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Characterising the transdisciplinary challenge in the development of Sustainable Plus Energy Neighbourhoods – what do emerging innovations tell us?

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Abstract. Accelerating decarbonization in the built environment is imperative for a sustainable future. Innovative building concepts on a neighbourhood scale present promising potential to revolutionise how buildings can be designed, built and operated in different climate zones that can bring about a significant decarbonization in the built environment. However, this potential can only be unleashed if a broad range of knowledge and understandings – both technical and non-technical – can be skilfully combined. Yet, such projects are often confronted with a transdisciplinary challenge that is inevitable and inherent. This paper characterises the transdisciplinary challenge in the development of four proofs-of-concept of Sustainable Plus Energy Neighbourhoods (SPENs) in four European countries. It adopts the qualitative research method capturing emerging innovations as practices to position the empirical lens close to what actors do to address the transdisciplinary challenge. The contribution of this paper is to better understand the transdisciplinary challenge that can slow down the uptake of the SPEN concept in the built environment. The paper ends with some suggestions for overcoming the transdisciplinary challenge in the development of neighbourhood scale building projects to unlock its positive effects.

1. Introduction

Accelerating decarbonization in the built environment is imperative for a sustainable future. Many innovative building concepts on a neighbourhood scale are being implemented to deliver proofs-of-concept to demonstrate that decarbonisation is not only possible but that it also has the potential to generate value. One pathway focuses on planning and designing multi-storey apartment homes on a larger scale than the conventional way of building, embarking on a novel concept called Sustainable Plus Energy Neighbourhoods (SPENs), put forth in the H2020 Innovation Action project syn.ikia project [1].

SPENs are envisioned to be groups of interconnected multi-storey apartment homes that are highly energy efficient and fitted with renewable energy sources that have the potential to generate a surplus of energy [4]. Via passive and active solutions, SPEN apartment homes aim to reduce its direct and indirect energy use towards zero over the year, with increased generation and use of renewable energy. They are also made ready with energy flexible solutions. Simply put, energy flexibility in buildings are efforts to capitalize on smart meters installed and to nurture the ability of the building to manage its demand and generation of energy according to local climate conditions, user needs and grid requirement [27]. If successful and diffused adequately as a way of building in the future, SPENs promise to revolutionise how multi-storey apartment homes can be designed and built in different climate zones that can bring about a significant decarbonization in the built environment.

However, being a novel concept that involves an array of social and technical innovations, the SPEN concept is also very challenging to communicate and understand, let alone implement and scaled up [21]. The reasons are many but can mostly be attributed to the ambiguity and lack of agreement regarding the energy concepts, the inclusion of new spaces between the buildings, the ineffective combination of a large variety of solutions and lastly the consideration of social issues and public acceptance and support [21]. The common thread running through these barriers is the almost impossible task of involving different types of stakeholders in the typically protracted process of planning and designing such a project appropriate to the local context, culture and climate zone. Ekambaram et al. [26] point out the importance of stakeholder management and collaboration among stakeholders when it comes to making use of energy efficient solutions in upscaling activities, including at the neighbourhood level (ref.): More fundamentally, it can be argued that planning and designing SPENs is not only a multidisciplinary and interdisciplinary undertaking but is also a transdisciplinary endeavour.

The meaning of multidisciplinary and interdisciplinary requires some distinction from transdisciplinary here [2] [3]. Whereas multidisciplinary projects juxtapose separate disciplinary approaches around a common interest, interdisciplinary projects strive for collaboration between disciplines. In other words, in multidisciplinary projects, stakeholders from each discipline work in a self-contained manner and there is little cross fertilisation among disciplines of the stakeholders involved. In interdisciplinary projects, efforts are made to involve bodies of knowledge and expertise derived from more than one discipline and to achieve effective communication between experts from different disciplines for stakeholders to negotiate ideas and perspectives.

However, building projects embarking on a neighbourhood scale are arguably transdisciplinary endeavours. Going beyond multidisciplinary and interdisciplinary, transdisciplinary projects aim to address societal problems by means of active co-creation among different categories of stakeholders such as practitioners, municipalities, end-users and researchers by transgressing boundaries between disciplinary knowledge. Accelerating decarbonization in the built environment via SPEN multi-storey apartment homes arguably requires a transdisciplinary approach to bring together social, economic and technical aspects, involving both technical and social innovations. Put another way, it is also this transdisciplinary challenge that comes to the fore when involving different types of stakeholders in the protracted process of planning and designing SPENs. In order to overcome this transdisciplinary challenge, we first have to seek a better understanding of the nature of this transdisciplinary challenge in the context of developing SPENs.

This paper therefore asks: ***How can aspects of the transdisciplinary challenge in the development of SPENs be characterised?***

This paper is organized as follows. We first situate the transdisciplinary challenge in different types of silo thinking in the context of development of sustainable plus energy neighbourhoods. To make clear how we may better understand transdisciplinary gaps, we draw on theories from the ladder of inference [5]. We then outline the research approach to focus on capturing emerging innovations as practices from an ongoing EU project syn.ikia. The results present two emerging innovations that help to shed light on the characteristics of the transdisciplinary challenge that is inherent in all SPEN projects. The paper then ends with some suggestions for overcoming this transdisciplinary challenge and unlocking its positive effects.

2. Transdisciplinary challenge in the development of SPENs

The interest in designing and constructing SPENS is to move from the building level to the neighbourhood scale. The argument is that buildings cannot be regarded as isolated units when considering the inclusion of renewable energy sources and the decentralisation of energy production. The single building level becomes an ineffective and inefficient unit to work with when one needs to properly assess the interdependencies that may occur among interconnected buildings. However, working on this large scale entails developing solutions that involve multiple urban stakeholders (such as smart technologies, electrical grid distributor, energy generations, municipalities, to name a few). This aspect has been recognized to be particularly challenging [6] [7], and many studies have acknowledged that getting this array of actors to collaborate is a necessary but complex and time-consuming task.

In the next sub-sections, we try to situate the transdisciplinary challenge, first in silo thinking followed by the ladder of inference. The transdisciplinary challenge needs to be overcome before collaboration and successful innovation on the neighbourhood scale can happen. This understanding needs to be achieved among a diversity of actors, with diverse and at times conflicting interests, over the protracted period of planning and designing such projects.

2.1 Transdisciplinary challenge and silo thinking

Silo thinking in the context of development of sustainable plus energy neighbourhoods has been defined as:

> the pursuit of one individual or group's interest or objectives without considering or recognising others' viewpoints and interests inside or outside of the organisation, discipline or community. It often leads to ineffective or suboptimal collaborations and partnerships or to failure in replicating successful programmes [22]

Five types of silo thinking in the context of neighbourhood scale building projects have been identified:

- Disciplinary silos between technical and social experts in PED policy and framework-making stages at EU and national levels;
- Administrative silos between different government departments in PED planning stage at national and local levels;
- Institutional silos in the implementation stage between local authorities, businesses and NGOs in collaboration;
- Silos of representation regarding public responses and their roles in the implementation stage;
- Silos of context that persists in the adoption, replication and scaling-up stage for PED.

While these silo types are recognised to emerge at different phases of the project and may involve different categories of actors, they stem from common socio-psychological and structural factors (Yoo et al.) In particular, misconceptions and prejudices that different groups of actors hold against one another during the collaboration processes can lead to friction in communication and understanding. Furthermore, different disciplines interpret SPENs based on their sociocultural-historical beliefs and ideologies, leading to unconscious biases, conflicting approaches and miscommunication. Collaborating with new categories of actors (such as construction value chain actors and residential energy value chain actors) and using new solutions require learning. These can slow down or even obstruct the efficient planning and implementation of a SPEN.

2.2 Capturing emerging innovations as practices

In many research projects, many innovations in the form of improved tools, methods and solutions are envisaged upfront to bring about desired project results. More often than not, in the course of the research project, unforeseen tools, methods and solutions are also advanced to address emerging issues and solve evolving problems that were not thought of beforehand. In the development of Sustainable Plus Energy Neighbourhoods, the unforeseen tools and methods are captured and studied as emerging innovations.

In this study, we posit that such emerging innovations can be captured as practices to position the empirical lens close to what actors do to address the transdisciplinary challenge. Research has made the position clear that practices are important and that they deserve our attention at the empirical level [23]. Practices are important because they can assist actors to improve the frame and structure used to shape the influx of information they face and to move beyond cognitive boundaries [24]. Furthermore, practices are feasible research endeavours because they are visible, explicit and observable [25]. In other words, researchers can attempt to investigate what emerging tools and solutions are important to advance the development of SPENs with the aim of uncovering the micro activities involved. Understanding the practices would allow us to better understand the transdisciplinary challenge that is inherent in all SPEN projects and better equip us to handle the transdisciplinary gaps.

In pursuit of our research question, we adopt the view that silo thinking in the development of SPENs manifest themselves in the emerging innovations that were not envisaged.

2.3 Locating the rise of transdisciplinary gaps in emerging innovations using the Ladder of inference

Different stakeholders have different views of reality. They have their own interpretation and understanding of, for example, the work that they engage in; people that they collaborate with; as well as the nature of interaction that they have with others. The different views of reality are shaped by and reflect silo thinking. The difference in understanding can influence the efficient conduct and progression of the development of technical and social innovations in a SPEN project. The difference in understanding can manifest in various activities. One of the activities in this regard is communication. Simple communication can lead to some misunderstanding and hence disruption of the intended progression of activities in the project. Schein [9] conducted a study on how employees, who belong to different departments (that reflect different disciplines) in an organization, understand apparently simple words in their communication. In this regard, he used the word "marketing". His study [9] showed what the word "marketing" meant for people who belong to different departments:

- “Product development” to the engineer
- “Studying customers through market research” to the product manager
- “Merchandising” to the sales person, and
- “Constant change in design” to the manufacturing manager.

If apparently simple words can create different understanding in an organization (as a result of silo thinking), then we can imagine the challenges of communication and collaboration in developing and delivering technical and social solutions for SPENs. Varying interpretation of concepts, actions and issues in multi-stakeholder environments, if not dealt with properly, can lead to misunderstanding, communication break-down, frustration, mistrust, unfavourable work-atmosphere, poor collaboration and conflicts. A potential consequence of this kind of situation could lead to a transdisciplinary challenge and even a collapse of the innovation initiative.

Therefore, it is important to look at how differences in understanding of reality (concepts, actions, events, issues, etc.) emerge. In other words, how silo thinking manifests and leads to action / behaviour. In this regard, we consider ladder of inference [5] that is presented in Figure 1. Ladder of inference presents different stages through which an individual understands the reality / world. As the ladder points out, the context / background that the individual belongs to or is accustomed to (for example, national culture or work culture pertaining to the individual's discipline), can influence creating this understanding.

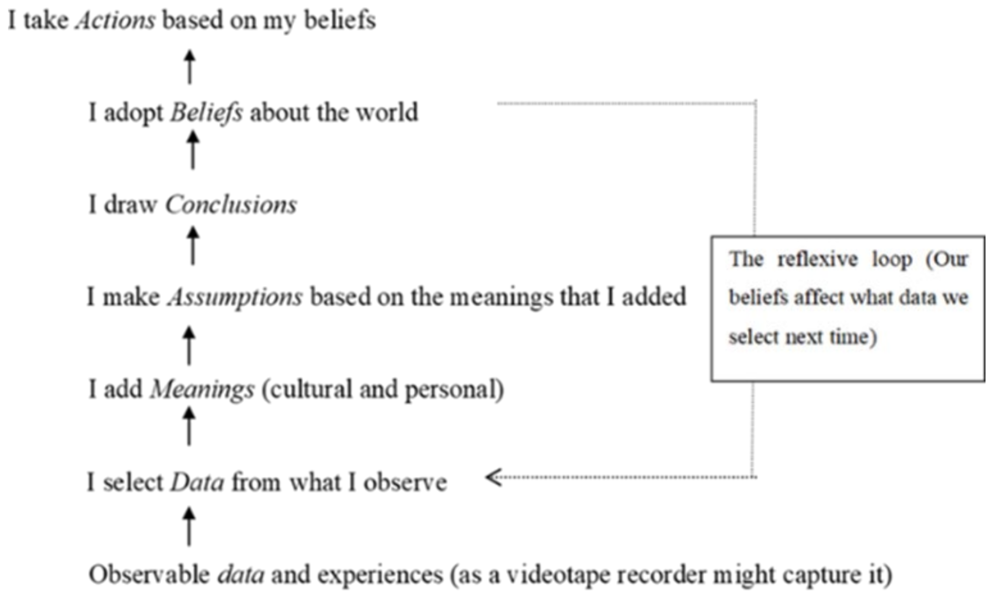

Figure 1. Ladder of inference [5, page 243]

Let us look at the ladder in connection with transdisciplinary multistakeholder settings. Two or more stakeholders in such settings, who experience or are expose to the same event or perceive one particular aspect/ issue, can interpret it differently and take different actions (by selecting data, adding meaning, making assumptions, etc.) In this regard, the various stages in the ladder of inference point out how (in what form) the difference can emerge step-by-step to produce a transdisciplinary gap.

It is also interesting to look at the notion of mental models in connection with the emergence of transdisciplinary gap. According to Senge [10]: "Mental models are deeply ingrained assumptions, generalizations, or even pictures or images that influence how we understand the world and how we take action. Very often, we are not consciously aware of our mental models or the effects they have on our behaviour (page 8)." In an organisational context, each discipline, function or organisational unit tends to have its own set of mental models and work-culture. Senge's definition shows the importance of mental models and gives an implicit understanding on how mental models can influence the way people interact in transdisciplinary collaborative environments.

Dealing with transdisciplinary gap in the work of developing a sustainable plus energy neighbourhood could be challenging. This shift of focus demands collaboration between a new or

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previously-less-known constellation of stakeholders. These stakeholders probably have their own set of mental models, different worldviews and approaches. Ladder of inference can be used to understand the transdisciplinary challenge.

2.4 Harnessing positive effects of transdisciplinary challenges

Once we understand the challenge, then the next step will be to find proper measures to effectively address the challenge. Deeply ingrained assumptions and generalizations that Senge mentions with regards to mental models, could make us to react to situations automatically without reflection. As Schön [11] seems to suggest, without reflection a professional or practitioner cannot "surface and criticize the tacit understandings that have grown up around the repetitive experiences of a specialized practice (page 61)". In discussions in transdisciplinary collaborative environments, we cannot simply assume that reflection on the tacit understandings will automatically and instantaneously take place and hence pave the way to generate a common understanding. In the case of transdisciplinary challenge confronting multi-stakeholder environments in the development of SPEN, active measures – in the form of questioning and applying different mind sets – may be necessary to narrow the gap.

Questioning can have three components comprising reflection (individual and collective), advocacy and inquiry [4]:

- Becoming more aware of one's own thinking and reasoning (reflection)
- Making one's thinking and reasoning more visible to others (advocacy)
- Inquiring into others' thinking and reasoning (inquiry)

Interplay among these three components in a discussion can help the participants to create a common ground for understanding.

Broo [12] mentions three mindsets that are relevant for facilitating transdisciplinary thinking and inquiry that deal with sustainability issues. These are systems mindset, futuristic mindset and design mindset. The decarbonisation challenge cannot be adequately dealt with from the domain of specific individual disciplines but through the accumulation of visions emerging from participating disciplines. To foster transdisciplinarity, combining all three mindsets can become a powerful to deal with the complex challenges of developing a SPEN.

The systems mindset replaces reductionism with expansionism and requires a shift from disconnections to interconnectedness, from linear to circular way of thinking, and understanding problems before attempting to solve them. The futuristic mindset is the ability to use a set of tools to track, analyse, imagine, decide and act on these changes, and is an important attitude to consider different outcomes of trends and uncertainties, imagine future scenarios, and develop strategies for different futures. Finally, the design mindset emphasises observation, collaboration, fast learning, visualisation of ideas, rapid concept prototyping and concurrent business analysis, which ultimately influences innovation. The design mindset attitude concentrates on understanding the needs and experiences of the user as a source of inspiration and can draw from a wealth of design toolkits such as storyboards, persona, empathy maps and roleplay.

The three mindsets would require reflection (individual and collective), advocacy and inquiry. One of the major requirements for successfully utilizing the three mindsets is to create a common ground for understanding among the stakeholders.

To sum up, in order to make concrete the characteristics of the transdisciplinary challenge in the development of Sustainable Plus Energy Neighbourhood, we will follow emerging innovations that try to deal with the challenges in the design, planning and operation of a group of interconnected buildings on the neighbourhood scale. The next section outlines how we have approached this study.

3. Research methods

Syn.ikia has been actively nurturing the development of both technical solutions for energy efficiency, renewable energy sources, storage, and flexibility as well as non-technical solutions, guidelines and tools for planning processes, market upscale and risk reduction to relevant market actors via four real-life demonstration cases in four climatic zones (Spain, Austria, Netherlands and Norway). The first author's role as work package leader responsible for innovation management, exploitation and market uptake of the H2020 Innovation Action project syn.ikia project has fostered close collaboration and ongoing dialogue (since 2021) with the stakeholders in the four proofs-of-concept. To comprehensively understand the emerging innovations, given the fluidity of actors, roles, and interactions in the project and across the different demonstration contexts, for the last 4 years, the first author has been actively engaged in the stakeholder analyses of neighbourhood-scale projects across the four contexts. The ongoing collaboration and involvement aligned research interests and the practical experiences of the demonstration leaders.

Data collection has relied on site visits, in-person discussions, bilateral digital meetings and email correspondence to better understand the development of the tools, methods and solutions for SPENs. In addition to extensive desk research (project deliverables), document analysis and literature reviews, the narrative, semi-structured interviews with the innovations owners were conducted and facilitated by the second author since 2022. The authors leveraged their collective expertise and experiences from various projects and initiatives to jointly identify, analyze and comprehend the emerging innovations in the advancement of SPENs in the demo sites in Salzburg, Uden, Barcelona and Fredrikstad.

We have applied the qualitative approach when it comes to research methods. In this regard, we have used the following research methods:

- Narrative literature study: According to Jahan et al. [15], narrative literature study is more informal in comparison with systematic literature study, and it does not necessarily require to report more rigorous aspects that structured literature review has – aspects such as search term, database that was used, and inclusion as well as exclusion criteria. Chapter 2 is based on narrative literature study.
- Document analysis and interviews (2 rounds per year): This includes digital documents, for example a digital innovation register that has been used by each innovation owner for registering progression of work in their respective innovations for each year from 2021 till to date. Innovation owners are required to update the register every April and October. Descriptions from these registers are used as a point of departure for interviews to understand the development of the technical and non-technical innovations in the project. Two rounds of interviews are held every year after the registers are updated. The register and the interviews allow us to follow the procedures and approaches that were necessary to develop the proof-of concept for SPEN in that climate zone.
- Innovation workshops (at least 1 per year): Whereas interviews with innovation owners provided us with relevant information and insight bilaterally (For example, how each of the innovation owners view their respective innovations, the barriers to overcome, and how they can better convey their solutions and methods to be easily understood and accessible by others), workshops provided a platform for innovation owners to interact

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multilaterally. Workshops were held digitally or in person. At least one workshop was conducted per year since 2020. Presentation of the innovations and how they are applied in the demonstration projects and the accompanied discussions (questions, clarification, reflection, etc.) in project meetings have provided opportunities to observe and capture how a common understanding of the innovations among the involved actors would emerge.

The usage of different research methods in our work can be characterized as methodological triangulation, at least to a certain degree. This triangulation can provide a more comprehensive understanding of the phenomenon / research questions that are under consideration.

4. Results

To design, build and operate SPENs, an array of innovations encompassing technical and non-technical solutions as well as guidelines and methods targeted at a diversity of stakeholders involved in the planning and development of SPENs are needed [16] [17] [18] [19] [20]. These were envisaged at the beginning of the project and were steadily developed. However, additional procedures and solutions that were not initially conceived were also developed.

In this study, we focused on these so-called emerging innovations that are instrumental to realise the proof-of-concept for SPENs. These emerging innovations are identified to be approaches and procedures for cooperative planning and for integral energy management.

4.1 Cooperative planning processes for SPENs

	Cooperative planning processes are a set of guidelines to involve various experts and take into consideration social aspects, users and extensive stakeholders in the planning and design of a SPEN.

The cooperative planning process has several components, including the pre-planning phase and the use of a quality agreement.

To develop Sustainable Plus Energy Neighborhoods, different expertise has to be taken into account: energy planner, building physics, architecture, mobility planner, landscape planner, housing technology and electricity. In addition to the planning and technical expertise, it is important to think about the social aspects and to consider the needs of the users (tenants and homeowners) and also the neighbors.

In the Austrian SPEN, a cooperative planning process was implemented in a very early planning phase by Salzburg Institute for Regional Planning and Housing or Salzburger Institut für Raumordnung und Wohnen (SIR). SIR is a competence centre for sustainable neighbourhoods in the Austrian National network. In this pre-planning phase, the project developer and city of Salzburg tried to include all interested stakeholders in the development process by a cooperative planning process. Several gatherings were held in this regard – for example, a joint inspection of the proposed site of the SPEN, three workshops, and a public presentation. These gatherings, especially the workshops, show the necessity to communicate and create a common understanding among the stakeholders. Some of the stakeholders who participated in the workshops are: Smart city experts, public transport expert, social area expert and representative from architectural advisory board. As the workshops facilitated communication and information-sharing, they presented opportunities to ask questions, clarify doubts and inconsistencies, and

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reflect collectively to obtain a common understanding. Thus, the pre-planning phase tries to provide the opportunity for participants to "come down" and operate at the lower end of the ladder of inference to avoid misunderstanding and communication gaps in the transdisciplinary collaboration.

Another component identified in our research is the Quality Agreement initiated by SIR, which is a non-legal binding agreement or an informal voluntary instrument. In the case of Salzburg, the Quality Agreement is an agreement between the project developer, the city of Salzburg, the architects, and other relevant planners, that describes the goals/qualities for six topics (management, communication, urban development, buildings, energy, mobility). It consists of documents that are short, easy to understand, and serve as reference points throughout the project. At the outset of the project, various actors convene in a workshop to share their interests, goals, and strategies. If a new actor joins the network later, another workshop is conducted to ensure that the agreement is understandable for new entrants while remaining open and flexible for new ideas and insights. The Quality Agreement is the result of a communication process and expresses the goals that must be fulfilled by the end of the project to ensure that all stakeholders deem it a success. These goals include reaching the requirements of the local building code and complying with the local housing subsidy directive.

4.2 Integral Energy Management for SPENs

	Integral Energy Management provides instructions for a building professional to manage the control, generation, and distribution of demand of energy. This role and procedure need to be in place to enable sharing of energy between two public buildings of different uses and schedules.

In the Spanish SPEN, to achieve a positive energy balance in a building, it was necessary to centralize the heating and sanitary hot water system, as it is the most efficient solution. However, this centralization requires the integrated energy management of the building to optimize its efficiency and to bill the tenants for the consumption of thermal energy used to heat the water.

The integral energy management procedures need to be put in place by the local public housing authority, Incasol, to establish the responsibility for controlling and optimizing production and consumption. Given the time lag between photovoltaic electricity production and the building's energy consumption, it is necessary to introduce management and expectation and storage strategies to make the most of production. But even so, surpluses occur during peak generation hours. And this is where it is necessary to look beyond the building and work on the neighbourhood scale in order to incorporate other buildings in communities (that have possibilities for electric or energy self-consumption) – for example, public facilities or other housing buildings – to take advantage of this surpluses and vice versa.

It was necessary to introduce integral energy management as a new procedure in the operational phase of the building. Integral energy management is necessary to manage a centralized system of sanitary hot water and heating that is more complex to manage than an individualized but more energy-efficient system. At the same time, and in order to gain more efficiency, it is necessary to expand the view to neighbourhood scale to optimize the use of surpluses. Energy Management is necessary to control and optimize the behavior of the Renewable Energy Self-Consumption Community suited to its local contexts. Drafting the role and the tasks for this function entailed multiple rounds of discussions and negotiations much akin to making space for respective participants in the construction value chain and the residential energy value chain to "come down" and operate at the lower end of the ladder of inference. On the one hand, it is expanding the role of traditional facilities management. On the other hand, it requires energy services companies to take up a new role.

5. Discussion and concluding remarks

This paper contributes to refining the understanding of the transdisciplinary challenge confronting the development of building projects on a neighbourhood scale. The different types of silo thinking were inherent in the SPEN projects. Our findings point to practices in different forms embedding the mechanism of bringing the diversity of stakeholders down to operate at the lower end of the ladder of inference. One of them is the cooperative planning processes which ensures that incumbent actors and incoming actors are systematically brought to a common understanding via the quality agreement tool. The other is the integral energy management procedures to bridge the gap between the different knowledge disciplines of building energy performance management and operating an energy community (which is an emerging discipline with many different operating models depending on local contexts). Going from a building to neighbourhood level is not only a matter of scale but also inclusion of new spaces (common areas, the spaces between buildings, facilities such as kindergarten etc.) This opens up opportunities (and challenges) for building energy professionals to interact even more deeply with other expertise such urban planners, social psychologists to relate to issues such as citizens' well-being and health.

These two emerging innovations go beyond targeting energy efficiency, energy production and energy flexibility measures in the design, construction and operation of multi-storey apartment homes. They have to navigate the ambiguity of moving from the building level to the neighbourhood scale which is still a very novel approach even though it has been acknowledged to be a very relevant scale in the framework of the energy transition of cities.

The concept of SPENs promises to revolutionise how multi-storey apartment homes can be designed and built and also operated in different climate zones that can bring about a significant decarbonization in the built environment. However, this potential can only be unleashed if a broad range of knowledge and understandings – both technical and non-technical – can be skilfully combined. In particular, for the operating phase, solutions are emerging to enable energy communities in different local contexts.

To conclude, investigating emerging innovations as practices offers fertile ground in developing a good understanding of the transdisciplinary challenge confronting the development of neighbourhood scale building projects. Practical implications include creating the awareness that transdisciplinary gaps are inevitably inherent in neighbourhood/ district scale projects such as SPENs but the ladder of inference can be a useful tool to narrow the disciplinary gaps among actors (from the construction value chain and residential energy value chain).

Further research can analyse more deeply the empirical material concerning emerging innovations for urban regeneration and large-scale retrofitting projects on a neighbourhood scale. Experiments can also be incorporated in the research design [8] to try out measures such as using the three mindsets in workshop setting / using questioning to create common ground for understanding. Selected stakeholder groups could be asked to exchange views from adopting a systems mindset, futuristic mindset and design mindset in turn.

In the bigger picture of energy transition, creating the awareness in professional and research actors to overcome the transdisciplinary challenge is only one part of the bigger puzzle.

Narrowing this transdisciplinary gap with end users (such as homeowners and tenants) and citizens is the other priority so that engagement strategies can be developed in a targeted way to increase the acceptance of neighbourhood scale projects by citizens (prosumers) to get them ready to be on board in the societal transition to the new energy system.

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