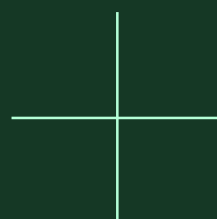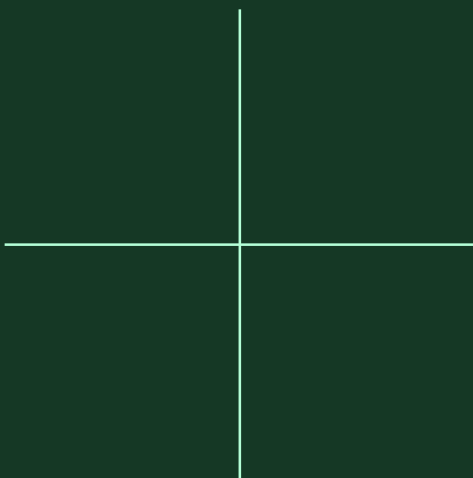# ARV
CLIMATE POSITIVE CIRCULAR COMMUNITIES

D3.1 PLAN AND OVERALL METHODOLOGY FOR ESTABLISHING CPCC LIVING LABS, INCLUDING STAKEHOLDER MAPPING

WP 3 CITIZEN ENGAGEMENT, ENVIRONMENT AND WELL-BEING

Caroline Cheng
Judith Thomsen

31.12.2022

PROJECT INFORMATION

Project acronym	ARV[1]
Project title	Climate Positive Circular Communities
Project number	101036723
Coordinator	Norwegian University of Science and Technology / Inger Andresen
Website	www.GreenDeal-ARV.eu

DOCUMENT INFORMATION

Deliverable Number and Title	D3.1 Plan and overall methodology for establishing CPCC Living Labs, including stakeholder mapping
Due Month	Month 12 (December 2022)
Work Package Number and Title	WP 3 Citizen Engagement, Environment and Well-being
Task number and Title	Task 3.2 Plan and develop an overall methodology for community activities and Living Labs
Dissemination Level	PU = Public, fully open
Date of Delivery	31.12.2022
Lead Authors	Caroline Cheng, SINTEF Judith Thomsen, SINTEF
Contributors	Lillian Sve Rokseth, SINTEF Claudia Moscoso, SINTEF Marianne Skaar, SINTEF Clara Mafé, Housing Europe Veronika Schropfer, ACE Gloria Oddo, ACE The following co-authors contributed to the LL chapters in the 6 locations: Marcello Curci, DTTN Kristina Bozhkova, Project Zero Anne Branderup, Project Zero

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[1] *ARV is a Norwegian word meaning "heritage" or "legacy". It reflects the emphasis on circularity, a key aspect in reaching the project's main goal of boosting the building renovation rate in Europe.*

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	Roel Massink, City of Utrecht Arno Peekel, UASU Joop ten Brink, Mitros Martijn Broekman, Boex Monica Hensen, City of Utrecht Nicol Staňková, CVUT Klára Dvořáková, CVUT Marta Nicolau Prohens, Palma Municipality Mar Saurina Monet, Palma Municipality Miquela Noguera Ferrando, Palma Municipality Bodil Motzke, OBF			
Reviewers	Michal Nesládek, CVUT Inger Andresen, NTNU			
Status	Final DRAFT version (Pending European Commission approval)			
Revision Log	**Version**	**Author**	**Main changes**	**Date**
	V.01	Caroline Cheng, SINTEF	First draft	28.11.2022
	V.02	Michal Nesládek, CVUT	Minor changes	13.12.2022
	V.03	Caroline Cheng, SINTEF	Second draft	19.12.2202
	V.04	Inger Andresen, NTNU	Minor edits	20.12.2022
	V.05	Caroline Cheng, SINTEF	Final version	21.12.2022

ABOUT THE ARV PROJECT

The vision of the ARV project is to contribute to speedy and wide scale implementation of Climate Positive Circular Communities (CPCC) where people can thrive and prosper for generations to come. The overall aim is to demonstrate and validate attractive, resilient, and affordable solutions for CPCC that will significantly speed up the deep energy renovations and the deployment of energy and climate measures in the construction and energy industries. To achieve this, the ARV project will employ a novel concept relying on a combination of 3 conceptual pillars, 6 demonstration projects, and 9 thematic focus areas.

The 3 conceptual pillars are integration, circularity, and simplicity. **Integration** in ARV means the coupling of people, buildings, and energy systems, through multi-stakeholder co-creation and use of innovative digital tools. **Circularity** in ARV means a systematic way of addressing circular economy through integrated use of Life Cycle Assessment, digital logbooks, and material banks. **Simplicity** in ARV means to make the solutions easy to understand and use for all stakeholders, from manufacturers to end-users.

The 6 demonstration projects are urban regeneration projects in 6 locations around Europe. They have been carefully selected to represent the different European climates and contexts, and due to their high ambitions in environmental, social, and economic sustainability. Renovation of social housing and public buildings are specifically focused. Together, they will demonstrate more than 50 innovations in more than 150,000 m² of buildings.

The 9 thematic focus areas are 1) Effective planning and implementation of CPCCs, 2) Enhancing citizen engagement, environment, and well-being, 3) Sustainable building re(design) 4) Resource efficient manufacturing and construction workflows, 5) Smart integration of renewables and storage systems, 6) Effective management of energy and flexibility, 7) Continuous monitoring and evaluation, 8) New business models and financial mechanisms, policy instruments and exploitation, and 9) Effective communication, dissemination, and stakeholder outreach.
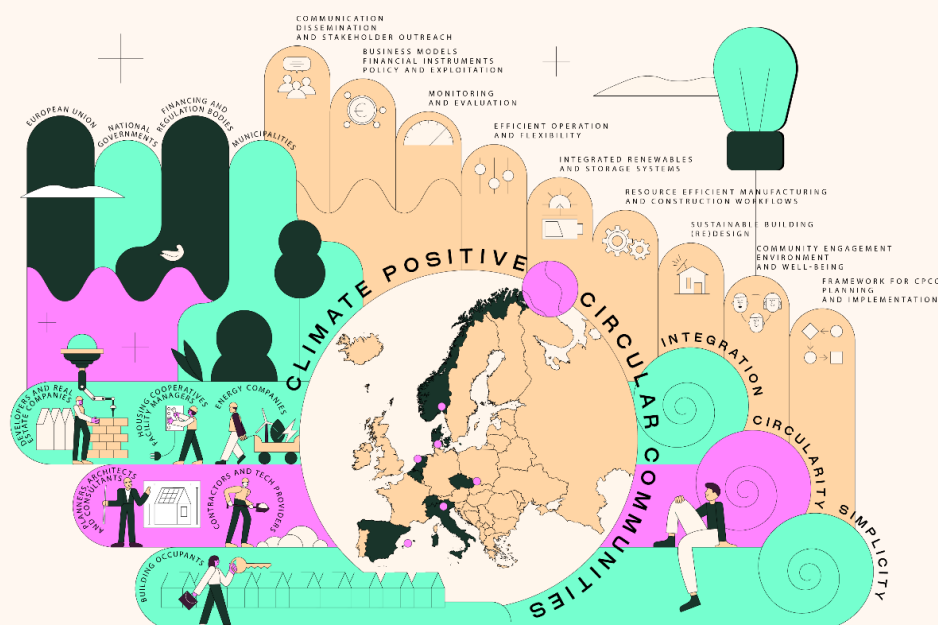
The ARV project is an Innovation Action that has received funding under the Green Deal Call LC-GD-4-1-2020 - Building and renovating in an energy and resource efficient way. The project started in January 2022 and has a project period of 4 years, until December 2025. The project is coordinated by the Norwegian University of Science and Technology and involves 35 partners from 8 different European Countries.

EXECUTIVE SUMMARY

Enhancing citizen engagement, environment and well-being is one of the 9 thematic focus areas of the ARV project. This thematic focus area works towards promoting active citizen engagement in processes of sustainable neighbourhood transformation. Active citizen engagement and feedback are often the missing link towards sustainable neighbourhood transformation. It is imperative to channel citizens' competences and experiences, ensuring their active engagement, in the planning and development of Climate Positive Circular Communities[2] (CPCCs). **CPCCs put people in focus, foregrounding their specific needs, interaction, and wellbeing. This is the heart of ARV's WP3 approach**. Engagement on a community level is therefore arguably the catalyst in the transformation of the built environment to contribute towards carbon neutrality. Living Lab (LL) approaches are known for engaging with multi-stakeholder groups in real-life contexts. CPCC LLs will therefore be established to focus on enhancing citizen engagement methods towards the planning, development, and operation of CPCCs.

The **objectives** of this report are three-fold:
- To provide a plan and an overall methodology for the establishment of a Living Lab approach towards citizen engagement in each of the ARV demonstration projects in 6 locations around Europe.
- To provide an overview of the CPCC LLs in the ARV project by describing the target groups, main goals of the LLs and issues to address as well as the initial planned activities for citizen engagement in each of the LL.
- To guide (and steer) the implementation of community activities (Task 3.3) and monitoring and reporting of CPCC Living Labs (Task 3.4) and lay a robust groundwork for enhancing citizen engagement methods (Task 3.5).

This report is organised in three main parts.
- In the beginning part, Chapter 4 outlines how the Living Lab concept has evolved into an approach for citizen engagement in a multi-stakeholder innovation environment while Chapter 5 provides an overview of the umbrella themes bringing together the 6 CPCC Living Labs and the different perspectives on a citizen's role before presenting the plan and overall methodology to get CPCC Living Labs up and running at each demo location.
- The middle part from Chapters 6 to 11 provides a concise overview and context of the six CPCC LLs, outlining its target groups, main goals of the LLs as well as the initial planned activities for citizen engagement. The actors most relevant for citizen engagement activities in each of the 6 Living Labs are also outlined in stakeholder maps.
- In the ending part, Chapter 12 concludes with what has been planned on the road ahead and presents a working definition of a CPCC Living Lab.

Three key takeaways to sum up the report:
First, in the context of the ARV project, Living Labs in each of the 6 locations can be differentiated based on which actor drives their activities, namely company-driven, municipality-driven, research-driven and user community- driven. Based on which actor drives the activities, they differ from one another in terms of goals, activities, structure, organization, and coordination. Evaluating citizen engagement methods and tools will have to take into consideration this typology to devise evaluation approaches.

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[2] A Climate Positive Circular Community has been defined in D2.1. A Climate Positive Circular Community (**CPCC)** is an urban area, which aims to net zero greenhouse gas emissions, enable energy flexibility, and promotes a circular economy and social sustainability. The CPCC concept focuses strongly on the **interaction** and **integration between new and regenerated buildings, users,** and **energy systems, facilitated by ICT to provide attractive, resilient, and affordable solutions** for citizens**.**

Second, to get CPCC Living Labs up and running in each demonstration site, we developed the S.M.I.L.E methodology drawing inspiration from the literature and in consultation with representatives from all the six demo sites. In a nutshell, we suggest focusing on five phases to establish a CPCC Living Lab – Scope, Map, Implement, Learn and Enhance. What stands out from most recommended approaches is the additional step: Map. Map envisions all the actors relevant for citizen engagement activities. Map allows the possibility to look at the map of relevant actors and the goals of the LLs, reviewing their congruence. Adopting the Living Labs networking approach requires thorough understanding of important actors' objectives and drivers, the alignment of operational processes, and establishment of open and collaborative culture. The S.M.I.L.E methodology provides a common point of departure for partners responsible for citizen engagement activities in each of the Living Labs, whether it is newly set up and is an extension of ongoing programmes.

Finally, it should be noted that a high degree of citizen engagement is not always required to deliver change processes and implement sustainable solutions. The transformative potential of a Living Lab can also be realised with a low level of user involvement. As the literature points out, the "higher level of engagement, the better" does not always hold true. Instead, it is more important to consider the right form of engagement at the right time.

Concluding remarks and the road ahead
Applying the typology based on which actor drives their Living Lab activities can be helpful to have an overview of the types of CPCC Living Labs and the corresponding citizen engagement activities that will be implemented in the 6 demo projects of ARV.

Depending on the context, target groups, and goals, there will be a need for a variety of methods and tools to support the diversity of citizen engagement activities in the CPCC Living Labs in the 6 locations. In ARV, we will not only evaluate the combination of citizen engagement methods and tools, but we will also focus on how the methods and tools are used and associated with the different contexts and target groups.

CPCC Living Labs are real-world multi-stakeholder innovation environments where novel social and technical solutions and measures related to sustainable transformation of urban communities are designed and tested alongside and with citizens in different perspectives (such as building occupants, neighbourhood residents, green ambassadors, youth ambassadors). Varying levels of engagement can be used to channel citizens' competences and experiences towards the planning and development of CPCCs.

TABLE OF CONTENTS

1. INTRODUCTION

Enhancing citizen engagement, environment, and well-being is one of the 9 thematic focus areas of the ARV project. This thematic focus area works towards promoting active citizen engagement in processes of sustainable neighbourhood transformation. Active citizen engagement and feedback are often the missing link towards sustainable neighbourhood transformation. It is imperative to **channel citizens' competences and experiences,** ensuring their active engagement, in the planning and development of Climate Positive Circular Communities (CPCCs) that reduce energy demand and enhance energy efficiency behaviour. **CPCCs put people in focus, foregrounding their specific needs, interaction, and wellbeing. This is the heart of ARV's WP3 approach**.

Engagement on a community level is therefore arguably the catalyst in the transformation of the built environment to contribute towards carbon neutrality. Living Lab (LL) approaches are known for engaging with multi-stakeholder groups in real-life contexts. CPCC LLs will therefore be established to focus on enhancing citizen engagement methods towards the planning, development, and operation of CPCCs.

Scope of this report
In ARV, the work of enhancing citizen engagement, environment and well-being has been broken down into four main tasks. This report focuses on the plan and overall methodology to get CPCC LLs up and running in each demo site (see Figure 1).

| Plan LL approach for Citizen Engagement activities

(this report)
Task 3.2 | → | Implement Citizen Engagement activities

Task 3.3 | → | Report Citizen Engagement Activities; Document use of methods & tools, Identify barriers and drivers
Task 3.4 | → | Explore and enhance Citizen Engagement toolbox for deep renovation projects

Task 3.5 |
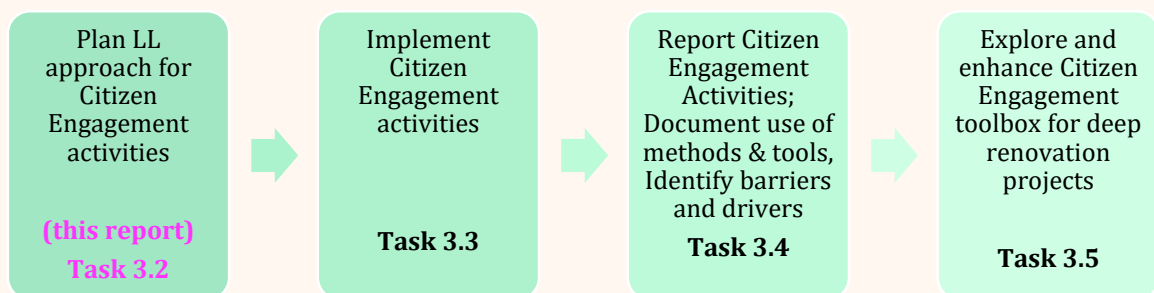
Figure 1. Scope of this report.

2. OBJECTIVES

Objectives of the report:
1. To provide a plan and an overall methodology for the establishment of a Living Lab approach towards citizen engagement in each of the ARV demonstration projects in 6 locations around Europe
2. To provide an overview of the CPCC LLs in the ARV project by describing the target groups, main goals of the LLs and issues to address as well as the initial planned activities for citizen engagement in each of the LL
3. To guide (and steer) the implementation of community activities (Task 3.3) and monitoring and reporting of CPCC Living Labs (Task 3.4), and lay a robust groundwork for enhancing citizen engagement methods (Task 3.5)

The reader will be informed of how the Living Lab approach for citizen engagement activities has been planned for each demo site. The reader will also be familiarised with the target groups to be reached out to and the preliminary citizen engagement activities in all the Living Labs. The reader will also get a good picture of how the work of enhancing citizen engagement, environment and well-being will be advanced in coordination with the demo owners.

3. HOW THIS REPORT WAS DEVELOPED

For the preparation of the report, we have relied on several activities.

- First, we conducted a literature review of Living Lab approaches to citizen engagement. In addition, special issues of the Living Lab topic were consulted for a more focused discussion (e.g. Technology Innovation Management Review).

- We also relied on project reports of relevance that our partners have been involved in such as IRIS[3], iSCAPE[4].

- We interacted with all six demo owners to better understand the context and needs of each demo site with respect to the work on enhancing citizen engagement. This was done via bi-lateral (online) meetings with demos in Mar/Apr 2022 and Oct/Nov 2022.

- Another source was the WP3 workshop conducted in Palma on 22 Jun 2022 during the first consortium meeting. The workshop focused on experiences with and expectations from citizen engagement activities. From the workshop, we understand that ARV partners are already practising with a number of engagement activities. ARV partners are also expecting to get feedback on solutions or to improve solutions, based on the perspective of citizens gathered by WP3 activities.

- Finally, we also had the opportunity to be onsite at the Utrecht and Palma demo sites to visit the neighbourhoods first hand in conjunction with the ARV Executive Board meeting in Utrecht on 28-29 Mar 2022 and the ARV Consortium meeting in Palma on 21-22 Jun 2022.

4. THE LIVING LAB APPROACH AND CITIZEN ENGAGEMENT

In this chapter, we outline how the Living Lab concept has evolved into an approach for Citizen Engagement in a multi-stakeholder innovation environment, outlining characteristics and types of Living Labs, as well as typical phases in establishment of Living Labs. We elaborate on how we use the Living Labs as an approach to citizen engagement and outline some preliminary ideas for evaluating the citizen engagement methods.

There is not one commonly accepted definition of "Living Lab", and many fundamental aspects of Living Labs remain dispersed (Westerlund et al., 2018). The concept of Living Labs (LLs) is diverse and evolving quickly. Prior to the 1980s, the concept was scarcely mentioned in literature (Leminen, Westerlund, Nystöm, 2012). When the Living Lab concept was developed, it was initially understood as a means to enable the careful study of people and their interaction with new technologies in a living environment (Schliwa, 2016). In other words, the origins of Living Lab approaches are rooted in product testing (Franz et al. 2015). According to Nesti (2018), the concept of the Living Lab was first used in the

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[3] https://irissmartcities.eu/
[4] https://www.iscapeproject.eu/

early 1990s to describe students' experimentation with a problem-solving approach in an inner-city neighbourhood. The concept was further developed by William J. Mitchell from the Massachusetts Institute of Technology (MIT) Media Lab and School of Architecture in 1995. The Philips Homelab and the Fraunhofer InHaus concept are European examples (Franz et al. 2015). The Living Lab concept then evolved to become an innovative research approach aimed at developing and testing new technologies and strategies to cope with complex social problems (Mitchell, 2003, as cited in Nesti, 2018).

Since 2000, Living Labs have been applied to promote citizen engagement in collaboration with research and development projects (Eskelinen et al., 2015). The concept has raised international interest over the years and has been extended to encompassing **urban areas** as an innovation platform, involving multiple stakeholders and co-creation processes (Leminen et al. 2012). While originally applied in technical and industrial contexts, the Living Lab approach has since grown and developed through a range of applications in different settings. In particular, the Living Lab approach has evolved to be applied in urban and regional settings as a means to promote innovation to the overall benefit of enterprises and economic activities. It is in this context that Living Lab approaches have by now become research tools through which local well-being can be enhanced through a constant and permanent process of multi-faceted and citizen-driven innovation (Eskelinen et al. 2015). Nowadays, the Living Lab approach can be understood as an attempt to bridge the gap between these multiple actors through directly involving them into the process of developing or transforming an urban neighbourhood (Steen & van Bueren, 2017).

4.1. DEFINITIONS, CHARACTERISTICS, AND TYPES OF LIVING LABS

Living Labs (LLs) is both a space (physical or virtual) and a research methodology. The European Network of Living Labs defines LLs as "*user-centred, open innovation ecosystems based on systematic user co-creation approach, integrating research and innovation processes in real life communities and settings*"[5].

Living Lab approaches are known for engaging with multi-stakeholder groups in real-life contexts (Franz et al., 2015). Westerlund et al. (2018) tried to outline the central characteristics in the operation of Living Labs and offers the following definition based on their multi-faceted perspective to understanding Living Labs: "*A Living Lab is a sociotechnical platform with shared resources, collaboration framework, and real-life context, which organizes its stakeholders into an innovation ecosystem that relies on representative governance, open standards, and diverse activities and methods to gather, create, communicate, and deliver new knowledge, validated solutions, professional development, and social impact*" (p. 56-57). In particular, this definition broadens the outcomes of Living Labs from new technologies, services, products, and systems to new knowledge, validated solutions, professional development and social impact.

Living Labs can find applications in many sectors. According to De Vita and De Vita (2021), LLs are often described as bridging the gap between "open innovation" (Chesbrough, 2003) and "user innovation" (von Hippel, 2005). Almirall et al. (2012), Arnkil et al. (2010), Leminen et al. (2012), and Mee & Crowe (2020) strongly emphasize innovation as the central aim of the LLs, for instance in "open-innovation networks" or "innovation arenas" and "innovation playgrounds". The European Network of Living Labs (ENoLL) emphasizes both innovation and the user-centred approach as main characteristics of LL`s.

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[5] https://enoll.org/about-us

Almirall & Wareham (2011) and Rizzo et al. (2021) also point out innovation, as well as user engagement and the real-life context as the central ideas driving LL`s.

Living Lab approaches can have a wide range of aims, e.g., the development of new products, systems, services, and processes. Methods and activities applied by LLs aim at integrating people into the entire development process. People can have different roles such as users and co-creators. The range of activities can be used to "*explore, examine, experiment, test and evaluate new ideas, scenarios, processes, systems, concepts and creative solutions in complex and real contexts*" (Bulkeley et al., 2017, p. 13).

Steen & Van Bueren (2017) review experiences with Living Labs in urban settings. The urban LL has evolved as an approach to tackle the complex challenges related to sustainable urban transition and neighbourhood development, while engaging with the citizens. When collecting the varieties of definitions found, they structured them by defining four dimensions that must be clearly defined and planned for when establishing an urban LL:

- **aim** (a. aimed at innovation, b. aimed at formal learning for replication, c. for urban Living Labs: aimed at increasing urban sustainability)
- **activities** (a. development, b. co-creation, c. iteration),
- **participants** (a. public actors, private actors, users, knowledge institutes, b. decision-making power), and
- **context** (a. real-life use context).

Leminen, Westerlund, and Nystöm (2012) emphasize that Living Labs are open-innovation networks and proposes four types of Living Labs differentiated based on which actor drives their activities. The four types can be more simply described as company-driven, municipality-driven, research-driven and user community- driven[6]. Based on which actor drives the activities, they differ from one another in terms of activities, structure, organization, and coordination (see Figure 2).

Company-driven	Municipality-driven	Research-driven	User community-driven
• Companies • Developing and testing firm products and services	• Municipalities • Pursue societal improvements • Reducing local unemployment, diverse social & structural problems	• Universities/ research institutes • Promoting theory, research dev • LLs for educational purposes	• Established by user communities • Solving users' everyday problems • Local housing community/ hobby group • Bottom-up principle

Figure 2. Four main types of Living Labs based on which actor drives their activities (from Leminen et al. 2012).

Such a typology was also applied by Menny et al. (2018) in their investigation between user involvement and the transformative potential of Urban Living Labs in four locations in Sweden and Germany. According to Menny et al. (2018), company-driven and user community-driven LLs can be understood as inhalation-dominated meaning they are more preoccupied with serving the needs of their leading actors, while municipality-driven and research-driven LLs can be understood as exhalation-dominated

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[6] Leminen et al. (2012) refer to these four types of LLs as utilizer-driven, enabler-driven, provider-driven, and user-driven.

meaning they seek to fulfil the needs of other stakeholders. This typology can be useful in classifying the diversity of LLs we are developing in ARV.

4.2. PHASES IN ESTABLISHMENT OF LIVING LABS

In practice, Living Labs can be viewed as a long-term programme, an initiative that needs a long-term commitment tied to a physical location. Living Labs are quite often embedded in existing activities tied to the physical location.

Almirall et al. (2012) outline four phases in their review of Living Lab methodologies:
- Contextualisation
- Concretization
- Implementation
- Feedback

In the **contextualization phase**, background information relevant for the project is gathered and sorted to inform the selection of participants comprising the LL. The objective of the next phase, the **concretization phase**, is to obtain forecasts or estimates which later can be compared with actual measurements of the new technologies or innovations once these are implemented. Tests and validation processes including both direct measurements as well as indirect measurements (such as ethnographic observations and qualitative interviews) are conducted in the **implementation phase**. In the **feedback phase**, "ex post" measurements are conducted. The results are compared to the results from the contextualization and implementation phase (hence an iterative process) and form the basis for the dissemination of recommendations regarding the new technologies or innovations that have been implemented (Almirall et al., 2012, p.14).

Steen & Van Bueren (2017), Nesti (2018), and Chronéer et al. (2019) all state that the Living Lab approach has developed in the direction of Urban Living Labs. (ULLs). ARV operates in an urban context, so the findings from Urban Living Labs are of specific interest for ARV.

McCormick & Hartmann (2017) outlines only three phases in establishing Urban Living Labs in their handbook: Design, Operation and Evaluation. In this manner, the concretisation phase and implementation phase that Almirall et al. (2012) described is included in the operation phase. As a practical guide, they also provide a checklist of questions for each phase (see Table 1).

Table 1. Useful checklists for DESIGN, OPERATION and EVALUATION of ULLs (from McCormick & Hartmann, 2017).

Design of ULLs	Operation of ULLs	Evaluation of ULLs
What is the shared vision for the future? How can an urban Living Lab contribute to this vision?	What will the urban Living Lab deliver in the course of its operation?	What is the purpose of the evaluation of the urban Living Lab?
How can the population living in the area of the planned urban Living Lab be characterised (e.g. socio-demographics, milieu)?	What are the expected or intended outcomes of the urban Living Lab? What are the milestones for the operation of the urban Living Lab?	What is the main question that needs to be answered about the urban Living Lab? Should the evaluation be of summative, formative, or interactive character?
Which stakeholder groups are passive or active in the creation of an urban Living Lab?	What resources (e.g. personnel, know-how, materials) are needed for the operation of the urban Living Lab?	What kind of data is needed for the evaluation – qualitative or quantitative?

Design of ULLs	Operation of ULLs	Evaluation of ULLs
How will stakeholders be addressed and involved in the proposed urban Living Lab?	How is the financing of the urban Living Lab ensured?	Which methods (e.g. interviews, surveys, observations) for data collection should be used in the evaluation?
What kind of local experiments will be organised within the urban Living Lab?	Who is the owner of the urban Living Lab?	What resources are needed to carry out the evaluation?
Why should local actors participate in the urban Living Lab?	Who are the key actors in the urban Living Lab?	What are the timeframes for the planned evaluation of the urban Living Lab?
What is needed to motivate actors to join and support the urban Living Lab?	Are decision and management processes defined?	Are there any ethical issues that need to be handled?
What kind of impacts or benefits can people living in the area expect from the urban Living Lab?		

It can be useful to use such checklists that the literature has offered in establishing Living Labs – to get the basic elements in place and ready for citizen engagement co-creation activities.

In addition to "typical" phases, we also noted that projects such as the iSCAPE project[7] incorporates identifying local partners as well as citizens, local groups and communities (in other words, mapping the important stakeholders) in its practical guide to establishing Living Labs.

4.3. LIVING LABS AS AN APPROACH TO CITIZEN ENGAGEMENT

Citizen engagement refers to the ways in which citizens engage in the life of a community in order to improve conditions for themselves or others, and to help shape the community's future.

According to Chronéer et al. (2019), engaging citizens and other stakeholders using different methods is among one of the four main aspects characterizing Living Labs operating in an urban context. The other three aspects are: Applying a long-term perspective that aims at improving the sustainability in urban areas; Create value and long-term sustainability; Develop a Living Lab which is connected to an urban area or a site.

In the following, we will focus on the first aspect of relevance for LL`s in urban settings; the engagement of citizens and other stakeholders.

4.3.1 LEVELS OF CITIZEN ENGAGEMENT

Citizen engagement aims at better understanding and including the needs of citizens, by involving them in ongoing processes, e.g., sustainable neighbourhood transformation in the context of the ARV project. The idea of engaging citizens is to create an active dialogue and increase the democratic interaction

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[7] Improving the Smart Control of Air Pollution in Europe – is a research and innovation project funded under the European Union's H2020 program. From 2016-2019, iSCAPE worked to reduce urban air pollution and the negative impacts of climate change across European cities. To do this, iSCAPE leveraged sustainable passive control systems, behavioural change initiatives and the Living Lab approach. See website: www.iSCAPEproject.eu.

between decision makers and the people of a community at the different stages of a planning process (Figueiredo Nascimento et al., 2016).

Citizen engagement has proven to contribute to increased ownership of outcomes, generation of ideas, building community trust, increase transparency in ongoing processes, and giving the opportunity to include varying target groups. For instance, vulnerable groups or minors that commonly are underrepresented in processes where public voices are asked for can be a goal of citizen engagement activities. Citizen engagement comprises a wide range of activities and can be structured according to different levels of engagement, depending on what the purpose is with the planned activities, ranging from merely **influencing and informing** people, to real **participation** and actual **decision making**.

As an alternative to Arnstein's (1969) ladder, the EU-lighthouse project IRIS developed a four-step Citizen Engagement Ladder model (Crombie et al., 2019) clarifying different levels of engagement. The model consists of four steps of increasing citizen engagement levels, including awareness raising, storytelling, co-creation for adoption, and co-creation for development. The level of influence the citizens have on the outcome of the project (IRIS) increases with the level on the ladder. The model is used to classify activities and to distinguish between communication-led engagement aiming at informing, and co-creation led activities involving citizens in the creation of their neighbourhood (Crombie et al., 2019, page 56-57).

Juujarvi and Pesso (2013) have identified **three ambition levels** in terms of citizen engagement commensurate with the goals of the Living Labs. In the first level, the urban context acts as a technology-assisted research environment by collecting as much citizen and user feedback as possible, such as by using different sensors and Internet of Things (IoT) deployments. In the second level, citizens are viewed as co-creators who contribute to designing and developing local services and urban artefacts (e.g. circular art, one stop shop solutions). The third level entails a new kind of urban planning that uses novel processes and tools that are developed by actively engaging citizens. In this third level of engagement, the aim is to plan procedures and facilitate vision planning, which will lead to increased mutual learning of various stakeholders, including citizens.

Compared to Arnstein's (1969) ladder, authors have also put forth alternative frameworks such as the wheel of participation (Davidson, 1998) as a more appropriate metaphor to deal with different levels of citizen engagement, beckoning the importance of a mix of engagement levels to effectively channel citizens' competences and experiences. In other words, co-creation should not be a single level of engagement to aim.

With inspiration from Juujarvi and Pesso (2013) and Davidson (1998), we can conceptualise the three ambition levels in a citizen engagement wheel, see Figure 3.
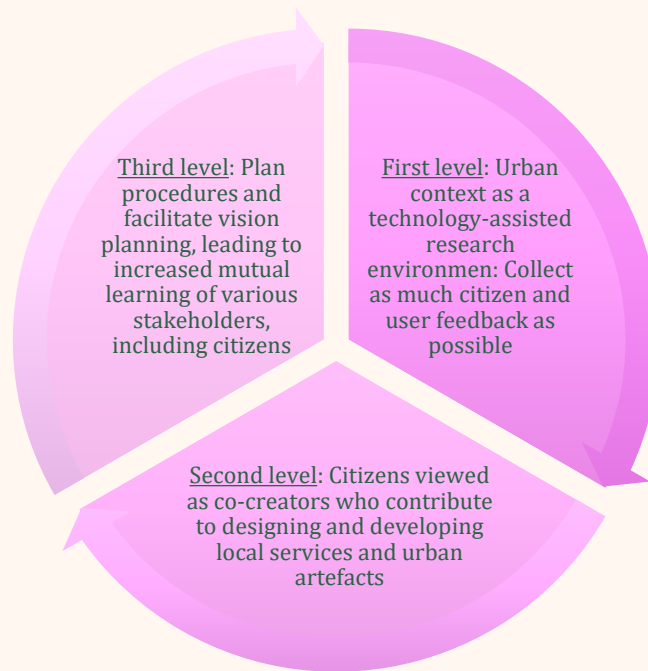
Figure 3. *Three ambition levels for citizen engagement (inspired by Juujarvi and Pesso, 2013 and Davidson, 1998).*

4.3.2 WHY CITIZEN ENGAGEMENT CAN BE DIFFICULT

Experience from practice and research show that there is no universal, off-the-shelf engagement process that fits all citizens. The task is to understand the variety of backgrounds, wealth, knowledge, and experiences of the target group and to tailor the methods accordingly. Doing citizen engagement can be difficult for a number of reasons.

Firstly, different ambition levels for citizen engagement exist. Not all engagement activities can or should be on the highest level of the engagement ladder model since direct participation is usually time consuming. To keep users motivated and engaged, it is important to know what drives users to participate and contribute to Living Lab activities as Living Lab efficiency is based on the creative power of user communities (Bergvall-Kåreborn and Ståhlbröst, 2009).

Secondly, even within a target group well analysed, the individual preferences and needs will differ. It has been reported that despite applying engagement methods, there remains a distance to the citizens' daily life, which may hinder engagement. As way to overcome this, it has been proposed to "go to where they are and live", for instance through involving social networks (Figueiredo Nascimento et al., 2016).

Another reason why citizen engagement can be difficult, is simply that there is a perceived lack of interest and lack of time on the part of citizens (Crombie et al., 2019, p. 53; Figueiredo Nascimento et al., 2016).

Furthermore, different stakeholders have different value perceptions and propositions, creating heterogeneity across their value spectrum (Hagy, Morrison and Elfstrand, 2016). For example, Figueiredo Nascimento et al.`s (2016) report resistance from authorities, researchers and policymakers to acknowledging that the citizen`s perspective is a valuable input (non-expert, lay knowledge). Engaging citizens in a way that produces good quality data with reliable methods and being representative of a segment of the population is often highly resource demanding. This is one reason why other stakeholders (e.g., public or private) keep engagement activities on a low level (or lowest

possible level). From the perspective of the EU commission, there is still a need for learning from previous experiences, knowledge sharing and learning in terms of competence, tools, and methods, as well as to spread knowledge on best practices. Resource efficiency and time intensity are named as areas of improvement (Figueiredo Nascimento et al., 2016).

In terms of organisation and operation, Habibipour, Stahlbröst, et al. (2018) describe challenges related to Living Lab activities, such as a lack of representative setting, extra work for end-users participating, resource allocation and recruitment, legal and ethical challenges, and the lack of control over the situation or innovation.

Engagement of citizens has been defined as a pre-requisite for the Living Lab approach, but it also turns out as one of the main challenges. A key finding of Steen & Van Bueren (2017)'s review on Living Labs is that half of the Living Labs did not directly involve users (non-participation), while the other half organised participation processes (participation). At the same time, engaging citizens on the highest level of the engagement level model through co-development activities only occurred in 12 projects of 90 projects reviewed (Steen & Van Bueren, 2017). Steen & Van Bueren, (2017) point out that the lack of participation or co-creation may be a result of discrepancies between the methods used in practice and the ambitions of sustainable Urban Living Labs defined in an early phase.

Menny et al. (2018) report similar findings from projects applying an Urban Living Lab approach where the level of co-creation aimed for was not always achieved, and it was mainly present in the implementation phase. According to their findings, the degree of user involvement depended much on the leading actors of the LL and the goals of the LL.

4.3.3 PITFALLS TO AVOID WITH CITIZEN ENGAGEMENT
Menny et al. (2018) has enriched our understanding of the living lab approach that a high degree of user involvement is not always required to deliver change processes and implement sustainable solutions. Depending on the goal and topic, the transformative potential of an Urban Living Lab can also be realised with activities with the lower levels of engagement. In other words, the "higher level of engagement, the better" does not always hold true. This is the pitfall to avoid with citizen engagement.

Rather, it is more important to consider **the right form of engagement and at the right time** (Menny et al. 2018 p. 77). This also serves as a point of departure for evaluating citizen engagement methods and tools in ARV.

4.4. EVALUATING CITIZEN ENGAGEMENT METHODS AND TOOLS

Studies have highlighted discrepancies between the methods used in practice and the initial ambitions of sustainable Urban Living Labs (Steen & Van Bueren, 2017). The Living Lab approach provides the opportunity to focus on the practical things of citizen engagement. The use of a multiple-methods approach will allow the participation of different stakeholders and user profiles. It can be useful to draw from the Strategy-as-Practice perspective which has made the position clear that tools are important practices that deserve our attention at the empirical level (Whittington et al., 2006; Whittington, 2006). At the same time, it is worthwhile highlighting that the preoccupation with the use of tools and methods is not to disregard the importance of activities and practices per se. Tools and activities are inextricably linked.

In order to shed light on how we may learn from doing the difficult task of citizen engagement (as ARV WP3 has set out to do), we are going to investigate and evaluate the tool uses in citizen engagement activities. We do so by viewing tools and methods as assisting with part of the citizen engagement activities. As the interpretation of tools becomes progressively augmented (Stenfors, 2007), we take into account that tools can be concepts, models, techniques, frameworks, and methodologies that structure or influence the citizen engagement activities and that they have their formal and informal aspects.

In addition to being sensitive to the different ambition levels for citizen engagement (from Figure 3), we also draw inspiration from approaches in citizen design science which strives to integrate citizens' ideas and wishes in the urban planning process (Mueller et al., 2018), and where there are at least three dimensions that can be considered for evaluating tool uses in citizen engagement activities:
- time and cost intensity,
- the level of inclusivity (extent of representation) as well as
- the potential to uncover tacit and hidden needs of citizens and occupants' preferred usage of the building and neighbourhood

By using different tools and techniques, citizens who do not have very high technical skills are also able to participate in the progress of their communities and can contribute to the development of different solutions that are beneficial for their community as well as their everyday lives.

The approach to consider these three dimensions will be worked on in Task 3.3 and Task 3.4. Plans will be made to collect qualitative and quantitative data on the citizen engagement activities and tools in each of the LLs. The data will be reported in Deliverables D3.3 in M24, M36 and M48.

5. DEVELOPING A PLAN AND OVERALL METHODOLOGY FOR CPCC LIVING LABS

This chapter explains why a Living Lab approach is used to enhance citizen engagement methods and tools in ARV. It then provides an overview of the two umbrella themes bringing together the six CPCC Living Labs and the different perspectives on a citizen's role before presenting the plan and overall methodology to get CPCC Living Labs up and running at each demo site. In addition, we describe how we approach and start the work of analysing each of the 6 multi-stakeholder innovation environments for citizen engagement activities.

5.1. WHY USE A LIVING LAB APPROACH TO ENHANCE CITIZEN ENGAGEMENT METHODS AND TOOLS?

The primary reasons to use the Living Lab approach to enhance citizen engagement methods in the context of deep energy renovations and the deployment of energy and climate measures are **three**-fold:

- Living Labs make innovations highly visible and usable in practice as the technologies, solutions and measures are tested in real-life settings, inside and outside the buildings, in the neighbourhood and in the community, and allowing citizen engagement activities to be firmly embedded within the innovation context.

- Living Labs channel citizens' competences and experiences, promoting their active engagement in producing plans for buildings and neighbourhoods that reduce energy demand and enhance energy efficient behaviour.

- Living Labs connect partners from various sectors who complement one another with a diversity of competences, human knowledge and skills, financial resources, and political influence.

In other words, the Living Lab approach is ideal and practical for investigating citizen engagement methods as it connects innovations, citizens' competences and experiences, and relevant partners from different backgrounds, through what McCormick & Hartmann, 2017, p. 4 has termed "*intentional collaborative experimentation of researchers, citizens, companies and local governments*".

5.2. LIVING LAB THEMES

Six Living Labs will be set up in all of the ARV demo sites (see Figure 4).
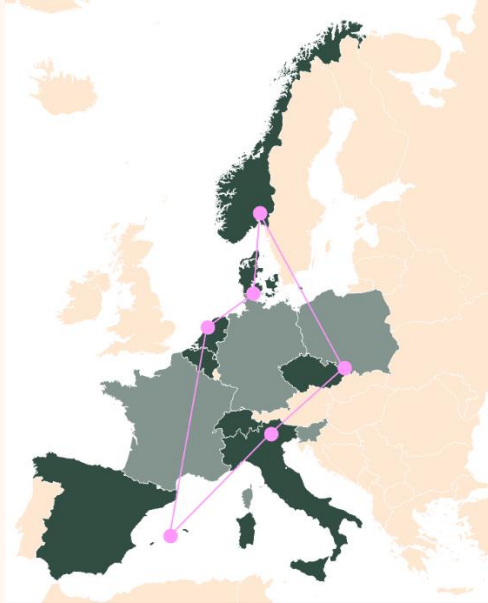
Figure 4. *Map of the ARV demo projects.*

The ARV Living Lab approaches address two focal themes, namely social renovation (as part of large-scale, sustainable renovations) and energy transition.

SOCIAL RENOVATION AS PART OF LARGE-SCALE, SUSTAINABLE RENOVATIONS

Large-scale, sustainable housing renovations can be challenging for both residents and the stakeholders planning and conducting a renovation, especially in housing areas with challenges related to the socio-economic conditions. Renovation projects commonly require a majority of residents to support the actions. The early planning phase is therefore crucial for an inclusive process and getting the residents (either renting or owning) on board of a renovation project. Several of the demonstration projects of ARV work with large-scale renovation of housing areas.

One of the innovations of ARV is called "social renovation". Social renovation[8] takes place before, during and after the actual physical renovation. The stakeholder(s) planning and organising a renovation will engage with the tenants firstly, to understand their needs. This includes one-to-one home visits and can also include dealing with social challenges occurring (e.g., debt, poverty, health issues). Through understanding the needs of the tenants during this initial process, it can at the same time serve as an opportunity to engage the tenants and community in the renovation. The expected impact of social renovation is a greater degree of including citizen in the process in a democratic manner and to give them a voice. Experience show that engaging with the tenants` results in a greater degree of support for the renovation, as well as improvements to both, the social and physical living environment in the long run.

The other LL`s in ARV dealing with large-scale renovation also focus on engaging the community at an early stage. The approaches for early-stage involvement, as well as the learnings drawn from experiences, will be documented to make them available to other projects.

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[8] The ARV partners of Utrecht have coined the term of Social Renovation.

ENERGY TRANSITION

The Living Labs on Energy Transition encompass a variety of ARV topics, including new solutions renewable energy generation, circularity and reuse, energy storage, testing and iteration of innovative and prototype solutions, as well as on energy coaching of occupants. The Living Labs aim at raising awareness and engaging citizens in various facets of an energy transition through activities on different engagement levels, from informing, educating, learning, to co-creation activities.

A special focus in most of the ARV LLs on Energy Transition is on involving young people. Both through understanding young people's ideas and needs and educating young people on the solutions applied to ARV projects. Young people will also be involved as youth ambassadors, taking the ideas of ARV home to their parents, friends, and community.

5.3. DIFFERENT PERSPECTIVES ON A CITIZEN'S ROLE

ARV Living Labs will be established taking different perspectives of a citizen's role - such as citizens as tenants and building occupants, citizens as residents and inhabitants of CPCC, and citizens as green ambassadors. The ARV Living Labs therefore use a variety of terms to characterise their target groups and their roles.

The following is not an exhaustive list of the different perspectives on a citizen's role ARV will adopt in the various Living:

- Youth ambassadors (Karvina)
- Residents, Tenants as Green ambassadors (Sonderborg)
- Tenants & Citizens; Tenants as Change Agents (Utrecht)
- Residents (Trento)
- Pupils, Teachers, Parents, Residents, Youth ambassadors (Oslo)
- Tenants, Citizens, Youth ambassadors (Palma)

5.4. S.M.I.L.E. METHODOLOGY TO GET CPCC LIVING LABS UP AND RUNNING

To get CPCC Living Labs up and running in each ARV demonstration site, we developed the S.M.I.L.E methodology drawing inspiration from the literature and in consultation with representatives from all the six demo sites. In a nutshell, we suggest focusing on five phases to get CPCC Living Labs up and running, as shown in Figure 5.
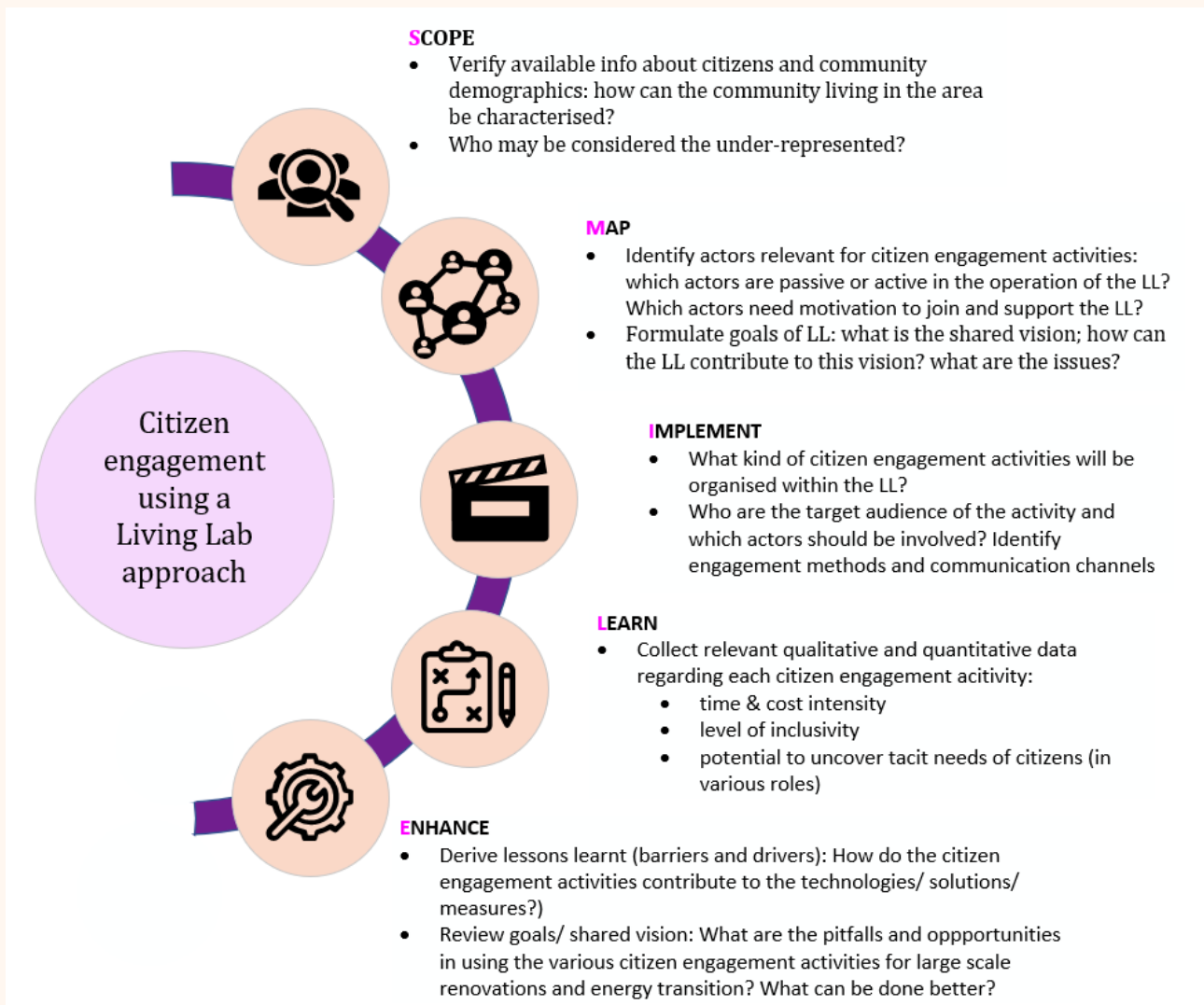
Figure 5. The 5 phases of S.M.I.L.E. methodology to get CPCC Living Labs up and running.

SCOPE

In the first phase, **Scope** foregrounds the importance of the citizens (in their various roles) and the community in the Living Lab approach. In this first step, a deep understanding of the citizens and community demographics is essential in order to regard citizens as catalysts of innovation and that their inputs can lead to better informed and robust outcomes in various measures and solutions. Once the citizens and the community living in the area has been characterized, the question of who may be considered the under-represented can then be posed.

MAP

In the second phase, **Map** tries to envision all the actors relevant for citizen engagement activities. This entails identifying and mapping out all the actors visually. It should be noted that this is a dynamic picture that needs to be regularly updated. Section 5.5 provides further details on how this can be done.

The Map phase also involves formulating the goals of the LL. Based on which actor drives the activities, Living Labs differ from one another in terms of activities, structure, organization, and coordination, The goals are also dependent on the main actor that drives the LL activities. As outlined earlier, Living Labs can come in many types, including company-driven, municipality-driven, research-driven and user community-driven.

Map allows the possibility to look at the dynamic picture of relevant actors and the goals of the LLs, reviewing their congruence. Afterall, adopting the Living Labs networking approach requires thorough understanding of important actors' objectives and drivers, the alignment of operational processes, and establishment of open and collaborative culture (Schaffers and Turkama, 2012).

IMPLEMENT

In the **Implement** phase, citizen engagement activities (info-providing activities vs. co-creation activities) are being planned, organised, and rolled out. Various citizen engagement methods and tools as well as communication channels will be deployed associated with the activities. The important question to keep asking here is: Who are the target audience of the activity and which actors should be involved?

LEARN

The **Learn** phase will be somewhat concurrent with the Implement phase. LLs will be evaluated and monitored for its citizen engagement activities and the use of various methods and tools. As mentioned in Section 4.4, at least three dimensions can be considered for evaluating tool uses in citizen engagement activities. In addition, other aspects of the Living Labs can also be evaluated[9], such as Operations and Organisation of the Living Lab. In the Learn phase, the developments as well as the barriers and drivers for citizen engagement will be documented.

ENHANCE

The **Enhance** phase will derive lessons learnt from the citizen engagement activities and analyse the barriers and drivers. The three important questions here are:
- How do the citizen engagement activities contribute to the social and technical solutions and measures related to sustainable transformation of urban communities?
- What are the pitfalls and opportunities in using the various citizen engagement activities for large scale renovations and energy transition?
- What can be done better?

HOW THE S.M.I.L.E. METHODOLOGY IS EMBEDDED IN WP3

Applying the SMILE methodology, the **Scope and Map phases** have been part of Task 3.2 and the output has been included in this report. In the coming Chapters 6-11, the respective target groups in each of the 6 Living Labs have been characterised. In addition, the work to identify the actors most relevant for citizen engagement activities in each of the 6 Living Labs are also outlined in stakeholder maps, along with the main goals of the Living Lab.

As a **start to the Implement phas**e, Chapters 6 to 11 provide a concise overview, context, and setup of the six CPCC LLs, outlining the initial planned activities for citizen engagement. The Implement phase per se is part of Task 3.3. Various tools and methods will be deployed in the Implement phase. Moreover, the Augmented Reality and Virtual Reality tools developed in WP2, Task 2.5 of the project will be deployed as engagement tools in two of the LLs.

The **Learn phase** is part of Task 3.4. The monitoring and reporting of the Living Lab activities will be in the form of self-assessment form (logbook) that will be co-developed with the LLs.

In the **Enhance phase** (Task 3.5), the goal is to promote replicable, feasible citizen engagement tools across deep renovation projects in Europe that will have a positive impact on the level of satisfaction

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[9] https://www.iscapeproject.eu/wp-content/uploads/2019/09/iSCAPE-D5.5_Final.pdf

and well-being as well as a good potential to anchor energy-efficient behaviours as a part of everyday life.

Before we end this chapter, the following section will detail how we have approached analysing the multi-stakeholder environments relevant for citizen engagement activities in each of the 6 Living Labs.

5.5. ANALYSING MULTI-STAKEHOLDER ENVIRONMENTS FOR CITIZEN ENGAGEMENT ACTIVITIES

Because each CPCC is a multi-stakeholder innovation environment which is complex, it is important to approach and understand it systematically. This section describes the tool that is being used to analyse each of the 6 multi-stakeholder innovation environments to prepare and plan for citizen engagement activities.

The use of Living Labs has become increasingly popular because they offer a multiple-stakeholder platform for collaborative innovation in real-life contexts (Leminen, Rajahonka, & Westerlund, 2017). According to Westerlund et al. 2018, a Living Lab organizes stakeholders and innovation activities into an innovation ecosystem, and such innovation ecosystem may incorporate a high diversity of active and passive stakeholders, and networks.

The CPCC Living Labs are expected to involve a plethora of actors since the 6 demonstration projects are pushing several solutions and technologies that are crossing the boundaries of the construction and the energy sector. To better devise an engagement strategy targeting the citizens, it is imperative to understand the multi-stakeholder networks, where the first step is to identify all relevant actors.

To find an approach that is suitable for analysing the multi-stakeholder networks of establishing a Living Lab, we had to return to **the concept of a stakeholder**. Stakeholder is a concept that can be defined in a narrow sense or a wide sense. In a wide sense, a stakeholder is any entity or organisation with different disciplines and with different needs, responsibilities and resources who can affect the development of the project or are affected by the project. In a narrow sense, a stakeholder is an identifiable actor on which the project is dependent for its continued survival. At this end of the spectrum (that is, in the narrow sense), instead of a faceless entity or a certain category of stakeholder, a stakeholder is interpreted as a full-faced actor in that they can affect or are affected by the development of the CPCC.

To prepare for the work of systematically analysing stakeholders for establishing and implementing Living Lab activities, we used an actor-oriented stakeholder mapping tool (Cheng et al. 2022) to envision the most relevant actors for citizen engagement activities (see Figure 6). It is also picturing the Living Lab embedded in its **web of relational actors** by outlining eight major categories of external actors with whom the coordinator/ driver of the Living Lab can, or must, interact.
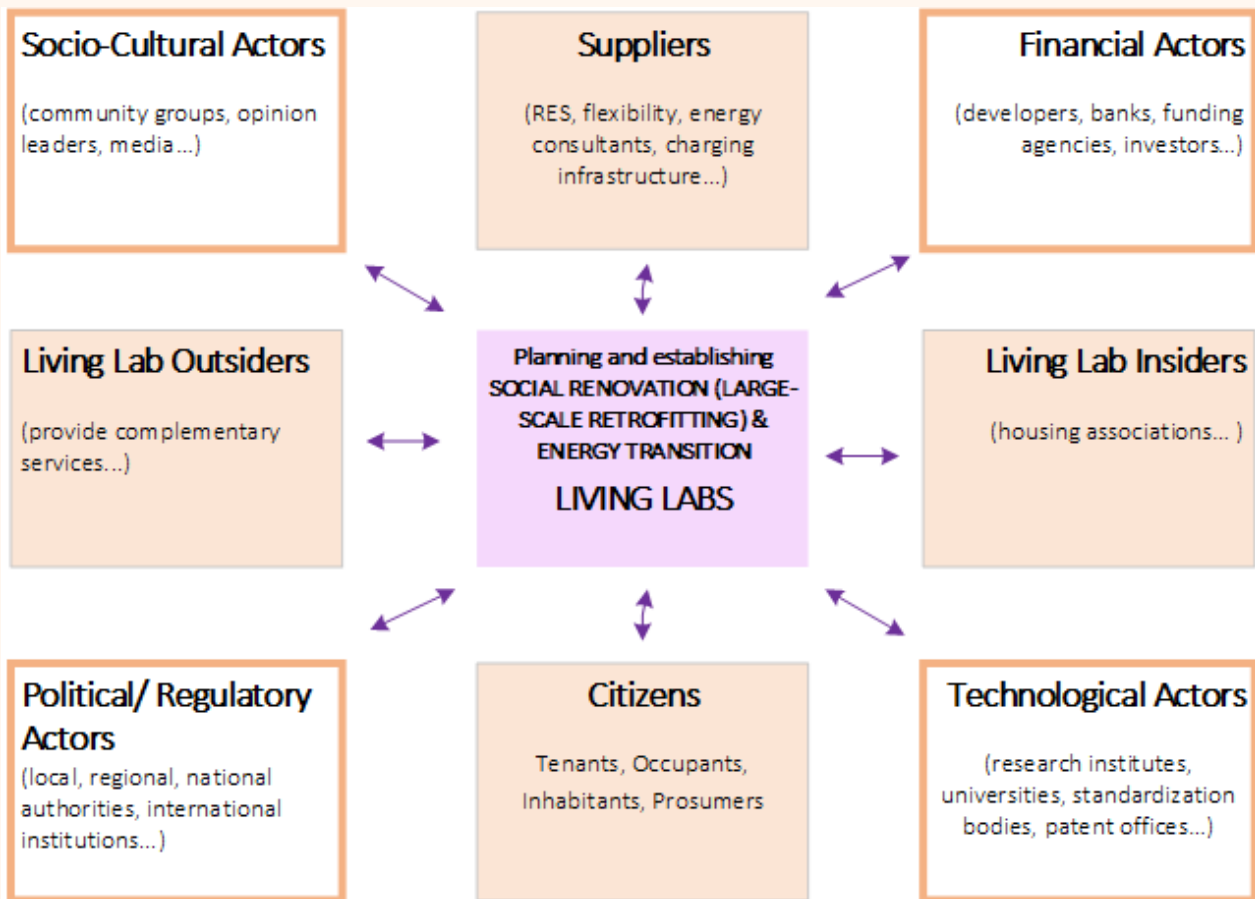
Figure 6. *Actor-oriented stakeholder mapping tool to envision the most relevant actors for citizen engagement activities.*

This tool facilitates a systematic analysis of the web of relational actors relevant for the planning and establishment of a Living Lab. Among these eight major categories of actors, a distinction can be made between so-called "direct" actors (shaded) and contextual actors (non-shaded). **Direct actors** can be understood as those entities that perform value-adding activities or consume the outputs of the Living Lab activities while **contextual actors** are those entities whose behaviour, intentionally or unintentionally, sets the conditions under which the direct actors must operate.

Direct actors refer to the suppliers of all the solutions and measures. This tool also helps to keep in view that Living Labs are developed for the ultimate users which are citizens (from tenants and occupants to inhabitants and prosumers and youth). In particular, youth lack the connections and access to decision makers that many adults and professionals have through work and social engagements, and engagement strategies will need to be adapted. Direct actors also include **Living Lab Insiders and Outsiders.** Living Lab Insiders can be housing associations and also those actors that support the administration of the Living Labs. Living Lab outsiders can be actors from the non-residential community such as health services and education.

Contextual actors are depicted in the non-shaded boxes, referring to the financial, technological, political/ regulatory actors and the socio-cultural actors. Identifying the direct actors can be tedious but doable since their business interests, capacities and agendas are more or less recognizable. Identifying the contextual actors is often complex and the work to map them out is difficult since in-depth local knowledge is required to understand them.

Studies have suggested that mapping stakeholders in the development of climate-friendly neighbourhoods should pay attention to the phases of development as stakeholder roles might shift and new actors can emerge (Cheng et al. 2022). Stakeholder identification is therefore not a one-time activity but should continually be done to review priorities. When interpreted as full-faced actors, stakeholders can then be further analysed by:

- Mapping relationships and connections among them (stakeholders can take multiple roles and stakeholder roles can also shift)

- Identifying blockages and opportunities based on understanding of the relationships among actors, organizations, and related subsystems.

In order to better understand the multi-stakeholder networks of Living Labs in the context of deep energy renovations and the deployment of energy and climate measures, a stakeholder map has started to take shape for each of the 6 Living Labs (see **Sections 6.4 -11.4**).

6. CPCC LIVING LAB IN TRENTO

The Living Lab activities of Trento in Italy will be related to the neighbourhood area of Piedicastello which is one of the oldest districts in Trento and, together with the historic centre, is part of the administrative district number 12. It lies surrounded by the right bank of the Adige River and at the foot of the hill called "Doss Trento", which represents the main landmark of the area (See Figure 7 and Figure 8).
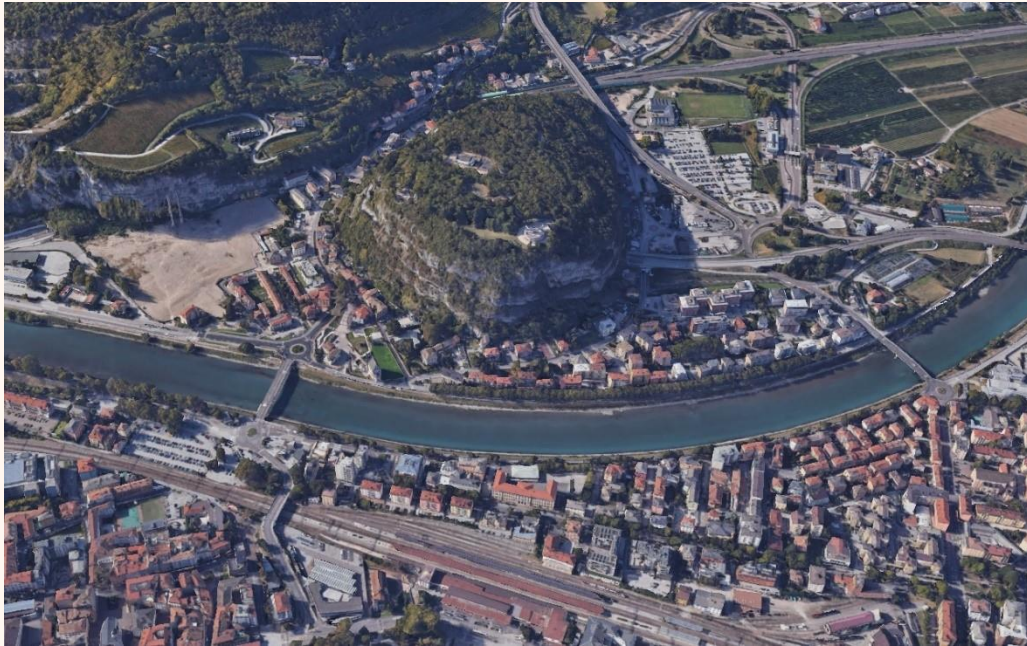

Figure 7. Aerial photo of Piedicastello in Trento.

Figure 8. Area map of Piedicastello to pinpoint the four areas in Trento LL.

The district represents the ARV large-scale demonstration site in Trento, which encompasses the following areas:

AREA 1: "EX ITALCEMENTI" BROWNFIELD

- **Area 1 – "Ex Italcementi" brownfield**: it is the large southern area of the district, which took its name from the concrete factory built up there in the early 20th century. It is now partially used as a car park and has been identified as the main target site of the so-called "Destra Adige Masterplan", a local urban regeneration plan approved by the City Council in 2021. Over the next few years, the Masterplan envisages the development of new tertiary and residential constructions in the disused area, including the new student residence of the University of Trento.

Considering its relevant regeneration potentials, Area 1 represents the replication area for the circular and sustainable construction methods and technologies which will be applied in Area 4 over the ARV project lifespan (see below).

AREA 2: ONE-STOP-SHOP URBANISATION AREA

- **Area 2** is an **urbanization area from the '50s-'70s** and was originally developed with a strong focus on social housing. Nowadays, it mostly includes medium-rise apartment buildings and condominiums, both privately owned and still managed by ITEA, the public and local social housing company.

In the framework of the ARV project, Area 2 will be the testing site for renovations through prefabricated timber-based façade elements and for testing and deploying the so-called **One-Stop-Shop approach (OSS)**, addressing residents of the area to provide them with technical support for a large-scale renovation of existing buildings.

AREA 3: LE GALLERIE MUSEUM CAR BYPASS TUNNELS

- **Area 3** corresponds to the two 250 m former Piedicastello car bypass tunnels built in the second half of the 20th century, still passing through the Doss Trento. In 2007, the bypass was diverted and since then the two tunnels hosted a local museum and exhibition gallery called "Le Gallerie".

In ARV the two tunnels will be used to install a geothermal structure prototype in order to supply and store energy for the new building (Area 4) and the renovated existing one (Area 2).

AREA 4: EX ZUFFO PARKING LOT

- **Area 4 - "ex Zuffo"** parking lot will be redeveloped with a service hub for the district and the city.

ARV envisages here the application of a **V2G approach**, simultaneously promoting the market penetration of e-mobility. In addition, a **new building** will be built here, based on a timber prefabricated system and on testing sustainable construction methodologies and technologies which will prove expedient, economical, local, and circular.

The **southern-northern boundaries of Piedicastello** can thus be located respectively in the "ex Italcementi" brownfield –corresponding to demo Area 1 - and in the "ex Zuffo" car parking – demo Area 4.

6.1. UNDERSTANDING AND APPROACHING THE TARGET GROUPS IN TRENTO LL

The available demographic data on Piedicastello refer to the larger administrative district number 12 ("Piedicastello – historic centre") which lays over both sides of the Adige River. The demographic data therefore pertains to the region at large rather than the actual LL area. The administrative district comprises 859,95 hectares and includes **20,696 residents** out of 118,288 at the city level. Female residents are equal to 51%; the total number of foreign residents is 18.6%.

Figure 9. Distribution of the population in the Trento LL by age.
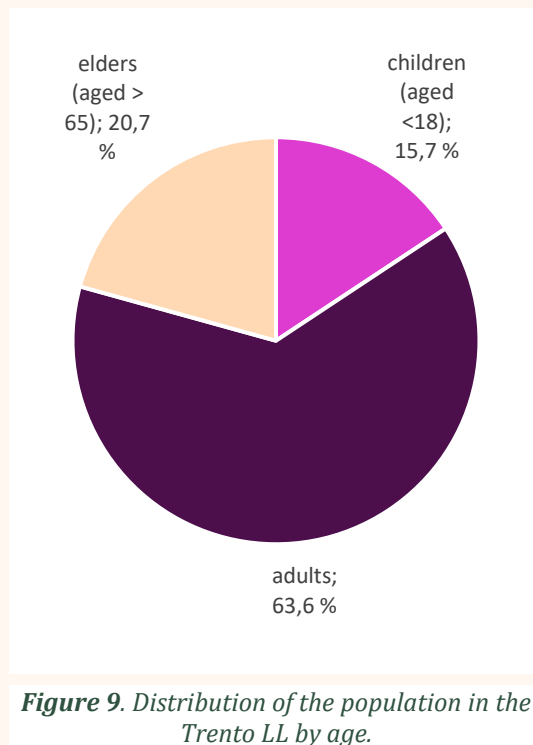
In terms of demographic structure by age, residents are on average aged 43. Children (< 18 years old) represent 15,7% of the total population, whereas the elders (aged > 65) are the 20,7% (see Figure 9). The number of registered families is 10,406 out of 53,732 at the city level. Average taxable family income is equal to € 38.952 for Italians and € 12.601 for foreigners.

Concerning the residential fabric of Piedicastello, it can be split into two parts, corresponding to the core historic area of the district, which still includes late 19th century workers' houses, and ARV demo area 2, comprising medium-rise apartment buildings constructed during the '50-70's .

Piedicastello hosts some basic education, social and leisure facilities: the local kindergarten, one sport-soccer centre and one meeting centre managed by the Municipality. The level of associationism is quite high considering the small size of the district: the neighbourhood association, called "**Comitato Piedicastello**", dates back to the 70s, when the public works for the car bypass tunnels started. This entity has always been sensitive to the urban changes and works which impacted the territory over the years. Moreover, Piedicastello hosts one elderly association ("**Gruppo anziani**") and the local branch of the mountaineer and hiking association (**SAT, Società Alpinisti Tridentini**). Next to the "ex Italcementi" brownfield is the location of the **Centro Sociale Bruno**, the main social centre in Trento, which traditionally arranges cultural, political and leisure activities.

Finally, the district is well-known for being the location of some relevant cultural attractions of Trento. This is a point of interest for tourism. On the top of Doss Trento, there are two cultural sites: the **Mausoleum of the Italian patriot Cesare Battisti** and the **National historical museum** dedicated to the "Alpini" military corps. The former tunnels passing through Doss Trento, once used as a car bypass, have been hosting since 2008 "**Le Gallerie**", an exhibition area and education centre managed by Fondazione Museo Storico del Trentino (Trentino Historical Museum Foundation).

6.2. MAIN GOALS OF TRENTO LL

- Establish a multi-stakeholder approach from the very beginning of the ARV project, by addressing Piedicastello residents, the community, and the local authorities, and involving them in the deployment of the demo activities.

- Develop a One-Stop-Shop approach for energy refurbishment of buildings, bringing together aggregated demand and supply of renovation works on the existing buildings of the district.

- Familiarize the residents with the available circular and sustainable technologies for the construction and renovation of buildings (i.e., wood value chain) and on the multiple advantages of these solutions.

- Expose the residents and the community to be an active part of energy transition through the deployment and installation of renewable energies facilities (i.e., geothermal energy).

- Inform policy making and the regeneration scenario of the "ex-Italcementi" area with the sustainable construction solutions and technologies which will be applied and monitored in demo area 4.

6.3. SET UP OF TRENTO LL

The Trento Living Lab is led by ARV partner Habitech - Distretto Tecnologico Trentino (DTTN) in close coordination with all the ARV local partners from the Trento demonstration site. Habitech's responsibilities encompass both the design and planning of engagement activities in collaboration with WP3, the involvement of local partners, as well as the facilitation of the relations between the ARV consortium and the local community.

Over the first year of the project, a stronger coordination has been established with Eurac Research – demo co-leader and expert on research and social engagement activities – and the University of Trento – main research partner located in the city. Nevertheless, from M12 onwards, a broader involvement of the local ARV partners is envisaged in order for the consortium to benefit from the technical expertise of each of them and to arrange tailored activities for the local community.

A preliminary connection with Piedicastello community is also being established: the district council has been informed on the ARV project. It is also taking an active role in raising awareness, spreading the voice of the ARV project and co-organizing a kick-off meeting in June 2022 (see Section 6.5 below). Close coordination is also being established with the political/administrative bodies of Trento, namely the city counsellors in charge of green transition and land-use planning, and the municipal officers working on mobility and urban regeneration. The latter coordination set up will be crucial to combine the demo activities with the existing regeneration strategies and initiatives planned by the Municipal government in Piedicastello and elsewhere in the city.

There are physical locations available in Piedicastello that will prove useful to organize onsite meetings. The local municipal centre has already been used (see Section 6.5 below: "Organized activities"). Meanwhile, "Le Gallerie" exhibition area and museum could be a very interesting location to arrange future meetings, as the facility will also be the location of ARV geothermal prototype.

Figure 10 represents the current set up of the Living Lab:
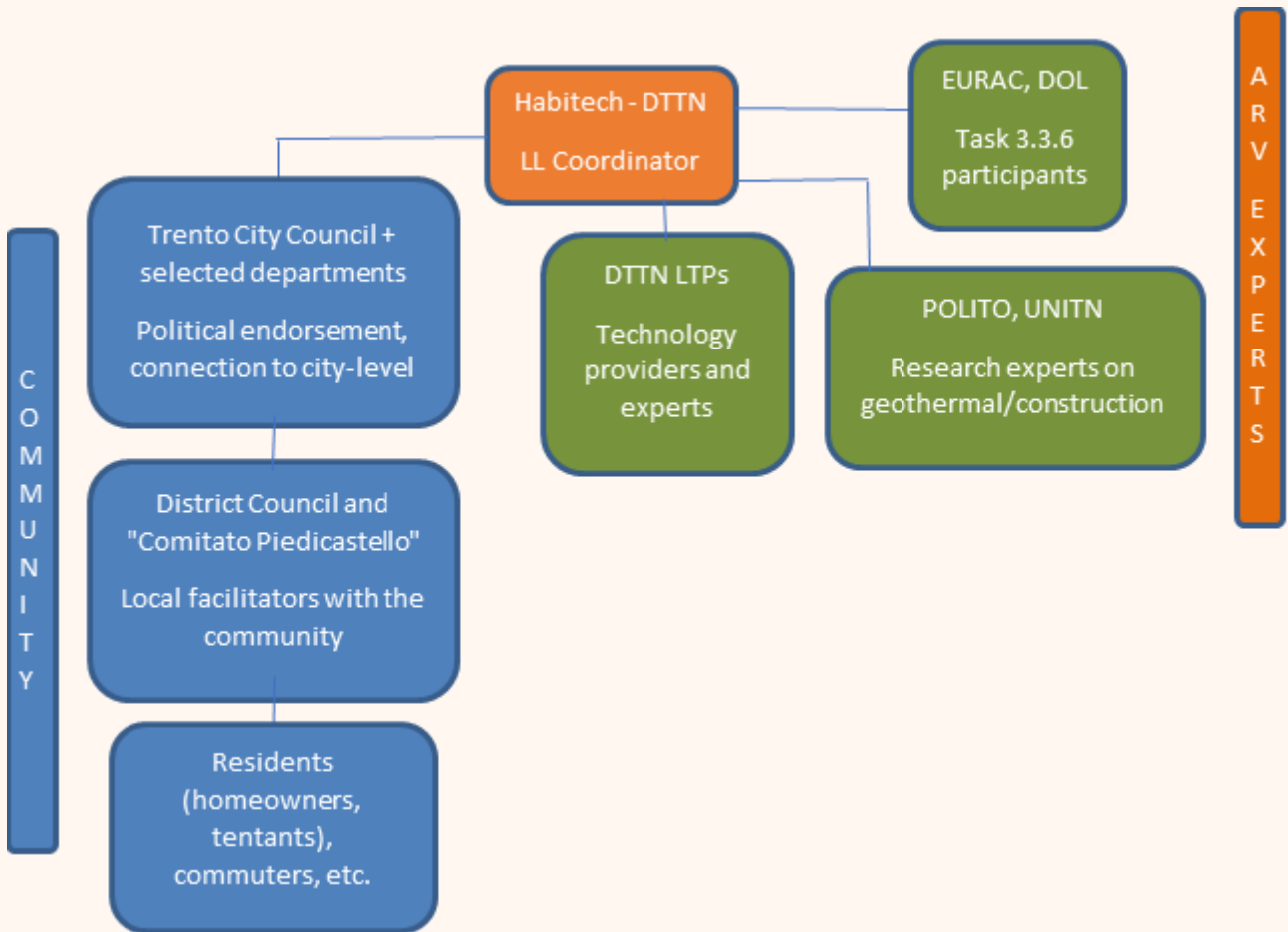
Figure 10. *How Trento Living Lab is being set up.*

6.4. ACTORS RELEVANT FOR PLANNING CITIZEN ENGAGEMENT ACTIVITIES IN TRENTO LL

The preliminary Trento LL stakeholder map has started to take shape (see Figure 11):

Figure 11. *Working stakeholder map of engaged and the potential stakeholders in Trento LL.*

6.5. PLAN OF CITIZEN ENGAGEMENT ACTIVITIES IN TRENTO LL

Organized activities

ARV local partners (EURAC, Habitech, Dolomiti Energia, University of Trento) arranged a kick-off meeting with the Piedicastello community on 24th June 2022 in the premises of Piedicastello meeting centre. The initiative, organized in cooperation with the district council, was attended by around 20 participants and aimed to provide them with an overview of the project also in the framework of planned municipal strategies for the renovation of the district area. At the end of the meeting, a preliminary contact list of around 15 interested citizens has been created, in order to facilitate the communication on the next engagement activities.

Planned activities

For the **2nd year** of the ARV project, a range of activities can be planned with regards to 4 domains:
- Informative sessions on the technologies deployed in the demo
- Site visits to the demo areas
- One-Stop-Shop approach
- Interactive online session for green ambassadors

Informative sessions

This activity aims to inform, raise awareness and familiarize the residents with the technologies deployed in the demo. A multi-stakeholder approach is envisaged, including ARV partners and local suppliers of technologies, as well as representative of the Municipality which can frame the intervention in the context of Piedicastello regeneration process.

Main topics to be addressed:

1. Circular and sustainable technologies for renovation and new constructions (1st semester 2023) with the following main ARV partners: DTTN, EURAC, UNITN + DTTN LTPs depending on the specific topics to address;
2. Proposal: Energy transition and geothermal structure (1st or 2nd semester 2023) with the following main ARV partners: DOL, POLITO.

Site visits to the demo areas

This activity aims to display the state of the art and the progress of the technology deployment. On-site visits can help citizens and residents to better understand the functioning of the technologies and the related advantages, as well as the monitoring systems that will be gradually installed.

One site-visit for the renovation/construction domain (new building and renovation) and one visit for the energy transition installation can be scheduled depending on the progress of the activities in 2022.

* The above-mentioned activities could be also combined together (thematic informative session + related site visit) depending on the actual implementation across the different demo areas.

One-stop-shop approach

The activity aims at creating a first match between the demand and supply of renovation interventions. The proposed methodology is the following:

1st semester 2022: **Framing the One-Stop-Shop**
- **Demand**: Exploring the availability of residents to aggregate their needs for renovation at a district-scale. This can be done through surveys collecting their needs/requests/info on buildings and by spreading the voice through the district council
- **Supply**: Creating an aggregated supply of sustainable renovation works: this action will be undertaken by Habitech-DTTN through an expression of interest to be forwarded to local enterprises (i.e., DTTN Cluster members and DTTN network)

2nd semester 2022: **Establish a connection between demand/supply stakeholders**
- Organizing a meeting/workshop in Piedicastello where both the demand and supply sides can interact.

Next steps: put in place an online **match-making platform** of energy refurbishment interventions, where interested home/building owners can find the right information on available firms and technologies. DTTN will perform the role of facilitator of the matchmaking.

Interactive online sessions for youth ambassadors (18-25) (heterogeneity in the disciplines)

As energy transition is a cross-cutting topic addressed by the ARV demos, it could be interesting to engage transnationally the youth community in shared activities. The approach to follow needs to be further framed with interested demos, but could be based on information sessions, workshops and knowledge sharing, and group works.

Table 2 provides an overview of the planned citizen engagement activities for the Trento LL.

Table 2. *Plan of Citizen Engagement Activities in Trento LL.*

Activity	Description	Target Group(s)	Time period
Informative sessions	Presentation of ARV technologies deployed and their progress	Piedicastello residents, policy makers and officers	1st semester 2023
Site visits to demo areas	Show the progress of the activities through physical visits	Piedicastello residents, Trento citizens, policymakers and officers	2nd semester 2023
Framing the One-Stop-Shop	Aggregation of the demand/supply of building renovations	Piedicastello homeowners, condominium administrators, local construction value chain	1st semester 2023
One-Stop-Shop match-making process	Establish at least one public event in the district where interested homeowners/firms can interact	Piedicastello homeowners, condominium administrators, local construction value chain	2nd semester 2023
Green transition online sessions	Digital activities to promote sustainable energy transition	Youth ambassadors, (opportunity for joint activities with the CPCC LL in Palma, Oslo and Karvina	TBD according to ARV demos availability

7. CPCC LIVING LAB IN PALMA

The Living Lab activities of Palma de Mallorca in Spain will be related to the two neighbourhood areas, namely **La Soledat Sud** and **Nou Llevant.**

The area of the neighbourhood is about 90 hectares. The neighbourhood development is a result of the urban expansion of the city of Palma over the last one hundred and fifty years, when suburban, agricultural areas were transformed into large, urbanized areas. Some parts are still in the process of urban transformation. Both La Soledat Sud and Nou Llevant, although developed in different decades, are the result of a sudden increase in the need for labour, see Figure 12.

Figure 12. Location of the two neighbourhood areas, La Soledat Sud and Nou Llevant, in the Palma LL.

7.1. UNDERSTANDING AND APPROACHING THE TARGET GROUPS IN PALMA LL

The total number of inhabitants in 2020 was 8,911, of which 2,428 inhabitants live in area 1, Soledad Sud, and 6,483 in area 2, Nou Llevant.

The two areas of the neighbourhood are today characterised by an aging population. More than 17% are over 65 years old. The demographic profile reflects the migration history of the area. The origin of La Soledat Sud was the result of a rural exodus from agrarian Mallorca to the city and its industrial and/or craft spaces. The expansion of the Nou Llevant is due to the migratory avalanches; first of origin of other Spanish areas from 1960, and later, already from 1990 until today with the arrival of newcomers of foreign origin.
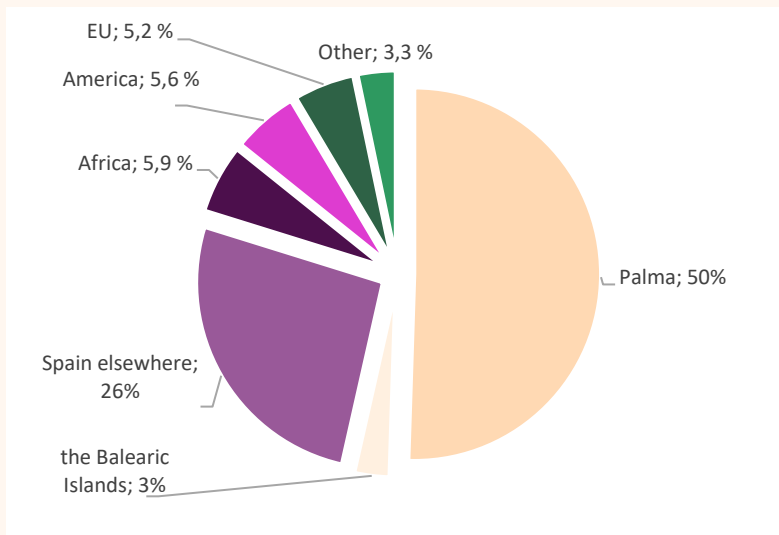
Figure 13. Inhabitants in Palma by place of origin.

Today we find that 50% of the inhabitants were born in Palma and 3% come from other towns in the Balearic Islands; 26% were born in other autonomous communities in Spain and 20% were born outside Spain. Of the foreign population, 29.50% come from Africa (mainly Morocco, Senegal, and Nigeria), 28.22% come from America (mainly Colombia, Ecuador, Argentina, and Bolivia) and 26% from other countries in the European Union (Bulgaria, Romania mostly) (see Figure 13). The educational level of the population is low, and approximately 70% do not have completed a school degree.

AREA 1: LA SOLEDAT SUD

Figure 14. Photos of the Le Soledat area (by Palma Municipality).

Historical development
The neighbourhood of La Soledat has its origins at the end of the 16th century, when the convent and the church that would give the neighbourhood its name, were founded. However, it was not populated until 1851 when the blanket factory of Can Ribas was established. At the end of the 19th century, the

urbanization of the neighbourhood started and the first homes for workers were built. During that time, it became one of the most prominent industrial neighbourhoods in Palma. From 1960, single-family houses with one or two floors with a small garden or courtyard were built in the neighbourhood (see Figure 14). At the same time, the industry of the neighbourhood struggled, and the decline of the area began, continuing until today.

Social aspects
In La Soledat Sud, most of the population is of working age (from age 16 to 67) and the gender representation is quite balanced. The foreign population of Le Soledat Sud accounts for 21% of the population, with greatest representation from South America and Asian countries. 25% of the households of La Soledat consist of adults with dependent minors, and 10% are single-parent families, mainly consisting of a mother and children.

Challenges in the Neighbourhood
La Soledat Sud is mainly a mono-functional housing area, with only a small number of businesses.
Within the Le Soledat neighbourhood, the energy standards are low, documented by mandatory Energy Certificates issued for each house when sold. Since there is a high turnover of houses in La Soledat, the number of Energy Certificates available is high. The certificates reveal information on poor energy performance, with poor air conditioning and poorly insulated windows and doors. Only in specific cases where the owners have been able to renovate, the energy and indoor environmental standards have been improved.

There is also a deficit of infrastructure and public services in the neighbourhood. There is only one public middle school, a day care centre for the elderly and few social housing projects for low-income households. The infrastructure for pedestrians lacks convenient and safe access to functions and amenities. For instance, the inhabitants of the districts must cross a four-lane main road to reach the schools and the health centre.

AREA 2: NOU LLEVANT

Figure 15. Photos of the Nou Llevant area (by Palma Municipality).

Historical development
The neighbourhood of Nou Llevant is characterised by state-owned social housing from the 1960s and 1970s. The construction of the area was driven by the housing deficit that confronted the arrival of immigrants from mainland Spain. At the same time, there was a high demand for workforce, linked to the rise of mass tourism and construction projects on Mallorca. Nou Llevant`s 6,483 inhabitants live in multi-family buildings with crowded living conditions. Since 2017, there has been a boom in the

construction of medium-rise blocks of mostly residential buildings (with 7 and 8 floors) and there are still many urban plots pending to be developed (see Figure 15).

Social aspects
The demographic profile of the neighbourhood consists mostly of inhabitants of working age (from 16 to 67) and the gender distribution is balanced. 17% of the population are minors and 18% are retired. 25% of the households consist of adults with dependent minors, and 10% are single-parent families, mainly consisting of a mother and children. The nationality of the inhabitants is primarily Spanish, with some African foreign representation. The construction of new luxury residential blocks in recent years has created two segments of the population within the same neighbourhood, characterized by large differences in purchasing power.

Challenges in the Neighbourhood
The inhabitants of Nou Llevant live mainly in buildings older than 50 years. The buildings are typically poorly insulated and energy inefficient unless they have been renovated. There are multi-family estates with crowed living conditions. The ground floors of the estates are either apartments or community spaces. They are occupied by shops or restaurants to a very low extent.

In contrast to the existing buildings, the neighbourhood has been experiencing a boom of construction of new luxury residential building block with high energy efficiency standards. And there are still many urban lots pending execution. Due to this development, the social profile is changing due to the new residents. The Nou Llevant neighbourhood is better equipped than the La Soledat neighbourhood. It has facilities that serve the population beyond the neighbourhood. There are three public secondary schools, three public kindergarten and/or primary schools, a health centre, and a network of social care services for citizens that serves all public, private and/or NGO initiatives that are active in the neighbourhood.

7.2. MAIN GOALS OF PALMA LL

Palma focuses on large scale renovation, energy transition and energy communities. The goal of the Living Lab is to involve the local community of the district into the energy renovation. A physical space (CitiLab) is at the core of the Living Lab, created as a meeting point for the local community. The goal of the LL is on different levels of engaging the community, including information giving, awareness raising, as well as co-creation activities. A special focus is on reaching out to young people, involving schools, as well as engaging the vulnerable part of the population in the district, which is usually difficult to reach out to.

7.3. SET UP OF PALMA LL

The Palma LL is organized by the ARV partner Palma Municipality in cooperation with other local ARV partners. In addition, a number of district specific organizations are consulted. The municipal space in the neighbourhood for the intervention of the ARV project, the CitiLab, is of main importance for the LL activities in Palma. The building is located at Carrer Fornaris, 65, in Plaça dels Mínims de La Soledat. It is being renovated to accommodate the one-stop shop (see Figure 16) for the promotion of housing renovation as well as energy transition.

Figure 16. *The one-stop-shop renovation project at the centre of activities (picture of building before renovation.*

The map below shows the location of the CitiLab and other places for activities planned (see Figure 17).

Potencials espais CitiLAB

- Palma Activa - CitiLAB
- Casal de barri Nou Llevant
- Centre de Dia - Llevant Sud
- Museu Krekovio
- CIFP Francesc de Borja Moll
- CEIP I ESO PINTOR JOAN MIRÓ
- CEIP Camilo José Cela
- IES Antoni Maura
- IES Aurora Picornell
- Fundació Patronat Obrer De Sant Josep
- Oficina de rehabilitació ARV (One stop-shop
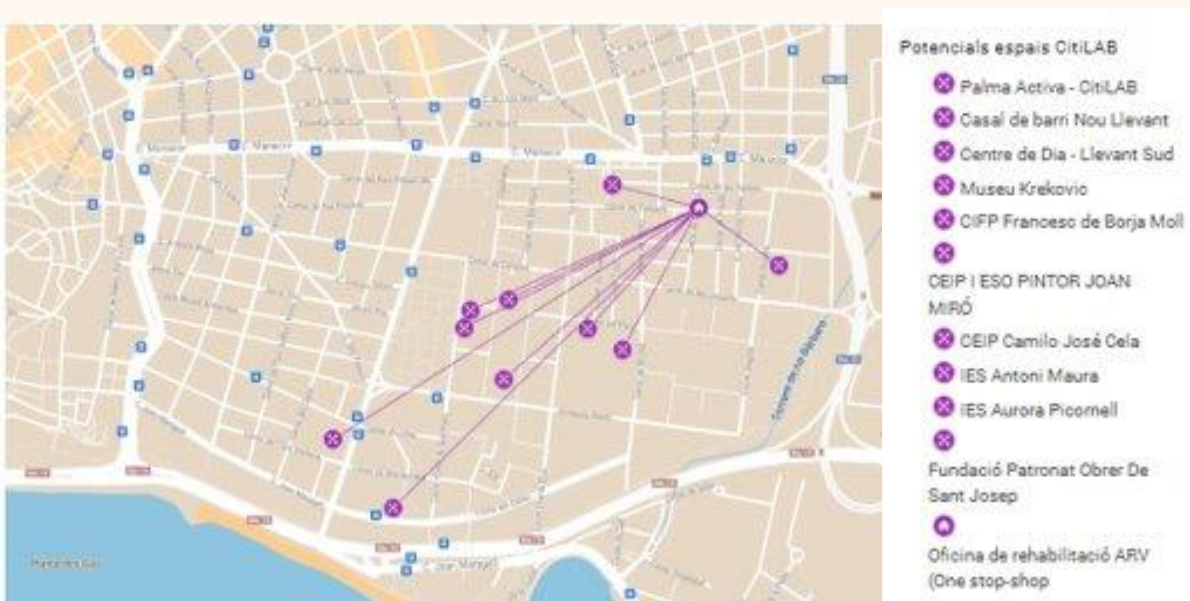
Figure 17. Map of the potential spaces of Palma Living Lab activities in the neighbourhoods.

The preliminary Palma LL stakeholder map has started to take shape (see Figure 18).
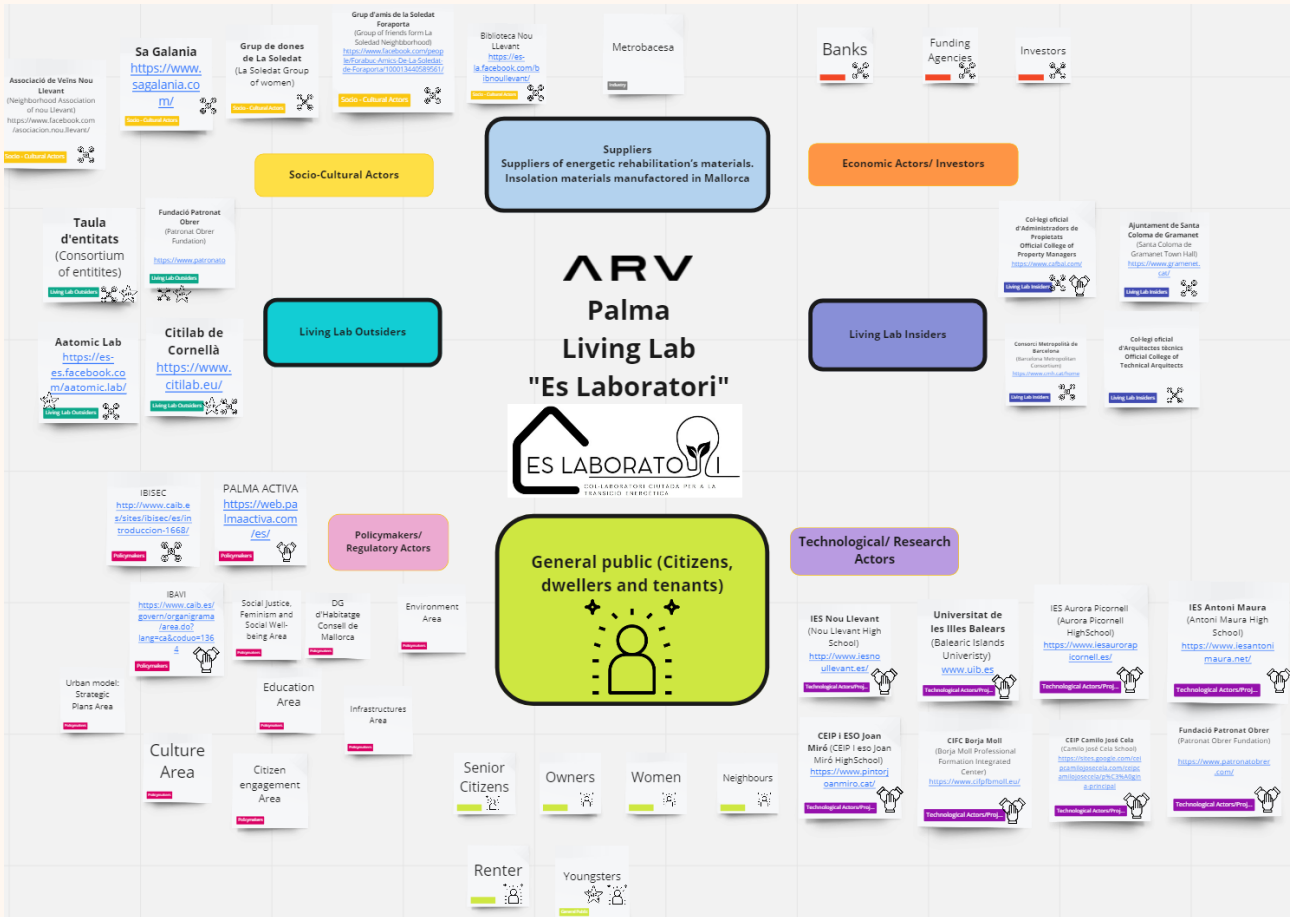

Figure 18. *Working stakeholder map of Palma LL.*

In order to prioritize action strategies with respect to the actors involved in the Palma LL, we have further tagged the stakeholders with three roles: target population, collaborators and resources (see legend in Figure 19). Furthermore, based on this division, we have identified which stakeholders are very important. With this strategy, we intend to establish further plans to engage with these stakeholders to align objectives and to build stronger alliances.

Target Audiences

Population profiles selected as the target objective of the activities

Collaborators

Entities and active participants in the achievement of objectives

Resources

Entities or participants that represent an aid or a means used to achieve the objectives

VIPs

Actors that have a special relevance for the project and are considered a priority

Figure 19. *Prioritising stakeholders in Palma LL.*

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7.5. PLAN OF CITIZEN ENGAGEMENT ACTIVITIES IN PALMA LL

For the following years, a range of activities are planned within the ARV topics of:

- Energy transition activities involving young people
- Energy transition activities for the community
- Energy communities

Energy transition activities involving young people

Robotic Competition.
Palma Municipality will collaborate with the University of Illes Baleares in the process of the World Robotic Olympiad (https://wro-association.org/). In 2022, they will contribute to dissemination. For 2023, it is planned to use this happening for ARV and adapt the theme of the year to the objectives of ARV.

Educational program "cooperation and services to the community"
An educational program on topics related to Energy transition is developed. It will focus on energy and the environment, and on energy consumption and rehabilitation. Site visits to ARV partner IBAVI`s buildings and to energy rehabilitation project of the high school are planned.

Renewable energy training cycle.
A meeting has been held with the General Directorate of Professional Training for schoolteachers to explore the possibility of carrying out a specific training cycle on renewable energy.

Training of teachers.
Explore possibility for training of teachers on ARV related topics, such as renewable energies, energy renovation, energy communities, and the Living Lab approach.

Green space at school.
Co-creation of an urban garden at the high school, involving young people with disabilities.

Energy transition activities for the community

Monitoring energy consumption.
The monitoring of energy consumption is an ongoing activity. The first voluntary homes have already been monitored and individual advice on energy consumption has been given. At the same time, there is an ongoing work with establishing collaboration strategies for the energy rehabilitation of a building on Bogotá Street in the area of Nou Llevant. ARV will contact homes interested in monitoring their consumption. Through that, they will gain better knowledge before we rehabilitate the building. We are waiting to carry out the workshops in the month of November 2022 to be able to contact more families and be able to do another round of monitoring. The purpose of the meeting of the neighbourhood community of Calle Bogotá is to present the project and the proposal for collaboration with workshops and monitoring.

Electricity Bill Workshop.
The workshops have the goal to increase the understanding of electricity bills among the target population of the neighbourhood (low-level education, language barriers, etc). Local networks support carrying out these workshops within their entity. The library of Nou Llevant and the health centre have offered their facilities to hold the workshops as part of ARV. Informative material has been distributed by the entities supporting the workshop.

VR tool

Visualisation techniques, specifically Augmented Reality (AR) and Virtual Reality (VR) have gained great attention in recent years. Both of these are being successfully used for research and training purposes. In the Palma Living Lab, VR will be used to better communicate and evaluate different scenarios across the targeted groups.

The development of the VR tool is currently focused on the Neighbourhood Scale Retrofit. The display levels using VR will allow to visualise in full-scale and high realism the defined priority areas of the Nou Llevant Innovation District. This will provide a better understanding to both the stakeholders (city planners and policy makers), and to the citizens. The involvement of the citizens will allow a participatory planning in the development of the Palma demo.

Energy Communities

The goal is to create a citizen energy community with the use of solar roofs of public facilities such as schools. A first meeting has been held, revealing resistance to the idea and as well financial issues to be further discussed. There are however some schools showing interested in creating of two energy Communities on their facilities. Two meetings have been planned for mid-November to work with strategies for establishing CEC`s at the schools interested.

For an overview of the planned citizen engagement activities for the Palma LL, please see Table 3.

Table 3. Plan of Citizen Engagement Activities in Palma LL.

Focus	Activity	Description	Target Group(s)	Time period
Young people	Robotic competition	Adapt the yearly topic to ARV topics, collaboration with university (UiB).	Young people	2nd trimester 2023 (Consider annually repeat)
Young people	Educational program "cooperation and services to the community"[10]	Energy and the environment, and on energy consumption and rehabilitation	Young people	2nd trimester 2023
Young people	Renewable energy training cycle	Explore the possibility of carrying out a specific training cycle in renewable energies	Young people	3rd trimester
Young people	Training of teachers	Training of teachers on the topics of renewable energies, energy renovation, energy communities, and	Teachers	2023 or 2024 (tbd)

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[10] The activities on "cooperation and services in the community", a training block on the environment and energy efficiency for young people will consist of several parts: The first part is a workshop, or work sessions where students will be provided with basic knowledge of the environment, climate change, energy efficiency and energy rehabilitation of buildings. A second part will consist of visits to different constructions of the Balearic Housing Institute. Finally, the students will conduct group work on energy renovation and improvements on the building, energy use in common areas, air conditioning, alternative energy solutions, green patios, etc.

Focus	Activity	Description	Target Group(s)	Time period
		the concept of the Living Lab		
Young people	Creation of green space	Co-creation activity	Young people	
Community	Monitoring energy consumption	Recruiting residents willing to monitor energy consumption.	Residents of the neighbourhood	2022-2023
Community	Electricity bill workshop	Increase understanding of consumption and possibilities for savings.	Residents of the neighbourhood	2022-2023
Community	VR tool	With WP2, VR tools are developed as stakeholder engagement methods.	City planners, policy makers, citizens	2023 tbd
Community	Energy Communities	Using the area of schools for renewable energy production for local neighbourhood	Schools, residents of neighbourhood	Ongoing work

The ARV Living Lab in Utrecht in the Netherlands focuses on two districts: the Overvecht-Noord district in the north and the Kanaleneiland-Zuid district in the south of the city of Utrecht.

Figure 20. Overview of the Utrecht Living Lab districts Overvecht-Noord and Kanaleneiland-Zuid.

Both districts were built in the 1960s and 1970s to account for the quick rise in urban population and are in general of low-quality. Both districts share the characteristics of lively multi-cultural districts, with high share of social housing, schools and shops, and a majority of low-income households. Social housing corporations Mitros, Bo-Ex (both ARV partners) and Portaal are faced with the challenge of renovating 5 000 to 10 000 social housing units in the coming years, while at the same time increasing the public space, quality of life, safety, mobility and culture in the area.

Figure 21. Houses in Utrecht LL districts (types and prices)(left) and energy labels in LL district Kanaleneiland Zuid (right).

The typology of ownership and rental housing types in the LL districts Overvecht (green) and Kanaleneiland-Zuid (orange) is shown in Figure 21 (left). Compared with the whole of Utrecht (light blue), the LL districts have a proportionally much larger share of social rent indicating the lower income groups that are living here. When looking at the quality of the housing, Figure 21 (right) shows the energy labels of buildings in the LL district Kanaleneiland Zuid indicating a large share of low-quality

energy labels (D to G). This is currently leading to challenges with energy poverty of the tenants living in social housing in these areas.

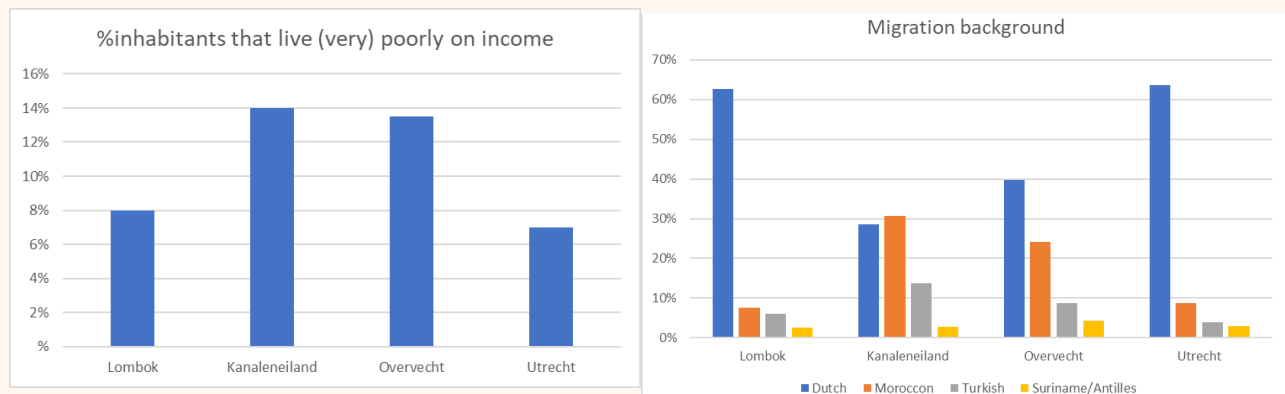## 8.1. UNDERSTANDING AND APPROACHING THE TARGET GROUPS IN UTRECHT LL

Figure 22. *%-Inhabitants that live on (very) poor income (left) and representation of ethnic groups in the LL district (right).*

Figure 22 (left) provides an indication on the number of inhabitants that live on a very low income in the LL districts. Compared to the average of the city of Utrecht, the percentage of inhabitants with very low income is almost double. Figure 22 (right) provides an overview of the percentage of inhabitants with a migration background and indicates the multi-cultural diversity of the district of Overvecht and Kanaleneiland compared to the average of the city of Utrecht.

Issues and trends to address
As indicated in the figures above, there are multiple issues and trends that need to be tackled when working towards climate positive circular communities in the area. This requires a multi-faceted and integrated solution approach. In the Overvecht district, a large governmental program is being implemented with coordinated investments in the social domain, schools and education, health and welfare and improvement of the public space. This program is complemented by investments from the social housing corporations in the physical renovation of the district. However, physical renovation alone is not enough, but there needs to be a better mix of income groups, education groups and age groups to improve the district. The intention of creating a greater variety of the population ("mix") in the area in the long run is part of the renovation programs the social housing corporations are implementing. In the district of Kanaleneiland, a similar program is currently being developed.

8.2. MAIN GOALS OF UTRECHT LL

The issues, trends and approaches described in the above section give a background on the context of the neighbourhoods the Utrecht LL is tackling.

The overarching (main) goal of the Utrecht LL is **to engage the tenants of the social housing corporations and the citizens of the LL districts to enable more positive outcomes in terms of their welfare and their energy consumption**.

The specific goals of the LL are related to the four (loosely coupled) interventions:

- Social renovation: to empower citizens to improve their social and physical living environment through the renovation project

- Human Capital program ("Bouw=Wouw"): to create jobs & internships for youngsters and people with a distance to building sector job market

- Energy coaching program: to empower citizens to lower their energy consumption and cost and improve their satisfaction with the energy systems in their new renovated dwelling

- Physical hub in district: to engage district inhabitants in the energy transition by organising training and coaching events in the circular pavilion "Panini Fresco" in Overvecht district.

8.3. SET UP OF UTRECHT LL

The activities in the Utrecht LL are embedded in larger programs of the ARV partners Bo-Ex, Mitros and city of Utrecht. The engagement of tenants is primarily done by the housing corporations Bo-Ex and Mitros (both ARV partners) as part of their retrofitting activities. The specific citizen engagement activities are supporting the retrofitting program on dedicated tasks and activities as described further in section below.

8.4. ACTORS RELEVANT FOR PLANNING CITIZEN ENGAGEMENT ACTIVITIES IN UTRECHT LL

The Utrecht LL consists of four interventions targeting different social aspects of the retrofitting program in Utrecht. The interventions have overlapping but also different stakeholder groups. In this phase of the project the main focus of development is on social renovation and human capital program 'bouw is wouw'. Two stakeholder maps are presented (see Figure 23 & Figure 24):
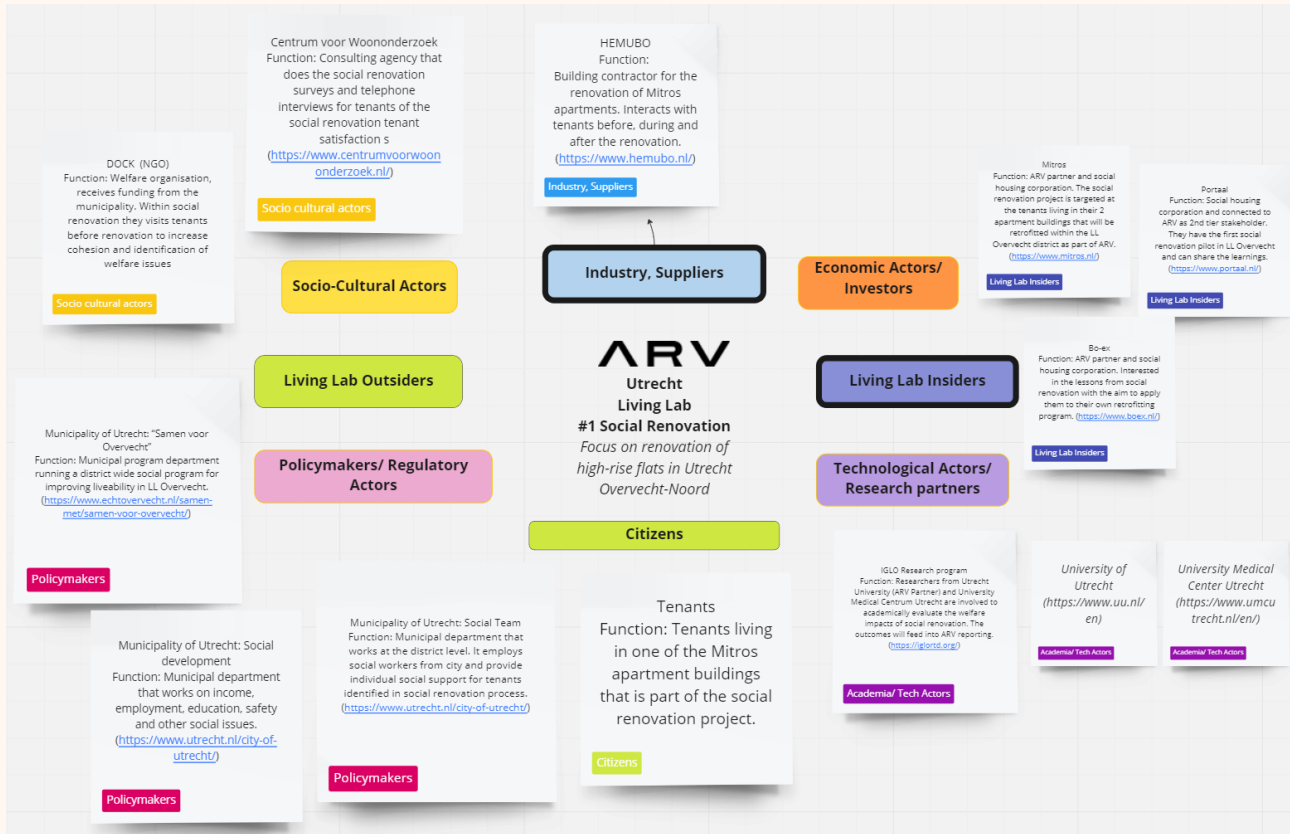
Figure 23. *Working stakeholder map of Utrecht LL for Social Renovation.*

<u>*Stakeholder map: Social Renovation*</u>

Type	Organisation	Involvement
Living Lab insiders	Tenants	Tenants living in one of the Mitros apartment buildings that is part of the social renovation project.
	Mitros	ARV partner and social housing corporation. The social renovation project is targeted at the tenants living in their 2 apartment buildings that will be retrofitted within the LL Overvecht district as part of ARV.
	Bo-Ex	ARV partner and social housing corporation. Interested in the lessons from social renovation with the aim to apply them to their own retrofitting program.
	Portaal	Social housing corporation and connected to ARV as 2nd tier stakeholder. They have the first social renovation pilot in LL Overvecht and can share the learnings.
Policy makers, regulators, urban authorities	Municipality of Utrecht: "Samen voor Overvecht"	Municipal program department running a district wide social program for improving liveability in LL Overvecht. The social renovation pilot is part of this program and the project coordinator responsible for the steering and evaluation of social renovation is part of this programme team.
	Municipality of Utrecht: Social development	Municipal department that works on income, employment, education, safety and other social issues. Forms part of the social renovation team and aims to help tenants that are identified to need support for job employment, debt or other social issues.
	Municipality of Utrecht: Social Team	Municipal department that works at the district level. It employs social workers from city and provide individual social support for tenants identified in social renovation process.

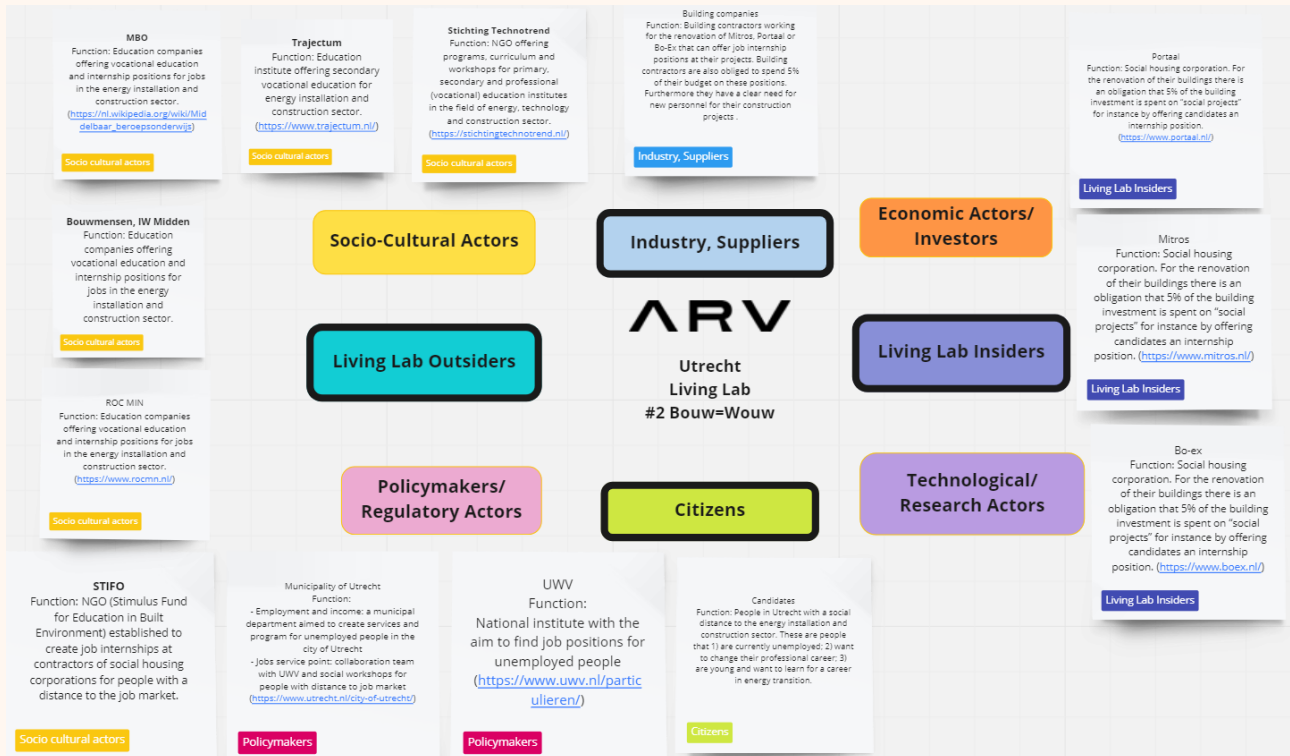|		
Socio-cultural actors	DOCK (NGO)	Welfare organisation, receives funding from the municipality. Within social renovation they visit tenants before renovation to increase cohesion and identification of welfare issues
	Centrum voor Woononderzoek	Consulting agency that does the social renovation surveys and telephone interviews for tenants of the social renovation tenant satisfaction surveys
Industry, suppliers	HEMUBO	Building contractor for the renovation of Mitros apartments. Interacts with tenants before, during and after the renovation.
Research community	IGLO Research program	Researchers from Utrecht University (ARV Partner) and University Medical Centrum Utrecht are involved to academically evaluate the welfare impacts of social renovation. The outcomes will feed into ARV reporting.
Economic investors	No investors are involved	---
Living Lab outsiders	No Living Lab outsiders	---
General public	---	---

Figure 24. *Working stakeholder map of Utrecht LL for the Human Capital program.*

Stakeholder map: Human Capital / Bouw=Wouw

Type	Organisation	Involvement
Living Lab insiders	Candidates	People in Utrecht with a social distance to the energy installation and construction sector. These are people that 1) are currently unemployed; 2) want to change their professional career; 3) are young and want to learn for a career in energy transition.
	Mitros, Bo-Ex, Portaal	Social housing corporation. For the renovation of their buildings there is an obligation that 5% of the building investment is spent on "social projects" for instance by offering candidates an internship position.
Policy makers, regulators, urban authorities	Municipality of Utrecht	- Employment and income: a municipal department aimed to create services and program for unemployed people in the city of Utrecht - Jobs service point: collaboration team with UWV and social workshops for people with distance to job market
	UWV	National institute with the aim to find job positions for unemployed people.
Socio-cultural actors	Mitros, Bo-Ex, Portaal	Social housing corporation. For the renovation of their buildings there is an obligation that 5% of the building investment is spent on "social projects" for instance by offering candidates an internship position.
	STIFO	NGO (Stimulus Fund for Education in Built Environment) established to create job internships at contractors of social housing corporations for people with a distance to the job market.
	Bouwmensen, IW Midden	Education companies offering vocational education and internship positions for jobs in the energy installation and construction sector.

	ROC MN, MBO	Education institutes offering professional vocational education for energy installation and construction sector.
	Trajectum	Education institute offering secondary vocational education for energy installation and construction sector.
	Stichting Technotrend	NGO offering programs, curriculum and workshops for primary, secondary and professional (vocational) education institutes in the field of energy, technology and construction sector.
Industry, suppliers	Building companies	Building contractors working for the renovation of Mitros, Portaal or Bo-Ex that can offer job internship positions at their projects. Building contractors are also obliged to spend 5% of their budget on these positions. Furthermore, they have a clear need for new personnel for their construction projects.
Research community	Not involved	---
Economic actors, investors	Not involved	---
Living Lab outsiders	Not involved	---
General public	Not involved	---

8.5. PLAN OF CITIZEN ENGAGEMENT ACTIVITIES IN UTRECHT LL

The plan of citizen engagement activities in the Utrecht LL is outlined around the four (loosely coupled) interventions:

Social renovation:
Before the actual renovation, the two Utrecht housing corporations will engage with tenants to explore and deal with social challenges (e.g., debt, poverty, health issues) and identify opportunities to create a more engaged community. The expected impact is a greater degree of citizen empowerment, and a greater degree of support for the renovation, as well as improvements to both, the social and physical living environment.

Intervention	Social renovation with housing tenants
Goals	Explore and create improvements for social challenges of tenants, increase resilience, create social opportunities, improvement of social cohesion in LL apartment blocks.
Methods	Questionnaire, structured interviews, focus groups, one-on-one approach with tenants, engagement during renovation, post-renovation coaching.
Target group	Tenants of selected social housing apartment blocks that will be renovated. Furthermore, welfare and public professional organisations are involved.
Mediators	social welfare organizations
KPI`s	No. of people reached, perception of satisfaction and well-being before, during and after renovation
Timeline	2022: one-to-one approach during pre-renovation, 2023: light engagement during actual renovation, 2024-2025 one-to-one post-renovation coaching

Human Capital program
The City of Utrecht is running a human capital program called 'Bouw=Wouw!', focusing on attracting young people of the district to work in the construction and technology sector. The two housing corporations & involved building value chain companies will create job and internship places related to the implementation and maintenance of ARV demonstration activities. The expected impacts are lessons, internships, job creation, involving and empowering of young people into ambitious building and renovation projects.

Intervention	Human capital program Bouw = wouw
Goals	Capacity building, inclusion, creating opportunities for future generation
Methods	Create training, job internship and coaching programs for youngster with education opportunities and people with a distance to the job market.
Target group	People in Utrecht with a social distance to the energy installation and construction sector. These are people that 1) are currently unemployed; 2) want to change their professional career; 3) are young and want to learn for a career in energy transition.
Mediators	There are local NGO's that work on the interface between public authority, education institutes, social housing corporations, construction and installation companies that can mediate the process of training, job internship placement and coaching.
KPI`s	No. of youngsters reached; No. of youngsters educated
Timeline	Changes of the program ongoing. 2022: ARV Utrecht team is currently redefining with stakeholders the next steps in this program. 2023: design of activities; 2023-2024: implementation of activities.

Energy transition:
Predictions about reductions in energy bills for residents is often used to promote energy efficient retrofitting programs in social housing corporations. This, however, is highly dependent on the future behaviour of residents. Energy coaching of residents is a key action to support them in the use of their

renovated homes. This action builds upon the energy coaching program implemented in the Positive Energy Building retrofit (executed before the start of ARV project) and is complemented with real-time monitoring data of energy usage (through a Home Energy Management System HEMS). In this social action, some residents are engaged and educated to act as **local change agents** coaching their fellow residents.

Intervention	Energy coaching of residents to reduce energy poverty
Goals	Energy saving, understanding, behaviour change of tenants of social housing
Methods	Visualization, monitoring systems, local change agents, information and talking to local tenants, one-to-one coaching
Target group	Tenants
Mediators	Local energy cooperative who employs energy ambassadors/coaches who visit the tenants
KPI`s	Save energy before and after (link to measurements), no. of tenants reached, satisfaction of tenants with the coaching
Timeline	2023: start of energy coaching campaign by energy cooperative

Physical Hub in district:
A circular pavilion in the district is expected. This circular pavilion will support community engagement & development with training, promotion & dissemination of the district energy transition and renovation programs. This hub will be used as the location in the district where the co-creation activities related to social renovation, Bouw=Wouw! & energy coaching will take place.

Intervention	Physical HUB in the district (Panino Fresco in Overvecht-Noord)
Goals	Co-creation of a circular pavilion (reuse of shipping container, old windows, etc) and using this for promoting, training, café, workshops, meeting point
Methods	Dissemination, engagement, informing, understanding
Target group	Neighbourhood community of people, stakeholders and companies
Mediators	Social entrepreneur and owner of cafe
KPI`s	No. of people participating in actions, diversity of actions, segments of citizens reached
Timeline	2022: construction completed; 2023: planning of district activities with ARV team and cafe-owner; 2023-2024: implementation of district activities.

9. CPCC LIVING LAB IN KARVINA

The Karviná Living Lab in the Czech Republic revolves around the health centre[11] which is located outside of the city centre in a residential area composed mainly of apartment buildings. There is a shopping centre in the vicinity and a large park on one side of the ARV demonstration project. The demo is in a rather secluded area with no direct connection to any other institutions or infrastructure; however, the ARV interventions may have an impact on the inhabitants of the residential area.
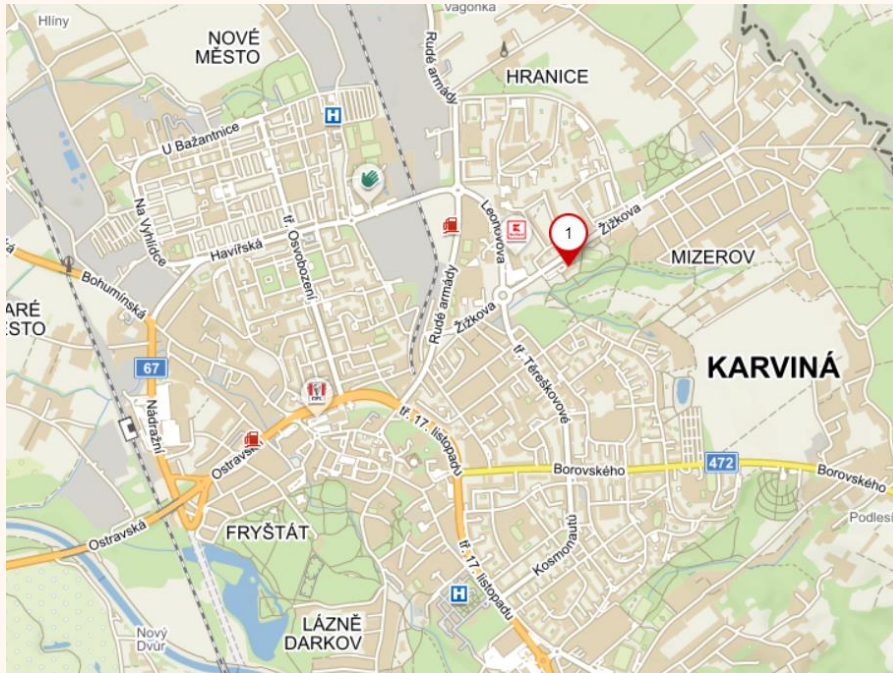

Figure 25. Map of Karvina LL showing the location of the health centre.

9.1. UNDERSTANDING AND APPROACHING THE TARGET GROUPS IN KARVINA LL

The city of Karviná is characterized by two main demographic trends – decrease in the number of inhabitants and ageing of the population, which is the common trend of the region as a whole.

The trend of population decrease started in the late seventies and early eighties and continues up to these days. The decrease slightly slowed down in the nineties but has intensified again in the last ten years. The population decreased 13,8 % during the years 2012-2021. The number of inhabitants was reduced from 57,842 to 49,881 (outflow of 7,961 people in total).[12]

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[11] The health centre is part of the first phase of PED (Positive Energy District) development in Karvina, which includes 9 municipality buildings (schools, sports facilities, nursing home, and the ARV demo building) which are all located within a radius of 500 meters.

[12] Data source: Czech Statistical Office (https://www.czso.cz/csu/czso/database-of-demographic-indicators-for-selected-towns-of-the-czech-republic)

The average age of the population changed from 42,2 in 2012 to 44,8 in 2021. The index of ageing[13] changed from 135,8 to 165,7 in the same years.[14] The average age in the whole Czech Republic in the year 2021 is 42,8 and the index of ageing is 128,1.[15]

Based on the prognosis for Karviná from the year 2018[16], the highest estimate for the number of inhabitants is 43,600 in the year 2033, which means a further decrease of 12,6 % (See Figure 26 left). Compared to the year 2018, the largest decrease would happen in the youth segments: minus 33% in the youngest age cohort 14 years and less and minus 24 % in the 15-64 age cohort. Correspondingly, it is expected to have a 9 % increase in the cohort of 65+. Based on these estimates, the index of ageing would be around 205 in the year 2033 (See Figure 26 right).
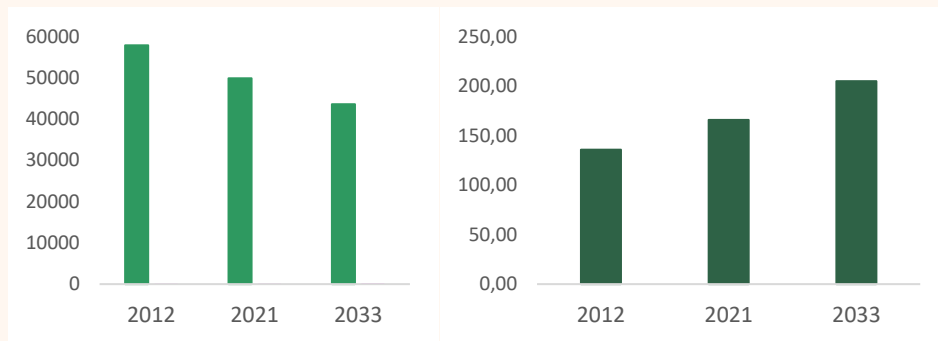

Figure 26. Population overview and prognosis for 2033 (left) and Index of ageing (right) for Karvina.

We do not have more detailed quantitative data on the composition of the population of the neighbourhood or the population affected by the demo. However, we do have at least a general idea of the affected groups at this point.

Other main groups of residents naturally affected are the tenants of the health centre and the medical patients. The health centre consists of dental, allergy and other outpatient clinics, the patients are of mixed age groups, not just the elderly. It is unclear at this point which tenants will remain and which will leave the clinic (taking their clients with them). The situation will become clearer over the next year. The groups that the demo does not directly affect, but which will be involved through the planned Living Lab activities, are students of secondary and high schools, and selected institutional stakeholders (further described in section 9.4).

9.2. MAIN GOALS OF KARVINA LL

The first issue which should be addressed in Karviná is the **outflow of young people**. One of the reasons for this trend is the lack of professional opportunities in the region. The city of Karviná is looking for more sophisticated methods to attract young people and for ways of closer cooperation with this group of citizens. Karviná considers the group of young people under-represented in the public debate.

The second issue of importance is the support of municipal projects and activities focusing on CO_2 emissions reduction and the improvement of the city environment. These projects and activities are in

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[13] Index of ageing is the number of people in the age cohort of 65 and more years old per 100 kids in the age cohort of 0 to 14 years old. Index of ageing being 165,7 in the year 2021 means that there are more than 165 65+ years old people per every 100 kids 14 years old and younger.

[14] Data source: Czech Statistical Office (https://www.czso.cz/csu/czso/towns-in-the-czech-republic-letter-k-10zfavukd9)

[15] Data source: Czech Statistical Office (https://www.czso.cz/csu/czso/ceska-republika-od-roku-1989-v-cislech-aktualizovano-2682022#01)

[16] Data source: Demographic study of Karviná
(https://www.karvina.cz/uploads/OSO/PF_Demograficka_studie_Karvina_ke_KP_2019.pdf)

line with the target of climate neutrality in the year 2050 which was set out in municipal adaptation strategy to climate change conducted in the year 2021[17]. One of the main projects championed by the municipality is the positive energy district (PED) concept that has been already introduced in Karviná. As mentioned, the health centre is part of 9 municipality buildings (others being schools, sports facilities, nursing home) located within a radius of 500 meters that is part of the first phase of PED development in Karviná. Based on these municipality strategies and plans, the ARV innovative solutions piloted in the demo building will have a great potential to be replicated in other buildings, as well as scaled up to a larger scale (district level).

Specific goals:
- **To engage schools and students** on energy, sustainability, climate-positive communities
  The main goal of the Living Lab for the initial phase of the ARV project is **to engage schools and students** in practical workshops on energy, sustainability, climate-positive communities, and related topics. Practical solutions using advanced technology will be demonstrated to them.

- To raise awareness among young people and attract them to study or work in CPCC topics in the future.
  We want to educate young people in these topics and teach them about the opportunities to be more engaged in the community and encourage them to become ambassadors to disseminate the knowledge to their peers and family members. We would also like to portray the region as one interested in these topics and offering related career opportunities. Equip the youth with tools to engage in the public debate. After the first phase of cooperation with young adults (section 9.5), this approach will be assessed and modified for the next years.

- To inform various groups of citizens, raising their awareness, and getting them involved and interested in activities and projects focused on CO_2 emissions reduction and the improvement of the city environment.

These can be done by:
  - closer involvement of the building tenants,
  - activization and raising awareness of members of the general public,
  - and building on a stakeholder ecosystem/platform that should serve as a seedbed for new energy projects following ARV.

9.3. SET UP OF KARVINA LL

The main organizer of the Living Lab activities is the City of Karviná with expert support from the UCEEB CVUT. The Karviná Living Lab is a collective activity being run by a task force including:
  - Michael Sikora (Karviná) – main contact person for WP3 activities at the demo
  - Josef Wozniak (Karviná) – representant and employee of the city
  - Nicol Staňková (CVUT UCEEB) – main coordinator of WP3 activities in the Czech demo
  - Klára Dvořáková (CVUT UCEEB) – working on planning the WP3 activities
  - Robert Wawerka (CVUT UCEEB) – technical support on WP3, providing expert knowledge

In the first phase the LL will be realized as a **series of four workshops** for middle and high schoolers that will happen throughout the school year. The seminars will take place at the building of the City Hall of the City of Karviná. The demo (health centre) is currently under construction and therefore not suitable for community engagement and LL activities. The workshops are partly educational and partly

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[17] https://www.karvina.cz/deje-se/adaptacni-strategii-na-zmenu-klimatu-statutarniho-mesta; specific sub-targets relevant to ARV project are 3.1 Decrease emissions from the energy sector and 3.3 Increase the public engagement in climate protection.

aimed at active participation by the students. Future years will be modified according to the feedback from the students, schools and other ARV members.

9.4. ACTORS RELEVANT FOR PLANNING CITIZEN ENGAGEMENT ACTIVITIES IN KARVINA LL

The preliminary Karvina LL stakeholder map has started to take shape (see Figure 27):
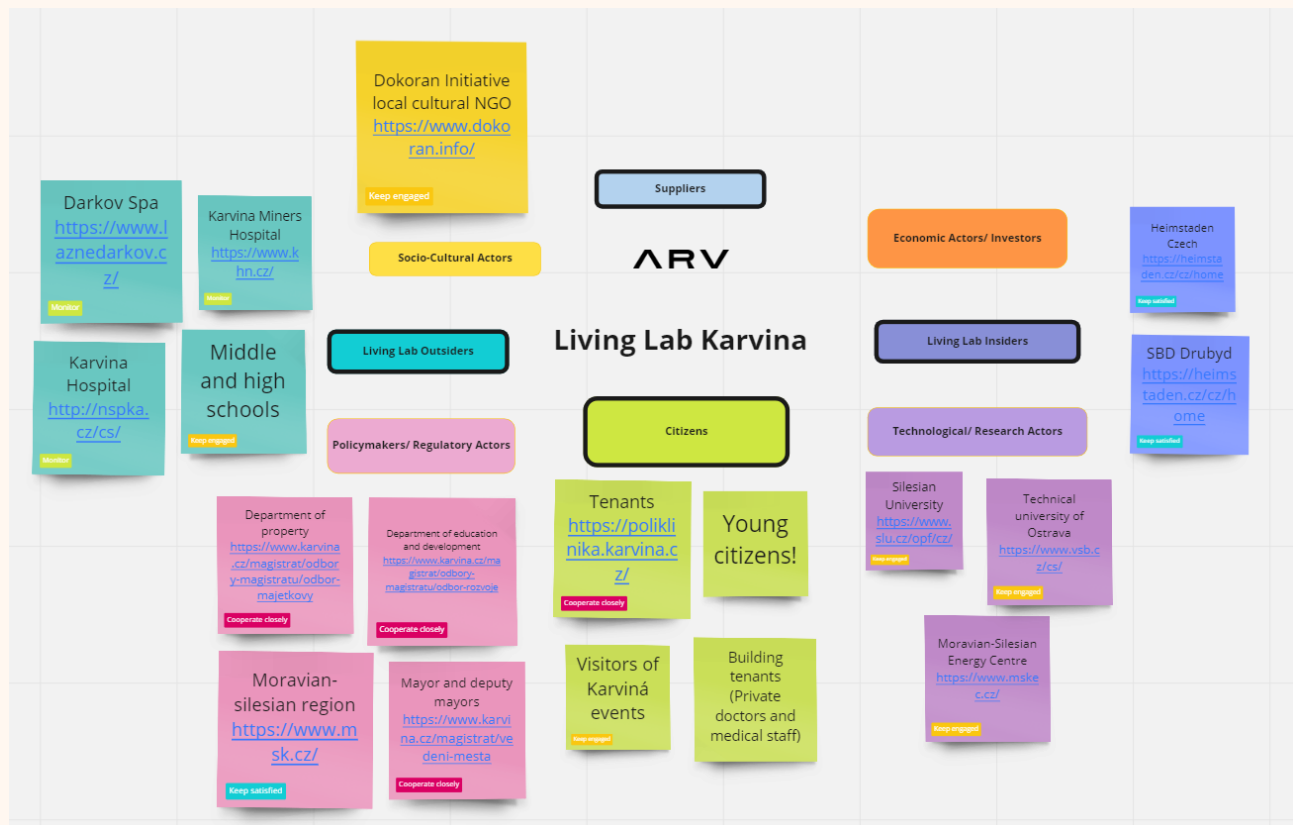

Figure 27. Working stakeholder map of Karviná LL.

Our main target groups in the broadest sense are **young citizens** (middle and high schoolers), building tenants, and stakeholders consisting of representatives of the main interest organizations. As shown in Figure 27, we are also in the process of prioritising the stakeholders into 4 groups: Keep satisfied, Monitor, Keep engaged, and Cooperate closely.

Young citizens
All primary schools in Karviná and three selected secondary schools, which most closely matched the topics discussed, were contacted to get them involved in Living Lab activities. Out of 12 primary schools, 9 schools confirmed their participation, 3 schools were busy with other activities. Of the 3 secondary schools, 2 schools confirmed their participation (a grammar school and a secondary industrial school), 1 school refused to participate due to its workload (a secondary medical school). In the first year, the activity is focused on selected nominated pupils interested in the topics discussed. In the following years, based on feedback, the activity may be extended to other pupils of the schools concerned.

<u>Building tenants</u>
This consists of current tenants of the demo building, who are mainly private doctors and medical staff with few others small businesses. The tenant composition is currently changing due to the reconstruction of the demonstration project – some of them are leaving and some new are coming in. It is unclear at this moment what the new composition will look like.

<u>Other stakeholders</u>
One of the stakeholders (The Veolia division - Veolia Energie CR) will contribute to the demo building by providing technology for BAPV and car charging stations.

Included in the category are:
- Big energy companies such as Veolia, OKD or Diamo.
- Housing companies such as Heimstaden or SBD Drubyd.
- Real estate group, owner of land and leasing office buildings Asental.
- Public administrative office of the Moravian-Silesian Region.
- Local companies, hospitals, spa, retail, culture, sport etc.
- schools, university, local communities, and NGOs

9.5. PLAN OF CITIZEN ENGAGEMENT ACTIVITIES IN KARVINA LL

<u>Young citizens</u>
The first phase of the Living Lab will be realized during the upcoming school year. It will consist of **four workshops** with selected Karviná's middle and high schoolers.

- The aim of the **first workshop** is to introduce the project, get to know the students, give an expert lecture on energy and sustainability topics and present further work and tasks.
- During the **second workshop**, teamwork will be assigned to the students including input data and workflow. The students will work in a team they will choose a certain urban building for their project and based on the assignment, they will design its installation of photovoltaics and other technologies to ensure its self-sufficiency. *Between the second and third workshop* the students will work on completing the tasks. They will get support and consultations from representatives of the municipality and CVUT experts. They will perform field research, visit the building on their own, take photos and basic measurements and conduct other related activities.
- During the **third workshop**, the students will present their work and the result will be evaluated.
- The **last workshop** is planned as an award ceremony with a fieldtrip to present technological solutions or sustainable approaches to the students.

The activity will be repeated in the next years but will be modified according to the feedback from the students, schools, and other ARV members. In preparation for this activity, all primary schools in Karviná and 3 selected secondary schools were contacted. There was a rather intensive communication between representatives of the city of Karviná (representatives of the ARV project) and the principals of the individual schools. Subsequently, a specific organizational meeting was organized with the responsible teachers, who helped to select the pupils and set the content of the activities from a pedagogical point of view.

<u>Building tenants</u>
Regarding building tenants, selected activities will be prepared in the following months of 2023. These will include online, and offline events aimed at keeping in touch with the citizens, at their activization and raising their awareness. They will happen in synergy with other municipal festivals focused on

environment and sustainability, build on them and complement them with additional public engagement activities and new topics. Participants will learn about and discuss the ARV project, demo progress and other municipal plans in energy and climate protection. Ongoing municipal festivals include the Earth Day (often linked to farmers' markets; including competitions and activities on environmental issues, sustainable agriculture, school art competitions on sustainability and education on recycling and waste management), Smokeman (an educational entertainment show focusing on proper home heating and household ecology) and European Mobility Week (an awareness campaign on clean transport including presentations by associations and companies focusing on clean mobility, open to the general public). Earth Day is planned for April 2023, Smokeman is planned for March 2023 and European Mobility Week is planned for September 2023.

Other possible directions are closer involvement of the building tenants and setting an institutional stakeholder ecosystem and platform that might serve as a seedbed for new energy projects or support the development of existing ones.

The first step concerning the demo tenants will be the mapping of current tenants of the building. The composition of the tenants has recently changed due to the changes in the demo and the rapid changes are still ongoing. Based on this mapping, the next steps will be established.

Other stakeholders
The first step concerning institutional stakeholder will be individual interviews. These will be aimed at co-creating the future energy platform and ecosystem. The City of Karviná will learn about current energy plans and projects of selected stakeholders, find overlaps with the municipal projects, recognize the stakeholders' ideas concerning the emerging platform and ecosystems and identify how is each of the stakeholders willing to contribute. Based on this information, the new system will be established.

10. CPCC LIVING LAB IN SONDERBORG

The Sonderborg Living Lab in Denmark is located in one of the housing associations in Sonderborg called SAB. The department involved is Kløver/Hvedemarken dept. 22. It includes 19 apartment blocks of 3 floors, in total **432 rented or owned apartments** with a floor area of 32,000 m2. The apartment blocks were constructed in 1970-1973.

Retrofitting in SAB:
In 2010, the buildings were renovated with more insulation, new energy efficient windows, new radiator systems and new district heating substations with heating controls connected to Danfoss Portal. There are 9 sub-stations covering the 19 apartment blocks.

In 2017, more than 3,000m² solar PV panels were integrated in the roofs of all 19 apartment buildings. The solar PV system can produce 460 kW solar electricity corresponding to 408,000 kWh per year covering 37 % of the total electricity consumption in the 432 apartments. At the same time, new LED outdoor lamps were implemented in the area around the 19 apartment blocks and in the corridors and basement.

In 2021, storage batteries were added to the solar panels in the 19 blocks, each with a storage capacity between 10 and 30 kWh depending on the number of apartments in each block. In 2021, Danfoss Lean Heat system was implemented in all buildings using artificial intelligence to control and monitor the centrally heated buildings.

10.1. UNDERSTANDING AND APPROACHING THE TARGET GROUPS IN SONDERBORG LL

A total of 833 residents live in Kløver/Hvedemarken SAB dept. 22 (data from 2021), and the age distribution is spread out as shown in Figure 28 (left). The share of immigrants/descendants from non-Western countries is 48,38 %. There is a majority of immigrants/descendants from non-Western countries, seen in relation to Sonderborg Municipality and the national average. There is an average of 2.0 people per apartment.

In terms of employment, compared to the national average, there is a relatively high proportion of residents outside of the labour market in the housing association's ward 22 (See Figure 28, right). The average household income is DKK 362,317, which is almost half of the national average (year 2020)[18].

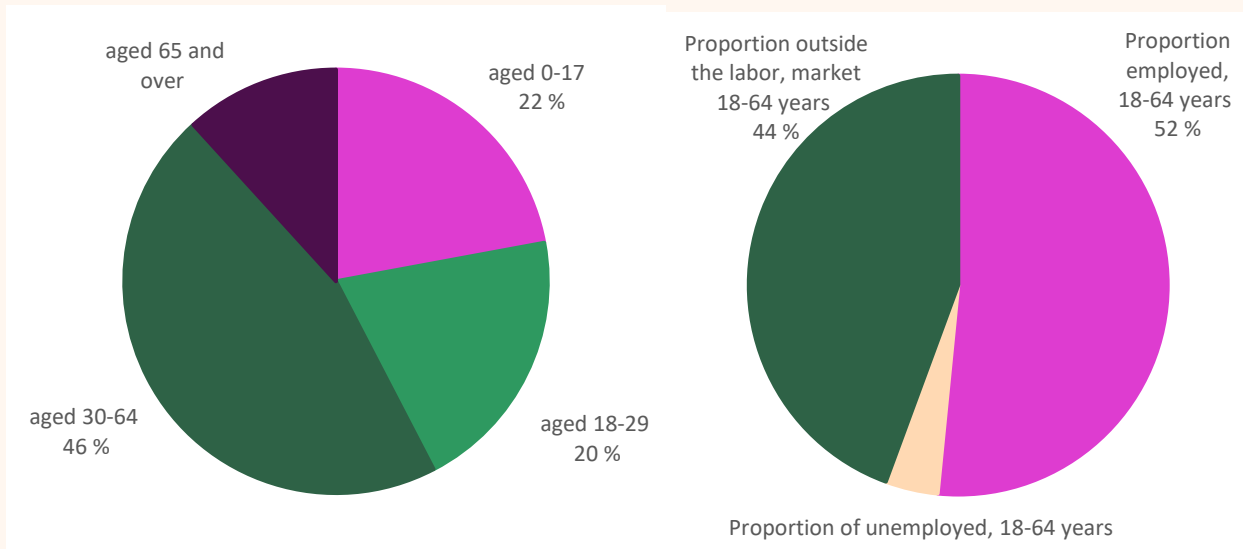---

[18] Data from Statistic Denmark

Figure 28. Overviews of the age distribution of the population (left) and employment (right, data from 2019).

10.2. MAIN GOALS OF SONDERBORG LL

Various retrofitting measures have been implemented in the buildings of the Sonderborg LL in the recent decade, however, these measures have been more focused on the buildings' envelopes, energy efficiency of the buildings and self electricity production. In the Sonderborg LL, department 22 is going to be focused on **district heating measures to reduce the district heating return temperature from the multi flat buildings**, by targeting the heating system (radiator level) as well as the DHW system (sub-station level). Involvement of tenants and citizens is crucial for the energy saving results of the planned technological measures and depend significantly on the daily energy performance of the tenants in the demo buildings.

The aims of Sonderborg LL are:
- To increase awareness of residents of their part in the overall energy transition
- To develop and use the green ambassador programme as a tool to boost tenant involvement

The Sonderborg LL is focused on energy transition. There is a need for facilitation of an understanding of the ARV project and the green transition in the housing association/citizens. This is planned to be done via one- and two-way communication such as website engagement (projectzero.dk), events, letters (physical/ digital), SoMe, newsletters and local/(national) media. In addition, green ambassadors (see Section 10.5) will be explored and developed together with the housing association and the residents themselves.

We will keep track on the development of the residents' actions within the green transition by examining whether the residents' knowledge changes during the demonstration project. It is measured e.g. via surveys.

10.3. SET UP OF SONDERBORG LL

The LL is being driven by ProjectZero supported by the SAB organisation. The Living Lab will not have a physical location (office). The communication with the main target group (tenants) will be done via scheduled physical events and online forms of communication.

Contact persons: Anne Branderup, ProjectZero and Kristina Bozhkova, ProjectZero.

10.4. ACTORS RELEVANT FOR PLANNING CITIZEN ENGAGEMENT ACTIVITIES IN SONDERBORG LL

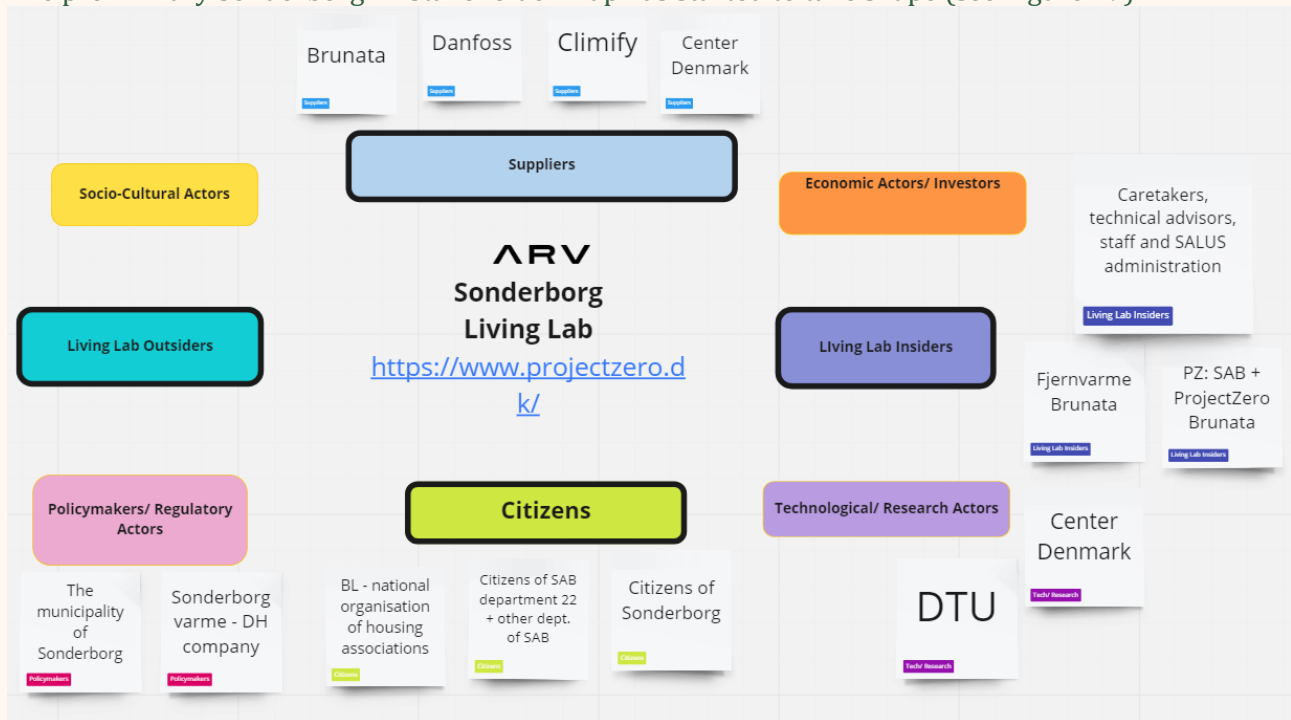The preliminary Sonderborg LL stakeholder map has started to take shape (see Figure 29):

Figure 29. Working stakeholder map of Sonderborg LL.

There are many actors involved in the LL which need to be aligned with each activity both on the technical and social aspect to achieve the best outcomes from the LL.

The main actors for the social aspects in the Sonderborg LL are the housing association SAB including building caretakers but also the residents of the buildings along with ProjectZero. The main engagement activities will be organized by ProjectZero and SAB and the main recipients will be the SAB residents.

Secondary actors within the social aspect are the municipality, the district heating provider and national housing association organisation as they are providing the framework conditions for possible technical measures and they also have their own channels of communication towards the housing associations in Sonderborg, incl. SAB.

The other partners visible on the stakeholder map are related to the technical aspect of the LL, some are responsible for the implementation of the physical measures agreed within the ARV project, some are responsible for data collection and modelling of data for best optimisation purposes.

10.5. PLAN OF CITIZEN ENGAGEMENT ACTIVITIES IN SONDERBORG LL

In order to bridge the gap between the technical and social context, the following activities have been planned:

- Define what a green ambassador should and can contribute with
- Define the role and responsibilities as a green ambassador

- Organization of Green Ambassadors in the housing association SAB (administration vs. citizens)
- Recruit green ambassadors
- Educate green ambassadors
- Information and dissemination to residents
- Ongoing further development

It is important to identify if the green transition for the population in Sonderborg and in SAB is something they value in their daily life, which areas of interest are most important, and how the housing association can support them. Identification of the measures that are needed to boost tenants' involvement in the green transition, including insights on resident composition and which measures affect the residents' **readiness for change** (including in the home / apartment) the most. The **green ambassador program** is the backbone of the citizen engagement activities planned in the Sonderborg LL. The idea behind the green ambassador program is **that the residents can speed up and support the green transition of their buildings**.

In the process, they could inspire and bring awareness to their fellow residents regarding the green efforts that the housing association is implementing. Being a green ambassador is voluntary, and one does not need to be an expert. The ambassador acts based on their own everyday life and their green behaviour in their homes, but also outside. In this way, they can contribute by influencing others. This benefits not only the housing associations, but ultimately the whole municipality. The ambassadors are also not left alone to do this task. On the contrary, the ambassadors' tasks are solved jointly. They become part of a strong network in their own housing association and get the opportunity to build good relationships with the other green ambassadors in the other housing associations.

Table 4. *Draft timeline of activities in Sonderborg LL (subject to change).*

	Q1	Q2	Q3	Q4
2022	First introduction to the project held in the neighbourhood/for tenants (event at the housing association). Segmentation in progress		LL development. Segmentation. Carry out a baseline survey of the residents' knowledge and actions in the green transition in relation to energy consumption etc	
2023	Carry out a baseline survey of the residents' knowledge and actions in the green transition in relation to energy consumption etc. Reach out to residents to recruit green ambassadors (ongoing)	Dissemination of information to residents regarding energy optimization in the home through various events, dissemination via various channels, etc. Reach out to residents to recruit green ambassadors (ongoing)		Reach out to residents to recruit green ambassadors (ongoing)
2023	Inform and educate residents in optimal energy management of the home			
2024	survey of the residents' knowledge and actions in the green transition in relation to energy consumption etc.	N/A	N/A	N/A
2024	Inform and educate residents in optimal energy management of the home			

	Q1	Q2	Q3	Q4
2025	N/A	N/A	Final survey of the residents' knowledge and actions in the green transition in relation to energy consumption etc. Evaluating LL.	N/A

The project of the Voldsløkka school and cultural centre in Oslo, Norway encompasses the construction of a new building to host 8 parallel secondary school classes for 780 pupils and a cultural hall, and the energy retrofitting of an existing cement factory (the Heidenreich building) to establish a cultural school. A multi-purpose sport hall on the neighbouring plot of land is also under planning. The school activities will cover an area of 12 200 m^2 in the new construction and 1 600 m^2 in the Heidenreich building. The secondary school and the cultural school will become operative in August 2023. The new facilities will be partly available to the public, when not in use by the school. This is facilitated by the sharing platform "Oslo-nøkkelen (The Oslo key)". The surrounding of the school area is dominated by a large public park with a skateboard hall, football field, and tennis courts. The adjacent districts are mainly housing areas, with single family housing to the West and apartment blocks towards the East, see Figure 30.
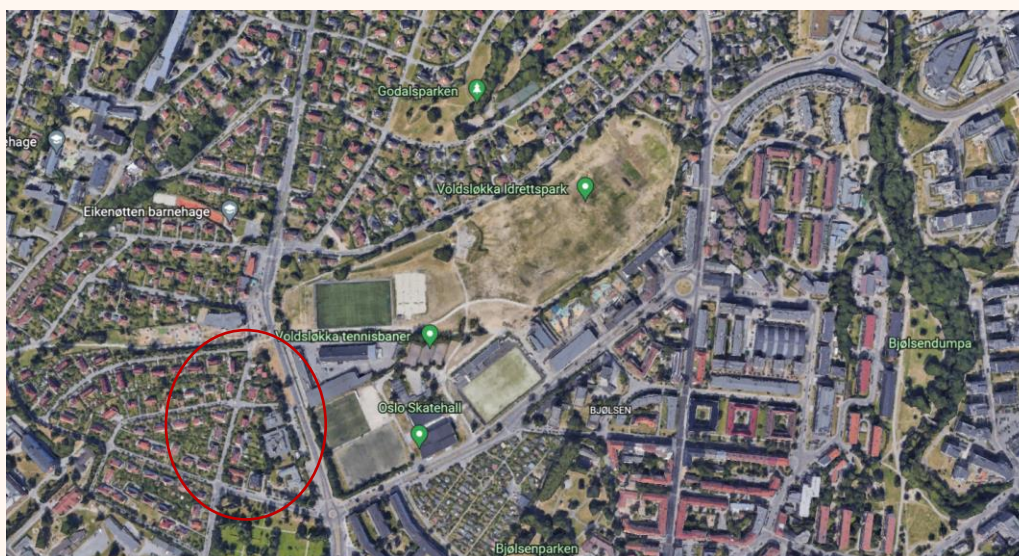

Figure 30. Map showing the building site of Voldsløkka school and cultural centre (marked in red) (www.earth.google.com).

The municipality of Oslo runs public cultural schools in the different districts of the city, offering education in 220 different subjects within dance, music, visual arts, and theatre. The "culture station" at Voldsløkka will be one of the largest culture school arenas in Norway, with a cultural hall, black box, dance hall and rehearsal rooms (see Figure 31). While the secondary school is district dependent, the cultural schools are not district specific but can be attended by pupils from all over Oslo, depending on the subjects they want to study. The mixture of socio-economic background of the pupils attending the cultural school may thus differ from the group of pupils attending the secondary school.

Figure 31*. Rendering of Voldsløkka school and cultural centre by Spinn/Kontur Arkitekter, showing the façade of the new cultural hall in front and the new secondary school building to the right.*

11.1. UNDERSTANDING AND APPROACHING THE TARGET GROUPS IN OSLO LL

Norway`s capital city Oslo, with a population of just under 700 000, can be described as a divided city between east and west when it comes to health and living conditions. The difference between the districts with the highest (west) and lowest (east) life expectancy is seven years (FHI, 2022). This gap has been reduced from being a gap of 10 years in the early 2000s (Berntsen, 2013), but the difference within the city is still large compared to other cities in Norway, as well as compared to other European cities like Stockholm and even London (Elstad, 2017).

Voldsløkka secondary school and cultural centre
Voldsløkka secondary school and cultural centre is located between two districts in Oslo with very different demographical composition. It is envisaged that in the first three years after its opening, Voldsløkka secondary school will (most likely, final decision will be made 1.11.2022) admit pupils from four different primary schools. This is a temporary arrangement while a new secondary school closeby is under construction, opening in 2024. From 2024, Voldsløkka will admission pupils only from two primary schools (Berg and Bjølsen schools). The following overview of the demographics will be based on the sub-districts where these two schools are located:

- Area 1: **Ullevål Hageby**
- Area 2: **Bjølsen**

Geographically speaking area 1 (Ullevål hageby) is located north of Voldsløkka, and area 2 (Bjølsen) is in the south (see Figure 32). However, looking at demographical differences, Area 1 can be characterized as a typical district of the "west", and Area 2, a typical district of the "east". These obvious demographic differences of the districts pertaining to Voldsløkka school were among the aspects that were discussed during a participatory program meeting, arranged by the Municipal educational officer (ref. D4.1, SINTEF`s interviews with Oslobygg) during the planning phase. One outcome of this meeting was an agreement that a focus on designing good meeting places for the youth was important.
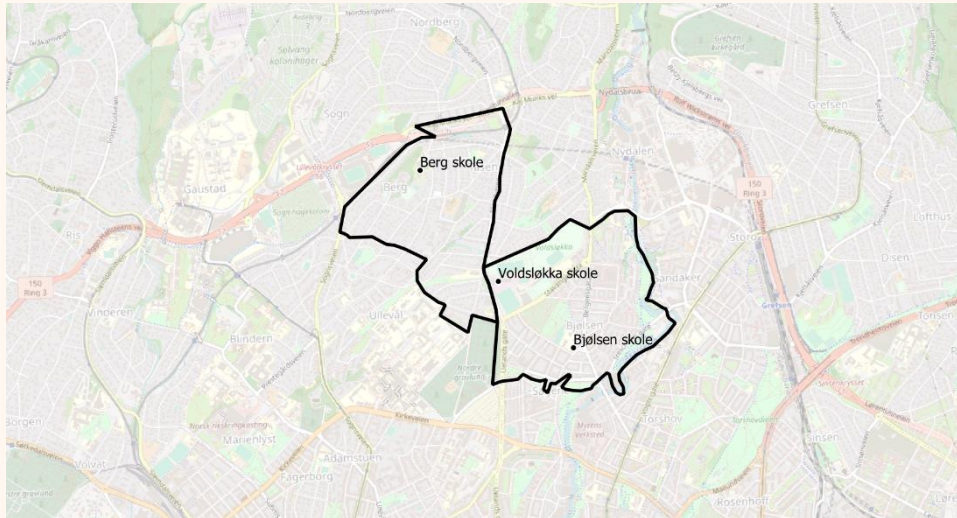
Figure 32*. Locations of the schools in the two areas described.*

Ullevål hageby in Area 1 is known for its architecture, resembling the building style of the English garden city movement around 1900 (www.Havebyselskap.no). The houses are very popular and rarely available on the market. The average price per m² is 9600 Euros (the average in Oslo being 7000 Euros). 42% of the households in this area are families with children, where 20,5% of them have two or more children. 69% own their house in this area.

Bjølsen in Area 2 is a typical apartment block area, popular with young adults. 17,5% of the households are families with children, and only 4 % of them are families with two or more children. The average price per m² in the area is 8500 Euros. The number of people owning their house or apartment is only 49% in this area and the number of low-income families is four times higher than in the Area 1.

The demographical differences between Area 1 and Area 2 are outlined in Table 5.

Table 5. *Demographics of the sub-districts, area 1 and area 2 in Oslo LL.*

	Area 1	Area 2
School district	Berg	Bjølsen
Sub-district	Ullevål hageby	Bjølsen
Number of residents in sub-district	6799	7580
Age structure		
0-5 years old (under school age)	5,8% (438)	6,3% (426)
6-12 years old (primary school)	3,4% (259)	11% (719)
13-15 years old (secondary school)	0,86% (65)	4,9% (333)
16-18 years old	1% (78)	4,1% (281)
19-29 years old	30% (2305)	16% (1080)
30-39 years old	28% (2118)	11% (722)
40-49 years old	11% (832)	15% (1000)
50-59 years old	7,7% (584)	14% (979)
67+ (pensioners)	7,5% (570)	11% (776)
Households with children		
with one child	11%	7,4 %
with two children	16%	3,5 %
with three or more children	4,5%	0,52%
Housing typology		

	Area 1	Area 2
Terraced/semi-detached/detached	61%	0,5%
Apartment block	39%	99%
Form of ownership		
Ownership	69%	50%
Renting	31%	49%
Public housing	0,36%	6,8%
Living conditions		
Crowded living conditions#	11%	25%
Low-income families with children	3%	12%
Low level of education	7,2%	14%
Housing prices purchase, average per m2	9600 Euros	8500 Euros

(#Crowded Living conditions are defined as number of rooms are less than nr of people, and m^2 per person is under $25m^2$. Source: Bydelsfakta, Oslo Municipality.)

11.2. MAIN GOALS OF OSLO LL

The goal of the CPCC Living Lab at Voldsløkka is **raising climate awareness** among the pupils of the secondary school and the cultural school, as well as among their parents and the citizens of the neighbourhood.

The focus of the Oslo LL is on energy transition, including solutions regarding energy technologies and circularity.

The Living Lab will make use of the educational facilities for engaging the pupils into activities of different types, including learning, co-creation and being youth ambassadors.

An activity of the Living Lab will be supported by the task 2.5, AR/VR.

The **target group** for the Living Lab in Oslo are the users of both schools, that is the secondary school and the cultural school. These involve: pupils, employees (teachers, maintenance, and operational staff), and parents.

11.3. SET UP OF OSLO LL

The Living Lab in Oslo is led by ARV partners SINTEF and NTNU and coordinated with Oslobygg (OBF). The activities at the school are planned in dialog with the principals of the school (Oslo Municipality department of education), and the cultural school (Oslo Municipality department of culture). The planning of activities` details will be done once the teachers are hired in spring 2023. The school will open its doors by the end of August 2023.

The set-up of the Living Lab will include activities anchored within the regular curriculum of the school, as well as extra-curricular activities (e.g., project weeks). The Living Labs project weeks are planned for school years of 2023 and 2024. While the curriculum activities will mainly be run by the teachers, the extracurricular activities will have to be supported by ARV team and the contact person from Oslobygg.

Some of the Living Lab activities will also be directed towards the neighbourhood, and the city. Local district associations can be considered as supporting actors. The school yard and the surrounding area (football lane, park) are open to the public, and results of activities may be at public display, if suitable. The preliminary plans are outlined in Section 11.5.

Parts of the school will be open to public use during the afternoon and evenings. This is an opportunity to display the pupils` activities and results of activities to a broader audience of the neighbourhood. During the planning phase, there was a specific focus on both out- and indoor spaces available to young people outside of the school hours.

The main responsibility for the planning and operation of the Living Lab at Voldløkka school are:

Ruth Woods, NTNU; Judith Thomsen, SINTEF; Caroline Cheng, SINTEF, Claudia Moscoso, SINTEF, Bodil Motzke; OBF; Ulf Brage Moe, OBF; Kjersti Svensen, Oslo Municipality, principal of the secondary school; the principal of the cultural school (to be appointed); a contact person among the teachers (to be appointed).

11.4. ACTORS RELEVANT FOR PLANNING CITIZEN ENGAGEMENT ACTIVITIES IN OSLO LL

The preliminary Oslo LL stakeholder map has started to take shape (see Figure 33):
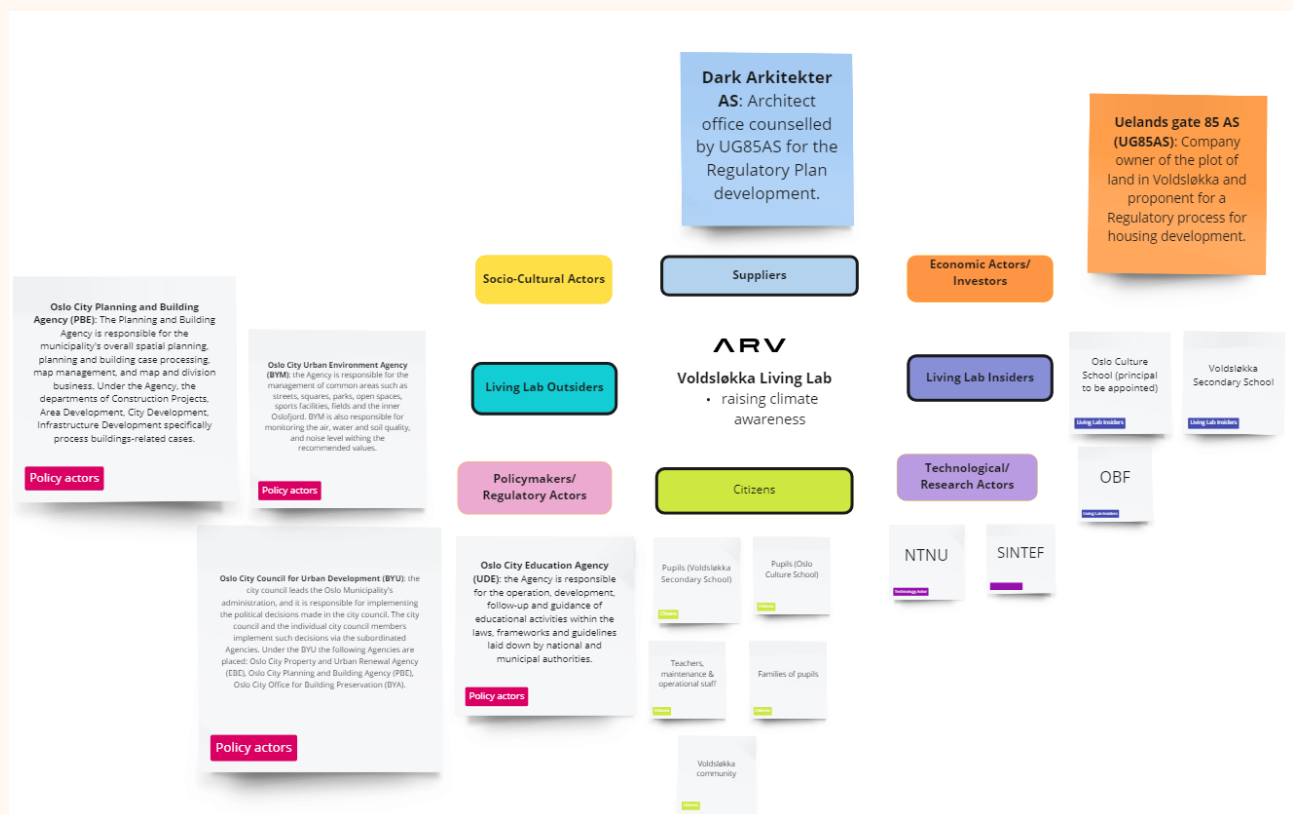

Figure 33. *Working stakeholder map of Oslo LL.*

11.5. PLAN OF CITIZEN ENGAGEMENT ACTIVITIES IN OSLO LL

- Design and decorate or build a "Physical space or object", as a co-creation activity with the pupils. This will either be a room in the school or a temporary construction outdoors.

- Plan and prepare events for the neighbourhood (being youth ambassadors), spreading the knowledge on energy and circularity. The events would be suitable for the planned collaboration with WP10, task 10.4.

- Teaching, informing, etc on energy communities, energy savings, energy technologies as a part of the regular curriculum, addressing different topics over the year. Here the school will have to define what they can include and what fits to the national goals for education. In addition to the regular curriculum, we can ask some ARV researchers and OBF to contribute to dissemination of knowledge on energy transition.

- Link to the AR/VR activities in dialog with WP2, task 2.5. The citizen engagement activities in Voldsløkka school will also apply the AR tool, in which different building elements will be visualised and studied. For each building element, different building materials will be visualised which provides the users with information about the CO_2 emissions of the different building materials. This facilitates education of the citizens, regardless of age group, on energy-related issues and could pave the way for their engagement in the development of CPCCs.

- Interactive sessions with other youth ambassadors at schools, digital workshops/conference by the end of the project. Organisation is proposed to be done in cooperation with WP10.

The **timeline** for preparing and establishing the Living Lab activities is:

Planning phase 2022-2023:

Autumn 2022, initial planning of the activities.
Spring 2023, anchoring the activities with the staff, organizing a workshop for co-ideation.
Spring - Summer 2023 planning of the activities.

Implementation phase 2023-2024:

Kick-off during consortium meeting in Oslo, May 2023
Autumn and winter 2023 conduct LL activities, 1st project week
Spring or autumn 2024, 2nd project week. Event for the neighbourhood (as one of the ideas). Involve HE here.
Spring 2025, ARV school Living Labs exchange experience on their activities in a digital conference (Palma, Oslo, Karvina, maybe Trento)

Evaluation phase 2024-2025:

Reporting and documentation of activities during LL, in dialog with task 3.4.
Evaluation of results after termination of activities, as input to task 3.5.

The plan of citizen engagement activities for the Oslo LL is provided in Table 6.

Table 6. Overview of citizen engagement activities in Oslo LL.

Activity	Description	Target Group(s)	Time period
Planning sessions with the principle	Planning of activities for both regular curriculum and extracurricular project weeks	Pupils of the secondary school and the cultural school, teachers, family	Dec 2022
Circular art co-creation	Use of existing building materials from Voldsløkka in an artwork, co-created with the future pupils of Voldsløkka school	Pupils of the schools, parents, neighbours, city	Jan – May 2023
Workshop with staff /teachers	Co-creation workshop to develop and anchor activities	Staff of the secondary and cultural school (Ambassadors?)	June 2023
ARV consortium meeting	Exhibition of the circular art project, Invite pupils and artists to present	ARV partner, pupils	24.-26. May 2023

Activity	Description	Target Group(s)	Time period
Curricular activity on Energy transitions	Activities on energy transition, embedded in curriculum.	Pupils, youth ambassadors, parents	Autumn 2023 to Jan 2025
Project week 1, ARV week	School opens. ARV can present project, technologies, inspire and learn. AR tool. WP3 runs ideation workshop with the pupils. What they want to do for circularity and energy weeks?	Pupils, teachers	Sep 2023
Project week, No 2 **Circularity week**	Co-creation of physical space, event for the neighbourhood, link to VR/AR activity, Use input from pupils from ARV week	Pupils, teachers, family, neighbourhood, other schools	May 2024
Project week, No 3 **Energy transition week**	Activities at school, link to VR/AR activity, Event for parents or neighbourhood/community	Pupils, parents, teachers, neighbourhood, other schools, city	2024/2025 tbd
Digital, international workshop with schools	Digital workshop with the ARV schools. Exchanging ideas and experiences from LL`s.	Youth ambassadors from different ARV demos	Tbd, during 2025

12. CONCLUDING REMARKS AND WHAT'S FORTHCOMING

Under the umbrella themes of social renovation and energy transition, all the six LLs will exhibit a spectrum of approaches. There is no one size fits all CPCC Living Labs. On the road ahead, applying the typology based on which actor drives their Living Lab activities can be helpful for the consortium to have an overview of the types of CPCC Living Labs and the corresponding citizen engagement activities that will be implemented. Based on which actor drives its activities, the CPCC Living Lab can have varying levels of engagement commensurate with its goals.

12.1 USING THE RIGHT CITIZEN ENGAGEMENT METHODS AND TOOLS

Sustainable transformation of urban areas into attractive, climate positive circular communities, creating value with and for the citizens, is a process of engaging the citizens and local stakeholders. The desired outcome of engagement is to channel citizens' competences and experiences towards the planning and development of CPCCs and to offer a citizen's perspective on developing or improving novel social and technical solutions and measures related to sustainable transformation of urban communities.

Approaching complex challenges such as social renovation and energy transition requires deepening our understanding of potential target citizen groups with a variety of interest, backgrounds, and values. Reaching the right citizens and involving the right mix of stakeholders is fraught with difficulties. Depending on the context, target groups and goals, there will be a need for a variety of methods and tools to support the diversity of citizen engagement activities in the CPCC Living Labs in the 6 locations. We do not have a lack of tools[19] in Living Labs, but the challenge is selecting the right tool to allow the participation of different stakeholder and user profiles. On the road ahead, we are planning for not only evaluating the combination of citizen engagement methods and tools, but also focusing on how the methods and tools are used, associated with its context and target groups.

12.2. WHAT IS A CPCC LIVING LAB?

A Climate Positive Circular Community (**CPCC**) is an urban area, which aims to net zero greenhouse gas emissions, enable energy flexibility, and promotes a circular economy and social sustainability. The CPCC concept focuses strongly on the interaction and integration between new and energy renovated buildings, users, and energy systems, facilitated by ICT to provide attractive, resilient, and affordable solutions for citizens (definition from D2.1).

For this report, we conclude with putting forth a working definition of a CPCC Living Lab:

> **What is a CPCC Living Lab?**
> CPCC Living Labs are real-world multi-stakeholder innovation environments where novel social and technical solutions and measures related to sustainable transformation of urban communities

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[19] See for example the UNaLab toolkit, https://unalab.enoll.org/, and Tips & Tricks for Living Labs, https://www.iscapeproject.eu/wp-content/uploads/2020/02/Tips-Tricks-for-Living-Labs.pdf.

are designed and tested alongside and with citizens in different perspectives (such as building occupants, neighbourhood residents, green ambassadors, youth ambassadors). Varying levels of engagement can be used to channel citizens' competences and experiences towards the planning and development of CPCCs.

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