Net Profit [EUR]	NPV [EUR]	IRR [%]	ROE [%]	ROI [%]
Minimum	0	120,981	35,450	65,162	47	4.3	13.3
Most frequent	6	58,400	−14,364	16,686	12	−1.6	6.0
Maximum	12	−4181	−64,179	−31,810	-	−6.8	−0.4

Currently, the sustainability check must be carried out with the third probability distribution of the costs of mitigating critical issues (shown in Figure 5). As can be seen from Figure 4, the cumulative result leads to an overall probability of exceeding the ROI of 5.07% equal to just over 60%. This means that, to date, approximately three out of five interventions are likely to generate positive results.

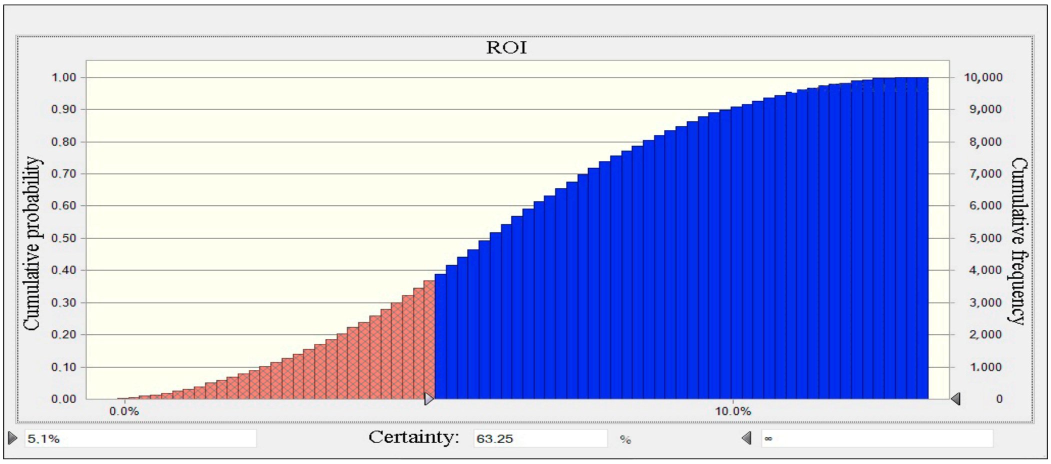

Figure 5. Cumulative probability distribution of ROI if critical levels (urban planning, technical, and administrative) are assumed for multi-family buildings after the introduction of CILAS (own elaboration).

From this last result, it is clear that, to date, an adequate evaluation of the financial risk induced by urban planning, technical planning, and administrative-fiscal problems on Superbonus investments leads to an estimate equal to 60% of the probability that these activities are positioned in a range of concrete financial sustainability for the economic operators who promote them. This means that, in these conditions, the same subjects will most likely be induced to find alternatives—more or less legitimate—to carry out the investments successfully. Surely, the following alternatives can be found among these: (i) Financial alternatives for the sale of credits acquired by condominiums (in fact, the number of financial operators to choose from has grown enormously in the last year); (ii) technical-design alternatives with specialized companies capable of creating economies of scale with an increase in quality and cost containment; and (iii) widespread diffusion of advanced technologies for project design and management (BIM, surveys with drones and laser scans, etc.).

However, there is no shortage of outlawed paths. So much so that until 10 December 2021, the Revenue Agency admitted 40,000 interventions for financing a total of € 6 billion in investments and, at the same time, identified fraud for € 4 billion [44]. These data, assuming three out of five interventions are substantially legitimate, generally confirm the results of this study regarding the probability of financial success of interventions in the Superbonus compared to the existing urban planning, technical, and administrative risks.

As of 30 June 2022, ENEA reports that the number of certifications filed has risen to 199,124. Of the total investments admitted as a deduction at the national level (more than € 35 billion), 30% refers to works not completed [45]. The figure represents further proof of the difficulties that companies are experiencing concerning the concrete application of the measure.

5. Conclusions

In this paper, the conditioning that problems of an urban planning, technical, and administrative nature have on the financial sustainability of energy retrofit projects encouraged by tax relief policies (tax deductions and tax credit) have been analyzed. Through a risk analysis, it is shown that in the Italian context, such interventions are currently financially sustainable for energy service companies only approximately three times out of five. As seen in the previous section, this result would appear to be in line with the data provided by the Italian Revenue Agency and ENEA. The methodological approach followed in this study can also be applied to assess the financial convenience of tax relief policies adopted by other countries (regardless of the maximum amount of tax deductions and tax credits). The results of the analysis acquire greater robustness as the number of projects increases from which it is possible to determine the property and the representative workings. For this reason, the datasets of projects built for this study will have to be periodically updated. In the same way, the costs necessary to mitigate the urban planning, technical, and administrative criticalities typical of the Superbonus must be kept under control to be able to evaluate the new probability distributions of costs in the coming years.

The results obtained are open to various political reflections. While, on the one hand, there is a need to increase the guarantees for the State against possible tax fraud by intensifying urban planning, technical, and administrative controls, on the other hand, both companies and clients should be better protected. Various measures have been taken to protect the state in recent months. In particular, budget law 2022 introduced article 122-bis in the law decree n. 34/2020, which provides specific measures to combat fraud on credit assignments and the strengthening of preventive controls [46]. Furthermore, in an attempt to introduce more and more limits aimed at preventing fraudulent conduct to the detriment of the Exchequer, an articulated discipline was outlined, which ended up reverberating on the circulatory events of tax credits. The «Anti-fraud» decree (Law Decree 11 November 2021 n. 157) and the budget law for 2022 were followed by the «Sostegni-ter» Law Decree of 21 January 2022, which intervened on tax bonuses, specifying that it is not possible to assign tax credits relating to building deductions several times. The measure, which, according to the legislator should increase the guarantees concerning possible tax fraud, has nevertheless produced centralization of the interventions in the hands of a few banking and insurance groups of national caliber, wiping out all the small and medium-sized enterprises that no longer have the possibility to operate autonomously being now fully subject—to be able to work—to the rules imposed by the large international groups that perform the role of general contractors.

On the other hand, some steps forward have been made to protect clients. The D.L. n. 21/2022, converted into law n° 51/2022, introduced the obligation from 1 July 2023 to issue the SOA (Certification Organisms Society) for works exceeding 516,000 euros to access the deductions provided for the Superbonus. The primary purpose of this document is to prove that a company in the construction sector has all the credentials, an extra guarantee for the client on the seriousness and reliability of those who will have to carry out the work. On the other hand, only SOA companies will have privileged access to credit assignments.

There is still much uncertainty regarding future developments regarding the Superbonus policy. According to the legislation currently in force, the rate remains at 110% until 2023 and then decreases to 70% in 2024 and 65% in 2025. For villas, i.e., single-family buildings, the deadline is 31 December 2022. However, it is not excluded that, with the new government, various changes could be introduced, such as the reduction of the rate up to 60% and the distinction of the subsidy for first and second homes. Certainly, to avoid fraud with the circulation of non-existent tax credits, the Revenue Agency will also intensify the assessment activity, based on the diligence assessment indices, which concern the absence of documentation or contradiction concerning the documentary confirmation of the product; the income and asset inconsistency between the value and the object of the work performed and the profile of the clients benefiting from the concessions in question; the disproportion between the amount of the transferred credits and the value of the real estate unit; the inconsistency between the value of the assigned credit and the financial and asset profile of the assignor of the credit if this is not the first beneficiary of the deduction; and anomalies in the economic conditions applied when assigning credits and failure to carry out the work [47].

To protect small and medium-sized enterprises involved in the works, one possible way could consist o reducing the deductible rate (bringing it, for example, to 60%), but including in the deductions part of the expenses necessary for companies (and the other actors involved) to activate the protection measures against recurring criticalities. Furthermore, the reduction of the amount subject to deduction could result in a more equitable distribution of the financial risk between individual private owners and companies. In general, tax relief policies need to be further optimized to make the energy transition in housing both financially and ecologically sustainable [48].

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Appendix A

Table A1. Classification of multi-family buildings, identification of the most common features, and selection of the representative property.

Multi-Family Buildings	Total Number of Floors			Number of Underground Floors			Number of Real Estate Units			Age of Construction			Type of Structure		Average Floor Area			Roof	
	From 1 to 5	From 6 to 10	>10	0	1	>1	From 2 to 10	From 10 to 30	>30	<1950	From 1950 to 1970	>1970	Framed structure in reinforced concrete	Load-bearing masonry structure	<200 m^2	From 200 m^2 to 300 m^2	>300 m^2	Pushing	Non-pushing
1		x		x				x			x		x		x				x
2	x			x			x			x				x	x			x	
3 *		x			x			x			x		x			x			x
4		x			x			x			x		x			x			x
5		x		x				x				x	x		x				x
6	x			x			x			x				x	x			x	
7		x				x			x			x	x			x		x	
8		x			x			x			x		x			x			x
9			x	x					x		x		x			x			x
10		x		x				x				x	x				x		x
11		x			x			x			x		x			x			x
12 *		x			x			x			x		x			x			x
13			x			x			x			x	x				x	x	
14			x		x			x			x		x			x			x
15			x	x					x	x			x			x			x
16		x			x		x					x	x				x		x
17			x	x				x			x		x				x		x
18		x			x			x			x		x			x			x
19		x			x			x			x		x			x			x
20 *		x			x			x			x		x			x			x
21		x		x					x			x	x				x	x	
22	x			x			x			x				x	x			x	
23		x			x			x			x		x			x			x
24		x				x		x		x			x				x		x
25			x		x				x			x	x		x				x
26 *		x			x			x			x		x			x			x
27		x		x				x			x		x		x			x	
28			x	x					x			x	x				x		x
29 *		x			x			x			x		x			x			x
30		X				x		x			x		x				x		x

* Projects representing both the properties with the most recurring characteristics (buildings in bold in this table) and the work most frequently performed when the Superbonus is used (buildings in bold in Table A2).

Appendix B

Table A2. Identification of the most recurrent works carried out on the properties under study.

Multi-Family Buildings	Insulation Opaque Structures	Replacement of Boilers	Replacement Fixtures	Installation Solar Screens	Photovoltaic System	Elimination of Architectural Barriers	Infrastructure for Charging electric Vehicles	Interventions on Buildings Subject to Cultural and Landscape Constraints
1	x	x	x		x			
2	x	x	x	x				
3 *	x	x	x	x	x	x		
4	x	x					x	
5	x				x			
6	x	x	x	x	x			
7	x	x	x					
8	x	x						
9	x		x	x	x		x	
10	x	x	x	x				
11	x	x	x					
12 *	x	x	x	x	x			
13	x	x			x			
14	x	x	x	x	x	x		
15	x	x	x				x	
16	x	x						
17	x							
18	x		x	x	x			
19	x	x	x					
20 *	x	x	x	x	x		x	
21	x	x						
22	x	x	x	x	x			
23	x	x						
24	x							
25	x	x	x	x			x	
26 *	x	x	x	x	x	x		
27	x	x	x	x	x		x	
28	x	x	x	x				
29 *	x	x	x	x	x			
30	x	x	x	x	x			
Recursivity	30	25	21	16	15	3	5	0

* Projects representing both the work most frequently performed when the Superbonus is used (buildings in bold in this table) and the properties with the most recurring characteristics (buildings in bold in Table A1).

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