UNIVERSIDAD POLITÉCNICA DE MADRID
Escuela Técnica Superior de Ingenieros Industriales

Towards Urban Transformations: A Spatial Approach to the Implementation of Household Energy Retrofit Policies and the Role of Intermediaries in Bridging Policy and Climate Action

DOCTORAL THESIS

Submitted for the degree of Doctor by:

Ana Corrêa do Lago
MS Design and Urban Ecologies

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A Manuela Navarro, impulsora de la transformación del barrio de Poblado de Orcasitas, en Madrid.

Abstract

The decarbonization of urban environments —understood as the reduction of greenhouse gas (GHG) emissions in cities—hinges critically on accelerating household energy retrofits, particularly across the European Union's aging and energy inefficient housing stock (Buildings Performance Institute Europe, 2024; UNEP, 2024). Despite increased public subsidies following the launch of the EU Green Deal (2019), and the resulting multi-level policy alignment aimed at achieving climate neutrality by 2050, household energy retrofit rates remain persistently low across EU cities—particularly in Spain, where renovation efforts continue to fall significantly short of EU targets.

This implementation gap motivates our study, which examines the implementation of household energy retrofit policies in Madrid as a lens to explore the broader challenges of urban transformation processes toward sustainability. Through a **mixed-methods approach**, this research combines **quantitative data** to map the socio-spatial distribution of household energy retrofit subsidies at both district and neighbourhood levels, with **qualitative analysis** to examine the role of actor-intermediaries in bridging municipal objectives and household decision-making in the context of energy retrofits. Building on the framework by Martiskainen and Kivimaa (2017), we propose a categorization of intermediaries into place-based and non-place-based types, adding a spatial dimension to better understand their roles within the retrofit system., and illustrate this categorization in our case study in Madrid.

By integrating theories of urban transformation and transition intermediaries in the context of zero-carbon buildings, the study aims to advance a spatially grounded approach to better understand how policy materialize across heterogeneous urban environments. Results indicate that subsidy uptake is disproportionately concentrated in three socioeconomically vulnerable neighbourhoods characterized by deteriorated building conditions. Although these areas were not being explicitly prioritized in the design of subsidy programs, the findings suggest that material necessity and the needs for repairs—rather than environmental concerns— are important drivers for demand of energy retrofits at the local level. Furthermore, the study underscores the importance of local network formation and demonstrates how organized community leadership—such as that in the neighbourhood of Orcasitas—can play a critical role in catalyzing collective retrofit adoption at the local level.

Theoretically, this research contributes to urban transformation scholarship by offering a granular, spatially grounded analysis of how climate policies can advance in specific areas—patterns of transformation that are not visible through an analytical lens focused solely at the

municipal level. Furthermore, a greater integration of place-based and non-place-based intermediary activities could enhance the feedback loop between neighbourhood-level dynamics and data-driven insights generated at broader governance levels. Policy recommendations emphasize the need for targeted strategies, facilitating local network formation, and building collaborative networks that leverage data feedback loops.

Resumen

La descarbonización de los entornos urbanos —entendida como la reducción de emisiones de gases de efecto invernadero (GEI) en las ciudades— depende críticamente de acelerar la rehabilitación energética de las viviendas, especialmente en Europa (UN; BPIE, 2024). A pesar del aumento de las subvenciones públicas tras el lanzamiento del Pacto Verde Europeo (2019) y de la alineación de políticas a múltiples niveles orientadas a lograr la neutralidad climática para 2050, las tasas de rehabilitación energética residencial siguen siendo persistentemente bajas en las ciudades de la UE, particularmente en España, donde los esfuerzos de renovación continúan estando muy por debajo de los objetivos marcados por la UE.

Esta brecha en la implementación motiva este estudio, que analiza la aplicación de políticas de rehabilitación energética de viviendas en Madrid como una lente para explorar los desafíos más amplios de los procesos de transformación urbana hacia la sostenibilidad. A través de un enfoque metodológico mixto, esta investigación combina datos cuantitativos para mapear la distribución socioespacial de las subvenciones a la rehabilitación energética a nivel de distrito y de barrio, con análisis cualitativo sobre el papel de los actores-intermediarios en la mediación entre los objetivos municipales y las decisiones privadas de las viviendas hacia la eficiencia energética. Basándonos en el marco conceptual de Martiskainen y Kivimaa (2017), proponemos una categorización de los intermediarios en tipos “place-based” y “non place based,” añadiendo una dimensión espacial para comprender mejor las funciones de los intermediarios en el ámbito de la rehabilitación de viviendas, y ejemplificamos esta tipología en nuestro estudio de caso en Madrid.

Al integrar teorías de transformación urbana e intermediarios en el contexto de edificios cero emisiones, el estudio busca desarrollar un enfoque espacialmente fundamentado que permita comprender cómo las políticas se materializan de manera desigual en entornos urbanos heterogéneos. Los resultados indican que la recepción de subvenciones está desproporcionadamente concentrada en tres barrios socioeconómicamente vulnerables, caracterizados por condiciones edilicias deterioradas. Aunque estas zonas no fueron explícitamente priorizadas en el diseño de los programas de subvención, los hallazgos sugieren que la necesidad material y las necesidades de reparación en las viviendas—más que las preocupaciones ambientales— han sido impulsores de la demanda de rehabilitación energética a nivel local. Además, el estudio subraya la importancia de la formación de redes locales y demuestra cómo el liderazgo comunitario organizado —como en el caso del barrio de Orcasitas— puede desempeñar un papel clave en la adopción colectiva de medidas de rehabilitación.

Teóricamente, esta investigación contribuye al campo de estudio de la transformación urbana al ofrecer un análisis granular y anclado al territorio para identificar cómo las políticas climáticas pueden avanzar en áreas específicas de la ciudad —con patrones de transformación urbana que no son visibles desde un enfoque analítico centrado únicamente en el nivel municipal. Asimismo, una mayor integración de las actividades de intermediarios podría fortalecer el ciclo de retroalimentación entre las dinámicas a nivel de barrio y los conocimientos generados mediante datos a escalas de gobernanza a nivel macro, para generar políticas públicas de descarbonización más eficaces. Las recomendaciones destacan la necesidad de estrategias dirigidas a territorios específicos, el fomento de redes locales y la construcción de colaboraciones que fortalezcan los circuitos de retroalimentación basados en datos.

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Abbreviations and Acronyms

UPM	Technical University of Madrid (*Universidad Politécnica de Madrid*)
itdUPM	Technology Innovation Center for Development at Universidad Politécnica de Madrid
APIRUS	Designated Areas to Promote Urban Regeneration Efforts (*Áreas Preferentes de Impulso a la Regeneración Urbana*)
ASVEYCO	Neighbourhood Association of Ciudad los Ángeles (*Asociación de Ciudad los Ángeles*)
AVA	Neighbourhood Association of Aluche (*Asociación* Vecinos Aluche)
BOE	Official Journal of Spain (*Boletín Oficial del Estado*)
CitiES	The national platform for Spanish cities towards climate neutrality.
COAM	Madrid Institute of Architects
CONAMA	National Environmental Congress of Spain (Congreso Nacional del Medio Ambiente)
SATE	Exterior Wall Insulation System (*Sistema de aislamiento térmico exterior*)
PNIEC	Integrated National Energy and Climate Plan in Spain *(Plan Nacional Integrado de Energía y Clima en España)*
ERESEE	Long-term strategy for energy renovation in the building sector in Spain (*Estrategia a largo plazo para la rehabilitación energética en el sector de la edificación en España)*
PRTR	The recovery Plan, transformation and Resilience (*Plan de Recuperación Transformación y Resiliencia*)
IRPF	Personal Income tax (*Impuesto sobre la Renta de las Personas Físicas*)
INE	National Statistics Institute (*Instituto Nacional de Estadística*)
UIMP	Menéndez Pelayo University (*Universidad Menéndez Pelayo*)

1. INTRODUCTION

The 2015 Paris Agreement set ambitious targets to limit global temperature rise to below 1.5°C, requiring a substantial reduction in greenhouse gas (GHG) emissions. In response, countries around the world are committing to climate action to curb their emissions in order to mitigate global temperature increases. With urbanization rates growing globally, cities—already responsible for 75% of global GHG emissions—have been identified as critical sites for climate action.[1] Recognized for their transformative potential in advancing emission reduction efforts, cities play an important role in the global response to climate change (Hölscher et al., 2019).

In cities, the building sector is a key contributor to GHG emissions: the sector alone contributes to 40% of global energy-related emissions, and has been recognized for its potential to mitigate climate change (UNEP, 2024) A very significant portion of emissions comes from the energy consumed in buildings, primarily for operational needs for space heating and cooling (UNEP, 2024). Improving thermal insulation in buildings - thereby reducing heat loss and heat surplus - is therefore understood as a key measure to reduce energy demand in the building sector, along with the installation of equipment from renewable sources (Buildings Performance Institute Europe, 2024; OECD, 2024).

As signatories of the Paris Agreement, the EU and its Member States have prioritized the renovation of existing buildings in their efforts to reduce emissions and achieve climate neutrality by 2050, as outlined in policy initiatives such as the EU Green Deal (European Commission, 2019b). In the EU, buildings account for 40% of total energy consumption and 35% of energy-related greenhouse gas emissions. Similarly, in Spain buildings account for approximately 30% of Spain's total energy consumption, and 25% of GHG emissions (GBCe, 2022).

As a result, improving the energy performance of buildings has become a central focus of climate policy interventions in European cities (European Commission, 2019b) Europe faces a unique challenge with its buildings stock due to its low building turnover: 80% of the current buildings are projected to remain in use by 2050. This contrasts sharply with India, for example, where only 40% of buildings are projected to remain in use by mid-century (La Salle et al., 2022). Furthermore, the European building stock is not only aging but also highly energy-

[1] See: https://www.unep.org/explore-topics/resource-efficiency/what-we-do/cities/cities-and-climate-change
https://blogs.worldbank.org/sustainablecities/cutting-global-carbon-emissions-where-do-cities-stand, Accessed on May 1st, 2025

inefficient, with 75% of its buildings demonstrating poor energy performance.[2] In Spain specifically these figures are even higher, as approximately 85% of existing buildings are rated E, F, or G (on a scale from A to G) based on energy consumption.[3] Additionally, 60% of Spain's buildings were constructed before 1980, prior to the enforcement of Spanish regulations that introduced minimal energy efficiency standards (Ministerio de Vivienda y Agenda Urbana, 2020).[4] As a result, energy poverty remains a significant issue in Spain, as 17% of the population struggled to keep their homes adequately warm in 2022—almost double the EU average of 9.3%.[5]

The urgency of mitigating climate change has placed household energy retrofits at the forefront of urban transformation strategies, particularly in Europe and Spain, where residential buildings account 76% of the built environment. While there is multi-level institutional alignment at European, national, and municipal levels to advance towards climate-neutral objectives —with a strong focus on policies that aim to reduce energy consumption in residential buildings—the transformation of the existing building stock is not progressing at the scale or speed necessary to meet emission reduction targets in European and Spanish cities set by the EU Green Deal (Buildings Performance Institute Europe, 2024; IDAE, 2021) The implementation of household energy retrofits is even slower in Spain, where renovation rates continue to fall significantly below the EU emission reduction targets, established for 2030 and 2050 (European Commission, 2019b; Provivienda, 2024). By 2023, only 37,784 households had been retrofitted, compared to the target of 120,000 per year set in the 2021–2030 in Spanish Energy Plans (Ministerio de Vivienda y Agenda Urbana, 2024; Provivienda, 2024). This highlights a substantial gap between the planned objectives and the actual pace of retrofits. Moreover, with the target increasing to 138,000 per year in 2024, the challenge of closing this gap has become even more pressing.

The context of household energy retrofits offers an interesting lens to examine the challenges that urban climate policies encounter to deliver urban transformation across European cities. Despite multi-level policy consensus to advance retrofits and the availability of financial incentives to it, a persistent breakdown exists between municipal targets and actual implementation outcomes at the household level. Despite efforts on the supply side, including expanded financial incentives in public programs to stimulate retrofit uptake, key challenges—such as collective decision-making in multifamily buildings, lack of homeowner awareness

[2] https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/energy-performance-buildings-directive_en Accessed in January 4th 2025

[3] https://www.renovate-europe.eu/wp-content/uploads/2023/10/REDay2023_2_Pager_Final.pdf Accessed May 12th, 2025

[4] https://energy.ec.europa.eu/system/files/2020-06/es_ltrs_2020_0.pdf Accessed January 4th 2025, p. 141

[5] https://www.bpie.eu/wp-content/uploads/2024/11/EU-Buildings-Climate-Tracker_Final.pdf Accessed January 4th 2025, p.55

regarding available subsidies, and fears of disruption—remain barriers for homeowners' adoption (Bobrova et al., 2024; Saniour, N., 2023; Wilson et al., 2015)

These barriers extend beyond the Spanish context and have been widely acknowledged in the literature examining household energy retrofit adoption in other cities (Bolton et al., 2023; Brown et al., 2018; Stieß & Dunkelberg, 2013; Walker et al., 2014; Wilson et al., 2015). Transition intermediaries have been proposed to link the demand and supply side of disruptive interventions such as energy retrofits (Kivimaa & Martiskainen, 2018). However, more needs to be understood about how these actors operate to enable more effective policy outcomes in retrofit initiatives (Owen et al., 2014; Zaunbrecher et al., 2021). Examining the role and influence of intermediaries in connecting municipal goals with household-level needs is crucial, as securing homeowner engagement is essential for meeting GHG reduction targets, given that retrofit decisions are made at the household level —directly affecting private spaces and everyday lives (Edwards & Bulkeley, 2017; Hodson et al., 2013; Parag & Janda, 2014). This study aims to deepen understanding of how intermediaries operate in this space and to explore how their collaboration can help bridge the implementation gap between municipal ambitions and household action. The detailed research questions, which link to the literature review in Section 2, are presented in Section 2.4.

This thesis examines the local implementation of household energy retrofit policies aimed at improving the thermal performance of residential buildings in European cities, by focusing on an in-depth case study in the city of Madrid. The study seeks to analyse specifically the implementation of policies designed to reduce operational emissions in the residential building stock through insulation measures that reduce energy demand**.** These measures include enhancing the building envelope and sealing air leaks by repairing windows and roofs. Such interventions often come accompanied by the introduction of renewable energy systems to further reduce the emissions footprint. By focusing on policies targeting operational carbon in existing buildings, this study does not examine policies aimed at reducing the footprint of embodied GHG emissions across a building's lifecycle, which is particularly important for new construction.

This study aims to deepen understanding of how intermediaries —actors who facilitate collaboration and mediate between different levels of implementation— contribute to the implementation of transformative urban climate strategies at the local level. The urban climate policy strategies in Europe in recent years have been influenced by urban transformation (UT) research, which emphasizes cities' pivotal role in mitigating the effects of climate change. This perspective has shaped climate policy agendas by underscoring the need for collaborative approaches to drive transformative urban development trajectories that break from business-as-usual (Hölscher et al., 2019; Patterson et al., 2017; Wolfram, 2016). In this context, the role and

influence of intermediaries have become increasingly relevant to understanding how such transformations are implemented locally. Therefore, this dissertation seeks to engage with theoretical debates in urban transformations UT literature particularly calls for more empirical studies that adopt a granular scale of analysis to better understand how transformation processes materialize at the local level. It also integrates the intermediaries literature in the context of energy retrofitting. This sub-city scale approach adopted in this study acknowledges that municipal environments are not homogeneous; rather, different patterns of policy adoption emerge across urban territories, with various actors playing distinct roles in shaping these outcomes and contributing to implementation processes (Castán Broto & Westman, 2020; Westman & Castán Broto, 2022).

The structure of this dissertation is as follows: **Chapter 2** outlines key concepts and the existing theoretical debates on scale of analysis within the UT literature – what this thesis coins as "the matter of scale." The chapter also explores the existing barriers to adoption of household retrofits, and the literature describing the role of actor-intermediaries in overcoming the "human dimension" place-based factors and facilitating retrofit uptake. **Chapter 3** proposes an analytical framework to deepen the understanding of the role and influence of intermediaries, specifically how they operate to mediate between municipal and local levels. This framework introduces a spatial dimension to intermediary roles, an aspect currently underexplored in the retrofit intermediaries' literature. **Chapter 4** describes the methodology employed in this study and explains the mixed-method approach that this case study employs to analyse spatial variations at district and neighbourhood levels to identify patterns of policy retrofit adoption and examine the existing and potential roles of intermediaries in influencing policy outcomes. **Chapter 5** describes the quantitative and qualitative results corresponding to research questions 1 and 2 and **Chapter 6** outlines key themes that emerged as the findings of this research with theoretical and practical implications that come out of the research questions. Finally, **Chapter 7** synthesizes the key findings of this thesis, highlighting the main theoretical contributions derived from the empirical case study. It discusses the policy implications of the research, addresses the central research questions, and reflects on the study's limitations. Finally, it identifies potential directions for future research to further advance understanding in this field.

2. LITERATURE REVIEW: GAPS AND PROBLEM FRAMING

2.1. The "matter of scale" in the Urban Transformations (UT) literature

A more granular approach, at the sub-city scale and grounded in the territory, allows to identify the mechanisms that intermediaries employ to accelerate the slow progress of household energy retrofit implementation, and therefore analyse their ability to drive path-deviant "urban transformations" towards sustainability.

2.1.1. Urban transformations literature: key concepts and definitions

In recent years, "urban transformations" towards sustainability have become an increasingly dominant term in policy discourse and global sustainability research (Patterson et al., 2017). The term is a call for a radical change in the ways that urban development is governed, aiming to accelerate more sustainable pathways at both local and global scales (Hölscher & Frantzeskaki, 2021; Westman & Castán Broto, 2022). Key areas of intervention include shifting energy systems to renewable sources, increasing energy and material efficiency, and ensuring the safety and reliability of water supply and waste management (McCormick et al., 2013). There is a wide consensus that transformation of urban governance is essential for advancing global sustainability goals: indeed, cities are recognized as a "strategic arena for climate action" and have become "obligatory passage points" for international climate change governance (Castán Broto, 2017). Such transformations are large-scale, and require a long-term perspective: as such, transformational processes do not occur "as one major step" but unfold in phases (Wolfram et al., 2019, p. 440). Authors agree there is "no single transformation pathway" and transformations are complex and uncertain given the long-term timeframe that presupposes transformational processes (Boyd & Juhola, 2015; van der Heijden et al., 2019; Wolfram et al., 2019).

The field of "urban transformations" research studies the governance capacities of stakeholders, processes and institutions to deliver transformative change towards sustainability in cities (Hölscher et al., 2019). "Transformative capacity" is a term that has been long established in the field of management science and organizational innovation before being integrated in urban sustainability discourse (Castán Broto et al., 2019). In the context of organizational

management, it refers to a company's capacity to reconfigure their structure and inter-departmental connections in order to adapt and respond to disruptive technological changes (Castán Broto et al., 2019). In urban studies, the embrace of systems thinking has encouraged the adoption of the concept of 'transformative capacity,' understood as the need to reconfigure the relationships among interdependent elements (the ways in which actors, institutions, and technology interact) within the city system. This reconfiguration aims to promote change—as, for example, becoming better prepared to adapt to and respond to challenges such as climate change.

In urban governance, Wolfram (2016) defines "urban transformative capacity" as the collective ability of urban stakeholders to initiate , prepare for, and implement path-deviant changes toward sustainability within the urban contexts in which they operate (Wolfram, 2016). Hölscher (2019) builds on Wolfram's definition arguing that transformative climate governance is an integrated process where multiple actors —not just governments— work together to effectively mainstream climate action that addresses the challenges of mitigation and adaptation in cities. Therefore, transforming urban climate governance means transforming "the ways in which public, private, and civil society actors and institutions articulate climate goals, exercise influence and authority, and manage urban climate planning and implementation processes" (Anguelovski et al., 2016).

There is wide consensus in the literature that transforming the governance of climate change in urban areas requires shifting away from hierarchical, state-led approaches towards distributed governance in cities (Castán Broto, 2017; Hölscher et al., 2019; Khan, 2013; McCormick et al., 2013; Patterson et al., 2017; Wolfram, 2016). Transformative climate governance therefore involves the capacity to drive effective alignment across different levels of government and collaborations with non-state actors (Castán Broto, 2017; Hölscher et al., 2019; Khan, 2013). This includes: 1) cross-scale collaborations: alignment across government scales ensuring coherent actions across national, regional, and local levels. 2) cross-sectoral collaborations: partnerships with non-state actors, such as businesses and civil society organizations, are essential for implementing transformational interventions (Westman et al., 2019). Thanks to an effective coordination of multiple stakeholders, municipal governments are able to increase their legitimacy and local capacity to implement climate action (Wolfram et al., 2019).

However, there is limited understanding of whether the prescription of such governance capacities suffices to drive transformations towards sustainability. Authors have identified, for example, stakeholders' resistance to change, even in cities that have institutionalized cross-sectoral and cross-scale governance arrangements to advance climate action and who are recognized as champions of climate change (Hölscher et al., 2019; Khan, 2013; Wamsler,

2015). Hölscher (2019) gives the example of New York and Rotterdam, arguing that mitigation and adaptation needs are often perceived as "doing something extra" and that climate agendas have remained "patches within overall city policy and planning" (Hölscher et al., 2019, p.853).While institutional conditions for transformative local climate action have improved in these climate champion cities, responses have tended to remain fragmented and piecemeal rather than integrated, —thereby preventing the path-deviant, transformative change needed (Borgström, 2019; Nagorny-Koring, 2019a).

The emphasis on collaboration and consensus-building in the governance approaches in urban transformations literature may obscure power imbalances and conflicts inherent in urban transformation processes. In fact, power imbalances among stakeholders involved in implementing city climate action is raised as a significant barrier that perpetuates the *status quo* and hinders transformative change (Carriquiry et al., 2020; Khan, 2013; Sareen & Waagsaether, 2022; Zografos et al., 2020). Khan (2013) exemplifies such limitations when describing how the resistance from established market actors in the transport sector hindered the implementation of low-carbon transport initiatives in the municipal project to transform the city of Vaxjo (Sweden) into a "fossil fuel free" city (Khan, 2013, p. 137). Similarly, Zografos (2020) describes power imbalances within the stakeholders involved in the superblocks project in Barcelona. He argues that urban planning interventions towards sustainability (such as the superblocks project) entail disputes over economic and political power rather than conflicting environmental visions: "Because of the scope of changes needed, transformational adaptation is a fight involving political ideology, urban development, market forces and globalization, (…) more than it is a fight over different visions for environmental policy and planning (Zografos, 2020, p.9)." Consequently, even though these interventions have aimed to be transformational, they have delivered incremental progress (Zografos et al., 2020, p.9)

In urban governance, transformative capacity can be understood as an indicator of the ability of a dynamic mix of public and private actors to guide urban development in a direction significantly different from historical patterns (Castán Broto et al., 2019). However this ability is not always present and authors have argued that the UT literature lacks empirical evidence of transformative capacity in urban environments (Castán Broto et al., 2019). Scholars have acknowledged that, while governance efforts have been made to promote cross-sectoral and cross-scale collaborations between governments and non-governmental institutions — considered a key driver of climate action in urban transformation studies— these procedural advancements, though necessary, remain insufficient to achieve tangible transformations on the ground (Castán Broto et al., 2019; Hölscher et al., 2019; Nagorny-Koring & Nochta, 2018). Castán-Broto et al. (2019) argue urban transformations require not only multi-level governance linkages but require also attention to place-specific capacities:

> *"Transformations require the combined recognition of place-specific capacities with cross-scale relations. That is, while certain dimensions of transformative capacity are fundamentally place-based (e.g. attention to societal needs and practical experimentation in a particular locale), others are dependent on connections that extend beyond that specific geography (e.g. actor networks and infrastructure systems)." (*Castán Broto et al., 2019, p. 452)

2.1.2. The debates on "the matter of scale" in the Urban Transformations (UT) literature: the city and sub-city scale

One of the key debates in the theorization of urban transformation (UT) literature, as identified in this dissertation, is the problem of scale of analysis, what we name "the matter of scale" in this study. There is a gap between policy rhetoric in city climate action and the practicalities faced during on-the-ground implementation and there are debates on whether current urban transformation (UT) frameworks can explain this gap (van der Heijden, 2019; Westman & Castán Broto, 2022). Urban transformative capacity in cities can be better understood through analysis at a granular, sub-city scale to empirically observe how transformation processes occur in heterogeneous urban environments.

The urban transformation (UT) literature explores how municipalities and institutions work together across sectors and levels of government, with the city unit as the primary unit of analysis to understand how these governance arrangements contribute to advance global climate goals. However, scholars have criticized the UT literature emphasis on identifying cities' "best practices" to focus on the development of transferable governance practices that could produce replicable solutions from one city to another (Nagorny-Koring & Nochta, 2018; Westman & Castán Broto, 2022, p. 1335). In fact, Westman and Castán Broto (2020) contend that the focus on pursuing "universal solutions" for cities, with its emphasis on best practices and replicability, has diverted attention from a more place-based perspective -one that is grounded in the social and material realities of communities in a particular place, and their everyday needs that will propel them to change:

> *"The increasing urgency of climate change has catalyzed a search for universal solutions that paradoxically may have diverted attention from the material realities and the very individuals that ultimately join and drive climate actions. What is largely missing although there is a nascent body of work that points towards alternatives—is a sober assessment of the mundane aspects of climate change governance on the ground*

> *capable of exploring concerns about what kind of cultural and socio-economic change is taking place, beyond a comparative analysis of the effectiveness of climate policies." (Castán-Broto and Westman, 2020, p. 11)*

These debates call for more empirical studies that employ a more granular scale of analysis at the sub-city scale to further understand urban transformations. Treating the city as the primary unit of analysis in the UT literature, risks perceiving it as a homogeneous entity that passively receives interventions. Scholars studying transformations in urban governance recommend shifting the focus from treating the city scale as the main unit of analysis to using more detailed approaches that allow for a closer examination of urban interventions towards sustainability (Castán Broto & Westman, 2020; van der Heijden et al., 2019). Van der Heijden et al. (2019) argue that by 'over-romanticizing' the potential of cities to address climate change, scholars in the UT literature have focused on the municipal scale as their analytical lens, overlooking critical place-based factors—both material and social—that shape how urban transformations unfold on the ground in different parts of the city. (Castán Broto & Westman, 2020; van der Heijden et al., 2019; Westman & Castán Broto, 2022).

Additionally, Uyarra (2013) points out that the emphasis on institutions in the UT literature analysis often lacks spatial grounding. This spatial perspective is necessary to understand how problems are experienced at the local level, and their ties to specific places and territories (Uyarra & Gee, 2013). Adopting a more granular approach at the sub-city scale allows for a closer examination of overlapping socio-spatial conditions in the territory, and the localized factors that shape different capacities for change across the city. This emphasizes the need for a deeper, localized understanding of both the resistance to change and the capacity of actors to influence others toward sustainable actions within specific sectors (Castán Broto, 2017; Frantzeskaki et al., 2018; Hamann & April, 2013; Nagorny-Koring & Nochta, 2018).

This shift of scale aims to uncover the heterogeneous nature of cities – highlighting how different social groups experience unequal material conditions across space, identifying a wider range of actors involved in change processes - including those operating outside institutional frameworks- and broadening the scope of the UT literature that has mainly focused on local governments and non-governmental institutions as the primary agents of change (Nagorny-Koring, 2019).

2.1.3. Towards granular and spatialized approaches to analyse urban transformation processes

The analytical approach at the municipal scale has been criticized for neglecting place-based experiences at the sub-city scale in favour of providing generic 'good governance' recommendations, thus overlooking the role and agency that local actors and their place-based conditions play in driving climate action in different territories inside the city unit (Bulkeley & Betsill, 2005; Castán Broto, 2017; Castán Broto & Westman, 2020; Nagorny-Koring, 2019; Westman & Castán Broto, 2022). Scholars have argued that the focus on global coordination and orchestration in city governance in the literature may have downplayed the place-based conditions that drive differing capacities towards climate action (Bulkeley & Betsill, 2005; Westman & Castán Broto, 2022).

In fact, Castán Broto (2020) claims that the jump from awareness to "doing something about low-carbon" depends on situated, and place-based drivers such as emotional associations and attachment to spaces and communities which will make action possible or not (Castán Broto, 2020, p. 251). Westman & Castán Broto (2022) argues that personal narratives and emotions "that may inspire resistance or change" are absent from the field of UT, although behavioral change is a known factor to prevent transformational outcomes (Westman & Castán Broto, 2022, p. 1335). Frantzeskaki (2018) makes a similar argument when she delves into the neighbourhood of Carnisse in Rotterdam to demonstrate that "sense of place" and community is a key driver of transformations (Frantzeskaki et al., 2018, p. 1055). She highlights the importance of symbolic values, feelings, belonging, and meanings embedded in individuals' "sense of place" and its potential to foster agentic processes of change (Frantzeskaki et al., 2018).

Acuto (2014) underlines the tension between the micro-scale of routine "everyday" life and macro-scale of the urgency of crisis-driven globalist thinking (Acuto, 2014, p. 346). Acuto (2014) critiques the pursuit of global solutions for minimizing the significance of the everyday, mundane spaces where change takes place. He defines the "everyday" as the "spatiality of situated, mundane, habitual practices" which he argues are not sufficiently acknowledged in international relations and climate (Acuto, 2014, p. 346). As a result, they argue that the search for "global solutions" to climate change often neglects the significance of the complex social fabric and dynamics embedded in everyday habits and values, exposing the tension around scales of analysis between municipal and local, household level (Acuto, 2014).

Consequently, when analysis is limited at the municipal level, cities are often viewed as relatively homogeneous spaces which passively receive interventions. This approach overlooks how processes of change are ”anticipated, interpreted, adapted, and acted upon differently” across various parts of the city, and how transformations are spatially differentiated based on locally experienced challenges (Uyarra & Gee, 2013, p. 2013). Additionally, Nagorny-Koring (2018) argues that the focus on formal, contractual relations renders invisible actors operating outside institutional structures who have a role in enacting transformations (Nagorny-Koring, 2019a; Westman & Castán Broto, 2022). Recognizing the broader network of actors driving transformations in cities could provide new insights to processes of urban transformations. This is particularly relevant in the following section where we analyze barriers to transforming the building sector toward net-zero emissions –an urban transformation that requires the engagement of householders, and which cannot be led by the government alone.

2.2. Household energy retrofits: a key pillar to deliver urban transformations towards low carbon

2.2.1. Policy context: governance frameworks for accelerating household energy retrofits in the EU and in Spain

The notion of transformative change towards sustainability has gained growing attention in urban policy discourse in recent years. Transformative-oriented policy is viewed as a means to bridge the gap between the urgent necessity to address environmental problems and the inherently incremental approach of existing environmental policies (van der Heijden et al., 2019; Wolfram et al., 2019, p. 201). In cities, the building sector is recognized for its transformative potential as described in the introduction chapter.

In Europe, household retrofit policies are considered a crucial lever for transforming European cities to achieve climate neutrality by 2030 (European Commission, 2019b). Residential buildings dominate the EU's building landscape, comprising 75% of the entire building stock. Across this residential building stock, about ⅓ of the European population lives in multifamily buildings (See Figure 2.1). In Spain however, the share of multifamily buildings is much more pronounced; nearly ⅔ of the population resides in multifamily buildings, with residential buildings comprising the majority of the overall building stock, 76% (See Figure 2.2). This fact makes the Spanish context particularly significant, as the prevalence of multifamily significantly impacts who has agency in decision-making. In multifamily buildings, the household is not the sole decision-maker, which affects the ability to comply with policy changes as collective decisions must be made. Renovation rates have progressed slowly across Europe and are off track to reach 2030 goals, and the slow progression is even worse in Spain

where the rate of retrofitting stands at just 1%, performing below the European Commission recommended retrofitting rate of 3% to achieve EU's climate targets (IDAE, 2021).

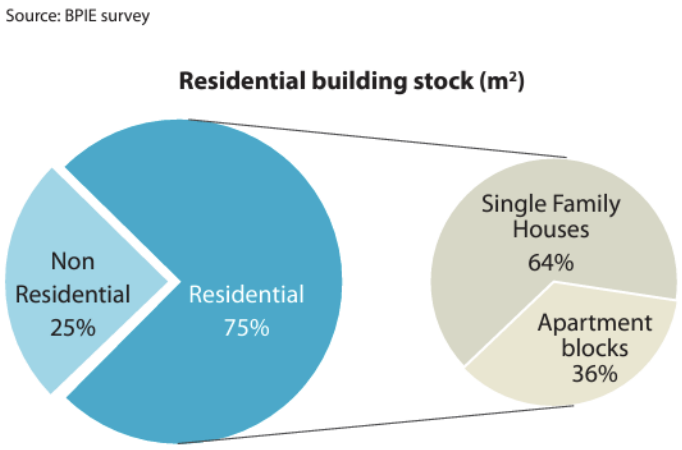

Figure 2.1 : Share of residential buildings in the EU, including multifamily and single-family homes

Source: European Commission, 2019a

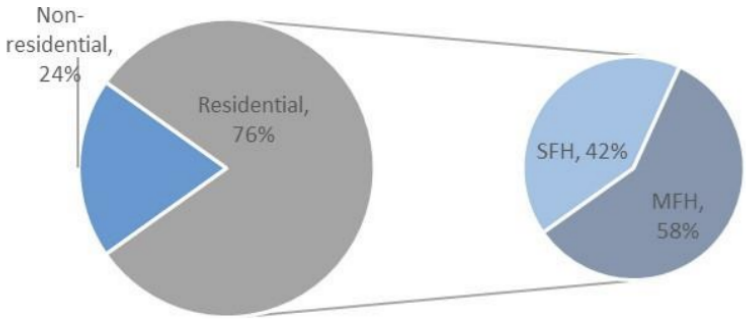

Figure 2.2 : Share of residential buildings in Spain, including multifamily and single-family homes

Source: European Commission, 2019a

Within the residential sector, effective household insulation plays a critical role in reducing energy consumption and is a key focus of EU emission reduction policies. The greatest energy demand in buildings is primarily consumed by thermal needs (such as heating and cooling), and to a lesser extent lighting and electricity. In residential buildings specifically, heating accounts for a significant portion of energy use: in the EU in 2022, the primary energy consumption by households was attributed to heating their homes, constituting 63.5% of the final energy consumption in the residential sector.[6] As a result, EU policies are focusing on interventions

[6] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Energy_consumption_in_households Accessed January 4th, 2025

specifically targeting thermal needs to achieve significant reductions in overall household energy use.

In short, the building sector plays a crucial role in driving urban transformations towards climate-neutrality in the EU, to deliver 2030 objectives. Residential buildings represent the majority of the existing building stock in the EU, a region characterised by a very low building turnover: as a result, renovations in this sector are a crucial vector of intervention. In Spain, where multifamily buildings dominate the residential landscape, the necessity of collective decision-making presents additional challenges for households to embark on renovations to improve energy efficiency. Furthermore, Spain lags behind in renovation rates, progressing at a pace that remains insufficient to meet EU targets for energy efficiency and climate neutrality for 2030 and 2050. Compounding these challenges, the country experiences higher-than-average energy poverty rates, ranking among the six EU nations with the poorest performance in this regard (Buildings Performance Institute Europe, 2024, p. 55). The European Union and Spanish governments have established a governance structure to achieve the climate neutrality goals set by the EU Green Deal to make Europe the first climate-neutral continent by 2050 (European Commission, 2019b) This commitment includes interim targets to reduce greenhouse gas emissions by 2030. The renovation of buildings is identified as a critical intervention to improve energy efficiency in the sector, focusing on policies that promote household retrofits to reduce energy consumption (European Commission, 2020).

On the policy side, improving energy efficiency in the building sector, particularly in residential buildings, is a key focus of public investment by the EU thanks to its potential to significantly reduce greenhouse gas (GHG) emissions in the region and contribute to climate-neutral goals set by the EU Green Deal. Additionally, in response to the COVID-19 pandemic, an unprecedented amount of economic recovery funds was channelled to Member States, to align recovery efforts with the objectives of improving energy-efficiency in support of the EU Green Deal (2019). The Renovation Wave Strategy (2020) specifically, has strengthened existing EU directives on renovations to improve buildings' energy performance, by setting more ambitious targets (European Commission, 2020). Already existing EU directives such as the Energy Performance of Buildings Directive (EPBD) and the Energy Efficiency Directive (EED), were revised in 2020 and further updated in 2024, introducing increasingly ambitious targets to improve energy efficiency and buildings' thermal performance to align with the continent's 2050 carbon-neutrality targets under the EU Green Deal (Saniour, N., 2023).

Aligned with European guidelines, Spain instituted its own national strategy towards energy efficiency such as the PNIEC (*Plan Nacional Integrado de Energía y Clima*) and ERESEE (*Estrategia a largo plazo para la rehabilitación energética en el sector de la edificación en*

España), to ensure that the goals outlined in EU directives are integrated in national plans and legislation (Ministerio de Vivienda y Agenda Urbana, 2020, 2024). The PNIEC, revised in 2020, set the goal to renovate 1,2 million households for the period 2021-2030, aiming for 300,000 household energy retrofits per year by 2030: this means increasing tenfold the number of buildings that are renovated yearly in Spain. The PNIEC was revised in 2024, increasing the target from 1,2 million to 1,38 million (Ministerio de Vivienda y Agenda Urbana, 2024).

The PRTR (*Plan de Recuperación, Transformación y Resiliencia*) launched in 2021, further reinforces the already existing national energy efficiency strategies, ERESEE and PNIEC, by introducing additional funding streams such as Next Generation funds to support existing measures and new interventions aimed at accelerating progress toward the 2030/50 climate objectives and the EU Green Deal (Gobierno de España, 2021). The urban dimension of the national PRTR is grounded in intervening in high-emitting sectors that contribute to the path towards a clean energy transition, such as building retrofits and urban mobility (Gregorio Hurtado, 2023; Saniour, N., 2023).

On the household side, household energy retrofit interventions involve significant material disruption to the homeowner since they require entering people's homes and private space to perform the necessary work that can reduce energy consumption. "Energy-efficient renovations" or “energy retrofits” consist first of upgrades to the building envelope, including the insulation of the building facade with “SATE” (Exterior Wall Insulation System*)*, replacing windows, repairing roofs, and sealing air leaks to prevent heat loss in winter and heat gain in summer — thereby improving thermal performance (Wilson et al., 2015). Second, after insulating households, thermal equipment is replaced with renewable energy technologies, such as solar panels or heat pumps. Thirdly, educating occupants on how to use this equipment plays a crucial role, as it involves training them on energy-saving practices to foster energy conservation when using newly installed equipment.

In this study, we will examine specifically the household energy retrofit policies designed to improve the thermal performance of residential buildings and reduce energy demand for heating and cooling needs to maintain comfortable indoor temperatures. We also assume that homeowners are the primary decision-makers: since the majority of homes in Spain are owner-occupied (70%) we focus on decisions made by homeowners who both own and reside in the properties.

2.2.2. Unmet policy objectives: Despite consensus, the implementation of retrofits remains slow in Spain and in the EU

Despite the enforcement of EU directives (EED, EPBD) for over a decade – the recognition of the necessity to prioritize household retrofits in national energy efficiency plans (PNIEC, ERESEE), the recent momentum of the EU Green Deal (2019), and increased funding to accelerate retrofits since COVID-19 in 2020 (PRTR) – progress remains slow, even as each revision of these plans introduces increasingly ambitious targets. The pace and scale of household renovations currently underway is not happening at the speed required to contribute to national objectives: while the goal is to reach 300.000 per year by 2030, in 2023, only 37.783 households were retrofitted in Spain (Provivienda, 2024). And while this represents a 9,4% increase from 2022, the public investment in retrofitting was not nearly enough to meet the target or show benefit from the increased funding or number of policy programs dedicated to household retrofits.[7]

The sluggish response to household energy retrofits in Spain however is not novel throughout Europe but consistently worse in Spain, as evidenced by a report from 2021 which underlines that the pace of retrofitting in Spain lagged behind the European Commission's recommended rate of 3% to effectively contribute to the continent's net-zero goals (IDAE, 2021). In Spain, the percentage of residential buildings undergoing renovation stood at just 1% in 2021, a figure that remains below the rates observed in France (1.7%) and Germany (1.5%), thereby still not reaching the European Commission recommended rate of 3%. The slow rates are not a unique aspect in Spain and Europe but appear to be a global trend. According to the UN Global Alliance for Buildings and Construction's 2023 Global Status Report, the building sector is currently falling short of meeting climate targets (UNEP, 2024). Despite technologies being available, the building sector is not on track to meet the urban transformational change required.[8] While efforts to improve the supply-side of household energy retrofits —primarily through the deployment of financial incentives such as subsidies — the demand for retrofits by the homeowners and residents has not taken off as expected in the country (Saniour, N., 2023).

In Spain, studies and policy evaluation reports have pointed out factors such as lack of knowledge and information among homeowners in Spanish cities as well as insufficient data on building conditions and thorough territorial assessment to build more targeted strategies within cities. Indeed, according to the Report on the State of Energy Poverty in Spain 60.9% of homeowners are unaware of the available subsidies for household energy retrofits (CECU,

[7] https://elpais.com/economia/2024-02-15/la-rehabilitacion-de-vivienda-queda-lejos-de-los-objetivos-del-gobierno-pese-a-subir-mas-de-un-9.html?event_log=oklogin last accessed in May 12, 2025

[8] https://www.wri.org/insights/climate-action-progress-1-5-degrees-c-2022

2022). The particularities of the Spanish context with a dominance of multifamily buildings makes it more difficult for collective decisions to be made.

The current dominant approach overlooks critical place-based factors such as building age, energy efficiency, conservation state, and social vulnerability, potentially favoring communities with greater capacity to mobilize resources and apply for the retrofit subsidies made available (Casanovas, Cuchí, Herrero et al., 2018). Funds are often distributed according to demand without relying on thorough territorial and building assessment data, thereby failing to delineate target areas and address the diverse social and physical conditions found across cities (Casanovas, Cuchí, Herrero et al., 2018, p.8),

The context of household energy retrofits provides an interesting lens to examine the difficulties in achieving urban transformations towards climate-neutrality in European cities. The distance between municipal ambitions and actual implementation on-the-ground is worthy of study because securing the engagement of homeowners is essential to meet GHG emissions because decisions are made at the household level (Edwards & Bulkeley, 2017; Hodson et al., 2013; Parag & Janda, 2014). Scholars agree that here is a significant gap between the ambitious visions outlined in climate action plans and the actual transformation of the existing building stock (Kivimaa & Martiskainen, 2018; Stieß & Dunkelberg, 2013; Wilson et al., 2015; Zaunbrecher et al., 2021). This gap between policy ambition and everyday action reflects a broader challenge in urban climate governance. In fact, Hodson et al. (2013) argue there is a disconnect between the "symbolic representations of a low-carbon future," and the "material manifestations of low-carbon transition in particular places." (Hodson et al., 2013, p.1404).

2.3. Household Energy Retrofit policies: bridging municipal-level strategies and household-level decisions

While numerous studies have identified barriers to homeowners' engagement in energy retrofits (such as the human dimension factors aforementioned), less attention has been given to the role and influence of intermediaries in connecting actors at different scales of implementation. Greater focus on intermediaries could offer policymakers alternative approaches to policy design and more effective implementation strategies.

2.3.1. Barriers to implementation: Understanding the "human dimension" in household retrofit decisions

A "one-size-fits-all" approach to household retrofit policies—such the deployment of financial incentives that ignore variations in home construction or income levels— may overlook the diverse needs and motivations that lead to household retrofits, which may often be also driven by non-economic reasons such as emotional associations to home and community (Middlemiss et al., 2024; Zaunbrecher et al., 2021). In contrast with the "one size fits all" approach, authors have advocated for decentralized place-based approaches to address these "human dimension" factors that reflect heterogeneous social and material conditions of different communities within municipal boundaries. These place-based conditions that are connected to the human dimension influence retrofit decisions, which are closely tied to the practicalities of "everyday domestic life." (Middlemiss et al., 2024; Wilson et al., 2015, p. 13). In this section, we will break down these human dimension factors, their influence in household policy effectiveness, and connect these factors with the debates in urban transformations regarding the heterogeneity of urban environments.

Financial incentives alone - such as subsidies and tax cuts- have proved to be insufficient to accelerate energy retrofits according to a number of studies (Bobrova et al., 2024; Brown et al., 2018; Stieß & Dunkelberg, 2013; Wilson et al., 2015; Zaunbrecher et al., 2021). Authors have argued extensively that there is no latent demand for energy retrofits; therefore, incentives primarily appeal to those who are already determined and committed to undertaking a retrofit (Brown et al., 2018; Saniour, N., 2023; Zaunbrecher et al., 2021). They claim that the economic incentives may not be strong enough partly due to the uncertain energy cost savings and outcomes as well as the long-term return on investment (Bobrova et al., 2024; Stieß & Dunkelberg, 2013; Zaunbrecher et al., 2021). Overall, there is a consensus that financial incentives and technology alone are insufficient to drive the necessary pace of energy retrofit implementation in order to reduce GHG emissions.

Bobrova et al. (2024) argues that energy retrofit policies cannot be rolled-out through "nudges;" instead, a successful implementation requires "deep framing" approaches that engage with the core values and motivations of residents and homeowners (Bobrova et al., 2024, p. 11). Along the same lines, Owen et al. (2014) contend that the "human dimension" plays a crucial role in how homeowners make decisions about whether or not to undertake retrofits (Owen et al., 2014, p. 171). They argue that a household's physical structure is deeply intertwined with the social, cultural and emotional connections people have to their homes and neighbourhood communities. This adds complexity to renovation decisions, as such projects involve both

material and social disruptions (Edwards & Bulkeley, 2017; Raven et al., 2021; Wilson et al., 2015).

The literature on household retrofits highlight that such decisions are influenced by the following factors grouped in these studies as part of the "human dimension," term coined by Owen et al. (2014), in retrofit decisions:

1. **Social relations:** People often make decisions in consultation with or influenced by their social networks—friends, family, or local community actors (Bolton et al., 2023; Middlemiss et al., 2024; Parag & Janda, 2014; Raven et al., 2021; Wilson et al., 2015). In fact, Raven et al. (2021) suggest framing the "household unit" as a "situated social unit" emphasizing the place-based social dynamics within which households operate (Raven et al., 2021, p.100). In multifamily buildings –where collective agreement is essential– agreeing with neighbours can also present a challenge (Bolton et al., 2023; Wilson et al., 2015). Bolton et al. (2023) highlight the need to factor in the influence of these social dynamics to bring about change: "homes don't make decisions, people do, and they do so in the context of social relations." (Bolton et al., 2023, p.2). Authors have noted that policies relying solely on financial incentives often overlook the influence of homeowners' personal social networks on individuals' decision-making processes.

2. **Trust:** In the context of retrofits, we adopt the definition of "trust" proposed by De Wilde & Bellaby (2019), who define it as "the feeling or belief that an individual or institution will act in one's best interest" (De Wilde & Spaargaren, 2019, p. 2615). Homeowners need to feel they can trust that this transformation is worth all the disruptions they will be facing in their own homes (Arning et al., 2019; Bolton et al., 2023; Brown et al., 2018; Putnam & Brown, 2021). Bolton et al. (2023) argue that relationships with energy suppliers and governments are often marked by a lack of trust. To address this matter, authors have recommend engaging place-based stakeholders and leveraging existing community networks and "trusted messengers", who are rooted in particular territories to influence retrofit decisions (Bolton et al., 2023; Brown et al., 2018; De Wilde & Spaargaren, 2019; Edwards & Bulkeley, 2017; Parag & Janda, 2014; Putnam & Brown, 2021).

3. **Symbolic and emotional connections to the "home":** The notion of "home" carries deeply personal meanings shaped by place, context, and social ties within neighbourhoods and communities, carrying feelings of comfort, belonging, and emotional attachment, aesthetic preferences (Bobrova et al., 2024; Stieß & Dunkelberg, 2013; Wilson et al., 2015). Wilson et al. (2015) argues that situating decisions processes situate decision-making processes within the context of everyday domestic life is crucial, as it influences differing motivations to renovate. Such conditions of everyday

domestic life - place-based, social and material- can vary widely within municipal boundaries.

4. **Disruptions, place-based everyday necessities, rather than climate concerns, drive renovation decisions:** Authors have argued it is unlikely that people will choose to retrofit their homes primarily to improve energy efficiency. Instead, they are more often driven by place-based, mundane concerns, such as ensuring doors and windows close properly (Edwards & Bulkeley, 2017; Parag & Janda, 2014; Raven et al., 2021; Stieß & Dunkelberg, 2013). Scholars have argued that disruptions such as a boiler breakdown or particular damage to the building are “trigger points" to introduce energy efficiency upgrades (Wilson et al., 2015, p.14). Other “trigger points" can occur in particular moments of personal decisions over the course of a lifetime—such as purchasing a new home or becoming a parent that can be coupled with energy improvements (Wilson et al., 2015). Therefore, seizing these “situational opportunities” is crucial to push for energy renovations that are more likely to occur in conjunction with the replacement of broken pieces, or an unavoidable repair (Bolton et al., 2023, p. 258). Homeowners often perceive their energy performance as better than it is, so they may not see energy upgrades as urgent (Stieß & Dunkelberg, 2013). Due to fears of disruption from construction, homeowners are more likely motivated by immediate, unavoidable critical needs affecting daily life (De Wilde & Spaargaren, 2019).

5. **The cognitive burden of renovations and socio-demographics:** Homeowners need to navigate complex information to understand why renovations are necessary, what they consist of, and manage multiple stakeholders such as government agencies, architects, and construction companies to undertake a renovation project. The capacity and time available to deal with the complexity of such works include: facing upfront costs, managing payback periods and transaction processes, coordinating different professionals, dealing with specialized information, managing building licenses and bureaucracies. The ability to manage this cognitive burden —managing information, bureaucracy, and logistics—can vary depending on a combination of socio-demographic characteristics such as geographical location, age, income, and education (Arning et al., 2019; Nair et al., 2010). Studies have suggested that higher income younger and more educated populations are more likely to engage in energy retrofits. Older homeowners are less likely to invest in energy efficiency measures, often due to payback concerns, lower income, reduced awareness (Nair et al., 2010). On the other hand, younger and more educated individuals were more likely to adopt energy efficiency measures than older people with similar levels of education in Sweden (Nair et al., 2010). Factors such as the idea of investing in their future, transitioning to

> parenthood, and purchasing a home influence this behaviour in younger populations (Bolton et al., 2023).

In this study we use the term "human dimension" to refer to the place-based, and heterogeneous material and social contextual conditions in which household retrofits take place, acknowledging that these aspects can vary significantly across different areas of the city. (Bolton et al., 2023; Brown et al., 2018; Raven et al., 2021). While retrofit policies are more often framed as rational economic decisions supported by financial incentives, scholars have argued that these "human dimension" aspects—often highly place-specific— cannot be overlooked (Owen et al., 2014, p. 171). This connects with the debates on urban transformations literature and the call to analyze problems at the sub-city scale, acknowledging that the heterogeneous nature of cities' material and socio-spatial conditions generates different capacities to accelerate transformations and path-deviant change in urban environments.

Explaining the necessity of household energy retrofits to homeowners—especially in a context where they are not perceived as necessary or urgent—requires more than simply "passing on" information about financial incentives available and outlining the general steps homeowners need to take (Stieß & Dunkelberg, 2013). Instead, these interventions, which entail a disruption to everyday life and the home environment must be communicated in ways that resonate with homeowners' values, priorities, and everyday needs:

> *"Information is not simply 'passed on' from the expert to the user but rather needs to be contextualized and socially embedded (Guy and Shove, 2007). In this process, expert knowledge has to be actively translated (...) and adapted to the context of everyday life (Bartiaux, 2008;Desmedt et al., 2009)*." (Stieß & Dunkelberg, 2013, p. 252)

De Wilde and Spaargaren (2019) go further when defending the need to provide "tailored advice" and support to homeowners throughout the complex retrofit journey and cater to their specific place-based needs from the initial decision-making process to the completion of construction work (De Wilde & Spaargaren, 2019, p. 367; Owen et al., 2014).

Homeowners are the ultimate drivers of household retrofit interventions, and their material and social conditions can vary sharply within municipal boundaries. Therefore, mediation efforts and advice to homeowners that can bridge abstract policies and regulations with the everyday needs and priorities of homeowners are necessary. For these reasons, there is a recognition that a "place-based approach" to household energy retrofit policies is necessary to address the place-based, "human dimension" factors that play a decisive role in shaping homeowners' retrofit decisions (Brown et al., 2018; Middlemiss et al., 2024; Stieß & Dunkelberg, 2013; Wilson et

al., 2015). Effective mediation ensures that policy goals are translated into tangible benefits, making household retrofits more accessible, understandable, and aligned with homeowners' lived experiences.

2.3.2. Bridging the Gap: The role of intermediaries in connecting municipal-level strategies and household-level retrofit decisions

While numerous studies have identified human-dimension barriers that hinder homeowners from engaging in energy retrofits, less attention has been paid to the role and influence of intermediaries, and how their practices can support more effective policy implementation (Brown et al., 2018; Owen et al., 2014; Raven et al., 2021; Wilson et al., 2015). An "intermediary activity," as defined by Hodson et al. (2013), refers to the essential function through which advisors facilitate the alignment between external priorities and local contextual needs in interventions aimed at low-carbon transitions. This activity plays a crucial role in bridging the gap between the more abstract municipal level—often focused on setting greenhouse gas emission goals—and the household level, where decisions are grounded in everyday material needs and influenced by the "human dimension" of energy retrofit decisions (Bobrova et al., 2024; Hodson et al., 2013; Owen et al., 2014).

This intermediary activity is particularly relevant in the context of household retrofit policies, where climate-neutrality objectives often seem disconnected from the practical everyday needs of households located in specific territories (De Feijter, 2021). Intermediaries play a critical bridging role: they translate complex technical information and regulations into practical guidance, making energy retrofits—which homeowners rarely view as urgent—more accessible and aligned with their everyday needs. By connecting homeowners, government agencies, and technology providers, intermediaries bridge institutional gaps by aligning high-level policy goals with the practical concerns of those implementing retrofits on the ground (Arning et al., 2019; Kivimaa et al., 2018; Kivimaa & Martiskainen, 2018; Middlemiss et al., 2024; Moss, 2009; Owen et al., 2014; Parag & Janda, 2014).

While authors have agreed upon the importance of intermediation in the process of implementation of retrofits, the role and impact of intermediaries' activities is not fully understood (Martiskainen & Kivimaa, 2017; Middlemiss et al., 2024; Zaunbrecher et al., 2021). Scholars have called for a deeper understanding of how intermediaries operate, the types of intermediation that occur in urban energy contexts (such as retrofits) and their influence in promoting energy outcomes and accelerating retrofit implementation (Hodson et al., 2013; Kivimaa & Martiskainen, 2018; Middlemiss et al., 2024; Owen et al., 2014).

Additionally, Kivimaa et al. (2019) stress the importance of paying attention to the spatial dimension of intermediation, particularly how intermediaries connect actors and processes across different geographical scales (Kivimaa et al., 2018). While they acknowledge that intermediaries have a role in connecting local, national, and international scales, less attention is given to how these intermediaries operate at the local level within municipal boundaries — precisely where retrofit policy breakdowns often occur. To address this gap, this research introduces a spatial dimension to analyse intermediation at the local level, focusing on the roles and activities of intermediaries operating between municipal and household levels and examining how their collaboration can enhance household energy retrofit outcomes.

2.4. Research Questions

We aim to explore how intermediaries operate between municipal and household levels, drawing on two strands of literature. On the one hand, urban transformation studies emphasize the need for a sub-city lens to examine change in heterogeneous urban environments. On the other hand, the retrofit intermediation literature highlights the influence of place-based 'human dimension' factors in shaping retrofit decisions. Focusing on the role and influence of intermediaries in connecting municipal and household levels is particularly crucial for understanding how retrofit policies take shape (or fail to) within diverse urban contexts, even when there is political alignment and support across local, national, and international administrative levels.

The current study proposes to answer the following research question:
Considering the need to adopt a more granular scale of analysis and spatially grounded perspectives to understand the processes of urban transformation in a city's building stock, how do household retrofit policies unfold at the municipal level, and how do intermediaries influence spatial variations in implementation?

To address this question, we break it down into the following two sub-research questions:

1. Socio-spatial dimensions: How does the implementation of household retrofit policies vary spatially within municipal boundaries, given the heterogeneous social and material conditions of urban environments? What are the broader implications of this granular scale approach into how we might rethink climate policy strategies that have a greater chance of being implemented at a local level?

   Here, we use quantitative data to frame the problem. We use spatial methods and a granular approach, at the sub-city scale, to map spatial patterns in retrofit uptake, and

thus assess the progress of urban transformations in the existing building stock. This spatial and granular approach is largely absent from the existing literature, and our analysis seeks to map the varying patterns of urban transformation in heterogeneous environments and identify networks of actors operating in different spaces.

2. Intermediaries and the "human dimension": what role and influence do intermediaries play in bridging implementation, and how do they address the breakdown between municipal policies and the household level, where the human dimension is a decisive factor?

   Here we draw on qualitative data from interviews, participatory observation and direct observations from site visits. The framework of Martiskainen and Kivimaa (2017) is helpful to describe the role and influence of intermediaries operating within or across specific projects. Building on this, we introduce a spatial dimension and propose an analytical framework to analyse retrofit intermediation at the local level. This framework seeks to offer insights into how intermediaries influence both specific projects and broader policy networks and analyzes in what ways they can collaborate to facilitate connections between municipal strategies and household-level action.

3. ANALYTICAL FRAMEWORK: THE ROLE AND INFLUENCE OF INTERMEDIARIES

3.1. Intermediaries in the context of household energy retrofits

Intermediaries are individuals or organizations recognized for their ability to facilitate sustainability transitions by connecting stakeholders, actors and activities; they can either be newly established or existing actors that adopt intermediary roles during transition processes (Kivimaa et al., 2018; Soberón et al., 2022). Intermediaries in the particular context of retrofitting play a role in bridging the gap between technical requirements, government regulations, and homeowners' needs (Bolton et al., 2023; Fyhn et al., 2019; Wade et al., 2016; Zaunbrecher et al., 2021). They often possess both technical expertise and non-technical abilities that are both essential to advance more effective retrofitting practices, and overcome the place-based, 'human dimension' barriers in decision-making. Intermediaries with technical skills can be building professionals such as architects, carpenters, craftspeople, heating installers, contractors, and engineers specialized in energy who are equipped to provide guidance by translating complex building regulations to homeowners, recommending suppliers and technologies that suit homeowners needs, and managing administrative processes (De Feijter et al., 2019; Fischer & Guy, 2009; Fyhn et al., 2019; Wade et al., 2016). Intermediaries can also possess non-technical skills like the capacity for building personal rapport, effective communication, and cultivating relations of trust (Brown et al., 2018; Middlemiss et al., 2024; Owen et al., 2014; Putnam & Brown, 2021).

3.1.1. Technical skills in intermediation practices: balancing trust and financial interests

Intermediaries with technical expertise mentioned across the literature include architects, craftspeople, and heat installers, who possess a combination of technical, administrative and coordination skills. Authors have described intermediaries for having technical knowledge to interpret building regulations, navigate bureaucratic procedures to access retrofit subsidy programs, and have a strong understanding of construction materials (Brown et al., 2019; Fischer & Guy, 2009; Fyhn et al., 2019; Wade et al., 2016). They bridge the gap between government regulations and homeowners' understanding, translating complex policies into actionable guidance. They can also assess households' physical features, recommend appropriate suppliers and technologies, inform households about the available options and

benefits of comprehensive retrofits (De Wilde & Spaargaren, 2019). They engage both homeowner communities and supply chains to encourage retrofits. However, the personal interests and beliefs held by building professionals may influence the type of service they provide, and these values aren't necessarily aligned with low-carbon principles (Owen et al., 2014, p. 178).

In fact, intermediaries are more likely to be trusted when they do not have financial interests in promoting specific products or services (Brown et al., 2018). Homeowner communities may be skeptical of advice from intermediaries with financial stakes in the retrofit process, as they seek impartial guidance on financing options, technology, and the selection of tradesmen, contractors, and installers (Brown et al., 2018; Kivimaa & Martiskainen, 2018). Given that relationships with energy suppliers and governments are often marked by distrust, it is essential to position intermediaries as credible and impartial advisors (Bolton et al., 2023).

3.1.2. Non-technical skills in intermediation practices: building trust and connecting with homeowners' everyday needs

Beyond technical knowledge, intermediaries' non-technical skills are increasingly recognized as crucial for accelerating household retrofits (Owen et al., 2014). For homeowners to be confident that intermediaries act in their best interest, they need to trust the advice intermediaries provide (De Wilde & Spaargaren, 2019). To be effective, intermediaries build trusted relationships with homeowners and bridge the lack of trust between these homeowner communities and institutional stakeholders like governments and energy companies. These intermediaries possess strong interpersonal skills and the ability to communicate in ways that resonate with the values and needs of particular homeowner communities — understanding their sense of belonging to a place, their personal values and preferences (Bobrova et al., 2024; Raven et al., 2021; Wilson et al., 2015).

Intermediaries should be well-positioned to grasp these values, along with the social environments and pressing needs of homeowner communities. This deeper understanding fosters closer interactions and leads to better outcomes in retrofit projects (Owen et al., 2014). Scholars have emphasized the importance of engaging local stakeholders and utilizing pre-existing social relations and community networks, including "trusted messengers," to address the social and contextual factors that influence retrofit decisions (Bolton et al., 2023; Brown et al., 2019; Putnam & Brown, 2021). Unlike technical experts, these community-based intermediaries know their communities and are better positioned to communicate with homeowners and unlock their resistance to retrofit (Edwards & Bulkeley, 2017; Middlemiss et al., 2024; Parag & Janda, 2014). Parag and Janda (2014) offer the example of the embeddedness

of religious congregations in certain communities, as a potential entry point in specific communities, since they deeply understand these communities' shared values and living experiences (Parag & Janda, 2014). A key recommendation is to map existing intermediaries, such as religious groups or local community leaders, who are already active in specific neighbourhoods (Edwards & Bulkeley, 2017; Parag & Janda, 2014).

Physical presence also plays a crucial role in effectively addressing the unique needs and experiences of different social groups (Bolton et al., 2023). Edwards and Bulkeley (2017) refer to "local champions" as crucial "entry points for intervention," arguing that most retrofits are driven by place-based, everyday concerns (Edwards & Bulkeley, 2017, p. 1133). In mobilizing these place-based "champions" the gap between abstract energy efficiency concepts and the practical needs of households can be bridged, making retrofits both more feasible and appealing (Middlemiss et al., 2024). By being physically present in certain communities, intermediaries can alleviate the cognitive burden associated with renovations and provide personalized guidance to homeowners. This presence allows intermediaries to tailor solutions to the specific needs of diverse homeowner communities while also responding to situational opportunities, such as the need to replace defective equipment, adjust malfunctioning building components, or handle life transitions like parenthood and potential need to engage in construction works.

Finally, these authors argue it is essential to cater to different types of homeowners and neighbourhood communities, who fear the unavoidable disruption, inconvenience and uncertain outcomes (Bobrova et al., 2024). De Wilde and Spaargaren (2019) go as far as to argue it is necessary to "guide and craft the low-carbon retrofit experience" to ensure a smoother transition and broader acceptance of these interventions (De Wilde & Spaargaren, 2019, p. 363). Still, authors have argued that these intermediary actors remain overlooked in energy and climate policies, despite their agency and capacity to influence decisions thanks to their close ties to shared community values and everyday needs (Parag & Janda, 2014, p. 105). A stronger understanding as to how intermediaries operate and influence policy outcomes could offer policymakers alternative approaches to policy design and more effective implementation strategies.

3.2. The role and influence of intermediaries in the implementation of household energy retrofits

Existing literature primarily describes intermediaries in terms of their role in facilitating homeowner engagement in one particular project or across retrofitting projects, helping to overcome 'human dimension' barriers that might otherwise hinder participation. Their contribution to retrofit outcomes relies on the deployment of a combination of technical

knowledge (technical skills) and social abilities (non-technical skills) that enables them to provide informed advice while creating trusting relationships with homeowners. These intermediaries build trust through interpersonal skills and local social embeddedness, while simultaneously leveraging technical expertise to translate complex building regulations, guide homeowners through government paperwork, and liaise between government entities, suppliers, and homeowner communities

However, in recent years, the renewed emphasis on household energy retrofit policies throughout the EU and in Spain, suggests that the network of intermediaries involved in the retrofit system has expanded accordingly (Buildings Performance Institute Europe, 2020; Ministerio de Vivienda y Agenda Urbana, 2024; Provivienda, 2024). Given the recent nature of these policy developments, the key local intermediaries involved, and their modes of operation remains insufficiently understood. We are particularly interested in mapping how intermediaries operate between household and municipal levels, where the policy breakdown often occurs. We argue that these intermediaries operate both in particular retrofit projects and in policy development activities, navigating the expanding landscape of funding mechanisms and regulatory frameworks that emerged recently and that have been designed to promote homeowner engagement and accelerate large-scale retrofits in pursuit of the EU climate-neutrality goals.

In this study, we seek to map the role and influence of the broader network of intermediaries that has become involved in this expanded retrofitting policies' landscape. This includes both established actors and newly emerging intermediaries operating at and beyond the project level. The concept of "ecologies of intermediation," is particularly useful here as it refers to a system in which a diverse range of actors —each with distinct roles, goals, and interests— work together at different levels in the process of implementation (Soberón et al., 2022). We seek to explore the role and influence of this expanding ecology of intermediaries, focusing on how they operate and how greater collaboration might be fostered between municipal and household levels (where the policy breakdown often occurs).

3.2.1. Place-based and non place-based intermediaries: a conceptual framework

We propose an analytical framework to analyse the role and influence of this expanded network of intermediaries operating at the intersection of municipal and household levels (Figure 3.2). We build on the work of Martiskainen and Kivimaa (2017) who propose a typological framework for analyzing the role and influence of intermediaries in household retrofit projects, whether linking parties in a project or between projects (Martiskainen & Kivimaa, 2017). In this analytical framework, Martiskainen and Kivimaa (2017) emphasize the importance of the

role of intermediaries as 'champions' that overcome resistance to innovation in the context of household retrofits (see **Error! Reference source not found.**). They define intermediaries' championing activities as strong dedication and drive focused around a specific project. According to this framework, intermediaries operating in and across projects have differing degrees of championship depending on the activities they promote: some intermediaries are more focused on networking and learning activities, whereas others are more directly involved in the site "everyday orchestration" of the project (Martiskainen & Kivimaa, 2017).

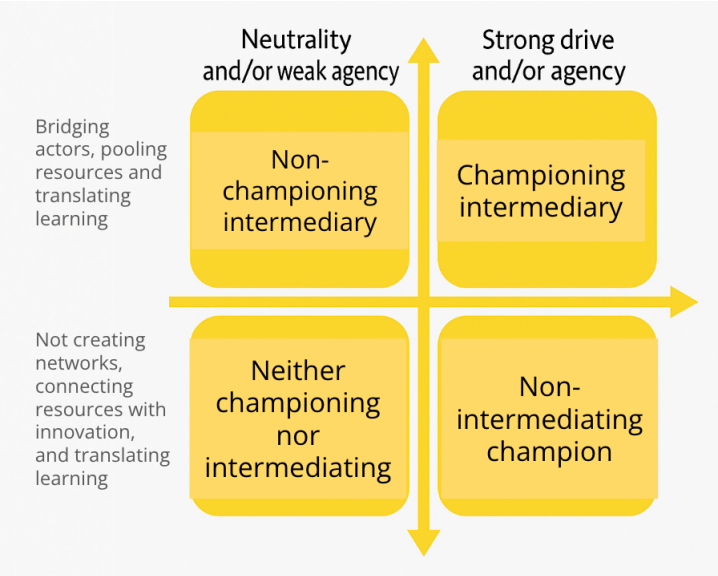

Figure 3.1: Analytical framework combining intermediating and championing in local projects (Martiskainen and Kivimaa, 2017)

Source: Own elaboration. Adapted from Martiskainen and Kivimaa, 2017

However, this analytical framework addresses retrofits at the project level or across projects, overlooking the need for a deeper understanding of the broader ecology of intermediaries who operate both within and beyond the project level in the current policy landscape. Our goal is to understand how these local intermediaries operate specifically at the municipal level—what are their drivers, the role and influence they have in policy outcomes, and how they connect municipal and household levels of implementation (See Figure 3.2). To examine the dynamics within this ecology, we build on Moore's (2019) concept of *ex-situ* intermediaries, who recognizes that actors operating beyond the project level influence retrofit uptake (Moore, Alastair, 2019). We also extend Martiskainen and Kivimaa (2017) framework by acknowledging that the growing network of intermediaries in the retrofit sector engages in complementary activities, with different actors acting as champions in various capacities—some focused on project-level implementation, while others shape policy development and broader retrofit agendas (See Figure 3.3). Understanding their role could help overcome resistance to innovation and improve coordination between policy development, and on-the-

ground initiatives. Importantly, our approach highlights the critical spatial dimension of intermediary activity in retrofitting, an aspect that remains underexplored in the existing literature.

We seek to understand how intermediaries, operating at different levels, have a role and influence local policy implementation. To do so, we outline two types of intermediary functions based on the degree of embeddedness in the territory, thereby incorporating the previously missing spatial dimension in which intermediaries operate (See Figure 3.3). The first type operates at a non-place-based level, focusing on policy development and influencing institutional frameworks. The second type is directly involved in projects, engaging with human factors and household needs to ensure retrofits materialize on the ground (place-based level).

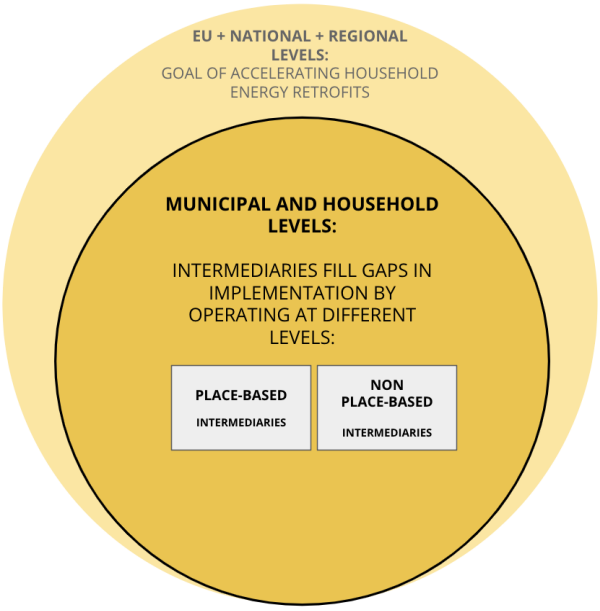

Figure 3.2: Intermediaries connecting municipal and household levels of implementation of household retrofits

Source: Own elaboration

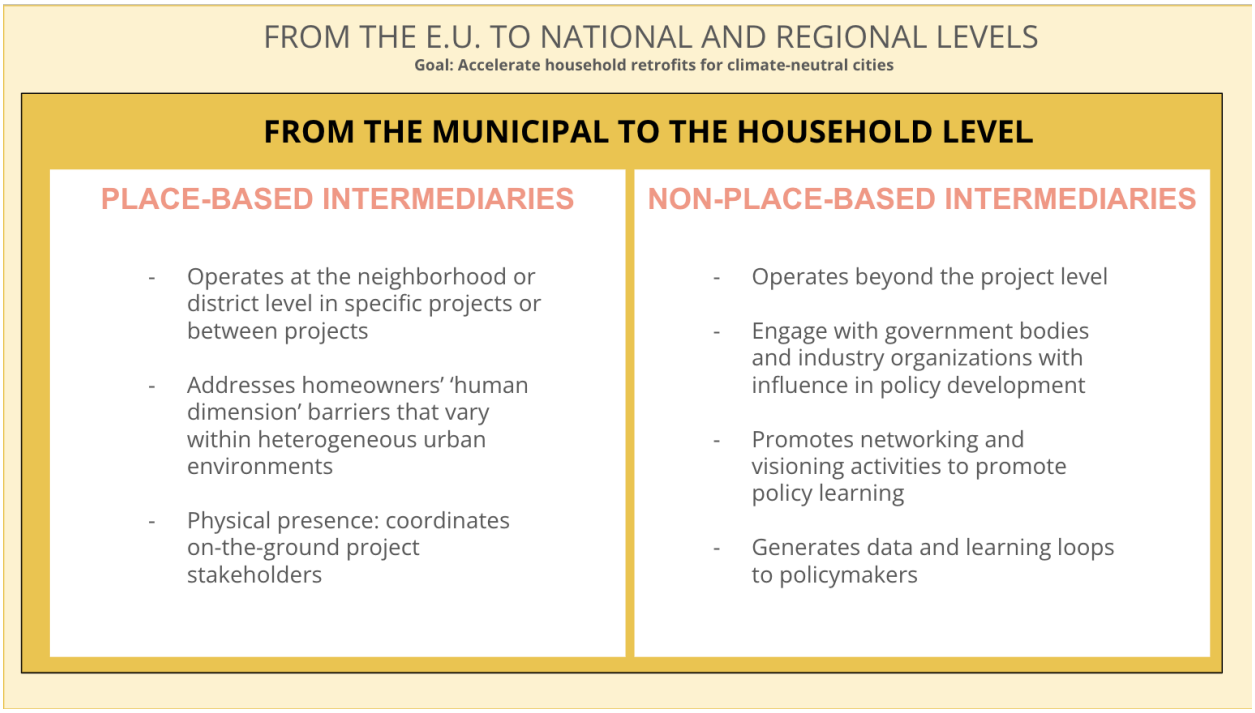

Figure 3.3: Analytical framework of place-based and non-place-based intermediaries operating between municipal and household levels

Source: Own elaboration

The non-place-based intermediaries focus less on individual projects and more on networking with government bodies, industry organizations, and NGOs to promote learning loops (Figure 3.3). These intermediaries are not embedded in a specific territory or engaged in one specific retrofit project; instead, their role focuses on overcoming inertia in policy arrangements by promoting cross-sectoral collaborations, generating data to inform feedback loops for policymakers, and addressing passive resistance within governmental and institutional structures. Non-place-based intermediaries relate to Kivimaa et al. (2018) conceptualization of "process intermediaries," who are in charge of facilitating connections between different stakeholders and promoting knowledge exchange to advance transitions (Kivimaa et al., 2018). In the context of retrofit policies more specifically, studies that describe the role and influence of intermediaries who operate beyond the building or project level are scarce, and we build on the efforts of Moore (2019), who offers a conceptualization of ex-situ intermediaries, acknowledging that retrofit intermediaries that work in closer proximity to policy networks, and are involved to lesser extent in projects, while also active. According to Moore, these ex-situ intermediaries work in closer proximity to policy level and may include utilities and NGOs. However, Moore (2019) is not specific about how they influence the breakdown between municipal and household levels, and our framework incorporates this spatial dimension

Place-based intermediaries are operating in specific territories, at the neighbourhood or district level (Figure 3.3). Some are trusted community members that are in a good position to support homeowners to overcome 'human dimension' barriers and engage them in retrofitting. Others can be businesses or private-sector actors with direct interests in these locations, and who are potentially involved in providing construction, maintenance or repair services, and thus maintain closer contact with homeowner communities' decision-making processes. Their level of influence is tied to their degree of embeddedness to a particular area, shaping their ability to foster trust, be present to provide guidance, and support homeowners throughout the retrofit process. Place-based intermediaries in retrofitting draw on Kivimaa's conceptualization of a "user intermediary" in advancing transitions (Kivimaa et al., 2018). User intermediaries operate between a niche innovation and the dominant system, articulating the demands of the user community in adopting new technologies. In the specific context of retrofits, we build upon their definition by adding the spatial dimension in which these intermediaries operate, a variable that is useful to analyse retrofit policy adoption.

Intermediaries "create spaces and opportunities," contributing to a network formation that influences the policy system (Martiskainen & Kivimaa, 2017). What these intermediaries share is their ability to unlock resistance to change at the different levels. We introduce the spatial dimension because we recognize that actors operating at the place-based level are more closely connected to specific retrofit projects. This proximity makes them more attuned to addressing "human dimension" factors that contribute to the resistance of homeowners to engage in retrofits. At the policy development level, a network of actors emerges promoting activities and networking as well as data, to help overcome the passive resistance of local governments in the way the policy is designed.

4. METHODOLOGY

4.1. Methodological approach: a mixed methods case study design

4.1.1. A case study approach

A case study is employed to explore a real-life, contemporary phenomenon: it is appropriate to analyze the "how" and "why" something is happening when the literature is limited (Yin, 2018). It is considered as a valuable methodological approach to shed empirical light on existing concepts and gaining further insights into a problem or refining a theoretical explanation (Yin, 2018). It is appropriate when the goal is to understand a real-world case where the context plays a significant role in shaping the “phenomenon” under investigation (Yin, 2018).

In this study we seek to understand the persistent implementation challenges of household retrofit policies that emerge in the breakdown between municipal and household levels, despite policy consensus at higher levels to support and accelerate retrofits. A case study involves in-depth investigation of a contemporary context or setting, and the data can be collected from observations, interviews, documents and reports (Creswell, 2014). We therefore select a case study methodology to examine the current public policy programs aimed at accelerating the slow implementation of household energy retrofits at the municipal level. The “phenomenon” under investigation—the household energy retrofit implementation gap—exists within the broader context of policies aimed at accelerating urban transformations to mitigate climate change impacts. To gain in-depth understanding of the place-specific, contextual and social factors that shape the conditions in which energy retrofits materialize in urban areas we examine how subsidy policies are being distributed at the district and neighbourhood level (Brown et al., 2018; Stieß & Dunkelberg, 2013). Finally, the literature on retrofit intermediaries emphasises these actors’ influence in household retrofit outcomes, especially because energy retrofits are rarely perceived as an urgent intervention (Edwards & Bulkeley, 2017; Zaunbrecher et al., 2021). Building on this and using a case study bounded at the municipal level, we aim to map not only how subsidies are distributed within municipal boundaries, but also the role and influence of intermediaries in bridging the municipal and household levels of implementation—thereby enhancing our understanding of how urban transformations materialize on the ground.

4.1.2. Mixed methods

A mixed-method approach is a type of research in which the researcher combines qualitative and quantitative data in the case study to collect complementary data to understand the phenomenon under study (Yin, 2018, p. 63). By definition, a mixed-methods research is more complex to execute than single-method approaches because it requires collecting a stronger array of evidence and triangulation efforts to ensure that case study findings are comprehensively supported by diverse and converging sources of information (Yin, 2018). As Yin (2018) explains, this complexity stems from the research design requiring in-depth and contextual investigation that relies on collecting a variety of relevant data from multiple sources of evidence (Yin, 2018, p. 127).

The research is approached in a sequential explanatory form, where the researcher first conducts a quantitative study and then follows up with qualitative data collection to provide deeper context and understanding (Creswell, 2014). This approach is particularly valuable when the initial quantitative findings reveal unexpected or complex patterns that require further investigation. By collecting qualitative data after the quantitative analysis, researchers can explore the underlying mechanisms and provide additional evidence behind statistical results, thus enriching the overall research insights (Creswell, 2014). The sequential approach allows for a more comprehensive interpretation of the data by integrating both numerical and narrative evidence (see Figure 4.1).

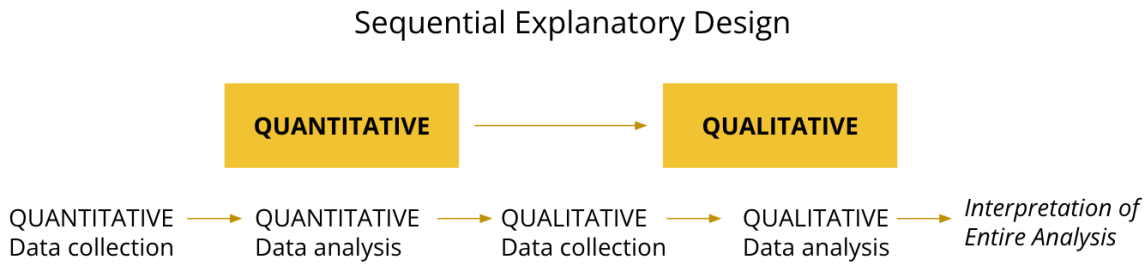

Figure 4.1: Sequential explanatory design research cycle adapted from Creswell (Creswell, 2014)

Source: Own elaboration. Adapted from Creswell, 2014

To analyse the implementation of policies aimed at accelerating household energy retrofits in the city of Madrid, the collection of information is made in two complementary stages, following the steps of a sequential approach (Creswell, 2014). First, a quantitative analysis is

conducted to map the spatial distribution of household energy subsidies by analysing data from the primary municipal subsidies annual program to retrofitting, "Plan Rehabilita" (years of 2020, 2021, 2022). Second, a qualitative investigation is carried out to map the intermediaries active in Madrid's retrofit policy landscape and explore the influence that the place-based and non-place-based intermediaries have in shaping policy outcomes and the spatial variations in subsidies' distribution which are to be obtained in the quantitative analysis.

4.2. Case selection

The slow implementation of household energy retrofits in Madrid serves as a compelling case to explore ongoing debates in urban transformations literature that remain insufficiently understood. We engage specifically in the debates on the "matter of scale" of analysis in the UT literature, as outlined in section 2.1, by examining the implementation of household energy retrofits through a more granular lens, at the sub-city scale.

Household energy retrofit policies are currently being implemented in European cities– having received heightened attention since 2020 and having become a prominent feature of climate action plans in European cities. However, the implementation is not at the pace and scale required to achieve climate-neutrality goals in most cities in Europe and globally (UNEP, 2024). Madrid's commitment is straightforward from a multilevel governance perspective: they are a part of the Mission for 100 climate-neutral cities (2022); they have outlined a roadmap towards climate-neutrality (2019); they have prioritized energy retrofits in their "The Recovery, Transformation, and Resilience Plan for the City of Madrid" (2021). Despite this strong emphasis in environmental action and alignment with multi-level climate change objectives (regional, national and European), the city Madrid falls short of meeting targets of household energy retrofit to achieve the established objectives at municipal scale (Provivienda, 2024).

The city of Madrid is chosen as our instrumental case study for its potential to illustrate how European cities, that have the resources and commitment to climate action, may fall short of meeting objectives, and further understand what policy adjustments can be made to avoid that (Stake, 1995). In a single instrumental case study, the researcher examines a specific issue or concern by selecting one bounded case to illustrate broader analytical insights (Stake, 1995; Yin, 2018). Therefore, we selected Madrid as a case study to analyze the potential disconnect between municipal and household-level policy implementation within a context of heightened support to accelerate household energy retrofits and climate-neutrality in the post-2020 policy landscape.

First, we will examine the spatial distribution of subsidies in Madrid, using data from the “Plan Rehabilita” subsidy program for 2020, 2021, and 2022 to identify patterns in retrofit uptake. Second, we will describe the network of actor-intermediaries that have emerged in the household retrofit system in recent years and analyse their role and influence using the interpretative framework proposed in section 3. We identify two main subunits of analysis: intermediaries are categorized based on their intermediating function as either place-based or non-place-based, comprising a total of seven selected. Though this categorization serves primarily as an analytical tool and the practical reality is more nuanced, the sample of intermediaries chosen for each category predominantly perform either place-based or non-place-based functions. The intermediaries who perform place-based intermediating functions include local neighbourhood associations, local construction companies, and property management representatives operating in the areas identified through quantitative analysis as having higher subsidy demand. These intermediaries were selected to gain insights into their role in facilitating subsidy uptake at the local level, particularly in areas where uptake has been higher. They were identified through expert consultation and site visits to neighbourhood associations in the high-demand areas identified in our quantitative mapping, which enabled the mapping of local actors. Other intermediaries analyzed include those performing non-place-based intermediating functions, such as the Universidad Politécnica de Madrid (itdUPM), energy utility companies like Iberdrola, and state-funded information hubs such as “Oficina Verde” and COAM, key actors in Madrid retrofit system and whose roles we also evaluate within this framework.

The need for more detailed analysis and granular data is supported by existing literature that point the challenge of understanding how urban transformation processes -such as household energy retrofits- are adopted in socially and materially heterogeneous urban environments. These disparities shape different capacities to implement transformative interventions and influence how urban change unfolds, underscoring the importance of context-sensitive research approaches. Additionally, in the context of household retrofits, the literature indicates that intermediaries play a key role in overcoming 'human dimension' barriers that decisively shape homeowners' energy retrofit decisions at the household level of implementation.

One key factor in the selection of Madrid as a case study has been the field access that the researcher has had in the city Madrid (Flick, 2018). The researcher has had access to detailed and granular public quantitative data, further enriched by qualitative insights from key informants active in Madrid’s household retrofit system policies. Thanks to the relational work and collaborations nurtured by itdUPM (Universidad Politécnica de Madrid), the researcher has had a unique access to ‘gatekeepers of the field’ (Creswell, 2014).

This research seeks to examine the implementation of energy retrofit policies in Madrid, particularly in light of recent policy developments that have strengthened support for such initiatives in the post-2020 context (Buildings Performance Institute Europe, 2020; Madrid City Council, 2024; Ministerio de Vivienda y Agenda Urbana, 2020). The insights and data generated in this study are useful for policymakers' practical application. Our findings aim to provide data and recommendations for policymakers involved in the implementation of energy retrofit policies and broader urban climate action plans and interventions which aim to implement urban transformations towards sustainability. This study seeks to offer insights for Spanish and European policymakers aiming to enhance city-level energy retrofit policies for climate neutrality, bridging the gap between research and practice and improve policy effectiveness.

4.3. Case description of Madrid: implementing climate-neutral policies through household energy retrofits

4.3.1. Madrid's residential building stock

The city of Madrid is committed to climate action and aligns its policies with the established national objectives and international urban agendas (De Gregorio Hurtado & Gharbi, 2022). The building sector contributes 44% of Madrid's greenhouse gas emissions, surpassing EU and global averages of 35% (Madrid City Council, 2022). Additionally, 80% of buildings have poor energy ratings (rating between E-G), and 66% were built before 1980, prior to the enforcement of thermal regulations (INE, 2021).

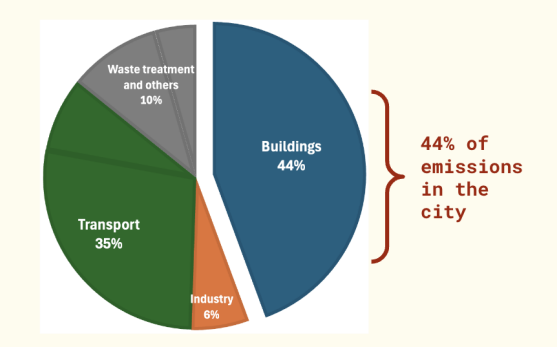

Figure 4.2: GHG Emissions in Madrid per sector

Source: Own elaboration. Data extracted from Madrid GHG emissions Inventory 2022.

Madrid, with its 21 districts, is home to approximately 3.2 million residents and 1.5 million households (Madrid City Council, 2019a). The city's residential building stock is

predominantly multifamily, comprising 95% of the total, and 70% of households in Madrid are owner-occupied (INE, 2021). The dominance of multifamily buildings in the residential sector adds complexity to the decision-making process, as it requires collective agreements, as previously noted in the Spanish context. Accessibility remains a challenge, as 75% of buildings are not accessible, and 40% of four-story buildings lack elevators (Madrid City Council, 2019a). Accessibility is an important metric, because energy retrofits often happen as a consequence of an initial desire to make a building accessible, which will later be discussed.

In this study we assume that building retrofit decisions in a building are made by owner-occupants, who take collective decisions in their homeowner community in each multifamily building. The majority of multifamily buildings in Madrid (81.3%) contain more than 10 household units, which we take as the average size of a homeowner community making collective decisions in this case study.[9] While retrofits can be undertaken in individual units (changing windows for example), we are interested in this study to examine whole-building decisions, as these interventions have a greater overall impact on optimizing energy demand, particularly through measures like façade insulation.

Collective decisions within buildings are regulated by the Spanish Law of Horizontal Property. The homeowner community within a particular building appoints a president, who is responsible for holding regular meetings with household unit owners in the building, and serves as the community's legal representative. Since whole-building energy retrofits require collective decisions, the president represents the interests of the community in these matters. In addition, the property manager of a building supports the President of a homeowner community in the execution of retrofit works (CSCAE, 2025)

Some revisions in decision-making and building energy consumption regulations since 2020 are worth noting. First, the Law on Horizontal Property *("Ley de Propiedad Horizontal"),* revised in 2022, modified the rules for establishing majorities in decision-making to facilitate the adoption of energy efficiency measures in multifamily buildings: such decisions are now approved with a simple majority of the votes ("*mayoría simple*"). For accessibility-related decisions, even if only a single household unit requests it, all other units are required to comply. Second, the 2020 Regulation of Thermal Installations in Buildings ("*Reglamento de Instalaciones Térmicas en los Edificios*") aims to reduce overall energy consumption in residential buildings by individualizing control and consumption in buildings with shared

[9] See : https://diario.madrid.es/blog/notas-de-prensa/el-70-de-los-hogares-madrilenos-son-viviendas-en-propiedad-frente-al-26-que-viven-de-alquiler/#:~:text=Tipolog%C3%ADas%20de%20hogares%20por%20localizaci%C3%B3n,llegando%20al%2013%2C3%20%25, Accessed August 30th, 2025.

heating systems. In Madrid, around 20% of the residential building stock has shared heating system. The installation of individual metering in these buildings must be fully implemented by 2027. According to Madrid's regional government, estimates that the final energy savings for all users of a building with individual consumption metering are close to 30%.

As mentioned earlier in this section, Spain and the city of Madrid share a similarly high rate of owner-occupancy (70%). Additionally, the duration of ownership tenure in Madrid has increased significantly since 2008. In the Madrid region, the median ownership tenure is slightly below the national average—15 years compared to 17.7 years across Spain, suggesting homeowners don't sell their household units frequently. (SEREG, 2024). In 2008, ownership tenure periods were much shorter, averaging eight years, reflecting the high-speculation period between 1997 and 2007. After the 2008 economic crisis, tenure periods became much longer, and the average period of ownership has more than doubled to the present day in Madrid and Spain more generally (SEREG, 2024). The payback period of retrofitting is estimated in 10-20 years (depending on materials and specific building construction properties); however the financial incentives that have been made available, which can cover up to 80% of the costs, can shorten these payback periods (CSCAE, 2025). The estimated increase in household unit value is about 25% for buildings constructed before 1979 and lower for those built afterward, when minimum insulation requirements were established by law for new construction (CSCAE, 2025). Since tenures have become longer, this study assumes that the impact of energy retrofits on unit sales is not a relevant concern, as owners do not sell their units frequently.

4.3.2. Policy context: governance frameworks to accelerate household energy retrofits in Madrid

Madrid's Roadmap for Climate Neutrality published in 2019 and revised in 2024, emphasizes the critical role of building stock, and in addition to the transportation sector, identifies the residential sector as having the highest potential to accelerate the reduction of direct GHG emissions and meet 2030/50 climate-neutrality targets (Madrid City Council, 2024). By integrating national plans such as the ERESEE and the PNIEC into local action, the roadmap prioritizes interventions in buildings that improve thermal performance, focusing on building insulation to prevent air leaks through windows, facades, and roofs, in order to reduce energy demand for thermal needs, and recommends installing renewable equipment to improve energy efficiency by 2030 (Madrid City Council, 2024). With a goal to increase renewable energy in electricity generation to 74% and scale up rehabilitation efforts to contribute to PNIEC and ERESEE targets, Madrid plans to move from retrofitting 2,040 households in 2021 to 20,400 annually by 2030, culminating in over 80,000 rehabilitated households (Madrid City Council,

2019a, 2024; Ministerio de Vivienda y Agenda Urbana, 2020, 2024). While other energy efficiency measures, such as appliance upgrades and general refurbishments are acknowledged as necessary, the roadmap identifies thermal improvements as the cornerstone of the city's decarbonization strategy in buildings (Madrid City Council, 2024).

In the context of economic recovery after COVID-19, the city of Madrid developed "The Recovery, Transformation, and Resilience Plan for the city of Madrid" (2021) to outline the allocation of Next Generation funds, putting an even stronger emphasis on environmental action that had already been outlined in national plans (Madrid City Council, 2021). In fact, 57% of the Next Generation funds have been channelled to environmental projects—exceeding the minimum requirements for environmental investment set by the Next Generation mechanism (De Gregorio Hurtado & Gharbi, 2022). In this way, post-COVID 19 economic recovery plans align and reinforce already existing national plans to improve energy efficiency and climate neutrality.

These municipal governance frameworks towards climate-neutrality have limitations as they outline interventions in broad, generalized terms without addressing spatial variations in detail. De Gregorio et al. (2022) highlight that the urban strategy for allocating Next Generation EU funds—focused on the buildings and transportation sectors and aligned with Madrid's Roadmap to Climate Neutrality and the Green Deal—lacks a territorial assessment. Further they critique the urban dimension of "The Recovery, Transformation, and Resilience Plan for the City of Madrid", remains too open-ended and fails to consider the diverse local conditions across different districts, for example. This lack of more granular data in the policy plans undermines the policy's ability to address local priorities effectively (De Gregorio Hurtado & Gharbi, 2022).

4.3.3. Policy instrument: The "Plan Rehabilita" municipal subsidies program

The primary policy instrument to encourage household retrofits in the city of Madrid is the provision of subsidies which can cover between 40% and 80% of the total project costs, depending on how much energy efficiency improvement is achieved and building location. In the residential sector specifically, the main program channelling municipal subsidies to retrofitting existing buildings is a year-round program named "Plan Rehabilita", managed by the municipality. Besides this municipal program, regional and national financial incentives are also available, including tax exemptions (IRPF) and funds from the national "State Housing Plan (2018-2021)", managed at regional and national levels. [10] Finally, the allocation of Next

[10]See page 39: https://www.comunidad.madrid/transparencia/sites/default/files/open-data/downloads/2018-2021_plan_estrategico_vivienda.pdf Accessed August 30th, 2025

Generation funds towards household retrofits, regulated by the Royal Decree RD 853/2021, temporarily expanded the available public funding between 2021 and 2023 to promote household energy retrofits in the city (BOE, 2021).

This study specifically focuses on the analysis of “Plan Rehabilita” data from 2020, 2021, and 2022. The main policy instrument in place to accelerate retrofits is this municipally funded program, though other less substantial subsidy programs, managed at regional and national levels exist. The analysis of the distribution of “Plan Rehabilita” funds is used as a proxy to analyse the distribution of publicly funded programs aimed at advancing retrofits in the city of Madrid.

This decision is based on the following reasons:

1) “Plan Rehabilita” datasets, and geolocalized data to map areas where publicly funded interventions took place, are processed by the municipal administration and are publicly available. However, geolocalized data on the subsidies distributed through the RD 853/2021 program has not yet been made publicly available due to its recent distribution — additionally these datasets are processed at the regional rather than the municipal level. Other public retrofit programs are managed at regional and national levels, and this fragmented data processing results in a lack of a consolidated, geolocalized dataset on the total building retrofits in Madrid that have been publicly funded.

2) Since “Plan Rehabilita” accounts for the largest share of publicly funded retrofits in Madrid and allocates funds based on the order of application rather than targeting specific areas, its datasets serve as a useful proxy for understanding the geographic distribution of public funds at the district level. The program operates year-round and represents a substantial portion of Madrid’s public funding for household retrofits. In contrast, data on subsidies distributed under Next Generation funds (RD 853/2021) remain unavailable due to recent implementation and ongoing processing of data at regional and national levels, limiting researcher access.

3) Researchers' access to local city officials to fact-check publicly available data was facilitated thanks to the established relationship between itdUPM in partnering with city council members.

The “Plan Rehabilita” deploys 50 million euros annually to promote four types of retrofit interventions: **Accessibility, Energy Efficiency, Remediation, and Conservation.** The procedure for granting subsidies to homeowner communities under the Rehabilita program, follows a "simplified competitive process" (*concurrencia competitiva simplificada*). Under this system, the primary criterion is the order in which applications are received, provided that the

minimum requirements have been met. (Madrid City Council, 2023, Article 20, p.103). While funds are allocated on a first-come, first-served basis, renovation projects in vulnerable areas are eligible to receive a higher percentage of subsidies to cover the total cost of renovation projects (Madrid City Council, 2023, p. 120). In contrast, the program that preceded "Plan Rehabilita" under the former government of 2015-2019 period, known as "Plan MAD-RE," specified a priority for distribution in "APIRUS" areas — areas in the city identified as having higher concentration of social vulnerability indicators. Following the change in government in 2019, both the program's name and distribution strategy were revised.

Energy efficiency improvements are not considered a "top priority" by Madrileños (Madrid City Council, 2019, p. 33). This perception is illustrated by the majority of "Plan Rehabilita" subsidies being channeled to accessibility interventions like elevator installations, which are considered a primary necessity by Madrid residents, while only 16% of funds are directed toward energy efficiency measures (Madrid City Council, 2019a). In addition to subsidies, the "Oficina Verde" was established in 2020 as an information desk aimed at addressing the well-known challenge of insufficient information about available retrofit subsidies and providing guidance on how to navigate the application process (Madrid City Council, 2019a). The office is located in the center of Madrid and is open to visitors, including individual homeowners or homeowner communities who go there to learn more about available subsidies and the steps needed to begin a retrofit process.

Outreach efforts from the "Oficina Verde," however, lack a spatially distributed presence in specific neighbourhoods. While "Plan Rehabilita" subsidy distribution data is publicly available and provides geolocalized information on the location of dwellings that have received public funds according to district, energy efficiency data for buildings is not systematically collected at the municipal level. Additionally, the impact of household retrofits on GHG emissions in specific locations is not tracked for policy evaluation: the city's GHG Emissions Inventory collects data on an aggregate level, categorized by sectors such as building and transportation, but GHG emissions per sector are not collected at the district or neighbourhood level yet (Madrid City Council, 2022). As a result, there is no structured data collection system to assess the impact of particular retrofit interventions, nor identifying which neighbourhoods benefit most from publicly funded programs or where efforts should be adjusted in the city.

4.4. Data collection and analysis

The research employs a comprehensive mixed methods approach to investigate energy retrofit policies in Madrid, utilizing a diverse range of data collection and multiple sources of evidence to construct research validity, necessary to conduct an in-depth research approach on a real-

world phenomenon (Yin, 2018). The data encompasses a comprehensive analysis of multi-level climate action plans, policy evaluation reports, archival records and quantitative assessments to achieve more granular insights on local policy implementation. It also includes qualitative research methods such as interviews with key informants, participant observations, site visits. To strengthen validity, the data collected from these multiple sources, including quantitative and qualitative, is triangulated to make an in-depth analysis of this climate policy implementation (Creswell, 2014).

4.4.1. Document analysis

A series of documents were retrieved and further analysed.

- **Climate action plans and policy evaluation reports at global, EU, and national levels:** Document analysis forms the initial stage, focusing on climate-neutrality and energy retrofitting policy reports across global, European, and national levels. This provides a solid foundation for understanding the broader policy landscape and the contextual framework shaping Madrid's climate-neutral strategy and household retrofit policies. Key documents include the EU Green Deal, the Mission for 100 Climate-Neutral Cities, and the Spanish national platform CitiES city guide for decarbonizing the building sector. Additionally, long-term national energy strategies—including PNIEC and ERESEE—are examined alongside national plans developed under the temporary deployment of Next Generation funds (e.g., PRTR). Finally, a broader global perspective on the building sector's contribution to GHG emissions is provided through key reports, including the UNEP Global Status Report for Buildings and Construction the OECD Global Monitoring of Policies for Decarbonizing Buildings, and analyses from the Climate Policy Initiative and WRI Urban Transformations. These reports examine the challenges and priorities cities face in decarbonizing the building sector, offering critical insights into global trends and policy effectiveness.
- **Climate action plans for Madrid:** We extend the document analysis to understand Madrid-specific initiatives aimed at accelerating building retrofits and climate-neutrality in general, including the city's climate-neutrality roadmap, the PRTR for Madrid, and Agenda Rehabilita (Madrid City Council, 2019, 2021, 2024). Studies tracking household energy retrofit implementation at a local level were limited (Saniour, N., 2023) even if Spanish implementation challenges are available (Casanovas, Cuchí, Herrero et al., 2018; Provivienda, 2024).
- **Call for proposals for subsidy programs in Madrid:** the call for proposals provides information about the administrative regulations and the procedures to apply for the funds provided by the "Plan Rehabilita" program and Next Generation funds RD 853/2021. The objective is to gain a deeper understanding of the selection criteria used

to evaluate and approve projects. Additionally, we revised the call for proposals from previous plans, such as Plan MA-DRE (pre-2020), which followed different selection criteria, including specific requirements for APIRUs zone recipients.

4.4.2. Quantitative data

Retrieval process, creation and curation of the database:

Informed by the literature, we engage with debates on scale and conduct a spatially grounded analysis, leveraging granular-level data to identify patterns of subsidy distribution across the city and map patterns in the uptake of public funds distributed in the annual municipal subsidy program, *"Plan Rehabilita"*, for the years 2020, 2021, and 2022. While the primary focus is to analyze uptake patterns in energy efficiency interventions, the *"Plan Rehabilita"* program also allocates retrofit subsidies for accessibility, conservation, and remediation. Considering these additional interventions provides essential context for understanding household-level retrofit dynamics, especially given that the literature highlights how energy efficiency upgrades often coincide with other necessary repairs or urgent improvements.

Information retrieval:

We extracted three different data sources with the goal of examining district-level variation in the distribution of energy efficiency subsidies from the "Plan Rehabilita" Program. This required the research to take on a data-mining process, sorting out large datasets collected and processed in different public departments.

1) Subsidy data per district: The researcher extracted data from the "Plan Rehabilita" program of the years 2020, 2021 and 2022 (Available publicly at *Geoportal Visor Platform):* [11] four tables informing the total number of households receiving subsidies for energy efficiency, conservation, remediation and accessibility were downloaded in .xlsx format. The entries were classified by corresponding district of each file numbers ("número de expediente") that received funding from the three calls for proposals
2) Net household income data per district: the table was obtained directly from Instituto Nacional de Estadística, with 2021 data.
3) Dominant energy performance rates per district: As mentioned before, there is no systematic collection of building energy efficiency data. In July 2024, the Comunidad de Madrid website published the first public dataset containing registered energy certificates for buildings in Madrid, by address and postal codes *(Registro de*

[11] https://sigma.madrid.es/hosted/rest/services/VIVIENDA/PLAN_REHABILITA_MADRID/MapServer

Certificados de Eficiencia Energética de Edificios).[12] The data obtained, however, contained 7,645 records of building and household energy efficiency rates sorted by postal code. By adding an additional reference table ('*Callejero completo*') the researcher was able to manually link postal codes with corresponding districts, as in some cases, one postal code corresponds to more than one district.[13] This resulted in a table with the 7645 records, classified by district, and the rates ranging from A-G (with the range of E-G classified as low-performance).

Data curation:

The information was compiled in one .xlxs file that gathers information per each of the 21 districts indicating the following columns (See Annexes
Annex I): the number of households that have received energy efficiency subsidies in the "Plan Rehabilita" program of the years 2020, 2021, 2022; 2) the number of households that have received accessibility, conservation and remediation subsidies under the same program in 2020, 2021, 2022.; 3) the net household income per district; 4) a conceptual estimation of the dominant energy efficiency rates (A-G letter rating) in each district.

The use of dynamic tables in Excel allowed for a count of the number of retrofitted households by intervention type (energy efficiency but also accessibility, conservation and remediation). Households benefiting from multiple interventions were not counted twice. Similarly, the dynamic tables facilitated a conceptual estimation of the proportion of low-performance (E-G ratings) in each district's building stock.

These tables facilitated the creation of graphic visualizations, complemented by GIS maps to visualize patterns of implementation both at district and neighbourhood levels. This provided a foundation for analyzing which areas received the most subsidies and how this distribution correlated with energy efficiency performance and income data—a particularly relevant aspect in a program where retrofits are allocated on a first-come, first-served basis. Finally, neighbourhood-level data from the three districts with the highest demand for energy efficiency subsidies was manually disaggregated, with the support of Geoportal search engine ('*limites administrativos'*) to identify which specific neighbourhoods were driving this demand.

[12] https://datos.comunidad.madrid/dataset/registro_certificados_eficiencia_energetica (Accessed July 2024)
[13] https://gestiona.comunidad.madrid/nomecalles/DescargaBDTCorte.icm (Accessed September 2024)

4.4.3. Qualitative data

Interviews, participatory observation and site visits

First, qualitative data enabled the researcher to gain a deeper understanding of existing policies through participation in meetings and workshops organized by Madrid City Council, as well as workshops facilitated by itdUPM and other networking events with non-place-based retrofit promoters, such as "Oficina Verde" and Oficina de Rehabilitación COAM, the national Spanish platform citiES and the Spain Green Building Council. Second, it served as a key source to gain perspectives on the role and influence of retrofit actors, and other insights in the spatial allocation of subsidies that were identified in the quantitative analysis (Yin, 2018). This involved exploring how material and social conditions, along with place-based actors, influence policy outcomes. Interviews were transcribed, coded, and analyzed to identify recurring ideas and key themes within our interpretative framework on intermediaries.

- **Semi-structured interviews with 25 key informants** (Appendix C). The research incorporates semi-structured interviews with key informants representing a comprehensive range of stakeholders within the retrofit policy ecosystem in Madrid (Appendix A). The semi-structured interview approach offers flexibility for participants to deeply explore and articulate what they consider most critical in the context of retrofits in Madrid and was instrumental for two reasons. First, the qualitative interview offers a valuable opportunity to refine and expand upon document analysis findings, clarify technical application details, verify data sources, and discuss preliminary quantitative results. This process helps capture complementary perspectives and understand how stakeholders interpret and make sense of the initial insights. Second, the interviews provide retrospective insights from participants' experiences with previous funding calls and retrofit interventions, aiding the researcher in contextualizing the findings and offering a deeper understanding of key transformations in policy design, targeting strategies and implementation.

  Interview participants encompass a diverse group including officials from local, regional, and national government levels, academic experts, non-profit organizations involved in retrofit, private sector representatives (from local construction companies to large private utilities), homeowner community representatives, neighbourhood association representatives and representatives from relevant professional associations (Appendix C). These key informants provided insights into retrofit policy dynamics, uncovered implementation challenges, and proposed potential strategies for accelerating urban energy transformation.

- **Participant observation:** Data is also obtained from participant observation. The researcher participated in three workshops facilitated by itdUPM in a project in collaboration with the Madrid City Council, which explored the social inequalities in building retrofit policies outlined in Madrid's climate neutrality roadmap. Held in March 2023, this series of workshops engaged third-sector representatives along with city council to revise the roadmap's shortcomings. The researcher also participated in the UIMP (Universidad Méndez-Pelayo) Summer Course in July 2023 devised by itdUPM under the leadership of the citiES platform, that brings together academics and policy officials involved in the Mission for 100 Climate-Neutral Cities every summer since 2022. The course focus groups offered deeper qualitative insights into the social inequalities and institutional aspects of energy retrofit implementation in Madrid and in other Spanish cities. Additional observational data was gathered from researcher's participation at public and networking events that promoted building retrofit policies, including "Jornadas de la "Oficina Verde"" (online participation, September 2024), "Jornadas de la Oficina de Rehabilitación COAM" (February 2025), "citiES under perspective" (March 2024) and CONAMA sessions titled "Una rehabilitación de edificios ambiciosa climáticamente" (December 2024).

- **Site visits** (See Appendix B): Direct observations are a key source of evidence in case study research, especially in urban studies (Yin, 2018). During the initial stage, visits such as the one organized by the local non-profit "Tangente" named (*"En Ruta hacia la Transición Energética,"* November 2023) were instrumental in gaining a practical understanding of what retrofit implementation and energy communities look like in practice. Visits to City Council offices, the "Oficina Verde", and the "Oficina de Rehabilitación COAM" information hubs provided key insights into the strategies of outreach of these institutions and allowed the research to identify roles and how the policy works in practice. At a more advanced stage as the quantitative analysis progressed, the researcher conducted site visits to the specific areas concentrating demand for energy retrofit subsidies: Aluche, Ciudad de los Ángeles, and Poblado de Orcasitas. These visits offered a deeper understanding of place-based intermediation dynamics, including the role of neighbourhood associations, local construction typologies, materials and the specific retrofit motivations within each area. Site visits included: Barrios de Ciudad los Angeles (ASVEYCO), Campamento (Latina), Asociación de vecinos de Aluche AVA, Asociación de vecinos Puerto Chico, and Poblado de Orcasitas neighbourhood and Asociación de vecinos Guetaría.

The qualitative data collected in this study was examined using the coding of repeating ideas, a process that systematically identifies common themes (Auerbach & Silverstein, 2003). This analytical approach begins by selecting relevant text from interview transcripts and other qualitative data collected. Related passages from interviews, observational notes from site visits and participant observation in workshops were grouped into repeating ideas—defined as ideas appearing consistently across multiple data points or expressed by two or more participants. These repeating ideas were subsequently organized into broader themes (Auerbach & Silverstein, 2003). The coding process involved both inductive and deductive approaches. The inductive approach was helpful in identifying new ideas emerging directly from the case study, allowing themes such as the importance of the imitation and spillover effect of retrofit interventions in particular areas (See Appendix D). Conversely, the deductive approach reinforced themes that had previously been identified in the literature review, highlighting for example the need for tailored support to homeowners and emphasizing the importance of building trust to successfully implement retrofits (See Appendix D). This method is designed also to overcome the limitation that no one can immediately see patterns in a large amount of text, instead providing a structured way to discover patterns within the organizational structure of the data.

The data analysis was conducted as a triangulation among multiple sources of evidence quantitative and qualitative (Yin, 2018). The interview coding findings were then cross validated with quantitative data, including an analysis of subsidies across the city, as well as observational insights from site visits. The use of multiple data sources—known as data triangulation—strengthens the study's internal validity by ensuring a more robust and comprehensive examination of the research question (Yin, 2018).

5. RESULTS

In this section we present the findings of our case study according to the following structure. Subsection 5.1 describes the quantitative results, detailing how retrofits are distributed across the city and highlighting patterns in relation to social and material characteristics of different areas. Subsection 5.2 describes the intermediary actors operating in the retrofit system in Madrid, organized according to the categorization proposed in our analytical framework (place-based and non place-based intermediaries).

5.1. Socio-spatial dimensions: what are spatial differences in the implementation of retrofits in Madrid? Analysing the distribution of "Plan Rehabilita" program

The "Plan Rehabilita" is the main municipal program allocating public funds to support the expansion of household retrofits in Madrid. Analysing data of how this policy instrument is implemented in the territory can provide insight into the spatial distribution of publicly funded programs to advance retrofits and highlighting which areas of the city are leveraging the availability of financial subsidies. Since these policies are not territorially targeted, this analysis aims to understand where retrofits materialize across different areas and where transformations in the built environment are occurring. This approach is informed by the existing literature that calls for more granular and spatially grounded approaches to observe urban transformation processes.

Spanish policy evaluation reports have highlighted the shortcomings of a "one-size-fits-all" subsidy policies to retrofits like the "Plan Rehabilita" program", which are demand-driven and lack both directionality—meaning they are not targeted to specific areas—and data-driven approaches. These include the lack of a comprehensive diagnostics of the building stock's conservation status, more granular GHG emission data at the building or district level (i.e. ITEs), and the integration of local social data and vulnerability assessments to identify where public funds are most needed to achieve policy objectives. Such limitations risk overlooking the diverse material, social, and built environments within a city, which create varying capacities for change in its heterogeneous urban landscape (Casanovas, Cuchí, Herrero et al., 2018; Stieß & Dunkelberg, 2013; Westman & Castán Broto, 2022). Spain presents one of the highest energy poverty rates in the EU, and one of the assumptions is that "first come first served policies" would disproportionately impact those with less access to information and with

lower income (Casanovas, Cuchí, Herrero et al., 2018). Moreover, Madrid officials have noted that knowledge and awareness of energy retrofits vary significantly by neighbourhood, with wealthier areas tending to be more informed about these public incentives.

To address these gaps, we analyze the distribution of energy efficiency subsidies at the district level (See Figure 5.1) and examine how it relates to income levels and the share of low-performance buildings in each district (Figure 5.2; Figure 5.3). This analysis aims to identify which areas are demanding more subsidies to energy efficiency and explore how these patterns of implementation relate to building emission and income levels in the city.

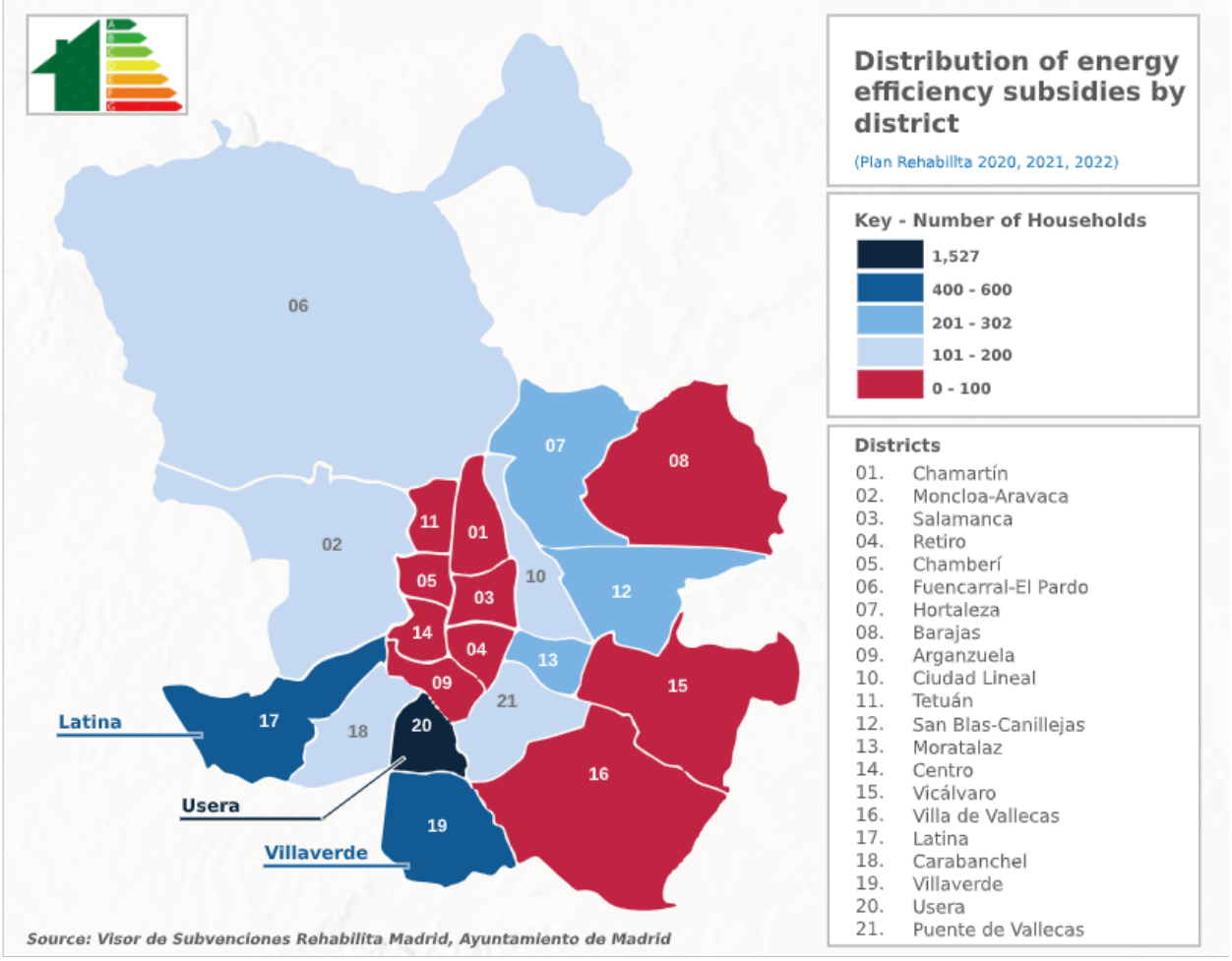

Figure 5.1: Distribution of energy efficiency subsidies by district ("Plan Rehabilita" 2020, 2021, 2022)

Source: Own elaboration. Map created using GIS based on data from "Plan Rehabilita" (Madrid City Council)

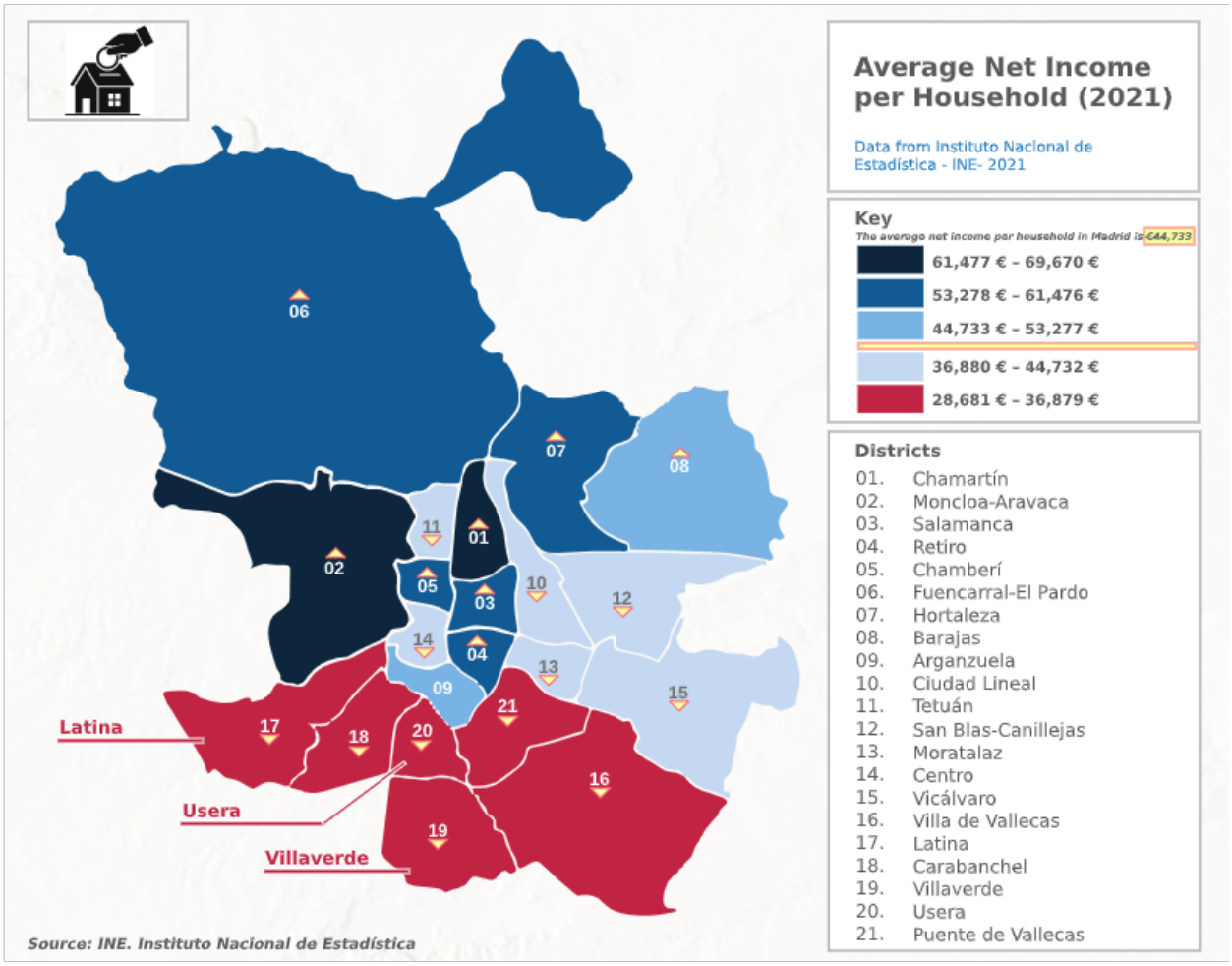

Figure 5.2: Average net income per household by district ("Plan Rehabilita" 2020, 2021, 2022)

Source: Own elaboration. Map created using GIS based on data from Census data (Instituto Nacional de Estadística)

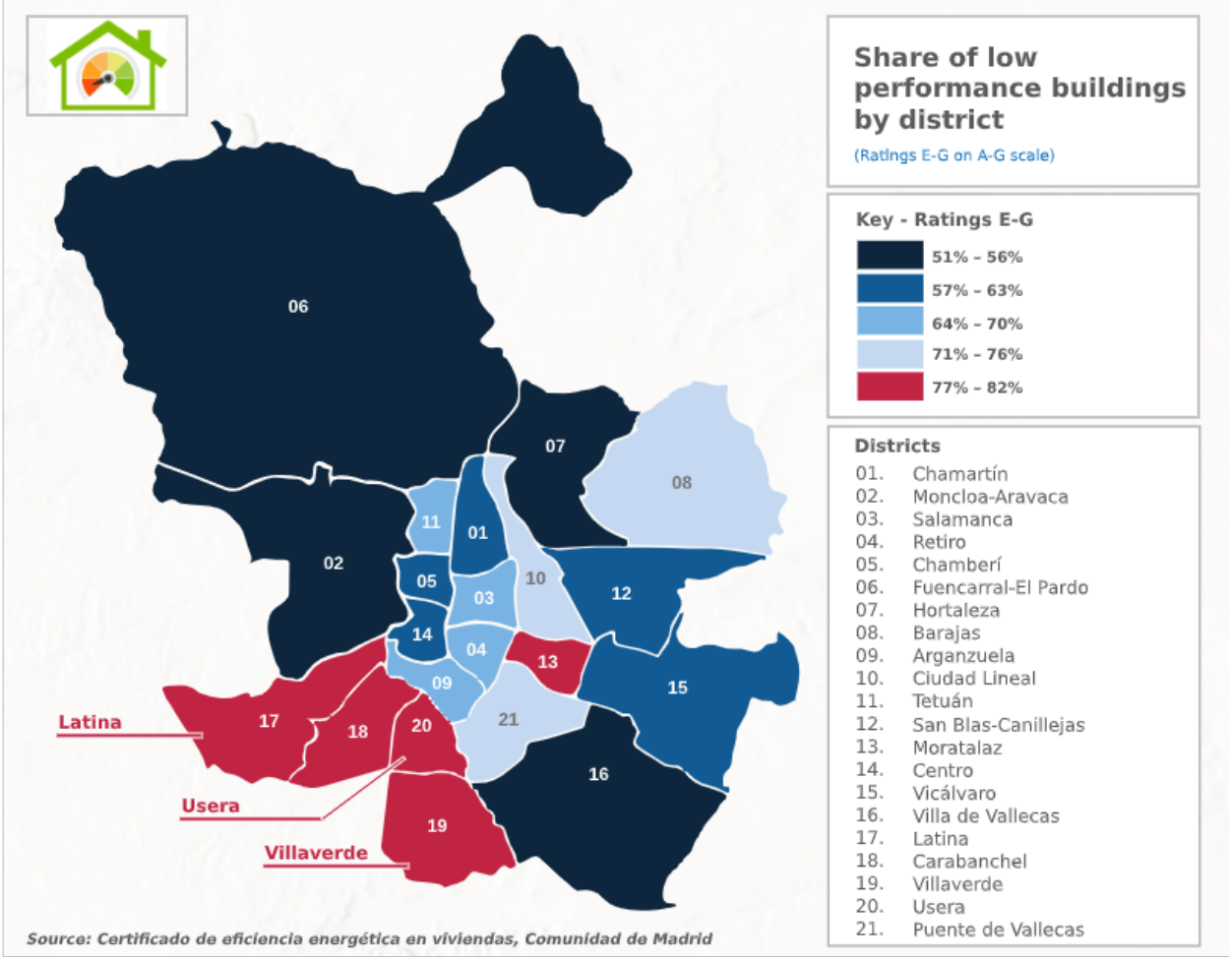

Figure 5.3: Share of low-performance buildings by district (E-G rates)

Source: Own elaboration. Map created using GIS based on data from database on energy certificates for buildings (*Registro de Certificados de Eficiencia Energética de Edificios,* Comunidad de Madrid)

5.1.1. Analysis of the spatial distribution of energy efficiency subsidies from "Plan Rehabilita" in years 2020, 2021, 2022 (district and neighbourhood levels)

The "Plan Rehabilita" is a yearly program that distributes subsidies to four types of retrofit interventions: conservation, remediation, accessibility, and energy efficiency, with a yearly budget of 50 million euros. Only 16% of the demand for "Plan Rehabilita" subsidies is directed specifically toward energy efficiency interventions, whereas a majority is demanded for accessibility interventions to install elevators (Madrid City Council, 2019a). Accessibility interventions represent 70% of the total budget of "Plan Rehabilita" in 2020, 2021, 2022 (Madrid City Council, 2019). Demand for retrofits in a single category often overlaps with other measures, as households frequently undertake multiple types of interventions simultaneously, including conservation, remediation, accessibility, and energy efficiency.

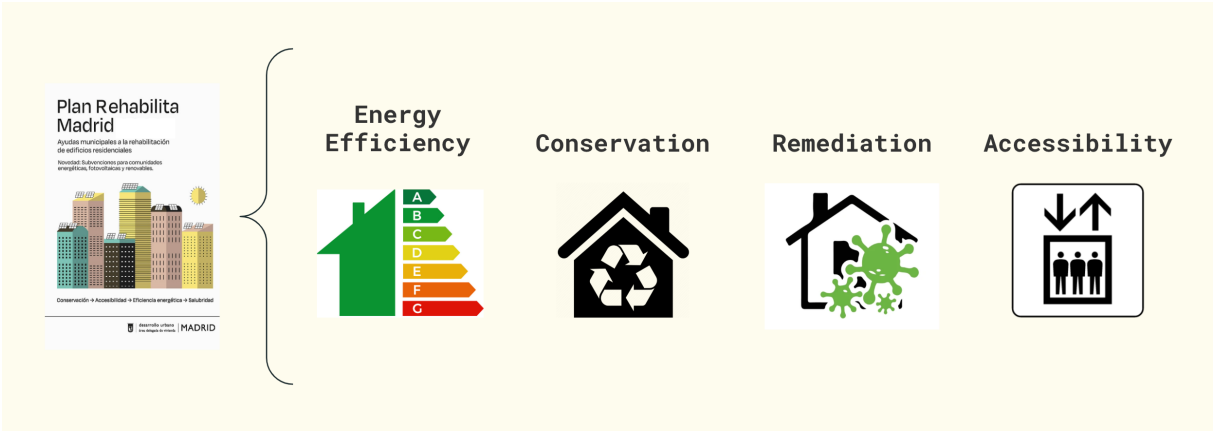

Figure 5.4: Four types of retrofits subsidised by the Program "Plan Rehabilita": Energy Efficiency, Conservation, Remediation and Accessibility

Source: Own elaboration

In terms of the spatial distribution of energy efficiency subsidies, we note that more than 50% of the energy efficiency subsidies from the "Plan Rehabilita" are concentrated in three districts in the South of Madrid: Usera, Latina, and Villaverde (Figure 5.1). These districts have below-average household incomes compared to the city's median of €44,733: Usera (€30,023), Latina (€37,790), and Villaverde (€30,673) (INE, 2021). These districts also exhibit a higher concentration of buildings with the lowest rates of energy performance (more than 75% of the building stock assessed is rated E-G), compared to other districts, underscoring the socio-spatial inequalities in energy efficiency within the city (See Figure 5.3). It is, however, striking to note that the **Usera** district accounts for a disproportionately higher share of subsidies, with three

times more demand for energy efficiency, conservation, and remediation interventions in the "Plan Rehabilita" program compared to the next two highest-ranking districts (Figure 5.1).

The charts show that these three districts also lead in the demand for conservation and remediation measures, suggesting a "spillover effect" ("*efecto arrastre*") where demand for energy efficiency accompanies other repairs: these districts also rank highest in conservation and remediation subsidies (Figure 5.5).While accessibility constitutes the largest share of total subsidy demand in the "Plan Rehabilita" program, the district-level pattern is less clearly defined compared to other three categories: conservation, remediation and energy efficiency (Figure 5.7). Still, the district of Latina stands out with particularly high rates for accessibility subsidies, accounting for 3,034 households benefiting from accessibility-related measures.

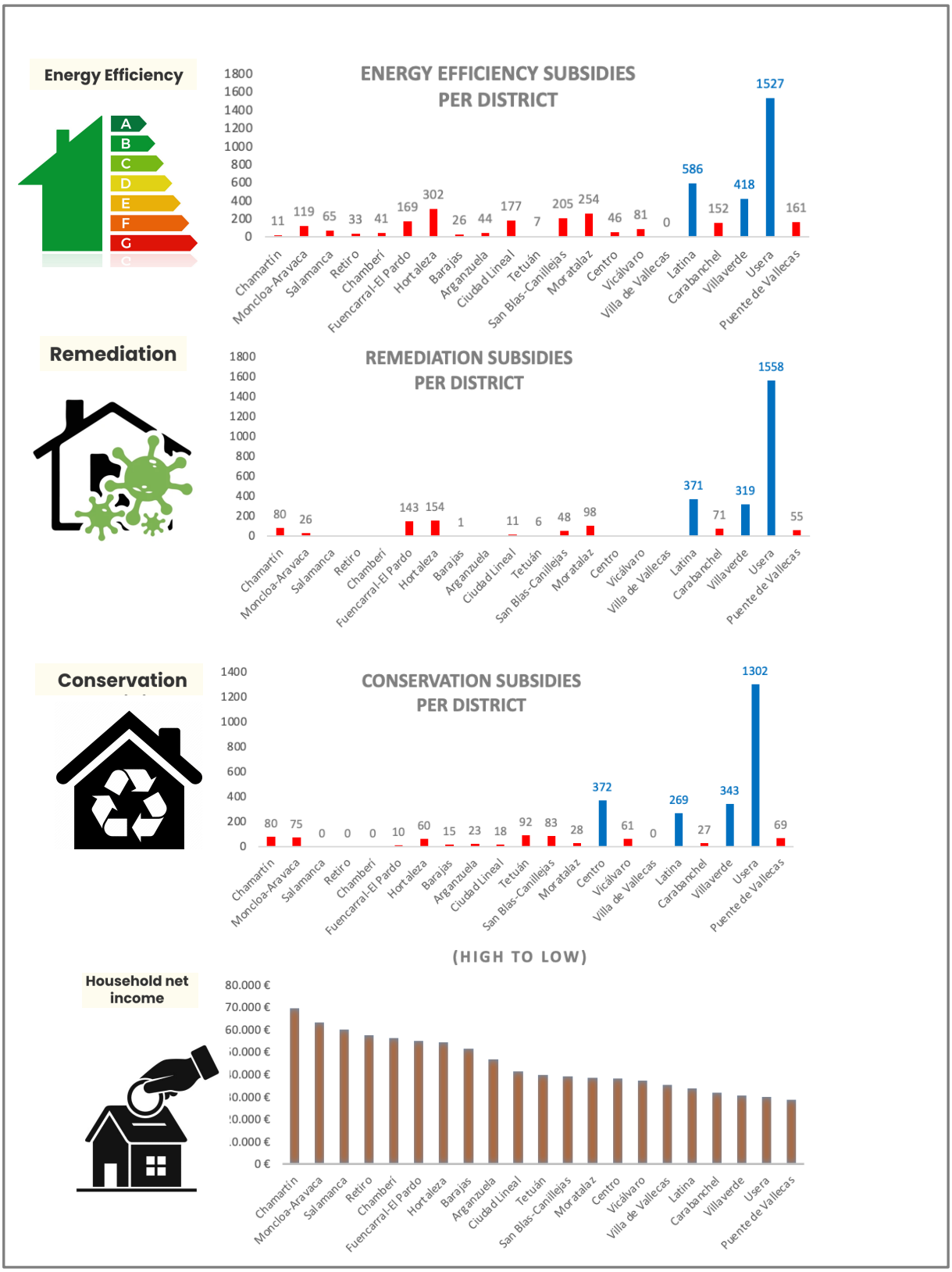

Figure 5.5 Distribution of "Plan Rehabilita" Subsidies for Energy Efficiency, Conservation and Remediation
(number of households per district ranked from highest to lowest income)

Source: Own elaboration. Data extracted from the "Plan Rehabilita" Geoportal Visor platform (Madrid City Council)

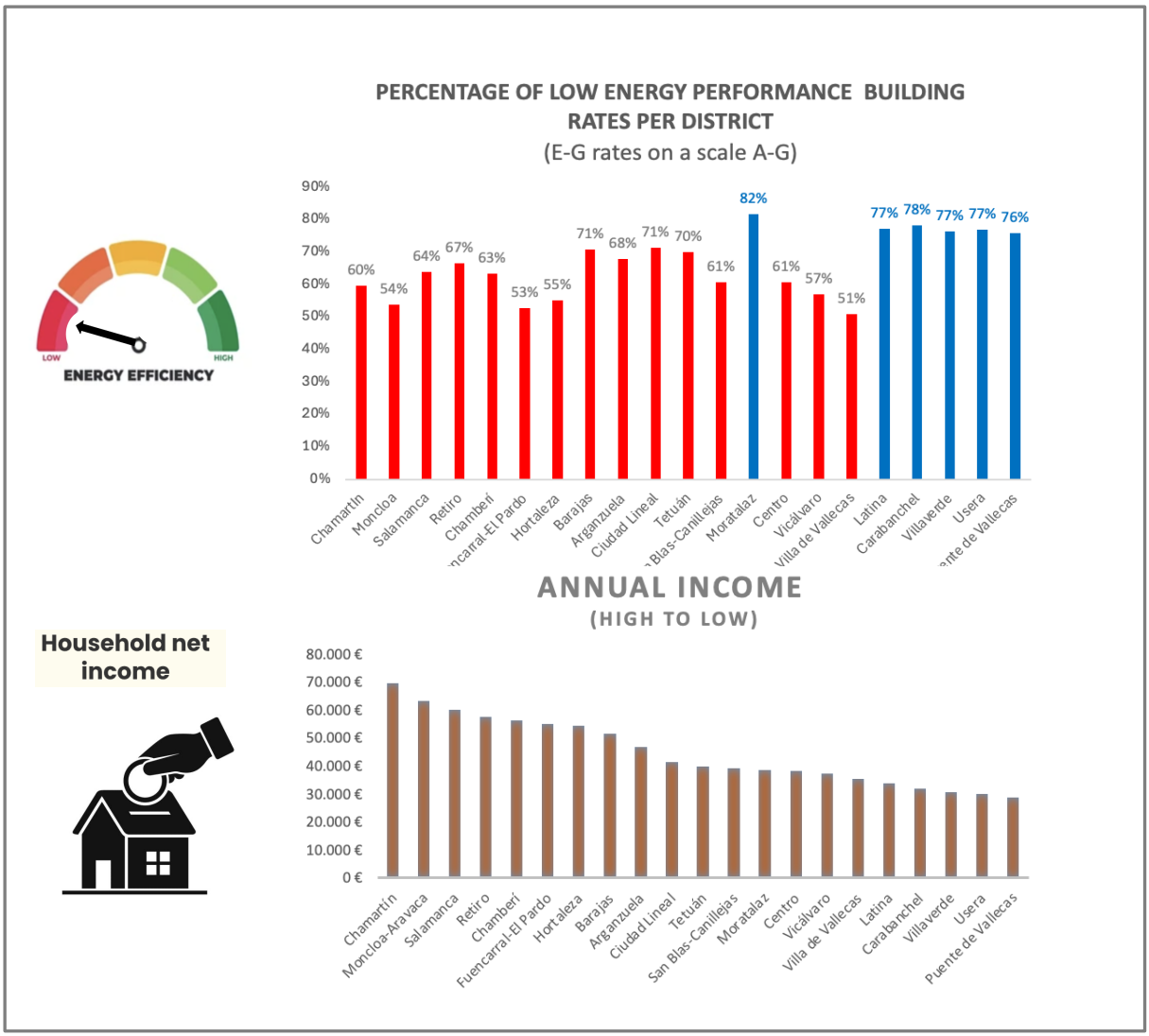

Figure 5.6: Percentage of Low Energy Performance Buildings by District: Ranked from Highest to Lowest Income

Source: Own elaboration. Data extracted from "Registro de Certificados de Eficiencia Energética de edificios" (Comunidad de Madrid)

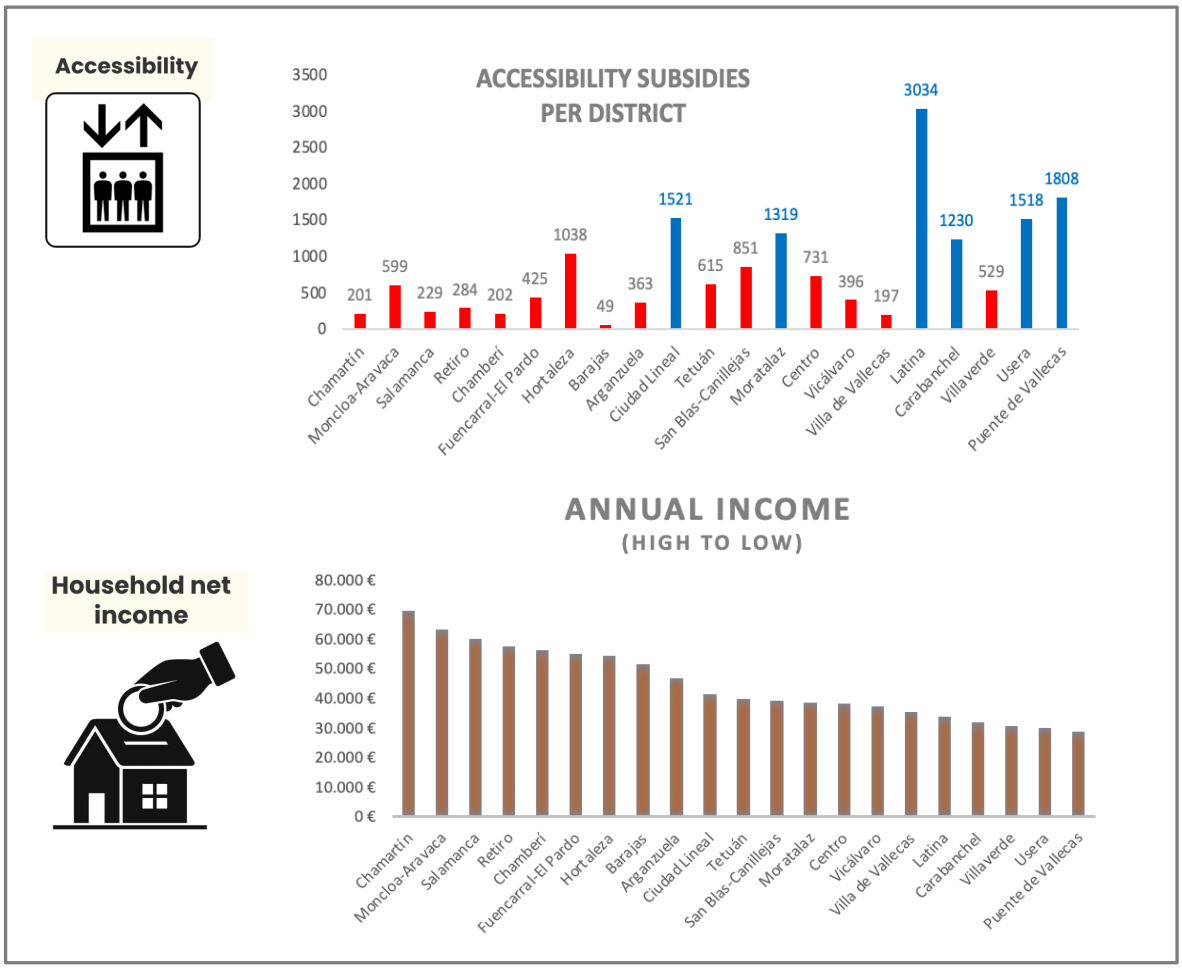

Figure 5.7: Distribution of "Plan Rehabilita" Subsidies for Accessibility

(number of households per district ranked from highest to lowest income)

Source: Own elaboration. Data extracted from the "Plan Rehabilita" Geoportal Visor platform (Madrid City Council)

5.1.1.1. Social characteristics of districts demanding most energy efficiency subsidies ("Plan Rehabilita", 2020, 2021, 2022)

In the three districts of Usera, Villaverde and Latina, homeownership rates align with Madrid's average of approximately 70-75%, which implies that a majority of homeowners making decisions are also residents (INE, 2021). With lower than Madrid average income (EUR 44.733), these three districts also show a higher-than-average concentration of residents over 65, indicating an aging population concentrated in these areas. Population data per district, however, indicates that the volume of households demanding subsidies per district is not proportionate to population size. For instance, districts like Usera and Chamartín have similar population levels but exhibit significantly different patterns of energy efficiency subsidies demanded in the "Plan Rehabilita" (Figure 5.8).

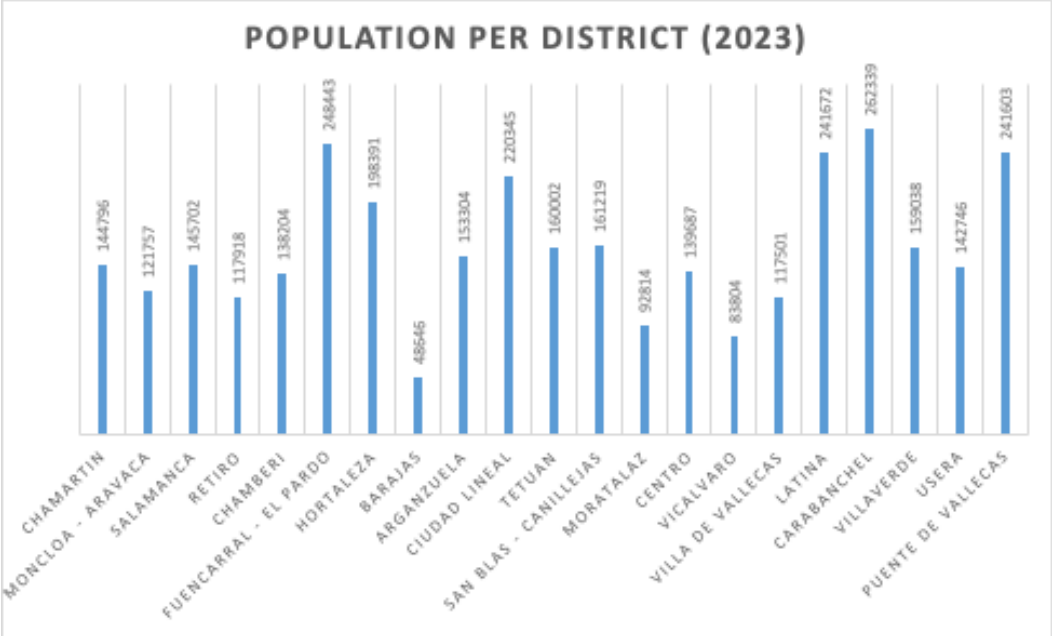

Figure 5.8: Population per district: Ranked from Highest to Lowest Income (2023)

Source: Own elaboration. Data from Madrid City Council Open Data Portal.

Regarding energy burden in these districts, the City Council does not collect data on energy burden rates at the district level. However, energy costs represent a heavy burden for 63.8% of households in Madrid, while only 35% consider it a reasonable expense (Madrid City Council, 2017). The only available measurement of energy burden is a perceived energy burden index, which classifies monthly energy bills as high or low based on household monthly income levels (see Figure 5.9). Given that the three districts—Villaverde, Latina, and Usera— are among

the five districts with the lowest income levels in the city, this suggests that the energy burden in these areas is significant.

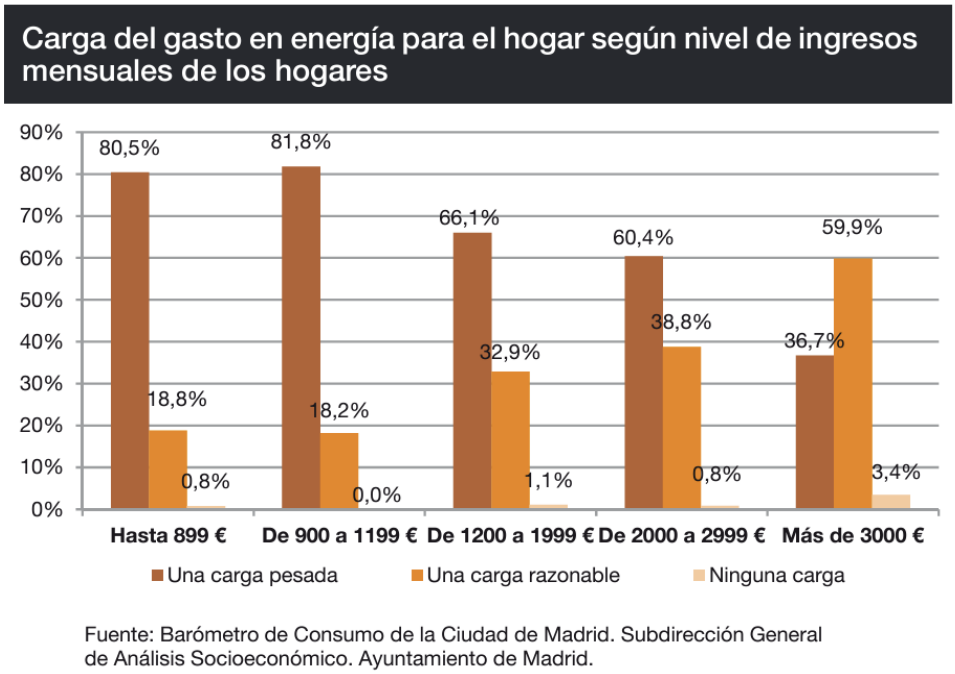

Figure 5.9: Energy burden for households (perceived as high or low) according to household monthly income in Madrid
Source: Madrid City Council[1]

5.1.1.2. Material and physical vulnerabilities of the building stock of districts demanding most energy efficiency subsidies ("Plan Rehabilita", 2020, 2021, 2022)

Beyond social factors (energy burden, income, age) there are physical and material aspects shared by the buildings in these areas. This analysis is informed by the literature's emphasis on paying attention to the varying social and material dimensions —rooted in specific, place-based contexts—when analyzing how interventions unfold in heterogeneous urban environments in order to gain deeper insight into the dynamics of urban transformations. The "human dimension" factors - which are deemed decisive in the decision to retrofit made at the household level - also encompass a combination of place-based contextual conditions unique to different communities in a city.

These three districts share a state of physical degradation of their building stock which necessitates renovation and this necessity for repair is an important driver in the demand for

subsidies. The buildings share common physical vulnerabilities that are typical of the housing developments from the "*desarrollismo*" era, a period of construction boom of the 1960s and 1970s that accommodated rural migrants (Tamayo Palacios, 2011). The "*desarrollismo*" era refers to the period of rapid economic development and urbanization in Spain characterized by massive construction projects and urban expansion, including the large-scale housing developments in the southern area of Madrid. Referring to this era, a member of city council states: "*These areas were built quickly, with poor quality materials, and for the people with few resources*" (City council member, Interview June 2024). A thorough study conducted by the municipality of Madrid elaborated in the years of 2015-2019 to inform urban regeneration efforts, also underlines that these districts, built during the "*desarrollismo*" era and concentrated in Madrid's southern zone, originated as working-class neighbourhoods. [14]

While the housing developments from this period follow homogeneous construction patterns, planned as open-block neighbourhoods, they exhibit different typologies depending on the neighbourhood. However, the buildings share common structural vulnerabilities: they are constructed with poor-quality materials that entail more frequent disruptions such as moisture problems and leaks, and often have roofs with asbestos, a common material at the time of the construction. The presence of asbestos in roofs, however, requires immediate intervention, as do cracks in the facades that compromise the buildings' structure and security.

> *"They have a leak, and they're going to repair it. But then they find out there are also asbestos... Asbestos is an important driver that motivates retrofits. That's when they come to us: when it's not elevators, it's the asbestos or roof leaks, which they really need to resolve." (Local Construction company, November 2024)*

Besides the structural conditions shared by these areas today, many residents who purchased their homes in the 1960s and 1970s are now aging, creating new needs such as the imperative of accessibility in buildings that often lack elevators. These unavoidable repairs often serve as entry points for energy efficiency upgrades, more often perceived as less urgent.

> *"It often starts with accessibility needs. When we begin studying the installation of the elevator, we often also propose energy efficiency —essentially, 'since we're installing the elevator, let's also improve efficiency.'" (Local Construction Company, November 2024).*

Another finding from the quantitative analysis of these three districts is the higher concentration of low-performing buildings, where 75% are rated E-G (on a scale A-G), indicating these

[14] https://estrategiaurbana.madrid.es/estrategia-de-distritos/

buildings' higher thermal transmittance (see Figure 5.6). This high thermal transmittance is in part due to the material thermal properties such as prefabricated concrete and brick walls, which characterise the construction of those areas. As a result, there is significant potential for energy efficiency improvements, especially since energy performance rate improvements are not linear—buildings with the lowest energy ratings are more likely to improve by more than one letter grade.

> *"Subsidies cover everything that helps your building move up at least one energy rating. The energy efficiency scale is not linear—it depends on which rating you depart from. Sometimes, efficiency improves by more than 30%. For example, moving from a B to an A is extremely difficult because the building is already highly efficient. But moving from an F to a D or from a G to an F is much easier. The improvement in those cases is much bigger." (City council member, August 2024)*

The "Plan Rehabilita" provides more funding for retrofit costs when a building improves by two letter grades rather than just one, with even greater support for buildings in designated vulnerable areas, including the designated APIRUS areas. The buildings in the three districts meet this criteria, which also makes them more suitable to get more substantial funding (Madrid City Council, 2023). By upgrading buildings of two energy performance letters through combined interventions - which can be achieved when property owners go beyond merely fixing asbestos and renovating roofs to also include SATE façade renovations—these owners can secure more substantial subsidies due to the greater energy efficiency gains. Construction companies that operate in the Southern of Madrid often advise homeowners of this advantage and make recommendations to homeowner communities to include energy efficiency when repairs need to be made:

> *'When they fix a leak or their roof, we argue that if they also add SATE* (*Exterior Wall Insulation System) to their facade, it ends up being much cheaper overall with the subsidy because fixing the roof alone does not exceed the two points in energy efficiency rating levels' (Local construction company, November 2024).*

Finally, some of these neighbourhoods have previously received targeted policies which appear to have created a spontaneous continuity in demand for retrofits, despite them no longer targeting these areas. Some neighbourhoods have learned to organize and replicate the retrofit process almost autonomously. A construction company from Ciudad los Ángeles reports that they don't even need to send out commercial agents, as demand emerges spontaneously from one neighbour to another. The company attributes this demand to the increased visibility of

retrofits in particular neighbourhoods—where neighbours ask each other about their experiences, and residents begin to better understand the advantages of these improvements.

> *"Previous policies that targeted the Ciudad Los Ángeles neighbourhood (Villaverde district) created a calling effect ('efecto llamada'), and the demand from residents persists even if the former targeted initiative is no longer in place. Since neighbours see it with their own eyes in their own neighbourhoods, it becomes something more tangible. (…) We don't have sales representatives; the neighbours do the work themselves by telling each other the benefits, how to get it done, and demand keeps coming!" (Local construction company, February 2025)*

> *"Once you finally see it… you see your neighbour feels warm and comfortable at home and even saves money. Envy is terrible. We people are really that simple, to be frank" (Neighbourhood association president, March, 2024)*

One example of a previous program that targeted funding allocation in particular areas is the program that preceded the "Plan Rehabilita", called "Plan MAD-RE" (2015-2019). This program specifically targeted more vulnerable areas (APIRUS) to be the main subsidy recipients - the neighbourhood of Orcasitas in Usera district was a part of APIRUS, and there, retrofit efforts began still during the "Plan MAD-RE" period around 2018. (Madrid City Council, 2019b, p. 17, 24).

> *"There's a legacy of the Plan Madre in the Orcasitas neighbourhood that helped getting this area prepared and expand their retrofitting efforts. Although the APIRUs criterion of allocation is no longer as fundamental, you have the 'contagion effect' : you see that the neighbouring building looks great and you also have the history to prepare your project and you request assistance…. It takes time for people to mobilize, so maturity matters…." (City council member, June 2024)*

The areas with greater demand for subsidies exhibit multiple overlapping material challenges: buildings constructed with materials that have poor thermal properties (higher thermal transmittance), frequent disruptions requiring unavoidable repairs, and often a lack of elevators. Although "Plan Rehabilita" distributes funding on a first-come, first-served basis, these neighbourhoods qualify for higher subsidy coverage because of their location. They are also more likely to achieve more significant energy efficiency improvements because their physical deficiencies present greater potential to upgrade in two letters their very low energy efficiency grades.

5.1.1.3. District energy efficiency demand catalyzed by single neighbourhoods

An analysis of neighbourhood-level data within these three districts reveals that demand is predominantly driven by a single neighbourhood in each district, with more than 60% of the demand in the district originating in one neighbourhood (Figure 5.10). This indicates a highly localized demand that shapes the demand for energy efficiency retrofits, suggesting there are neighbourhood-specific factors influencing demand for energy retrofits. The neighbourhoods exhibit higher-than-average rates of residents over 65 years old compared to their respective district averages. In the Usera district, 16.5% of the population is over 65 years old, with the Orcasitas neighbourhood having a higher proportion at 19%. In Villaverde, 16% of residents are over 65, while the Ciudad los Ángeles neighbourhood has a larger percentage at 23%. In the Latina district, 24% of the population is over 65, with the Aluche neighbourhood having an even higher proportion at 29%.[15]

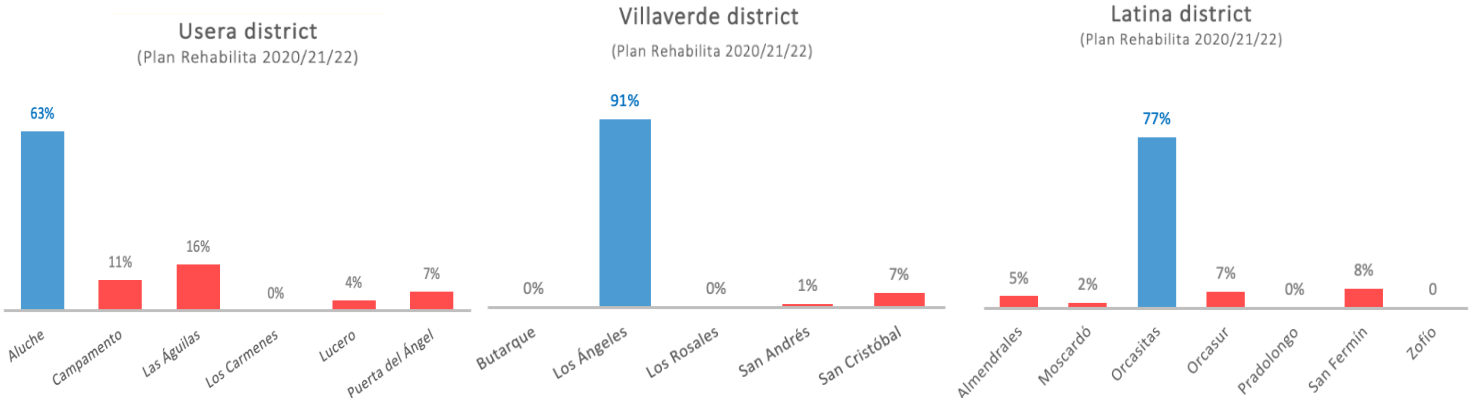

Figure 5.10: Districts of Usera, Villaverde and Latina: Distribution per neighbourhoods of energy efficiency subsidies ("Plan Rehabilita" 2020, 2021, 2022)

Source: Own elaboration. Data extracted from "Plan Rehabilita" Open Portal

[15] Distritos en cifras (Información de barrios): https://www.madrid.es/portales/munimadrid/es/Inicio/El-Ayuntamiento/Estadistica/Distritos-en-cifras/Distritos-en-cifras-Informacion-de-Barrios-/?vgnextfmt=default&vgnextoid=0e9bcc2419cdd410VgnVCM2000000c205a0aRCRD&vgnextchannel=27002d05cb71b310VgnVCM1000000b205a0aRCRD

In summary, the spatial distribution of energy efficiency subsidies in Madrid reveals significant concentration in three southern districts: Usera, Latina, and Villaverde (more than 50% of total energy efficiency subsidies). Despite similar population sizes, districts like Usera and Chamartín exhibit vastly different patterns of energy efficiency subsidy demand, further emphasizing the role of local socio-economic and building characteristics in shaping demand. The districts of Usera, Latina, and Villaverde, with below-average incomes compared to Madrid's median (€44,733), also exhibit a higher concentration of low performance buildings, with a dominance of E-G rates in 75-80% of the building stock in each district. Although Madrid's districts overall have a high share of low performing buildings, but in these districts the performance is even lower (Figure 5.3).

While homeownership rates in these districts align with the city average (between 70-75%), the energy burden is notably higher in areas with household incomes that reflect those of poorer districts, such as Villaverde, Usera, and Latina (€30,000-37,000) — this is an approximation since the city of Madrid does not collect energy burden data at district or neighbourhood level (INE, 2021; Madrid City Council, 2017). Additionally lower income levels and higher proportions of older residents over 65 years old (16-24% over 65, higher than Madrid average of 17.5%) underscore the compounded challenges residents face in these neighbourhoods. [16] This data underscores that demand for subsidies predominantly originates from areas characterized with material and social vulnerabilities.

When examining retrofitting demand through a more granular lens, a clearer picture of progress emerges that was not evident with a lens focused at the municipal scale. While retrofits in Madrid appear to progress slowly overall, a closer analysis of spatial data reveals that three districts—Usera, Villaverde, and Latina—account for 57% of the subsidies for household energy retrofits in the "Plan Rehabilita" Program of the years of 2020, 2021, 2022, and this concentration is not an intentional target of the program. Analysis at the district level also reveals that the demand for energy efficiency often comes together with conservation and remediation interventions, suggesting that a combined approach is more effective in advancing retrofits.

Finally, the granular lens revealed that demand for subsidies is highly localized within these districts, with single neighbourhoods driving more than 60% of the total demand in each district, suggesting neighbourhood-specific dynamics play a pivotal role in retrofit uptake (Figure 5.10).

[16] Distritos en cifras (Información de barrios): https://www.madrid.es/portales/munimadrid/es/Inicio/El-Ayuntamiento/Estadistica/Distritos-en-cifras/Distritos-en-cifras-Informacion-de-Barrios-/?vgnextfmt=default&vgnextoid=0e9bcc2419cdd410VgnVCM2000000c205a0aRCRD&vgnextchannel=27002d05cb71b310VgnVCM1000000b205a0aRCRD

This granular perspective reveals that despite slow progression at municipal and national levels there is significant progress in neighbourhoods like Orcasitas, Ciudad los Angeles and Latina. Therefore, it is instrumental to further understand with qualitative analysis the role that actors have had to contribute to the results that are observed in these neighbourhoods.

5.2. The role and influence of intermediaries in supporting household energy retrofit adoption in the city of Madrid

The uneven progress across different parts of the city identified in 5.1, further highlights the need to understand which actors are operating to facilitate retrofit adoption, bridging the gap between municipal-level goals and household-level uptake. The literature review suggests that this distance is often bridged by intermediary actors, who do more than merely "pass on" information about financial incentives or technological solutions to improve thermal performance—an especially important function in Madrid, where energy efficiency is not perceived as a necessity (Madrid City Council, 2019a). In this section we first outline the barriers to retrofit uptake in Madrid and then examine the role and influence of intermediaries operating within this particular context, detailing their roles, motivations, and how they influence policy outcomes. The analytical framework we propose incorporates the spatial dimension by distinguishing between place-based and non-place-based intermediaries, and actors mapped are presented accordingly.

5.2.1. Barriers in retrofit adoption in Madrid

The “Plan Rehabilita” program remains a central and consistent funding source managed by the municipality. The current approach of distributing subsidies on a “first come first served” basis without a targeted strategy is widely considered inadequate for accelerating annual retrofit rates — a perception shared by many interviewees from local government, academia, third sector organizations as well as policy evaluation reports (Casanovas, Cuchí, Herrero et al., 2018). As said by an academic expert on retrofits: *“If the goal is to achieve 300,000 household energy retrofits per year, subsidies alone are not an adequate mechanism.*” (Academic expert, Interview October 2023). Some of the limitations identified in Madrid about the current policy design are outlined below.

- **Distrust and cognitive burden when applying for retrofit subsidies**

Interviewees point out a generalized distrust surrounding public subsidies and retrofit programs. Application processes can be extremely complex and bureaucratic, and residents fear disruptions to their homes if they don't fully trust the results are worthwhile.

> *"You have to do 200.000 things in order to get your application accepted… Then you need to present lots of other documents to justify once the works are completed. Things are already complicated, so adding this to the list is a burden, really…". (Regional government representative, Decarbonization Department, Comunidad de Madrid, June 2024)*

> *"You have to make it easier for them—very easy—so it doesn't become yet another problem for them… because they already have enough problems of their own."* *(....)*
> *"People don't trust things will work out. There have been very bad experiences with subsidies in the past." (City council member, August 2024)*

> *"Government paybacks are often delayed and applying for subsidies also require a large volume and highly technical paperwork. (...) To apply for Next Generation funds you need to upload 36 different documents! (...) The online application procedures are too complex for elderly groups and those with limited resources…(...) ("Oficina Verde" representative, workshop itdUPM 2023)*

> *(...)People don't want to get involved in renovations (...) even if you tell them it's for free… 'You're going to come into my home, I'll have to leave for a few months? No way." ("Oficina Verde" representative, workshop itdUPM 2023)*

Many homeowner communities remain skeptical due to past negative experiences with subsidy procedures, while vulnerable groups struggle with digital and administrative procedures that may favour populations with the resources and time to navigate the hurdles to access subsidy application and information, potentially exacerbating inequalities (Casanovas, Cuchí, Herrero et al., 2018).

Another cognitive burden that is relevant is the dominance of multifamily buildings in Spain and the need for collective decisions to be made.

> *"In Spain, people own apartments in multifamily buildings. And that means that building ownership is very fragmented. Multifamily property owners are very disorganized because there is no tradition of joint, cooperative management, or anything like that...*
>
> *So, what is the dynamic of these property owner communities who only act when*

> *there is an urgent need? When a balcony falls down, when the elevator stops working, when there are leaks—that's when they come together and take action. But energy efficiency is something more abstract. It's something with long-term implications, not short-term."*
>
> *(Housing Policy and Urban Planning Consultant from Barcelona; September, 2023)*

This statement not only reinforces the challenges of making collective decisions within multifamily buildings—the dominant residential model in the Spanish housing landscape—but also indicates that homeowners are more likely to act when disruptions require immediate attention.

Additionally, the majority of the current policies and funding strategies in Spain are often oriented towards distributing public funds to push retrofits on a "first come, first served" basis (Casanovas, Cuchí, Herrero et al., 2018)**.** An academic expert interviewed in this research emphasized that funding distribution strategies should focus on identifying specific areas of weakness within city boundaries to prioritize interventions effectively:

> *"It's not just about offering some subsidies and waiting to see who applies for them. If they (the government) don't have a thorough territorial assessment to tell each building where it needs to be in 2050, how much it will cost, the steps required, and how they are going to help these buildings get there, how can we expect progress? This would require shifting the model from 'I hand out subsidies' to a model of 'let's determine where your building needs to be: this is what I would call a strategic vision." (Academic expert, June 2024).*

Figure 5.11: Image of a building undergoing retrofit construction in Poblado de Orcasitas

(Photo August 2023)

- **General lack of information of the need for household energy retrofits and little knowledge of what they involve**

There is a general lack of awareness of what energy retrofits are about, what energy efficiency interventions mean and their potential benefits, as stated by a member of the "Oficina Verde":

> *"There is a huge lack of awareness about what energy efficiency in households actually means." ("Oficina Verde" member, July 2023)*

> *"We need to reflect on how we communicate things—that's clear. What people haven't fully grasped about renovations is that they improve comfort, even without heating. (...) Since the concept of thermal comfort isn't deeply ingrained, the information is instead*

focused on energy savings. And it's true that it takes a long time to get a return on an investment like this." (City Council member, August 2024)

Other interviewees who have been in contact with homeowner communities highlight the generalized lack of knowledge and information about what building insulation consists in, such as installing a SATE (*Exterior Wall Insulation System)*, changing windows, and covering air leaks.

"We've been meeting with homeowner associations with offers for renovation. We say, 'install a SATE.' We show images and say, 'We're going to install a ventilated facade here.' And they say, 'Excuse me, but what exactly is that? Can you explain it to us?' They have no idea of what a SATE is." (Energy utility representative, July 2023)

"There just isn't enough information. Put out announcements! Small ones. Explain what a SATE is so that people start becoming familiar with it... The administration should be responsible for that. These are topics that people don't understand." (Neighbourhood association representative, March 2024)

Figure 5.12: The SATE system (Exterior Thermal Insulation System) on a building under construction and another completed building in Poblado de Orcasitas

(Photos August 2023)

- **The lack of information and knowledge about energy retrofits also varies in different areas of the city.**

Knowledge about energy retrofits also varies across Madrid's 21 districts, as observed by the "Oficina Verde" through their temporary 3-month mobile office initiative in 2023 to bring information closer to districts and raise interest (see Annex II).

> *"There are also significant differences between neighbourhoods in terms of energy efficiency awareness. In Chamberí, Salamanca, and Chamartín, knowledge is very high, whereas in other neighbourhoods, it is not. Some residents struggled to understand what we were doing." ("Oficina Verde" member, July 2023)*

> *"What drives certain groups of people to make this change? Investing in your home has a symbolic value—the desire to modernize your home, for example… or, alternatively, you only renovate when something breaks and needs to be repaired. We need to address the symbolic factors that influence different groups of people in different places to retrofit… What motivates different groups of people to retrofit their homes to make them more energy efficient?" (City council member, December 2023)*

Despite there being varying degrees of knowledge levels regarding retrofitting across the city, the government relies on a "one-size-fits-all" outreach strategy through the "Oficina Verde" to raise awareness and provide information on the subsidy lines available.

> *[About "Oficina Verde"] "No one's going to go there… First of all, they will think: what am I supposed to find out? Subsidies okay, but what for? People don't even know what questions to ask." (Neighbourhood activist, August 2023)*

> *"The "Oficina Verde" does interesting work, but of course, they reach very few people ('llegan a cuatro gatos'). There are too few of them. If you set up an office every couple of blocks, it might be a different story. We need to look for other kinds of solutions. (...) The private sector usually faces resistance because residents think they are going to be scammed." (City council member, January 2024)*

Some interviewees argue that the "Oficina Verde" centralized approach is inadequate, particularly because it relies on citizens actively seeking out information. Given that most people have limited awareness of retrofitting programs and their benefits—and retrofitting is not a top priority for many Madrileños—there are significant barriers to participation.

To improve public awareness of these expanded funding opportunities, the "Oficina Verde" was launched as an outreach initiative. Despite these efforts, a widespread lack of understanding remains regarding the importance of energy efficiency, its urgency, the specific interventions required, and the necessary materials. Additionally, this general lack of knowledge and urgency varies significantly across different areas of the city.

We seek to map those operating closer to policy development networks (non place-based) as well as the actors who are place-based, working in specific districts, neighbourhoods and projects. Place-based intermediaries operate more closely with local communities and are better positioned to address the decisive human dimension factors that have been highlighted in the literature as an important barrier to energy renovations.

5.2.2. The role and influence of non-place-based intermediaries in the city of Madrid

5.2.2.1. itdUPM: The Technology Innovation Center for Development at Universidad Politécnica de Madrid

5.2.2.1.1 ItdUPM and Madrid City council: Learning through multi stakeholder collaborations: integrating social equity dimensions into Madrid's climate-neutrality Roadmap

The Technology Innovation Center for Development (itdUPM) is an interdisciplinary center based at the Polytechnic University of Madrid that functions as a university-based transition intermediary organization (Soberón et al., 2022). The center specializes in facilitating multi-stakeholder projects and promoting collaborative spaces that integrate interdisciplinary expertise through partnerships with public, private, and non-profit sectors on sustainable transitions. This study focuses on a participatory observation process that occurred during the participatory workshops that took place in Spring 2023 conducted by itdUPM during the process of revision of Madrid's Roadmap Towards Climate Neutrality, originally launched in 2019. In this project itdUPM collaborated with the Madrid City Council's Energy and Climate Change division towards integrating equity-focused lens to the revision of the roadmap to ensure that climate-neutral interventions in the building sector - one of the key sectors of intervention in Madrid's roadmap- could address social disparities more effectively.

Through participatory workshops involving municipal departments and non-profit organizations itdUPM facilitated networking and knowledge exchange between the City Council and non-profit organizations working on just transition frameworks in Madrid. The

initiative involved seven municipal departments, eleven nonprofit organizations, and six private companies (see Annex II). These workshops brought together these stakeholders to discuss diagnostic assessments of the current state of energy retrofit policies in Madrid, and promoted a collective visioning process to identify the social inequities arising from the current household retrofit policies. Members of the city council, including the "Oficina Verde", were in dialogue with non-profit organizations such as Oxfam Intermón, Save the Children, and EAPN (European Anti Poverty Network), who provided insights on energy poverty data and barriers to engage in retrofits in the city of Madrid. These discussions explored how climate-neutral policies could be implemented more equitably, providing insights on subsidy distribution, energy poverty, and social vulnerability. As a result, the City Council refined its approach to social equity in their climate-neutrality roadmap, leading to the publication of a revised Roadmap towards climate-neutrality in 2024 (Madrid City Council, 2024).

Figure 5.13: Workshop session at itdUPM

(Photos from May 2023)

5.2.2.1.2 itdUPM and the citiES platform: Enhancing learning through multi-level collaboration

Beyond Madrid, itdUPM extended its knowledge-sharing efforts through the CitiES platform. The CitiES 2030 platform in Spain facilitates knowledge exchange and collaborative learning among municipalities, helping cities develop and implement climate-neutral strategies. In 2023, the CitiES 2030 platform supported five pioneering cities—Madrid, Valencia, Valladolid, Vitoria-Gasteiz, and Zaragoza—in developing their Climate Agreements, with household renovation as a key area of intervention, in line with the Green Deal guidelines (European Commission, 2019b). These city agreements earned the European Commission's 'Mission Label,' recognition that enhances access to funding from national, regional, and EU sources, as well as private investments to implement climate-neutral interventions in cities.

ItdUPM's successful integration of just transition principles into Madrid's climate neutrality roadmap has created a valuable blueprint for other Spanish cities that are part of the CitiES 2030 platform in their efforts to embed social equity considerations into their newly launched climate contracts. Thanks to ItdUPM's role as a transition intermediary organization, municipal-level learnings from Madrid are shared across CitiES 2030 platform members, composed of Spanish cities' representatives, academic institutions, businesses, and civil society organizations working together toward climate neutrality. The CitiES platform has thus emerged as a mechanism for scaling Madrid's policy learnings across other Spanish cities participating in the platform.

One key initiative under itdUPM and CitiES 2030 intermediation activities and policy learning, is the annual summer course at UIMP that gathers 150 participants for 3 days —jointly organized by EIT Climate-KIC and itdUPM under the CitiES platform. Hosted by the Universidad Internacional Menéndez Pelayo (UIMP), this course creates a space for collaboration among academic institutions, businesses, and civil society organizations involved in the EU Mission in Spain (Ezquerra Lázaro, 2024). In 2023, the sessions of the course centered on household retrofit policies, with ItdUPM designing a workshop that leveraged Madrid's experience in addressing social equity challenges in climate-neutral policies. This approach deepened discussions and fostered valuable learning among other Mission Label municipalities. Since 2023, CitiES 2030 and ItdUPM have continuously facilitated cities' incorporation of social equity considerations into their climate contracts through regular work sessions and dynamic peer exchanges. This sustained engagement has cultivated a vibrant, evolving network of learning that remains active today. The ongoing knowledge transfer has empowered participating municipalities to implement more comprehensive revisions of their climate strategies, ensuring their climate-neutral policies achieve both environmental effectiveness and equity considerations.

Figure 5.14: Summer course UIMP: workshop session on retrofit policies and the social dimension for Spanish cities July 2023

Source: citiES Platform for Spanish Cities [17]

The revision process of the Madrid roadmap, led by itdUPM, presents an opportunity to strengthen feedback loops between policy design and on-the-ground implementation by integrating real-time data into decision-making and policy adjustments. Madrid's climate neutrality roadmap has incorporated social equity considerations into household retrofit policies, aiming to prevent the unequal distribution of benefits from energy efficiency programs managed by the municipality. These insights extend beyond Madrid, fostering valuable learning for other Spanish cities through CitiES 2030—a multi-level collaboration platform connecting local governments, businesses, and civil society. By fostering knowledge exchange and policy learning, CitiES 2030 helps ensure that best practices in retrofit strategies, social equity, and climate neutrality can be shared and adapted across different urban contexts. This knowledge exchange informs how climate-neutral policies in the building sector can be designed to achieve both environmental effectiveness and social equity simultaneously.

[17] See citiES website: https://cities2030.es/recursos/#curso-de-verano-2023

5.2.2.1.3 The partnership with University of Catalunya to promote data-driven strategies for building renovations

One interesting example of a collaboration with non-place based actors who are well positioned to collect granular data to assess the building stock is the collaboration between the Basque Country and the University of Catalunya. While Madrid lacks a comprehensive inventory of building data or systematic energy efficiency reporting, initiatives in the Basque Country demonstrate how university partnerships can support municipalities in generating detailed data. These efforts help map building conditions, assess renovation needs, and develop customized retrofit roadmaps. Collaborations, such as the partnership between the Basque government and the *Universidad Politécnica de Cataluña*, highlight the potential for universities to support public authorities in their data collection efforts, collecting granular data and target specific areas of intervention:

> *"You have to encourage them and to do so you need to go after them (...) That's a different approach from what's happening now. Instead of just waiting 'let's see who applies for it', you need to ensure that those who are in the worst conditions actually come forward." (Academic expert, June 2024)*

> *"This means working building by building, based on their rating. (..) Every building has an energy rating. How do you plan renovations to improve one rating level at a time? Since all buildings will eventually need to reach an 'A' rating, what's your step-by-step approach to gradually improve different systems to achieve this goal?"(Academic expert, June 2024)*

Still, developing detailed building-level roadmaps that outline necessary renovations and associated cost estimates for energy efficiency improvements require substantial teamwork and resources. In addition, using energy rating certificates to guide gradual, step-by-step renovation plans and reaching out to specific homeowner communities that have been mapped requires political will.

> *"But this demands more people…and this means, a lot of money, and more importantly it requires immense organization capacity" (Academic expert, June 2024)*

> *"Here's what we did for Basque Country. There, we developed a roadmap for each building, showing where it needs to be, how it can get there, the available options, costs, reductions—everything. (...) That is strategic planning. For each building, we have a draft of what its renovation passport should look like to reach 2050. (...) Then you need to actively seek out building owners and tell them: 'I'm offering you this financial aid,*

but only because you need to reach this and that specific intervention in your particular building.' (Academic expert, June 2024)

5.2.2.2. Iberdrola, the energy utility

Iberdrola is Spain's largest utility company, in charge of producing, distributing and commercializing electricity services. Iberdrola has established an increasingly prominent role in Spain's household energy retrofit sector since the expansion of regulations and policy support following the European Green Deal (2019) and the deployment of economic recovery funds Next Generation (2021). Since 2022, Iberdrola has become involved in household energy retrofit projects by launching operations as a delegated developer that manages subsidy applications and managing renovation processes.[18]

Iberdrola, as a delegated developer ("*promotor delegado"*), usually does not work directly with homeowner communities. They primarily rely on partnerships with architects and construction firms, who they hire to carry on projects with communities. Despite possessing detailed building-level electricity consumption data, they don't target specific areas in the cities in which they operate, including Madrid. They leverage their financial capacity to advance the necessary funds and hire architects and builders to streamline retrofit works of insulation and equipment replacement on behalf of homeowner communities.

"These subsidies are essential to encourage people to take advantage and use this funding to carry on these improvements. We (Iberdrola) are the first ones to be interested in electrifying massively… and these subsidies are a unique opportunity to support decarbonization, aren't they?" (Iberdrola representative, July 2023)

They operate under a long-term vision, understanding that energy efficiency rules will be stricter or even mandatory in the next few years -they aim to position themselves as a key player in this evolving market-and they argue they are in a good position to ease the financial burden this represents for many homeowner communities: they can facilitate upfront costs and the management of retrofit works undertaken.

"That financial burden, potential upfront payments can discourage many homeowner communities to begin (...) We can take advantage of our financial capacity as a big company, our liquidity, to step in and take on these projects." (Iberdrola representative, January 2024)

[18] See: https://www.iberdrola.es/homeowners-associations/electricity/energy-rehabilitation , last accessed on March 27, 2025

> *"Energy retrofits are important because we have in mind that, in a few years, all the energy efficiency regulations coming from Europe will eventually require buildings—whether in five, six, ten, or fifteen years, or whatever the timeline may be—to present energy efficiency improvements. If they don't, these homeowners will face major limitations when it comes to transferring, selling, or managing their property." (Iberdrola representative, January 2024)*

They do point out that they do face a resistance in certain homeowner communities', who feel distrust when seeing a market player behind this, and they argue that promoting household energy retrofits is aligned with their core business, now focused on scaling up electrification in the areas they provide electricity to in the country:

> *"Iberdrola's ultimate goal is decarbonization and, therefore, electrification. The more you (Iberdrola) electrify, the more you produce electricity, the more you distribute, the more you sell, and the more you commercialize right?" (Iberdrola representative, February 2025)*

Iberdrola's involvement in retrofits has grown in response to policy shifts, yet its direct impact remains relatively small, with only 43 projects completed nationwide since 2022. Indeed, their approach remains primarily driven by long-term electrification goals rather than maximizing the volume of household energy retrofits. Their growing influence in the sector has positioned them as active participants in discussions on building regulatory changes. In particular, they are now part of the discussion surrounding the revision of the planning regulations of the municipality of Madrid ("*Plan General de Ordenación de Madrid*") in which they advocate for easing urban planning restrictions to facilitate the installation of aerothermal equipment on building facades.

5.2.2.3. The "Oficina Verde": the city council information hub

The "Oficina Verde" was established in 2021 to bridge the information gap surrounding household energy retrofit processes and subsidies, a need that became even more critical with the increased allocation of public funds aimed at accelerating implementation (Madrid City Council, 2019a). The "Oficina Verde" functions as an information hub within the City Council, located on Calle Bustamante, and is open to walk-ins from the general public. It serves as a first point of contact for residents and building professionals seeking guidance on renovation processes and available funding sources. By addressing questions such as *"Where do I begin?"*, the "Oficina Verde" was established in 2021 to bridge the information gap on retrofits. They organize weekly informational sessions (in person and online) to connect building professionals

and raise awareness to the public in general about public subsidies, with recordings accessible online in their webpage.

Based in a single location, the office relies on partnerships to increase their reach. With a team of only four people in central Madrid, it extends its impact across districts and neighbourhoods through these partnerships rather than adopting a decentralized structure of neighbourhood offices distributed in the city:

> *"Neighbourhood offices ("oficinas de barrio")? No, we don't have the kind of structure in which an office remains on a specific street for, like, two years, assisting residents and guiding them through the entire application process until the final paperwork is completed"("Oficina Verde" representative, July 2023).*

> *"Because we are just one office, we rely heavily on public-private collaborations: we usually refer our visitors to the Institute of Architects of Madrid (COAM) or to the Architectural Technicians Association… In these professional institutions, they can provide a list of certified architects who can provide the work of a "retrofit agent" ("Oficina Verde" representative, July 2023)"*

Figure 5.15: The "Oficina Verde" Office

(Photo from July 2023)

The role of retrofit agents ("*Agente Rehabilitador*"), as mentioned in the interview, emerged in 2020 to address the office's limited territorial reach. Relying on public-private partnerships, "Oficina Verde" focuses on providing information, while retrofit agents offer direct support to homeowner communities by managing subsidy applications and overseeing renovation processes.

As a part of this public-private partnership model, the "Oficina Verde" directs visitors to the Institute of Architects of Madrid ("*Colegio Oficial de Arquitectos de Madrid*," *COAM*) for recommendations on qualified architects or building professionals who can serve as rehabilitation agents. While COAM is qualified to provide certified recommendations, they highlight that the lack of legal requirements and regulations regarding the role and obligations of retrofit agents allows anyone to enter the market, posing risks for homeowner communities to receive an inconsistent quality of service:

> *"It's a role that hasn't been regulated here in Madrid. Anyone can be a rehabilitation agent and you don't need any registration, any qualification. (...) regarding subsidies, what we're seeing, is that to install a SATE to insulate a facade, the architects that are involved are not necessarily certified by the Architectural institute of professionals" (Madrid Institute of Architects member, January 2024)*

> *"I think it can get very unprofessional because people have been spending money, trusting that these rehabilitation agents would manage it for them, and now they find themselves abandoned (...). After all, they are not regulated… There are neighbours who call: 'Hey, about my window. They installed them. They promised they would manage the subsidy for me and I haven't heard anything from them."(Madrid Institute of Architects member, January 2024)*

The interview highlights the lack of formal regulation for this role, leading to inconsistencies in service delivery, potentially leaving homeowner communities vulnerable to inadequate technical expertise and unreliable support for their renovation projects.

5.2.2.4. The "Oficina de Rehabilitación COAM": the information hub of the Madrid Insistute of Architects

The Madrid Institute of Architects (COAM) is a professional organization that supports architects in Madrid by providing information, networking and advisory services. Since 2022, they have operated an information office "Oficina de Rehabilitación COAM" with a team of 6 professionals, funded through Next Generation funds via the regional government:

> *"Our office here at COAM only exists because of the subsidies. That is, we are sustained by Next Generation funds since 2022. Same for the Architectural technicians institute."* (*Madrid Institute of Architects member*, January 2024)

The "Oficina de Rehabilitación COAM" is located at the professional institute headquarters, in the city center. The office organizes informational sessions and networking events with architects of the institute and other building professionals, disseminating information on the subsidy lines available and tax benefits for energy retrofits:

> *"Speaking to the general public is very difficult from a professional association, but with our members, yes, definitely. We've held sessions for our members, talking about the benefits, the opportunity of subsidy lines available..."* (*Madrid Institute of Architects member*, January 2024)

COAM also offers in-person consultations twice a week by appointment to provide guidance to building professionals seeking to navigate subsidies and tax exemption options they can offer to their clients who undergo retrofits. They report having more visits from building professionals and architects rather than homeowner communities which are harder to reach from their intermediary position. As a result, their influence is rather stronger in connecting building professionals in the sector rather than engaging and advising homeowner communities directly.

5.2.3. The role and influence of place-based intermediaries in the city of Madrid

5.2.3.1. Neighbourhood associations (Ciudad los Angeles, Orcasitas and Aluche neighbourhoods)

Neighbourhood associations are community-based organizations that advocate for residents' interests before authorities and other organizations. Their efforts play a crucial role in fostering social cohesion within neighbourhoods, promoting g cultural, sports, and social activities for residents. They work to enhance local infrastructure and services. These associations rely on active resident participation, with members contributing a fee to support their initiatives. This study examined four neighbourhood associations operating in the three areas identified with a higher demand for energy efficiency subsidies: *ASVEYCO* (Ciudad Los Ángeles), *Asociación Vecinos de Puerto Chico* (Aluche), *Asociación Vecinos Aluche - AVA* (Aluche), and *Asociación Vecinos Guetaría* (Poblado de Orcasitas).

5.2.3.1.1 Promoting social cohesion activities and ongoing community engagement

In Madrid, the role and influence of neighbourhood associations vary significantly across the three neighbourhoods analysed: Ciudad Los Ángeles, Orcasitas, and Aluche. While the Orcasitas neighbourhood association has played a pivotal role in driving demand for energy efficiency subsidies, the same cannot be said for Ciudad Los Ángeles and Aluche, where retrofit initiatives have largely been led by homeowner communities rather than neighbourhood associations. The perception that neighbourhood associations are more focused on social cohesion activities in the neighbourhood is highlighted by an interviewee, working in a construction company working in the Southern zone of Madrid:

> *"In the district of La Latina, which is in Aluche or Campamento, it's the same. All the associations are just that, Cultural Association of Flamenco, Cultural Association of whatever, but there isn't a neighbourhood association, there isn't a leadership like the one in Poblado de Orcasitas anywhere."" (Local construction company, November 2024)*

> *"There are neighbourhood associations, many of them (...). But their collective effort is focused on cultural matters, that is, for example group excursions... Dance classes, language classes, and teaching Spanish to immigrants. Not on a social policy for neighbourhood improvement. (...) They're more oriented toward education, toward training..." (Local construction company, November 2024)*

Figure 5.16: Entrance desk showcasing the social cohesion activities promoted by the Neighbourhood association of Puerto Chico in Aluche neighbourhood

(Photos Jan. 2025)