



**UNIVERSITÀ
DI PAVIA**

Dipartimento di Scienze Economiche e Aziendali Corso di

Laurea Magistrale in “Economics, Development and

Innovation” (MEDI)

Analysis of Subsidies for Energy Renovations: A Comparative Perspective on France and Italy

Relatrice/Coordinatrice:

Chiar.ma Prof.ssa Marcella Nicolini

Correlatore:

Chiar.ma Prof.ssa Sonia Schwartz

**Tesi di Laurea
di Daniele Tazio**

Matr. n.537383

Anno Accademico 2024-2025

Master « Economie du développement »
parcours « Développement durable »

Analysis of Subsidies for Energy Renovations: A Comparative Perspective on France and Italy

Enseignante référente (UCA) :
Sonia Schwartz

Mémoire réalisé par : Daniele Tazio

Enseignante référente (UniPv) :
Marcella Nicolini

Date de soutenance (pour les M2) : octobre 2025

Année universitaire : 2024-2025

Abstract

Energy renovation subsidies are widely recognized as key instruments to promote energy efficiency, yet their effectiveness depends crucially on policy design, national economic conditions, and implementation mechanisms. The economic rationale for public intervention lies in the correction of market failures and behavioural barriers: in the absence of regulation, negative externalities such as pollution are not internalized, while positive externalities due to energy renovations in the form of reduced emissions and improved public health remain undervalued in private decision-making. This thesis applies a comparative policy analysis to examine energy renovation subsidies in France and Italy, focusing on their structure, eligibility criteria, financing mechanisms, and macroeconomic implications. Using official reports, empirical studies, and sectoral data, the research evaluates the impact of these incentives on households' renovation behaviour in undertaking energy renovations, energy consumption, and the construction industry. Beyond mapping similarities and differences, the analysis aims to identify policy trade-offs between cost-effectiveness, fiscal sustainability, and distributional fairness. The findings contribute to the debate on how subsidy schemes can be designed to maximize additionality, avoid free-riding and market distortions, and ensure an equitable transition. Policy recommendations are offered to guide future reforms in the European context.

Abstract

I sussidi per la riqualificazione energetica sono ampiamente riconosciuti come strumenti chiave per promuovere l'efficienza energetica; tuttavia, la loro efficacia dipende in modo cruciale dal disegno delle politiche, dalle condizioni economiche nazionali e dai meccanismi di attuazione. La logica economica dell'intervento pubblico risiede nella correzione dei fallimenti di mercato e delle barriere comportamentali: in assenza di regolamentazione, le esternalità negative come l'inquinamento non vengono internalizzate, mentre le esternalità positive derivanti dalla riduzione delle emissioni e dal miglioramento della salute pubblica restano sottovalutate nel processo decisionale degli agenti economici. Questa tesi applica un'analisi comparata a livello di politiche pubbliche per esaminare i sussidi per la riqualificazione energetica in Francia e in Italia, concentrandosi sulla loro struttura, i criteri di ammissibilità, i meccanismi di finanziamento e le implicazioni macroeconomiche. Utilizzando rapporti ufficiali, studi empirici e dati settoriali, la ricerca valuta l'impatto di tali incentivi sul comportamento di riqualificazione delle famiglie, sul consumo energetico e sul settore edile. Oltre a identificare somiglianze e differenze, l'analisi mira a identificare i trade-off di policy in termini di costo-benefici, sostenibilità fiscale ed equità distributiva. I risultati contribuiscono al dibattito su come i sussidi per l'efficientamento energetico possano essere disegnati per massimizzare l'addizionalità, evitare il free-riding e le distorsioni di mercato, e garantire una transizione equa. Vengono infine offerte raccomandazioni di policy per guidare le future riforme nel contesto europeo.

Abstract

Les subventions à la rénovation énergétique sont largement reconnues comme des instruments essentiels pour promouvoir l'efficacité énergétique, mais leur efficacité dépend de manière cruciale de la conception des politiques, des conditions économiques nationales et des mécanismes de mise en œuvre. La justification économique de l'intervention publique réside dans la correction des défaillances de marché et des barrières comportementales : en l'absence de régulation, les externalités négatives telles que la pollution ne sont pas internalisées, tandis que les externalités positives liées à la réduction des émissions et à l'amélioration de la santé publique demeurent sous-évaluées dans la prise de décision privée. Cette thèse applique une analyse comparative des politiques publiques afin d'examiner les subventions à la rénovation énergétique en France et en Italie, en se concentrant sur leur structure, leurs critères d'éligibilité, leurs mécanismes de financement et leurs implications macroéconomiques. À partir de rapports officiels, d'études empiriques et de données sectorielles, la recherche évalue l'impact de ces incitations sur le comportement de rénovation des ménages, la consommation d'énergie et le secteur de la construction. Au-delà du repérage des similitudes et des différences, l'analyse vise à identifier les arbitrages politiques entre efficacité-coût, soutenabilité budgétaire et équité distributive. Les résultats contribuent au débat sur la manière dont les dispositifs de subventions peuvent être conçus pour maximiser l'additionnalité, éviter l'effet d'aubaine et les distorsions de marché, et garantir une transition équitable. Des recommandations de politique publique sont formulées afin d'orienter les réformes futures dans le contexte européen.

LIST OF CONTENTS

INTRODUCTION.....	11
CHAPTER 1: THEORETICAL AND POLICY FRAMEWORK.....	15
1.1 Historical Perspective on Energy Efficiency in Economics.....	16
1.2 Economic Rationale for Public Intervention in Energy Renovations	19
1.2.1 Barriers to Energy Renovations	19
1.2.2 Externalities.....	20
1.2.3 Information and Behavioural Barriers.....	25
1.2.4 Liquidity Constraints to Energy Renovations	29
1.2.5 Uncertainty	29
1.3 Residential Energy Consumption Determinants	30
1.4 Policy Instruments Against the Energy Paradox.....	34
1.4.1 Free Riding.....	35
1.4.2 Rebound Effect.....	37
1.5 The EU Policy and Regulatory Framework	38
1.5.1 The Strategic Framework: Green Deal, Fit for 55, and the Renovation Wave	39
1.5.2 The Legislative Framework: EPBD, EED, and State Aid Guidelines	40
1.5.3 Financial Instruments: Recovery and Resilience Fund and Cohesion Policy	41
1.5.4 The Role of National Energy and Climate Plans (NECPs).....	42
Chapter Conclusions	43
CHAPTER 2: OVERVIEW OF ENERGY RENOVATION POLICIES IN FRANCE AND ITALY	44
2.1 The French Residential Sector: State of Play and Challenges	44
2.1.2 Historical Evolution of Incentives.....	48
2.1.3 How does the system work today?	51
2.1.4 Private Profitability of Energy Renovations: Critical Analysis and Key Issues	55
2.2.1 Historical Evolution of Incentives in Italy	60
2.2.2 The Effectiveness and Criticisms of Italian Subsidies	62
Chapter Conclusions	67
CHAPTER 3: A COMPARISON BETWEEN ITALIAN AND FRENCH INCENTIVE MODELS	68
3.1 The French and Italian Policies: Different Approaches, Different Scales	68
3.2 The Challenge for the National Budgets and the Uncertainty on Future Incentives.....	70

3.3 Policy Design Implications	73
Chapter Conclusions	76
CONCLUSIONS	77
BIBLIOGRAPHY	80

LIST OF TABLES

TABLE 1 FRENCH INCENTIVES FOR ENERGY RENOVATIONS. SOURCE: TABLE 1 IN GIRAUDET (2024).....	52
TABLE 2 SECTORAL IMPACTS ON VALUE ADDED GROWTH BETWEEN 2023 AND 2020 USING INPUT-OUTPUT TABLES. SOURCES: ACCETTURO ET AL. (2024) ELABORATION ON ISTAT DATA	64
TABLE 3 DIFFERENCES BETWEEN THE ITALIAN AND FRENCH SUBSIDY MODELS	73

LIST OF FIGURES

FIGURE 1 JAFFE & STAVINS' (1994) ORIGINAL DIAGRAM AND GIRAUDET & MISSEMER (2023) EXTENSION PROPOSAL.....	18
FIGURE 2 FACTORS UNDERLYING THE IMPLICIT DISCOUNT RATE IN SCHLEICH ET AL (2016).....	27
FIGURE 3 GHG EMISSION IN THE RESIDENTIAL/TERTIARY SECTOR (MINISTERE DE LA TRANSITION ECOLOGIQUE, 2020)	33
FIGURE 4 GREENHOUSE GAS EMISSIONS BY SECTOR IN FRANCE IN 2022 (PROVISIONAL ESTIMATE); SOURCE: (SDES, 2023, P. 53)	45

FIGURE 5 PRIVATE AND SOCIAL PROFITABILITY OF THE RENOVATION OF THE ENTIRE HOUSING STOCK (NET PRESENT VALUE): FORM FIGURE 2 IN FACK & GIRAUDET, 2024)	47
FIGURE 6 ITALY’S HOUSEHOLDS TENURE STATUS PER INCOME LEVEL (SOURCE: ISTAT)	58
FIGURE 7 SIAPE’S BUILDINGS ENERGY CLASSES (AUGUST 2025)	59
FIGURE 8 CONTRIBUTIONS OF ITALY'S CONSTRUCTION SECTOR TO LABOUR PRODUCTIVITY (SOURCE: ISTAT)	63
FIGURE 9 CONSTRUCTION COST INDEX FOR RESIDENTIAL AND NON- RESIDENTIAL BUILDINGS (SOURCE: ISTAT)	65

INTRODUCTION

Buildings account for approximately 40% of final energy consumption and 36% of CO₂ emissions in the European Union, making decarbonizing the building sector an urgent priority in the EU's climate strategy (Maduta et al., 2023). Not by chance, improving energy efficiency through building renovations is one of several tools envisaged by the European Union to implement the ambitious Green Deal package. In addition, such a policy is commonly seen as a means to stimulate economic recovery, reduce energy poverty, and improve living conditions. Renovation programs generate significant employment opportunities, particularly in the construction and energy service sectors, thus supporting economic growth during recovery periods (IEA, 2024)¹. Energy-efficient retrofits also lower household energy bills, alleviating energy poverty among vulnerable populations (Bouzarovski & Petrova, 2015). Moreover, improved building performance enhances thermal comfort, air quality, and overall health, improving living standards (WHO, 2018).

Public subsidies for energy renovations have become key tools for achieving both environmental and economic goals, usually justified by the belief that it is a win-win situation, where households can reduce their bills and decrease pollution. Such subsidies are designed to correct market failures, such as information asymmetries and externalities, while mobilising private investment. However, they come with significant fiscal costs and must be carefully evaluated regarding their cost-effectiveness and fairness.

Throughout this thesis, we will analyse the subsidy programmes for energy renovations implemented in France and Italy. These are two particularly instructive case studies. Both

¹ See also: (Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – A Renovation Wave for Europe – Greening Our Buildings, Creating Jobs, Improving Lives, 2020).

countries have implemented large-scale subsidy programmes to promote energy renovation in the residential sector, yet their policy designs differ markedly. France has favoured targeted and gradually evolving incentives like a tax credit, before, and a bonus, after; on the contrary, Italy, which already implemented a tax credit for building renovations in 2007 (Ruggieri et al., 2023), introduced the 2020 highly generous *Superbonus 110%*, sparking both enthusiasm and controversy.

These differences raise important economic questions about policy design, cost-effectiveness, and the broader macroeconomic and distributional implications of such programmes. This thesis aims to assess and compare the economic performance of subsidy schemes for residential energy renovation in France and Italy. The central question of the research is: how effective and economically efficient are public subsidy programmes for energy renovations? What is the overall assessment of these policies in the case studies of France and Italy?

To answer this question, the thesis will first address the theoretical and political framework underlying the economic rationale for public intervention in the energy renovation market. When it comes to the policy implementations in France and Italy, instead, we will then answer to the following sub-questions:

- i. What are the main instruments used to support energy renovation in each country, and how are they designed?
- ii. How do these subsidies perform in terms of uptake, energy savings, and fiscal cost?
- iii. What are their implications for fairness and accessibility, particularly for low-income households?
- iv. To what extent can these policies be considered economically sustainable? Do they face any degree of free-riding?

The overall objective is to conduct a comparative analysis that draws insights from the French and Italian experiences and contributes to the policy debate on the optimal design of green public spending. The research adopts a comparative economic policy analysis approach, grounded in the theory of public economics and environmental policy. The methodology combines: a) qualitative policy analysis, based on official documents, legislation, and the field literature; b) quantitative evaluation, using available statistics (e.g., number of renovations, public spending, energy savings) from national and EU sources such as Eurostat, the European Commission, the “Agence de l'environnement et de la maîtrise de l'énergie” (ADEME), the “Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile” (ENEA). Rather than performing a new empirical assessment of cost-effectiveness and distributional outcomes, the thesis builds upon and integrates the findings of existing empirical research. This approach enables a comprehensive and contextually rich synthesis of the available evidence, while also identifying opportunities for future investigation.

Moreover, as stressed by Bellantuono (2011), when it comes to comparative energy research, a mix of three disciplines is required: **i)** firstly, Comparative Energy Economics, which explores the impact of regulation on energy systems; **ii)** secondly, Comparative Energy Policy which provides an assessment of the initiatives undertaken by the relevant institutions and does not rely exclusively on economic analysis; **iii)** and finally, Comparative Energy Law which instead tries to describe and assess similarities and differences among legal rules.

The comparison between France and Italy is justified by their common EU-level obligations, their similar housing stock profiles, and their divergent approaches to subsidy design. Such a comparative lens allows for a nuanced understanding of the trade-offs and performance of different policy schemes within a shared European context. The thesis is structured in four chapters.

Chapter 1 presents the theoretical and analytical framework, drawing on economic literature on energy efficiency, market failures, and public intervention. It also provides an overview of the EU policy context, including funding mechanisms and regulatory constraints.

Chapter 2 first examines the policies implemented in France and subsequently those in Italy to promote energy renovation.

Chapter 3 presents a comparative assessment of Italian and French policies, seeking to draw lessons from the evolution of their subsidy policies.

Finally, Chapter 4 concludes by discussing the broader policy implications and offering recommendations for improving the efficiency and fairness of subsidy programmes. We will then conclude with a summary of the findings and suggestions for future research.

Chapter 1: Theoretical and Policy Framework

This chapter presents the theoretical and political foundations that underpin the justification for public intervention in energy renovations. It begins by drawing on key insights from the economic literature on energy efficiency and a historical perspective on its evolution within economic thought. We will therefore focus on the so-called energy paradox, which occurs when economic operators do not invest in energy-efficient technologies that could generate significant future energy savings and offer attractive financial returns. This behaviour contrasts with the predictions of standard economic theory, according to which such economically advantageous opportunities should be readily seized.

The literature identifies several barriers to energy-saving investments: namely, market failures, economic barriers, and uncertainty that deters agents from energy-saving equipment and energy renovations. Analysing the energy paradox will help identify the structural and behavioural barriers that limit the adoption of energy-efficient solutions, providing useful insights for the design of more effective public policies. Hence, this chapter builds on the First Fundamental Theorem of Welfare Economics and is informed by approaches from public and environmental economics.

Understanding market failures is essential, as they form the economic rationale for a wide range of public policies and financial incentives aimed at improving the environmental energy performance of buildings. More in general, governments intervene not simply to correct inefficiencies, but also to ensure that the private decisions of individuals and firms better align with broader social and environmental goals such as the urgent need for mitigation measures as set out by several international agreements, including the Paris Agreement, Agenda 2030, the United Nation Framework Convention on Climate Change (UNFCCC), and the Sendai Framework for Disaster Risk Reduction, among others.

Alongside this theoretical foundation, the chapter also introduces the policy context at the European level. Energy renovations have become a central pillar of the European Union's climate strategy, and the regulatory and financial framework reflects this priority. Key legislative instruments, such as the Energy Performance of Buildings Directive (EPBD), are examined, as well as the European Union strategy towards climate neutrality by 2050 (the so-called European Green Deal).

By combining economic theory with institutional and policy analysis, this chapter provides a comprehensive framework for understanding why public intervention in the renovation sector is both necessary and complex. It also lays the groundwork for assessing how well current EU policies respond to the underlying economic challenges.

1.1 Historical Perspective on Energy Efficiency in Economics

A brief overview of the historical treatment of energy efficiency in economics can provide a valuable foundation for understanding the current debate and the key issues at stake. Giraudet & Missemmer (2023) provide a comprehensive historical analysis of how energy efficiency has been conceptualized within economics from the mid-19th century to the present day. They distinguish three major chronological phases: the classical age (1860s-mid-20th century), the modern age (1970s-1990s), and the contemporary age (since the early 2000s).

In the classical age, the focus mainly pertained to the field of macroeconomics: the driver was the concerns about resource scarcity. The historical examination grounds its roots in the 19th century with the pioneering work of William Stanley Jevons. In his famous work "The Coal Question" (1865), Jevons first articulated what is now known as the "rebound effect" at the macroeconomic level. He observed that an increase in technical efficiency in the use of a resource, such as coal, did not necessarily lead to a decrease in its total consumption. On the contrary, by making energy cheaper, efficiency stimulated its wider use and new applications,

potentially increasing aggregate demand. In other words, Jevons' paradox means that efficiency gains can increase overall energy use. This insight, though debated over time, laid the foundation for future discussions on the limits of technical progress in reducing energy demand and paved the way for the concept of "induced demand".

The modern age shifted to a microeconomic lens, coinciding with the oil crisis of the 1970s. It introduced the concept of the energy efficiency gap, emphasizing underinvestment in cost-effective efficiency improvements. This era saw the application of public economics to energy policy, distinguishing between market barriers (e.g., risk, heterogeneity) and market failures (e.g., externalities, asymmetric information), as articulated in the influential work of Jaffe & Stavins (1994). It is important to note that the "energy efficiency gap" means that adoption is below the socially optimal level, for example, because energy prices do not adequately reflect environmental externalities, whereas the "energy efficiency paradox" refers to the concept that some energy efficiency technologies that would be profitable for those who adopt them are nevertheless not adopted (Gerarden et al., 2017; Schleich et al., 2016).

In the contemporary age, the focus turned to behavioral economics and empirical rigor. Energy efficiency became a testing ground for studying the deployment of policy nudges. Research moved from the concept of energy efficiency gap towards the one of "energy performance gap". This latter is defined as the difference between predicted and actual savings, which was observed in large-scale retrofit programs (Astier et al., 2024; Charlier, 2021; Glachant & Blaise, 2019). Despite technical promise, empirical findings have shown modest average savings, fostering the debate among economists. In their article, Giraudet & Missemmer, (2023) note persistent controversies – particularly over the magnitude of rebound effects and actual savings from efficiency interventions. They argue that while economic perspectives have evolved alongside broader trends in the discipline, consensus remains elusive. To address this, they propose updating Jaffe et al.'s framework by integrating behavioral dimensions and

considering additional markets (e.g., finance, real estate) that affect energy efficiency outcomes.

Figure 1 illustrates their framework.

In conclusion, their historical perspective underscores the interdisciplinary nature and policy relevance of energy efficiency, calling for the renewed inclusion of macroeconomic approaches and a stronger dialogue with the broader social sciences.

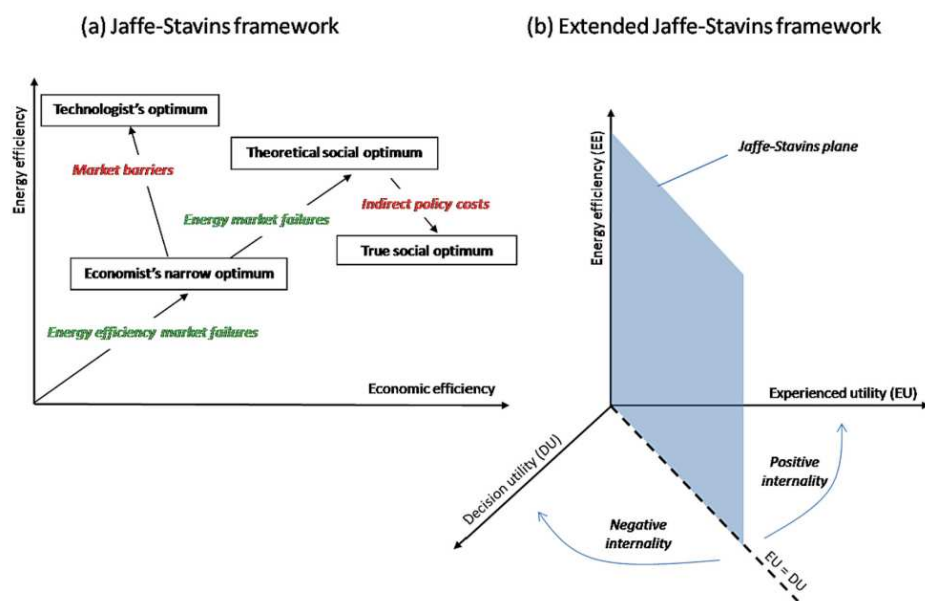


Figure 1 Jaffe & Stavins' (1994) original diagram and Giraudet & Missemmer (2023) extension proposal.

1.2 Economic Rationale for Public Intervention in Energy Renovations

Improving the energy performance of buildings is widely acknowledged as a key lever for achieving climate neutrality, given that buildings account for over one third of the EU's greenhouse gas emissions and energy consumption (IEA, 2024). However, market forces alone often fail to deliver the scale and speed of renovations needed to achieve broader societal goals such as emissions reduction, energy security, and social justice. As a result, public intervention becomes justified if not essential. The economic rationale for such intervention is rooted in foundational principles of welfare economics and supported by insights from environmental and public economics. In the next subsections, we will analyse several barriers to energy efficiency retrofits, spanning from market failures to behavioural biases.

1.2.1 Barriers to Energy Renovations

Following Richards (2023), rather than relying solely on a simplified distinction between regulatory and market-based instruments, we adopt a comprehensive framework based on the First Fundamental Theorem of Welfare Economics. Recall that in a basic economic model, it is assumed that there is a market for every private good, and this market determines the value of that good. The theorem establishes that, under a set of idealized conditions – perfect competition, complete markets, and perfect information – any competitive equilibrium is a Pareto efficient allocation, which coincides with the concept of economic efficiency. Indeed, a Pareto optimum allocation is one in which no individual can be made better off without making someone else worse off, implying that all opportunities for mutually beneficial trade have been realized. In perfectly competitive markets, there is a price for each good as well as the atomicity of supply and demand². Under these conditions, there is no reason for the State to intervene to increase market efficiency. When it comes to the context of energy renovations, this suggests

² The presence of numerous buyers and sellers means that no one can influence the price.

that homeowners or property developers should invest in upgrades such as insulation, efficient heating systems, or double glazing whenever the private benefits outweigh the costs. In such a scenario, decentralized decisions guided by market-price signals would result in a socially optimal level, rendering public intervention unnecessary. However, the real-world characteristics of the renovation market deviate significantly from the assumptions of the theorem.

The literature proposes a theoretical framework that categorizes barriers to energy efficiency as either internal or external. **Internal barriers** are primarily linked to individual preferences and behavioral factors, while **external barriers** are shaped largely by institutional and structural conditions (for a review see: Cattaneo, 2019). We will introduce the latter first: namely, externalities, market failures, and information asymmetries. These three are then interlinked with internal barriers, which will be analysed together with the issue of information asymmetries³.

1.2.2 Externalities

One of the most prominent market distortions arises from **externalities**. Remember that externalities can be defined as:

“The indirect effects of one agent’s consumption or production activity on another agent’s utility function, without the affected individuals being involved in the decision-making process that led to this externalisation.”

Note that these effects do not act through a price system: indeed, externalities are an off-market phenomenon. They can be positive or negative depending on the consequences they

³ Notice that the distinction between internal and external barriers is more theoretical than practical (see: Cattaneo, 2019).

have on individuals outside the decision-making process. In the presence of externalities, the competitive equilibrium no longer coincides with the Pareto optimum.

The building sector is responsible for negative externalities in the form of greenhouse gas (GHG) emissions (e.g., from fossil-fuel-based heating systems) and air pollution, both of which contribute to the deterioration of public health (WHO, 2018). Since pollution is not traded in markets, its costs are not reflected in prices. Nevertheless, its consequences are evident, affecting both the environment and individuals in different ways. Environmentally, pollution damages ecosystems and contributes to biodiversity loss. For individuals, it reduces overall well-being, with adverse effects on both physical health and psychological conditions. These effects highlight how pollution blurs the line between the economy and the environment, showing that economic activity can have serious impacts beyond markets or prices. Furthermore, as mentioned before, agents who suffer from externalities do not participate in the decision-making process for the externality.

On the contrary, energy renovations should generate positive externalities in the form of reduced GHG emissions and lower pollution, which result in improved public health (IPCC, 2022). Nonetheless, as positive externalities, their societal benefits are not reflected either in the market price of energy or in the homeowner's direct economic calculus. As a result, individuals often underinvest in renovations from a social welfare perspective. This misalignment due to positive and negative externalities constitutes a strong rationale for corrective public policies in the energy renovation market.

Consequently, to restore market efficiency in the presence of externalities, mechanisms must be created to incorporate these external costs (negative externalities) and benefits (positive externalities) into market prices. Several proposals have been made in the literature to internalise externalities in market prices. The idea is to achieve the socially optimal level of

pollution, defined as the level of pollution that takes into account the interests of society as a whole. Agents are divided into polluters and polluted.

The literature distinguishes between decentralized and centralized solutions, depending on the role assigned to the State in internalizing externalities. In this thesis, the focus is on centralized approaches and, more specifically, on their implementation in the field of energy renovations.

In the case of negative externalities, two main policy instruments are generally considered: Pigouvian taxes and quota markets. Conversely, when positive externalities are at stake, governments may intervene through Pigouvian subsidies. This is precisely the case of subsidies for energy renovations, whose objective is to overcome households' underinvestment in energy efficiency, encouraging the uptake of energy renovations. In fact, individuals often lack either the information or the motivation to undertake efficiency upgrades, even when these investments would bring long-term benefits such as lower energy bills and reduced pollution. The uncertainty of future gains contributes to what is known as the energy efficiency paradox, thereby justifying public intervention to encourage retrofits and ensure that their wider social benefits are realized.

We can categorize the centralised approach in three broad families: i) regulatory framework, the so-called command and control approach; ii) the Pigouvian tax (or subsidy), from its proponent Arthur Cecil Pigou (1932); and finally, iii) the establishment of a quota market. We will focus our description on the first two mechanisms.

In a centralized framework, the state can adopt a standards-based approach to environmental regulation. This involves setting pollution limits that reflect the socially optimal level of emissions. Two main standards are used: pollution standards, which establish maximum allowable emission levels, and performance standards, which require the adoption of specific technologies or practices. While both approaches aim to reduce pollution and internalize

externalities, they do not reveal the actual cost of pollution. In other words, the price signal associated with environmental damage remains hidden for market agents. Note that these standardization policies may be accompanied by “nudges” aimed at promoting the behaviour envisaged by the legislator.

Pigou (1932) argues that negative externalities pose a problem because they are not priced within the market system. As a result, economic agents fail to consider these external costs when making decisions, leading to a divergence between competitive equilibrium and the Pareto optimum allocation. To address this, Pigou proposes a corrective tax – the Pigouvian tax – where the state intervenes to assign a price to the externality. By doing so, the government substitutes the market mechanism and restores optimality. The tax is set where the marginal damage (Dm) equals the marginal benefit (Bm) of emissions at the socially optimal level:

$$t = Dm(E^*) = Bm(E^*)$$

This reflects the cost of the externality and internalizes it within the economic system, following the polluter-pays principle. As we mentioned, Coase offers a different explanation, linking the existence of externalities to poorly defined property rights. Nevertheless, Pigou’s approach focuses on the lack of pricing as the source of inefficiency, thus justifying state intervention for artificially setting the price.

Pigou also discusses the possibility of using subsidies instead of taxes. In this case, the government compensates the victims of pollution rather than taxing the polluters, providing incentives to adopt cleaner behavior. Note that while both approaches aim to achieve the same environmental outcome, their redistributive effects are different: subsidies require public spending, whereas taxes generate revenue for the government. It is then crucial to distinguish between Pigouvian – incentive-based – taxes and contributive taxes. Contributive taxes are primarily used to finance public spending and distort economic decisions, reducing efficiency.

Pigouvian taxes, on the other hand, are designed not to raise funds, but to modify behaviour by targeting externalities directly – the tax base is pollution, not income or consumption. In practice, however, this distinction is often misunderstood. The carbon tax increase in France in 2018, which coincided with a rise in oil prices, triggered the “Gilets Jaunes” movement. Many perceived the tax as a fiscal measure rather than an environmental one. While the intention was to reduce emissions, not all individuals had viable alternatives and thus bore the financial burden (see: Douenne & Fabre, 2022). A carbon tax without redistribution is regressive, a direct consequence of the fact that, in the Western world, the energy demand has an income elasticity slightly below unity. Indeed, the fraction of income spent on the tax is higher for low-income households (Blanchard et al., 2022). While carbon taxes are often perceived as regressive and punitive, there is broad support for green infrastructures and subsidies for green technologies and thermal insulation (Blanchard et al., 2022; Dechezleprêtre et al., 2022). One effective way to exercise a carbon tax compensation, would be to use its revenues for energy retrofit subsidies, as studied in Bourgeois et al. (2021). Otherwise, a measure designed as a Pigouvian tax may be widely perceived by the public as a normal contributive tax if accompanied by insufficient information.

A solution that stands at the intersection between centralized and decentralized internalisation is the creation of market quotas. As outlined by Blanchard et al. (2022) “a carbon tax puts a price on carbon emissions and thus makes economic actors accountable for their pollution. The cap-and-trade system is an alternative approach to taxing carbon. Since 2005, Europe has subjected the electricity, aluminum, cement, and other industrial sectors – representing around 40 percent of the EU’s greenhouse gas emissions – to this different form of carbon tax.” The cap-and-trade method cited is a reference to the proposal of creating a pollution permit market system, first proposed by Crocker (1966) and Dales (1968). The trade of permits will generate a price for pollution, and it is the State that gives the allowance for

polluting until a certain threshold (the pollution quotas available in the market). Nonetheless, this solution is behind the scope of this thesis and has little to do with the case for subsidies for energy renovations. Thus, we will focus on subsidies for energy retrofits as an example of Pigouvian subsidy aimed at encouraging the uptake of household energy renovation.

1.2.3 Information and Behavioural Barriers

A second and particularly persistent barrier is information asymmetry. Households and property owners frequently lack access to reliable information on the energy performance of their buildings, the costs and expected savings of renovation measures, or the quality of available service providers. In other words, it is difficult for the contractor to understand which work is the most efficient and the types of material to be used. Consequently, workers in the sector must be trained and behave correctly and not cheat customers about the real quality of the renovation work. Such asymmetries make energy efficiency renovations a “market for lemons” (Akerlof, 1970), as is the case for medical treatments, assurances, and car repairs. Energy retrofits, in such cases, assume the value of “credence goods”: goods whose value is never fully revealed to the buyer, even long after purchase (Giraudet, 2020). Moreover, households and dwellings are heterogeneous: the return on investment is very specific to the investor and the kind of energy renovations performed. Nonetheless, we should expect that the return on energy renovations goes hand in hand with the quality of the building: it is expected to be higher for old and very inefficient houses (Risch, 2013). Similar knowledge gaps are further compounded by behavioral biases, such as status quo bias, time inconsistency, and distrust of contractors, which lead to inertia even in the presence of financially rational renovation opportunities.

Another issue concerns the different behaviour of households living in rented accommodation compared to those who own their homes: tenants are less likely to have an

energy-efficient heating system than homeowners. This may be related to the split incentives between landlords and tenants: households that do not pay for heating directly, but have these costs included in their rent or service charges, opt for greater thermal comfort and therefore higher energy consumption (Gillingham et al., 2012). To address these barriers, governments have developed a range of instruments aimed at increasing awareness, improving transparency, and building trust in the renovation process. For instance, France's FAIRE initiative (Faciliter, Accompagner et Informer pour la Rénovation Énergétique), launched in 2018, combined media outreach with free personalized advice for homeowners – later integrated into the broader France Rénov' scheme in 2022⁴. At the EU level, the BUILD UP portal was launched in 2009 and continues to provide resources and updates to support energy efficiency in buildings across member states⁵. These instruments play a key role in overcoming informational barriers and stimulating demand for energy renovations, particularly by making the benefits of efficiency improvements more visible and accessible to the general public.

So far, we have described the external barriers to energy efficiency renovations. When it comes to internal barriers, instead, in recent years, behavioural economics has offered valuable insights into why households often fail to invest in energy efficiency measures, even though such investments appear economically rational. Traditional models assume that individuals act as fully rational agents and struggle to account for the persistent under-adoption of cost-effective energy renovations. As discussed by Cattaneo (2019), a range of behavioural factors – including cognitive biases, heuristics, and non-standard preferences – can help explain the gaps between expected and actual behaviour.

Schleich et al. (2016) distinguish the different factors underlying the individual's high implicit discount rates (IDRs). Discount rates play a crucial role in model-based policy

⁴ For further details see: <https://www.prefectures-regions.gouv.fr/hauts-de-france/Actualites/Energie-Faciliter-Accompagner-et-Informer-pour-la-Renovation-Energetique-des-logements>

⁵ BUILD UP portal available at: <https://build-up.ec.europa.eu/en/home>

assessments, such as energy efficiency policy assessments. In economics, the discount rate can be defined as the rate used to calculate the present value of a future payment. In other words, it reflects how much individuals value the future over the present (Hassett & Metcalf, 1993). In the scope of energy renovations, it highlights how much individual value the future benefits of investing in energy retrofits. Schleich et al. (2016) highlight three broad categories of factors underlying the IDRs for household adoption of energy-efficient technologies (EETs): i) preferences; ii) (ir)rational behaviour; iii) external barriers [for a graphical summary, see Fig. 2].

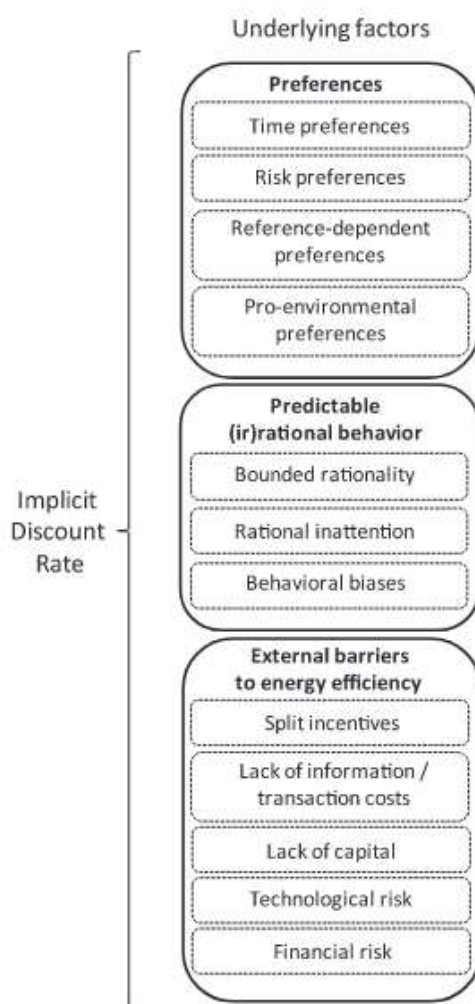


Figure 2 Factors underlying the implicit discount rate in Schleich et al (2016)

One key issue is present bias, where individuals give disproportionate weight to immediate costs over future benefits. This is particularly relevant for energy renovations, which often involve high upfront costs but deliver savings only over time. Among the various factors, bounded rationality plays a role: people face limits in their ability to process information, especially when it is complex, abstract, or presented in unfamiliar formats. As a result, consumers may overlook long-term savings or undervalue the benefits of EETs. This is linked with the issue of energy retrofit works as “credence goods” (Giraudet, 2020). Similarly, status quo bias leads individuals to stick with existing technologies and behaviours, even when better alternatives are available.

Such insights have practical implications for policy design. Behaviourally informed interventions, often referred to as “nudges”, can help address these barriers in subtle but effective ways. For example, programs that set energy-efficient options as the default (such as default thermostat settings or opt-out enrolment in green energy plans) can take advantage of inertia rather than fighting it. Loss-framed messages, which highlight the potential losses from not acting (rather than the gains from acting), have also been shown to be more persuasive in encouraging energy-saving behaviour (Abrahamse et al., 2007). Likewise, goal-setting and commitment programs give individuals a reference point and can help overcome impulsivity or a lack of self-control. Providing clear, simple, and tailored feedback, or using visual tools like thermal images to show heat loss, can make energy inefficiency more visible and concrete (Goodhew et al., 2015). These kinds of interventions are thought as especially useful for tackling (ir)rational inattention, where consumers do not focus on energy costs unless prompted to do so.

Finally, in her literature review, Cattaneo (2019) stresses that policy effectiveness can be improved by better targeting. People who already value environmental protection may be more responsive to messages that align with their values, such as appeals to social or environmental responsibility (Steg et al., 2014).

Overall, behavioural economics does not replace traditional policy tools but complements them. By recognising how people make decisions, rather than how they should, it allows for the design of more effective, realistic, and inclusive energy efficiency programs. Although an in-depth analysis of behavioural economics is beyond the scope of this thesis, it was important to highlight its role in understanding the complexities and effectiveness of energy efficiency policies, especially in increasing the adoption of energy-efficient solutions by households.

1.2.4 Liquidity Constraints to Energy Renovations

Another obstacle to undertaking energy-saving renovations is the liquidity constraint. Many households, particularly low-income ones, do not have collaterals, and credit institutions are reluctant to grant them loans. In a vicious circle, they face liquidity constraints to invest in energy-saving technologies, even though their energy expenditure accounts for a significant share of their budget (Steg et al., 2014). Indeed, energy is a merit good, meaning that the share of households' energy expenditure decreases as income grows⁶. Furthermore, it is no secret that low-income households usually live in older buildings, which are the worst in terms of energy efficiency, thus reinforcing the vicious circle mentioned above. For this reason, part of our work will consist of informing policymakers to encourage incentives for this population group, in order to avoid wasting public money, improve building efficiency and reduce greenhouse gas (GHG) emissions.

1.2.5 Uncertainty

One possible explanation for the “energy efficiency paradox” is offered by Hassett & Metcalf (1993), who argue that two key features – uncertainty over future energy savings and the irreversibility of such investments – significantly influence decision-making. As Risch summarizes, the volatility of energy prices makes it difficult to predict returns on energy-saving technologies, and once implemented, these investments (like insulation) cannot be reversed or resold if prices fall. This discourages immediate action and results in households applying high implicit discount rates to energy efficiency projects – often much higher than those used for similarly risky investments. Hassett & Metcalf (1993) modeled a 15% tax credit and found its effectiveness limited by this underlying uncertainty. Therefore, according to Risch

⁶ Empirical evidence of this phenomenon in Italy can be found in the works of [Colabella et al. \(2024\)](#); [Faiella et al., \(2022\)](#); [Faiella & Lavecchia \(2021\)](#) (cited in (de Blasio et al., 2024)).

interpretation, mandatory performance standards might be more effective, as they are not subject to consumer expectations about future savings. In France, such regulations were introduced for new buildings in 1974 and extended to renovations in 2008 (Risch, 2013).

In sum, the case of energy renovations illustrates the gap between theoretical market efficiency and empirical evidence. The assumptions underpinning the First Fundamental Theorem do not hold in the energy renovation sector. This is why market outcomes fall short of what is socially optimal. Public intervention is not merely justified on normative grounds but becomes necessary to address concrete economic inefficiencies. By identifying and targeting some of the specific market failures we briefly discussed (e.g., externalities, public goods, and information barriers), policymakers can design more effective, targeted instruments to steer private investment toward climate-aligned renovation efforts.

1.3 Residential Energy Consumption Determinants

It should be noted that the thesis aims to assess the economic effectiveness of subsidies for energy renovation to boost both energy efficiency and the ecological transition, following the “win-win” call for energy renovations. In addressing this issue, we focus in particular on the residential sector, as its response to public subsidies has been extensively studied in the literature. In the next chapter, we will present the state of play in energy renovations in the residential sector for France and Italy. In that context, we will discuss which policies were implemented by the two countries to ease households undertaking renovations.

But to better discuss the next chapter, it is worth first introducing the determinants of households’ energy consumption. The determinants of energy consumption can be examined at several levels: one of the most common is the distinction between consumption linked to household behaviour and consumption linked to dwellings characteristics. Risch (2013), using

a discrete-continuous methodological framework, found that households' sociodemographic characteristics play a weak part in explaining the amount of energy used. Indeed:

“Energy consumption is largely determined by dwelling quality and energy prices. In particular, it appears that the replacement of collective heating systems with individual heating systems can help significantly decrease energy consumption in the residential sector. To be efficient, an environmental policy must encourage households to renovate and adopt energy-efficient equipment.” (Risch, 2013, p. 21)

Building on Risch's findings, the distinction between household behaviour and dwelling characteristics is relevant to understanding which policy levers are more effective in triggering energy-saving renovation works. For what **household-related determinants**, these include income level, household size, age composition, and environmental awareness.

Although Risch found that sociodemographic characteristics have a relatively weak influence on energy consumption, other studies suggest that behavioural patterns – such as preferred indoor temperature, habits related to ventilation, and appliance usage – can nonetheless play a significant complementary role in determining energy demand (Frederiks et al., 2015; Guerra-Santin & Itard, 2010). Moreover, households' willingness to invest in energy renovation is often influenced by perceived costs and expected benefits, as well as by the availability of information and trust in energy service providers.

For dwelling-related determinants, instead, the most significant factors concern the thermal performance of the building envelope (insulation, window quality), the age and type of the building, the heating and cooling systems in place, and the energy source used. Buildings constructed before energy performance regulations were implemented are generally less efficient and more energy-intensive. Dwelling tenure (ownership vs. rental) and the availability

of renovation financing are also relevant, as they affect the incentives and capacities to undertake energy-saving investments⁷.

A key point that emerges from the literature is that the structural characteristics of buildings tend to explain a greater share of energy consumption than household behaviour alone. Consequently, public policies aiming to reduce residential energy demand should primarily target the physical renovation of dwellings, particularly in countries like France and Italy, where a large proportion of the housing stock was built before the 1980s⁸. Figure 3 provides a comprehensive map of the multifaceted sources of pollution in the residential sector, deconstructing this issue into its fundamental components and illustrating the various available policies for public intervention (Ministère de la Transition écologique, 2020). Heating is a clear protagonist. The vast majority of emissions associated with a building's daily operation stem from the energy required to heat its spaces, with hot water production following as a significant, though secondary, contributor. This immediately highlights that the thermal performance of a building is the most critical area for action. The diagram then identifies the underlying forces driving this energy consumption. On the left, it lists a series of key determinants, ranging from the intrinsic physical characteristics of the building – such as the quality of its insulation (the “performance of the envelope”) and the efficiency of its installations – to human and economic factors, like occupant behavior (“intensity of use”) and the carbon intensity of the energy source itself. It is precisely these levers that energy renovation policies, such as the subsidy schemes analyzed in this thesis, aim to influence.

⁷ This relates with the split incentives problem, aforementioned (Gillingham et al., 2012).

⁸ See the sections about the state of play of the Italian and French residential sectors.

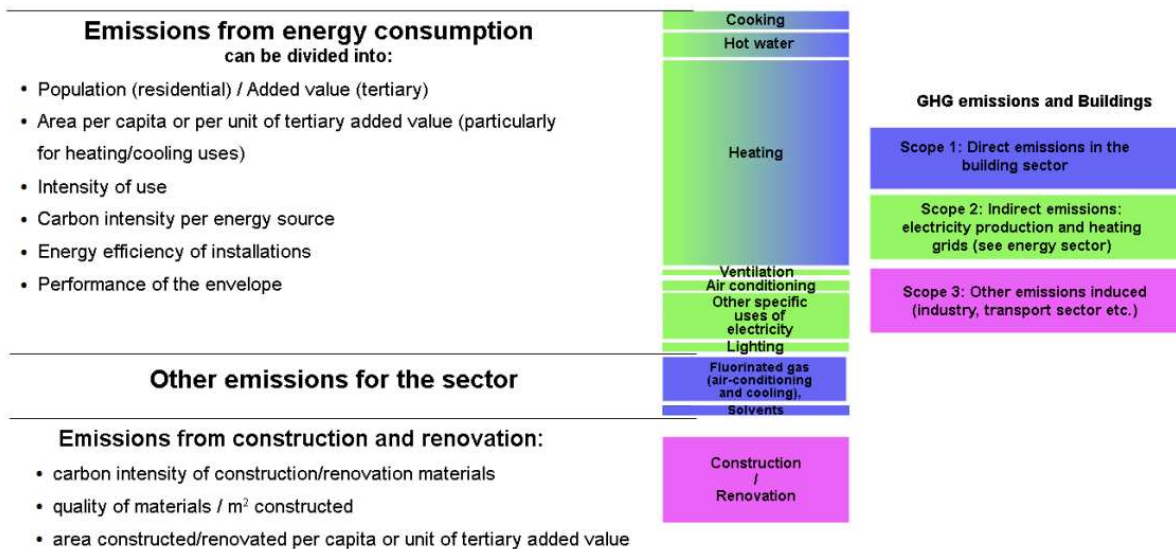


Figure 3 GHG Emission in the Residential/Tertiary Sector. Source: (Ministère de la Transition écologique, 2020)

Beyond these daily operational emissions, the framework introduces another, often overlooked, dimension: the embodied emissions from construction and renovation. These are the emissions generated not from using the building, but from the construction process – for example the usage of manufacturing materials like cement and steel.

Finally, the diagram on the right classifies these different streams using the standard GHG Protocol framework. The direct burning of fuel for heating on-site is categorized as Scope(1). Emissions from power plants that supply electricity and heat to the building fall under Scope(2) and are considered indirect emissions. The broader Scope(3) category captures all other induced emissions, most notably the embodied carbon from the construction supply chain.

Ultimately, Figure 3 tells a clear and compelling story: although the climate impact of a building is multifaceted, the path to decarbonisation runs directly through the boiler room and the walls of the building. Any effective policy must therefore prioritise deep renovations that address both the efficiency of heating systems and the thermal integrity of the building envelope itself.

1.4 Policy Instruments Against the Energy Paradox

The energy efficiency paradox, which results in lower-than-optimal investment in energy-saving technologies, highlights the need for public intervention to stimulate renovation and retrofitting activity. Across Europe, public policies play a crucial role in addressing the market failures and behavioral barriers that hinder households from engaging in energy-efficient improvements. Such interventions are essential for achieving significant reductions in energy consumption and greenhouse gas emissions.

Policymakers have a range of complementary measures at their disposal, generally categorized as informational, financial, and regulatory tools (Cattaneo, 2019; Risch, 2013).

Informational instruments aim to influence consumer behavior by increasing awareness and understanding. The goal is to overcome some of the information asymmetries we mentioned above. Among these kinds of policies, we can include energy labels on appliances, public awareness campaigns, and building energy performance certificates that provide transparency at the point of sale or rental (such as the Diagnostic of Energy Performance (DPE) certificate in France or the requirement for french enterprises to get the “Recognized Guarantor of the Environment”, Reconnu Garant de l'Environnement, RGE).

Financial incentives, instead, are used to reduce the upfront cost of energy-efficient investments. These include subsidies such as tax credits, reduced Value Added Tax (VAT) rates for renovation work, and zero-interest loans, such as those implemented through schemes like Italy's Superbonus 110% or France's energy-efficient renovation programs.

Lastly, **regulatory measures** enforce minimum standards and compliance. At the EU level, directives such as the Energy Performance of Buildings Directive (EPBD) have mandated member states to set minimum energy performance standards for new constructions and major renovations. Requirements for disclosing energy performance during property transactions and mandatory renovation targets for worst-performing buildings are also part of this regulatory

push. These three instruments are to be seen as complementary to one another and as the cornerstones for an effective energy renovation strategy.

A notable example of financial policy is the French tax credit for energy transition (Crédit d'impôt pour la transition énergétique, also known as CITE), which allowed households to deduct a portion of their renovation expenses from income taxes. We will further analyse this policy in the next chapter on French policies for energy renovations.

Despite these efforts, the effectiveness of environmental policies can be weakened by behavioral responses such as rebound effects, lack of trust in energy savings, or low uptake due to informational gaps. Therefore, designing coherent, well-targeted, and easily accessible policy frameworks remains a key challenge for governments. In the next subsections we will briefly introduce: the so-called “free riding” and the “rebound effect”.

1.4.1 Free Riding

Financial incentives face a significant challenge due to the presence of free riding, which occurs when households undertake energy renovation projects and receive public subsidies despite being likely to carry out the renovations even in the absence of such incentives. This is why the incentives have to be carefully implemented and targeted.

Olsthoorn et al. (2017) conduct an *ex ante* evaluation of the cost-effectiveness of rebate programs aimed at encouraging the premature replacement of residential heating systems in eight EU Member States. The study introduces a novel distinction between strong and weak free riders: the former refers to households already intending to adopt energy-efficient heating systems regardless of incentives, while the latter includes households that would adopt if made aware of the technology, but do not require a financial incentive. The authors estimate that free rider shares exceed 50% in most countries at rebate levels equal to 50% of the system cost. Their results are aligned with other *ex-post* studies in Europe (Alberini et al., 2014; Nauleau,

2014). Typically, weak free riders outnumber strong free riders, suggesting that information-based interventions could play a significant role in reducing unnecessary subsidy expenditures.

Olsthoorn et al. (2017) conclude that rebate programs alone are not cost-effective unless free riding is substantially reduced. They recommend a sequential policy approach, where information campaigns are first deployed to activate weak free riders, followed by targeted rebate programs for those still unwilling to adopt. This approach could significantly enhance program efficiency and fairness while moderating public expenditure. The issue of free-riding will be central in our evaluation of the Italian Superbonus, whose generosity may have incentivised a significant share of free-riders.

In addition, the design of public incentives to ease energy efficiency technologies adoption among households is further complicated by the fact that the costs and benefits of an investment vary significantly across individuals; what proves profitable for one person may not be so for another. The heterogeneity among agents plays a crucial role in explaining the variation in energy-efficient behaviors, as individuals differ in their time preferences, risk tolerance, and pro-environmental attitudes (Schleich et al., 2016).

It is worth to highlight that the phenomenon of free riding is closely linked to the principle of additionality of investments. When evaluating public policies on energy efficiency, the fundamental question is whether they have stimulated new investments that would not otherwise have been made (defined as “extensive margin” investments). If not, the next step is to assess whether the investments that would have been made anyway have increased in scale compared to a scenario without policies (intensive margin). This distinction will be particularly relevant when examining the case of CITE in France (Boomhower & Davis, 2014; Fack & Giraudet, 2024; Risch, 2020).

1.4.2 Rebound Effect

Another frequent criticism of energy efficiency policy evaluations is that they often overlook or inadequately take into account the rebound effect. The principle that improvements in energy efficiency reduce the marginal cost of energy services, leading to an increase in demand and, consequently, lower-than-expected reductions in overall energy consumption (Gillingham et al., 2009).

Although today's context is different from the debate of Jevons' times (see section 1.1), this paradox remains conceptually central to the evaluation of energy efficiency policies. Policymakers need to assess whether the energy savings achieved at the microeconomic level through the renovation of a residential building are partially, if not totally, offset by a subsequent increase in consumption (e.g., by maintaining higher temperatures inside the home).

In their literature review, Gillingham et al. (2006) acknowledge the existence of the rebound effect but emphasize that several empirical studies estimated that its magnitude is often overstated and unlikely to offset the overall benefits of most energy efficiency programs. Moreover, they highlight that the cost-effectiveness of such policies remains robust, particularly when accounting for environmental co-benefits, such as reductions in CO₂ emissions.

Nonetheless, Glachant & Blaise (2019) present an *ex-post* assessment of the impact of energy renovation work in the residential sector on energy expenditure, using data from the Maîtrise de l'Énergie survey (ADEME) from 2000 to 2013. They aim to assess whether energy renovation works led to a decrease in the energy consumption of households. The model identified a very modest effect of the work, since the additional expenditure in energy renovations leads to an average modest reduction in the annual energy bill (-0.64%). Their finding is that the discounted net benefit of renovating an average home is very negative, calling into question the relevance of public subsidies and grants for renovation if they are motivated solely by energy savings.

1.5 The EU Policy and Regulatory Framework

Energy efficiency has progressively emerged as a central pillar in the European Union's climate and energy agenda. As the EU pursues its climate neutrality target by 2050, reducing energy demand is not only a technical imperative but also a socio-economic priority. The policy framework surrounding energy efficiency combines binding legislation, strategic planning instruments, and significant financial mechanisms. This section outlines the main components of the EU's approach, with a particular focus on the Green Deal, the Fit for 55 package, the Renovation Wave strategy, the core directives, updated state aid rules, key funding channels (Recovery and Resilience Facility, Cohesion Policy), and the strategic role of the National Energy and Climate Plans (NECPs).

In 2022, the sector with the largest share of final energy consumption, defined as the amount of energy consumed by end-users in different sectors, was the transport sector, which consumed 31% of the total amount. The second largest sector was the residential sector, consuming 26.9% of the total amount. The industry sector came in third, with a share of 25.1%. The services sector was the least consuming, with a share of 13.5% (Tsemekidi Tzeiranaki et al., 2025). According to Eurostat, the main energy use by households in the EU in 2023 was for heating their homes (62.5% of final energy consumption in the residential sector), with renewables accounting for more than a quarter (33.0%) of EU households' space heating consumption. Other end-uses are: water heating (15,1%), cooking (6,5%), lighting appliances and electronic devices (European Commission, 2024).

Reducing or slowing the growth of residential energy consumption remains a core element of climate change mitigation strategies. According to the International Energy Agency (IEA), energy efficiency remains the “first fuel” of the clean energy transition, playing a pivotal role in mitigating the growth of global energy demand. In its assessments, the IEA emphasizes that efficiency improvements are indispensable for balancing rising consumption, particularly in

rapidly urbanizing regions, where energy demand pressures are expected to intensify in the coming decades (IEA, 2025).

The benefits of reducing energy consumption in the residential sector are manifold: it helps reduce energy import dependency, lowers local environmental impacts, and enhances household purchasing power through lower energy bills. Such factors make residential energy efficiency a priority area in sustainable development and energy transition policies (Charlier, 2018; Ryan & Campbell, 2012). Furthermore, renovations in the residential sector are crucial for a decarbonized economy given the low share of new buildings in the housing stock. While buildings erected after the 1980s consume about half the energy of earlier stock and are, since 2021, required to meet nearly zero-energy building (NZEB) standards, the energy transition in this sector cannot rest solely on new construction, notwithstanding its greater efficiency. With an annual growth rate of less than 1%, new buildings are unable to tip the balance in order to meet the 2030 targets (Ruggieri et al., 2023). The real priority, and at the same time the great opportunity, lies in upgrading the current building stock, which is largely energy inefficient. Around 75% of buildings in Europe do not meet high efficiency standards, and 80% of them are expected to still be in use in 2050⁹. For this reason, political action must focus its efforts on deep and widespread renovation of the existing building stock.

1.5.1 The Strategic Framework: Green Deal, Fit for 55, and the Renovation Wave

In 2019, the European Green Deal redefined the EU's long-term trajectory by setting the objective of achieving climate neutrality by mid-century. Within this strategy, energy efficiency is framed under the principle of energy efficiency first, requiring that demand-side solutions

⁹ Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – A Renovation Wave for Europe – Greening Our Buildings, Creating Jobs, Improving Lives (2020)

must be prioritised before investing in new energy supply. This principle marks a shift in policy design, recognising the socio-economic and environmental benefits of reducing consumption across all sectors, particularly in buildings, which account for approximately 40% of the EU's total energy use and 36% of greenhouse gas emissions (Maduta et al., 2023).

The Fit for 55 legislative package, presented in 2021, puts the Green Deal into action by revising key elements of climate and energy legislation in order to achieve the new interim target of reducing emissions by at least 55% by 2030 compared to 1990 levels. Among these, the revisions to the Energy Efficiency Directive (EED) and the Energy Performance of Buildings Directive (EPBD) are relevant for increasing the renovation of the building stock and energy savings.

The Renovation Wave Strategy seeks to double the annual renovation rate by 2030 and to ensure that at least 35 million building units are renovated. The strategy aims to address structural inefficiencies in the European housing sector, while also tackling energy poverty and promoting social inclusion. It prioritises the renovation of public buildings, social housing, and schools, and acknowledges the multiple co-benefits of energy renovation - from improved indoor air quality and comfort to job creation in the construction sector.

1.5.2 The Legislative Framework: EPBD, EED, and State Aid Guidelines

One of the main EU policies targeting both residential and non-residential buildings is the Energy Performance of Buildings Directive (EPBD), which was adopted in 2002 and then revised in 2010 and 2018. The EPBD is the EU's core legal instrument for improving the energy performance of buildings. Its latest revision in 2024 introduces minimum energy performance standards (MEPs), enhances the reliability and accessibility of Energy Performance Certificates (EPCs), and promotes the use of digital tools and lifecycle emissions assessments. The EPBD

thus plays a critical role in shaping long-term renovation strategies and in integrating climate goals into the building sector.

The Energy Efficiency Directive (EED), originally adopted in 2012, was recently updated in 2023¹⁰. It strengthens national obligations by increasing the overall 2030 energy efficiency target and introducing binding annual energy savings requirements. The revised EED sets a new target to reduce final energy consumption by 11.7% by 2030 (relative to 2020 projections), and reinforces governance mechanisms by requiring Member States to integrate energy efficiency across all levels of policymaking¹¹.

The 2022 revision of the Climate, Environmental Protection and Energy State Aid Guidelines (CEEAG) further contributes to aligning national support schemes with EU energy objectives. The guidelines enable Member States to subsidise energy renovation efforts – such as deep retrofits – under conditions that minimise distortions in the internal market and promote cost-effectiveness and transparency (CEEAG, 2022). This is something to bear in mind when assessing France’s and Italy’s subsidies to energy renovations.

1.5.3 Financial Instruments: Recovery and Resilience Fund and Cohesion Policy

Achieving the EU’s energy efficiency objectives requires substantial investment, particularly in the building sector, where, as we discussed in the theoretical framework, upfront costs and long payback periods often act as barriers. Several EU-level funding mechanisms support Member States in this domain.

The Recovery and Resilience Facility (RRF), introduced as part of the EU’s response to the COVID-19 pandemic, dedicates at least 37% of its expenditure to climate-related investments¹².

¹⁰ Directive (EU) 2023/1791 of the European Parliament and of the Council on energy efficiency (2023)

¹¹ For a definition of primary and final energy consumption see: <https://ourworldindata.org/energy-definitions>

¹² (Regulation (EU) 2021/241 Establishing the Recovery and Resilience Facility, 2021)

In that context, many National Recovery and Resilience Plans (NRRPs) allocated a significant share of funds to energy renovation to restore the building stock. For instance, Italy's National Recovery and Resilience Plan (NRRP) dedicates over €15 billion to energy efficiency in residential and public buildings, including tax incentives, local renovation schemes, and social housing interventions (Diana, 2021). The Cohesion Policy Funds – particularly the European Regional Development Fund (ERDF) and the Cohesion Fund – continue to support energy efficiency in regions facing structural disadvantages. Moreover, the 2021-2027 programming period emphasises green priorities, with targeted support for urban regeneration and public infrastructure retrofitting.

1.5.4 The Role of National Energy and Climate Plans (NECPs)

Under Regulation (EU) 2018/1999 on the Governance of the Energy Union, Member States are required to submit National Energy and Climate Plans (NECPs), outlining their 2030 targets and policy measures across five dimensions: decarbonisation, energy efficiency, energy security, internal market integration, and research and innovation.

NECPs are central to the coordination between national and EU-level energy policy. They serve as planning, monitoring, and reporting tools, ensuring consistency between EU objectives and domestic implementation. In the context of energy efficiency, NECPs must include concrete measures to increase renovation rates, address barriers such as energy poverty or the landlord-tenant split incentive, and detail investment needs and financing strategies. In the context of French policies we will refer to the National Low Carbon Strategy (SNBC).

To sum up, the EU policy and regulatory framework on energy efficiency reflects an increasingly integrated approach that combines legislative instruments, strategic planning, and financial support. As buildings represent one of the most significant yet still underexploited sources of energy savings, the European Union's strategy places renovation at the crossroads of climate action, social inclusion and economic recovery. The alignment between EU directives,

funding mechanisms, and national planning processes represents a key test for the credibility and effectiveness of the EU's energy transition.

Chapter Conclusions

This chapter outlined the economic and political reasons for public intervention in energy renovations, highlighting the persistence of market failures, externalities and behavioural barriers that limit private investment in energy efficiency. Indeed, from an economic point of view, energy renovation is a positive externality, and its adoption should be incentivised via Pigouvian subsidies. Moreover, governments think of this subsidies as a energy renovations are a “win-win” scenario, allowing to reduction of energy demand (and money) and reducing environmental externalities. After having described the theoretical framework, the analysis also introduced the European regulatory and financial framework, showing how EU instruments seek to align national policies with climate neutrality objectives.

Chapter 2: Overview of Energy Renovation

Policies in France and Italy

Having established the theoretical framework for public intervention in the energy renovation sector in Chapter 1, this chapter moves to a practical application of the latter. It provides a detailed analysis of the policy strategies used in France and Italy, two nations that serve as key case studies within the European context. Both countries have launched large-scale, yet different, subsidy programs to speed up the decarbonization of their aging housing stocks. The chapter will first examine each country's policy framework individually, detailing the evolution of its subsidy instruments, its specific design, and the context in which they operate. Indeed, to better understand the rationale behind subsidy programmes, it is necessary to present the specific challenges and characteristics of the national contexts. Therefore, section 2.1 outlines the current state of the French residential sector, its contribution to national greenhouse gas emissions and the ambitious decarbonisation targets set by the government. In section 2.2, we will do the same to present the Italian case. The aim is to provide a comprehensive description of the different policy frameworks in place in the two countries.

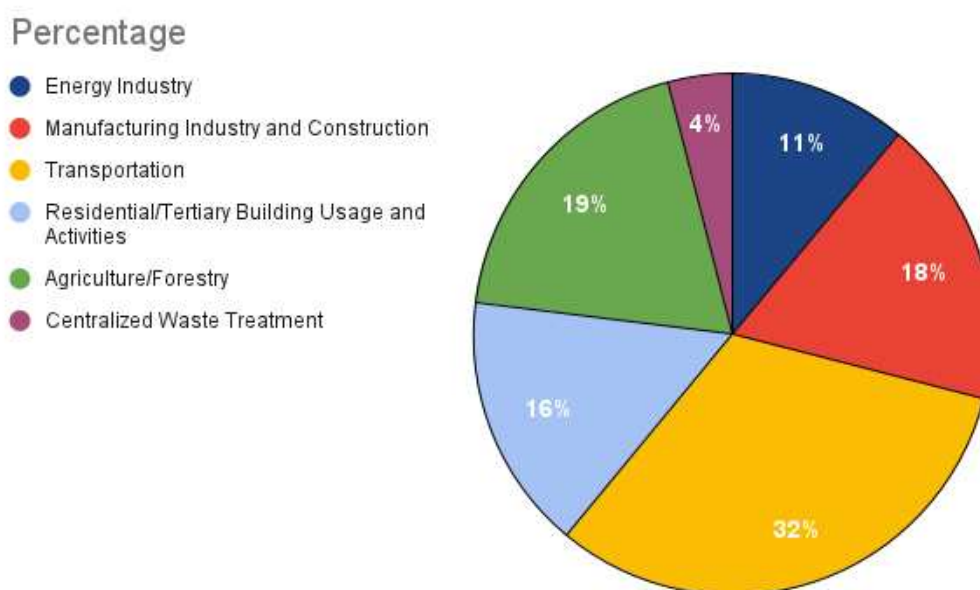
By understanding each system on its terms, we lay the groundwork for the direct comparative analysis that will follow in Chapter 3.

2.1 The French Residential Sector: State of Play and Challenges

To address the case of France, we will base our work on the policy notes published by the *Conseil d'analyse économique* (CAE) in June 2024. These notes, published annually and drafted independently by CAE members, offer observations and recommendations on a variety of topics. In fact, Note 2024/1 No. 81 is dedicated to public policies for energy renovations and

includes four Focuses (Nos. 103, 105, 106, 107), which further analyse the topic of energy renovations in its many aspects.

In 2022, GHG emissions in France, excluding “Land Use, Land-Use Change and Forestry” (LULUCF), were 2.7% lower than in 2021, and 25.1% lower than in 1990. Transport is the leading emitting sector in 2022, with 130.5 Mt CO₂ eq (32.3% of emissions excluding LULUCF), followed by agriculture (19%), manufacturing and construction (18.1%), the energy industry (11%), and centralised waste treatment (3.8%). France differs from other EU countries in that its share of emissions from the energy industry is low due to the high proportion of nuclear power in electricity production (Service des données et études statistiques (SDES), 2023). The residential sector accounts for 16% of national emissions; therefore, the building sector is one of the largest contributors to greenhouse gas emissions in France. Nearly two-thirds of emissions come from residential buildings and are mainly due to heating, making this sector a priority for decarbonisation. Below is the figure for France’s emissions by sector in 2022.



*Figure 4 Greenhouse Gas Emissions by Sector in France in 2022 (provisional estimate);
Source: (SDES, 2023, p. 53)*

To address decarbonisation, the French National Low Carbon Strategy (Stratégie National Bas-Carbon, SNBC)¹³ sets specific targets for energy-efficient home renovation: 370,000 efficient renovations per year, then 700,000 from 2030 onwards, to achieve “low-energy buildings” (LEBs) by 2050 (Ministère de la Transition écologique, 2020). These national targets are ambitious, given the current rate of around 66,000 energy-efficient renovations per year, reported in 2022 by the Agence nationale de l’habitat (Anah) in Fack & Giraudet (2024). Meanwhile, the French residential sector consumes 30% of the total energy consumption, more than does the industrial sector, and nearly a similar amount to that of the transportation sector. Moreover, approximately 60% of existing French residential dwellings were built before 1975 (Fack & Giraudet, 2024).

The main aims of the strategy (SNBC 2) for the sector are twofold: **i)** a 49% reduction in emissions by 2030, compared to 2015 levels; **ii)** the achievement of full decarbonisation by 2050, in line with the national carbon neutrality target. In fact, one of the most pressing challenges is that, by 2050, 70% of the building stock could be made up of buildings constructed before 2012. Renovating this part of the building stock is essential to reduce energy consumption during the operating phase. In addition, the scale of the project means that it will have to be phased in gradually, at the cost of very strong incentives (Ministère de la Transition écologique, 2020).

Referring back to the CAE analysis, it provides a strong justification for public intervention in the French energy renovation sector, highlighting a significant gap between private and social benefits. Figure 5 shows the profitability of investments to meet LEB standards and notes that, without policy support, only 5% of homes are renovated in a way that is profitable from a private perspective. This figure contrasts sharply with the 26% of homes

¹³ Here we refer to SNBC 2, as the strategy was revised in March 2020.

for which renovation would be profitable in a theoretically perfect market, free of frictions such as high financing costs, credit rationing or coordination problems between condominiums. This in itself confirms that public intervention is necessary and justified. Furthermore, when non-monetary external benefits – such as reduced CO2 emissions and improved health through better thermal comfort (positive externalities) – are included, the percentage of socially profitable renovations rises to 55%. This shows that most of these interventions, although not profitable for the individual, represent a valuable investment for society as a whole. To bridge the gap between the 5% that would occur without any incentive and the 55% that would be socially optimal, the document estimates a public funding requirement of around €6 billion per year until 2050 if France wants to achieve its carbon neutrality goals.

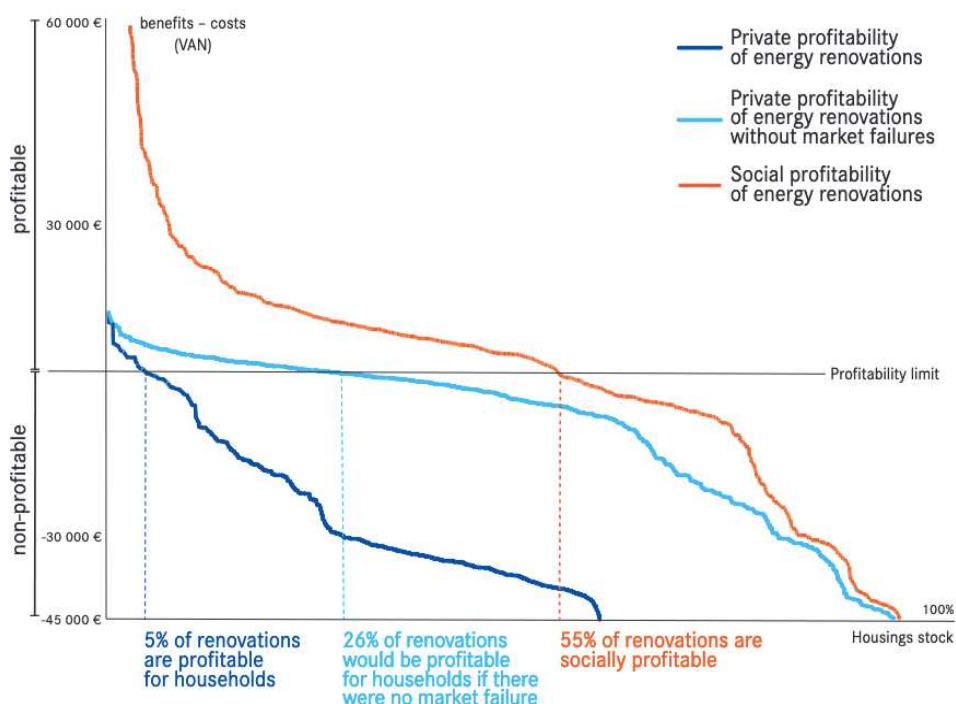


Figure 5 Private and social profitability of the renovation of the entire housing stock (net present value): form Figure 2 in Fack & Giraudet, 2024)

2.1.2 Historical Evolution of Incentives

The French case is a prime example of how the policy approach to energy efficiency has evolved from simple incentives to a more complex multi-instrumental system. Indeed, France's experience in residential energy retrofits clearly illustrates an evolutionary trajectory of public intervention strategies. Over the years, multiple energy renovation policies have been implemented, as well as cross-sectoral policies to reduce GHG emissions, such as a Pigouvian Carbon Tax. By increasing energy bills, it encourages both investment in energy efficiency and energy-saving behaviour. However, it can have the counterproductive effects mentioned in the theoretical framework: for example, it often translates into regressive policy. It may also end up exacerbating the health effects associated with heating restrictions for low-income households (Giraudet, 2020; Giraudet & Vivier, 2024).

In France, the price of CO₂ emissions was introduced in 2014 in the form of a “carbon tax” on fossil fuels. In autumn 2018, an increase in the carbon tax triggered the “yellow waistcoat” movement (“gilets jaunes”). Following strong protests, the French government decided to freeze the carbon tax rate at the 2018 level until 2022 (Giraudet, 2020; Giraudet & Vivier, 2024). The issue of an often widespread opposition to a Carbon Tax, which may be perceived as a regressive and contributive tax by public opinion, also deals with the degree of acceptability of a policy. Several studies have shown that subsidies are more widely accepted than taxes, even though they represent a significant cost to the public budget (Blanchard et al., 2022; Dechezleprêtre et al., 2022; Douenne & Fabre, 2022). This is also why subsidies offer a palliative to the limitations of a carbon tax and can be a complementary tool for legislators: recycling its revenues in the form of subsidies for energy renovation can more effectively reduce energy poverty and its associated health effects (Bourgeois et al., 2021).

With energy prices soaring after the Russian invasion of Ukraine in 2022, the theme of energy sobriety has taken hold in France, similarly to what was seen during the oil crisis in the

1970s. Facing such a time of uncertainty, the government brought in the idea that “the cleanest and cheapest energy is that which we do not consume”¹⁴. Guided by that principle, French governments have deployed an evolving toolkit that, as outlined by Fack & Giraudet (2024), can be analyzed as three distinct and overlapping waves of intervention.

The first wave was characterized by a primary reliance on financial incentives designed to stimulate voluntary action by lowering the upfront cost barrier for households. This initial phase saw the introduction of a diverse set of instruments, including a reduced VAT rate (5,5%) for renovation works in 1999, the landmark tax credit (Crédit d’Impôt pour la Transition Énergétique, CITE) in 2005¹⁵, the market-based White Certificates scheme (Certificats d’Économies d’Énergie, CEE) in 2006, as well as the zero-interest eco-loan (Éco-Prêt à Taux Zéro, EPTZ) in 2009. This approach aimed to make renovations more affordable and to trigger a large-scale market response, tackling the liquidity constraint and financial barriers for energy renovations. The flagship policy of this initial incentive-based wave was the tax credit for energy transition (CITE). As described by (Risch, 2020), the CITE instrument offered households, both owners and tenants, an income tax deduction for a significant portion of their energy-saving renovation expenditures, ranging from 10% to 50% depending on the specific equipment. The deductible expenses were capped based on household size. For instance, the maximum amount of expenses deducted depended on the number of people in the household (the maximum expenses deductible was €8000 for a household with one person and €16,000 for a couple). Essentially, the policy was designed to be widely accessible: there was no income limit to qualify, and households that did not pay income tax would have received a direct rebate, making the subsidy universally available¹⁶. The only condition was the requirement to hire a

¹⁴ For further analysis of the French public debate on energy sobriety in 2020, see the newspaper article by [Gable \(2022\)](#) published in *Le Monde* on 02/08/2022.

¹⁵ CITE was then turned in MaPrimeRénov’ (MPR) bonus in 2020. MPR provides support for energy renovation work at the time the work is carried out, with assistance proportional to household income.

¹⁶ However, since 2008, the deduction rate and eligibility conditions have changed.

qualified professional for the renovation work. The main equipment concerned by CITE were renovations on the heating systems, the insulation materials, as well as investments in the adoption of renewable energies. The CITE proved to be extremely popular, but it came at a significant fiscal cost. Considering only the period between 2005 and 2008, 4.2 million French households benefited from the tax credit, with public expenditure amounting to €7.8 billion during that period, and averaged around €2 billion per year from 2009 to 2011 (Clerc & Mauroux, 2010). The high cost of the program raised critical questions about its cost-effectiveness, paving the way for future reform in 2020 with the aforementioned introduction of the MPR scheme.

Therefore, **a second wave** of policy emerged, acknowledging that financial barriers were not the only barrier. This phase focused on tackling the pervasive informational market failures discussed in Chapter 1. To address information asymmetry and improve transparency for buyers and renters, the mandatory Energy Performance Certificate (Diagnostic de Performance Énergétique, DPE) was introduced in 2007: it categorizes dwellings' energy systems with labels spanning from A (best energy efficient) to G (worst energy efficient)¹⁷. Subsequently, to combat the issue of poor workmanship and build consumer trust – addressing the “credence good” nature of renovations (Giraudet, 2020) – the “Recognized Guarantor of the Environment” (Reconnu Garant de l'Environnement, RGE) label was made a requirement in 2014 for artisans to carry out subsidized works. Hence, the “informational wave” added new types of instruments to the existing financial ones.

Finally, **the third and most recent wave** marks a significant paradigm shift towards coercive regulatory measures. Recognizing that even the combination of financial and

¹⁷ Note that a renovation is considered efficient if it achieves the consumption thresholds of the A or B labels of the DPE. Nonetheless, the DPE instrument was the object of several criticisms regarding its gap between theoretical and actual consumption. As studied by [Astier et al. \(2024\)](#), the DPE system reveals a gap between theoretical and actual consumption, ranging from 20% for A homes to 70% for G homes. This difference can be explained by the fact that the less efficient the home, the greater the restriction on consumption (Fack & Giraudet, 2024).

informational tools was insufficient to achieve the necessary renovation rate, the French state has begun to move from incentivizing to mandating action. The flagship policy of this new phase is the progressive ban on renting out the most energy-inefficient homes, known as *passoires thermiques*. With a time horizon ranging from 2023 (G+ dwellings within the DPE) to 2034 (gradual extension to G, F, and E dwellings), this measure marks a fundamental change in strategy, in which regulatory obligation, rather than voluntary choice, becomes the ultimate driver to undertake the renovation of the worst-performing segment of the housing stock.

Finally, from 2020 onwards, the CITE and Anah (Agence nationale de l'habitat) subsidies have been merged under MaPrimeRénov' (MPR), now the main public funding source for energy renovations. To give an idea of the amount of funding, the annex to the Projet de Loi de Finance (PLF, 2024) reports that, in 2023, public expenditure amounted to approximately €2.4 billion for MPR, €2 billion for reduced VAT, and €45 million for the EPTZ¹⁸. The same document states that, between 2018 and 2024, the resources allocated to energy renovation of buildings have doubled and would have reached more than €12 billion in 2024.

2.1.3 How does the system work today?

As a result of this historical evolution, the current French framework for encouraging energy renovation does not consist of a single policy, but rather a complex ecosystem of interconnected instruments. The French multi-pillar approach combines different instruments with divergent properties and objectives, as summarised in Table 1.

In fact, the French legislator drew four policies at the disposal of the residential sector for undertaking energy efficiency technologies: **i)** MaPrimeRénov' (MPR), a direct, income-

¹⁸ It should be noted that this amount is much lower than the resources needed, estimated by the CAE at €6 billion per year until 2050, to achieve climate neutrality in the sector (Fack & Giraudet, 2024).

based grant that forms the centerpiece of the system;¹⁹ **ii**) the market-based Energy Savings Certificates (CEE) scheme, which operates in parallel for the private sector²⁰; **iii**) the Zero-Interest Green-Loan (Eco-prêt à taux zero, EPTZ), designed to cover remaining upfront costs; and **iv**) a reduced VAT rate on renovation works (Giraudet, 2024).

Although all these instruments contribute to the public support landscape, the following analysis will focus primarily on the CITE tax credit and its reform in the MPR. This operational choice is due to the possibility of comparing these two French public policies with the Italian subsidy system, based mainly on a tax credit, which we will analyse later.

	MaPrimeRénov' (MPR)	Energy Savings Certificates (CEE)	Zero-Interest Green-Loan (EPTZ)	Reduced VAT (5.5%)
Nature	Direct Grant	Premium / Bonus	Loan	Tax Reduction
Amount	Capped & Progressive	Flat-rate & Progressive	Capped	Proportional
Effect on Liquidity	Positive	Neutral	Positive	Neutral
Effect on Cost of Capital	Neutral	Neutral	Negative	Neutral
Distributional Effect	Progressive	Progressive	Progressive	Regressive
Leverage Effect	Positive	Positive	Positive	Positive
Effect on Deep Renovations	Positive	Low	Positive	Positive

Table 1 French Incentives for Energy Renovations. Source: Table 1 in Giraudet (2024)

¹⁹ MaPrimeRénov' was first introduced in 2020, substituting the previous 2005 tax credit regime CITE.

²⁰ The CEE scheme is based on an energy saving obligation imposed on [French] energy suppliers (electricity, gas, heating, cooling, domestic fuel oil, LPG, LPG fuel and motor fuels). Energy suppliers must encourage energy savings (in particular through energy renovation subsidies) to demonstrate to the government that they are meeting their energy saving obligations. The amount of the obligation implies a contribution from the private sector to the financing of the energy renovation policy: in 2023, it represented around €3 billion per year in aid for the renovation of the residential housing stock through standardised and specific operations (installation of efficient heating systems, insulation of housing, including for people in fuel poverty) (Giraudet, 2024; PLF, 2024). The system is an interesting example of the use of a quota market to boost energy renovations.

Past evaluations of France’s former tax credit (CITE) suggested a significant policy failure regarding its efficiency. The headline figure is indeed stark: empirical studies found that a staggering 80% of households receiving the subsidy would have undertaken renovations anyway, indicating a significant free-riding problem (Charlier, 2018; Nauleau, 2014; Risch, 2020). From this perspective – also identified as the “extensive margin”, or the decision to invest at all – the program appeared to be largely redundant, subsidizing actions that were already planned.

However, a deeper analysis reveals a more complex and nuanced reality. The overall assessment of the policy changes when we shift our focus to the “intensive margin” – meaning that we assess not whether households would have renovated anyway, but how much more they invested thanks to the subsidy. In this sense, the CITE proved to be more effective. Research demonstrated that a certain percentage of “free-riders”, prompted by the availability of the subsidy, significantly increased their spending on the renovation projects they had already planned, opting for deeper and more ambitious upgrades (Risch, 2020). When these two effects are combined, the final verdict is more balanced. The overall “leverage effect” of the policy was found to be close to or even greater than one, meaning that each euro of public expenditure succeeded in mobilizing at least one additional euro of private investment (Bourgeois et al., 2021; Chlond et al., 2023; Giraudet, 2024). Thus, the CITE was a policy that encouraged homeowners to invest more deeply in energy efficiency than they otherwise would have.

As the direct successor to the long-standing tax credit CITE, MPR represents the most significant and innovative reform in France’s recent policy design. A noteworthy aspect of Ma Prime Rénov is that, to access the subsidy, an attestation – which may also be carried out ex post – must be issued by independent experts certifying the actual impact of the energy efficiency intervention. The subsidy amounts to EUR 1,000 for heating systems and up to EUR 8,000 for the installation of solar panels (de Blasio et al., 2024). Moreover, it is explicitly aimed

at overcoming the key limitations of previous subsidy models, which were particularly problematic in well-targeting the liquidity constraints for low-income households. This is why the evolution of CITE in MPR was also justified from a social justice perspective. In fact, before the launch of MPR, the CITE mainly benefited households in deciles D7 to D10: in 2019, these households accounted for 73% of beneficiaries, while deciles D1 to D4 accounted for only 11% of beneficiaries²¹. The most popular measure was window replacement (34% of work covered by CITE in 2019), followed by external wall insulation (27%) (PLF, 2024). On the contrary, MPR is primarily intended for households with low and very low incomes, which were the only eligible groups in 2020, provided they owned the property they occupied as their main residence. In 2021, the CITE was definitively closed and MaPrimeRénov' is now open to all owner-occupiers and landlords.

We can conclude that MPR is a policy that represents a change from the previous system of *ex-post* tax credits (CITE). The main tool to boost energy renovations is no longer based on a form of deduction but it is rather moving towards a better targeted model for certain categories of beneficiaries, and based on direct subsidies to carry out energy renovation works. Such a transition goes hand-in-hand with the aims to counteract the liquidity constraint, as they constitute critical barriers for low-income households in the previous system. To achieve this objective, MPR policy design incorporates a strong social dimension through a progressive income-based tier system, which aims to provide greater support to those who need it most. According to the annex to the PLF (2024), since 2020, those in the low and very low income brackets represent 68% of MPR beneficiaries (compared to 30% of households with intermediate incomes and 2% of households with higher incomes).

²¹ PLF (2024) divide population into deciles with different level of income: D1 is the 10% of the population with the lowest income, D10 is the 10% with the highest income.

2.1.4 Private Profitability of Energy Renovations: Critical Analysis and Key Issues

The effectiveness of French energy renovation policies is at the heart of an intense debate, centered on the gap between the ambitious goals of the National Low Carbon Strategy and the concrete results achieved.

A central issue in the academic and public debate revolves around the so-called “energy efficiency gap” and the effectiveness of the instruments designed to bridge it. Glachant (2022) highlight that the optimistic belief that energy renovations are a “win-win” scenario, where energy retrofits increase energy savings outweighing investment costs, and reduce pollution, is not always supported by empirical evidence. Their *ex-post* analysis of French households found that a €1,000 investment in renovation led to a mere €8.29 annual reduction in energy bills, a stark contrast to the often-promised returns²². This finding casts serious doubt on the relevance of subsidies if they are solely motivated by the economic calculus of energy savings. The discrepancy, identified as the “energy performance gap” (the difference between predicted and actual savings), is not random but can be attributed to specific factors.

The Conseil d’Analyse Économique (CAE) identifies three main causes: **i)** behavioral adjustments (the “rebound effect”); **ii)** modeling errors (namely, the difference between *ex-ante* engineering predictions and *ex-post* economic evaluations); and **iii)** quality defects in the work performed (Fack & Giraudet, 2024).

The rebound effect shows that efficiency gains can paradoxically increase energy consumption as homeowners increase their comfort levels, offsetting a portion of the expected savings (see Chapter 1, subsection 1.4.2). Additionally, the reliability of technical standards has been called into question. The Diagnostic de Performance Énergétique (DPE), while a

²² It should be noted, however, that their dataset is limited to the period 2000-2013. Due to the lack of more recent data, it was not possible for them to further analyse whether this result is still valid in recent years. See Glachant (2022)

cornerstone of French policy, has been criticized for modeling errors and a lack of credibility, partly due to the “credence good” nature of energy renovations (Giraudet, 2020). This is linked to Akerlof, 1970) “market for lemons”: informational asymmetry can lead to a market where poor quality tends to drive out good quality, especially in the absence of robust oversight. Nonetheless, advisory services like MonAccompagnateur Rénov’ reflect another recognition of the fact that information asymmetry and lack of consumer trust are significant barriers to investment²³.

Therefore, the effectiveness of subsidies for energy renovations remains a subject of debate. The CAE suggests that while the RGE label aims to assure quality, its low standards and lack of rigorous *ex-post* controls may be insufficient to combat widespread quality defects. Glachant (2022) further argues that, though the RGE label attempts to overcome these limitations, it has been poorly effective given that Qualibat, the organisation that certified 50,000 of the 60,000 RGE companies, announced that it had only withdrawn the label from around fifty companies, or 0.01% of the total, meaning that mediocre companies have likely slipped through the net. This points to a need for a more strategic public role, one that moves beyond a passive subsidy model to actively guide and monitor the renovation process. The evolution from a broad, less-targeted scheme like CITE to the more progressive and income-differentiated MPR is a response to both efficiency and equity concerns.

As already mentioned, the CITE was criticized for a significant “free-riding” problem, with a large share of subsidies going to households that would have renovated anyway. The MPR, on the other hand, aims to target low- and very low-income households more specifically, for whom liquidity constraints represent a significant obstacle.

This shift aligns with the recognition that a well-designed subsidy must maximize the policy leverage effect, directing resources where they are most needed to unlock new

²³ See <https://france-renov.gouv.fr/mon-accompagnateur-renov>

investments. The move towards coercive measures, such as the progressive ban on renting out energy-inefficient homes, further demonstrates this strategic shift, signaling that voluntary action alone is insufficient to meet France's climate target.

2.2 The Italian Residential Sector: State of Play and Challenges

Similarly to what has been done in the French section, for our analysis of the Italian incentives, we rely on three occasional papers published by the Bank of Italy in 2024 (particularly no. 845, 860, and 903)²⁴. We start with a description of the current state of Italy's residential sector.

In 2022, the Italian housing stock comprised around 36 million homes (de Blasio et al., 2024). In 2024, based on Istat's Household budget survey (HBS), around 82% per cent of households live in owner-occupied dwellings, whereas the remaining 18% per cent are rented (which rises to around 38 per cent for households belonging to the first decile of the distribution of equivalent expenditure, see Figure 6 below)²⁵. Notice that around 10% live in usufruct or free-of-charge housing (de Blasio et al., 2024).

It should be borne in mind that the percentage of historic buildings in Italy that are exempt from EU directives could be significant, as is the presence of buildings that are unoccupied or used for limited periods of time. Moreover, as de Blasio et al. (2024) points out, the expected demographic decline will contribute to an increase in vacant real estate. According to ISTAT estimates, the resident population is projected to decline from the current 59 million

²⁴ Note that: "the series Occasional Papers presents studies and documents on issues about the institutional tasks of the Bank of Italy and the Eurosystem. The Occasional Papers appear alongside the Working Papers series, which are specifically aimed at providing original contributions to economic research. The Occasional Papers include studies conducted within the Bank of Italy, sometimes in cooperation with the Eurosystem or other institutions. The views expressed in the studies are those of the authors and do not involve the responsibility of the institutions to which they belong. The series is available online at www.bancaditalia.it".

²⁵ In France, 57% of households owned their main residence (either outright or with a mortgage), while 40.3% were tenants (22.9% in the private sector, 17.4% in public housing); a further 2.6% lived free of charge (INSEE, 2024).

to 54 million in 2050 and to 46 million in 2080. In light of these considerations, it is therefore essential that public subsidies are well targeted at both the right population and the right buildings.

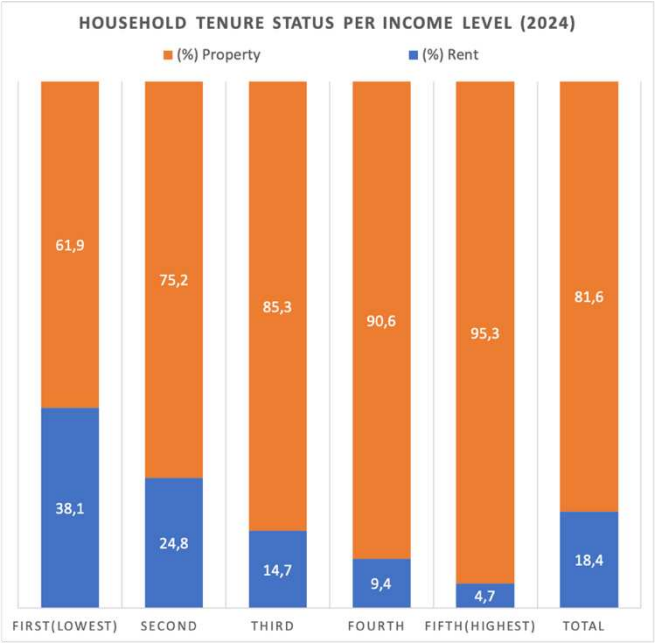


Figure 6 Italy’s Households Tenure Status per Income level (Source: Istat)

A large portion of this housing stock was built before the introduction of the first thermal insulation regulations in 1976. The Italian legislator introduced in 2009 a certification of the status of energy efficiency of a building, which, since 2015, is called “Attestato di prestazione energetica” or APE (Energy Performance Certificate, EPC). It is mandatory to produce an EPC assessment in the case of rental, sale, or renovation of a building. The EPC is issued by certified technicians listed in regional registers, and subsequently submitted to regional archives, most of which are now connected to the national cadastre managed by ENEA (the national land registry SIAPE)²⁶. According to the update of August 2025, the register collected 7.4 million

²⁶ For further detail see Box 2 in [de Blasio et al. \(2024\)](#). In this paragraph we update their numbers as of August 2025 SIAPE survey (Figure 7).

EPCs (6.5 residential and 0.9 non-residential). A significant proportion, approximately 50% of the properties surveyed, are in the lowest energy classes (F and G); whereas only about 12% show excellent energy performance (classes A1 to A4). However, it is worth noting that these data, extrapolated from SIAPE, are probably underestimated. SIAPE's energy classes have a positive bias towards the most efficient classes, which are the most valued ones in the real estate market (de Blasio et al., 2024)²⁷. A simulation of the entire housing stock suggests that the amount of inefficient homes (classes F and G) could be around 26% higher (Braggiotti et al., 2024). Such an old housing stock represents a significant challenge in terms of energy efficiency, a cornerstone of the EU decarbonization strategy (see Section 1.5).

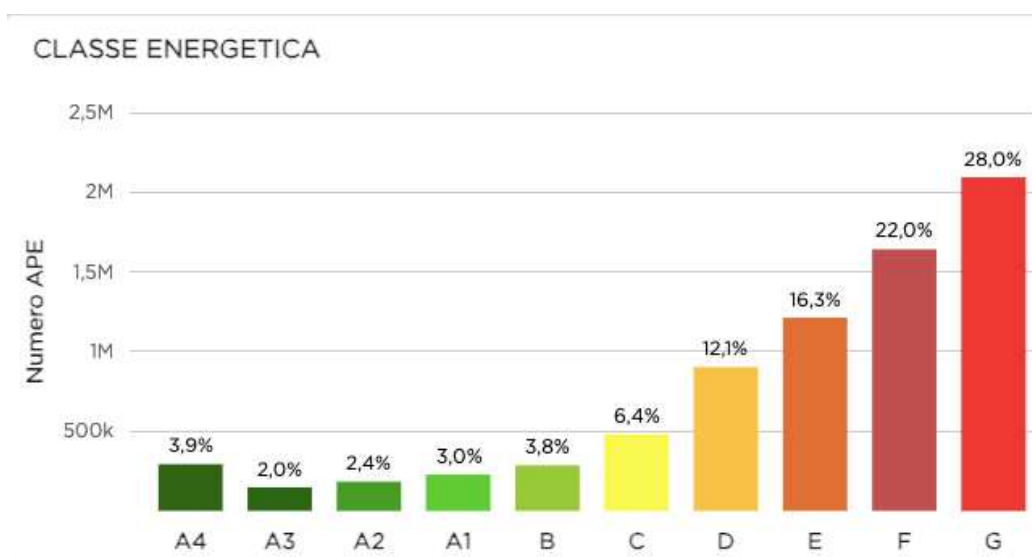


Figure 7 SIAPE's Buildings Energy Classes (August 2025)²⁸

In response to this situation, Italy introduced a system of tax incentives for renovations in 1998. It also attempted to reduce tax evasion in works performed on private residential buildings. Later on, since 2007 and the introduction of the Italian EPCs, building improvements began to be linked to energy efficiency performance (Codogno, 2024).

²⁷ Indeed, EPCs are mandatory only for sale, rental, or renovation.

²⁸ Available at: <https://siape.enea.it/caratteristiche-immobili>

In general, the tax credits stood out for their generosity. They usually took the form of a deduction (“detrazione”) of a share of the expenditure, to be spent over several years. Note that we use the term deduction for a tax relief (“detrazione”) rather than an abatement on the tax base (“deduzione”).

Until the end of 2024, this system was based mainly on two instruments: the Ecobonus, which basic rate was 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), and the more recent Superbonus, introduced in 2020 with an unprecedented rate of 110% for dwelling renovations aimed at improve the EPCs by two classes.

Both of them had the possibility of credit transfer or invoice discount, a measure that made it possible to apply for the incentive also for the poorest quintile. Besides these measures, the “Bonus Facciate” incentive, established by the 2020 Budget Law, provided for a 90% deduction for the renovation of external facades. State expenditure on this measure was reduced in 2022 (to 60%) and abolished in 2023. In 2021, it accounted for more than half of the total incentives resources (de Blasio et al., 2024).

2.2.1 Historical Evolution of Incentives in Italy

The history of Italian tax incentives for energy efficiency began in 2007 with the introduction of tax deductions for residential building renovations (de Blasio et al., 2024). Initially conceived as temporary, these measures have been subsequently extended and modified over the years. The main mechanism, the Ecobonus, initially offered a 55% deduction for energy efficiency improvements, which was then increased to rates ranging from 65% to 85% depending on the type of intervention. It was also a successor of the previous Sismabonus, introduced in 2013, which aimed at reducing hydrological and seismic risks (Codogno, 2024).

A key turning point was the launch of the Superbonus in 2020, designed to counteract the economic slowdown caused by the pandemic. In fact, the government released the Relaunch Decree (Decreto Rilancio, DL n. 34/2020), introducing the so-called “Superbonus 110%”, a fiscal incentive aimed at promoting energy-efficiency interventions and structural renovations. Initially limited to projects undertaken between July 2020 and December 2021, the measure was subsequently extended until December 2022 with the deduction rate maintained at 110%, and, for a significant share of interventions, also throughout 2023. The allowance, initially at 110%, was subject to successive amendments aimed at reducing the benefit for expenditure incurred from 2023 onwards: for condominiums and 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 (Accetturo et al., 2024). The Superbonus was devoted to specific interventions (such as thermal insulation and replacement of heating systems). Particularly, the condition for accessing the Superbonus was to improve the energy performance by at least two classes. The possibility of a discount on the invoice and the transfer of credit made the incentive accessible even to households with little or no tax capacity (de Blasio et al., 2024).

The incentive was very successful in inciting investment in energy renovations. Its success can be attributed to two main factors: the generosity of the 110% rate, which covered the entire cost of the interventions, and the possibility of transferring the tax credit. On the other hand, the generosity of the Superbonus caused a significant deterioration in public finances, with costs to the state exceeding expectations and a partial tax return against a large expenditure outlay. Indeed, subsequent reforms of the Superbonus, aimed at reducing the rate and eliminating credit transfers, as an attempt to stem these costs and restore the financial sustainability of the measure.

Looking ahead, studies indicate the need for a more balanced and targeted combination of regulatory, fiscal, and financial instruments that goes beyond the logic of a single incentive and focuses on deep renovation measures and the most vulnerable households. Future policies should aim to mitigate the risk of deadweight loss and ensure an effective energy transition of the building stock (Accetturo et al., 2024; de Blasio et al., 2024; Ruggieri et al., 2023).

2.2.2 The Effectiveness and Criticisms of Italian Subsidies

Academic and institutional analyses have attempted to highlight the pros and cons of these policies and evaluate their effectiveness.

It should be recalled that, although aimed at energy efficiency, the Superbonus was primarily a fiscal policy designed to recover the economy after the recession caused by the COVID-19 pandemic. The construction sector was coming from nearly a decade of steady decline (Accetturo et al., 2024). The Superbonus can also be defined as an unconventional fiscal policy to boost the economy (Codogno, 2024). We will try to assess the effectiveness of the measure with respect to several areas

A) Macroeconomic Effect and Spillovers: Supporters of the measures claimed that Superbonus effectively acted as a driver for investment and employment in the construction sector, paving the way for Italy's economic recovery. A report of the Consiglio Nazionale dei Dottori Commercialisti e degli Esperti Contabili (2022) estimated that, in 2021, the construction sector contributed to the generation of added value of €78.2 billion, equal to 5.2% of the total, employing 1,656,500 people (6.6% of the total). Nonetheless, in their empirical assessment (Accetturo et al., 2024) calculate that, although incentives accounted for around three-quarters of the value-added growth in the construction sector between 2020 and 2023, they had a rather limited spillover effect on other sectors. Hence, the effects on long-term growth are questionable, as it is questionable to subsidise that much a sector which historically contributes

a little (only up to 0.6% in 2022) to the overall labour productivity growth of the Italian economy (see Figure 8 below)²⁹.

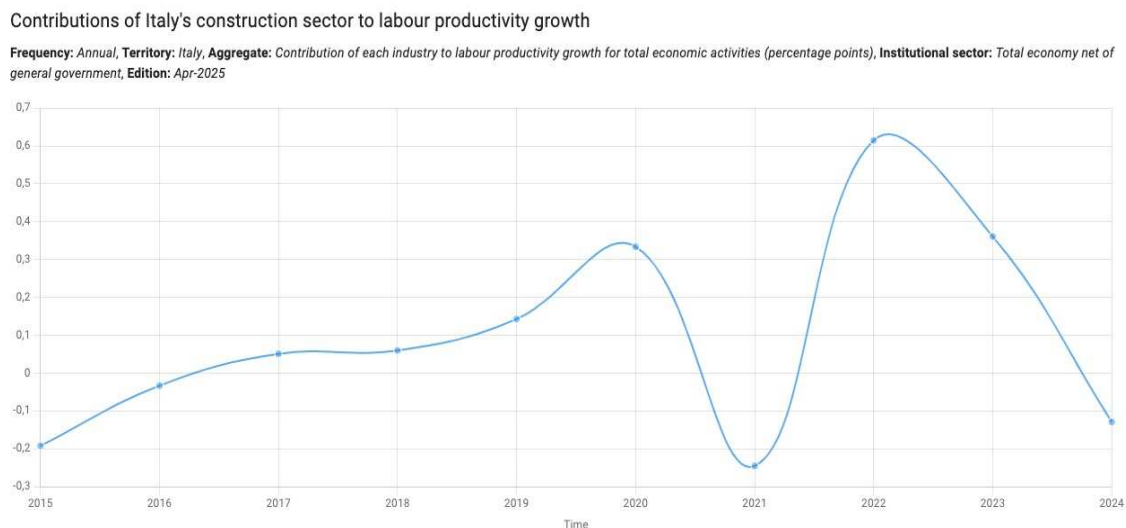


Figure 8 Contributions of Italy's construction sector to labour productivity (Source: ISTAT)

Moreover, the Superbonus did not imply a significant spillover in other sectors nor a rise in overall economic productivity. Using input-output tables, Accetturo et al. (2024) evaluated that in the period 2020 to 2023 the growth of the construction sector played a rather limited role (Table 2 below reports author's data on the economic spillover of the Superbonus relative to other sectors).

²⁹ Indeed, we can consider the construction sector a labour intensive sector with little added value compared to others.

SECTORS	Growth in real value added Actual (%)	Contribution of bonuses: Lower bound (%)	Contribution of bonuses: Upper bound (%)
Manufacturing	19.7	1.7	2.3
Construction	38.8	30.4	30.6
Services	12.9	1.2	2.1
Total (1)	13.5	2.6	3.4

Table 2 Sectoral impacts on value added growth between 2023 and 2020 using input-output tables. Sources: Accetturo et al. (2024) elaboration on Istat data

B) Emissions reduction: under the point of view of environmental effectiveness, Alpino et al. (2023) highlighted how spending on the Superbonus has reduced emissions far lower than could have been achieved with alternative investments. They estimate that the economic return in terms of environmental benefits would repay the financial costs in about 40 years, or even that the costs of efficiency improvements exceed the benefits, even taking into account the positive externalities. Their analysis suggests that there may be more cost-effective tax credit rates which would achieve the same result in terms of emissions reduction.

C) Construction Costs: for what concerns the surge of producing costs in the building sector, much of the inefficiency can be attributed to policy design flaws. Firstly, the 110% rate of the Superbonus eliminated cost sharing by beneficiaries, stimulating prices in the construction sector to rise and raising moral hazard issues (Figure 9 below and Chapter 3). Combined with the high demand of interventions, there was allocative inefficiency and a sharp increase in prices in the construction sector³⁰. This phenomenon has effectively cancelled out part of the economic benefit of the incentive, reducing its real effectiveness. Corsello & Ercolani (2024) estimate that about half of the total increase in construction costs in Italy between September 2021 and December 2023 is directly attributable to the Superbonus.

³⁰ It is important to highlight how Figure 9 only shows a correlation and cannot imply causality with the Superbonus (e.g. contemporary Russian invasion of Ukraine spiked prices up too). Nonetheless, the study by Corsello & Ercolani (2024) had exactly two objectives: first, to find the causality between price increases in the construction sector and Superbonus; and secondly, to assess its impact.

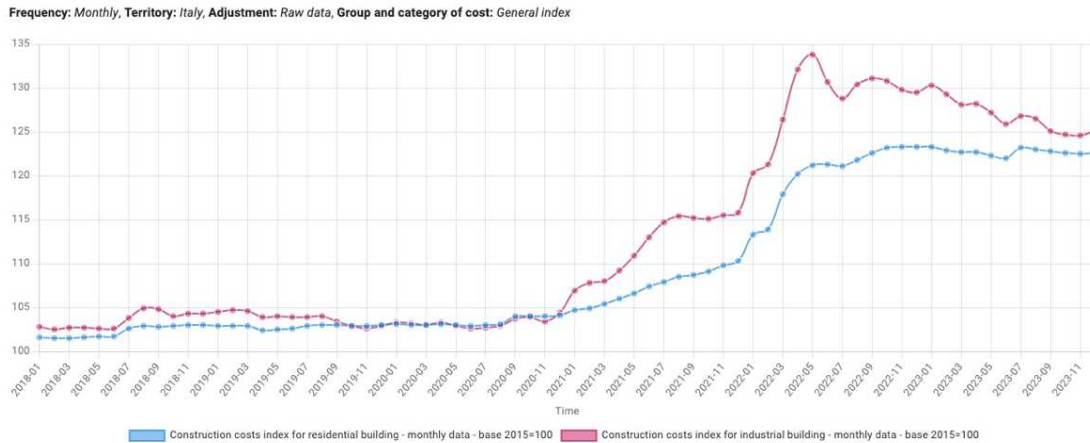


Figure 9 Construction Cost Index for Residential and Non-Residential Buildings (Source: ISTAT)

D) Distributional Effects: from a distributional point of view, the literature already suggests that subsidies such as tax credits tend to be regressive and captured mainly by wealthier households. These households are usually the ones not subject to liquidity constraints and that would probably have carried out the work even without incentives (Borenstein & Davis, 2016; Feger et al., 2022)³¹. This resonates with what we analysed in the theoretical framework: the issue of additivity of investments, the “deadweight loss” phenomenon, and the free riding behaviour of economic agents discussed. In an audit, the Italian Parliamentary Budget Office (Ufficio Parlamentare di Bilancio, UPB, 2023) declared that between 2008 and 2019, the amount of deductions effectively used rose from EUR 2.6 billion to EUR 9.2 billion, of which EUR 7.4 billion concerned building renovations and EUR 1.8 billion energy efficiency measures. Data from tax returns made it possible to reconstruct the distributional profile of these deductions, showing that both incentives are highly regressive. Indeed, just over 10% of the wealthiest taxpayers – those with high incomes, real estate assets, and sufficient liquidity

³¹ In contrast, Davis (2023) concludes that, in the US, subsidies for heat pumps, unlike those for other “green” technologies, have more equitable distributional implications, reaching a wider audience across different income brackets. Furthermore, his preliminary estimate suggests that the effectiveness of these subsidies, in terms of cost per carbon emission reduction, is comparable to that of other “green subsidies”.

and tax capacity to bear the upfront costs – captured half the total amount. The geographical breakdown further confirms this regressive pattern: during the period under review, more than 60% of deductions were claimed by taxpayers residing in northern regions. The Superbonus slightly weakened this issue, but further data must be gathered to assess how much of the incentive was given to the highest quintiles of the income distribution.

Moreover, if the transferability of the credit mitigated the regressive nature of the instrument, making it accessible even to families with low fiscal capacity, it also contributed to a significant cost to the treasury and widespread fraud, especially in the scope of the facade bonus, which had also lower environmental standard requirements (Consiglio Nazionale dei Dottori Commercialisti e degli Esperti Contabili, 2022).

E) Additivity of investments and free-riding: Accetturo et al. (2024) employed a synthetic control method (a variant of the Difference in Differences methodology) and estimated that, out of a total government expenditure of €170 billion, approximately a quarter of the Superbonus amounts (€45 billion) would constitute a deadweight loss, as the renovation work would have been carried out regardless of the incentive. A more recent study, using the synthetic control method as well, estimated that the incentives generated approximately €116 billion in additional investment in residential construction between 2020 and 2023, out of a total of approximately €186 billion in gross costs, implying that almost 70 billion investments would have been carried out anyway, representing a substantial fiscal cost and deadweight loss (Cignarella & D’Imperio, 2025).

F) Public finance: in terms of impacts on State coffers, the situation was particularly critical. Although the policy generated a partial increase in tax revenues, it did not “pay for itself” (Accetturo et al., 2024; Cignarella & D’Imperio, 2025; Codogno, 2024). The costs to the state far exceeded initial expectations, leading to a significant deterioration in the public deficit. The accounting uncertainty associated with the nature of tax credits further complicated budget

management (for further details see: de Blasio et al., 2024). Subsequent legislative reforms, aimed at limiting the generosity and transferability of the credit, were an attempt to stem these costs, but they in turn introduced uncertainty and obstacles for investors.

In summary, the analysis of the effectiveness of the 110% Superbonus has highlighted a twofold impact: a significant stimulus to demand in the construction sector, but also a series of structural problems in terms of costs and sustainability. The Superbonus experience offers an emblematic case study of how a fiscal policy, albeit with laudable objectives of economic stimulus and green transition, can generate inefficiencies, market distortions and fiscal imbalances if its design is not carefully calibrated to maximise the additionality of investments and contain costs, while maintaining a long-term vision.

Chapter Conclusions

This chapter analysed France and Italy policy framework when dealing with the incentives for energy renovation. We traced the state of play of their current housing stock, the historical evolution and the current structure of their subsidy programmes. We have seen that France has adopted a gradual and targeted approach, while Italy has resorted to large-scale fiscal measures such as the 110% Superbonus, which has stimulated demand but also raised many concerns in its implementation. The comparison has highlighted both the opportunities and critical challenges that each country faces in promoting the energy retrofitting of residential buildings.

Chapter 3: A Comparison between Italian and French Incentive Models

After analysing the subsidy systems in France and Italy separately, this chapter undertakes a comparative assessment to identify common patterns and key differences. The aim is not only to assess the relative effectiveness of the two systems, but also to draw lessons from concrete cases on the design of renovation subsidies. Particular attention is paid to three aspects: the economic effectiveness of incentives in promoting energy renovations (section 3.1), the fiscal and budgetary challenges for the state coffers (section 3.2), and the implications in terms of the design of relevant fiscal policies (section 3.3). By comparing two different approaches, the chapter seeks to highlight the challenges for States in promoting effective and sustainable incentives for energy renovation programmes.

3.1 The French and Italian Policies: Different Approaches, Different Scales

To undertake a meaningful comparison between the Italian and French models, the analysis begins with assessing the impacts engendered by the respective incentive schemes. It must nevertheless be underscored that the two policy instruments were underpinned by markedly divergent objectives: whereas MaPrimeRénov' (MPR) in France was conceived primarily as a mechanism to foster gradual and widespread improvements in household energy efficiency, the Italian Superbonus 110% was endowed with a broader macroeconomic scope, serving both as a stimulus to the construction sector and a driver of large-scale renovations, as well as a tool to sustain the country's post-pandemic recovery. Moreover, while the French

scheme represented a policy upgrade of the pre-existing tax credit system (CITE), the Italian measure was deliberately framed as an extraordinary intervention, which is reflected in the markedly different scale of expenditure associated with the two incentives.

In Italy, the 110% Superbonus has acted as a powerful stimulus to demand in the building sector and to mobilise investments in energy renovations. As said, it is estimated that the incentives have generated approximately €116 billion in additional investment in residential construction between 2020 and 2023, out of a total of approximately €186 billion in gross costs (Cignarella & D’Imperio, 2025). Construction companies that benefited from the Superbonus recorded significantly higher growth in production and employment than companies not involved (Accetturo et al., 2024). However, the expenditure has been described as a “huge experiment” with uncertain economic benefits and significant risks for public finances (Codogno, 2024).

In contrast, the French approach, historically less generous and based on more targeted incentives, has had a wiser targeting of the beneficiaries. Yet, empirical analyses suggest programmes such as the *Crédit d’impôt pour la transition énergétique* (CITE) have had a certain degree of “free-riding” and some limitations in the additivity of investments (Giraudet, 2024; Risch, 2020). This has led to the subsequent introduction of better-targeted instruments, such as *MaPrimeRénov’*, which has aimed to maximise the additionality of investments, focusing on more profound interventions and specific income brackets.

In general, the Italian tax incentive system – even excluding the Superbonus – appears particularly generous in terms of the size of the benefit (deduction rates and ceilings) and the breadth of eligible buildings and interventions. Unlike other contexts, where tax deductions and credits are less widespread and generally limited to primary residences and owners, in Italy, these incentives apply to all types of dwellings and any eligible occupant. A quite significant issue if we think of the structure of the Italian housing stock (see section 2.2): further analyses

have to be conducted, but certainly Superbonus also incited the renovations of second houses, which are usually unoccupied for long periods of time. Another difference is that, while direct cash transfers are less common in Italy, in the French experience, it has been the predominant form of support since the introduction of MPR. This choice reflects the greater importance given to the targeting of low-income households and the administrative advantages of addressing a smaller circle of beneficiaries (de Blasio et al., 2024).

Finally, it is worth noting that the French experience over time has been largely based on multi-oriented policies that complement each other, while the Italian model has mainly been based on its system of tax credits without innovating the design of policies for energy renovations.

3.2 The Challenge for the National Budgets and the Uncertainty on Future Incentives

The financial sustainability of renovation incentives for the State coffers has emerged as a central challenge in both France and Italy, where the reliance on public resources has made national budget allocations decisive in shaping policy continuity. Despite their different designs, both MaPrimeRénov' in France and the Superbonus 110% in Italy reveal the tensions between ambitious renovation objectives and the fiscal space available to governments.

In the French case, the approach has been one of gradualism, with the MaPrimeRénov' conceived as a balanced mechanism to stimulate demand for energy renovations while containing budgetary exposure. Yet successive revisions of the scheme have revealed the vulnerability of such instruments to fiscal adjustments. The initial allocation was revised several times, and the general trajectory points to volatility.

This gap underlines how budgetary uncertainty risks undermining the credibility of the

scheme and discouraging households and firms from undertaking long-term commitments, despite the partial support provided by EU instruments such as the Recovery and Resilience Facility (RRF) and Cohesion Funds.

The Italian experience, especially in Superbonus, has been marked by an expansive policy that raised several issues at the expense of long-term fiscal sustainability. The tax credit of 110% offered tax deductions exceeding the cost of renovation works, thereby triggering an exceptional increase in construction investments, with profound distortions in the building sector. The fiscal consequences soon proved unsustainable. While the measure was initially expected to cost around €35 billion, by April 2024 the official figure had already reached over about €120 billion, with alternative estimates placing the total burden near €200 billion (Accetturo et al., 2024; Cignarella & D’Imperio, 2025; de Blasio et al., 2024).

Furthermore, the economic benefits generated by the scheme appear limited when compared to its fiscal costs. The overall economic multiplier of the measure was estimated below the unity, indicating that the societal returns were insufficient to justify its fiscal magnitude (Accetturo et al., 2024; Alpino et al., 2023).

Uncertainty and discontinuous policies are common in both France and Italy systems., despite their different approaches. Both countries face similar challenges: rising debt levels and the end of the EU’s Recovery and Resilience Fund are creating fiscal constraints. As a result, France and Italy are expected to tighten their budgets in the coming years³². In 2024, France and Italy, despite being respectively the second and third economies of the EU, reached very high debt/GDP ratio: France is at 113% of GDP and Italy has reached the 135%, compared to the EU-27 average of 81% (Eurostat, 2025). Such a debt burden involves structural impediments to growth for both countries. In the meantime, households and market actors have

³² The French government recently announced the aim to save 40 billion from the State coffers through rigorous revising of the budget: https://www.lemonde.fr/les-decodeurs/article/2025/07/15/ou-trouver-les-40-milliards-d-euros-d-economies-voulus-par-bayrou_6621348_4355770.html?search-type=classic&ise_click_rank=3

difficulties in predicting the evolution of incentives, and the confidence in the durability of national renovation strategies is undermined. More broadly, these cases exemplify the structural tension between the ambitious targets set by the Green Deal and the fiscal constraints faced by member states. Unless predictable and adequate funding mechanisms – complemented by EU-level instruments such as the RRF, Cohesion Policy, and the National Energy and Climate Plans (NECPs) – are secured, national renovation policies are likely to remain exposed to budgetary pressures that weaken their long-term effectiveness. Italy, after four years of unprecedented incentives, has terminated the Superbonus scheme without introducing a new strategy for energy renovations³³. Meanwhile, since June 2025 on, the French government, at a time when demand for energy renovations was increasing – partly in response to new legislation on the energy efficiency of rental properties – chose to reduce the budget allocated to the MaPrimeRénov’ (MPR) program, cutting it by €340 million in 2025 and temporarily suspending its instrument. This has sparked the public debate over the cost-opportunity of spending on such subsidies³⁴. These policy shifts are likely to have discouraged households in both countries from undertaking further renovations, as they may fear that financial incentives will no longer be available. Table 3 briefly reports the two subsidy design.

³³ See: (Arcano et al., 2024; Pisauro, 2022; Rizzo, 2024)

³⁴ For further knowledge around the uncertainty on MPR in the next French financial budget for 2026: see the newspapers articles published on Le Monde in June 2025 (Chocron, 2025a, 2025b, 2025c).

Policy Dimension	Italian Model	French Model (CITE → MaPrimeRénov')
Nature of Subsidy	Tax credit (with credit transfer/invoice discount option)	Tax credit (CITE) evolved into a direct bonus/grant (MPR)
Subsidy rate	Initially 110% (exceeding the cost), then gradually reduced	Variable rate (10-50% for CITE), then progressive based on income for MPR
Targeting	Universal, not based on beneficiary income	Initially universal (CITE), then strongly targeted at low-income households (MPR)
Quality Requirements	Technical requirements (jump of 2 EPC classes), but no mandatory certification for companies.	Mandatory use of RGE-certified professionals ("Recognized Guarantor of the Environment")
Estimated <i>Free-Riding</i>	Very high (estimated <i>deadweight loss</i> between 26% and 37% of expenditure)	Significant for CITE (estimated at 80% on the extensive margin), but with leverage on the intensive margin

Table 3 Differences between the Italian and French Subsidy Models

3.3 Policy Design Implications

The comparison between Italy and France highlights a trade-off in the design of incentive policies. While succeeding in mobilising an unprecedented volume of investment, the Italian model has fallen short in terms of allocative efficiency, fiscal sustainability, and price control. The French model, albeit with a more modest quantitative impact, seems geared towards more controlled management of public resources but falls short of attaining the ambitious climatic goals needed³⁵. Hence, an effective “green” policy is not based solely on generous incentives, but must rely on careful policy design, with the aim to maximise the

³⁵ Recall that in 2022 the Anah reported a rate of only 66,000 energy-efficient renovations per year, against the 370 000 that would be needed from this year to 2030 (700 000 from 2030 on) in Fack & Giraudet (2024) (see section 2.1).

additionality of investments, contain market distortions, and ensure a fair and sustainable allocation of resources, issues that the Italian experience has further highlighted. Looking ahead, Italy's experience emphasizes the need for a more balanced "policy mix". Recommendations include complementing tax credits with carefully designed criteria, restricting transferability to cases with strict safeguards, expanding the use of means-tested eligibility (e.g., level of income), and leveraging new financial instruments to mobilize private finance (de Blasio et al., 2024). These proposals converge with France's focus on certification and targeting, illustrating that sustainable renovation strategies require governance mechanisms that align fiscal responsibility with energy efficiency outcomes.

As regards the design of future policies aimed at accelerating energy efficiency in the building sector, both MaPrimeRénov' and the Superbonus 110% demonstrate how poorly calibrated incentives – whether underfunded or fiscally excessive – can generate uncertainty, undermine credibility, and weaken the effectiveness of public action. In this sense, the empirical evidence confirms the broader recommendation advanced in the literature: renovation policies should be predictable, targeted, and fiscally sustainable to mobilise households and private investors while avoiding discontinuous policies (de Blasio et al., 2024; Fack & Giraudet, 2024).

Indeed, the predictability and stability of incentives are crucial. Households and firms require long-term certainty to plan investment decisions. In France, the frequent revisions of the MPR budget and eligibility criteria have limited the scheme's credibility, while in Italy, the abrupt retrenchment of the Superbonus has disrupted ongoing projects. Both experiences suggest that predictable multiannual frameworks are preferable to yearly budgetary adjustments.

Moreover, policy design must ensure fiscal proportionality and cost-effectiveness. The Italian case illustrates the risks of having incentives, where benefits to households and firms were outweighed by the fiscal burden imposed on public finances. By contrast, the French

scheme, while fiscally more cautious, remains insufficiently resourced to meet national targets. This comparison points to the need for incentives that are both adequate to trigger renovation at scale and carefully aligned with fiscal sustainability. Better targeting of subsidies towards low- and middle-income households, as recommended by recent analyses, can maximise social and environmental returns while limiting budgetary costs.

Besides the budgetary concerns, renovation policies should be integrated with EU climate and energy frameworks and hence pursue a horizon of multiannual policies. National instruments should not be conceived in isolation but rather embedded within the objectives of the Green Deal, the “Fit for 55” package, and the National Energy and Climate Plans (NECPs). By aligning eligibility criteria, monitoring standards, and financing channels with European guidelines, member states can ensure consistency and enhance the efficiency of public spending. This has to deal with the necessity of more data and transparency by the government in order to run more independent empirical analysis which can further inform policymakers.

To sum up, the cases of France and Italy highlight the need for institutional capacity and policy coherence. The implementation of renovation incentives requires robust administrative systems capable of processing applications, preventing fraud, and coordinating across levels of government. Weaknesses in these areas, particularly evident in the Italian Superbonus, have exacerbated fiscal overruns and reduced efficiency. Strengthening governance structures and monitoring mechanisms is therefore a key implication for future policy design.

In conclusion, the lessons drawn from the French and Italian experiences underline that ambitious renovation targets cannot be achieved through unstable or disproportionate incentives. Future policy design should prioritise predictability, fiscal sustainability, targeting, and integration with EU frameworks, thereby creating a coherent and credible path towards the decarbonisation of the building stock.

Chapter Conclusions

In sum, the comparative analysis of French and Italian subsidy models reveals how different design choices lead to divergent outcomes in terms of efficiency, fiscal impact, and social fairness. While France has pursued gradual and targeted measures, Italy has experimented with highly expansionary incentives, each approach offering both valuable lessons and cautionary insights. These findings set the stage for the final chapter, which brings together the main results of the thesis and reflects on their broader policy implications.

Conclusions

This thesis explored the role and economic effectiveness of energy efficiency incentive programmes, comparing the divergent experiences of Italy and France. Our work has been grounded on the theoretical framework of public economics and has evaluated the rationale for public intervention in the energy renovation market. Subsidies for energy renovations take the form of a Pigouvian subsidy aimed at internalizing a positive externality. In theory, it should create “win-win” situation in which citizens save money and provoke less harm to the environment. Other economists, instead, think that subsidies, in practice, are costly and inefficient relatively to other policies. They estimate that it would be preferable to set the same emission reduction goals with taxes on consumption rather than subsidies on energy efficiency (Alpino et al., 2023); or they evaluate that the rebound effect is substantial and off-sets the improvements in energy efficiency (Glachant, 2022). The debate is open and further empirical assessment (with better data and statistics) is strongly needed. Nonetheless, along the work, we kept our focus on the design of subsidies for energy renovations.

In fact, we moved to analyse practical examples of policy implementation in France and Italy. We collected the recent empirical evidence and revealed that, despite starting from a common challenge, the two countries have taken different paths that offer valuable lessons for European Union policies in energy renovation. For both, the building stock has an urgent need of renovation both as a matter of social equity and energy transition. The Italian and French experiences represent two different paradigms that offer fundamental lessons on the risks and opportunities of public spending in a strategic sector for the energy transition such as energy renovation. The Italian case, dominated by the 110% Superbonus, has emerged as a political and fiscal experiment of unprecedented scope. While the impact on the construction sector has undoubtedly been significant, with the measure partly acting as a countercyclical stimulus at a time of deep economic crisis, the associated inefficiencies and costs have been notable.

Estimates show that the fiscal multiplier was less than one, suggesting that, from a macroeconomic point of view, the measure did not “pay for itself” and that the additional tax revenues did not cover the gross costs to the State coffers. Moreover, a considerable portion of the investments, estimated at between €45 and €70 billion, would have been made anyway, representing a “deadweight loss” for public finances (Accetturo et al., 2024; Cignarella & D’Imperio, 2025). The excessive generosity of the incentive has also fuelled a surge in construction costs, about half of which is directly attributable to the Superbonus, causing an erosion of benefits and significant market distortions (Corsello & Ercolani, 2024).

The French model, on the other hand, has followed a more cautious and targeted approach. Through a system that has gradually replaced tax credits with direct subsidies differentiated according to income, France has sought to maximise the additionality of investments and to focus aid on both the most needy segments of the population and on buildings. Although it did not generate the same volume of expenditure as the Superbonus, the French approach seems to have favoured a balance between fiscal sustainability and social objectives, avoiding the distortions observed in Italy.

Ultimately, the policy implications that emerge from this work are straightforward. In the first place, the rate of an incentive must be carefully calibrated to overcome liquidity constraints without eliminating cost sharing. Indeed, effective renovation policies require predictability, proportionality, and fiscal sustainability. A lower rate, can incentivise investment while maintaining control over costs and quality of work. Then, targeted and progressive policies are to be preferred: the effectiveness and fairness of policies increase significantly when incentives are targeted specifically at the segments of the population (e.g., low-income households) and real estate assets (the least efficient buildings) that need them most. This approach reduces free-riding and maximises the social impact of public spending (Accetturo et al., 2024; Cignarella & D’Imperio, 2025; de Blasio et al., 2024). Not to overlook the importance

of stable and predictable policies: frequent and radical changes to incentive schemes, as has happened in Italy and France, create uncertainty for businesses and investors, hindering long-term planning and, consequently, the sector's ability to grow sustainably.

Both underfunded schemes and overly generous incentives end up exactly in the opposite way, weakening credibility, creating instability, and undermining long-term effectiveness. This insight resonates with the broader EU framework: while the Renovation Wave, the “Fit for 55” package, and the revised directives on energy efficiency and buildings set ambitious goals, the fact of relying heavily on national budgets for implementation might reduce the aforementioned ambitions, given the fiscal constraints of Member States. Indeed, the cases of France and Italy illustrate the difficulties of aligning European goals with domestic fiscal realities, revealing the persistent tension between European integration in climate policy and the incomplete fiscal capacity of the Union.

Future research could expand on these findings by exploring the political economy of renovation incentives, the distributive effects of different subsidy designs, and the role of private finance in complementing public support. Moreover, a comparative extension to other member states could shed light on the diversity of national responses and their implications for the EU's collective ability to deliver on climate neutrality by 2050.

In conclusion, achieving the goals of the European Green Deal will require not only regulatory ambition but also credible and sustainable financing frameworks. The experiences of France and Italy demonstrate that without stability, targeting, and EU-level support, national renovation policies risk falling short of their potential. Bridging this gap is not only a matter of climate policy but also of advancing European integration towards a more complete and resilient Union.

Bibliography

- Abrahamse, W., Steg, L., Vlek, C., & Rothengatter, T. (2007). The effect of tailored information, goal setting, and tailored feedback on household energy use, energy-related behaviors, and behavioral antecedents. *Journal of Environmental Psychology*, 27(4), 265–276.
<https://doi.org/10.1016/j.jenvp.2007.08.002>
- Accetturo, A., Olivieri, E., & Renzi, F. (2024). Incentives for dwelling renovations: Evidence from a large fiscal programme. *Questioni Di Economia e Finanza*, 860, 1–27.
https://www.bancaditalia.it/pubblicazioni/qef/2024-0860/QEF_860_24.pdf
- Akerlof, G. A. (1970). The Market for “Lemons”: Quality Uncertainty and the Market Mechanism. *The Quarterly Journal of Economics*, 84(3), 488–500. <http://www.jstor.org/stable/1879431>
- Alberini, A., Bigano, A., & Boeri, M. (2014). Looking for free riding: Energy efficiency incentives and Italian homeowners. *Energy Efficiency*, 7, 571–590. <https://doi.org/10.1007/s12053-013-9241-7>
- Alpino, M., Citino, L., & Zeni, F. (2023). Costs and benefits of the green transition envisaged in the Italian NRRP - An evaluation using the social cost of carbon. *Energy Policy*, 182, 113744.
<https://doi.org/10.1016/j.enpol.2023.113744>
- Arcano, R., Capacci, L., & Galli, G. (2024, March). *Post mortem per il Superbonus: Extra deficit, extra debito e rallentamento in atto nel settore delle costruzioni*. Università Cattolica del Sacro Cuore. <https://osservatoriocpi.unicatt.it/ocpi-pubblicazioni-post-mortem-per-il-superbonus-extra-deficit-extra-debito-e-rallentamento-in-atto>
- Astier, J., Salem, A., Fack, G., Fournel, J., & Maisonneuve, F. (2024). *Performance énergétique du logement et consommation d'énergie: Les enseignements des données bancaires* (Focus No. 103; Les Notes Du Conseil d'analyse Économique, pp. 1–20). Conseil d'analyse économique.
<https://cae-eco.fr/static/pdf/focus-103-dpe-230110.pdf>

- Bellantuono, G. (2011). Comparative Energy Law: Some Methodological Issues. *Oil, Gas & Energy Law Intelligence*, 9(2). <https://ssrn.com/abstract=1818820>
- Blanchard, O. J., Gollier, C., & Tirole, J. (2022). *The portfolio of economic policies needed to fight climate change* (Nos 22–18; Working Paper, pp. 1–39). Peterson Institute for International Economics. <https://doi.org/10.2139/ssrn.4276886>
- Boomhower, J., & Davis, L. W. (2014). A credible approach for measuring inframarginal participation in energy efficiency programs. *Journal of Public Economics*, 113, 67–79. <https://doi.org/10.1016/j.jpubeco.2014.03.009>
- Borenstein, S., & Davis, L. W. (2016). The Distributional Effects of US Clean Energy Tax Credits. *Tax Policy and the Economy*, 30(1), 191–234. <https://doi.org/10.1086/685597>
- Bourgeois, C., Giraudet, L.-G., & Quirion, P. (2021). Lump-sum vs. energy-efficiency subsidy recycling of carbon tax revenue in the residential sector: A French assessment. *Ecological Economics*, 184, 107006. <https://doi.org/10.1016/j.ecolecon.2021.107006>
- Bouzarovski, S., & Petrova, S. (2015). A global perspective on domestic energy deprivation: Overcoming the energy poverty–fuel poverty binary. *Energy Research & Social Science*, 10, 31–40. <https://doi.org/10.1016/j.erss.2015.06.007>
- Braggiotti, F., Chiarini, N., Dondi, G., Lavecchia, L., Lionetti, V., Russo, R., & Marcucci, J. (2024). Predicting buildings' EPC in Italy: A machine learning based-approach. *Questioni Di Economia e Finanza*, 850, 1–39. <https://doi.org/10.32057/0.QEF.2024.0850>
- Cattaneo, C. (2019). Internal and external barriers to energy efficiency: Which role for policy interventions? *Energy Efficiency*, 12(5), 1293–1311. <https://doi.org/10.1007/s12053-019-09775-1>
- Charlier, D. (2018). Décisions d'investissement en efficacité énergétique dans le secteur résidentiel: Incitations et obstacles à la rénovation. *Revue économique*, 69(2), 335–366. Cairn.info. <https://doi.org/10.3917/reco.pr2.0113>

- Charlier, D. (2021). Explaining the energy performance gap in buildings with a latent profile analysis. *Energy Policy*, 156, 112480. <https://doi.org/10.1016/j.enpol.2021.112480>
- Chlond, B., Gavard, C., & Jeuck, L. (2023). How to Support Residential Energy Conservation Cost-Effectively? An analysis of Public Financial Schemes in France. *Environmental and Resource Economics*, 85(1), 29–63. <https://doi.org/10.1007/s10640-022-00754-2>
- Chocron, V. (2025a, June 4). *Le dispositif MaPrimeRénov' « mis sur pause »*. https://www.lemonde.fr/societe/article/2025/06/04/maprimerenov-pourrait-etre-mise-sur-pause-des-juillet_6610475_3224.html?search-type=classic&ise_click_rank=2
- Chocron, V. (2025b, June 16). *MaPrimeRénov': Le gouvernement recule et renonce à la pause estivale pour les petits travaux de rénovation*. https://www.lemonde.fr/societe/article/2025/06/16/maprimerenov-le-gouvernement-recule-et-renonce-a-la-pause-estivale-pour-les-petits-travaux-de-renovation_6613591_3224.html
- Chocron, V. (2025c, June 17). *Derrière la pause de MaPrimeRénov', un coup d'arrêt à la rénovation énergétique*. https://www.lemonde.fr/idees/article/2025/06/17/derriere-la-pause-de-maprimerenov-un-coup-d-arret-a-la-renovation-energetique_6613625_3232.html
- Cignarella, C., & D'Imperio, P. (2025). The effects of tax incentives for dwelling renovations: The case of Italy. (Working Papers No 3), MEF. https://www.dt.mef.gov.it/export/sites/sitodt/modules/documenti_it/news/news/Working-Paper-The-effects-of-tax-incentives-for-dwelling-renovations-the-case-of-Italy.pdf
- Clerc, M.-É., & Mauroux, A. (2010, October 14). *Le recours au crédit d'impôt en faveur du développement durable—Insee Première—1316*. <https://www.insee.fr/fr/statistiques/1283214>
- Codogno, L. (2024). *Italy's Superbonus 110%: Messing up with demand stimulus and the need to reinvent fiscal policy* (Working Paper No. 93; p. 29). Hans-Böckler-Stiftung, Institut für Makroökonomie und Konjunkturforschung (IMK). <https://www.econstor.eu/handle/10419/301181>

- Colabella, A., Michelangeli, V., Lavecchia, L., & Pico, R. (2024). To Eat or to Heat: Are Energy Bills Squeezing People's Spending? *Questioni Di Economia e Finanza*, 800, 1–36. <https://doi.org/10.2139/ssrn.4849271>
- Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – A Renovation Wave for Europe – Greening Our Buildings, Creating Jobs, Improving Lives (2020). <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020DC0662>
- Consiglio Nazionale dei Dottori Commercialisti e degli Esperti Contabili. (2022, September). *Informativa n. 124/2022—Legge di conversione del decreto-legge 9 agosto 2022, n. 115 (cd. 'Decreto Aiuti bis'). Prime indicazioni.* <https://commercialisti.it/wp-content/uploads/2024/04/Allegato-informativa-124-2022.pdf>
- Corsello, F., & Ercolani, V. (2024). The role of the Superbonus in the growth of Italian construction costs. *Questioni Di Economia e Finanza*, 903, 1–18. <https://doi.org/10.32057/0.QEF.2024.903>
- Crocker, T. (1966). The structuring of atmospheric pollution control systems, volume 1 of the economics of air pollution. *Harold Wolozin, New York*, 61–86.
- Dales, J. H. (1968). Pollution, Property, and Prices: An Essay. *Policy-Making and Economics*. Toronto: University of Toronto Press.
- Davis, L. W. (2023). *The Economic Determinants of Heat Pump Adoption* (Working Paper No. 31344). National Bureau of Economic Research. <https://doi.org/10.3386/w31344>
- de Blasio, G., Fiori, R., Lavecchia, L., Loberto, M., Michelangeli, V., Padovani, E., Pisano, E., Rodano, M. L., Roma, G., Rosolin, T., & Tommasino, P. (2024). Improving the energy efficiency of homes in Italy: The state of the art and some considerations for public intervention. *Questioni Di Economia e Finanza*, 845, 1–51. DOI: 10.32057/0.QEF.2024.0845
- Dechezleprêtre, A., Fabre, A., Kruse, T., Planterose, B., Sanchez Chico, A., & Stantcheva, S. (2022). *Fighting Climate Change: International Attitudes Toward Climate Policies* (SSRN Scholarly

Paper No. 4165337). Social Science Research Network.

<https://papers.ssrn.com/abstract=4165337>

Diana, M. (2021, June 11). *Efficienza energetica e riqualificazione degli edifici: Oltre 15 milia.*

ENEA - Dipartimento Unità per l'efficienza energetica.

<https://www.energiaenergetica.enea.it/vi->

[segnaliamo/https%3A%2F%2Fwww.energiaenergetica.enea.it%2Fvi-](https://www.energiaenergetica.enea.it/vi-)

[segnaliamo%2Fefficienza-energetica-e-riqualificazione-degli-edifici-oltre-15-miliardi-dal-](https://www.energiaenergetica.enea.it/vi-)
[piano-nazionale-di-ripresa-e-resilienza-pnrr.html%3Futm](https://www.energiaenergetica.enea.it/vi-)

Directive (EU) 2023/1791 of the European Parliament and of the Council on Energy Efficiency,

Official Journal of the European Union (2023). <https://eur-lex.europa.eu/legal->

[content/EN/TXT/?uri=CELEX:32023L1791](https://eur-lex.europa.eu/legal-)

Douenne, T., & Fabre, A. (2022). Yellow Vests, Pessimistic Beliefs, and Carbon Tax Aversion.

American Economic Journal: Economic Policy, 14(1), 81–110.

<https://doi.org/10.1257/pol.20200092>

European Commission. (2024, June 5). *Energy consumption in households*. Eurostat Statistics

Explained. <https://ec.europa.eu/eurostat/statistics-explained/index.php?oldid=636658>

Eurostat. (2025). *General government gross debt*.

https://ec.europa.eu/eurostat/databrowser/view/SDG_17_40__custom_2193722/bookmark/tab

[le?lang=en&bookmarkId=fef0c906-5609-4e2c-9a0f-692e93535757](https://ec.europa.eu/eurostat/databrowser/view/SDG_17_40__custom_2193722/bookmark/tab)

Fack, G., & Giraudet, L.-G. (2024). *Housing's energy efficiency: Renovating public action* (Focus

No. 81; Les Notes Du Conseil d'analyse Économique, pp. 1–12). Conseil d'analyse

économique (CAE). <https://cae-eco.fr/static/pdf/cae081-renovation-energetique-en.pdf>

Faiella, I., & Lavecchia, L. (2021). Households' Energy Demand and the Effects of Carbon Pricing in

Italy. *Questioni Di Economia e Finanza*, 614, 1–43. <https://doi.org/10.2139/ssrn.3852271>

- Faiella, I., Lavecchia, L., Michelangeli, V., & Mistretta, A. (2022). A climate stress test on the financial vulnerability of Italian households and firms. *Journal of Policy Modeling*, 44(2), 396–417. <https://doi.org/10.1016/j.jpolmod.2021.11.001>
- Feger, F., Pavanini, N., & Radulescu, D. (2022). Welfare and Redistribution in Residential Electricity Markets with Solar Power. *The Review of Economic Studies*, 89(6), 3267–3302. <https://doi.org/10.1093/restud/rdac005>
- Frederiks, E. R., Stenner, K., & Hobman, E. V. (2015). Household energy use: Applying behavioural economics to understand consumer decision-making and behaviour. *Renewable and Sustainable Energy Reviews*, 41, 1385–1394. <https://doi.org/10.1016/j.rser.2014.09.026>
- Gable, M. (2022, August 2). *Sobriété énergétique, une impression de déjà-vu*. https://www.lemonde.fr/economie/article/2022/08/02/sobriete-energetique-une-impression-de-deja-vu_6136934_3234.html
- Gerarden, T. D., Newell, R. G., & Stavins, R. N. (2017). Assessing the Energy-Efficiency Gap. *Journal of Economic Literature*, 55(4), 1486–1525. <https://doi.org/10.1257/jel.20161360>
- Gillingham, K., Harding, M., & Rapson, D. (2012). Split Incentives in Residential Energy Efficiency: Theory and Empirical Evidence. *The Energy Journal*, 33(2), 37–62. <https://doi.org/10.5547/01956574.33.2.3>
- Gillingham, K., Newell, R. G., & Palmer, K. (2006). Energy Efficiency Policies: A Retrospective Examination. *Annual Review of Environment and Resources*, 31(1), 161–192. <https://doi.org/10.1146/annurev.energy.31.020105.100157>
- Gillingham, K., Newell, R. G., & Palmer, K. (2009). Energy efficiency economics and policy. *Annual Review of Resource Economics*, 1(1), 597–619. <https://doi.org/10.1146/annurev.resource.102308.124234>

- Giraudet, L.-G. (2020). Energy efficiency as a credence good: A review of informational barriers to energy savings in the building sector. *Energy Economics*, 87, 104698.
<https://doi.org/10.1016/j.eneco.2020.104698>
- Giraudet, L.-G. (2024). *Efficacité et effets distributifs des politiques de rénovation énergétique* (Focus No. 107; Les notes du conseil d'analyse économique, pp. 1–12). Conseil d'analyse économique (CAE). <https://www.cae-eco.fr/efficacite-et-effets-distributifs-des-politiques-de-renovation-energetique>
- Giraudet, L.-G., & Missemmer, A. (2023). The history of energy efficiency in economics: Breakpoints and regularities. *Energy Research & Social Science*, 97, 102973.
<https://doi.org/10.1016/j.erss.2023.102973>
- Giraudet, L.-G., & Vivier, L. (2024). *Analyse socio-économique des gains à la rénovation* (Focus No. 106; Les Notes Du Conseil d'analyse Économique, pp. 1–32). Conseil d'analyse économique (CAE). <https://www.cae-eco.fr/analyse-socio-economique-de-la-renovation-energetique-des-logements>
- Glachant, M. (2022). Le point de vue d'un économiste sur la rénovation énergétique des logements et sa régulation. *Réalités Industrielles, Annales des Mines*, 19–21. <https://annales.org/ri/2022/ri-mai-2022.pdf>
- Glachant, M., & Blaise, G. (2019). Quel est l'impact des travaux de rénovation énergétique des logements sur la consommation d'énergie ? *Revue de l'Energie*, 646, 45–60.
<https://minesparis-psl.hal.science/hal-02451696>
- Goodhew, J., Pahl, S., Auburn, T., & Goodhew, S. (2015). Making Heat Visible: Promoting Energy Conservation Behaviors Through Thermal Imaging. *Environment and Behavior*, 47(10), 1059–1088. <https://doi.org/10.1177/0013916514546218>

- Guerra-Santin, O., & Itard, L. (2010). Occupants' behaviour: Determinants and effects on residential heating consumption. *Building Research & Information*, 38(3), 318–338.
<https://doi.org/10.1080/09613211003661074>
- Guidelines on State Aid for Climate, Environmental Protection and Energy 2022 (CEEAG) (2022).
https://ec.europa.eu/competition-policy/public-consultations/2021-ceeag_en
- Hassett, K. A., & Metcalf, G. E. (1993). Energy conservation investment: Do consumers discount the future correctly? *Energy Policy*, 21(6), 710–716. [https://doi.org/10.1016/0301-4215\(93\)90294-P](https://doi.org/10.1016/0301-4215(93)90294-P)
- IEA. (2024). *Energy Efficiency 2024*. International Energy Agency.
<https://www.iea.org/reports/energy-efficiency-2024>
- IEA. (2025). *Energy Efficiency—Energy System—IEA*. https://www.iea.org/energy-system/energy-efficiency-and-demand/energy-efficiency?utm_source
- INSEE. (2024). *Le parc de logements au 1er janvier 2024—Insee Focus—332*.
<https://www.insee.fr/fr/statistiques/8251576#onglet-1>
- IPCC. (2022). *Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press. <https://www.ipcc.ch/report/ar6/wg3/>
- Jaffe, A., & Stavins, R. (1994). The energy-efficiency gap What does it mean? *Energy Policy*, 22(10), 804–810. <https://EconPapers.repec.org/RePEc:eee:enepol:v:22:y:1994:i:10:p:804-810>
- Maduta, C., D'Agostino, D., Tsemekidi-Tzeiranaki, S., Castellazzi, L., Melica, G., & Bertoldi, P. (2023). Towards climate neutrality within the European Union: Assessment of the Energy Performance of Buildings Directive implementation in Member States. *Energy and Buildings*, 301, 113716. <https://doi.org/10.1016/j.enbuild.2023.113716>

- Ministère de la Transition écologique. (2020). *Stratégie Nationale Bas-Carbone (SNBC 2)*, mars 2020. République Française. https://www.ecologie.gouv.fr/sites/default/files/documents/2020-03-25_MTES_SNBC2.pdf
- Nauleau, M.-L. (2014). Free-riding on tax credits for home insulation in France: An econometric assessment using panel data. *Energy Economics*, 46, 78–92. <https://doi.org/10.1016/j.eneco.2014.08.011>
- Olsthoorn, M., Schleich, J., Gassmann, X., & Faure, C. (2017). Free riding and rebates for residential energy efficiency upgrades: A multi-country contingent valuation experiment. *Energy Economics*, 68, 33–44. <https://doi.org/10.1016/j.eneco.2018.01.007>
- Pigou, A. C. (1932). *The Economics of Welfare* (4th edn). Macmillan.
- Pisauro, G. (2022, June 29). Un Superbonus distorsivo e poco sostenibile | G. Pisauro. *Lavoce.info*. <https://lavoce.info/archives/91831/un-superbonus-distorsivo-e-poco-sostenibile/>
- PLF. (2024). *Effort financier de l'État en faveur de la rénovation énergétique des bâtiments*. Projet Loi Finances. <https://www.budget.gouv.fr/documentation/effort-financier-renovation-energetique-2024>
- Regulation (EU) 2021/241 Establishing the Recovery and Resilience Facility, Official Journal of the European Union (2021). <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32021R0241>
- Richards, K. (2023). Energy Policy Instruments for a Low-Carbon Energy Transition. In G. Bellantuono, L. Godden, H. Mostert, H. Wiseman, & H. Zhang (Eds), *Handbook of Energy Law in the Low-Carbon Transition* (pp. 81–98). De Gruyter. <https://doi.org/10.1515/9783110752403-012>
- Risch, A. (2013). *Environment and energy: Analysis and evaluation of public policies* (Issue 2013GRENA027) [Doctoral dissertation, Université de Grenoble]. <https://theses.hal.science/tel-00944138>

- Risch, A. (2020). Are environmental fiscal incentives effective in inducing energy-saving renovations? An econometric evaluation of the French energy tax credit. *Energy Economics*, 90, 104831. <https://doi.org/10.1016/j.eneco.2020.104831>
- Rizzo, L. (2024, April 24). Il Superbonus colpisce ancora | L. Rizzo. *Lavoce.info*.
<https://lavoce.info/archives/104522/il-superbonus-colpisce-ancora/>
- Ruggieri, G., Andreolli, F., & Zangheri, P. (2023). A Policy Roadmap for the Energy Renovation of the Residential and Educational Building Stock in Italy. *Energies*, 16(3), 1319.
<https://doi.org/10.3390/en16031319>
- Ryan, L., & Campbell, N. (2012). *Spreading the Net: The Multiple Benefits of Energy Efficiency Improvements* (IEA Energy Papers No. 2012/08). OECD Publishing.
<https://doi.org/10.1787/5k9crzjbpkkc-en>
- Schleich, J., Gassmann, X., Faure, C., & Meissner, T. (2016). Making the implicit explicit: A look inside the implicit discount rate. *Energy Policy*, 97, 321–331.
<https://doi.org/10.1016/j.enpol.2016.07.044>
- Service des données et études statistiques (SDES). (2023). *Chiffres clés du climat—France, Europe et Monde. Édition 2023*. Ministère de la Transition écologique et de la Cohésion des territoires. <https://www.statistiques.developpement-durable.gouv.fr/chiffres-cles-du-climat-france-europe-et-monde-edition-2023>
- Steg, L., Bolderdijk, J. W., Keizer, K., & Perlaviciute, G. (2014). An Integrated Framework for Encouraging Pro-environmental Behaviour: The role of values, situational factors and goals. *Journal of Environmental Psychology*, 38, 104–115.
<https://doi.org/10.1016/j.jenvp.2014.01.002>
- Tsemekidi Tzeiranaki, S., Bertoldi, P., Dagostino, D., Castellazzi, L., Maduta, C., Clementi, E., Paci, D., Della Valle, N., & Saviuc, I. (2025). *Energy Consumption and Energy Efficiency trends in*

the EU, 2000-2022 (Publications Office of the European Union). European Commission: Joint Research Centre. <https://doi.org/doi/10.2760/8246638>

UPB. (2023, March). *Audizione sugli effetti macroeconomici e di finanza pubblica derivanti dagli incentivi fiscali in materia edilizia*. <https://www.upbilancio.it/audizione-sugli-effetti-macroeconomici-e-di-finanza-pubblica-derivanti-dagli-incentivi-fiscali-in-materia-edilizia/>

WHO. (2018). *Housing and Health Guidelines: Executive Summary* (No. WHO-CED-PHE-18.10). World Health Organization. <https://iris.who.int/bitstream/handle/10665/277465/WHO-CED-PHE-18.10-eng.pdf?sequence=1>