TUDelft

Delft University of Technology

RE-DWELL Towards a Transdisciplinary Environment for Affordable and Sustainable Housing
Deliverable 4.6

Diaconu, A.; Elsinga, M.G.; Haffner, M.E.A.; Sentieri, C.

Important note
To cite this publication, please use the final published version (if applicable).
Please check the document version above.

Towards a Transdisciplinary Environment for Affordable and Sustainable Housing

Deliverable 4.6

Lead Beneficiary: TUD

Date: September 30, 2024 (month 48)

Submission date: November 22, 2024

Version: 1

Dissemination level: Public

RE-DWELL

Deliverable 4.6 . Towards a Transdisciplinary Environment for Affordable and Sustainable Housing

Coordinator:

Marja Elsinga (TUD)

Authors:

Adriana Diaconu (UGA)

Marja Elsinga (TUD)

Marietta Haffner (TUD)

Carla Sentieri (UPV)

Version	Date	Authors
0.1	May 2, 2024	Adriana Diaconu (UGA), Marja Elsinga (TUD), Marietta Haffner (TUD), Carla Sentieri (UPV)
0.2	August 9, 2024	Adriana Diaconu (UGA), Marja Elsinga (TUD), Marietta Haffner (TUD), Carla Sentieri (UPV)
0.3	September 24, 2024	Adriana Diaconu (UGA), Marja Elsinga (TUD), Marietta Haffner (TUD), Carla Sentieri (UPV)
0.4	November 11, 2024	Adriana Diaconu (UGA), Marja Elsinga (TUD), Marietta Haffner (TUD), Carla Sentieri (UPV)
0.5	November 13, 2024	Leandro Madrazo (La Salle-URL) - review and editing
0.6	November 19, 2024	Adriana Diaconu (UGA), Marja Elsinga (TUD), Marietta Haffner (TUD), Carla Sentieri (UPV)
1.0	November 21, 2024	Leandro Madrazo (FUNITEC) - review and editing

Table of contents

Executive summary

This report presents the Transdisciplinary Environment for Affordable and Sustainable Housing (TEASH) developed in the three-year activity of the RE-DWELL network. Together with Deliverables 4.1-4.5 and 4.7, it represents the work done in the project to create a transdisciplinary learning and research environment spanning over academia, research and practice.

Housing affordability and sustainability are key issues in contemporary societal and policy debates. Affordability relates to social justice and welfare policies across Europe, while sustainability also addresses the urgent need for energy transition and climate change action, influencing policies continent-wide. Housing functions simultaneously as a human right, a physical structure, and an economic asset. As such, it intersects with various academic disciplines—including sociology, architecture, and economics—and spans multiple policy areas, such as welfare, urban planning, environmental and economic policy. Affordable and sustainable housing presents a "wicked problem," difficult to define and solve due to its complexity. It involves numerous factors—economic conditions, public policies, social dynamics, and environmental concerns—and multiple stakeholders. Residents, government bodies, developers, and cooperatives each have their own priorities and views on what constitutes "affordable" or "sustainable" housing.

A transdisciplinary approach is well-suited to addressing the complex challenge of providing affordable and sustainable housing. The systematic integration of academia and practice is achieved by applying three types of knowledge identified by the Zurich School for Transdisciplinarity: target, systems, and transformation knowledge. By distinguishing these types of knowledge, academic research outcomes (system) can be aligned with a desired normative direction (target) and connected to the practice and policy mechanisms (transformation) necessary for change. Contributing to transformative change also requires specific competencies—such as reflexivity regarding one's own values and the ability to co-frame complex problems—to effectively collaborate within transdisciplinary teams. Reflecting on the boundaries of one's expertise and transforming these into connections with other experts, both in academia and practice, is essential for co-creating a deep understanding of the complexities surrounding affordable and sustainable housing. Such understanding is a prerequisite for transformative change.

The purpose of RE-DWELL is to train a new generation of professionals and academics equipped with the competencies needed to contribute to transformative change in the provision of affordable and sustainable housing. RE-DWELL courses, collaborative activities, secondments in various organizations, and the co-development of tools are all focused on building these competencies.

To promote understanding and knowledge exchange across disciplines, as well as between academia and practice, the following tools have been developed and implemented in the network training and research activities:

- **A vocabulary** (presented in Deliverable 4.4) which comprises definitions of main concepts used by ESRs in their PhD thesis. It summarises their academic literature reviews from different disciplinary and multidisciplinary perspectives.

- **A case library** (presented in Deliverable 4.5) made of short analytical presentations of good examples of practice. It is composed of four categories: buildings and designs, participatory and learning processes, policy and financing and urban planning and regulations.

- **A toolbox for knowledge construction and exchange** among academics and housing practitioners and policy-makers implemented in local settings (as described in Deliverable 4.7).

The transdisciplinary learning and research environment built collaboratively throughout the project has been structured and systematized retrospectively to facilitate its understanding and future replication. The Transdisciplinary Environment for Affordable and Sustainable Housing (TEASH) is composed of four layers:

1. **Crossing disciplines**, necessary to understand the challenges and trade-offs at stake, to identify strategies across disciplines and fields (see Deliverables 4.1, 4.2 and 4.3)

2. **Linking academia and society**, to collaboratively construct knowledge around specific housing problems, based on a tripartite structure: target, systems, and transformation knowledge.

3. **Exchanging knowledge,** by means of tools and methods aimed at fostering the collaboration of the diverse stakeholders involved, experts and non-experts

4. **Building impact,** creating outputs -white papers, guidelines, policy recommendations, academic publications- that facilitate a better understanding of the specific challenges that the various stakeholder involved are facing.

To provide a comprehensive overview of the work undertaken and its implications for researchers, academics, and practitioners within the RE-DWELL network, the report summarizes the challenges of affordable and sustainable housing, the core principles of transdisciplinary research, the activities carried out to foster knowledge exchange between researchers and practitioners, examples of assessment frameworks emerging from a transdisciplinary approach to affordable and sustainable housing, and the insights gained from the collective experience.

1. Purpose and structure of the report

While the need for affordable housing that is also sustainable is widely acknowledged, the way to achieve this remains a complex issue. Its complexity is given by:

- The multiple dimensions and challenges of housing which set different agendas for different stakeholders (such as human rights activists, developers and investors, landlords, local authorities and central governments, as well as homeowners, tenants, or people searching for a home), but also different disciplinary approaches and research foci (e.g. for economists, sociologists, political scientists, architects, engineers, etc.).
- The multiple scales of housing projects and policies, from the local to the European levels, the differences between these contexts in terms of regulations, policies and strategies. These differences are also determined by the path-dependence of political traditions and institutional arrangements.

Because of these specific features, researchers have described housing problems as complex or "wicked problems" (Jonsson et al., 2021; Rittel, 1973). The term was first used by Rittel (1973) to describe social policy and planning issues that involve a variety of institutions and individual actors with their own views and interests and "complex relationships, including a web of variables that directly or indirectly affect each other in an intricate way" (Jonsson et al., 2021, p. 3). Moreover, what makes a problem "wicked" is uncertainty and the fact that it does not have a single solution "but only the best possible solution at any particular time" (Ibid.). Housing challenges are interwoven with globalised economic and financial logics that go beyond the intervention level of local or national authorities. They are also determined by dominant habits, cultures and representations (e.g. the ideal of home ownership as a means of social accomplishment) that are highly inertial. For these reasons, changing ways of doing things, introducing new ideas, models of practice and public policies is particularly difficult and can have unexpected or perverse effects.

The RE-DWELL programme hypotheses that the creation of a transdisciplinary training environment for early-stage researchers (ESRs) and of tools for collaboration with professional partners can initiate change in housing systems towards the development of more affordable and sustainable solutions. Such transformative impact can stem from research-based decision-making, but also from new ways of thinking about housing issues and from new alliances between stakeholders, beneficiaries and academics. The aim is to identify and clarify different perspectives and values of academics and practitioners, in order to create mutual understanding. To achieve this, the RE-DWELL programme provided a suitable learning and research environment, through the training of early-stage researchers and through tools for knowledge exchange between them and with non-academic stakeholders.

This report presents the construction of a Transdisciplinary Environment for Affordable and Sustainable Housing (TEASH) as a process of defining and assembling a series of building blocks. It shows how these building blocks have been co-created as part of various training and networking activities throughout the RE-DWELL journey, based on contributions from early-career researchers, academic supervisors and partners from

practice and using the existing academic literature. Since this was not an easy or straightforward process, a number of challenges appeared along the way:

- **Understanding across disciplines**: The 15 ESRs, coming from diverse fields such as architecture, planning, and the social sciences, had to engage in dialogues across various disciplines but also with practitioners of different backgrounds.
- **Linking academia with society and being relevant for both**: Norms, approaches and research interests diverge not only between different academic disciplines but also between academia and practice.
- **Facilitating knowledge exchange between academia and practice and between different European contexts:** This could only be achieved by understanding the needs and motivations of partner organisations, which operate at different levels and scales, whether local, national or international.

Throughout the RE-DWELL journey these challenges have been addressed and turned into milestones for the construction of TEASH. Through courses, collaborative activities and secondments in different organisations, ESRs acquired the necessary knowledge and skills for understanding the specificities of local and national contexts and adapting to them. Moreover, several tools have been created for facilitating understanding, knowledge exchange between disciplines and between academia and practice:

- **A vocabulary** (presented in Deliverable 4.4) which comprises definitions of main concepts used by ESRs in their PhD thesis. It summarises their academic literature reviews from different disciplinary and multidisciplinary perspectives.
- **A case library** (presented in Deliverable 4.5) made of short analytical presentations of good examples of practice. It is composed of four categories: buildings and designs, participatory and learning processes, policy and financing and urban planning and regulations.
- **A toolbox for knowledge construction and exchange** among academics and housing practitioners and policy-makers implemented in several local settings (as described in Deliverable 4.7).

Since the aim of the project was to create a learning and research environment to address the "wicked problem" of affordable and sustainable housing, Chapter 2 starts by defining key concepts such as housing, affordability and sustainability, along with the various dimensions involved, drawing on academic literature. The chapter outlines the foundational premises of a comprehensive approach that is necessary to tackle housing affordability and sustainability—one that embraces multiple realms and discourses.

In Chapter 3, this approach is further developed through the introduction of the notion of transdisciplinarity. While showing that the concept itself is not new, the chapter highlights different ways in which transdisciplinarity has been understood since the 1970s and explores various aspects of its implementation from a theoretical point of view. Since its practical application remains challenging, the chapter addresses the hurdles to overcome and the key concepts selected for creating the TEASH, building on the work of the Zurich school (Pohl & Hadorn, 2007).

As transdisciplinarity principles were first translated in the training of the 15 early-stage researchers, Chapter 4 outlines the various training activities and consortium events. The innovative training network included summer schools, workshops and conferences. This collaborative work and the lessons learned contributed to the creation of a transdisciplinary environment for affordable sustainable housing. However, an additional element was needed to bridge the gap between academic approaches and practice-based perspectives on relevant research questions and agendas.

To address this gap, Chapter 5 focuses on the perspectives of the non-academic partners from practice and policy. It explores why these partners are eager to collaborate with academia in their pursuit of a better understanding of major housing challenges, as well as for solutions to everyday problems. By hosting ESRs during secondments, these partners provided the young researchers with the opportunity to understand current housing challenges of affordability and sustainability in real-world settings. This chapter presents examples of complex problems put forward by the RE-DWELL partners, as well as the various levels and interrelated aspects that make these problems "wicked".

In order to meet the needs of partners, a study has been conducted on existing tools for guiding the provision of affordable and sustainable housing through a systematic approach that integrates multiple perspectives. Based on a literature review, Chapter 6 provides an overview of so-called "multistakeholder frameworks" designed to support decision-making in the field. The analysis reveals that it is not possible to develop a single framework that can assess all types of initiatives. The key lesson learned is that clarifying different dimensions and perspectives supports fruitful knowledge exchange between stakeholders.

Building on this overview, Chapter 7 presents the foundational building blocks for the construction of the RE-DWELL transdisciplinary environment. These blocks are based on the different perspectives gathered from training activities, exchanges with partners, and the literature reviews, while also considering the challenges raised by ESRs and partners. These components together form the different layers for the construction of a Transdisciplinary Environment for Affordable and Sustainable Housing (TEASH).

Finally, Chapter 8 presents the reflections from early-stage researchers on their experience with transdisciplinarity. It brings forward the divergence between academic norms across different disciplinary perspectives and how these differences were confronted in concrete situations during the network activities. These reflections conclude the presentation of the process of building the transdisciplinary training environment, as they outline the challenges faced and the strategies used to overcome them through mutual understanding and learning.

2. Key Concepts

Complexity and uncertainty are key characteristics of the "wicked problem" of affordable and sustainable housing. The "wickedness" is particularly complex because of the tensions between the two in practical situations; for example, when resources are scarce, and, more fundamentally, when they belong to different domains and discourses. This chapter explores these key concepts of housing, affordability (Section 2.2), and sustainability (Section 2.3), beginning with an introduction to the frequently discussed dimensions of housing—the physical, the social and the economic—and their associated disciplines and policy areas.

2.1. Physical, social and economic dimensions of housing

Housing included in the United Nations Sustainable Development Goals. As such it has been considered a basic need and a human right since the 1948 United Nations Universal Declaration of Human rights. Adequate housing for all citizens is key, not only for the welfare of human beings, but also for the sustainability of societies and of economies; therefore, housing is core of many strategies for development. In this sense housing can be regarded as a social investment delivering benefits to society (Haffner & Elsinga, 2018).

An "investment" requires the balancing of costs and benefits. Balancing is also required among the three dimensions of housing known as physical, social, and economic, and that are elaborated further in this section. These dimensions signal involvement in providing affordable and sustainable housing of multiple disciplines, as also reflected in the three pillars defined in the RE-DWELL programme: Design, Planning, and Building (Deliverable 4.1), Community Participation (Deliverable 4.2) and Policy and Financing (Deliverable 4.3).

Physical: dwelling and neighbourhood

A dwelling refers to the physical structure or building where people live and carry out their daily activities. A dwelling comes in various forms, such as single-family units including terraced housing and stand-alone dwellings, as well as multi-family units, such as apartments and condominiums. The type of dwelling that a person chooses to live in depends on their lifestyle, budget, and preferences (Beer & Faulkner, 2011).

When interpreted as a land-use organising principle, housing will be concerned with steering the land-use development, taking into account its relationship with other land-use claims (Iglesias, 2008). This interpretation looks particularly relevant in planning policies that aim to address environmental challenges. Limiting the consumption of new green land, for example, will contribute to reduced biodiversity loss.

The physical dimension of housing appears relevant to spatial planning and urban renewal at different geographic levels: national, regional, neighbourhood, and building. Furthermore, environmental, energy and circular economy policies will affect the design of the physical dimension of housing. In addition to urban planning (e.g., resilient neighbourhoods, undivided cities), other disciplines will be involved, including engineering (e.g., building retrofitting), architecture (e.g., design and construction), environmental

sciences (e.g., circular environments), policy sciences (e.g., green transitions), and economics (e.g., transaction costs and business models). On the other hand, when housing is considered a tool for creating social order, it will affect settlement patterns in neighbourhoods; therefore, it will also influence the social dimension of housing, which is the topic of the next section.

Social: basic need and human right

From a social perspective, a dwelling is considered an essential aspect of human life, fulfilling one of the basic human needs. As the place where people live and carry out their daily activities, housing provides shelter, security, privacy, and comfort to individuals and families. In addition to providing such safe and comfortable shelter, housing serves as a "home" and has a significant impact on an individual's physical and mental well-being. When housing is regarded as a human right, investing in adequate housing is seen as investing in human development (United Nations, 2009). Iglesias (2008, p. 5) connects housing as a human right to "proper human development" in the following way:

> "The Housing as a Human Right ethic contends that adequate, safe and affordable housing is critical to proper human development. Such housing enables individuals to be healthy, to take advantage of educational opportunities, to be productive members of the workforce, and to form nurturing families."

This social dimension of housing is studied across various disciplines, including law (e.g., human rights), social policy (e.g., welfare models), sociology (e.g., access to housing, housing inequalities), and social geography (e.g., segregation and gentrification).

Economic: investment and consumption good

Housing is not only a utility and an everyday necessity, but also a financial investment. Housing is called residential real estate by professional investors when it is part of the real estate portfolio. For individual households, buying a house is considered as a way of equity building and is often considered as a pension, a nest egg (Doling & Elsinga, 2012). The role of housing as an economic good directs attention also to the market provision of most housing production and consumption. As such, housing has been referred to as the 'wobbly pillar' of the welfare state (Torgerson, 1987). In line with this reasoning, housing is regarded as an investment, asset, or commodity that requires financing and delivers income to the investor, which the consumer generates by paying rent or imputed rent (Poterba, 1984; Wetzstein, 2017; Haffner & Hulse, 2021).

The economic dimension of housing is studied by academic disciplines such as economics, business sciences, policy sciences, sociology, law (e.g., property rights) and engineering. It is also relevant for housing policies (e.g., affordable and social housing), construction policies (e.g., continuity in the industry), economic policies (e.g., housing as driver of the economy) and tax policy (e.g., taxing investment and consumption).

2.2. Housing affordability

The Housing Partnership (2018, pp. 5, 11) defined affordable housing in the Urban Agenda of the EU as housing in the range between emergency housing and market housing. According to this definition, affordable housing includes "social, public and municipal housing, affordable rental housing, affordable cooperative housing, and affordable home ownership." This definition highlights that housing, in itself, must be affordable.

"Affordability of housing," however, is broader than "affordable housing", as it expresses the outcomes of policies affecting housing residents—is the housing affordable?—regardless of whether the housing is specifically designated by policy as "affordable housing." The policies interact also with market forces to produce outcomes; the concept of housing affordability focuses on the ability to pay for housing. To assess whether housing is affordable or unaffordable, a benchmark is required. Affordability assessments typically compare the resident's housing costs to their income. Furthermore, a broader evaluation framework also includes assessing the quality of the housing in relation to its costs. This benchmarking allows for a statement whether the housing is affordable for its residents and of adequate quality, considering the relevant institutional context and associated standard of living (Maclennan & Williams, 1990).

For several decades, research on the assessment of housing affordability based on housing costs (and quality), has been expanded to a broader vulnerability assessment of the resident, particularly in terms of poverty: whether housing costs push the resident into poverty, a phenomenon referred to as "shelter poverty" by Stone (1998; 2006; Stone et al., 2011) and "housing-induced poverty" by Diaz McConnell (2012) (see overview provided by Haffner & Hulse, 2021). In this vulnerability context, the question arises: do living costs also encompass housing costs? (Valderrama et al., 2023). In this regard, direct links between income poverty and material deprivation have been examined (Fusco et al., 2011). Furthermore, Salama (2011) broadened the framework for affordable housing to include lifestyle factors—such as status, work, and culture/values/attitudes—while also taking into account place attachment and home appropriation.

2.3. Housing sustainability

Similar to housing affordability, the question arises regarding sustainable housing, as outlined in SDG 11.1, and housing sustainability. Is the latter to be considered a broader concept than the former? Sustainable housing is typically defined by three dimensions: environmental, social, and economic (Mensah, 2019; James, 2015; Ibem & Azuh, 2011; Parris & Kates, 2003). These three dimensions are rooted in the Brundtland Report's definition of sustainable development (Ibem & Azuh, 2011, p. 26; Brundtland, 1987).The dimensions—also referred to as pillars or domains—may have different names and potentially (slightly) different content depending on the context. For example, the OECD (2021) identifies key dimensions for housing policies as inclusion, (environmental) sustainability, and efficiency. Sustainable housing and housing may then be used interchangeably.

Environmental sustainability (also referred to as ecological sustainability) includes indicators such as housing standards and quality, as well as housing availability criteria, as developed in the extensive literature review by Ezennia and Hoskara (2018). The social dimension refers to neighbourhood qualities, social cohesion, access to facilities, and

employment opportunities, among others. Economic sustainability primarily focuses on indicators of affordability and mortgage finance.

Including different dimensions in the form of different criteria, attributes, or subdomains can make the performance measurement of housing more diffuse, as each sustainability dimension may represent different objectives that may not always align with each other (Randolph et al., 2007; see also Mensah, 2019; Arman et al., 2009a; OECD, 2021). A clear example, which underscores one of the reasons for the existence of the RE-DWELL programme, is the need for negotiations and trade-offs. For instance, investments in environmentally friendly housing may not always contribute to the affordability of the same housing. More generally stated:

> "Although the inter-relationships between, for example, the economic, social and environmental spheres of development are well documented, there are many pragmatic challenges in holding these tensions in balance and progressing toward a sustainable future (Arman [et al.], 2009a)" (Pullen et al., 2010, p. 52).

In addition to the three core dimensions or pillars of sustainability, which may be slightly varied in their perception or definition (e.g., "society" rather than "social"; Mensah, 2019), the very definition of sustainability itself adds complexity. Definitions range from the literal concept of "the capacity to maintain some entity, outcome, or process over time" (Mensah, 2019, p. 5, based on Basiago, 1999) to more specific interpretations, such as balancing the needs of current and future generations in terms of sustainability dimensions and human well-being. Furthermore, the field of study (e.g., housing, real estate, energy, climate) or the specific activity (e.g., living, building, developing) will influence how the framework is designed to address the unique requirements for balance. Sustainable housing must not only generate positive external effects in the present but also in the future. It will need to fulfil a range of requirements, as stated in a report for the United Nations (Figure 2.1)

> "Sustainable housing offers a great spectrum of opportunities to promote economic development, environmental stewardship, quality of life and social equality, while mitigating the precarious convergences of the problems related to population growth, urbanisation, slums, poverty, climate change, lack of access to sustainable energy, and economic uncertainty" (Golubchikov & Badyina, 2012, p. 6).

BOX 3: SUSTAINABLE HOUSES

Sustainable houses are those that are designed, built and managed as:

- Healthy, durable, safe and secure,
- Affordable for the whole spectrum of incomes,
- Using ecological low-energy and affordable building materials and technology,
- Resilient to sustain potential natural disasters and climatic impacts,
- Connected to decent, safe and affordable energy, water, sanitation and recycling facilities,
- Using energy and water most efficiently and equipped with certain on-site renewable energy generation and water recycling capabilities,
- Not polluting the environment and protected from external pollutions,
- Well connected to jobs, shops, health- and child-care, education and other services,
- Properly integrated into, and enhancing, the social, cultural and economic fabric of the local neighbourhood and the wider urban areas,
- Properly run and maintained, timely renovated and retrofitted.

Figure 2.1. Characteristics of sustainable housing (Golubchikov & Badyina, 2012, p. 9)

The time dimension embedded in the criterion of the welfare of future generations in the definition of sustainability invites the use of the concept of sustainable development. However, sustainable development itself is defined in many ways, leading to a "plurality of purpose … and … the confusion of terminology, data and methods of measurement" (Parris & Kates, 2003, p. 23). Not surprisingly, Parris and Kates (2003, p. 23) concluded for the "emergent sustainability science … [that] …. Yet to date, there are no indicator sets that are universally accepted, backed by compelling theory, rigorous data collection and analysis, and influential in policy".

James (2015) may be an exception to the claim of missing theory in the field, as outlined in the book *Urban Sustainability in Theory and Practice* (p. xvi). The preface explains that the book applies an "Engaged Theory approach" to develop the "Circles of Sustainability" method. This method was created in collaboration with UN-Habitat and other partners for the United Nations Global Compact Cities Programme, known as Metropolis, and led by Josep Roig. The Circles of Sustainability method is visually represented as a circle divided into four domains: politics, culture, economics, and ecology, with each domain further divided into seven subdomains (p. xii). For instance, within the political domain, subdomains like "Organisation & Governance" and "Ethics & Accountability" are included. Each subdomain is assessed on a nine-point scale, ranging from "critical" to "vibrant sustainability."

Given the multitude of sustainability and sustainable development indicators, achieving consensus on how to measure sustainability performance, including housing sustainability, remains a significant challenge. Decision-makers face the difficult task of balancing competing aims and indicators, particularly when it comes to allocating scarce resources. This requires making decisions that weigh both urgency and fairness. Arman et al. (2009a, p. 3034) capture this challenge with the statement: "Sustainability is one of the

most contested ideologies of our time because everyone acknowledges that it must occur but no one can agree on what needs to change in response."

2.4. Conclusion

This chapter lays the foundation for understanding three core RE-DWELL concepts: housing—in its physical, social and economic dimensions—, affordable housing, and sustainable housing. While the specific definitions of these concepts depend on the aims of housing policies and the context, two key conclusions can be drawn. First, housing affordability and sustainability can be interpreted as broader concepts than affordable housing and sustainable housing, although in the case of sustainable housing the difference can be considered as more diffuse. Second, housing affordability fits within the financial or economic dimension of sustainability. The diversity of these dimensions and indicators provides a promising starting point for engaging with the concept of transdisciplinarity in the next chapter. By systematically analysing complex problems and solutions, these dimensions and indicators facilitate conversation among relevant actors and their contributions.

3. A transdisciplinary approach to housing

As discussed in the previous chapter, the provision of affordable and sustainable housing must be viewed as a "complex societal problem." Housing affordability and sustainability are central topics in distinct societal and policy debates: affordability concerns social justice and welfare policies across Europe, while sustainability focuses on the urgency of the energy transition and climate change, influencing policies throughout the continent. Housing serves as a human right, a physical structure, and an economic good simultaneously. Housing affordability and housing sustainability are topics of different strands of societal and policy debates: the first one dealing with social justice and welfare policies, the second with the energy transition and climate change policies across Europe. In other words, housing crosses a range of academic disciplines—such as sociology, architecture, and economics—and spans various policy fields, including welfare policies, urban planning, and environmental and economic policy.

The complex issue of affordable and sustainable housing can be addressed through a "transdisciplinary approach," which not only combines (multi) and intertwines (inter)integrates multiple scientific disciplines but also actively involves practitioners in defining research problems and identifying strategies for solutions. As Salama and Alshuwaikhat (2006) noted, "Affordable housing can be viewed as a web of influences and inter-relationships of a wide spectrum of issues, reflecting the transdisciplinary nature of sustainable affordable housing investigation or development." Transdisciplinary research begins with the wicked problem at hand, rather than pre-established bodies of knowledge.

This chapter explores the background of transdisciplinarity (TD) and examines how this approach can be applied within the RE-DWELL project. Section 2 traces the origins of the transdisciplinarity and discusses its development and the academic debates surrounding it. Section 3 compares transdisciplinarity with multi- and interdisciplinarity, clarifying what transdisciplinary knowledge-building entails. Section 4 focuses on the "transdisciplinary approach" itself, drawing on the Zurich School, which distinguishes three types of knowledge, and highlights the competences required from participants in a transdisciplinary endeavor. Section 5 addresses the challenges of applying a transdisciplinary approach within academia, including potential hurdles to academic careers and maintaining academic independence. Section 6 explores the learning process in transdisciplinary work, differentiating between the competences needed for "learning to become transdisciplinary" and those for being a "valuable member of a transdisciplinary team." The concluding section draws conclusions and elaborates on the practical application of the transdisciplinary approach in the RE-DWELL project.

3.1. Background of transdisciplinarity

Origin of transdisciplinarity

Faculties and disciplines are considered efficient vehicles to organise science in and to produce and maintain knowledge in coherent structures and realms (Scholz, 2020). Disciplines possess their own theories, methods, schools and scientific journals tailored for one's own circle of academics. In the second half of the twentieth century, thinkers grappled with the limitations of their disciplines and pondered transcending them.

Multidisciplinarity involves studying the same topic from different disciplines simultaneously, while interdisciplinarity entails transferring methods from one discipline to another, potentially generating new disciplines. Transdisciplinarity goes beyond the disciplines, addressing what is between them, across different disciplines, and beyond all disciplines. Its goal is to comprehend the present world, with the unity of knowledge being one of its imperatives (Nicolescu, 2010). The term transdisciplinarity emerged in the 1970's and was introduced by experts from various disciplines often combining their discipline with philosophy. These early thinkers possessed not only a multidisciplinary background, but also a multicultural one. Their ambition extended beyond their comfort zone, aiming to understand reality and to contribute to the academic debate beyond single disciplines.

This intriguing debate emerged in various corners of the academic spectrum, spanning both social and natural sciences. Early thinkers often labelled themselves as both practitioners and philosophers, offering evaluations of their disciplines from a meta-level perspective. Two key figures are psychologist Piaget and physician Nicolescu.

Piaget, a Swiss psychologist and philosopher, introduced the term transdisciplinarity in 1970 at a seminar on interdisciplinarity in Nice. Studying the cognitive development of children and knowledge theory, he envisioned transdisciplinarity as a superior stage not limited to recognizing interactions and reciprocities between specialised research but locating them within a total system without stable boundaries between disciplines. Piaget suggested transdisciplinarity as a super- or hyperdiscipline, a kind of science of sciences (Bernstein, 2015). Moreover, Piaget states his vision on academic knowledge: "the acquisition of higher ordered knowledge (which goes beyond mental operations on what is directly perceivable) calls for institutions that codify, restructure, condense and teach the relevant knowledge thus far acquired in human history. This can be guaranteed only by public institutions such as universities" (Scholz, 2020).

Nicolescu as an expert in quantum physics states: "it might seem paradoxical that it is from the very core of exact sciences that we arrive at the idea of limits of disciplinary knowledge" (Nicolescu, 2010). He distinguished three axioms (levels of reality) of the methodology for transdisciplinarity: the ontological axiom, the logical axiom and the complexity axiom describing the complexity of structure. Nicolescu aims to rethink the traditional absolute separation of the subject and the object. He considers transdisciplinarity applicable to the integration of humanities including spiritual subjects such as religion and philosophies of knowledge with physical science subjects. Nicolescu concerns himself with the meaning of going beyond disciplines and asserts that transdisciplinarity identifies with a new knowledge about what is between, across and beyond disciplines (Mc Gregor, 2015; Bernstein, 2015).

Different strands of transdisciplinarity

The ongoing debate since the 1970s underscores the ambitious nature of transdisciplinarity, with its emergence in both the social and natural sciences. Academics felt the need to think beyond disciplinary boundaries in order to understand complex society and its challenges. Interestingly we can broadly distinguish two complementary streams of thinking: an academic oriented one elaborating on "transdisciplinarity in terms of a way of being and a metatheory" and a society oriented one thinking in terms of "teamwork working on wicked problems".

The first stream of thought focuses on the idea of a science of science, or a meta-theory, as suggested by Piaget. Efforts have been made to develop "systems transdisciplinarity" as a metadiscipline. In 1990, Mokiy, along with specialists from the Russian School of Transdisciplinarity, began advancing the type of systems transdisciplinarity proposed by Erich Jantsch in 1972. Jantsch argued for the coordination of all disciplines and interdisciplines within the education and innovation systems. Other perspectives emphasize that transdisciplinarity should also encompass the arts and even spiritualism. Esbjorn Hagens (2009), for instance, speaks of a "theory of everything," a holistic way of being, which includes spiritual dimensions. Another defining characteristic of transdisciplinarity is its emphasis on lateral, imaginative, and creative thinking—not just about problem-solving, but also about the factors that need to be considered in combination. This, in turn, calls for input from the arts and humanities (Clark & Button, 2011). Finally, in this first stream transdisciplinarity is not just an intellectual endeavor but also a way of being. As Pasquier and Nicolescu (2019) put it, "To be or not to be transdisciplinary, that is the new question." This view is echoed by Rigelot (2020), who discusses "transdisciplinarity as a discipline and a way of being: complementarities and creative tensions." The debate on the nature and definition of transdisciplinarity has been ongoing for decades, with Nicolescu (2010) even describing it as "a war on definitions."

In the second stream, not the theory but the wicked problem is the focus of the debate. This stream considers transdisciplinarity as a joint effort to address a very complex societal challenge. There is a Swiss stream that is advanced transdisciplinary thinking. The Zurich 2000 conference on transdisciplinarity considers it as joint problem-solving among science, technology, and society as an effective way for managing complexity. This approach aligns well with the RE-DWELL project and will be further elaborated in Section 3.3.

3.2. Transdisciplinary knowledge

Transdisciplinarity differs from interdisciplinarity and participatory research. Figure 3.1 illustrates these differences by comparing transdisciplinarity with multidisciplinarity, participatory research, and interdisciplinarity. Multidisciplinarity involves bringing together different disciplines under a common theme, but each discipline sets its own goals and methodologies. While different perspectives from various disciplines can contribute to a better understanding of a "wicked problem," there is no integration of knowledge. Instead, the results from each discipline are presented independently, using their own language. This leads to knowledge exchange, but not knowledge integration.

Similarly, in participatory research, academic knowledge meets practical or local knowledge. Figure 3.1 demonstrates this relationship. In participatory research, while there is an exchange of knowledge between academics and practitioners, there is no

deep integration of these different knowledge bases in the way that transdisciplinarity demands.
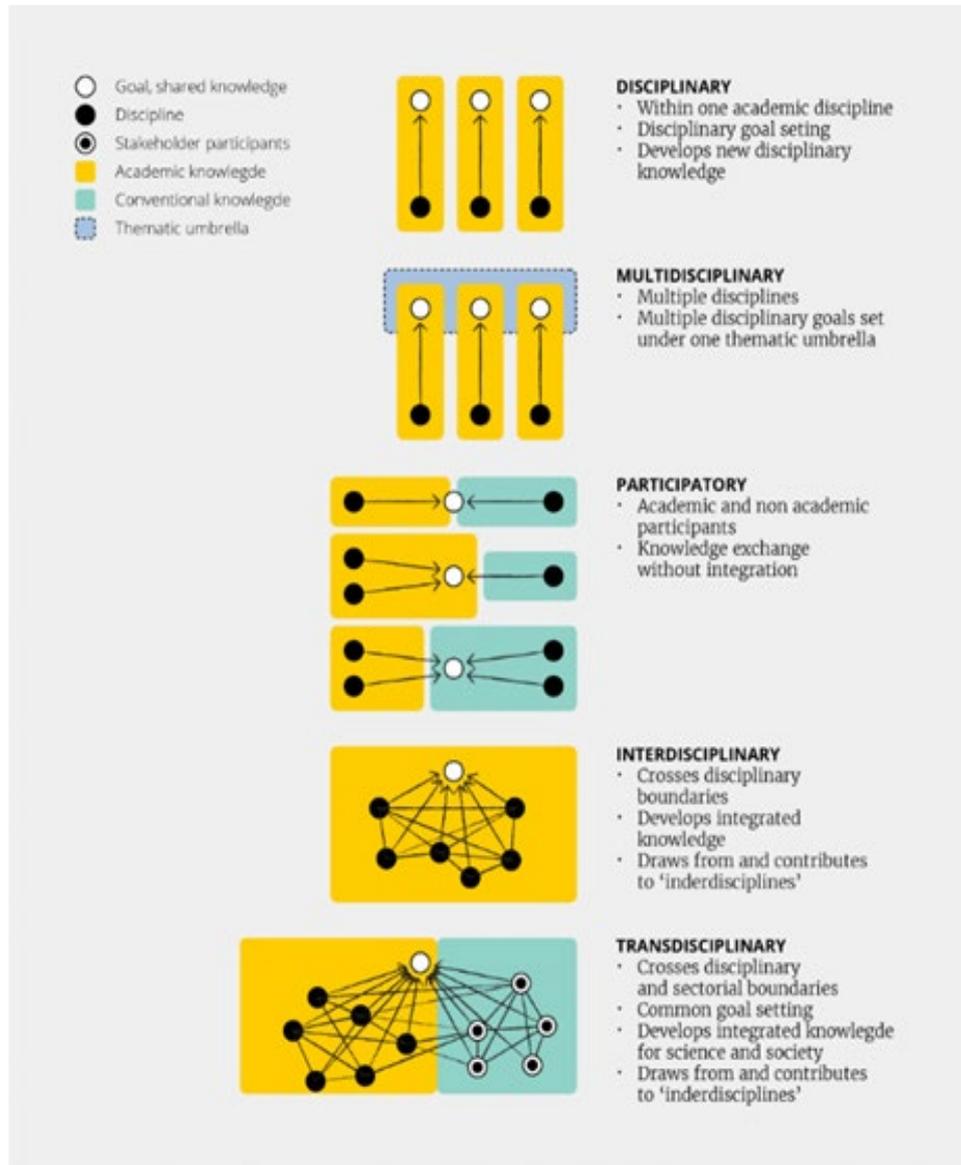
Figure 3.1. Schematic representation of transdisciplinary research (In Robinson (2019), adapted from Morton et al. (2015), originally from Tress et al. (2005))

Transdisciplinarity is often promoted as the key to solving complex societal problems in particular when normative problems arise in which valuation and decision-making are major decisions (Tobias et al., 2018). The term transdisciplinarity is mentioned many times in relation to "wicked problems" and "complex systems", but the distinction between what is transdisciplinary knowledge and what not is not always clear. In this regard, Nicolescu (2012) makes an interesting comparison between disciplinary knowledge and transdisciplinary knowledge as presented in Table 3.1.

Table 3.1. Disciplinary knowledge and transdisciplinary knowledge (Nicolescu, 2012)

Disciplinary knowledge	Transdisciplinary knowledge
In vitro	In vivo
External world (object)	Correspondence between external world (object) and internal world (subject)
Knowledge	Understanding
Analytical intelligence	New type of intelligence - balance between mental, feelings and body
Oriented towards power and possession	Oriented towards bewilderment and sharing
Binary logic	The logic of the included third
Values exclusion	Values inclusion

Transdisciplinarity methodology enriches different disciplines, bringing new and necessary clarifications which cannot be generated by a disciplinary methodology; transdisciplinarity methodology does not replace the methodology of each discipline; so disciplinary and transdisciplinary knowledge are not antagonistic but complementary (Popescu, 2014).

Key differences between disciplinary and transdisciplinary knowledge that are ultimately relevant to the RE-DWELL project are:

- **Understanding**: Transdisciplinary knowledge emphasizes a deep comprehension of the complex societal issues at hand. In the case of RE-DWELL, this involves understanding the multifaceted nature of affordable and sustainable housing across various contexts—spanning different countries, systems, ideologies, and institutions. The team itself brings diverse perspectives from both practice and different academic disciplines, requiring an integrated understanding of the problem that goes beyond traditional disciplinary boundaries.
- **Values Inclusion**: Unlike traditional disciplinary approaches that strive for objectivity and often aim to remain value-neutral, transdisciplinary research is inherently normative. In the RE-DWELL project, the provision of affordable, sustainable housing is not merely a technical or economic challenge, but a means to achieve broader, normative sustainable development goals. This involves considering the ethical dimensions, values, and goals related to social justice, equity, and environmental responsibility, all of which shape the project's outcomes and impact.

3.3. Three types of knowledge

Like interdisciplinary research, transdisciplinary research generates knowledge that transcends existing disciplines (e.g., Morton et al., 2015; Tress et al., 2005). The Zurich International Transdisciplinarity Conference (2000) established a shared definition of the transdisciplinary approach: "A new form of learning and problem-solving involving cooperation among different parts of society and academia to address complex societal challenges."

This approach goes beyond traditional academic theoretical and empirical knowledge. It includes a pragmatic understanding of complex realities and integrates values that guide the desired direction of change. This leads us to a useful distinction among three types of knowledge, as described by Buser (2018) and Pohl and Hadorn (2007): system knowledge, target knowledge, and transformational knowledge.

These three types of knowledge can be conceptualized within a triangle defined by facts, values, and agency (Figure 3.2). Facts are strongly associated with system knowledge, values with target knowledge, and agency—the capacity to act purposefully—with transformational knowledge (Pohl & Hadorn, 2007).

Like interdisciplinary research, transdisciplinary research produces knowledge that surpasses existing disciplines (e.g., Morton et al., 2015, and Tress et al., 2005). The Zurich "International Transdisciplinarity Conference (2000)" agreed on a shared definition of transdisciplinary approach: "a new form of learning and problem-solving involving cooperation among different parts of society and academia in order to meet complex challenges of society".

This is beyond the classic academic theoretical and empirical knowledge, it includes pragmatic understanding of complex reality and also values as a desired direction to go. This brings us to a very useful distinction in three types of knowledge as described by Buser (2018) and Pohl and Hadorn (2007): systems knowledge, target knowledge and transformation knowledge. The three types of knowledge can be usefully conceptualised as being located within a triangle delimited by facts, values, and agency (Figure 3.2). Facts are strongly associated with systems knowledge, values with target knowledge, and agency—the capacity to act in a purposeful way—with transformation knowledge (Pohl & Hadorn, 2007).
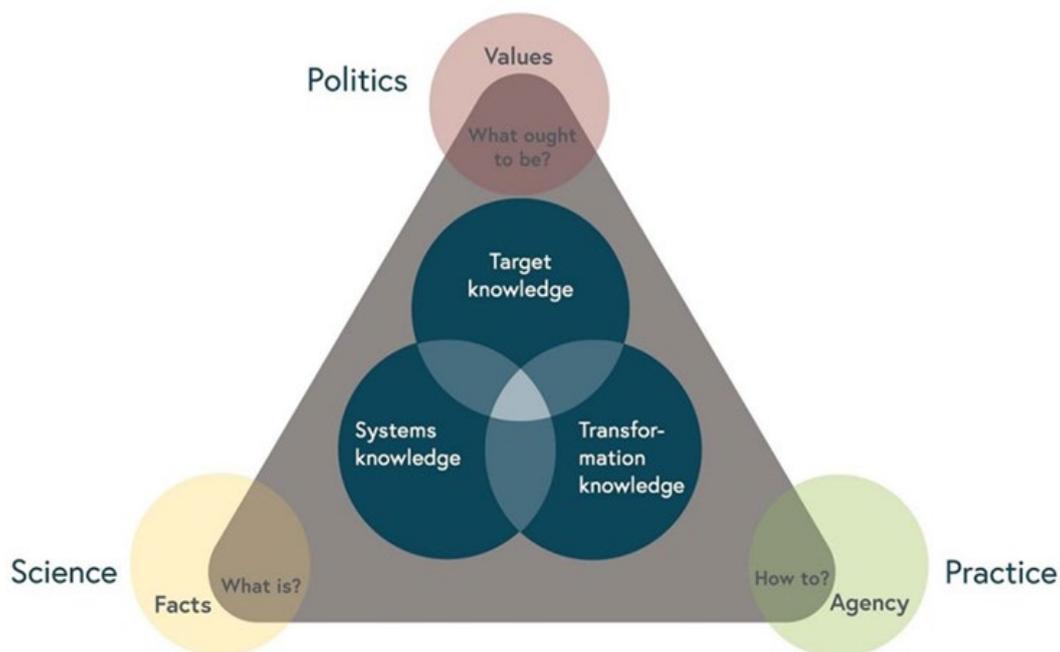

Figure 3.2. Three types of knowledge. (Pohl & Hadorn, 2007)

Three questions are helpful for operationalizing the relationship between the three types of knowledge:

- **Target knowledge** addresses the question, "What ought to be?"

- **Systems knowledge** answers the question, "What is?"

- **Transformation knowledge** defines the question, "How to?"

In the case of *target knowledge*, the question is what *the multiplicity* of *social goals* means for research, for society's practice-related problems, and for transdisciplinary collaboration between science and actors in the life-world. Transdisciplinarity faces the challenge of clarifying a variety of positions and prioritising them in the research process according to their significance for developing knowledge and practices that promote what is perceived to be the common good. This is necessary not only when the need for action has to be identified and objectives have to be determined, but also when describing the systems to which they refer and the possibilities of inducing change.

Systems knowledge confronts the difficulty of how to deal with uncertainties. Transdisciplinarity faces the challenge of finding a transparent way of dealing with uncertainties in order to avoid blocking the research process. Afterall, if systems knowledge is uncertain, this can be used as an argument to block attempts to transform a problem situation. Empirical or theoretical knowledge about a problem may be lacking, and depending on the interpretation of a problem, these uncertainties may be assigned different degrees of importance, which leads to diverging assessments of the need for action and of target knowledge and transformation knowledge.

In the case of *transformation knowledge*, established technologies, regulations, practices and power relations must be taken into account. Options for change have to rely on existing infrastructure, on current laws, and to a certain degree on current power relations and cultural preferences, in order to have any chance at all of being effective. When these social, cultural and technological givens are not considered, this leads to the often-criticised discrepancy between knowledge and practice. The challenge here is to learn how to make what is established more "flexible" (Pohl & Hirsch Hadorn, 2007).

Application to RE-DWELL project

The debate on transdisciplinarity demonstrates that transdisciplinarity is relatively young and the development of this approach is ongoing. Therefore, a fully tested method to do transdisciplinary research with guaranteed success is not available. Being aware of the history of thinking beyond disciplines and academic debate around this is important to understanding the different approaches of existing frameworks for affordable and sustainable housing for defining RE-DWELL's own transdisciplinary environment.

RE-DWELL is a project comprising early-stage researchers and supervisors from different disciplines aiming to work together beyond their discipline together with partner organisations from practice and policy. It is important to note that the project does not aim to develop a meta-theory or an overarching holistic approach to teach transdisciplinarity as a way of being. Instead, the project views transdisciplinarity as a

team effort of academics and non-academics, aspiring to contribute to the improved provision of affordable, sustainable housing in Europe and with that to the overarching SDG11: sustainable communities and cities in Europe. Therefore, knowledge on the *target* "how can affordable and sustainable housing contribute to sustainable communities?", on the *system* "what is the current situation in housing in Europe?" and *transformation* "who and how can contribute to moving from the current situation to the targeted situation?" is crucial.

Transdisciplinarity requires a willingness to engage in dialogue and negotiate meaning across disciplinary and cultural boundaries, while embracing uncertainty and ambiguity as integral parts of the research process. Therefore, a transdisciplinary project addressing a complex societal challenge like affordable and sustainable housing requires an open attitude within the research team, as well as activities that cross disciplines and involve practical engagement. These aspects are elaborated in the following four dimensions:

1. **Tackle complex and multifaceted problems**, such as the combination of major societal challenges of climate change and growing social inequality. Involving the stakeholders from practice helps to ensure that the research is grounded in real-world challenges and is more likely to have practical applications.

2. **Embrace ambiguity and uncertainty**. This requires to critically reflect on one's own disciplinary assumptions, go through the pain of abandoning one's own comfort zone: reflect on one's own limits (experiences during secondments). Researchers engaged in transdisciplinary research must be willing to critically reflect on their own disciplinary assumptions and methods, and be open to alternative ways of knowing and approaching problems.

3. **Negotiate meaning across disciplines** by debate on affordable, sustainable, and housing. This requires a willingness to engage in dialogue and negotiate meaning across disciplinary and cultural boundaries, and to embrace uncertainty and ambiguity as part of the research process (Bernstein, 2015).

4. **Co-operate with stakeholders outside academia.** A key characteristic of transdisciplinary research is its focus on co-creation and co-production of knowledge with stakeholders outside of academia. This involves engaging with stakeholders from the outset of a research project, involving them in the research process, and co-designing research activities and outputs that are relevant to their needs and interests.

There is an overwhelming amount of debate and literature on transdisciplinarity (Pohl et al, 2020). It is interesting to see that authors from different disciplines and angles all emphasise to cross the borders of disciplines as well as the border between reality/practice and academia. This approach is necessary to understand complex challenges and to find ways and tools to deal with them. However, crossing disciplinary borders and stepping out of one's comfort zone is not without drawbacks, such as the risk of negatively impacting academic careers and jeopardising academic independence.

3.4. The role of academia in transdisciplinary

Transdisciplinarity is increasingly embraced as an approach to deal with wicked problems in the fields of sustainability and wellbeing. It is however important to recognize the consequences of this approach for both academic careers and academic independence.

Hurdles for academic careers

Working with other disciplines and non-academics is far from easy, it requires patience, effort and time to overcome misunderstandings. The literature also deals with challenges of a transdisciplinary approach (Chebet et al., 2018; Schneider et al., 2021), a short summary below:

– **Lack of clarity.** This is a self-explanatory consequence of crossing borders of logic and broadly embraced support for particular definitions and methods. Crossing disciplines implies going beyond clear borders and this cannot go without numerous misunderstandings and questions and thus creating insecurity and confusion.

– **Time investment**. Crossing disciplinary boundaries and leaving behind clear definitions can create complexity, misunderstandings, and uncertainty. This makes it difficult for a transdisciplinary approach to have short-term impact, as overcoming these challenges requires time and effort. Achieving practical impact, therefore, demands both patience and sustained commitment.

– **Expertise and time to make a transdisciplinary teamwork**. Building an effective transdisciplinary team requires not only knowledge and skills from various disciplines but also dedicated training and networking opportunities. Managing confusion and frustration within the team requires time for reflection and addressing misunderstandings. Overcoming these complexities demands patience and a commitment to continuous learning. Successful collaboration, therefore, depends on training and time investment (OECD, 2020).

– **Lack of academic recognition**. Academia and academic journals are typically organized along disciplinary lines. To publish in high-impact academic outlets, academics need to meet discipline-specific criteria, including clear definitions and methodologies. This can hinder the publication of transdisciplinary research, as it may be more difficult to align with traditional disciplinary standards. As a result, research that crosses disciplinary boundaries may face more obstacles compared to research within a single discipline (OECD, 2020).

Academic independence

Transdisciplinarity includes a direction and guidelines for action, so it is not "independent" but normative: aiming for a particular target that is considered the common good. Moreover, transdisciplinary research also gives a role to societal stakeholders and the question is how this relates to the concerns about the entrepreneurial university. However, in the last decades the outside world became more and more connected to academic thinking.

Since the 1990's neoliberal thinking also entered academia and attracting funding became a crucial task of senior academics. Involving stakeholders was integrated in "entrepreneurial" universities that rely on the funding of societal partners and companies and do research on the topics they consider relevant. This way of funding research is welcomed since it is considered relevant research with many possibilities for high impact. Afterall, the funders are prepared to invest money in it. However, this implies that the partners with funding become key players in setting research agendas for academic researchers threatening the independence of academic research. Therefore, the entrepreneurial university is criticised for this policy and not taking care of the ultimate academic good: freedom of thinking. According to Scholz transdisciplinarity can be considered in another way: universities as a change agent (Scholz, 2020).

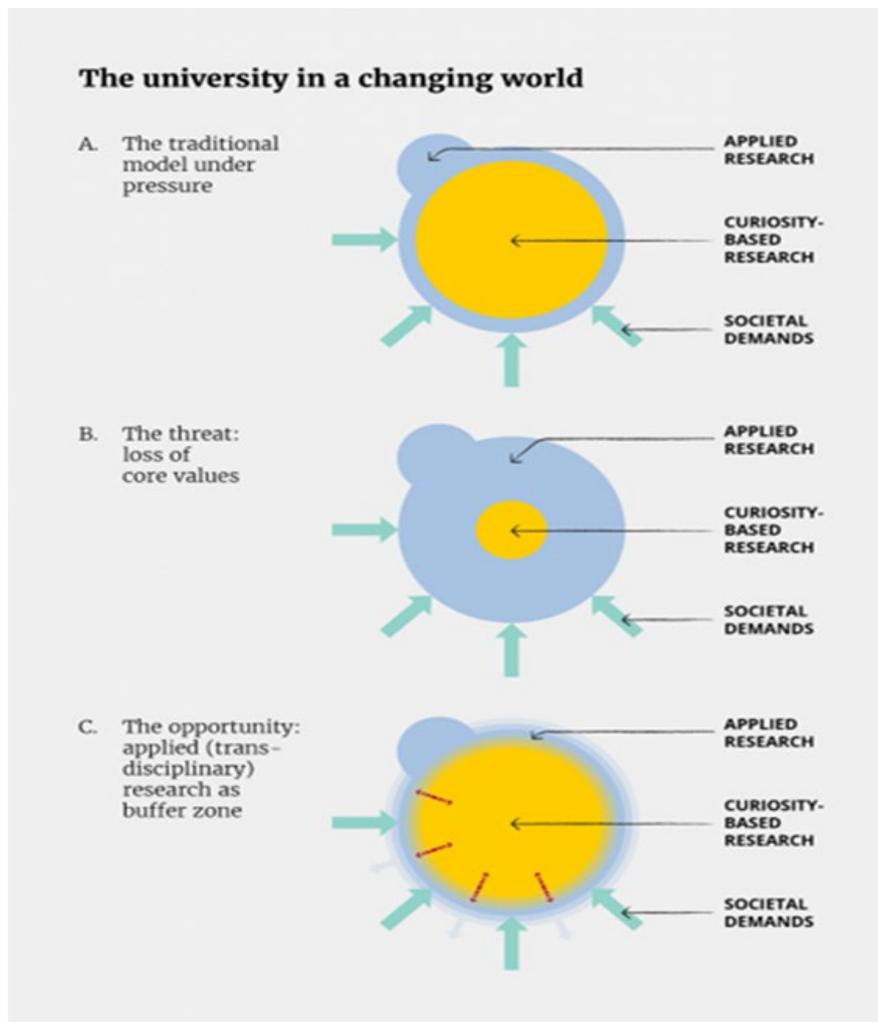*Figure 3.3. The position of university in a changing world (Robinson, 2019)*

This role of universities was already explored by Jantsch in 1972. He referred to the "purposive level" as a means whereby universities become "transdisciplinary" institutions. Instead of working as a "laissez-faire type of self-organisation" describing "what is," theories should focus on "what should be". Jantsch promoted knowledge

(*Bildung* = education) for enabling the "judgement of complex dynamical changing situations" and "research on complex dynamic situations". The university should take "an active role in planning for society and technology in the service of society".

Switzerland has been a pioneer in transdisciplinarity. In 1991, the Swiss National Science Foundation (SNF) initiated the Swiss Environmental Priority Programme (SPPU). All of its projects were required to include transdisciplinary research. The Zurich 2000 conference on "Transdisciplinarity: Joint Problem Solving among Science, Technology, and Society An Effective Way for Managing Complexity", an event, attended by 300 practitioners and 500 scientists, may be seen as the cradle of transdisciplinarity practice and theory (Häberli et al., 2000; Klein, 2004).

With *growing pressures for the university to pursue impactful and socially-relevant research* it may seem as if transdisciplinary research is in competition with traditional, curiosity-driven or disciplinary approaches (Figure 3.3). According to Robinson (2019) transdisciplinary research does not have to be a threat to scientific core values, there is an opportunity for it to act as a buffer zone which protects those core values while also addressing societal demands. We should remember, as Nowotny writes, "Reliable knowledge remains the in-dispensable conditio sine qua non of the fact that 'science works'" (2003, p. 155). In our understanding, transdisciplinary research builds on a rich set of reliable, disciplinary knowledge, and helps to mediate between these disciplines and societal demands, expanding the scope of academia. Moreover, transdisciplinary research means engaging stakeholders in significant ways throughout the research process, rather than collecting data, informing stakeholders or valorising knowledge afterwards.

Involving societal stakeholders throughout the research process is what was applied in the RE-DWELL project. The project included a variety of partner organisations from practice and policy who were invited by the academic partners to join the project to bring in their key questions and knowledge about their field. Moreover, they were part of the training programme by hosting several secondments for the early-stage researchers. In this way, the 10 academic partners in the project embraced "an active role in planning for society and technology in the service of society," as described by Jantsch (1972).

3.5. Transdisciplinary in education

Transdisciplinarity as an alternative for a single or multi-disciplinary education is described in the literature. A transdisciplinary pedagogy "helps students to learn to co-create, co-disseminate and co-use transdisciplinary knowledge, which emerges from the iterative interactions between disciplines and the rest of the world". (McGregor, 2017). Transdisciplinary education, therefore, challenges the traditional academic structures that are built around compartmentalised disciplines and subjects. These static academic structures are inadequate to address the multifaceted and dynamic challenges.

As Godeman (2008) argues "Universities can be places which provide the time and the motivation for transdisciplinary research. However, the academics who work there must be able to look beyond their own boundaries, must be capable of disciplined self-reflexivity, able to engage in a knowledge integration process in a reflexive manner, and able to take on new ideas." To foster this kind of education, it is essential to create new learning spaces born at the confluence of a number of disciplines, including education and design (Boddington and Boys, 2011).

Ultimately, education in sustainability "aims at enabling people to not only acquire and generate knowledge, but also to reflect on further effects and the complexity of behaviour and decisions in a future-oriented and global framework of responsibility" (Godeman, 2008). The integration of transdisciplinary methodologies across all levels of higher education institutions, from undergraduate to graduate and post-graduate programmes, is essential for addressing sustainability challenges. This integration necessitates a reformulation of educational objectives. As Biberhofer and Rammel (2017) noted, the "traditional emphasis on cognitive learning, enriched with sustainability topics, is neither sufficient to incorporate the principles and objectives of ESD nor is it able to engage with real qualitative change." A more comprehensive approach to education that goes beyond simply adding sustainability topics is necessary.

To foster genuine qualitative change, educational programmes must embrace active learning strategies, critical thinking, and collaborative problem-solving that engage students in real-world sustainability issues. As Sibilla and Kurul (2020) contend, "Higher education is called to develop a new generation of practitioners, who will become the actors in the knowledge transfer networks. These future actors should be able to manage the complex layers of technical and social issues that relate to sustainability". This includes not only understanding the scientific and technological aspects of sustainability but also the social, economic, and ethical implications of their decisions.

Transformative learning prepares individuals to confront such complexities by developing critical thinking skills and the ability to engage with diverse perspectives. It helps learners understand that their problems are often shared and interrelated, emphasising collective action. Transformative learning is according to Mezirow (1985): "...the process of becoming critically aware of how and why the structure of our psychocultural assumptions has come to constrain the way in which we perceive our world, of reconstituting that structure in a way that allows us to be more inclusive and discriminating in our integrating of experience and to act on these new understandings..."

To prepare students to become transdisciplinary practitioners, they must be provided with the skills that enable them to integrate and interpret the diverse knowledge they will face in their future careers: skills for integrating diverse knowledge, fostering reflective practices to critically examine their decisions, and developing the competencies to create holistic understandings of complex issues (Polk, 2015). Wiek (2011) identified five essential competencies for sustainability research that focus on problem-solving through the interplay of various dimensions:

1. *Systems thinking:* It emphasises the ability to understand and analyse the interconnectedness of various components within a system. It involves recognizing how social, economic, and environmental factors interact and influence one another

2. *Anticipatory competence:* This refers to the capacity to foresee potential future developments and challenges related to sustainability. Individuals with anticipatory competence can engage in scenario planning and risk assessment, helping them to identify trends and prepare for uncertainties.

3. *Normative competence:* It involves the ability to articulate and evaluate values, principles, and norms related to sustainability. It requires individuals to critically assess ethical considerations and to establish what is desirable in terms of sustainability goals.

4. **_Strategic competence_:** Skills needed to develop and implement effective strategies for achieving sustainability objectives. Individuals with strategic competence can analyse various options, prioritise actions, and mobilise resources to address sustainability challenges.
5. **_Interpersonal competence:_** It includes skills such as negotiation, conflict resolution, and active listening, which are essential for building consensus and achieving collective action in sustainability initiatives.

An alternative list of competences proposed by Pearce et al. (2018) puts the emphasis on the development of the skills for individuals:

1. **_Communicating values_:** Students are able to identify, ground and communicate assumptions and normative values in topics related to the concept of sustainable development.
2. **_Reflecting about self and others_:** Students are reflective about their own perceptions and biases with regards to sustainable development.
3. **_Applying concepts in the real-world:_** Students are able to appropriately apply conceptual knowledge to specific contexts, and, in parallel, exercise practical skills (such as project organisation and time management) to deliver the required end products.
4. **_Framing complex problems with others:_** Given a real-world topic and its accompanying conflicts and uncertainties, students are able to identify and frame clear, relevant problems with those who have contrasting perspectives or opinions.
5. **_Researching in and with the real-world:_** Students are able to translate real-world problems into viable research questions. They are also able to identify the adequate research method(s) to investigate these questions and to co-produce knowledge with society.
6. **_Imagining solutions and their consequences:_** Students are able to explore and develop solutions for real-world problems, while being aware of the possibility of unintended consequences of these solutions and taking responsibility for them.

3.6. Conclusion

The literature review in this chapter shows that the term "transdisciplinarity" originated across various academic domains, with early contributions from psychology and physics. The main motivation behind this approach is the recognition that single disciplines are limited in their ability to fully understand complex societal challenges. Transdisciplinarity is a relatively recent approach in academia and is still a topic of ongoing debate, it bears some risks, such as potentially limiting academic careers and challenging scientific independence.

For RE-DWELL, which addresses the multidimensional challenge of affordable and sustainable housing as described in the previous chapter, this transdisciplinary approach holds great promise. It aligns well with RE-DWELL's goals of training early-stage researchers from diverse disciplinary backgrounds to work collaboratively and engage with partner organisations from policy and practice.

The literature review revealed that the Swiss School approach (Pohl et al., 2007), which distinguishes three types of knowledge, aligns well with the goals and structure of the RE-DWELL project. These three types—target knowledge, system knowledge, and transformation knowledge—serve as key components of the transdisciplinary environment for affordable and sustainable housing (TEASH), which will be presented in Chapter 7.

Working transdisciplinarily is not yet mainstream and presents challenges for all stakeholders involved. Therefore, we reviewed literature on education in transdisciplinarity and identified a range of competences essential for successful transdisciplinary collaboration. Pearce et al. (2018) outlined a set of personal competences necessary for contributing effectively to a transdisciplinary team, such as reflexivity and the ability to co-frame complex problems. These competences are largely addressed through training activities described in Chapter 4, as well as in the development of a knowledge exchange toolbox, which is discussed in Chapter 7.

4. The RE-DWELL journey: events and activities

Transdisciplinary learning, as Pearce et al. (2018) contended "refers to both the condition of learning in a transdisciplinary setting and learning about transdisciplinarity, including the methods and assumptions that researchers take on when carrying out transdisciplinary research." In line with this perspective, the purpose of this chapter is to present the construction of two fundamental components of the RE-DWELL transdisciplinary learning and research environment. First, to show the steps that the network took towards developing a Transdisciplinary Environment for Affordable and Sustainable Housing (TEASH). And second, to explain how different activities helped the RE-DWELL participants to better understand the competences needed to engage in transdisciplinary activities for the provision of affordable and sustainable housing.

The learning process spanned over the three years of the work, in three stages. A first stage, starting with the first on-line activities in July of 2021 and ending in the Nicosia summer school in November 2021, focused on getting to know each other, the different approaches from different disciplines, the concepts around the housing problem and the tools that would be used during the project: the vocabulary and the case studies. The second stage that ended with the Zagreb workshop in March of 2023, focused on fostering a cross-disciplinary dialogue across network members (researchers, supervisors and partner organisations). The main objective was to promote understanding of different perspectives and values among the researchers with various backgrounds, and between them and the partner organisations, building on the experiences of the secondments. The third stage, starting with the ISHF workshop held in Helsinki in June of 2021 and ending with the Barcelona conference in May of 2024, represented a step forward from interdisciplinarity to transdisciplinarity. It dealt with the development of participatory tools to engage non-academic stakeholders concerning the provision of affordable and sustainable housing, as elaborate in Deliverable 4.7.

During the three years of the network activity, we created step-by-step a learning environment to support the acquisition and application of transdisciplinary skills among ESRs. The construction of the transdisciplinary learning and research environment comprised:

- **Courses**, providing the fundamental concepts on research methods and tools and transferable skills (see Deliverables 2.3-2.8)

- **Networking activities**, engaging researchers in cross-disciplinary dialogues with other disciplines

- **Secondments**, training (traineeships) for the ESRs in practice with stakeholders involved in the provision of affordable and sustainable housing

This learning and research environment was established from the very beginning of the project and developed step-by-step through a diverse range of activities in a blended-learning format. During this development, we designed and experimented with a variety of activities which combined in-person work during the workshops and summer schools with on-line work conducted in the periods in-between gatherings in parallel to the development of the PhD thesis by ESRs.

The following sections provide an overview of the activities conducted during the development of the research and learning environment. The following sections provide an overview of the activities carried out during the progressive development of the research and learning environment. Section 4.1 outlines the initial stages in which network members met and became familiar with each other's specific perspectives, research interests and disciplinary backgrounds. Section 4.2 develops on the next stages of activities, during which the ESRs establish connections between their individual research projects and with partners from practice. All these experiences formed the basis for the development of a transdisciplinary approach through network activities presented in Section 4.3.

4.1. Getting familiar

This section provides an overview of the journey, starting with the presentation of the network members at the kick-off session in July 2021 and the first in-person meeting at the Lisbon Workshop in September 2021.

Dimensions compared to RE-DWELL fields of study

The RE-DWELL process of constructing a transdisciplinary learning environment began with a four-day programme that enabled network members to get to know each other and initiate collaboration on research and training activities (Figure 4.1). Due to the limitations imposed by the COVID-19 pandemic, the activities were held online. Early-stage researchers (ESRs), supervisors, co-supervisors, and secondment representatives participated in the event.
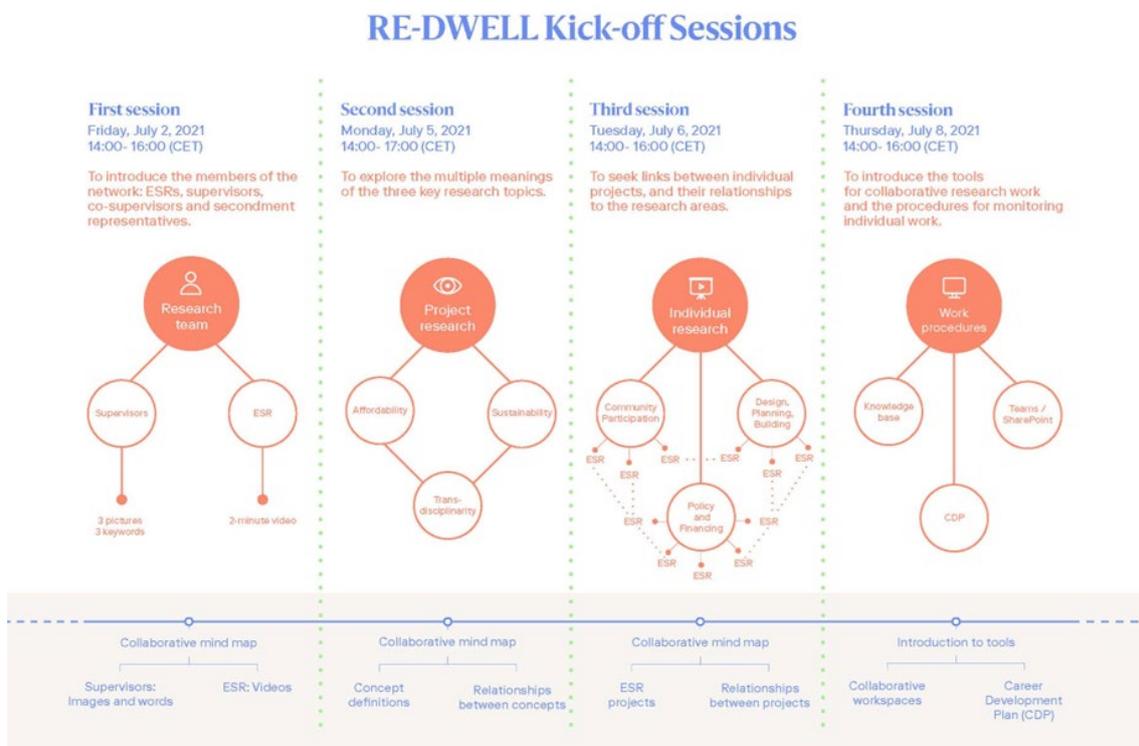

Figure 4.1. Activities carried out in the four-day kick-off programme

The programme agenda was as follows:

- **Research team:** ESRs introduced themselves with a 2-minute video. Supervisors, co-supervisors, and secondment representatives introduced themselves using a 1-minute presentation with three pictures and three keywords. Participants collaboratively created a mind map to identify affinities among team members, supervisors, ESRs and partner organisations.
- **Project research:** Teams of 3 ESRs explored the multiple meanings of the three key research topics: affordability, sustainability, and transdisciplinarity. Each team presented their insights in a plenary session, and a shared mind map was created during the discussions.
- **Individual research:** Participants explored connections between individual projects and their relevance to the research areas. Each ESR gave a 5-minute presentation of their project, after which peers summarised the presentations in a shared mind map, establishing links between projects. The findings from the five teams were summarised in the mind map, with identified links between ESRs' projects discussed collaboratively.
- **Collaborative working procedures:** The session introduced tools for collaborative research, as well as procedures for monitoring individual work. These included website sections (vocabulary, case library, blog) and online collaboration platforms (Teams, SharePoint).

The kick-off programme was the first step in creating a collaborative, reflective, and resource-rich environment, encouraging participants to transcend disciplinary boundaries and work towards common goals. First of all, it enabled network members to get to know each other, along with their backgrounds and motivations. Activities that required participants to summarise and map out their peers' research projects promoted reflexivity—an essential aspect of transdisciplinary education. Through mind-mapping exercises and shared reflections, the programme facilitated the initial development of a collective framework (Figure A1.1 in Annex 1).

For four days, the ESRs began exchanging information and collaboration and learning among them. They had the opportunity to share their knowledge and experience on the topic of affordable housing and become aware that they were in a process that was not only aimed at developing the PhD thesis, but a more far-reaching goal: to acquire deep learning through a transdisciplinary approach.

> *"Not only we all had a chance to meet each other in smaller groups, but we also had a chance to share our research interests, ambitions and plans, which revealed many possible synergies and complementary topics that we agreed to follow and work on together throughout the project."* ([Blogpost](#) by Marko Horvat)

This exchange of information allowed the group to know what everyone's background was and to understand that it was going to be critical throughout the project to understand the perspectives of the others to be able to answer a problem as complex as that of sustainable and affordable housing. The first difficulties of understanding appeared, and it was realised that each discipline started from different knowledge about a common problem. ESRs even learned that the working tools were distinct between disciplines, and understanding and developing new methods would be part of their learning process.

"These exercises were beneficial in identifying our educational background and work experience, which we then used in group work, trying to provide meaningful definitions of certain elements of the topic we will be studying. Throughout the group work, we have quickly become friends and companions on our journeys, and I can only say that now, at the beginning of my PhD journey, I look forward to collaborating with other PhD candidates and supervisors, all the hard work this project will bring." ([Blogpost](#) by Marko Horvat)

The concept of transdisciplinary and the need for this transdisciplinary environment to be able to respond to the housing problem was addressed, and the conflicts between sustainability and affordability were made aware with some reflections such as this one:

"My group consisted of two architects (me included) and a political scientist. Combining our mixed experiences brought up some interesting points which I am sure would not have been considered, had it just been limited to architects." ([Blogpost](#) by Anette Davis)

"The term 'Transdisciplinarity' was the most interesting for me to discuss in the sessions as it is relatively new for me. It is a form of research that we are going to adopt in our research projects where different disciplines are crossing the boundaries of each other to find new solutions for complex problems. We are coming from different fields of expertise and educational background. In our case, affordability and sustainability are the two conflicting sides of the housing equation and our real challenge is to find a profound balance." ([Blogpost](#) by Aya Elghandour)

Lisbon workshop – September 2021

The first in-person network activity took place at the [Lisbon workshop](#). Before the meeting, ESRs prepared an abstract of the research project in written and visual formats which were shared on the project website. They also produced an A0 poster which was exhibited during the workshop and used in the collaborative activities (Figure A1.2 in Annex 1). By having ESRs prepare abstracts and posters for their research projects, participants are prompted to articulate their work in a manner that is accessible to peers from diverse disciplines, developing at the same time their communication skills, written and visual. Posters allow researchers to present complex information visually, develop communication skills and promote engagement and discussion.

In a group session in Lisbon, ESRs and supervisors organised in teams (two ESRs and one supervisor/co-supervisor) answered the questions about each research project:

- **What to research?** Teams defined the specific focus of their research, allowing for a clearer understanding of the project's objectives and scope. This collaborative approach helped participants clarify their individual and collective research interests, promoting interdisciplinary dialogue about various topics.

- **Why is it needed?** By discussing the significance of their research, teams articulated the relevance of their projects in addressing real-world challenges. This step encouraged participants to consider the societal impact of their work, fostering a shared commitment to meaningful research that transcends disciplinary boundaries.

- **How to do it?** Teams explored methodologies and approaches for conducting their research, encouraging a cross-pollination of ideas and techniques from different fields. This collaborative discussion allowed ESRs to learn from one another and adopt innovative strategies that might not have been part of their original disciplines.

- **With/by who?** By identifying potential collaborators, stakeholders, and target audiences for their research, participants began to build networks that extended beyond their immediate teams. This element is crucial for transdisciplinary education, as it emphasises the importance of involving diverse perspectives and expertise in the research process.

The collaborative activity was followed by a four-minute presentation by each group, which received feedback from the rest of participants.

Overall, the activities carried out in the workshop fostered the development of transdisciplinary skills among ESRs by enhancing their communication abilities, promoting collaboration, encouraging critical thinking and problem-solving, facilitating networking, and instilling a practice of reflexivity.

Participants appreciated the opportunity to explore diverse approaches—ranging from community and finance to design—and recognized that collaboration would be crucial in achieving shared project goals.

The exercise also fostered meaningful dialogue, particularly through presentations, which helped highlight overarching themes, cross-cutting concepts, and new vocabulary, such as "empowerment" and "top-down/bottom-up" approaches. Group work encouraged further exploration of these connections and facilitated productive discussions. (Figure A1.3 in Annex 1). See more in Deliverable 3.1.

> "*The importance of devoting comprehensive efforts to develop the field of housing studies, assembling not only economists but also architects, urban planners and other professionals involved in the production of the built environment; and to bring about a real research culture at the heart of architecture schools, are some of the takeaways I got from this stimulating debate.*" (Blogpost, Leonardo Ricaurte)

Nicosia summer school – November 2021

Based on the outcome of the meetings with the supervisors/secondments before the summer school, ESRs met in a hands-on session during the Nicosia summer school with peers in clusters of two to exchange information about their contacts with partner organisations and to discuss the potential role of the secondments in their research thesis (Figure A1.4 in Annex 1). The outcome of their discussion was presented on post-it panels (Figure A1.5 in Annex 1). The thirty-minute activity was followed by a presentation by each group, which received feedback from the participants (ESRs, supervisors, co-supervisors and partner organisations' representatives). The group started to be aware of each other and understood the project and the need for interdisciplinarity.

It was reinforced with some activities in place, like other networking activities. The summer school included site visits to local housing developments, focusing on

sustainable and affordable housing in the historic city centre and regeneration projects in Limassol and interactions with local issues, providing insights into real-world issues.

> *"The summer school ended with the viewing of documentary film 'Anamones'…The film investigates the sociological impact of designing in starter bars (structural steel rods) protruding from the roofs of homes in Cyprus for "future use"…This served to highlight the importance of knowing what the end-user needs are in the design process in housing, which is one of the key issues being explored by the RE-DWELL network."* (Blogpost, Annette Davis)

Participants appreciated the opportunity to discuss common secondment interests, explore new project connections, and brainstorm on how secondments could support their research. The interactive format, especially the poster session and well-matched ESR pairs, was highlighted as a successful way to foster collaboration. The ERS, the supervisors, co-supervisors and the partners were aware of the multidisciplinarity inside the network and they understood better their relation to the other participants in the process of knowledge exchange.

4.2. Finding connections

Budapest workshop – March 2022

Continuing with the interweaving of online and in-person activities, some preparatory work was done before the workshop in Budapest, which was then presented and discussed collectively. The activities included exploring the contents of the vocabulary and finding relationships between terms and definitions provided by ESRs. The fellows further grouped the concepts in clusters, which helped them understand the relationships between the three areas of the RE-DWELL research network: "Design, Planning, Building"; "Community Participation"; and "Policy and Financing." (Figures A1.6 and A1.7 in Annex 1). This exploration and the effort of the ESRs to explain the significance of the vocabulary in relation to the case library enabled ESRs to develop interpersonal competencies.

During the workshop, a game session was organised by the local NGO CoHousing Budapest Association to develop a common vision regarding the challenges of community building (Figure 4.2). The aims were to learn methods and forms of democratic decision-making, practice sociocracy and direct democracy, establish a common standard for conflict management, and formulate rules for internal and external communication. Participation in this game provided insights into the later activities carried out concerning the development of a toolkit to foster collaboration between experts and non-experts for the next stage of building the transdisciplinary environment (see Deliverable 4.7).

Figure 4.2. Introduction to the game session and interactions among participants, Budapest Workshop

The game activity helped foster the ability to anticipate future developments and challenges related to sustainability and skills in negotiation, conflict resolution, and active listening. Overall, the session was recognised for its engaging nature and ability to provide valuable insights into the interaction between communities and housing organisations.

> *"The term reflexivity was often mentioned in the discussion, referring to collective self-reflection practices about the participants' positionalities, authorities, verbalisation skills, experience, and values. As people often come with different resources in the process of co-creating cooperative housing, a way to take this into account is to create various levels of participation, making it less demanding for people that do not have the same time or economic capacity. In this way, the collaboration factor would be present, being aware of the importance of redistributing knowledge and resources."* (Blogpost by Zoe Tzika)

International Social Housing Festival Helsinki – June 2022

RE-DWELL participated in the Festival organising a workshop. The aim of the workshop was to apply a holistic approach to the provision of affordable and sustainable housing through a specific use case: "A municipality has a piece of land in a working-class neighbourhood that is to be developed through a sustainable master plan, including affordable housing." Participants organised in teams to develop a step-by-step strategy that considered the interrelationships between the three themes of the RE-DWELL research network: "Design, Planning, Building"; "Community Participation"; and "Policy and Financing." For each theme, participants received a brief explanation of the most relevant issues, methods, and tools, summarised in a wheel diagram. This workshop

enabled the network to put the transdisciplinary approach into practice for the first time and to start building a TEASH toolbox[1] (see Deliverable 4.7).

Valencia summer school – July 2022

The scenario-based methodology- the collaborative session using some descriptors for each pillar- implemented at the ISHF RE-DWELL workshop in Helsinki (see Deliverable 4.7) was reviewed during the Valencia summer school. There was a session discussing how it could be improved in next versions and the beginning of a structured "game". Each ESR presented their research to peers, engaging in discussions, asking questions, and providing feedback. Supervisors also participated in these discussions. The outcomes were documented on a shared Miro board, which visually mapped and connected the various research projects (Figure 4.3). These collaborative reflections enabled researchers to develop self-awareness of their own conceptual frameworks and contributed to the emergence of knowledge that is "in-between, across and beyond disciplines" (Nicolescu, 2007). "The social and public housing sector has the responsibility to balance all these aspects in their projects, which is often a very complex puzzle. It requires technical and financial capacity and knowledge on how to work with residents and communities as well as different stakeholders." "We have to make sure the social aspects of the energy transition are at the same level as environmental objectives, or it will not work, nor generate the consensus and take up that are needed." (HE)

---

1 The term "toolbox" refers to a collection of tools that assist in exchanging knowledge across disciplines and with participants from practice. The "TEASH toolbox" is described in detail in Deliverable 4.7.

Figure 4.3. Mapping of links across research projects arising from the team activity, Valencia Summer School

The relationships among the various research lines were examined in a separate activity using the vocabulary and case library, which served as valuable learning resources. The collaborative task required participants to choose one term from the vocabulary and one case and then discuss the significance of their individual research perspectives. Teams analysed how the selected term (Figure A1.8 in Annex 1) and case study library (Figure A1.9 in Annex 1) connected to their specific focus areas, fostering a deeper understanding of the interplay between different research lines within the overall framework. The collaborative activities further contributed to the development of interpersonal competences and communication skills, while also continuing to enhance their systems thinking capacities by interrelating their research projects through the vocabulary and case library (see also D4.4 and D4.5). Attendees appreciated the dedicated time to update one another on their projects, fostering connections and knowledge exchange through unstructured discussions.

Supervisory board meeting – November 2022

The aim of this online meeting was to share with all members of the network (ESRs, supervisors, co-supervisors and partner organisations) the work done in the secondments completed so far. ESRs together with partner organisations where they held their secondments were requested to make a 10-minute presentation focusing on the following related to transdisciplinary research (cutting across fields, and engaging stakeholders outside academia), answering the following questions:

- To what extent has the secondment contributed to a better understanding of RE-DWELL's transdisciplinary approach, bridging research to have an impact on existing practices (design, construction, management, participation, financing, policies, etc.)?

- How the secondment contributed to the PhD research (topics, methods, objectives).

- How the host organisation has benefited from the secondment.

- What transferable skills were developed or enhanced during the secondment?

- Lessons to be learned for future secondments to achieve better the objectives of RE-DWELL and the individual doctoral studies.

The answers were collated at the end of the presentations (Figure A1.10 in Annex 1). Through this session, participants—ESRs and partner organisations' representatives— enhanced their communication skills on digital media and reflected on their work in relation to others. ESRs needed to align their research findings with real-world problems and, with the support of the secondment representatives, translate those problems into research questions.

4.3. Towards a transdisciplinary approach

The activities conducted during the Zagreb workshop marked a significant qualitative advance in the collaborative work of the network and the advancement of the adopted approach. The collaborative activities brought together outcomes from various strands of work, including:

- Experiences and insights gained from secondments

- Contributions to the vocabulary and case library

- Challenges identified within individual research projects

Fellows were tasked with reflecting on the connections between the diverse knowledge generated by the network, the vocabulary, case library, secondments and research projects- and related to the three research areas identified in the RE-DWELL research framework (Figure A1.11 in Annex 1). Five teams were formed to carry out this task, each consisting of three members representing the three distinct research areas. Teams worked on their assignments before the Zagreb meeting, where they presented their reflections to the group (Figure A1.12 in Annex 1)

The Zagreb meeting was a fruitful event which resulted in very interesting teamwork (Figure 4.5) of the ESRs and some conclusions:

- Need for more study into what transdisciplinarity implies (see Chapter 3)

- Information about the needs and expectations of the partner organisations is needed (see Chapter 5).

The works presented by the ESRs showcased diverse approaches to tackling the task, as well as diverse levels of engagement with the shared goal of contributing to transdisciplinary learning.

Figure 4.5. Work from ESR team Tijn Croon, Carolina Martin and Androniki Pappa, Zagreb Workshop

In their answers to the evaluation survey, participants appreciated the different interpretations of transdisciplinary co-production within RE-DWELL, finding most contributions insightful. However, they found that there was still room for further development. The variety in the assignment presentations sparked helpful feedback and meaningful discussions, with interesting points raised by each group.

> *"But! the more I expand the perspective to understand how the provision of affordable and healthy homes for low-income communities on a large scale is challenging, the more I discover new challenges and new factors "the devil's in the detail". It is also becoming clearer to me that it is not just the responsibility of the architects. In fact, there are too many factors and challenges that I learn about through my ongoing interviews that tie the hands of architects. That is why transdisciplinary research is necessary!"* (Blogpost by Aya Elghandour)

Dialogue between ESRs and partner organisations – May 2023

Secondments provide a space for meaningful exchange and interaction between researchers and professionals, bridging the gap between theory and practice. This collaboration between academics and non-academics is essential for researchers to gain transdisciplinary knowledge (see Chapter 5).

At the end of their secondments, ESRs submitted reports detailing their activities to their supervisors and produced public summaries for the Blog section of the website. These

summaries serve as a valuable resource, capturing the experiences gained through direct engagement with a range of practitioners working on affordable and sustainable housing initiatives.
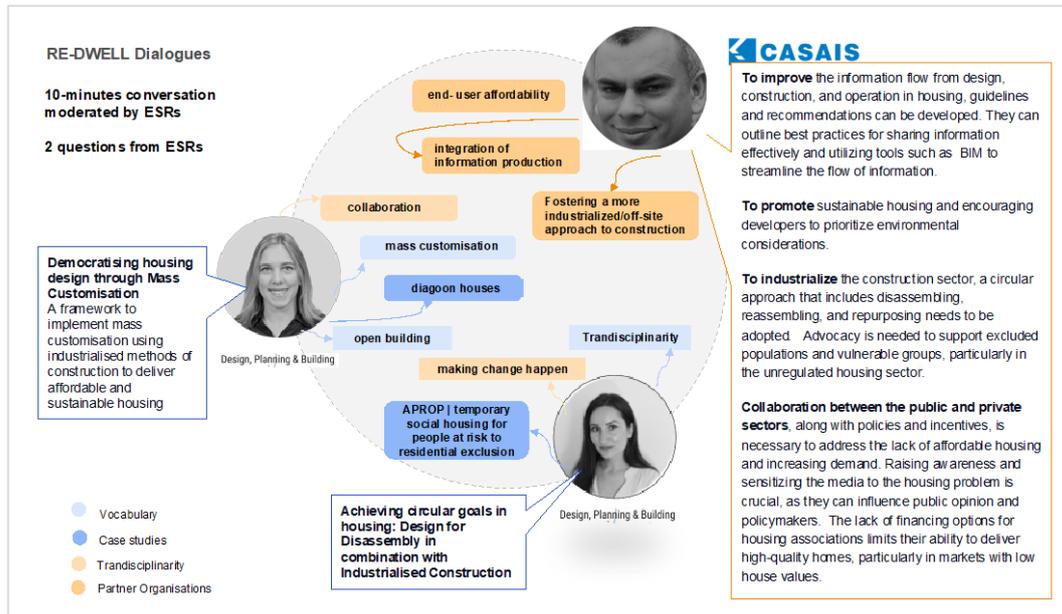

Figure 4.6. Dialogue between ESRs and partner organisation Casais

An online interactive session was organised on May 22, 2023 (Figure 4.6), involving ESRs and partner organisations, to share experiences gained during the secondments (see Deliverable 4.7). Prior to the session, partner organisations received a questionnaire to outline their needs and challenges regarding the provision of affordable and sustainable housing, as well as their expectations for the outputs of the RE-DWELL network (see questionnaire in Annex 2 and the analysis of the answers in chapter 5). During the two-hour session, ESRs asked two questions to partner representatives from the organisation where they had completed their secondment.

Reading summer school – July 2023

The summer school in Reading was a crucial moment in the RE-DWELL project. The cross-disciplinary insights from Zagreb, together with the input from partner organisations, were brought together in the first version of a "RE-DWELL game". As a follow-up to the Helsinki session, a toolbox for knowledge exchange for affordable and sustainable housing was further developed. This game tool is based on the GAIA toolkit and the Ph.D. work of the ESRs (see Deliverable 4.7). The test session using the first version of the toolbox included several partner organisations, the ESRs and their supervisors.

The process of creating a transdisciplinary learning and research environment continued with the development of the toolkit designed to apply the RE-DWELL transdisciplinary environment to real-world scenarios. After the first implementation of the toolkit in Reading, network members - ESRs, supervisors and partner organisations- actively contributed to analysing and improving it in specific sessions during meetings in Delft, in October 2023 and in the Barcelona conference, in May 2024 (see Deliverable 4.7).

4.4. Conclusion

This chapter has outlined the steps in the RE-DWELL journey for training 15 ESRs from diverse backgrounds, equipping them with the necessary skills and methods to address the complex "wicked problem" of affordable and sustainable housing provision. These steps included: getting to know each other (Section 4.1), connecting disciplines (Section 4.2), and fostering transdisciplinarity by intertwining disciplinary approaches with practice- and policy-based perspectives (Section 4.3).

Initially, the three research fields of the RE-DWELL programme encompassed the thematic research interests of ESRs, linked to their backgrounds and individual research goals. Building connections and establishing links involved creating a shared understanding among different research approaches cantered on a common theme: affordable and sustainable housing. This approach enabled researchers to broaden their collective understanding of housing challenges by becoming aware of various conceptual frameworks and terminologies.

In addition, the construction of a shared vocabulary around affordable and sustainable housing helped researchers recognize the diverse terminologies used to describe a common problem. Overcoming confusion and clarifying the various terms and theoretical backgrounds were essential steps in fostering connections between research projects. Selected cases of affordable and sustainable housing, identified by researchers or proposed by local stakeholders from locations where network activities took place, provided insight into the various approaches to addressing housing issues. Moreover, interactions with partners from practice during secondments further contributed to the development of transdisciplinary competencies, such as reflexivity, awareness of different perspectives, openness, and communication skills to facilitate knowledge exchange among diverse parties.

The collaborative work conducted throughout the network activities supported the creation of a transdisciplinary research and learning environment in two parallel ways: through the development of ESRs' individual research projects and through the joint construction of a set of principles and tools to guide knowledge exchange between academia and practice, within the network and beyond.

Additionally, this collaborative work focused on developing a toolbox to support the cooperation of academics, practitioners, policymakers, and non-experts in participatory activities aimed at jointly defining housing problems in local contexts. This toolbox materialized as a series of serious games, which were devised, tested, and refined during various events, including the Budapest workshop in 2022, Helsinki ISHF 2022, Reading Summer School 2023, Delft meeting 2023, and finally, the Barcelona conference in 2024. Further details on how these building blocks from the research and training environment contributed to the foundation of TEASH are outlined in Chapter 7.

5. Understanding need of partner organisations

The development of the RE-DWELL transdisciplinary learning and research environment for affordable and sustainable housing relies on the involvement of the partner organisations of the programme. As discussed in Chapter 3, a transdisciplinary approach cannot be based exclusively on academic perspectives, even if such views combine disciplines and methods and open up to non-academics. Since a transdisciplinary approach is triggered by values and oriented towards impact, it needs to build on different types of knowledge, such as experiences of users /residents and of different housing professionals. Unlike more conventional research approaches, such expertise comes into play not only in specific research phases, such as data collection, but at several stages of the research processes, from the definition of research questions and objectives to that of collaborative methods of knowledge co-production and to the translation of results in orientations for policy and practice. Moreover, being a European network, RE-DWELL needed to address the conditions for the mobility of good and inspiring models of practice between European contexts. Therefore, the RE-DWELL training environment had to facilitate two types of collaborative processes, one bridging academic requirements and practitioners' needs, and the other connecting different European settings in a meaningful way. This chapter presents these two challenges that have shaped the training of the early-stage researchers and have therefore contributed to the construction of the TEASH (as shown in Figure 7.1).

The first section addresses the premises of collaborative research between academics and practitioners in RE-DWELL and then focuses on the forms of collaboration carried out during the secondments of early-stage researchers at partner organisations. The second section addresses practitioners' views on the tensions between affordability and sustainability in housing production. While recognising that these perspectives are not entirely in line with those of academics, the analysis of the partners' points of view helps to build a shared understanding of the challenges of producing affordable and sustainable housing. The third section addresses the challenge of context- and path-dependency of tools, policies and practices that adds another level of complexity to the construction of a transdisciplinary environment for affordable and sustainable housing within RE-DWELL. Since tools for TEASH need to consider and adapt to the specificities of concrete settings in order to contribute to the mobility of inspiring practices and policies between European contexts, this last chapter is dedicated to some of the essential conditions for successful mobility of ideas.

The main material analysed in this chapter are the answers to an online survey, provided by the representatives of all partner organisations and an online collective discussion in which PhD candidates addressed questions to their hosting partner organisations. The survey, carried out in April 2023, was composed of three sets of questions, aimed to gather partners' opinions on their involvement in the RE-DWELL programme, their experience with secondments and their views on the project outcomes and on its potential impact. The specificities of the eleven partner organisations, their main interest and motivations to be part of RE-DWELL are described in Annex 2.

5.1. Collaboration with academia

This section addresses the motivations behind the participation of partner organisations in the RE-DWELL programme, as well as some uncertainties regarding collaboration with academia, expressed in the survey. The policy of encouraging such joint ventures between academic and practice-based organisations is already longstanding and RE-DWELL partners have already been involved in such activities before. Several of them declared having chosen to participate in the RE-DWELL programme because of previous successful cooperation with universities or with other partner organisations of the consortium (SYHA, Clarion, EFL). One of the main drivers for such collaboration are knowledge exchange and learning, expressed in different ways: "sharing information and knowledge", "platforms for cross-learning" (CLDC), "learning from and presenting relevant experiences and practices for sustainable construction" (Casais), knowledge exchanges that are aimed at "capacity building" (Ceraneo).

Partner's perception of the RE-DWELL programme and their expectations are influenced by these previous experiences, just as they are also determined by one's own area of activity. Since some of the partners already conduct research as their main or secondary activity, collaboration with RE-DWELL's academic network is an opportunity for expanding – "broadening and deepening" (MRI) – and confronting their own ongoing research with other research work. In addition, the development of R&D departments within housing organisations and other companies in the field of housing, raises questions about the specificities of exchanges between research and practice called transdisciplinary when the initiative lies within academia, as compared to exchanges initiated and coordinated by practitioners:

> *"I believe our research team (and by extension many colleagues across our Housing Association or Development arm) already take a transdisciplinary approach. We work with building physicists, social scientists, sustainability experts, community groups, architects, designers and other professionals. A deep understanding of the difference between practice and academia is still required."* (Clarion)

A main concern among partners is the possible detachment between theory and practice that could characterise collaboration with academia: the fact that researchers' interests and research outputs might be confined in theoretical and conceptual terms, whereas practitioners need "research that would have practical application" (SYAA), "useable and implementable knowledge" (Ceraneo). Therefore, in order to be relevant to practitioners, research should not be "detached from (...) down to earth everyday problems" (Incasòl), but rather connected to them, in order to try to "find solutions to the problem statements" (Clarion). Such solutions can be of different types, such as "solid evidence for decision makers to prioritise sustainability from an economic point of view" (SYHA), or "results that can be applicable on a general policy level and on a more specific and practical organisational level" (EFL).

However, bridging theory and practice is necessary both in terms of knowledge building and in terms of knowledge transfer. Upstream, different types of stakeholders should be included in the research process in order to reflect the different perspectives of the "policy and practice 'community'"(HE) and contribute to a research co-creation process. Downstream, such a process should also "help to bring the results into practice with our members" (EFL) i.e. housing associations, companies and experts in the field. Therefore, partners should play a significant role in all phases of a transdisciplinary research process. They intervene in the identification of challenges and of knowledge gaps for the definition

of research topics and research questions, in setting up research methodologies involving practitioners and in collaborative data gathering, as well as in validating and disseminating results and in their translation in orientations for action.

The RE-DWELL secondments

The most intense interactions between partner organisations and the RE-DWELL PhD researchers took place during the secondments, that are periods of one to three months during which the researchers were based on the premises of one partner organisation where they participated in the organisation's activities, in conjunction with their own research work. The exchanges that took place during these periods have fuelled the first two phases of the individual research projects, namely the elaboration of the project including inputs from practice, and the definition and implementation of the research methodology. ESRs could gather first-hand knowledge of practices in their host organisations and had access to resources and support for the development of their individual research projects.

Moreover, secondments can be seen as a two-way exchange and as a way of contributing research to the activities of partners, since they allow partners to use the research capacities of the ESRs for their own activities. Since the relation between the organisation and the consortium is not a commercial one and the PhD researchers are not in an employment relationship with the partner organisation, their common interest is in joint learning.

Part B of the survey addressed to partners (see Annex 2) concerns their experience with secondments and invited them to provide feed-back on how these periods were perceived by the hosting organisation. First and foremost, immersion in a professional environment is acknowledged as a possibility for ESRs to bridge theory and practice and to get to grips with the complexity of real-life problems. This complexity is due to the specificities of the social housing field and of the functioning of large organisations (e.g. Clarion), but also to the local and cultural background that is needed for apprehending the field when one comes from another country and a different culture, since housing policy issues have deep roots in the "socio-cultural tradition of communities and societies" (Ceraneo). Overall, secondments allowed PhD candidates to perform "a reality check to their research hypothesis" (HE), while also deepening the understanding of the topic and clarifying research questions (MRI).

Moreover, researchers could acquire a fine-grained understanding of the institution contexts, not only in terms of constraints and what can be considered bureaucratic red tape, but also in their adaptation potential and in terms of resources and leverages for transformative change:

> *"They learned about the actual complex governance of social housing management structure and finance in a region such as Catalonia. And about a number of projects that have been upgrading public rental housing in Catalonia and also projects led by local authorities that build on tenants' involvement."* (Incasòl)

> *"We believe it was learnt that the institutions have semi-rigid ways of facing problems, but that the technical staff, together with the local partners they work with, present creative ways of overcoming this rigidity with the focus on responding to the needs of the territories."* (LCC)

This potential for adaptation also lies in the "supportive working culture" within housing associations (SYHA) and other organisations, that researchers acculturated with during the secondments. In return, ESRs could also contribute at their own level, to possible transformations in thinking about certain aspects of partner organisations' ongoing work, by bringing in their own experiences and research-based approaches. Overall, they contributed "a different approach to thinking about our work" (SYHA), creativity, "new thinking" (Clarion) new insights and the opportunity to learn about topical issues that are high on the political agenda (EFL, HE). ESRs have also helped partners in organising and carrying out their own research work by exploring new ways of "working with existing data [...] and through its results, build new instruments" such as those for promoting "participatory citizenship in favour of sustainable integrated local development" at Lisbon City Council, or carry out research in a more effective way.

> "We learned how to make empirical research in a limited period of time with committed ESRs on a relevant topic and present our organisation to local networks as an inventive stakeholder" (Ceraneo).

Altogether, ESRs showed a high capacity to connect to the real-life problems that housing practitioners face and therefore bridge theory and practice for tackling those problems:

> "What we noticed so far is that the ESRs have a much better understanding of the real practices within the social housing sector (both housing associations and tenants) and therefore are much more capable to relate theory and practice." (EFL)

5.2. "Wicked problems" experienced

In this section we illustrate the exchanges between the research network and partner organisations by means of the concrete wicked problems that partners brought into discussion, either through the survey (Annex 2, section D) or during the forum discussion. Since the RE-DWELL programme should allow knowledge building for tackling problems related to affordable and sustainable housing, the very characteristics of the problems are key for defining the specificities and the purpose of such transdisciplinary efforts. In addition, partners' perspectives into the necessary ingredients of a favourable environment for meaningful knowledge co-production and transfer are .

One of the requirements of partner organisations regarding knowledge production in a European network such as RE-DWELL was its connection to existing institutional and regulatory frameworks. This coherence would ensure the practical employability of results, as, for example, for housing associations in particular locations:

> "The practical application needs to be achievable. Ideally with frameworks embedded within the current systems that already exist, the planning framework, the regulatory framework or funding mechanisms, such as Homes England." (SYHA)

However, the large number of stakeholders and of regulatory frameworks involved, that are themselves a moving landscape, constitute the very essence of national and local housing systems.

A systematic approach for apprehending "wicked problems"

Transdisciplinary research involving academics with different disciplinary backgrounds along with practitioners is needed for tackling "wicked problems" (see Chapter 3).

Moreover, systems mapping can be used as a tool for apprehending interactions between the different dimensions of the problem, the involved stakeholders and their interrelations (Jonsson et al., 2021; Rittel, 1973). Moreover, systems thinking has been suggested as a reference for RE-DWELL by one of the partner housing organisations, based on previous work done in 2020 by the National Engineering Policy Center, in the UK. This work consisted of mapping the multiple actors, disciplines and perspectives across the national housing system, based on a participatory mapping methodology. Such a comprehensive and systemic approach is considered by several RE-DWELL partners as being useful for tackling complex problems of housing and for steering transformative change in the field:

> *"As a sector we already have multiple checklists, toolkits and guidance documents of all kinds. What is lacking is a systems approach to how these mesh together."* (Clarion)

> *"A full system approach [would be necessary for large scale production, especially when using modern methods of construction (MMC or 'smart construction')], so a recognition that it isn't just an association that delivers housing, it's contractors, it's smaller, medium sized enterprises, etc. etc."* (SYHA, forum)

Certain aspects of complex problems of affordable and sustainable housing can be more recent or be exacerbated by the present economic context, such as:

> *"The increasing cost of construction (mainly driven by the price of materials but not only), as well as delays in construction and renovation due to different factors; increasing interest rates/cost of finance; increasing inflation which is impacting the capacity of tenants to make ends meet."* (HE)

Yet, other aspects that are part of "wicked problems" are long standing, or even structural, mostly related to the financial models of social housing in different countries: "in many cases a 'weak' financial model – or better we should say necessarily dependent on public funding" (HE). Such structural problems become more burdensome in the present context of inflation, but also in times of disengagement of public authorities from housing issues and in an age of austerity in public funds management.

"Wicked problems" as trade-offs at different levels

The economic and political environments are unfavourable both to the development of affordable housing and to the implementation of advanced sustainability principles in new housing production and retrofit. The essence of most complex problems lies in this double struggle and reflects in trade-offs at different levels. We will illustrate such trade-offs that practitioners from the housing field face, starting with the political and strategic level, to the internal priorities of housing organisations' activities, all the way to the design of new developments or renovation schemes. The need to prioritise investments puts in competition the main objectives of housing policies in Europe, that are, according to Housing Europe, affordability, sustainability and availability (HE). In these trade-offs, preference may also be given to certain stakeholders over others, which often results in the views of communities directly affected by certain policies being overlooked:

"The social and public housing sector has the responsibility to balance all these aspects in their projects, which is often a very complex puzzle. It requires technical and financial capacity and knowledge on how to work with residents and communities as well as different stakeholders." "We have to make sure the social aspects of the energy transition are at the same level as environmental objectives, or it will not work, nor generate the consensus and take up that are needed." (HE)

These trade-offs and the necessity to balance between diverse actors, and sometimes contradictory factors, are the essence of wicked housing problems, to which add the local specificities of each housing system. Let's take a first couple of examples of wicked problems at the policy level. In Catalonia, Incasòl, as a public housing developer, provides land, produces housing and is also involved in local policy making for increasing social and affordable housing provision. Boosting this production, both through partnerships with public and non-for-profit developers, is a complex challenge. Public housing providers find it difficult to change the tenure model from ownership to rental, and non-for-profit developers face difficulties in accessing finance and scaling up their production. The situation is even "wicked" since private developers don't find interest in engaging in affordable rental schemes. Several factors, such as increasing costs and changing legislation, keep them from developing partnerships with local public agencies such as Incasòl for accessing land, as well from teaming up with investors for accessing finance. In this case, research could give an account on the multiple tensions that need to be integrated at the strategic level, and to identify the enablers and inhibitors of new forms of cooperation for the production of affordable rental housing, or for the renovation of the existing housing. "Tools and resources, but not just financial" (Incasòl, forum) are needed to attract private companies towards the construction of new affordable rental schemes, but also, in order to renovate the existing housing stock such tools and resources should be oriented towards mobilising homeowners.

However, what makes a problem "wicked" are the interconnections between different factors that new policy adoption can generate unintended effects that can be contrary to the foreseen goal. Therefore, understanding how the whole system works, including housing policy, the social structure but also "interactions between the different actors in the housing market and households" is essential for embedding new policy in an existing system and in this way ensure its effectiveness. The representative of the Metropolitan Research Institute in Budapest gave the example of passing a law that forbids the eviction of families with children. Such a law can have as an unintended side effect the increase of rents for families with children reflecting landlords' reluctance to let their properties to families (MRI, forum). Altogether, a thorough understanding of how the whole system works is the way for tackling wicked problems at the policy level.

At a second level, that of organisations, trade-offs between different aspects of their activities become necessary in order to manage the financial tensions between them: keeping the rents and the financial burden for tenants on an acceptable level; improving the current stock both in terms of overall quality and of sustainability; meeting the demand and therefore expanding the housing stock in a period of housing affordability crisis; offering more social support for the tenants (EFL).

Finally, trade-offs and conflicting limitations are found also at a third level of the housing project, and they concern, for example, the relation between quality and costs in housing design, as for example at South Yorkshire Housing Association:

"We want to increase our output of new homes without compromising on quality if possible. We value the impact of place-making on people's self-image and quality of life, as well as the quality of the home itself. We see our homes as delivering on people's wellbeing as well as providing a roof over their head."

"We want to build the highest quality homes that we can, but times are tough and costs have escalated so the temptation is always to cut the up-front costs and 'dumb down' a scheme." (SYHA)

Evidence production for transformative change

Understanding the different dimensions of "wicked problems" in housing is essential for fostering change through the existing system's adaptation. The role of research from this perspective can also be the production of evidence that enables decision-making and ultimately shifts current practices. Evidence production as leverage for transformative change can come in different forms, as for example, evaluation and monitoring of new or experimental policy initiatives. For example, the evaluation of citizen participation policies carried out by Lisbon City Council and the assessment of their impacts (LCC) or "evidence-based policies for vulnerable groups associated with new social risks regarding affordable housing" (Ceraneo) including the "systematic monitoring of programs and measures" (Ceraneo, forum).

Evidence can also come in the form of economic calculations or modelling, or through the evaluation of specific strategies and projects in terms of efficiency and cost effectiveness. Partners have proposed the co-production of a business case by practitioners and academia that can be used as an argument in the trade-offs of social housing production (SYHA). In the context of inflation and austerity that pushes to superfluous cost reduction and of a housing market where house values are low, the grant rates requested by housing organisations are not always deemed value for money by the funders (forum discussion). Changing the financial rationale of grant allocation needs solid evidence, such as life cycle costs calculations that can prove that the costs are lower on the long run when higher investments are made on "environmental sustainability measures and other quality aspects such as higher space standards, public realm etc" (SYHA).

Evidence can further contribute to change in current "business models", and create drivers for the promotion of certain types of construction, such as prefabricated sustainable buildings – or 'smart construction' – when supported by targeted policy incentives and financing mechanisms (Casais, forum). However, such change in practices also relies on change in mentalities, imaginaries and values that are embedded in the professional and political culture. This is another dimension that makes affordable and sustainable housing production a "wicked problem". In Portugal, for example, in order to scale up production, new values such as sustainability of buildings and end user affordability need to gain importance over "the overall profitability of the development" (Casais). In a similar way, for new and more productive building solutions to be implemented "shifting the mindset [is needed] from conventional construction to the industrialized one" (Ibid.).

Even if national housing regimes are still dominant, especially in terms of specificities of legislative organisation of the field, certain "wicked problems" need a systemic perspective that goes beyond the national scale and includes European policy and

international organisations. Such an approach can instil change through transfers of policy and inspiring examples of practices, but also by joint knowledge production among activity sectors and academic disciplines:

> *"Sustainability and affordability and more specific energy poverty, require a more multi or transdisciplinary way of working. It would be very helpful if RE-DWELL could provide a framework [for] how to align the different levels: (inter)national policy – organisational policy and connecting the different disciplines involved (technic, finance, social)."* (EFL)

5.3. A pan-European perspective

As mentioned in Section 5.1, knowledge exchange and learning among the different European partners is one of the main drivers for their participation in the RE-DWELL project. However, the knowledge contributed by them is situated in particular geographic, social and political contexts, and embedded in very different institutional traditions and diverse housing systems. How partners' inputs articulate with common intentions in a collaborative process represents one of the most challenging aspects of the construction of a transdisciplinary environment within RE-DWELL: "Is the intention to devise a pan-European assessment or one that is sensitive to local context?" (Clarion).

The creation of a transdisciplinary environment combined different levels and contexts where partners' practices and knowledge are rooted: specific local, national and sometimes international settings (see Table A.1 in Annex 2). In addition, ESRs' research projects span between different geographical locations, such as those of partner organisations that hosted them for secondments and those of the case studies they analysed, and create connections between them. Moreover, the TEASH tools should be applied in different European contexts and thus be relevant for stakeholders in different settings.

In this section we will discuss the perspectives of partner organisations on possible interactions between these different levels – from specific local contexts to the European scale. We will also examine the nature of the possible relationships between these different levels of creation and implementation of a transdisciplinary environment and of tools for knowledge exchange and knowledge building.

Knowledge building from the local to the European level

One of the ingredients for the construction of the TEASH is the library of cases (presented in Deliverable 4.5). These examples have been selected, documented and shared through the website, while others have been presented in different network events. Sharing "best practices" and learning from them appeared to be one of the main interests mentioned by several partners in the survey (LCC, Casais, Ceraneo, EFL). Inspiring examples of practice in response to similar challenges that partners face in their own practice also allow to translate theoretical positions or policy orientations, that can be considered too abstract sometimes, into specific and concrete actions:

"We very much believe in best practices because they inspire our members to apply the recommendations and guidelines in practice. Furthermore, policy and practice recommendations should be well applicable for housing associations, which asks for a real connection between theory and practice." (EFL)

"Recommendations should be translated at a level at which housing providers can really use them and make them work. This is one of the basic assignments that we have as organization." (EFL, forum)

Knowledge sharing and learning about different practices at European level, or between certain selected areas, can also be more structured knowledge, such as comparisons and taxonomies. In some cases, ESRs develop such systematic comparisons in their research (e.g. the PhD project of Tijn Croon, the paper of Fernández et al., 2023). Partners have expressed their interest in this type of structured knowledge on specific themes. For example, Lisbon City Council was interested in "a taxonomy of local governance structures for shared decision-making between the public administration and neighbourhood local organisations." (LCC)

Transferring back from the European to the local level

Moreover, sharing "best practices" and knowledge among stakeholders from different geographical areas should be the first step towards transformative change in one's own context of practice. Inspiring examples from a different setting can generate experiments for innovations in a new context. However, in order to transfer practices, the adaptation of the model to the specificities of the local housing system appears to be a huge pitfall. Hasty transfers can be risky:

"There is huge diversity across Europe and very diverse 'starting points' in terms of quality of the stock, types of ownership, actors involved, policy and regulatory frameworks... we should avoid falling into the 'one size fits all' approach." (HE)

"A broad best practice often feels too rooted into a specific local environment (legal, economic, social) and extremely hard to transplant. Guidelines and recommendations that take into account local constraints are more useful." (Incasòl)

Local and national housing contexts are very different in terms of policies and legal frameworks, history and traditions, institutional landscape of housing providers, characteristics of the housing stock, housing and land ownership patterns, etc. Nevertheless, even in front of such diverse housing contexts, practitioners face certain common and long-lasting problems (i.e. housing provision for low-income households) and they often develop similar solutions and policies to tackle them. These commonalities make the search for inspiring models of practice from other settings in Europe and their translation into one's own context a noteworthy strategy. Therefore, RE-DWELL can give an impetus "for trying our new ideas, solutions and policies", thus stimulating mobility of such models of practice, that can eventually promote the "most robust ideas." (Clarion, forum)

Deepening, broadening and scaling up

In order to avoid "one size fits all" approaches and a too hasty translation of "best practices", cross-reflections on one's own system of reference and on similarities and differences with another inspiring context are needed, as suggested during the forum: "It's really very important to understand the difference of the nature of the housing affordability in Amsterdam and housing affordability in Bratislava or in Budapest." (MRI, forum) This can allow a deep understanding of the problem embedded in a particular local context and of possible solutions that one needs to align to that context. Such context-related thinking can allow one to reflect on "why might something work in this place but not in another place" (Clarion, forum). This reflective process can result in changes in the way of considering the problem and have implications in terms of transforming ideas, practices and even organisational arrangements.

The literature on policy mobility has studied such processes of "policy transplantation" and has stressed the context-dependency of policies that "prosper under specific conditions", hence the importance of paying special attention to the social context and cultural acceptance (Noori et al., 2023). These authors propose a theoretical framework for successful transplantation processes that comprises two preliminary phases of "readiness assessment" and of good practices analysis and learning before the actual policy transfer (Ibid.). In the process of policy transplantation, the first phase concentrates on the socio-economic and technological environments of the recipient context, as well as on the politics and governance systems at the national and local levels. It is a preparation stage that comprises knowledge exchange and pilot experiments that can "shift policy preferences or beliefs of decision-makers and encourage them to select policy ideas" in order to answer local problems. The selection of policies is thus in line with local circumstances. Moreover, the subsequent "policy localization" of selected "good practices" prepares the policy adoption phase by "exerting contextual constraints, application constraints, and entails the mutation of transplanted policies which leads to co-called policy innovations" (Ibid., p.7).

Knowledge transfer and learning thus constitute a prerequisite to policy mobility. They help in the selection of policies and practices that are relevant to a particular local problem, and in the adaptation of structural arrangements in the recipient local context prior to policy transplantation. In the literature on the management of sustainable transition experiments, such adaptations through knowledge exchange are called "deepening" (Van den Bosch & Rotmans, 2008) :

> "What actors learn when deepening includes shifts in ways of thinking, values and perspectives (culture); shifts in doing things, habits and routines (practices); and shifts in organizing the physical, institutional or economic context (structure)." (Grin et al., 2010, p. 208)

The TEASH can play a role in fostering such "deepening". It can engage partners in learning processes with the aim of understanding different models of practice and their possible implementation in a new context with the aim of changing one's own professional culture, professional practices and of getting partners involved in the transformation of local institutional structures.

Finally, another challenge is to prepare innovations to scale up or be replicated in another context when "their time has come" (Clarion, forum). The two other phases of experiment innovation development towards transformative change have been conceptualised as "broadening" and "scaling up" (Grin et al., 2010; Van den Bosch & Rotmans, 2008).

"Broadening" means repeating experimental practices "in different contexts and linking to other functions or domains" (Grin et al., 2010, p. 208). In the field of affordable and sustainable housing, this implies translating practices between contexts, with all the difficulties that such translations imply. However, the "deepening" phase, mentioned before, allows to prepare the "broadening" stage, through comprehensive understanding of the problem and of possible solutions and adaptations of the existing system in order to support new solutions. Finally, "scaling up" allows for the new "constellation" of the transformed culture, practices and structure, in relation to alternative practice, to "attain higher influence and stability and to increase its share in meeting a social need" (Grin et al., 2010, p. 209) and thus become part of the dominant way in which housing needs are fulfilled.

5.4. Conclusion

Partner organisations brought in concrete problems they are confronted with in their current practice, put forward as "wicked" or complex. Such challenges span over different domains and involve multiple stakeholders from multiple activity sectors, from the public to the private and third sector all the way to residents and citizens. Research can support the definition of the appropriate tools, resources and leverage actions in line with the expected outcomes. It can also help in identifying unintended results that might appear when new policies and their implementation mechanisms are confronted to the reality of the housing market and to the practices and cultures of its different actors, such as housing providers, households, financial organisations, etc. Research can contribute to addressing the wicked problems of housing when they are translated in trade-offs between different aspects of affordability and sustainability.

As argued in this chapter, trade-offs appear at different levels. At the political and strategic level, they concern, for example, resource allocation and political priorities definition between the social and environmental aspects of energy transition. Furthermore, they concern the involvement and support of certain stakeholders, such as home owners and companies involved in renovation, for example, and the neglect of other concerned parties such as tenants.

At the level of affordable housing providers, the trade-offs are numerous in the current period of inflation (of building costs, energy, etc.), of increase in land prices in urban areas and of austerity in public expenditure. In order to maintain their economic balance, housing organisations must set priorities and mediate between conflicting imperatives: retrofitting the existing stock or building new in order to meet the increasing demand of affordable housing. On the one hand, these expenditures impose increasing own funding that can be provided through rent increase or from selling a part of the housing stock, for example. But on the other side, social imperatives require more social support for tenants and maintaining rents affordable, and building new housing at affordable prices in well-located areas becomes an almost impossible equation. Last but not least, trade-offs appear at the level of new housing projects: between quality of the designed spaces with consequences on the quality of life of future residents, environmental sustainability performance and, also of the balance, the funding possibilities and the final housing cost.

RE-DWELL partners expressed different needs that the programme could answer. First of all, the knowledge production that they seek should prepare them to engage in these trade-offs with policy-makers and funders, among other partners. They are looking for

research-based evidence supporting their arguments in negotiations, building alternatives and ultimately changing the dominant practices and mentalities beyond their own organisations. Secondly, knowledge produced in the programme should be directly related to a problem statement, applicable on policy and organisational levels, and translated in concrete actions such as a business case and connect to existing institutional and regulatory frameworks. Thirdly, the main need expressed by the partners was gaining a deeper understanding and a broader view on possibilities for action. Last but not least, the knowledge environment the partners need should not be a set of criteria or checkboxes. Instead, comprehensive tools for affordable and sustainable housing production should clarify the interrelations that constitute a local housing system, in order to allow actors to activate leverages and prevent unintended effects of new policies or practices. They should facilitate learning, be oriented towards "deepening", as a preparatory phase for transformative change. "Deepening" can facilitate the transplantation of policies and practices from another context, by embedding such new actions in a local system while also transforming it. In the learning process initiated by RE-DWELL, transdisciplinarity is present both in terms of fluidity of knowledge circulation between academia and practice, between activity sectors related with housing and between different European local contexts.

6. Existing tools for affordability and sustainability of housing

In the previous chapter, discussions with partners highlight the complexities of addressing affordability and sustainability housing challenges. A conclusion can be drawn that knowledge tools are essential for analysing and tackling these issues collaboratively with practitioners and academics from various disciplines.

This chapter follows up and is intended as a state-of-the-art overview, focusing on tools designed to facilitate learning about affordable and sustainable housing in collaboration with other stakeholders to achieve shared objectives. Specifically, it provides an overview of "multistakeholder frameworks" featured in academic literature as decision-making tools to address housing affordability and sustainability.

The starting point was to identify frameworks that address the complexities of both housing affordability and sustainability, providing insights into existing knowledge. Frameworks were selected for this overview based on criteria that aligned with a transdisciplinary approach: (1) the inclusion of multiple stakeholders from diverse disciplines and (2) the inclusion of academic knowledge and practical knowledge from policymakers, professionals, consumers, and other relevant actors to create tools that help stakeholders address the complex challenges.

Criterion for a framework to be included was that it was developed (directly or indirectly) through a (systematic) academic literature review, followed by engagement with stakeholders relevant to that framework's objectives. These tools establish criteria to "assess" affordability, sustainability, and the trade-offs between them within specific projects, thus functioning as frameworks that structure each project's approach.

The nine frameworks are briefly introduced in the next three sections of this chapter, with a comparative analysis in Section 6.4 and conclusions in Section 6.5.

6.1. Housing policy

UN-Habitat multi-scale framework for sustainable housing policies

To design sustainable housing policies, UN-Habitat published a variation of the - sustainability dimensions approach (Chapter 2) and presented a so-called "multi-scale framework [specifically] for sustainable housing policies" (Golubchikov & Badyina, 2012, p. 8), which is summarised in Figure 6.1. To achieve sustainability:

> "Housing practices must be adjusted to achieve multiple benefits across the four sustainability dimensions – to simultaneously improve people's livelihoods, contribute to the economy, and enhance the environment. A crucial aspect is sustainable policy delivery. The latter relies on a strategic vision and supportive institutions, multistakeholder cooperation, and sustainable sources of funding – all underpinned by appropriate regulation and capacity building." (Golubchikov & Badyina, 2012: 66).

From a human rights perspective, the emphasis is on the added value of adequate housing for people and society. In other words, affordable sustainable housing is not just

an aim, it is at the same time a means to achieve other/higher goals such as reducing poverty and negative effects on the climate.

SUSTAINABLE HOUSING		
Environment Housing in natural and local environment	**People** Housing as arena for socio- spatial justice and culture	**Prosperity** Housing as a driver of economic growth
Housing system to protect natural environments, use natural resources prudently, mitigate and adapt to climate change	Housing system to ensure everyone has access to a decent affordable shelter in a place which is desirable to live in	Housing system to support a strong, responsive and competitive economy at local, regional and national levels
Social footprint assessment, economic footprint assessment, environmental footprint assessment		
• Appropriate institutional, legal and regulatory setting • Multi-level and multi-stakeholder governance and cross-sectoral cooperation • Housing as part of National Development Srategies, Sustainable Development Strategies, Poverty Reduction Strategies • Tools: housing strategies, building regulations, spatial planning, land provision, funding, capacity building • Monitoring, implementation or policies and projects		

Source: UN-Habitat, 2012.

Figure 6.1. Sustainable housing policy (Golubchikov and Badyina, 2012, p. 67)

Underlying such policies is the framework of four dimensions, as developed in the Circles of Sustainability method (James, 2015), including social (rather than politics) and environmental (rather than ecology) as dimensions, next to the cultural and economic dimensions. Underlying is also the attempt to ensure to take into account the multiple scales of governance: macro (national), meso (region, city) and micro (neighbourhood, household), as can be observed from Figure 6.2.

	MACRO (NATIONAL)	MESO (REGION, CITY)	MICRO (NEIGHBORHOOD, HOUSEHOLD)
Environmental dimension	Housing to support climate mitigation and adaptation efforts. Mainstreaming green housing practices and innovations. Ensuring energy and resource efficiency in the building industry. Integrating national housing and energy systems.	Achieving good location and density for residental areas and access to infrastructure. Serviced land in environmentally safe locations and green areas. Protection of ecosystems and biodiversity. Promoting sustainable and low-corbon urban infrastructure, public transport and non-motorised mobility, energy systems. Waste management and recycling.	Ensuring energy efficiency, micro/ generation, water and resource efficiency. Green design, using sustainable local construction and materials. Sanitation, preventing hazardous and polluting materials. Affordable use of resources. Improving resilience and adaptation of homes.
Social dimension	Fulfilling the right to adequate housing and promoting the right to the city. Ensuring affordable, decent and suitable homes for all, including disadvantaged groups. Developing social housing provision. Promoting choice and security of tenure.	Promoting integrated comunities and ensuring trust in communities. Providing community facilities, preventing segregation and displacement. Regenerating and reintegrating 'neglected' areas into regional, urban fabric. Ensuring infrastructural integration of housing into wider areas. Upgrading inadequate housing and slum areas.	Empowering people and ensuring public participation. Ensuring health, safety, well-being in residences. Creating a sense of community, 'sense of place', and identity. Meeting secific needs and wants in housing (including those related to gender, age and health). Providing access to infrastructure and public spaces.
Cultural dimension	Promoting links between housing and knowledge-based and cultural economies. Promoting traditional, indigenous and local knowledge (including of relevance to sustainable resource use, energy efficiency and resilient building techniques). Protecting cultural heritage.	Promoting urban creativity, culture, aesthetics, diversity. Shaping values, tradition, norms and behaviours (eg. in relation to energy use, recycling, communal living and place maintenance). Protecting housing heritage and familiarity of city (eg. preventing unnecessary social replacement/ gentrification or complete redevelopment).	Culturally responsive settlements and house planning and design. Imrpoving aesthetics, diversity and cultural sophistication of the built environment and residence. Helping community creativity (i.e. via amenities; affordable sporting, cultural and entertainment facilities. Assisting people's transitionfrom rural and slums areas to decent housing or multifamily housing.
Economic dimension	Institutional capacities for sustainable housing markets and housing development. Articulating housing productivity within national economic systems. Improving housing supply and effective demand, stabilising housing markets. Improving housing finance options. Promoting innovations in housing. Stimulating necessary technological developments for sustainable housing.	Managing economic activities and hrowth by strengthening housing provision and housing markets. Provision of necessary infrastructure and basic services to housing. Providing serviced land for housing. Strengthening entrepreneurship of communities, local building industry and enterprise. Promoting local and traditional building materials and techniques. Promoting regional and urban regeneration.	Ensuring housing affordability for different social groups. Providing adequate residences to raise labour productivity; ensuring housing is integrated with employment. Supporting domestic economic activities and enterprise. Promoting petty landlordism and self-help housing. Housing management and maintenance. Strengthening resilience and future-proofing of homes.

Source: UN-Habitat 2011c

Figure 6.2. Multi-scale framework for sustainable housing policies (Golubchikov & Badyina, 2012: 8)

Framework for evaluating the sustainability of public housing programs

Arguing that such a framework is missing, Ibem and Azuhs' (2011) develop another framework that started explicitly from 'the' human rights perspective (Brundlandt, 1987). It aims to ensure the balance wellbeing of present and future generations, but also to evaluate the sustainability of public housing programs in developing countries, as presented in Figure 6.3:

> "housing programmes are described as sustainable initiatives when they provide housing that meets the needs of present generation without compromising the chances of future generations to meet their needs... sustainability of public housing programmes is therefore viewed as the [four-pillar] long-term economic viability, social acceptability, technical feasibility and environmental compatibility of such programmes that ensure their continuity." (Ibem & Azuh, 2011, p. 28).

The cultural dimension links architecture with the way of life of residents and their cultural values, as well as with the history and culture of the location. Ibem and Azuh (2011) leave the testing of the "subjective" assessment framework to others by proposing that data collection should take place by observation, interviews or surveys.
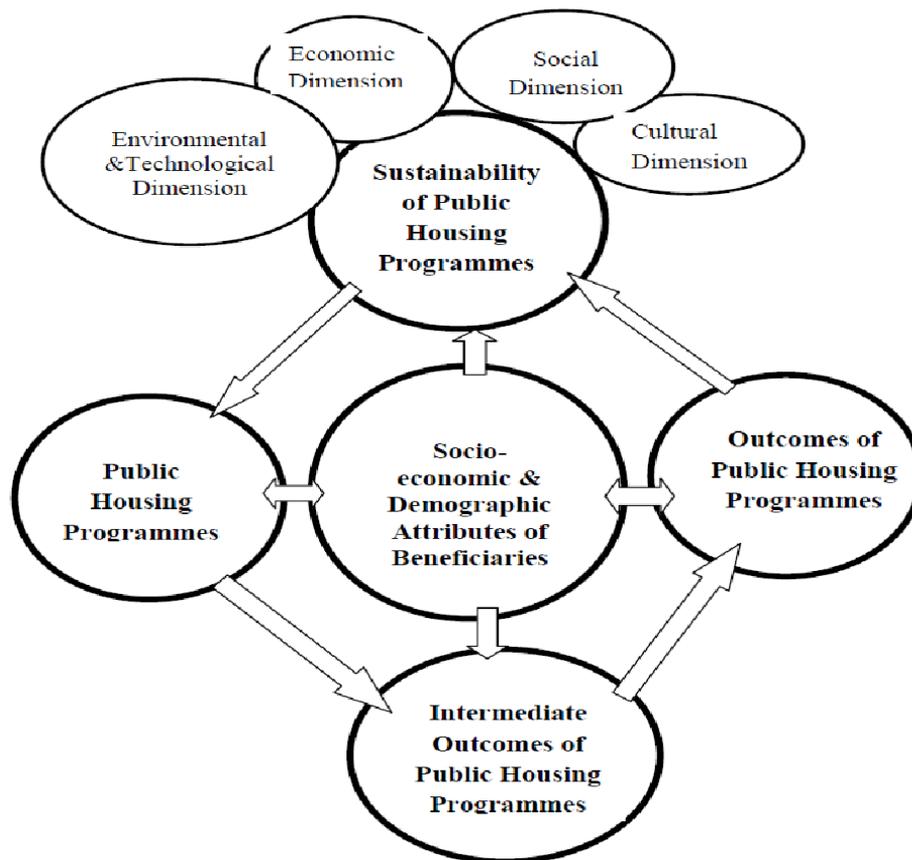
Figure 6.3. Framework for evaluating the sustainability of public housing programmes (Ibim & Azuh, 2011, p. 32)

6.2. Sustainable housing

Sustainable housing development principles

The framework by Turcotte and Geiser (2010) aims to test the implementation of ten sustainable housing development principles derived from the literature (Figure 6.4) in projects that develop sustainable housing.

1. Incorporate **green design**: Promote integrative approaches through water and resources conservation, energy efficiency and renewable energy use, improved indoor air quality, use of natural sunlight, recyclable and less toxic materials, and ongoing sustainable operation practices to minimize adverse environmental impact.

2. Provide **safe internal conditions**: Maintain an indoor environment with adequate space, comfortable temperature and humidity levels that are physically safe and healthy, and where overall psychological well-being is promoted.

3. Encourage **affordable and equitable distribution/consumption of housing** resources: Maintain occupant housing costs at a level that does not sacrifice resident's ability to meet other needs; allow individuals at the same income level and housing needs to access comparable housing resources with the targeting of these resources (subsidies and tax incentives) to groups with the greatest needs; and regardless of household income, all individuals will have access to a level of housing quality as defined by and occupied by most groups in society.

4. Support **financial viability for housing producers**: Create an economic environment with sufficient incentives (but not so excessive as to impact affordability) to address the community demands and needs for shelter over the long-term.

5. Promote **occupant-neighborhood linkage:** Locate and design housing in mixed-use neighborhoods to maximize density and efficient land use, minimize sprawl and automobile use by encouraging alternative transportation options (trains, buses, metro, biking, walking, etc.), and to promote active living near employment, commercial establishments, and important community institutions.

6. Maximize access to **healthy environments and support services**: Promote access to safe and attractive public recreational areas, community institutions, and healthy, affordable food outlets and support services, recognizing the relationship between occupant health and a safe, attractive, cohesive, and quality neighborhood, and development of positive social capital.

7. Support **worker well-being**: Maximize the health and safety of workers throughout the supply chain, during construction and maintenance of buildings, and provide fair compensation.

8. Preserve **cultural and housing heritage**: Design housing that preserves, respects, and recognizes the unique historical and cultural characteristics of an area and its residents.

9. Foster **participation and harmonious decision-making**: Promote full stakeholder participation as appropriate to their interests, while addressing the needs of current and future residents, regardless of socioeconomic status, ethnic, religious, and racial background, while enhancing understanding, consensus, and harmony.

10. Increase **adaptability and flexibility**: Provide occupants with flexibility to economically change and upgrade the shape and layout of their homes to meet changing needs within the households (e.g., "Open Building" system) and offer "visitability" for everyone.

Figure 6.4. Ten sustainable housing development principles (Turcotte & Geiser, 2010, pp. 90-91)

Affordable housing is one of the principles and is combined with fairness in the distribution of resources, while a viable business model for the providers is also one (the fourth) balancing the interests of the residents and the providers. The principles were

applied in a study to test two US cases in terms of what definitions were employed and to which extent the principles were applied. Turcotte and Geiser (2010, p. 112) found that the principles form a useful framework, which works in understanding the likelihood of certain factors stimulating that housing development will be sustainable, even if some of the principles are being (partly) ignored. Further testing of the principles are welcome in other projects and in other contexts.

Housing Sustainability Assessment Tool (HSAT)

With a housing sustainability assessment tool (HSAT), Adamec et al. (2021) proposed an indicator-based assessment of housing sustainability in urban areas. The HSAT takes on board the sustainability dimensions (p. 4) from the UN Geneva Charter on Sustainable Housing (United Nations Economic Commission for Europe, 2015): environmental protection, economic effectiveness, social inclusion and participation and cultural adequacy. It also takes on board the housing-related components called the building, the community and the locality.

For each dimension and component (in total 107, reduced to 55 (p.6)) indicators were analysed by an expert panel to conceptualise sustainable housing. This process took on board the trend of the indicators getting more diversified away from only green, for instance, including housing affordability or urban energy consumption (p. 5). Next came the literature study with the help of which the distribution of indicators across dimensions and components were visualised. Figure 6.5 shows, for example, that the social dimension is the largest group with 19 indicators, while the component building is mostly measured with 10 environmental performance indicators.

In conclusion: "HSAT provides a comprehensive tool to assess housing sustainability and to design sustainable housing policies and practical measures" (Adamec et al., 2021, p. 11). The indicator set will be interesting for policy makers (p. 1), urban planners, city officials and investors, once the indicator set will be available as "user-friendly application", the authors expect (p. 11).
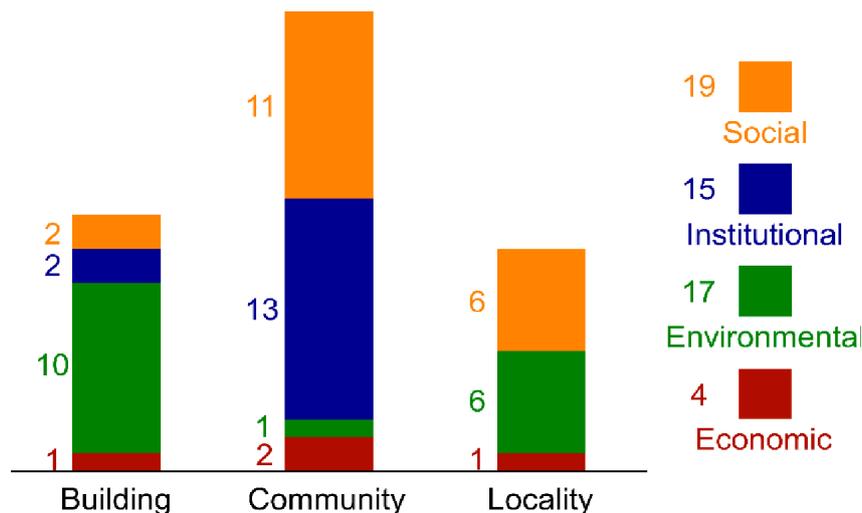

Figure 6.5. HSAT—distribution of indicators within sustainable housing components and sustainability dimensions (Adamec et al., 2021, p. 9)

Design assessment for sustainable housing (DASH) framework

Starting from the observation that most existing sustainability frameworks, assessment tools and guides do not adequately consider the cultural aspects based on resident needs, Piparsania and Kalita's (2022) developed a multistakeholder framework: design assessment for sustainable housing (DASH) framework. The question was, basing the study on three pillars of sustainability from the Brundtland report (Brundtland, 1987), whether the "cultural" dimension based on residents' needs can be considered as extension of the social dimension or whether it should be considered as a fourth pillar in sustainable design.

Figure 6.6. DASH: revised framework, whereby cultural indicators are included in the social dimension (Piparsania & Kalita, 2022, p. 17)

To formulate an answer, Piparsania and Kalita (2022) collected relevant indicators in secondary literature, interviewed Indian residents, asked them to fill in a survey and finally took into account expert opinions. The quantitative research was concerned with calculating correlations between the social and cultural indicators and the indicators from the so-called Green Building Rating System. Figure 6.6 shows their proposed version of integrating the cultural in the social dimension of the Brundtland framework of sustainability. The authors caution that it is a draft framework that can be further developed across other contexts and with more reliable data, while in the end Piparsania and Kalita (2022, p. 18) argue that their work "can be used as a foundation for developing a tool or translating the framework into any suitable application format."

Capability-wheel based on themes of the Quality of Life Foundation (QoLF)

The final framework discussed in this section is the housing assessment framework that Dissart and Ricaurte (2023) propose. They call the framework, which Figure 6.7 shows, a "capability-wheel", as the concept of social value (SV) developed by the Quality of Life Foundation is framed in the capability approach. Capabilities are traditionally defined as citizens' freedom to choose a life which they have reason to value. The framework's aim is to facilitate the understanding of residents' perspectives on the three traditional pillars of sustainability (social, economic, environmental) in terms of their constraints and freedoms.

The framework aims to assist practitioners in using research to design buildings from the starting point of residents' capabilities; in short to stimulate "evidence-based design practice" (Dissart & Ricaurte, 2023, p. 878): "This aim is in line with the need for architects to be more present in discussions about SV [social value] and to demonstrate the potential of design to unpack and create value within communities through post-occupancy evaluation (POE)." (*Ibid.*) Further detailing of the framework is expected to work by taking into account feedback from relevant actors on the different variables. Such a systematic approach aims to allow for prioritising social values across contexts.
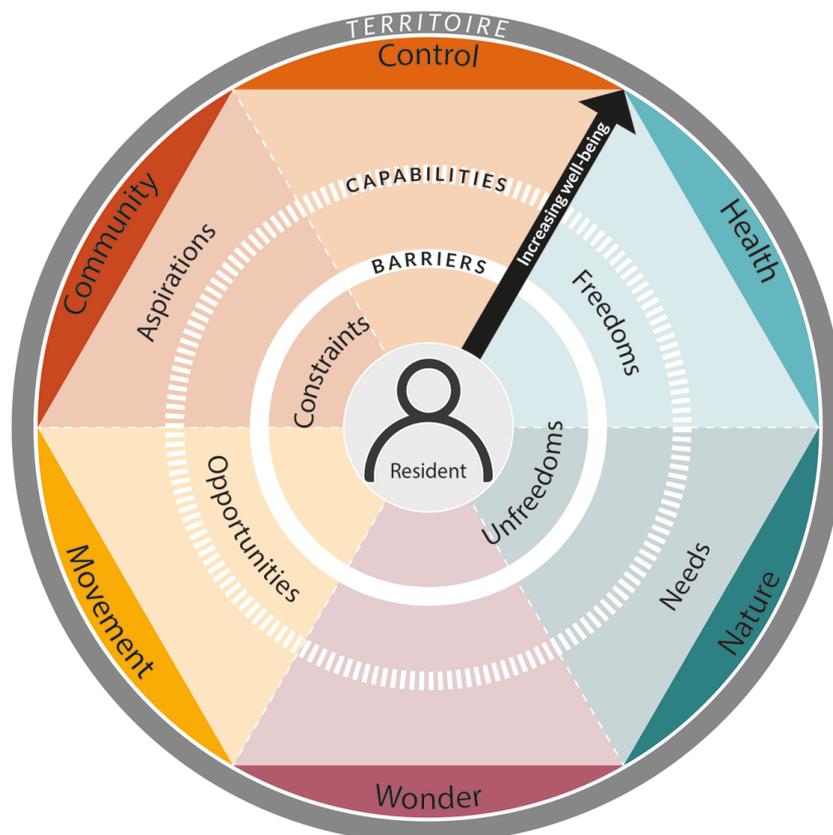
Figure 6.7. The Capability-wheel of spatial quality of life assessment of residents (Dissart & Ricaurte, 2023, p. 879)

6.3. Affordable housing

This section analyses multistakeholder affordability frameworks that explicitly combine with a sustainability perspective or starting point, regardless of whether the start of the exercise is from the affordability point of view.

Affordability and Sustainability Assessment Framework

Starting from the so-called "sustainability paradox" (from Rotmans, 2006, p. 37) that "our current problems cannot be solved with current methods and tools", Pullen et al. (2010, p. 52) suggested that systems thinking (interpretation of Davidson & Venning, 2009; Daniell et al., 2005) may be the future. This entails moving away from the expertise "silos" around the three dimensions of sustainability towards decision making that takes the "inter-relationships" between the three dimensions into account (also: Davidson & Venning, 2009, p. 10).

The interim framework designed by Pullen et al. (2010) aims to assess new urban densifying construction in Australian cities. It is presented in Figure 6.8 and departs from the sustainability point of view but focuses on affordable housing, as it is expected that most benefits of energy efficiency can be scored where these will be most needed. It comprises a whole list of indicators taken from a literature study, among which technical and affordability indicators. The performance assessment framework for evaluating densifying urban house building, that was put together with a team of experts from construction, architecture, planning, local government, land management, housing agency, and with consumers, therefore goes beyond earlier frameworks that mostly focused on environmental sustainability, as Pullen et al. (2010) argue.

Figure 6.8. Interim Affordability and Sustainability Assessment Framework as presented to Industry Discussion Forum (Pullen et al., 2010, p. 58)

This reality check delivered suggestions about possible adaptations of the assessment framework. Pullen et al. (2010) conclude that their interim framework can already be used for qualitative assessment of existing and new projects; however, assessment may be context-specific, and subjective, while the indicators also present "inherent synergies and

tensions" (p. 61) that need further study. Furthermore, "A quantitative application will depend on the evaluation of more rigorous metrics and the development of mechanisms that consider the interrelations between indicators." (p. 61).

Multicriteria decision making frameworks

In contrast to other frameworks, Emma Mulliner and colleagues developed in diverse publications (2013, 2015 and 2016) a multi-criteria framework that is a quantitative one: multi-criteria decision making (MCDM). In these studies, authors developed the criteria for the so-called sustainable housing affordability indicator. This indicator started from the point of view that affordability is not only an economic dimension (housing costs versus income), but also entails indicators impacting on the resident's quality of life; later leading to the focus on neighbourhoods, as well as environmental sustainability (Mulliner et al., 2015).

Methods to build the indicator were a literature study to collect the possibly relevant components which were then validated (survey) by checking the relevant stakeholder perceptions of these indicators, be it 300 (Mulliner et al., 2016, p. 146) or 600 stakeholders (Mulliner & Maliene, 2015) in different studies and different publications.

The housing affordability indicator that was designed aligned with traditional three sets of sustainability criteria. The first set of criteria of Mulliner and Maliene (2015, p. 255) could be classified in the economic dimension as they are concerned with affordability measures (house price to income, rental costs to income, interest rates and mortgage availability; and housing quality) and the availability of rental dwellings, low-cost and market value homeownership products. Under the social dimension, one could include safety (crime), deprivation in the area, and access to employment, as well as other services (transport, education, etc.). Environmental sustainability criteria would include low presence of environmental problems, energy efficiency, and waste management. Putting weights to the different criteria of the sustainable housing affordable indicator, the MCDMs offer a way of trading off conflicting criteria as Figure 6.9 shows for different methods of MCDM (WSM, WPM, etc. in ten locations (A1 through to A10) (e.g., Mulliner et al., 2013). Weighing implies the importance of the targets set.

Method	Alternatives									
	A1	A2	A3	A4	As	A&	A1	As	Ag	A 10
WSM rank	0.1015	0.0972	0.0962	0.1055	0.1013	0.0989	0.0903	0.1024	0.0932	0.1134
	4	7	8	2	5	6	10	3	9	1
WPM rank	0	0.0923	0.0932	0.1029	0.0981	0.0972	0.0811	0.0905	0.0835	0.1105
	10	6	5	2	3	4	9	7	8	1
Revised AHP 1 rank	0.81	0.7812	0.7816	0.832	0.8121	0.7937	0.7407	0.8131	0.7682	0.8884
	5	8	7	2	4	6	10	3	9	1
Revised AHP 2 rank	0.9222	0.8434	0.8445	0.9824	0.9278	0.8775	0.7326	0.9308	0.8079	1.1365
	5	8	7	2	4	6	10	3	9	1
TOPSIS rank	0.4713	0.629	0.4889	0.7909	0.6148	0.5445	0.299	0.5271	0.252	0.8092
	8	3	7	2	4	5	9	6	10	1
COPRAS rank	0.099	0.1015	0.0961	0.1096	0.1021	0.0982	0.0891	0.1009	0.0912	0.1123
	6	4	8	2	3	7	10	5	9	1

Figure 6.9. Ranking of ten locations (A1-A10) based on different multi-criteria decision making (MCDM: WSM rank, WPM rank, etc.) (Mulliner et al., 2015, p. 149)

Good qualitative affordable -equitable- housing prototype for practitioners

Starting from the argument that interdisciplinary academic knowledge does not reach practitioners, Lespagnard et al. (2023) develop a multistakeholder prototype for a framework that is to facilitate the communication between stakeholders on the project level. In their view, "more sustainable and equitable living situations and buildings" (p. 2) will be achieved, defining equitable housing as "affordable or qualitative housing, as the term refers to physical, social, environmental, and financial aspects" (p. 2).

This framework, as the other frameworks in this chapter, was designed based on different types of sources of information: literature and semi-structured interviews with relevant stakeholders. The result is an overview of fifteen dimensions of equitable housing, distinguishing between the following categories of criteria: using, living, financing, dwelling, see Figure 6.10. The idea is to set upper and lower limits for the different dimensions to negotiate solutions that will be acceptable to the relevant stakeholders. These limits are found at the edges of the black area in the figure.
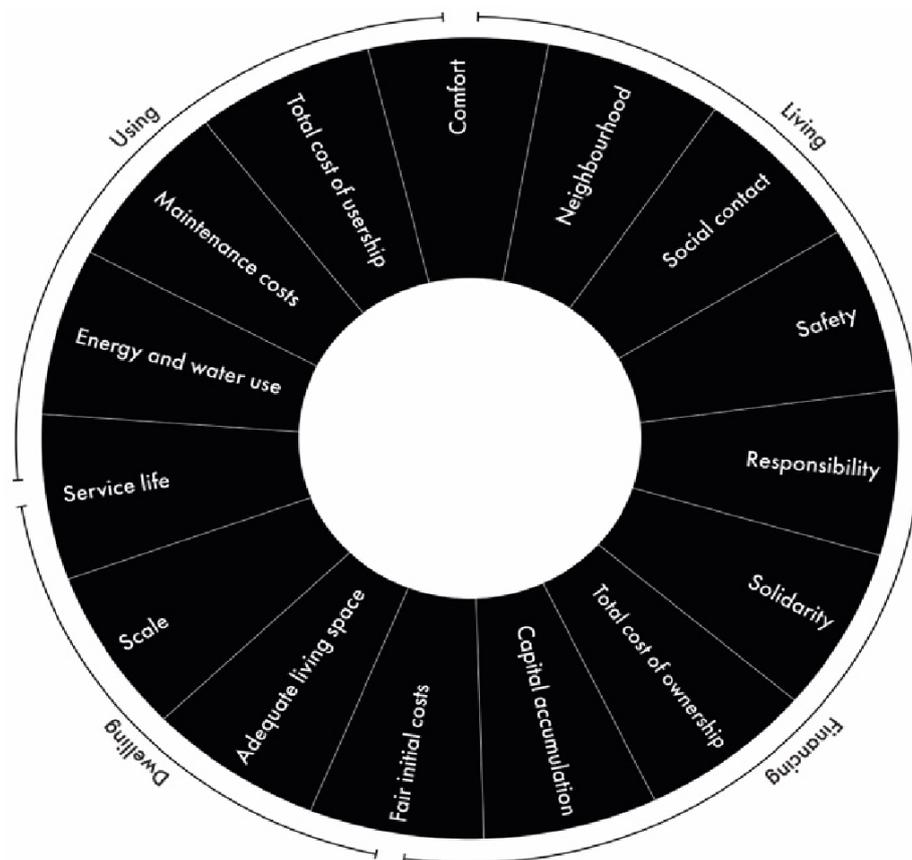

Figure 6.10. To create an equitable housing project, stakeholders should strive to stay in between the defined limits (black area) (Lespagnard et al., 2023: 7)

The prototype was tested with non-academic stakeholders in two workshops studying retrospectively the decision-making process of two projects in Belgium. The prototype aims to facilitate discussion between all stakeholders of a design project, which will include the residents (Lespagnard et al., 2023, p. 6):

> "Therefore, the framework for equitable housing focuses more on the discussion that can arise between different stakeholders and how one design decision can ignite a series of consequences for other dimensions. Rather than obtaining a score, the framework leads towards an inclusive equilibrium of design decisions that fit within the limits indicated by different stakeholders."

It will be clear that not only because each indicator has different dimensions, the impacts will also be diverse, impacting different dimensions of equitable housing, each with its own limits. Sharing facilities, for example, may impact on social contact, safety and solidarity in a project, possibly reducing the cost of ownership. Given different limits for the different dimensions, it is therefore likely that the links between the fifteen dimensions in the prototype require negotiations, most likely striving for win-win situations. Main win will be the communication striving for understanding among stakeholders:

> "Given that every project is unique, the framework allows enough room for interpretation and does not make judgements on the values of stakeholders. Moreover, it allows design teams to think further than their discipline. The framework allows stakeholders from various niches to speak the same language and discuss their needs. It does not tell the users exactly what to do but guides and opens the conversation on topics the stakeholders might not have thought about or were not able to express before." (Lespagnard et al., 2023, p. 11).

6.4. Tools compared

Intended as a state of the art presented in Table 6.1, this section explores existing tools, mostly called frameworks by their designers, that integrate affordability and sustainability dimensions of housing. These frameworks are tools that provide knowledge for the challenge at hand by integrating both housing dimensions from different points of departure. Column 1 of Table 6.1 shows the points of departure of the frameworks, those that departed explicitly from a human-rights-based policy perspective, then from a sustainability perspective and ending from an affordability starting point. This order may be perceived as a bit loose, as technically the sustainability framework with the three or more dimensions can be derived often (implicitly) from human rights roots (Brundtland, 1987), although this is not always acknowledged as such.

A wide range of publications exists on frameworks for affordable and sustainable housing, especially those considered multistakeholder frameworks from a design perspective. The types of stakeholders consulted in the design process are listed in column 4 of Table 6.1. This column, which briefly describes each framework's methods, shows that most frameworks were developed by directly combining insights from academic literature with input from practice (such as surveys or expert panels). This approach helped create definitions of assessable elements and indicators that characterize the dimensions of sustainability and affordability, drawing on knowledge from both academia and practice.

The framework designed may serve several purposes: assessing types of sustainable and affordable housing projects or policies, defining sustainable and affordable housing, providing policymaking guidelines, or facilitating communication among stakeholders (and potentially fostering a common language) (see column 3). The studies addressed various challenges, as shown by the target stakeholders (column 5), target housing types

(column 6), and specific outcomes (column 7). Consequently, each framework was tailored to meet its unique design objectives.

Most studies were exploratory in nature (see column 3). During the design phase, these frameworks benefited from incorporating insights from various stakeholders—primarily professionals but also residents—to understand diverse perspectives. The studies often recommended further refinement of their draft, initial, or prototype frameworks (as indicated in column 7), with the aim of advancing to the next stage of development.

Together, the studies indicate a shift from focusing solely on green sustainability criteria toward a broader range of sustainability dimensions, including social, cultural, economic, technical, and financial aspects. This expansion in dimensions and criteria increases the complexity of housing projects and thus heightens the potential for conflicts among different criteria, a challenge noted by many studies. From a transdisciplinary perspective, this development demands greater efforts to bridge disciplinary divides—whether among content areas or between actors.

Complex challenges necessitate some form of negotiation or regulation to balance the various aspects of sustainability, must be the conclusion. The multi-criteria decision-making (MCDM) models presented by Mulliner and colleagues (2011, 2013, 2015, 2016) illustrate this point well: outcomes vary based on the weighting of criteria. In this context, values and justice are useful concepts to consider. Instead of prescribing rigid measures, the equitable housing prototype developed by Lespagnard et al. (2023) provides a flexible framework for dialogue, adaptable to specific contexts and the perspectives of participating stakeholders. In summary, frameworks that facilitate communication and knowledge sharing appear to be a promising approach for addressing the complexities of housing affordability and sustainability.

Table 6.1. Multistakeholder frameworks for housing affordability and sustainability reviewed in this chapter

(1) Perspective/ Angle	(2) Publication	(3) Type of framework	(4) Method of framework design	(5) Target stakeholder	(6) Target housing	(7) Outcomes
Policy making based on housing as a human right,	UN Habitat (Golubchikov & Badyina, 2012)	Multi-scale sustainable housing policy framework	UN-Habitat cooperation with others; author perspective	Policy makers	Policy making, sustainable cities, developing countries	Recommendations for policy design
Policy making based on housing as means to improve quality of life	Ibem & Azuh (2011)	Proposed framework for evaluating the effectiveness of the sustainability of public housing programs	Literature review	End user and provider (including architect); however, testing of framework: researchers, policy makers and professionals in the field	Public housing, developing countries	Recommendations on applying and testing the framework
Sustainability	Turcotte & Geiser (2010)	A first version of the framework to guide sustainable housing development projects	Literature study followed by in-depth interviews	Development industry professionals, planners, researchers, and construction trade union officials	New housing project development process in urban area, US	10 principles, whether they are applied to development process
Sustainable housing	Adamec et al. (2021)	Proposed housing sustainability assessment tool (HSAT)	Literature reviews and expert panel	Planners, policy makers citizens	Sustainable housing, urban areas	Indicators of sustainable housing; to be transformed into user-friendly system
Sustainable housing	Piparsani & Kalita (2022)	Draft design assessment for sustainable housing (DASH) design framework	Literature study followed by interviews with residents	Scholars, researchers and professionals developing sustainable design assessment frameworks	New housing development projects, India	Indicators for cultural sustainability; integration of cultural variables in Brundtland social sustainability dimension
Sustainability	Dissart & Recaurte (2023)	Proposed assessment framework for resident quality of life: capability-wheel	Social value as developed in the UK Quality of Life Framework	Policy makers and practitioners (architects, designers)	Design and built environment, UK	Indicators that measure/understand the resident quality of life by design: barriers, capabilities, quality of life
Sustainability for affordable housing	Pullen et al. (2010)	2nd interim assessment framework for affordable and sustainable housing	Literature study, indicators and frameworks, tested with experts (discussion forum)	Building industry stakeholders, such as designers, planners, including policy makers, consumers	New housing projects for urban densification, Australia	Performance indicators: affordability and environmental sustainability
Sustainable affordability	Mulliner & different colleagues (2013, 2015, 2016)	Sustainable affordability housing indicators, quantitative multi-criteria decision making (MCDM)	Literature study followed by survey with relevant professionals	Professionals at housing associations, local authorities (planning, housing services), and housing developers	Local policy makers, UK	Ranking of importance of criteria and compared across regions, types of professionals, and MCDM models
Sustainable affordability	Lespagnard et al. (2023)	Visualising equitable housing: a prototype for a framework	Literature study, expert interviews, two retrospective case studies	Practitioner stakeholders in project design; researchers	Design project communication, Belgium	Framework that offers the development of common language among stakeholders

6.5.Conclusion

The frameworks analyzed in this chapter were selected based on their multistakeholder approach, involving diverse stakeholders and an academic foundation. These frameworks share several key features. They are multidimensional, linking housing affordability with sustainability challenges and objectives, and addressing various dimensions of each concept. This approach underscores the complexity of housing affordability and housing sustainability, and different contexts introduce unique requirements. As such, these frameworks bring together diverse dimensions, stakeholders from practice and academia, different disciplinary perspectives, and a range of contextual factors.

Given the current state of the art, frameworks remain exploratory, primarily integrating the knowledge available at the time of writing. Typically, they present academic insights and then assess these with stakeholders within specific contexts. They call for further refinement. Or new frameworks may need to be designed for other purposes.

Importantly, these frameworks often do not serve as direct evaluators of housing issues. Rather, they function as catalysts or facilitators of communication among relevant actors, dimensions, and contexts. By guiding discussions and negotiations, frameworks help to develop a shared understanding (or even a common language), which is essential for balancing the interconnections among dimensions and stakeholders in affordable and sustainable housing contexts. This shared understanding also lays the groundwork for negotiating successful, mutually beneficial—so-called win-win—solutions.

The main takeaway from this chapter is the shared need to grasp the complexity of affordable and sustainable housing, as well as the importance of tools that facilitate this understanding. The frameworks discussed here are shown to support communication, though each has its limitations. In the next chapter, RE-DWELL addresses the need for knowledge exchange in building its transdisciplinary environment.

7. Transdisciplinary environment for affordable sustainable housing

RE-DWELL's research faces a central challenge: how to effectively bridge disciplines and make a transdisciplinary approach impactful for society. In the context of affordable and sustainable housing, transdisciplinarity means fostering a "joint focus" through coordinated activities that build shared understanding and facilitate knowledge exchange. Achieving this requires creating transdisciplinary research and learning environment, involving both the competencies of participants and tools that support knowledge sharing.

In this chapter, we introduce a RE-DWELL transdisciplinary environment for affordable and sustainable housing as the result of the collective activities, a comprehensive literature review, and an assessment of the needs of partner organizations. The focus is on equipping ESRs with the skills to make a meaningful impact on the "wicked problem" of affordable and sustainable housing provision in Europe.

The chapter includes lessons learned from our project journey and establishes the foundations for the RE-DWELL transdisciplinary environment. It covers the steps taken and the learning process of not only ESRs but the whole consortium, in particular in overcoming differences in methods, concepts, and approaches. Additionally, partner organizations and societal stakeholders look for insights that can help address their challenges. They value research that generates knowledge directly applicable to their complex issues. The literature shows that numerous tools exist for addressing affordable and sustainable housing, each with unique strengths and limitations. However, it also indicates that transdisciplinarity is a demanding approach, requiring time, reflexivity from academic partners, and structured activities to develop mutual understanding of the complex challenges and each other's perspectives.

7.1. Lessons from literature and RE-DWELL events

RE-DWELL training sessions and workshops have revealed numerous connections between the ESRs' PhD projects and the three RE-DWELL research areas: "Design, Planning and Building," "Community Participation," and "Policy and Financing." Furthermore, interactions and assignments have highlighted the multiple terms and conceptual frameworks to approach the common problem of housing affordability and sustainability. Secondments and training sessions have demonstrated that bridging the gap between academia and practice requires both team competencies and tools for effective knowledge exchange.

Partner organisations working in the field of housing are interested in research that clarifies problem statements to make them applicable, context-specific, and relevant to existing institutional frameworks. They seek assistance in addressing trade-offs between affordability and sustainability in housing policy, partnerships, and projects, including tools, evidence, arguments, and business models. They aim for cross-learning between research-practice and European contexts, "best practices" transplantation through "deepening" (shifts in perspectives, practices, structures).

An overview of tools for knowledge exchange between academia and practice in affordable and sustainable housing has shown that multistakeholder frameworks are just

target-specific approaches. Moreover, they serve as vehicles to facilitate productive communication among stakeholders and help develop an understanding of the necessary trade-offs to negotiate win-win situations. They act as facilitators rather than providing clear answers to complex, "wicked" challenges. This facilitating role serves as a foundation for the transdisciplinary environment described in the next section.

7.2. A transdisciplinary environment in four layers

A primary goal of the project has been to create a learning and research environment that fosters the development of the competencies and tools needed to generate societal impact through collaboration between academia and partner organizations. This environment, which has been built collaboratively throughout the project, can now be structured and systematized retrospectively to facilitate its understanding and future replication.

This section outlines the structure of this environment, which is composed of four layers (Figure 7.1).
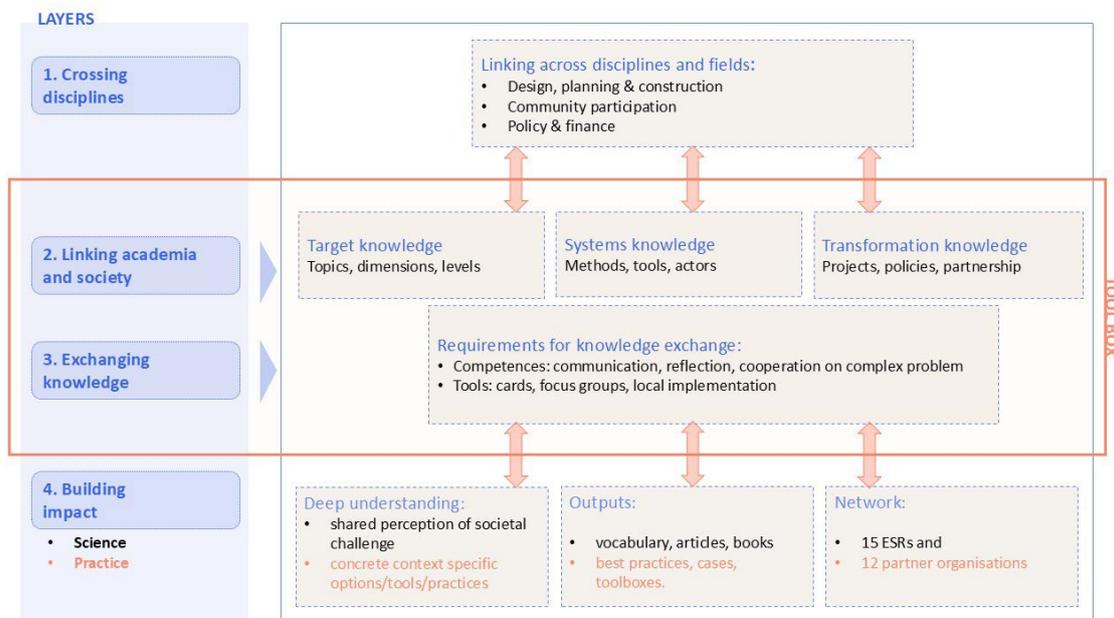
Figure 7.1. A transdisciplinary environment for affordable sustainable housing (TEASH)

Layer 1: Crossing disciplines

The RE-DWELL project was established with the aim of crossing disciplinary boundaries and developing a transdisciplinary framework for affordable and sustainable housing provision in Europe. While design, planning and construction primarily fall within the realms of architecture and urban planning, these aspects require additional knowledge to ensure feasibility, acceptability, and implementation. Community participation addresses the challenges associated with involving citizens in design and planning processes and establishing a foundation for implementation. Additionally, policy and finance represent another critical aspect for achieving affordable and sustainable housing. In the RE-

DWELL project, this area was explored within the domain of social sciences, focusing on societal institutions that facilitate affordable and sustainable housing initiatives.

This crossing of fields and disciplines is described in Deliverables 4.1, 4.2 and 4.3 and depicted in layer 1 in Figure 7.1. This discipline crossing is necessary to understand the challenges and trade-offs at stake, to identify strategies across disciplines and fields

Layer 2: Linking academia and society and distinguishing three types of knowledge

The core aim of transdisciplinarity is to leverage scientific knowledge to tackle complex societal issues. Recognizing the three types of knowledge (Pohl et al., 2007) has been instrumental in supporting the goals and ambitions of the RE-DWELL project.

Target knowledge, addresses the question: "What ought to be?" It pertains to understanding the direction of challenges within the project. The overarching goal of the project is to contribute to the United Nations Sustainable Development Goals (UN SDGs), with a specific focus on SDG 11, which includes affordable and sustainable housing. This goal serves as a guiding principle for both the researchers and their academic supervisors, as well as for the partner organisations involved in practice and policy.

Within the realm of target knowledge, various challenges (Deliverables 4.1, 4.2, 4.3) are identified by the early-stage researchers. A challenge represents a key issue that stakeholders engaged in affordable and sustainable housing initiatives must address. These challenges stem from the collective knowledge gained ESRs throughout their research endeavours, including their PhD theses, secondments, and interactions with third parties. Different focuses within a challenge can be distinguished:

- **Topics**: They refer to the specific issues or areas of focus within the broader field of affordable and sustainable housing, for example: energy poverty, building retrofitting, social housing, etc.
- **Dimensions**: Dimensions are the broad categories or perspectives through which the topics are analysed or addressed: environmental, social, economic, institutional, etc.
- **Levels**: These describe the scale or scope at which issues are considered: building, neighbourhood, municipality, metropolitan area, region, country, etc.

Systems knowledge provides an answer to the question: What is? It concerns scientific knowledge on how the system is composed and can be understood. Researching the system requires methods, tools and actors involved.

- **Methods** (research oriented): Systematic processes to conceptualise and define the scope of a housing project on affordable and sustainable housing with a multidisciplinary perspective, its objectives and stakeholders.
- **Tools** (practice oriented): Devices, instruments, techniques, and methodologies to support a specific method.
- **Actors** (key players involved in formulating the challenge and using the tools): Persons and organisations involved in one way or another in an affordable and sustainable housing project.

Transformation knowledge answers the question: How to? It deals with knowledge about learning how to make existing technologies, regulations, practices and power

relations more flexible. In other words what is needed to make changing happen in society and we distinguish three transformation items here:

- **Policies**: A deliberate system of instruments to guide decisions towards achieving affordable and sustainable housing.
- **Projects**: A series of planned tasks, activities, and collaborations that are systematically executed to carry out an affordable and housing initiative, in a specific spatiotemporal context.
- **Partnerships**: Collaborative arrangements between various actors aimed at achieving the common goal of advancing affordable and sustainable housing initiatives.

Layer 3: Exchanging knowledge

A range of competences is essential for successful transdisciplinary work (Pearce et al, 2018). Key competences addressed in RE-DWELL courses and workshops, as described in Chapter 4, include the ability to communicate assumptions and normative values, reflect on oneself and others, and apply conceptual knowledge to specific contexts. The competences of framing complex problems collaboratively, conducting research in and with the real world, and envisioning solutions were cultivated during secondments with partner organizations and in workshop sessions, as outlined in Deliverable 4.7.

A key aspect of collaboration between researchers, practitioners, and non-academics in addressing localized housing problems is the use of appropriate methods and tools to facilitate the joint knowledge construction. To support this, a toolbox (encompassing layers 2 and 3) was progressively developed throughout the project and subsequently used in local workshops (see Deliverable 4.7).

Layer 4: Building impact

The need for deep understanding and a broader view was emphasised by the partner organisations (see Chapter 4). Addressing the provision of affordable and sustainable housing with a transdisciplinary approach requires a shared definition of the challenge, drawing on knowledge from various angles and expertise in both academia and practice. Next to this deep understanding of the issues at stake, good knowledge of the institutional context is crucial for decision making in practice. Finding strategies to address the challenge, defining the dilemma's and making their trade-offs transparent can support stakeholders in their decision making.

Creating outputs—such as products and deliverables—that support impact on the provision of affordable and sustainable housing in Europe is the second component of the fourth layer. A key output of the project is the vocabulary library, which provides academic definitions of key concepts to facilitate dialogue across researchers. Compiled by the ESRs, this glossary includes definitions of critical terms on the field, helping partners and stakeholders to better understand each other's perspectives and objectives. Additionally, the case library on affordable and sustainable housing is a valuable research output, offering examples that illustrate the objectives of the RE-DWELL transdisciplinary approach. Impactful outputs also include the publications produced by the ESRs as part of their PhD projects, which contribute to the broader scientific debate.

Ultimately, the primary outcome of the project is the network of 15 ESRs, 10 universities, and 12 partner organizations, all of whom will carry the knowledge gained throughout the project into their future careers, as well as their academic and professional practices, generating valuable knowledge for both society and science.

Transdisciplinary Environment for Affordable and Sustainable Housing (TEASH)

The four layers together form a structured approach to co-produce and organize knowledge addressing the complex issue of affordable and sustainable housing. This approach aims to foster transformative change in society.

Layer 1 "Crossing disciplines" outlines the three fields of the RE-DWELL project, which are interconnected. Most societal challenges span all three fields and involve multiple academic disciplines. Layer 2, "Linking academia and society," brings together different types of knowledge. This includes target knowledge, which addresses challenges in promoting affordable and sustainable housing across Europe. The challenges explored in RE-DWELL relate to politics and policies at local, national, and EU levels. Scientific knowledge examines the housing system, including its current state, trends, and underlying mechanisms. Finally, transformation knowledge incorporates societal perspectives represented by partner organisations, focusing on implementing change within projects, policies, and partnerships. These three types of knowledge are organised into a tool that facilitates knowledge exchange: the toolbox, which includes three types of cards representing each type of knowledge, designed for use in various settings. Layers 2, "Linking academia and society," and 3, "Knowledge exchange," together form the core of the TEASH toolbox, encompassing the competencies and tools needed to apply the three types of knowledge. Layer 4, "Building impact," presents the various results emerging from knowledge exchange and knowledge building for both science and society.

Figure 7.2 provides an overview of the contributions of all seven deliverables in Work Package 4 and how these contribute to the four layers of TEASH. Deliverables 4.1, 4.2, and 4.3 describe the scientific environment in layer 1 and place the PhD work of the 15 ESRs within the context of addressing interlinked societal challenges. Deliverables 4.4 and 4.5 introduce the vocabulary and the case library, two tools developed to facilitate understanding across disciplines and with partner organizations. Deliverables 4.6 and 4.7 focus on knowledge exchange, highlighting the transdisciplinary environment TEASH and demonstrating how the toolbox is implemented and tested. Together deliverables 4.4, 4.5, 4.6 and 4.7 focus on the creation of understanding and exchange of knowledge, which are the core of layers 2 and 3. The ultimate aim of all deliverables together is layer 4: building impact for affordable and sustainable housing in science and society.
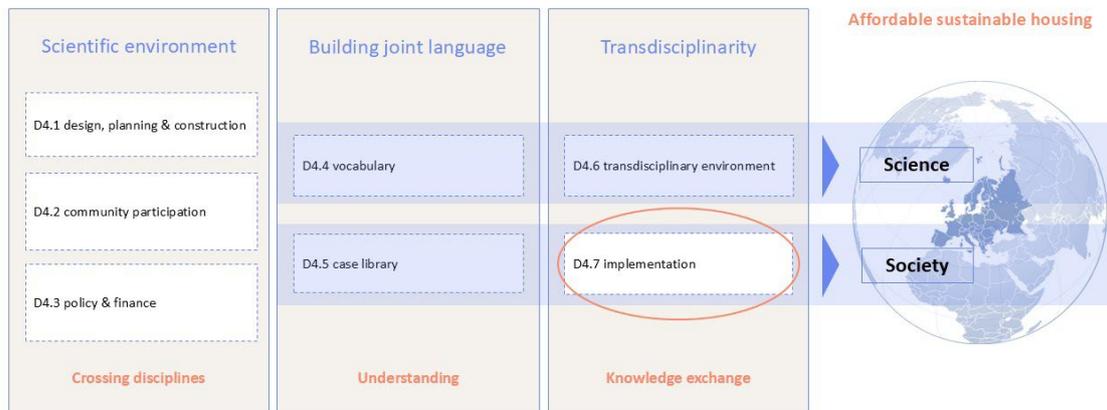
Figure 7.2.   Aiming for impact on affordable and sustainable housing in Europe, overview deliverables

7.3. Conclusions

This chapter presents the Transdisciplinary Environment for Affordable and Sustainable Housing (TEASH) consisting of four layers. The first two layers of this framework are academic: "crossing disciplines" and "types of knowledge." The third and fourth layers— "knowledge exchange" and "towards impact"—focus on addressing the central, complex societal challenge of affordable and sustainable housing. Together, these layers and concepts enable cross-disciplinary collaboration, foster shared understanding, and facilitate knowledge exchange to drive impact in the field. The four layers of TEASH are the result of all project activities and collective learning, encompassing the multidimensional nature and complexity of housing and deepening our understanding of transdisciplinarity.

The TEASH toolbox can be used and further developed to enhance understanding of the challenges at hand, the perspectives of others, and the trade-offs involved, which will enable new perspectives to improve projects, policies, and partnerships. Deliverable D4.7 extensively reports on how this was done in the project together with the partner organisations. Moreover, it can be considered a foundation for facilitating a transdisciplinary learning and research environment on affordable and sustainable housing, adaptable across various academic levels and structures.

The transdisciplinary approach using the TEASH toolbox appears to enhance TEAcHing competencies and TEASing out the complexities of affordable and sustainable housing in Europe, as illustrated in the reflections presented in the next chapter.

8. Reflections

This final chapter reflects on the various disciplines involved in housing and the RE-DWELL project. It provides a brief overview of the diversity of disciplines represented in the project and includes reflections from the 15 ESRs engaged in this transdisciplinary endeavour.

8.1. Crossing disciplines

As Bruno Latour – a philosopher and science anthropologist- notes, "Our society is made of law, science, technology, religion – made of all these different regimes and modes of truth" (Truong, 2023). The social fabric is composed of various segments, each with its own distinct truths, which are often incomprehensible to one another. In every discipline, scientific language differs, with terms, concepts, and methodologies that may be unfamiliar to researchers from other fields or carry different meanings depending on the discipline, complicating communication. A major barrier to cooperating across disciplines is intellectual egocentrism and a tendency to guard one's disciplinary perspective, often preventing outside influences. Productive interdisciplinary dialogue depends on defining problems from various viewpoints, acknowledging the limits of each discipline's solutions and knowledge.

Destructive criticism from any one discipline can hinder progress, whereas constructive collaboration—acknowledging limitations, being open to critique, and learning from others—promotes effective teamwork. The complexity of the problems addressed in interdisciplinary research underscores the necessity of such cooperation. Consequently, mutual respect, trust, and open-mindedness emerged as essential for recognizing the complementary insights each discipline could contribute to the project.

The success of transdisciplinary work depends on individuals who demonstrate flexibility, trust, patience, intuition, divergent thinking, sensitivity, moderation, mediation, and the ability to foster partnerships and transfer knowledge. As Zárate (2007) highlights, these traits are crucial for initiating and sustaining productive, critical dialogue. This type of research is time-consuming, demanding, and carries greater risks compared to traditional disciplinary approaches, but the rewards are invaluable in advancing knowledge and addressing complex social challenges (Wallerstein, 1996).

As noted by the OECD (2020), adopting a transdisciplinary approach requires time and can be particularly challenging for early-stage researchers. This was evident in the RE-DWELL project, where both ESRs and their supervisors came from diverse disciplinary backgrounds (see: https://www.re-dwell.eu/esr). Of the 15 ESRs involved in RE-DWELL, most held master's degrees in architecture and urban planning, often complemented by additional qualifications in other fields. Others had master's degrees in various social sciences, including political science, sociology, and economics. Figure 8.1 illustrates the primary disciplinary backgrounds of the ESRs and the positioning of their PhD work within the three RE-DWELL fields.
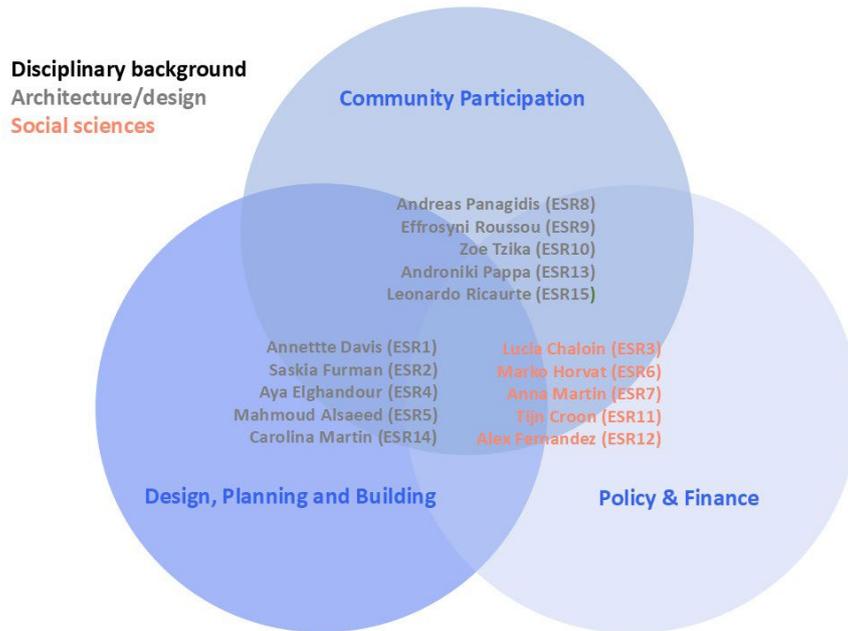
Disciplinary background
Architecture/design
Social sciences

Community Participation

Andreas Panagidis (ESR8)
Effrosyni Roussou (ESR9)
Zoe Tzika (ESR10)
Androniki Pappa (ESR13)
Leonardo Ricaurte (ESR15)

Annettte Davis (ESR1)   Lucia Chaloin (ESR3)
Saskia Furman (ESR2)   Marko Horvat (ESR6)
Aya Elghandour (ESR4)   Anna Martin (ESR7)
Mahmoud Alsaeed (ESR5)   Tijn Croon (ESR11)
Carolina Martin (ESR14)   Alex Fernandez (ESR12)

Design, Planning and Building   **Policy & Finance**

Figure 8.1. Disciplinary backgrounds and research areas of the ESRs

Different disciplines apply distinct terminologies, a point that became increasingly evident during the RE-DWELL events and assignments, as described in Chapter 4. To facilitate understanding of diverse terminologies, the team developed a joint vocabulary (see Deliverable 4.4), which proved to be an essential tool. This vocabulary allowed participants to share definitions and gain insights into how others understood the key terms used in the project.

Additionally, the project included an overview of case studies on affordable sustainable housing. The purpose of this "case library" was to share real-world examples considered inspirational both researchers and partner organisations. Interestingly, the term "case study" itself became an early source of misunderstanding within the consortium. In architecture, a case study typically refers to a concise description of a building or project, presented in a strict format that includes details such as the year, style, designer, and an explanation of its significance as an inspiring example. In social sciences, however, a case study refers to the selection of locations or target groups related to the research topic, used to gather empirical evidence through methods such as interviews or questionnaires. Unravelling these differing definitions sparked valuable discussions about terminology, ultimately leading to the decision to rename Deliverable 4.5 as a "case library" to avoid confusion around the term "case study."

During RE-DWELL events, it became evident that architecture and social sciences not only cover distinct fields and apply different terminologies but also adopt fundamentally different ways of reporting within their respective disciplines. This distinction was particularly noticeable when using visual representations—both in online and live sessions—to identify connections between topics (see Annex I). In the design and architecture disciplines, ESRs with a background in architecture often rely on graphs and

complex figures to visually illustrate how different topics and projects are interconnected. In this context, a visual representation is often seen as a result in itself, visually showcasing these connections and allowing the diagram to "speak for itself." In contrast, social scientists organize their findings by formulating and answering research questions. For them, a visual representation is more of a starting point for theory-driven exploration of causal relationships rather than a self-explanatory result. In other words, these differing approaches to reporting reflect the underlying focus of each research type: systematization in architecture versus causal relationships in social sciences.

Moreover, the disciplinary differences extend beyond definitions, methodologies, and modes of communication to include variations in outputs as well. For instance, RE-DWELL featured several exhibitions—a familiar method of presenting results for architects but a novel output for social scientists. Table 8.1 provides an inventory of the diverse disciplinary elements that emerged and were discussed during the project.

Table 8.1 Differences in focus between disciplinary fields encountered during events

	Architecture/design	Social sciences
Focus	Inspiring design	Testing or building theories
Research	Organising information in a systematic way	Answering research questions
Methodology	Mapping and building libraries	Searching for causality
Outputs	Visual representations/exhibitions, libraries/repositories, books, academic articles	Academic articles, special issues, books

Crossing disciplines and navigating different ways of working, analysing, disseminating, and presenting appeared both complicated and worth doing. The next section presents reflections from the 15 ESRs on working across disciplines and with partner organisations on affordable and sustainable housing.

8.2. Reflections from early-stage researchers

Crossing disciplines, dealing with different "languages"

Architects and social scientists are trained in different ways and therefore have different vocabularies, methods and quality standards. The following contributions make clear how different ESRs dealt with this: different ways of presenting, different meanings for same words, different approaches. Discovering own disciplinary logic: "narrow down to research questions" in social science, "breaking down information in fixed chunks" in architecture and with that learn about own qualities and the need to cooperate with others for full understanding and collaboration to create transformational knowledge. Finally, one of the ESRs chose the outsider perspective and was only criticising the project design considering transdisciplinarity as an approach to fight against, expressing apparently not feeling part of the journey.

Architects tend to approach housing with a 'holistic' lens, using what social scientists might deem 'buzzwords' or 'window dressing' like democratisation or social cohesion. Conversely, architects often perceive social scientists as overly incremental and focused on narrowing research questions to the point where the broader societal implications might be lost. This divergence can also be illustrated in our way of presenting. Attend a RE-DWELL network meeting, and you will see in an instance whether a slide deck is from an architect (pictures and mind maps) or a social scientist (bullet points).

Tijn Croon

Although I have always found the beauty in producing diagrams for communicating thoughts and processes, let alone produce them collaboratively (even in cases that the results were more superficial or vague), there was a particular moment that I felt that truly reflected our collective work in a thought-provoking way. This was during developing the preparatory diagrams for the workshop we hosted in the Social Housing festival in Helsinki. In my opinion this moment marked a shift towards a more meaningful use of diagrams as a tool to collaborate within the network and was also the first step in the development of our transdisciplinary research framework -even if we didn't know it at that moment.

Androniki Pappa

While I believe architects are creative problem solvers, social scientists certainly demonstrate greater strength in asking the right questions. This may lie in architects' training in categorising information, creating typologies, working with planning requirements, and meeting sustainability tick-box exercises. I've learned that not everything can be put in a box; perhaps information can fit into two 'categories' at the same time, and concepts are much more complex and fluid in reality, especially when tackling a systemic issue such as housing.

Annette Davis

Therefore, the concept of transdisciplinary research has been especially difficult to adopt from the beginning. Even towards the end of the project, the term arguably still bears some ambiguity amongst us. I personally began to understand the term as being subjective and varying according to the way one understands their role 'outside' of academia.

Andreas Panagidis

By overlooking critical questions regarding societal impact and resource allocation, Re-Dwell fails to address the complex trade-offs inherent in housing provision. This oversight perpetuates intergenerational disparities and exacerbates existing inequities within housing access and affordability.
Re-Dwell's procedural rigidity stifles creativity and inhibits the exploration of unconventional solutions. In conclusion, Re-Dwell's uncritical adherence to

transdisciplinarity, coupled with its emphasis on design, lack of methodological coherence, and procedural rigidity, impedes its efficacy in addressing entrenched socio-economic disparities in housing provision.

Alex Fernández

Working transdisciplinary goes beyond crossing disciplines, it requires joint understanding of each other and of the societal challenge at stake. During the project it became clear that even the key terms affordability, sustainability and framework were subject to different interpretations. To build the necessary joint understanding requires openness and willingness to learn as explained in the following contributions:

In the discussions that followed, my colleagues – from a management and assets background – expressed a different understanding of sustainability, emphasising aspects such as project feasibility, funding availability, operational challenges, carbon reduction, and energy efficiency. This revelation led to a crucial shift in my PhD focus towards investigating the different perceptions and interpretations of sustainability among housing providers and practitioners.

Mahmood Alsaeed

I think that the main lesson all the Re-Dwell participants have absorbed is learning to learn, changing one's own codes of operating to put something in between: a layer super codes and infra practices, between reflexivity and operation every individual carries on. I would call this layer the learning to learn posture, that is supra your codes since it prevents you from operating automatic cognitive patterns, that is also the work carried on with reflexivity, and it is infra since it informs your practices and routines, i.e. your operations, meaning you are effectively creating a kind of more aware bourdieusian habitus.

Lucia Chaloin

Through the project, we have embarked on a journey of learning how to approach complex societal problems and paving the way for our potential contributions to the housing sector. I felt that the main objective of the innovative research network was to prepare young researchers for the challenges that lie ahead: contribute to the housing sector by understanding how to communicate, collaborate and co-create across diverse disciplines. I have realised the importance of openness - openness on how to understand reality, how to analyse it, how to communicate it and how to create shared ways of improving it. The true measure of our project's success will unfold in the years to come as we explore novel avenues to foster synergies and transcend traditional boundaries in addressing practical challenges. As we look at the road ahead, we are faced with an impending challenge: how do we translate the lessons learned from this project into tangible contributions to our future endeavours?

Zoe Tzika

I particularly remember the workshop in Zagreb as a defining event for the RE-DWELL project. The preparatory activities in which, along with two other colleagues, we had to address the until that point recurring but intangible theme of transdisciplinarity; started to provide the discussion with very much-needed substance to go beyond what is evident - that transdisciplinary makes sense and that is in danger of becoming another buzzword that researchers use lightly.... The cross-pollination between us every time we had the chance to meet up at a different event of the network is one of the main takeaways for me. We were building brick by brick at the time the communities of knowledge and practice that Monserrat mentioned, in the same previously mentioned workshop in Zagreb.

For transdisciplinary research, it is fundamental to have an open attitude towards each other inputs to create the common ground necessary to push the boundaries of disciplines a little further. It is not an easy process - there's no doubt about it.

Leonardo Ricaurte

Zagreb assignment by Androniki Pappa, Tijn Croon, and Carolina Martin
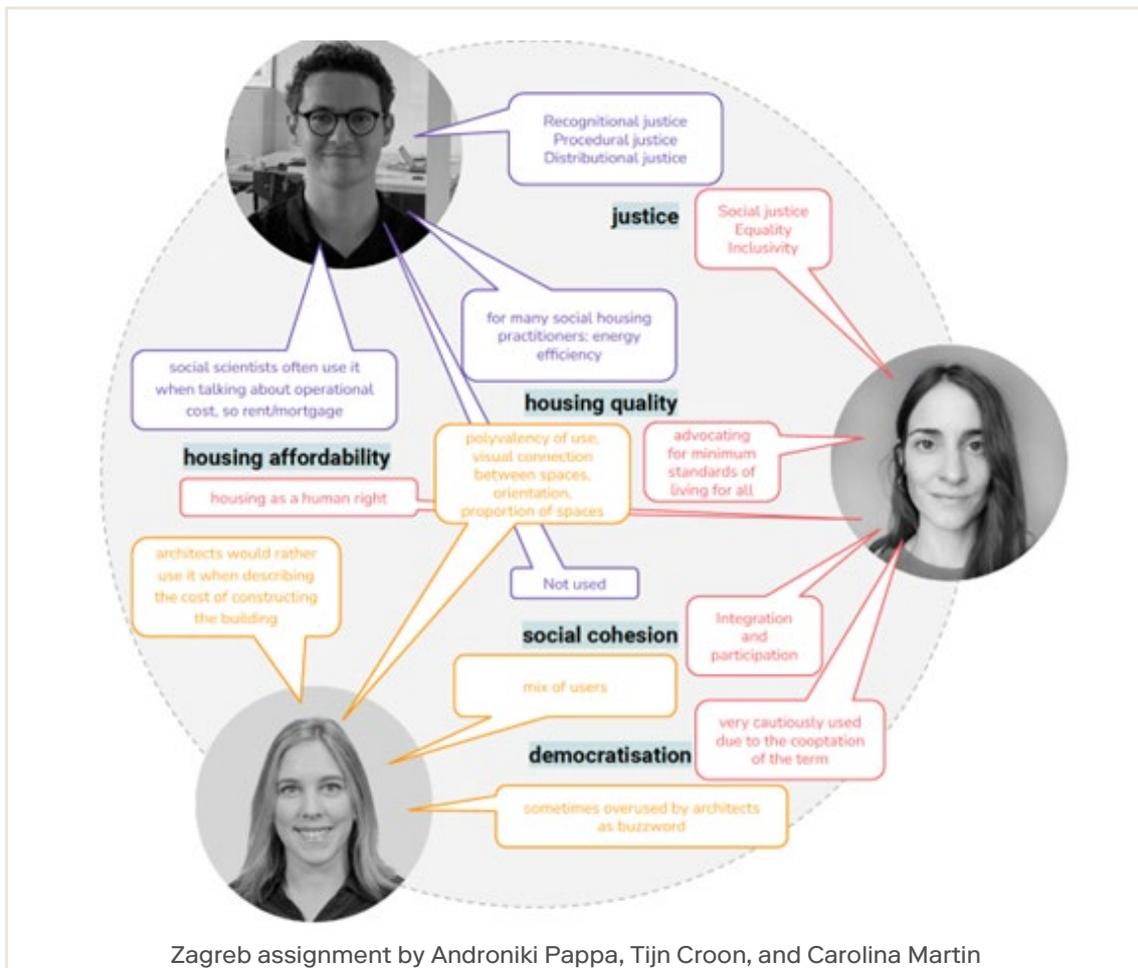
Transdisciplinarity is simply about "Being Humble," putting our biases and egos aside and focusing on the problem at hand. It is about recognising that everyone is on a continuous learning journey and that no one knows everything. Throughout my RE-DWELL journey, discussions, secondments, and research interviews, I learned that what I might think a solution is and being excited about it, could be problematic for someone else.
"Being Humble" entails listening, questioning others and ourselves, reflecting, and sharing. It is also about being open to change and expressing what we need for that change, both for others and for ourselves.

Aya Elghandour

Combining different pillars creates tensions

Providing affordable and sustainable housing in Europe is the focus of the RE-DWELL project. This joint focus is addressed from three different angles, called pillars in the project: design, planning & construction; community participation; policy & finance. Working across these pillars makes clear that there are tensions between these angles: a solution from one angle may be a challenge for another. Moreover, the secondments and fieldwork for the PhD research took place in different countries with different contexts for affordable and sustainable housing. The reflections of the ESRs on this topic are collected in boxes.
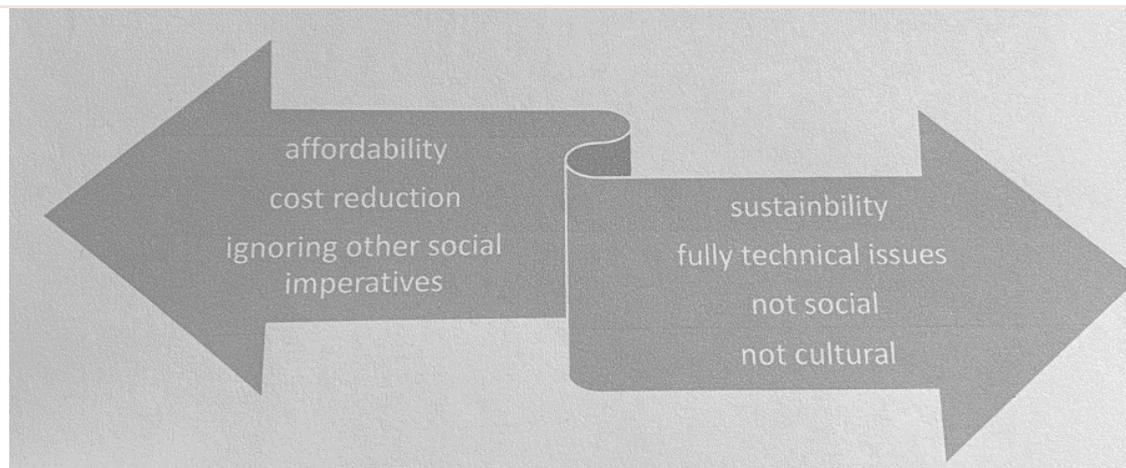
Zagreb assignment by Anna Martin, Aya Elghandour, and Zoe Tzika

The involvement of residents in the decision-making of multi-family housing requires longer participation processes that are in most cases contradictory to the shorter timeframes of building with industrialised methods of construction.
Additionally, case studies analysed showcased that not everything can be customisable at an affordable price.

Carolina Martin

Firstly, the policy and finance pillar did not pursue a housing policy aimed at vulnerable groups, but at young families eligible for a mortgage. This policy led to a gradual increase in housing prices, which worsened the affordability of housing for vulnerable groups. Secondly, there was a tension between policy and finance and the sustainable planning sub-pillar which failed to consider the wellbeing of urban spaces and how the increase in housing prices and home ownership will impact on cities and incorporate dimensions of sustainability. Furthermore, the sub-pillar of inclusive neighbourhood design and quality of life in the city was not considered.

Marko Horvat

During my two secondments, I witnessed situations where community engagement proved difficult. For instance, in Lisbon, the SRU architects responsible for affordable public housing had only three months to prepare a design brief, making it hard to involve the community meaningfully. In England, the SYHA team working on new developments cannot engage future residents because they have not yet been identified.

Aya Elghandour

These tensions between the pillars were clarified and resulted in a number of statements about the need for shared ambition to address the wicked problem of affordable sustainable housing.

Cleaning up concepts and defining their boundaries and meanings across disciplines does not require complexity but a holistic perspective to address the challenges involved. To this extent, I quote Alexis de Tocqueville (1835): "A false but clear and precise idea will always have more power in the world than a true but complex one". In short, transdisciplinary research offers a new way to address the pathways of a problem rather than proposing ad hoc measures to solve it. However, the fear of implementing transdisciplinarity is still real, as its exact meaning, possibilities, and limitations have yet to be determined and discussed.

Mahmoud Alsaeed

I learned that the path to sustainable housing solutions necessitates the collective input of architects, technicians, housing providers, residents, and other stakeholders, underscoring the indispensability of hybrid decision-making frameworks. In addressing the multifaceted challenges of social housing retrofit, no single stakeholder holds the definitive answer; instead, it is through collaborative synergy that innovative solutions emerge.

Saskia Furman

The inadequate consideration of affordability and sustainability within prevailing approaches highlights the necessity for transdisciplinary interventions. While conventional mono- and multi-disciplinary methodologies necessitate a strict adherence to disciplinary boundaries among researchers, transdisciplinary knowledge production offers a more reflective and socially accountable approach to problem-solving.
The establishment of a "pool of expertise" is essential to facilitate the exchange of best practices and knowledge dissemination. Collaborative partnerships should involve a wide array of stakeholders, including both public and private entities.

Anna Martin

The pursuit of a sustainable future requires a departure from superficial declarations such as "housing for all" or "zero poverty". Likewise, the efficacy of transdisciplinary collaboration transcends superficial inclusion in decision-making processes. The cultivation of shared values and visions, if not ideologies, along with a shared, nuanced comprehension of the rhizomatic nature by which hegemonic structures intertwine to sustain systemic injustices, is a foundational imperative in fostering any meaningful transdisciplinary endeavour.

Effrosyni Roussou

8.3. Transdisciplinary lessons

Thinking in disciplines is inherent to the academic community and its way of performing and competing. Different disciplines apply distinct methods, definitions, and communication styles. In the RE-DWELL project, these differences played an important role, and the ESRs shared some of their experiences and lessons in this chapter. Collaborative training activities increased the understanding of the differences, which along with the qualities of reflexivity and collaboration, played a key part of the training for the early-stage researchers in RE-DWELL.

The implications of interlinking housing "affordability" and "sustainability" were not understood in the same way by everyone. The conversation about clarifying these concepts played an important role throughout the project and in the various joint undertakings of the network. Many ESRs have now become aware of these challenges and complexities. They have developed an open mind toward other perspectives and recognize that a solution from one viewpoint can create problems in another dimension. This was particularly the case for the wicked challenge of affordable and sustainable housing; aiming for affordability impacts sustainability and vice versa. Therefore, a shared understanding is necessary for formulating research questions and ensuring that research results have a meaningful impact on society.

Building knowledge and awareness of one's areas of expertise—and, even more importantly, areas where one is not an expert—is likely the cornerstone of a transdisciplinary research. Reflecting on the boundaries of one's expertise and transforming them into connections with other experts, both in academia and practice, is essential for creating added value in the field of affordable and sustainable housing.

9. Bibliography

Adamec, J., Janoušková, S., & Hák, T. (2021). How to Measure Sustainable Housing: A Proposal for an Indicator-Based Assessment Tool, *Sustainability*, 13, 1152. DOI: https:// doi.org/10.3390/su13031152

Arman, M., Zuo, J., Wilson, L. Zillante, G., & Pullen, S. (2009a). Challenges of responding to sustainability with implications for affordable housing, *Ecological Economics*, 68(12) 3034–3041. DOI: https://www.sciencedirect.com/science/article/abs/pii/S092180090900278X

Arman, M., Wilson, L., Zuo, J., Zillante, G., & Pullen, S. (2009b). Conceptualising affordable and sustainable housing: Towards a working model to guide planning and construction, *Proceedings of 34th Australasian Universities Building Educators Conference*.

Arusey, C., Njoroge, R., Otinga, A. N., & Ng'etich, W. (2018). Efforts toward improving maize yields on smallholder farms in Uasin Gishu County, Kenya, through site-specific, soil-testing-based fertiliser recommendations: A transdisciplinary approach. *East African Agricultural and Forestry Journal*, *82*(2-4), 1-13. DOI: https://doi.org/10.1080/00128325.2018.1443413

Basiago, A.D. (1999). *Economic, social, and environmental sustainability in development theory and urban planning practice: The environmentalist*. Kluwer Academic Publishers.

Beer, A., & Faulkner, D., with Paris, C., & Clower, T. (2011). *Housing Transitions through the life course. Aspirations, needs and* policy, Bristol: The Policy Press.

Bernstein, J.H. (2015). *Transdisciplinarity: a review of its origins, development and current issues.* City University of New York: CUNY Academic works.

Brundtland, G.H. (1987). *Report of the World Commission on Environment and Development. Our Common Future*. United Nations, https://sustainabledevelopment.un.org/content/documents/5987our-common-future.pdf

Clark, B., & Button C. (2011). Sustainability transdisciplinary education model: interface of arts, science, and community (STEM), *International Journal of Sustainability in Higher Education*, 12(1), 41-54.

Daniell, K., Sommerville, H., Foley, B., Maier, H., Malovka, D. & Kingsborough, A. (2005). Integrated urban system modelling: methodology and case study using multi-agent systems, In A. Zerger, & R. Argent (Eds.), *MODSIM 2005: International Congress on Modelling and Simulation* (pp. 2026-2032), Modelling and Simulation Society of Australia and New Zealand.

Davidson, K., & Venning, J. (2009). Applying integrated decision making frameworks for sustainability: An urban context, *Australian New Zealand Society of Ecological Economics.* Darwin, 27 October.

Diaz McConnell, E. (2012). House poor in Los Angeles: Examining patterns of housing-induced poverty by race, nativity, and legal status, *Housing Policy Debate*, 22(4), 605-631. DOI: https://doi.org/10.1080/10511482.2012.697908

Dissart, J.-C., & Ricaurte, L. (2023). Assessing social value in housing design: contributions of the capability approach, *Buildings and Cities*, 4(1), 867–882. DOI: https://doi.org/10.5334/bc.328

Doling, J., & Elsinga, M. (2012). *Demographic Change and Housing Wealth*, Springer Science & Business Media.

European Commission (2017). *Report from the Commission to the Council on the Urban Agenda for the EU.* COM(2017) 657 final, https://ec.europa.eu/regional_policy/sources/policy/themes/urban/report_urban_agenda2017_en.pdf

Ezennia, I.S. & Hoskara, S.O. (2019). Methodological Weaknesses in the Measurement Approaches and Concept of Housing Affordability Used in Housing Research: A Qualitative Study. *PLoS ONE* 14, e0221246. DOI: https://doi.org/10.1371/journal.pone.0221246

Fernández, A., Haffner, M., & Elsinga, M. (2023). Three contradictions between ESG finance and social housing decarbonisation: A comparison of five European countries. *Housing Studies*, 1-27. DOI: https://doi.org/10.1080/02673037.2023.2290516

Fusco, A., Guyo, A-C., & Marlier, E. (2011). *Income poverty and material deprivation in European countries*. CEPS/INSTEAD, Working Paper No 2011-04.

Godemann, J. (2008). Knowledge integration: A key challenge for transdisciplinary cooperation. *Environmental Education Research*, 14(6), 625-641.

Golubchikov, O., & Badyina, A. (2012). *Sustainable housing for sustainable cities: a policy framework for developing countries*. Nairobi: United Nations.

Grin, J., Rotmans, J., & Schot, J. (2010). *Transitions to Sustainable Development: New Directions in the Study of Long Term Transformative Change*(1er edition). Routledge.

Häberli R., Scholz R.W., Bill A., Welti M. (2000). *Transdisciplinarity: joint problem-solving among science, technology and society. Workbook I: dialogue sessions and idea market*. Haffmans Sachbuch, Zürich.

Haffner, M.E.A., & Elsinga, M.G. (2018). *Towards inclusive service delivery through social investment: the case of housing*. Delft University of Technology.

Haffner, M., & Hulse, K. (2021). A fresh look at contemporary perspectives on urban housing affordability*, International Journal of Urban Sciences.* DOI: 10.1080/12265934.2019.1687320

Housing Europe (2023). *The State of the Housing in Europe 2023. Social housing between a fair energy transition and dealing with crisis*. Housing Europe, https://www.housingeurope.eu/resource-1811/the-state-of-the-housing-in-europe-2023

Housing Partnership (2018). *The Housing Partnership Action Plan.* https://ec.europa.eu/futurium/en/system/files/ged/final_action_plan_euua_housing_partnership_december_2018_1.pdf

Ibem, E.O., & Azuh, D.E. (2011). Framework for Evaluating the Sustainability of Public Housing Programmes in Developing Countries, *Journal of Sustainable Development and Environmental Protection*, 1, 24-39.

Iglesias, T. (2008). *Our Pluralist Housing Ethics and Public-Private Partnerships for Affordable Housing.* University of San Francisco Law Research Paper No. 2008-5.

Jantsch, E. (1972). Towards interdisciplinarity and transdisciplinarity in education and innovation. In L. Apostel, G. Berger, A. Briggs, & E. Michaud (Eds.), *Interdisciplinarity: Problems of teaching and research in universities*. (pp. 97–121), University of Nice, Nice.

James, P., with Magee, L., Scerri, A., & Steger M. (2015). *Urban Sustainability in Theory and practice. Circles of sustainability.* Earthscan, Routledge.

Jonsson, O., Frögren, J., Haak, M., Slaug, B., & Iwarsson, S. (2021). Understanding the Wicked Problem of Providing Accessible Housing for the Ageing Population in Sweden. *International Journal of Environmental Research and Public Health*, *18*(3), 1169. DOI: ttps://doi.org/10.3390/ijerph18031169

Klein, J.T. (2004). Prospects for transdisciplinarity. *Futures*, 36, 515–526.

Lespagnard M., Galle. W., & De Temmerman, N. (2023). Visualizing Equitable Housing: A Prototype for a Framework, *Sustainability 15*, 4110. DOI: https://doi.org/10.3390/su15054110.

Maclennan, D., & Williams, R. (1990). *Affordable Housing in Britain and the United States.* Joseph Rowntree Foundation*.*

McGregor, S. L. T. (2015). The Nicolescuian and Zurich approaches to transdisciplinarity. *Integral Leadership Review*, 15, 2.

McGregor, S.L.T. (2015). Transdisciplinary knowledge creation. In P.T. Gibbs (Ed.), *Transdisciplinary professional learning and practice* (pp. 9-24). Springer.

Mensah, J. (2019). Sustainable development: Meaning, history, principles, pillars, and implications for human action: Literature review, *Journal Cogent Social Sciences* 5(1) 1653531. DOI: https://www.tandfonline.com/doi/full/10.1080/23311886.2019.1653531

Mezirow, J. (1985). A critical theory of self-directed learning. In S. Brookfield (Ed.), Selfdirected learning: From theory to practice. *New directions for continuing education* (pp. 17-30). Jossey-Bass.

Morton, L.W., Eigenbrode, S.D., & Martin, T.A. (2015). Architectures of adaptive integration in large collaborative projects. *Ecology and Society, 20*(4), 5. DOI: https://doi.org/10.5751/ES-07788-200405

Mulliner, E., Smallbone, K. & Maliene, V. (2013). An assessment of sustainable housing affordability using a multiple criteria decision making method. *Omega*, 41(2) 270-279.

Mulliner, E., & Maliene, V. (2015). An Analysis of Professional Perceptions of Criteria Contributing to Sustainable Housing Affordability. *Sustainability*, 7(1) 248-270.

Mulliner, E., Malys, N. & Maliene, V. (2016). Comparative analysis of MCDM methods for the assessment of sustainable housing affordability. *Omega*, 59, 146-156.

National Engineering Policy Centre (NEPC) (2020). *Sustainable living places – a systems perspective on planning, housing and infrastructure.* Royal Academy of Engineering, https://raeng.org.uk/media/5h0hlmkj/policy-sustainable-living-v11.pdf

Neuhauser, L. (2018). Practical and scientific foundations of transdisciplinary research and action. *Transdisciplinary theory, practice and education: The art of collaborative research and collective learning*, 25-38.

Nicolescu, B. (2010). Methodology of transdisciplinarity: levels of reality, logic of the included middle and complexity. *Transdisciplinary Journal of Engineering & Science*, 1, 17-32.

Nicolescu, B. (2012).Transdisciplinarity: the hidden third, between the subject and the object. *Human and Social Studies*, 1(2), 13-28.

Noori, N., Hoppe, T., De Jong, M., & Stamhuis, E. (2023). Transplanting good practices in Smart City development: A step-wise approach. *Government Information Quarterly 40*(2), 101802. DOI: https://doi.org/10.1016/j.giq.2023.10180

OECD (2020), "Addressing societal challenges using transdisciplinary research", *OECD Science, Technology and Industry Policy Papers*, No. 88, OECD Publishing, Paris. DOI: https://doi.org/10.1787/0ca0ca45-en

OECD (2021). *Brick by Brick: Building Better Housing Policies*. OECD Publishing. DOI: https://doi.org/10.1787/b453b043-en

Parris, T.M., & Kates, R.W. (2003). Characterizing and measuring Sustainable Development, *Annual Review of Environment and Resources*, 28(13), 559-586.

Pasquier, F. & Nicolescu B. (2019). To be or not to be transdisciplinary, that is the new question. So, how to be transdisciplinary? *Transdisciplinary Journal of Engineering & Science*, 10, 1-7.

Pearce, B., Adler, C., Senn, L., Krütli, P., Stauffacher, M., & Pohl, C. (2018). Making the link between transdisciplinary learning and research. In D. Fam, L. Neuhauser, & P. Gibbs (Eds.), *Transdisciplinary theory, practice and education: The art of collaborative research and collective learning*. (pp. 167-183) Springer.

Piparsania, K., & Kalita, P.C. (2022). Development of DASH: Design Assessment Framework for Sustainable Housing, *Sustainability*, 14(23), 15990. DOI: https://doi.org/10.3390/su142315990

Pohl, C. & Hadorn, G. H. (2007). Principles for Design in Transdisciplinary Research; proposed by the Swiss Academies of Arts and Sciences, Munich: Oekum Verlag.

Pohl, C., Pearce, B. J., Mader, M., & Senn, L. (2020). Integrating systems and design thinking in transdisciplinary case studies. *GAIA - Ecological Perspectives for Science and Society, 29*(4), 258-266. https://doi.org/10.14512/gaia.29.4.11

Polk, M. (2015). Transdisciplinary co-production: Designing and testing a transdisciplinary research framework for societal problem solving. *Futures*, 65, 110-122.

Popescu, G. (2014). From psychologist -disciplinary knowledge to a transdisciplinary one, *Social and Behavioural Sciences*, 128, 438-441.

Poterba, J.M. (1984). Tax subsidies to owner-occupied housing: An asset-market approach, *Quarterly Journal of Economics*, 99 (Nov), 729-752.

Pullen, S., Zillante, G., Arman, M., Lou, W., Zuo, J. & Chileshe, N. (2010). Developing an Assessment Framework for Affordable and Sustainable Housing, *Australasian Journal of Construction Economics and Building*, 10(1/2), 48-64.

Quality of Life Foundation & URBED (2021). *The quality of life framework*. URBED & Quality of Life Foundation. https://www.qolf.org/framework/

Randolph, B., Kam, M. & Graham, P. (2007). Who Can Afford Sustainable Housing? In A. Nelson (Ed.) *Steering Sustainability in an Urbanising World: Policy, Practice and Performance.* (203 - 214) Routledge.

Rigolet, C. (2020). Transdisciplinarity as a discipline ad a way of being: complementarities and creative tensions, *Humanities & Social Sciences Communications*, (2020)7, 100.

Rittel, H.W.J. (1973). Dilemmas in a general theory of planning. *Policy Sciences*, *4*, 155–169.

Robinson, J. (2021). *Transdisciplinary Field Guide:* https://www.uu.nl/en/research/transdisciplinary-field-guide/get-started/what-is-transdisciplinary-research#related

Robinson, J. (2019, 17 May). "*Transdisciplinarity: The limitations of the alphabet*", Presentation at Pathways to Sustainability Workshop on Transdisciplinarity, Utrecht University.

Rotmans, J. (2006). Tools for Integrated Sustainability Assessment: A two-track approach, *The Integrated Assessment Journal: Bridging Science and Policy*, 6(4), 35-57.

Salama, A. M., & Alshuwaikhat, H. (2006). A trans-disciplinary approach for a comprehensive understanding of sustainable affordable housing. *Global Built Environment Review*, 5(3), 35-50.

Salama, A.M. (2011). Trans-Disciplinary Knowledge for Affordable Housing, *Open Housing International*, 36(3), 7-15. DOI: https://doi.org/10.1108/OHI-03-2011-B0002

Schneider, F., Tribaldos, T., Adler, C., Reinette, O. Biggs, De Bremond, A., Buser, T., Krug, C., France Loutre, M., Moore, S., Norström, A., Paulavets, K., Urbach, D., Spehn, E., Wülser, G., & Zondervan, R. (2021). Co-production of knowledge and sustainability transformations: a strategic compass for global research networks, *Current Opinion in Environmental Sustainability*, *49,* 127-241.

Scholz, R. W. (2020). Transdisciplinarity: science for and with society in light of university's roles and functions, *Sustainability Science*, 15, 1033-1049.

Schot, J., & Steinmueller, W.E. (2018). Three frames for innovation policy: R&D, systems of innovation and transformative change. *Research Policy*, *47*(9), 1554–1567. DOI: https://doi.org/10.1016/j.respol.2018.08.011

Sibilla, M., & Kurul, E. (2020). Transdisciplinarity in energy retrofit. A Conceptual Framework. *Journal of cleaner production*, 250, 119461.

Stone, M. (1998). Shelter poverty. In W. Van Vliet (Ed.), *The encyclopaedia of housing* (pp. 534–535). Sage.

Stone, M.E. (2006). What is housing affordability? The case for the residual income approach. *Housing Policy Debate*, 17(1), 151–184.

Stone, M., Burke, T. & Ralston, L. (2011). *The residual income approach to housing affordability: The theory and the practice*. AHURI Positioning Paper no. 139. Australian Housing and Urban Research Institute.

Tan, Ekim (2017). *Play the city; games informing the urban development*, Jap Sam Books.

Tobias, S., Stroebele, M., & Buser, T. (2019). How transdisciplinary projects influence participants' ways of thinking: A case study on future landscape development. *Sustainability Science, 14*(4), 883-895. https://doi.org/10.1007/s11625-018-0532-y

Torgerson, U. (1987). Housing: The wobbly pillar under the welfare state. In B. Turner, J. Kemeny, & L. Lundqvist (Eds.), *Between state and market: housing in the post-industrial era* (pp. 115-126). Almqvist and Wiksel International.

Tress, G., Tress, B., & Fry, G. (2005). Clarifying integrative research concepts in landscape ecology. *Landscape Ecology, 20*, 479-493. https://doi.org/10.1007/s10980-004-3290-4

Truong, N. (2023). *De aarde bewonen; Nicolas Truong in gesprek met Bruno Latour*, Amsterdam: Octavo publicaties.

Turcotte, D., & Geiser, K. (2010). A Framework to Guide Sustainable Housing Development, *Housing and Society*, 37(2), 87-117.

UN-Habitat (2011). *Strategy paper: i-House, housing sustainability* (version 2). Unpublished manuscript, Nairobi (referenced in Golubchikov & Badyina, 2012).

UN-Habitat (2012). *Going Green: A Handbook of Sustainable Housing Practices*. Nairobi: United Nations Human Settlements Programme (UN-Habitat).

United Nations (2009). *The Right to Adequate Housing.* Fact Sheet No. 21/Rev.1. New York Office: Office of the United Nations High Commissioner for Human Rights United Nations, https://unhabitat.org/sites/default/files/documents/2019-5/fact_sheet_21_adequate_housing_final_2010.pdf

United Nations Economic Commission for Europe (2015). *The Geneva United Nations Charter on Sustainable Housing: Ensure Access to Decent, Adequate, Affordable and Healthy Housing for All*; UNECE information service (E/ECE/1478/Rev.1); United Nations Economic Commission for Europe: Geneva, Switzerland

Valderrama, L., Gorse, P., Marinkov, M., & Topalova, P. (2023). *European Housing Markets at a Turning Point. Risks, Household and Bank Vulnerabilities, and Policy Options*. IMF Working Papers WP/23/76. IMF.

Van den Bosch, S., & Rotmans, J. (2008). *Deepening, Broadening and Scaling up: A Framework for Steering Transition Experiments, Essay 02*. Knowledge Centre for Sustainable System Innovations and Transitions (KCT).

Van Dooren, E., Boshuizen, E. Van Merriënboer, J. et al. (2013). Making explicit in design education: Generic elements in the design process, *International Journal of Technology and Design Education*, 24, 53-71 (2014) DOI: https://doi.org/10.1007/s10798-013-9246-8

Wallerstein, I. (1996). *Open the social sciences. Report of the Gulbenkian Commission on the restructuring of social sciences*. Stanford: Stanford University Press.

Wetzstein, S. (2017). The global urban housing affordability crisis. *Urban Studies* 54(4), 3159–3177.

World Health Organization (2016). *Gender, equity and human rights: Availability, accessibility, acceptability, quality—Infographic. WHO*.

Wiek, A., Withycombe, L., & Redman, C.L. (2011). Key competencies in sustainability: a reference framework for academic program development. *Sustainability Science*, 6, 203-218.

Zárate Gamarra, C. (2014). El reto de la interdisciplinariedad: Desde su concepción hacia la práctica pedagógica. *Cuaderno de Pedagogía Universitaria, 4*(8), 9-10. https://doi.org/10.29197/cpu.v4i8.67

Annex 1 – Outputs from network activities
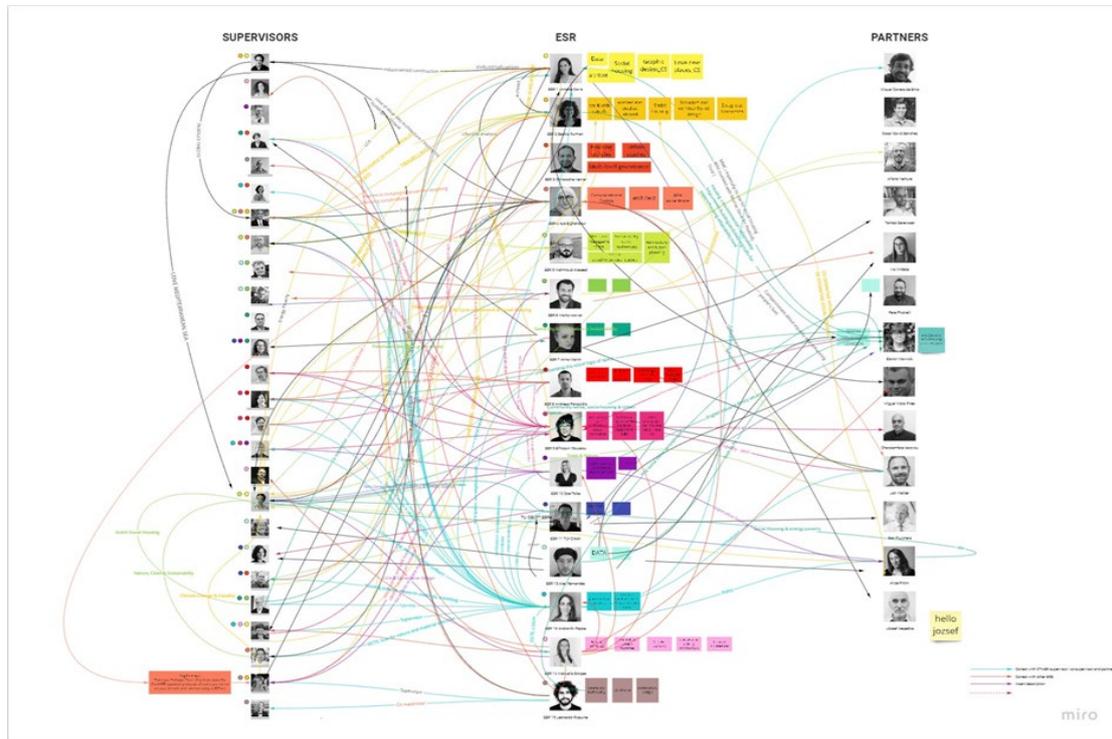
Figure A1.1. Mind map collaboratively created in the kick-off session showing potential links between ESR projects and partner organisations
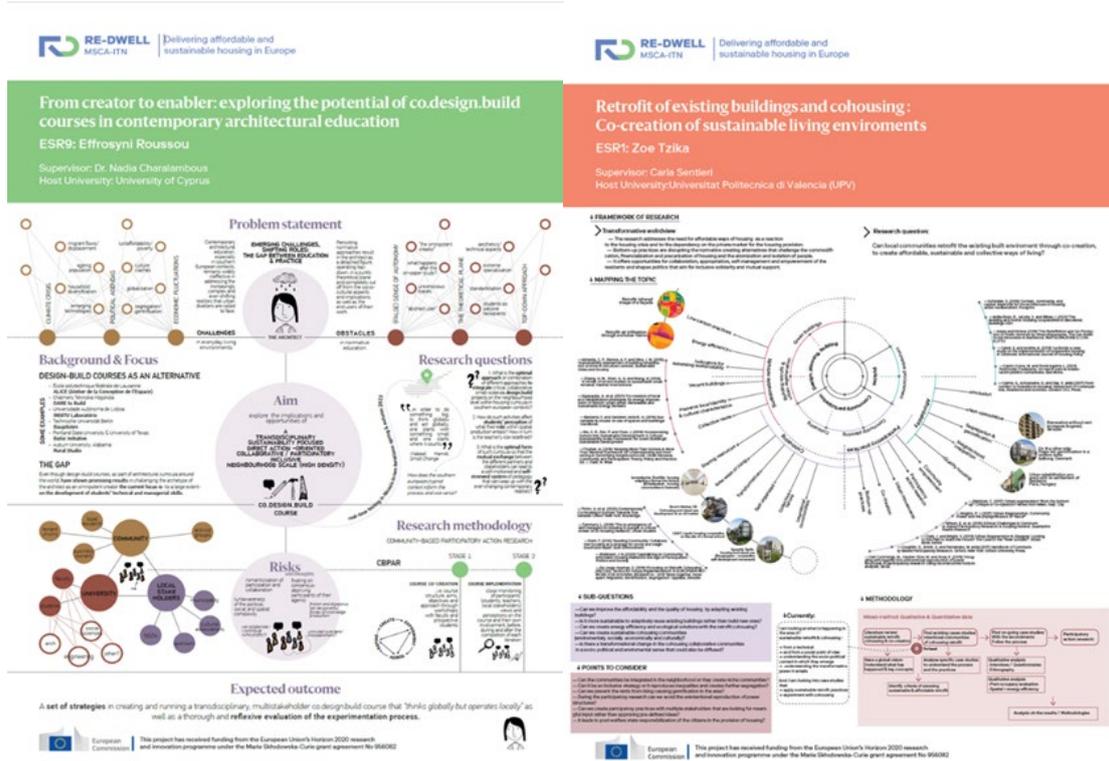
Figure A1.2. A0 poster summarizing the research project, by Effrosyni Roussou and A0 poster summarizing the research project, by Zoe Tzika project, by Effrosyni Roussou
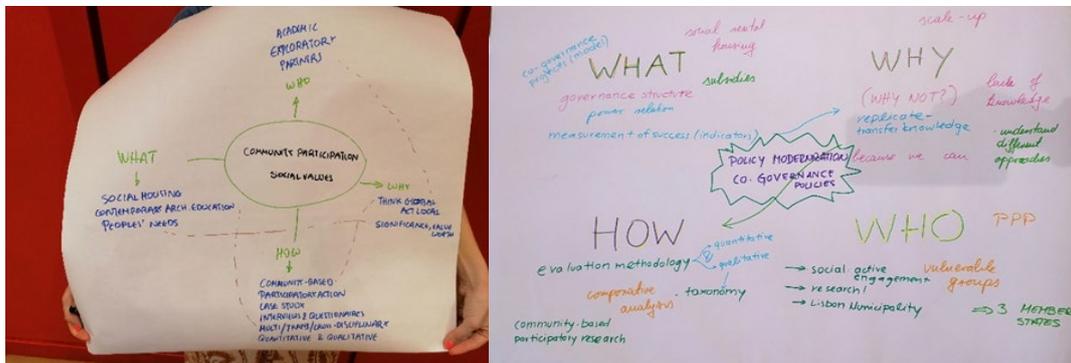
Figure A1.3. Summary of the discussion between the team, supervisor Carla Sentieri and ESRs Effrosyni Roussou and Leonardo Ricaurte and Summary of the discussion between the team, co-supervisor Vasco Moreira Rato and ESRs Aya Elghandour and Tijn Croon
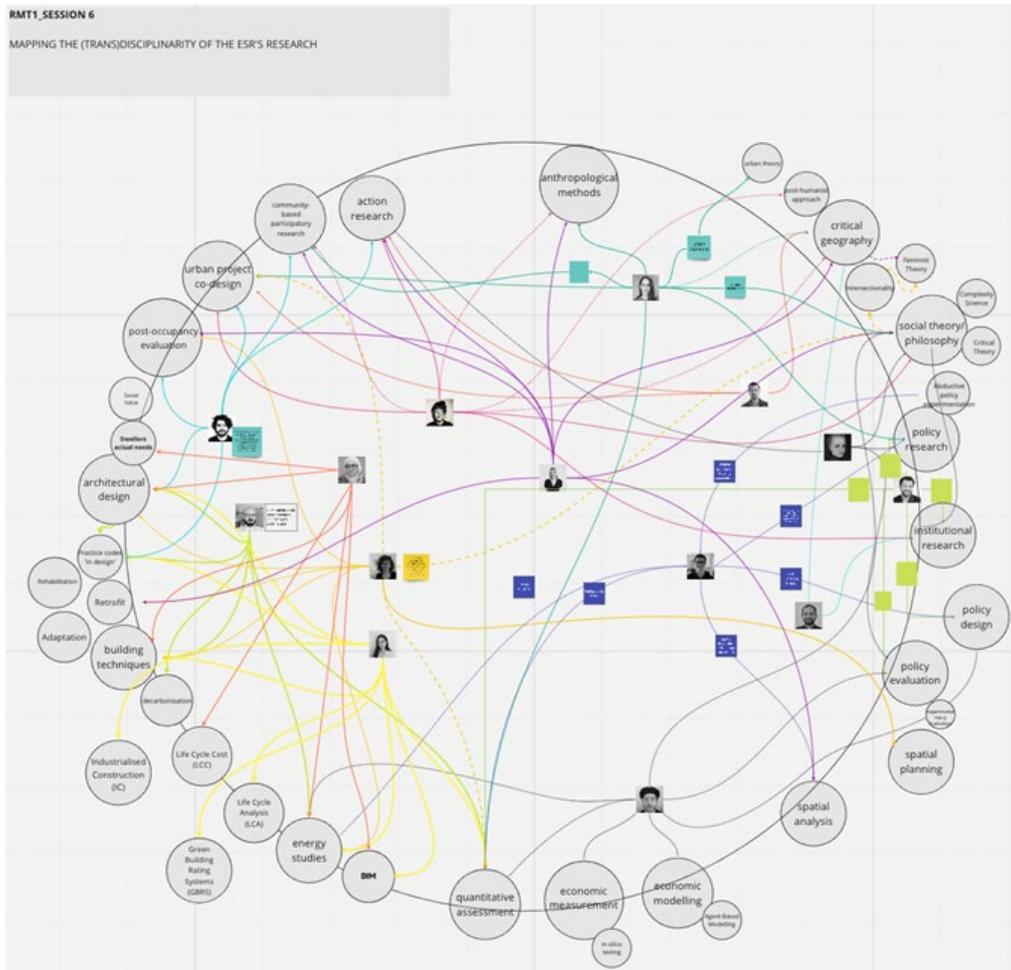
Figure A1.4. Collective map of ESRs' research as part of the RTM1 course activities. Source: Adriana Diaconu, UGA

Figure A1.5. Exchanging experiences about secondments and their impact on research projects
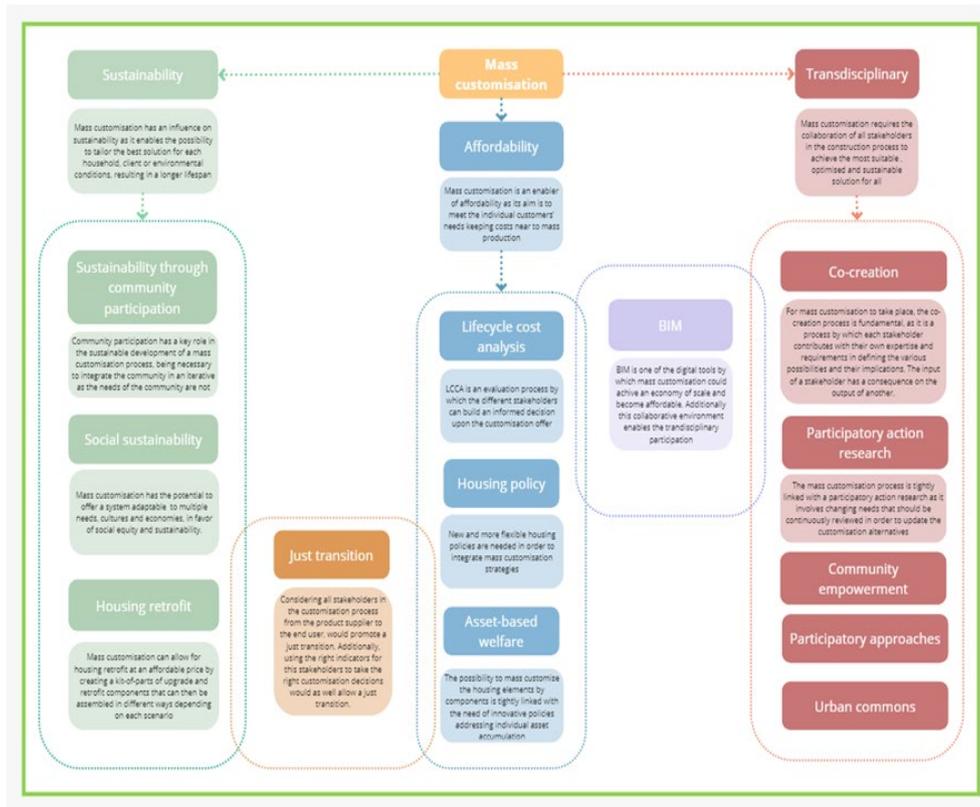
Figure A1.6. Clustering and relating concepts connecting the three areas of the RE-DWELL research framework , done at Budapest workshop by Carolina Martin
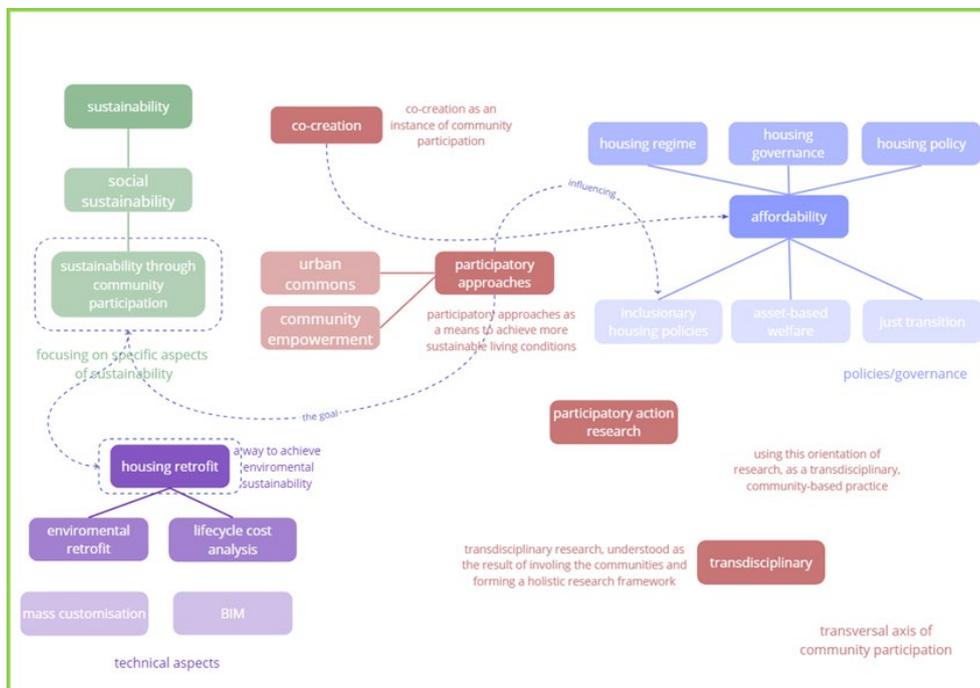
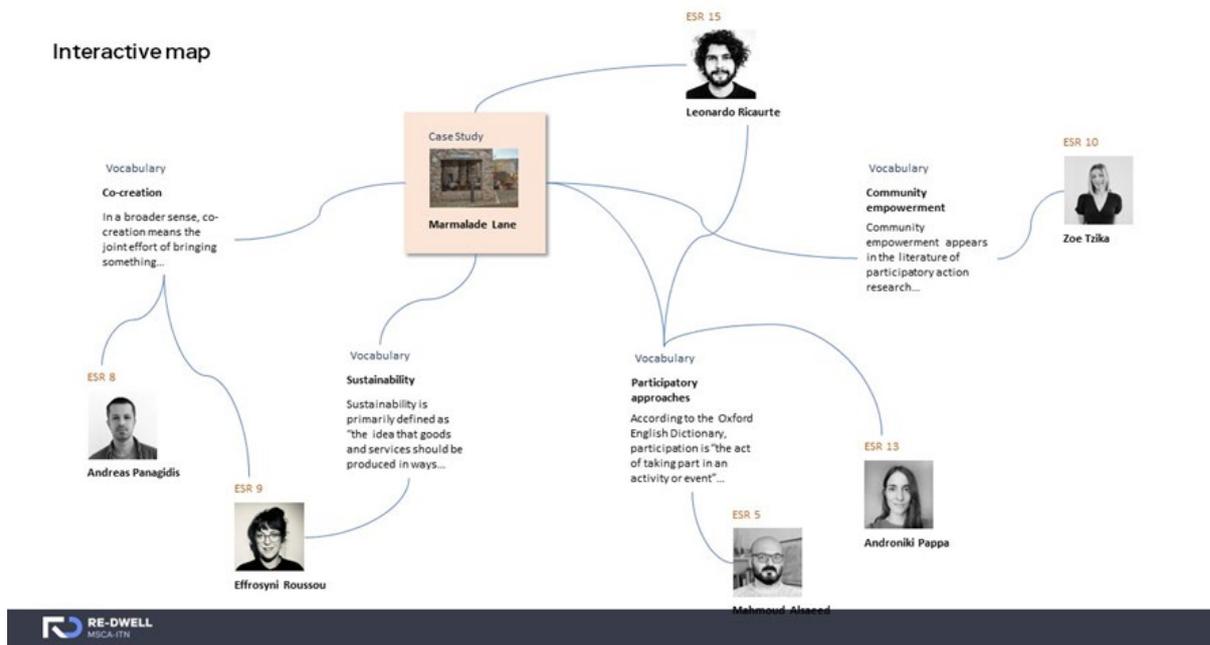Figure A1.7. Clustering and relating concepts, by Zoe Tzika
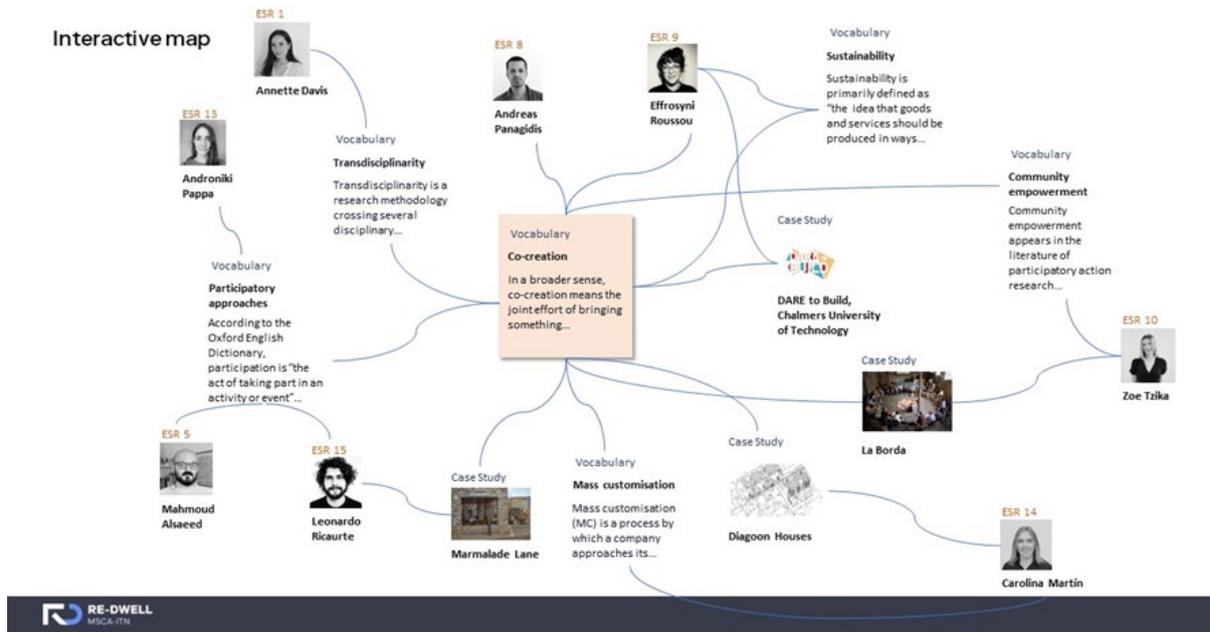
Figure A1.8. Team discussion around the term "Co-creation"

Figure A1.9. Team discussion around the case "Marmalade Lane"

Figure A1.10. Compilation of the responses provided by ESRs and partner organisations teams at Supervisory Board meeting
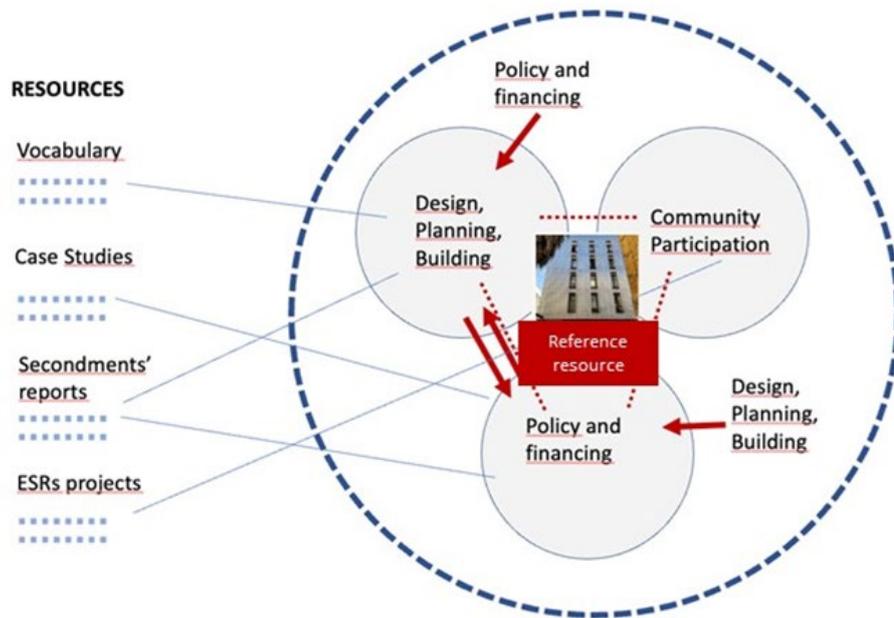

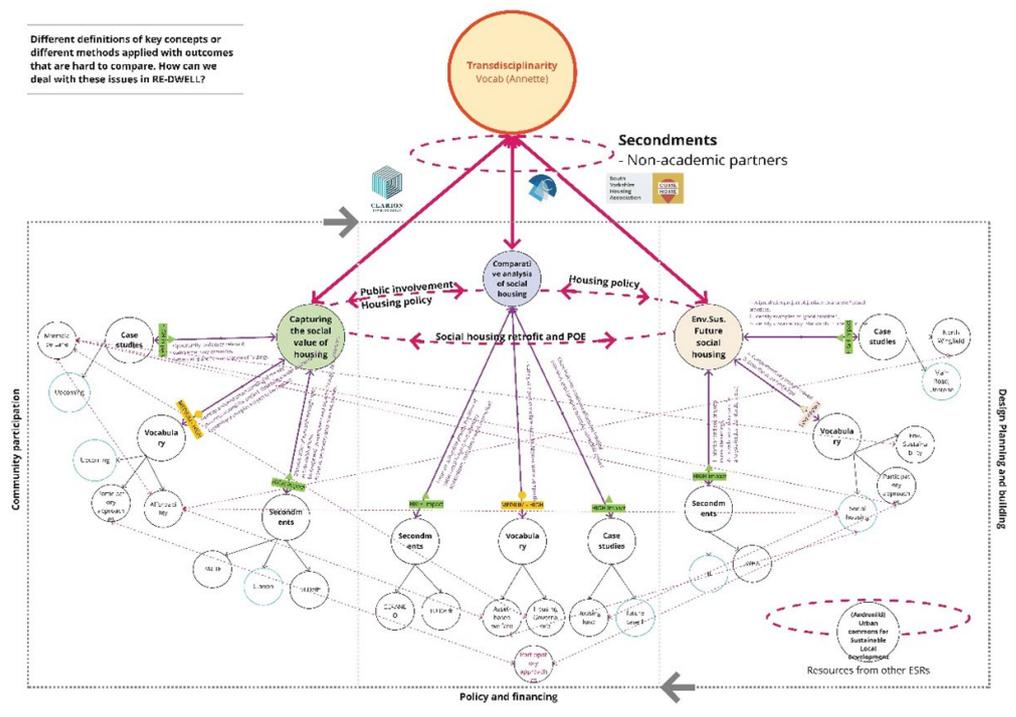*Figure A1.11. Structure of the assignment Zagreb workshop*

Figure A1.12. Work by ESR team Mahmoud Alsaeed, Marko Horvat, and Leonardo Ricaurte, Zagreb workshop

Annex 2 - Partner organisations

2.1. The RE-DWELL partner organisations

The survey responses from the partners must be understood in the context of their specific characteristics, including organization type, activity sector, location, and geographic scope, which are summarized in Table A2.1.

Table A2.1 Characteristics of RE-DWELL partner organisations

PO name (short name)	Organization type	Activity sector	Location	Geographic scope
Lisbon City Council (LCC)	Public authority	Public administration	Lisbon, Portugal	Lisbon
Budapesti Módszertani Szociális Központ (BMSK)	Public agency	Homeless service provider	Budapest, Hungary	Budapest
Ceraneo	Think Tank	Research and advocacy in social policy	Zagreb, Croatia	Croatia, CEE countries
Institut Català del Sòl (Incasòl)	Public agency	Implement housing and local development policies, develop land in the public interest	Barcelona, Spain	Catalonia
Clarion Housing Group (Clarion)	Housing association	Social housing landlord	London, UK	England
Casais	Private company	Engineering and construction, Specialties and industry, Asset management	Braga and Lisbon, Portugal	Portugal and other 16 countries
Cyprus Land Development Corporation (CLDC)	Public organization	Implementation of housing policies, land development	Nicosia, Cyprus	Cyprus
South Yorkshire Housing Association Ltd. (SYHA)	Housing association	Social housing landlord	Sheffield, UK	South Yorkshire and North East Derbyshire
European Federation for Living (EFL)	European network of housing associations, companies and experts	Research and innovation projects, networking	Amsterdam, The Netherlands	19 European countries
Housing Europe (HE) - the Observatory	Network of public, social and cooperative housing providers	The Observatory: Research, policy support	Brussels, Belgium	25 European countries
Városkutatás Kft (Metropolitan Research Institute – MRI)	Scientific Think Tank	Research and consultancy on housing and urban development	Budapest, Hungary	Europe

Table A2.1 shows a great diversity among the eleven partner organisations that participated in the survey:

- one is a local public administration, in Portugal's capital city (Lisbon City Council - LCC);

- two are housing associations, both located in the UK (the largest housing association in the UK that builds and manages homes all across the country – Clarion, and a local housing association in South Yorkshire - SYHA);

- two are land developers engaged in promoting affordable housing in Catalonia (Incasòl) and in Cyprus (CLDC);

- one is a private company in the field of engineering and construction in Portugal (Casais);

- one is a service provider for the homeless in Hungary (BMSK)

- four organisations are active in the field of research and advocacy, and among them two are European-wide federations of housing providers (EFL and Housing Europe), whereas the other two are think-tanks, one based in Budapest (MRI) and the other one in Zagreb, Croatia (Ceraneo).

The needs and interests of partner organisations span widely between more practice-based, and more research-based approaches, and cover a wide range of themes:

- from building techniques and processes: i.e., integration of information and production in the building process, deployment of BIM and development of a material passport philosophy (Casais), and more general construction process management models aiming to shorten the production time (Incasòl),

- to tools for decision making in housing investment, such as "life cost analysis" (SYHA),

- and more police-oriented themes, like the "the role of participatory movements" and methods for boosting participatory citizenship (LCC), or advocacy for housing for vulnerable groups and promotion of "evidence-based policies" (Ceraneo).

Partner organisations thus cover different sectors and have different positions in the housing system: from local policy-making, policy counselling and advocacy, housing production and management, to the design of construction and building processes. These specificities are reflected in their expertise and in their standpoints in the housing debate, and also influence their expectations for collaboration with academia (Table A2.2). A common element of the problems they bring into the discussion about affordable and sustainable housing is the necessity to adapt the present housing system in order to achieve the transition to sustainability, without compromising on the social role of housing.

Table A2.2 Main themes of interest brought into discussion by partner organisations

PO name (short name)	Themes of interest
Lisbon City Council (LCC)	Participatory movements – its roles in urban development, methods and tools for local authorities to support the development of participatory actions
Budapesti Módszertani Szociális Központ (BMSK)	Housing accessibility for people excluded from the private housing market
Ceraneo	Evidence-based policies for vulnerable groups associated with new social risks regarding affordable housing; advocacy and the role of media
Institut Català del Sòl (Incasòl)	Shortening the time of housing production through more efficient building procedures
Clarion Housing Group (Clarion)	The sustainability agenda of social housing
Casais	Integration of the information of buildings (development of BIM, "material passports philosophy") and of production (building design, construction and operation) for increasing sustainability, increasing efficiency, lowering costs and thus promoting affordability
Cyprus Land Development Corporation (CLDC)	Provision of affordable rental and affordable home ownership
South Yorkshire Housing Association Ltd. (SYHA)	Life cost analysis for the evaluation of design options of new built homes
European Federation for Living (EFL)	Energy poverty and its effects on tenants
Housing Europe (HE)	The Green Deal/Renovation wave in practice and the social aspects of the energy transition; the effects of the increasing cost of construction and of the delays in construction and renovation; the effects of inflation and of increasing interest rates on accessing housing and on housing affordability; the impact the reformed EU economic governance on governments' spending (i.e., member states' public support to the housing sector)
Városkutatás Kft (Metropolitan Research Institute – MRI)	Introduction and development of different forms of affordable housing in CEE countries: subsidized rental housing and restricted housing ownership

2.2. Survey partner organisations

This is the survey facilitated to partner organisations, as preparation for the discussion with early-stage researchers held during the online meeting held on May 22, 2023.

A- About your involvement in RE-DWELL

You supported the application of the MSCA-ITN RE-DWELL.

- Why did you decide to become partner in the RE-DWELL project?
- What were you considerations to take part?
- What do you expect from the RE-DWELL project?

B- About your experience with secondments

If you hosted one or more ESRs, what are your experiences so far:

- What did the ESR(s) bring to your organisation?
- What do you think they learned during the secondment?
- What did you learn from hosting the ESR(s)?

C- About the project outcomes

A main outcome of RE-DWELL is an assessment framework for affordable and sustainable housing (both together) to be validated by partner organisations.

- What are according to you important ingredients of such a framework? Think about: checklists, toolkits, best practices, policy and practice recommendations, guidelines, platforms for cross learning…

- What would you need to make your current practices go in line with RE-DWELL transdisciplinary approach?

D- About the impact of RE-DWELL

The RE-DWELL project aims to have impact on the societal challenge of affordable and sustainable housing.

- What are your current priorities in affordable and sustainable housing?
- What are the challenges and problems you come across?

E- Further issues

Please write here any other comments and suggestions which can help us to reach the project objectives.